

1x800 MW TANGEDCO NORTH CHENNAI TPP

TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED

***TECHNICAL SPECIFICATION
FOR
FUEL OIL HANDLING SYSTEM
&
MISCELLANEOUS TANKS***

SPECIFICATION NO. : PE-TS-423-166-A101



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



TITLE
1x800 MW TANGEDCO NORTH CHENNAI TPP
FUEL OIL HANDLINGS SYSTEM &
MISCELLANEOUS TANKS

SPECIFICATION NO. PE-TS-423-166-A101

REV 00

Section IA Date 02/02/2017

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SPECIFIC TECHNICAL REQUIREMENTS

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IA – Specific Technical Requirement (Mechanical)

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SPECIFIC TECHNICAL REQUIREMENTS

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IA – Specific Technical Requirement (Mechanical)

	1x800 MW TANGEDCO NORTH CHENNAI TPP TECHNICAL SPECIFICATION FOR FUEL OIL HANDLINGS SYSTEM & MISCELLANEOUS TANKS	SPECIFICATION NO. PE-TS-423-166-A101	
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1.0

INTENT OF SPECIFICATION

1.1

This specification is intended to cover design, engineering, manufacture, fabrication, assembly, inspection & testing at vendor's & sub-vendor's works, painting, forwarding, supply and delivery at site including start up and commissioning spares, chemicals, properly packed for transportation, unloading / handling and storage at site, in site transportation, assembly, erection and commissioning, minor civil works, preparation and submission of "As Built" drawings, site testing, carrying out Hydro tests at site and handover of FUEL OIL HANDLING SYSTEM & **MISCELLANEOUS TANKS** as per the details in different sections / volumes of this specification for **1x800 MW TANGEDCO NORTH CHENNAI TPP**

1.2

The bidder's scope shall also include any other services, etc. if called for in the succeeding sections of the specification.

1.3

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 them of the responsibility of providing such facilities to complete the supply, erection and commissioning of Fuel oil handlings system and **Miscellaneous Tanks** within quoted price.

1.4

It is not the intent to specify herein all the details of design and manufacture. However, the equipment / system 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.

1.5

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.

1.6

Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.

1.7

The general terms and conditions, instructions to tenderer and other attachment referred to elsewhere are hereby made part of the tender specifications. The equipment / material and works covered by this specification is subject to compliance to all the attachments referred in the specification. The tenderer shall be responsible for adherence to all requirements stipulated herein.

1.8

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 Sec.-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

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prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

- 1.9 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.
- 1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.11 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 Customer as interpreted by BHEL in the relevant context. Please refer GCC/SCC for better clarity.
- 1.12 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and dispatch release issued by BHEL/Customer.
- 1.13 BHEL's Customer's representative shall be given full access to the shop in which the equipment's are being manufactured or tested and all test records shall be made available to him.
- 1.14 Various codes and standards to be used shall be as indicated in various parts of the specification. In case bidder uses any standard other than those indicated in the specification, the onus of establishing equivalence of the same with the specified standards will rest with the bidder and acceptance of the same shall be sole prerogative of customer. The bidder will also arrange for BHEL a copy of the standards in ENGLISH language. The cost of such service will be deemed to have been included by the bidder in the total cost of the package. BHEL will not entertain any additional cost on account of the same.
- 1.15 All text/ numeric in the document / drawings to be generated by the successful bidder will be in English language only.
- 1.16 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

Note:

Bidder to note that BHEL reserves the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document 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://dmsserver.bhelpem.com/Wrench%20Web%20Access/Login.aspx>).

Chapter 2

Project Information



**1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III
EPC TENDER SPECIFICATION FOR BTG PACKAGE**



**CHAPTER 2
PROJECT INFORMATION**

1.1 GENERAL

TANGEDCO has planned to establish 1X800MW Coal Based Super Critical North Chennai Thermal Power Project Stage III in the premises of existing NCTPS at Ennore & Puzhuthivakkam Village, Ponneri Taluk, Thiruvallur District, Tamil Nadu, India. This project will be executed in two package mode i.e, BTG with related Civil Works and BOP with related Civil Works.

1.2 LOCATION

The proposed site for main power plant is located near Ennore port (approx 5 km) and also 35 km from Chennai City.

The nearest Railway station is at Athipattu Pudunagar (approx 5 km)

All weather road from Pattamandri on the Thiruvotriyur-Ponneri highway is the nearest road access.

The nearest airport is at Chennai at a distance of 60 km.

1.3 PROJECT INFORMATION

1.1	Project Title	:	1 x 800 MW North Chennai Coal Based Super Critical Thermal Power Project Stage III.
1.2	Plant capacity	:	800 MW
1.3	Type of project	:	Brown field
1.4	Owner	:	Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)
1.5	Plant site location	:	In the premises of North Chennai Thermal Power Station (NCTPS)
1.6	Location co-ordinates	:	80° 19' E to 80° 20' E Longitude 13° 13' N to 13° 18' N Latitude
1.7	Nearest Village	:	Ennore & Puzhuthivakkam Village
1.8	Nearest Town & City	:	Chennai (35 Km)
1.9	State Capital	:	Chennai (35 Km)



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EPC TENDER SPECIFICATION FOR BTG PACKAGE

1.10	Nearest Railway Station	:	Athipattu Pudunagar (~ 5 Km) on Chennai – Vijayawada Line
1.11	Nearest Airport	:	Chennai (~ 60 Km)
1.12	Nearest Seaport	:	Ennore (~ 3 Km)
1.13	Nearest Road access	:	All weather road from Pattamandri on the Thiruvottiyur – Ponneri highway
2.0	Meteorological Condition		
2.1	Climate	:	Tropical, very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind
2.2	Site Elevation	:	(+) 10.0 Meter above Mean Sea Level
2.3	Ambient Temperature		
a.	Annual Maximum Mean Temperature	:	45 °C
b.	Annual Minimum Mean Temperature	:	15 °C
c.	Design ambient temperature	:	30 °C
2.4	Relative Humidity		
a.	Maximum	:	90 %
b.	Minimum	:	36 %
c.	Design	:	75 %
2.5	Annual Rainfall		
	Maximum	:	2540 mm
	Average	:	1600 mm
	Minimum	:	1175 mm
2.6	Basic Design Wind Pressure	:	As per IS: 875 (Latest Edition)



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2.7	Wind Speed	:	11.8 kmph (Avg), 50 m/s (max)
2.7	Seismic zone	:	Zone: III as defined in IS:1893-2002
2.8	Design ambient temperature for Electrical equipment	:	50 °C

1.4 ACCESS TO SITE

Site is well connected to all weather road from Pattamandri on the Thiruvotriyur – Ponneri highway. Site is located adjacent to the Chennai – Howrah broad gauge line and thus well connected by rail also.

1.5 PLANT RATING, CAPACITY, AVAILABILITY, PLF

Plant continuous rating will be 800MW at Generator terminals based on the following site conditions.

- Ambient Air temperature
- Condenser cooling water inlet temperature of 33 Deg. C and 9 Deg. C temperature rise across the condenser.
- Generator Power factor of 0.85
- Fuel Specification as given elsewhere
- Design temperature of electrical equipment is 50 Deg. C

The VWO capacity of the steam turbine shall not be less than 105% TMCR flow at rated parameters. Boiler maximum Continuous Rating (MCR) is at least 1.02 times the steam flow at turbine VWO condition plus continuous auxiliary steam requirement of unit at TMCR, rounded to next integer divisible by 5.

The capacity of the unit is selected so as to deliver the rated output even after ageing that will occur between overhauls, as a result of deposition of salts in turbine blades, wear and tear etc. The plant load factor (PLF) being considered is 85%.

1.6 SOURCES OF FUEL

TANGEDCO has long term linkage of Coal from the coal sources of Talcher or Mahanadi in Orissa. Domestic coal requirement for the power plant will be sourced from kalinga block of the Talcher, Mahanadhi and IB valley coal field.

The Imported coal has been sourced from foreign countries through sea to Ennore port. The coal will be conveyed from port through conveying system.

The steam generator shall be designed for the following conditions:

Best Coal – 100% Imported Coal
Design Coal – 70% Imported & 30% Domestic Coal
Worst Coal – 50% Imported & 50% Domestic Coal



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EPC TENDER SPECIFICATION FOR BTG PACKAGE

1.7 Coal Analysis

1.7.1 Coal Quality parameter

a) Domestic Coal

A. Proximate Analysis			
1.	Total Moisture	%	16.0
2.	Ash	%	45.0
3.	Volatile matter	%	19.0
4.	Fixed Carbon	%	20.0
5.	Gross calorific value (as received basis)	kcal/kg	2800
B. Ultimate Analysis			
1.	Carbon	%	27.7
2.	Hydrogen	%	2.6
3.	Sulphur	%	0.5
4.	Nitrogen	%	0.52
5.	Oxygen	%	7.26
6.	Moisture	%	16.0
7.	Ash	%	45.0
8.	HGI		45 -55, Avg 52
9.	Carbonates		0.38
10.	Phosphorous		0.04
11.	YGP Index	mg/kg	50-70
12.	Shale and Sand stone Content	%	Max 20
13.	Feed Coal Size	mm	Upto 50
C Ash Fusion Temperature			
	Initial Deformation, IT	Deg. C	1100
	Spherical, ST	Deg. C	1200
	Hemispherical, HT	Deg. C	1300
	Fluid, FT	Deg. C	-
ASH ANALYSIS			
	SiO ₂	%	59.54
	Al ₂ O ₃	%	29.00
	Fe ₂ O ₃	%	6.42
	CaO	%	1.50
	Na ₂ O	%	0.08
	K ₂ O	%	-
	TiO ₂	%	1.60
	SO ₃	%	0.25
	P ₂ O ₅	%	0.51
	MgO	%	0.50
	Others	%	0.60
	Total		100.00
	Resistivity of Fly Ash	Ohm-cm	1.73 X10 ¹²



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EPC TENDER SPECIFICATION FOR BTG PACKAGE

b) Imported Coal

A. Proximate Analysis			
1.	Total Moisture	%	16.50
2.	Ash	%	6.62
3.	Volatile matter	%	36.45
4.	Fixed Carbon	%	40.43
5.	Gross calorific value (as received basis)	kcal/kg	5642
B. Ultimate Analysis			
1.	Carbon	%	60.12
2.	Hydrogen	%	4.38
3.	Sulphur	%	0.53
4.	Nitrogen	%	1.48
5.	Oxygen	%	10.37
6.	Moisture	%	16.5
7.	Ash	%	6.62
8.	HGI		51
9.	Carbonates		-
10.	Phosphorous		-
11.	Total		100
C Ash fusion temperature			
	Initial Deformation, IT	Deg. C	1230
	Spherical, ST	Deg. C	1270
	Hemispherical, HT	Deg. C	1320
	Fluid, FT	Deg. C	-
ASH ANALYSIS			
	SiO ₂	%	36.00
	Al ₂ O ₃	%	13.90
	Fe ₂ O ₃	%	14.80
	CaO	%	12.70
	Na ₂ O	%	0.70
	K ₂ O	%	1.70
	TiO ₂	%	0.80
	SO ₃	%	10.6
	P ₂ O ₅	%	0.20
	MgO	%	8.60
	Others	%	-
	Total		100.00



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EPC TENDER SPECIFICATION FOR BTG PACKAGE

- c) The plant should be suitable to accept imported coal sourced from any country. The limiting parameters of imported coal are furnished below :

A. Proximate Analysis			
1.	Total Moisture (ARB)	%	Upto 23 Max
2.	Ash (ADB)	%	6.62
3.	Gross calorific value (as dried basis)	kcal/kg	5800 - 6500
4.	Fixed Carbon(ADB)	%	30 - 50
5.	Volatile Matter (ADB)	%	25 - 45
6.	HGI		45 - 60
7.	IDT (Under Reducing Atmosphere)	Deg.C	1100 - 1250
3.	Sulphur (ADB)	%	Upto 1 Max
4.	Size	mm	< 50

1.7.2 Specification of LDO

Specific Gravity @ 15° C kg/cu.m	: 0.8348
Gross calorific value, kcal/kg	: 10400
Pour point "°C" max.	: 12
Flash point "°C" min.	: 66
Sulphur % "T" max.	: 0.5
K. Viscosity in Centistokes @ 50° C Max	: 7.5
Ash by wt. %	: 0.01
Water & Sediment content Vol. Max. %	: 0.25
Sediment Max. Content by Wt%	: 0.1
Relevant Indian Standard	: IS 1460

1.7.3 Specification of HFO

Flash point "°C" min.	: 66
Sulphur % "T" max.	: 4.5
Viscosity in Centistokes @ 50° C	: 370
Ash by wt. %	: 0.1
Water content Vol. Max. %	: 1.0
Sediment Max. Content by Wt%	: 0.25
Gross Calorific Value, kcal/kg	: 10800

1.8 Fuel Transportation

The coal shall be received at Ennore port. The coal will be transported by conveyor from coal berth 3 in Ennore Port and then through the conveyor to the coal bunker directly or to coal stockyard.



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EPC TENDER SPECIFICATION FOR BTG PACKAGE

1.9 SOURCE OF WATER

Source of water for the proposed project is sea water. The intake shall be from the existing cooling water fore bay of NCTPS Stage-II. Treated water shall be provided to the plant cycle makeup and other requirements of BTG package at the respective terminal points. Refer Chapter 4 of this section.

1.10 SOURCE OF EQUIPMENT

The proposed plant will be supplied, erected and commissioned on dual EPC basis, i.e, BTG with related civil works and BOP with related civil works.

1.11 POWER EVACUATION PLAN

1x800MW Steam Generating Units shall be with a SF6 Generator Circuit Breaker [GCB] along with necessary additional items between Generator Transformer [GT] and Generator. Therefore GT shall be used for unit start-up / unit shutdown as well as for power evacuation by synchronization of unit by closing GCB.

Power will be evacuated from the proposed thermal power station at 765 KV voltage level through 765 KV transmission lines. The power evacuation lines would be double circuit 765 KV lines which will act as Line in & Line out circuit.

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SECTION: IA**SPECIFIC TECHNICAL REQUIREMENT (MECHNICAL)
FUEL OIL HANDLING SYSTEM AND CONDENSATE STORAGE TANK**



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1.0.0 SCOPE OF WORK FOR FUEL OIL HANDLING SYSTEM

Design, engineering, manufacture, inspection and testing at vendor's/ sub-vendor's works, painting, forwarding, proper packing, shipment and delivery at site, unloading, handling & transportation at site, Erection & Commissioning, minor civil works as required, Performance and guarantee testing and handing over of Fuel Oil System shall be as per details in different sections of this specification. P&I Diagram and write-up for Fuel Oil Handling System (for tender purpose) is enclosed with the specification. Detailed P&I Diagrams, System write up & Control philosophy (As applicable) shall be furnished by the successful bidder during detail engineering & the same shall be subject to customer approval without any commercial implication.

3.1.0 SCOPE OF SUPPLY

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

- 1) One nos. of fixed roof type M.S storage tanks for HSD storage of effective capacity 80cum each along with accessories as indicated in P&ID.
- 2) Instrumentation & control System as applicable including instruments, interlocking & protection devices complete in all respects required for safe, efficient and reliable operation of the plant and to be read in conjunction with C&I portion of specification. Minimum instrument and control system requirement is mentioned in the P&ID.
- 3) Complete Fuel oil piping including, drain piping and vent piping, valves as applicable for Fuel oil handling system.
- 4) Drain and vent connection in lines along with isolation valve at every low and high point as per layout requirement of FOHS.
- 5) All foundation bolts/ anchor bolts required for any equipment foundation under the package. For HSD day tank, minimum 4 nos. anchor bolts (M33 grade) to be considered irrespective of calculation.
- 6) Pipes from HSD tank to FO pump house and return will be free issued to bidder. However E&C of same is in bidder scope. Other pipes for tank, Flanges, fasteners, gaskets with suitable hangers, supports, pipe trestle within dyke and pump house as required etc. as applicable within the terminal point will be in vendor scope.
- 7) Pipe-supporting structures over the insert plates for pedestal supported pipes and also on pipe rack supported pipe.
- 8) Nozzle for foam pourer, heat detector on tank roof & pad plates welded to the tanks as per details to be furnished to the successful bidder for welding supports for water piping and hydrant piping.
- 9) Platform and approach ladder to the platform for foam pourer.
- 10) Wrapping and coating of any buried MS pipes as required.
- 11) All MS structures for cross overs, valve / instruments / equipment operating & maintenance platforms, approach ladders for access to platforms, trench/pit.
- 12) Painting of equipment along with their accessories within battery limit. Final coat of paint on all the equipment's / item covered under the package shall be done at the time of handing over of package.
- 13) C&I Scope as per enclosure elsewhere in the specification.



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- 14) Erection & commissioning spares as required for the complete system.
- 15) One set of special maintenance tools & tackles, if any. These tools shall not be used for erection/ commissioning purposes and shall be in an unused and new condition when they are handed over to the customer at site. Each tool shall be stamped so as to be identified easily for its use. The tools shall be supplied in a steel toolbox. This list shall be reviewed during detail engineering.
- 16) Mandatory spares as per enclosure elsewhere in the specification.
- 17) Initial charge of all lubricants and fluids except HSD.
- 18) All valves, counter- flange with nuts, bolts and gaskets at all the terminal points.
- 19) Flowable non- shrink grout of one grade higher than concrete used for civil work grouting below base plate for all structure/ equipment & for grouting of foundation / anchor bolts.
- 20) Any other item covered in specification for Fuel Oil Handling System
- 21) Relevant scope of supply as per GTR, GCC & SCC.
- 22) Valves in pit outside dyke with limit switch as required as per latest OISD recommendation complying with requirement whichever is more stringent.
- 23) Any other instrument, equipment / item required for making the installation complete in all respect and for satisfactory operation of the system for the scope within the terminal point, as well as to meet any statutory requirement relevant to the package, unless specifically EXCLUDED from scope of supply.

3.2.0 SCOPE OF SERVICES

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

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



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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.

- 11) Preparation of all drawings as per list enclosed under section III.
- 12) Preparation of drawings / document / P&ID's and providing soft copy of same to BHEL.
- 13) Preparation of all necessary drawings/data/ documents for obtaining necessary Approval of statutory authorities like CCOE , IBR , Weight & Measures Department and any other agency/ competent authority related to installation of Fuel Oil Handling System on behalf of the customer. All expenses required to obtain the approval shall also be borne by the successful bidder. Successful bidder shall inform customer well in advance requirement of authority letter along with format for the same. After issuance of authority letter by customer, it will be vendor's responsibility to regularly follow up with the concerned authorities to obtain timely approval from these authorities. Any delay on account of the same, unless any specific information related to above approval to be furnished by customer is delayed by customer, shall be to vendor's account and shall not be used as a reason for extension in contract completion.
- 14) Layout drawing to be prepared for statutory approval apart from showing the technical requirements shall necessarily show key plan showing approach to site with mile stone, Survey No., Khesra No, Plot No. etc.
- 15) Supply of temporary equipment and services for chemical cleaning, steam blowing, energization, testing etc. as applicable.
- 16) Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.
- 17) All other facilities/ services as described in section on site services in specification and related to Fuel Oil Handling System scope of work within terminal point.
- 18) Relevant requirements as per GTR, GCC, ECC & SCC.
- 19) Any other service required for making the installation complete in all respect within battery limits and for satisfactory erection & commissioning of the system as well as to meet any statutory requirement relevant to the package, unless specifically EXCLUDED from scope of services.

4.0.0 EXCLUSION

- a) Supply of pipes from HSD day tank to FO pump house and return line. However, E&C of the same including supporting arrangement shall be in bidder's scope of supply:
- b) Civil work for fuel oil storage system including
 - i) Tank foundations
 - ii) Dyke wall and barbed fencing
 - iii) Encasing of buried pipes, providing culvert for the same, if required.
 - iv) Hume Pipes, if any
 - v) Civil works like pits, wherever required.
 - vi) Handrails in Dyke wall approach staircase, Trench if any in FO unloading area. Structural crossover supplied by bidder and other item / equipment supplied by bidder shall be in bidder scope.
 - vii) Various cable & pipe trenches, pipe pedestals, drains, sumps, insert plates for pedestals for pipe supports.



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viii) Pipe rack/trestle (refer definition of pipe rack/ trestle elsewhere in the specification) outside pump house and dyke area.

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

- c) Fire Protection system for storage tanks,
- d) Exclusion as indicated in C&I portion of technical specification
- e) Relevant exclusion as per GTR, GCC, SCC & ECC.

5.0.0 SERVICES TO BE PROVIDED BY THE CUSTOMER

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

6.0.0 TERMINAL POINT

HSD

:

Towards oil unloading side:

Inlet valve of HSD Day tank

Towards oil Supply to pressurizing pump for Aux. boiler

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

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

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

Bidder to match pipe elevation and orientation as per Terminal point, Details to be provided during detail engineering

Separator (OWS)

(under ETP scope).

Drain from dyke area :

To OWS during normal condition & to plant drain during rainy season through two way valve pit. Valves in the valve pit along with limit switch for the same are included in bidder's scope. Min. size of the valve in dyke wall catch pit shall be 150 NB.



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

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

7.0.0 ADDITIONAL LAYOUT REQUIREMENTS

- a) System layout shall conform to the requirements of the Petroleum Act 1934 & Petroleum Rules 2002, OISD 118 latest edition whichever is more stringent. The layout shall also confirm to all other relevant OISD specifications
- b) All established engineering practices with regard to layout of various equipment & piping shall be followed and the same shall be subject to Customer approval during detail engineering without any commercial implication.
- c) Tentative Location of items related to Fuel Oil handling System is shown in enclosed PLOT PLANS and Sketch of FOHS. This will be finalized during detail engineering based on equipment dimensions and other layout related requirements. There will however be no cost implication on account of the same.
- d) While selecting pipe size, velocity inside the pipe shall not overshoot the velocity criteria indicated elsewhere in the specification.
- e) To the extent possible, all valves shall be located at grade level for easy operation & maintenance. Where location at grade level is not possible, suitable operating and maintenance platform made of MS grating and access ladder/ staircase/walkways to the same shall be given by the bidder. The platform and walkways will be designed by considering load of at least 750Kg/M2.
- f) Where pipes are routed in a manner that it hampers man movement in that area, suitable no. of cross overs made of MS gratings with handrail shall be given across such pipes to facilitate easy man movement in such areas. Further, suitable access ladder of MS construction shall be given for access to equipment/ pipes located in pit/ trench. Such structures shall be designed by considering a load of at least 750Kg/M2.
- g) For all pedestal supported pipes, BHEL scope will be limited to pedestal with insert plates. Maximum height of pedestal to be provided by BHEL shall be 300 mm from FGL/FFL in the corresponding area. Structures required above these pedestals for supporting the pipes are included in the scope of the bidder. Pipe having BOP up to 2.0m from the grade level / FFL / FGL in the corresponding area shall be pedestal supported. However, inside the pump house no pedestals / insert plate shall be provided for fixing. Bidder shall support the pipes using pipe supports and anchor fasteners inside the pump house.
- h) Layout shall be prepared in a way to avoid the buried piping to the maximum possible extent.
- i) Straight length required before and after flow element/ flow meters shall be provided as per latest standard/ applicable codes.
- j) Rainwater collected inside the dyke shall be diverted to storm water drain while contaminated oily waste shall be sent to local sump. All valves required in pits outside the dyke are included in bidder's scope of supply.



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- k) 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.
- l) 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. 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.
- m) Instrument/ LIE/LIR shall not be located in space meant for walkway & maintenance space across the equipment, maintenance bay of building. Location of all instruments shall be marked in tipping layout drawing to ensure correct location of the same.
- n) Requirement given under relevant clause of specification shall also be followed.
- o) All primary Instruments, hardwares & JB's etc. used for measurement for LDO Oil system shall be flameproof (IEC-79.1, Part I).

1.0 SCOPE OF SUPPLY FOR CONDENSATE STORAGE TANK

1.1 Steel tanks fabricated and supplied at site under this specification shall be as per enclosed DATA SHEET and sketch for Condensate Storage Tank. Modifications may be made by the bidder to suit good engineering practice to the satisfaction of the customer. The customer, however, reserves the right to reject any modifications.

1.2

- a) The connections and accessories which are required to be supplied with each tank by the bidder shall be as indicated in the enclosed DATA SHEET and sketch for Condensate Storage Tank .
- b) The piping material inside the tank shall be supplied by the bidder. All inlet piping shall be extended up to the bottom of the tank and the clearance between the bottom of the tank and the edge of the inlet piping shall be kept as 500 mm (maximum).
- c) The inside piping shall be adequately supported and shall be provided with adequately sized vent connection at pipe top.
- d) Weir plates of adequate thickness (minimum 8 mm) shall be provided for all inlet piping.
- e) Pad plates on the tanks for supporting outside piping shall be provided by the bidder. Details of the pad plates (sizes, quantity etc.) shall be informed to bidder during detail engineering.
- f) Fabrication and supply of all flanges and counter flanges for all nozzles and valves of tank connections shall be included in the scope of work of the bidder. Necessary bolts, nuts and gaskets for these connections shall also be supplied by the bidder.
- g) The manhole shall be of hinged and bolted type with nuts, bolts and gaskets in bidder's scope of supply. The size of the manhole shall be minimum 600 mm.

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1.3

The scope of works shall also include supply and installation of special accessories as indicated in DATA SHEET and sketch for Condensate Storage Tank. The necessary fixtures and other accessories for mounting these special fittings shall be included in the scope of work of the bidder.

1.4

Level gauge / indicator for each tank shall be provided by the bidder along with all fittings & accessories as required for mounting the level gauge / indicator on the tanks. Float and board type level gauge / indicator shall be provided unless otherwise specified in Datasheet and sketch for Condensate Storage Tank.

1.5

Required number of tapings with 25NB instrument root valves shall be provided by the bidder for mounting instruments like level switches, level transmitters etc. The number of tapings shall be as indicated in the Datasheet and sketch for Condensate Storage Tank.

1.6

a) Sampling Connection with isolation valve of size 25 NB for each tank (if indicated in Data sheet for Condensate Storage Tank).

b)

Drain valve of size 100 NB for CST tank shall be provided by the bidder unless otherwise indicated in the Datasheet and sketch for Condensate Storage Tank.

c)

Quantity and size of spare nozzles and valves shall be supplied by the bidder as per Datasheet and sketch for Condensate Storage Tank.

1.7

NaOH / KOH breather and seal pot shall be provided with necessary drain valve of size 25 NB with stainless steel construction unless otherwise specified in the Datasheet and sketch for Condensate Storage Tank. 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.

1.8

Pipes, fittings, nozzles, flanges and counter flanges shall be supplied by the bidder. The minimum requirement like quantity, size, type etc. are indicated in the Datasheet and sketch for Condensate Storage Tank may undergo change during detail engineering stage and these shall be supplied by the bidder as per the approved drawings / documents for which no commercial implication shall be entertained by BHEL. Material of construction of all pipes, fittings, nozzles, flanges and counter flanges shall be as per Datasheet and sketch for Condensate Storage Tank.

1.9

a) Material of construction of all tanks shall be mild steel conforms to IS-2062 Grade – B.

b)

All valves shall be of stainless steel construction as per section -I for Condensate Storage Tank

1.10

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.

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Vent size calculation shall be furnished by the bidder during detail engineering stage based on the tank filling / emptying rate for approval and increase in vent size from the minimum size requirement, if any, shall be provided by the bidder without any commercial implication.

The overflow pipe from overflow nozzle to seal pot shall also be in bidder's scope of work.

- 1.11 The minimum number of anchor bolts along with the minimum size has been specified in clause no. 3.23 of this section. However, any additional anchor bolts of higher size if found applicable during detailed Engineering shall be provided by bidder without any commercial implication.
- 1.12 Bidder shall provide adequate numbers of earthing / grounding pads for each tank. Each pad shall be made of mild steel of required size, which will be informed to the successful bidder during detail engineering stage for which no commercial implication shall be entertained by BHEL. Further, grounding of tank with the earth mat shall be in BHEL scope.
- 1.13 Internal Painting-Shall be provided as per CI .6.7.1, Vol II, Sec-I, Chapter-8,painting, under customer specification .External Painting-Shall be as per page 6/12 CI 6.4 Chapter 8 Design basis, painting mentioned under customer specification .
- 1.14 Commissioning spares as specified under SECTION -I shall be in bidder's scope.
- 1.15 Platforms, monkey ladder inside tank, staircase (hand railing, knee guard and toe guard (in stair case and all along the periphery of roof of the tank) etc. as per the relevant design code / good engineering practice (as indicated in the Datasheet for Condensate Storage Tank) shall be included in bidder's scope of work. All stair tread and platforms shall be made from 8 thk. chequered plate. Roof level interconnection between CST shall be done.

2.0 SCOPE OF SERVICES

Services shall include but not be limited to the followings:

- 2.1 Design, engineering, preparation of detailed fabrication drawings, bill of material, tag and piece numbers, welding procedures etc. Stiffeners and other structural framing for supporting the tank shall be designed by the fabricator and properly shown in the fabrication drawings.
- 2.2 Erection & Commissioning of Tanks.
- 2.3 Erection of all foundation bolts / anchor bolts etc. as required for any equipment/ foundation /concrete.
- 2.4 Minor civil work like chipping of foundation, grouting below base plate for all structures, equipment, grouting of pockets, excavation & filling of earth for buried MS pipes if and as required.
- 2.5 Inspection & testing and carrying out demonstration test.
- 2.6 Painting of tank and other equipment within the battery limit.



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- 2.7 Any other equipment / material / services as required to make the installation complete in all respects shall be deemed to be included in bidder's scope of work whether mentioned above or not.

3.0 TERMINAL POINTS

- Matching counter flanges for all nozzles & valves mounted on the tank and its accessories. However, counter flanges for all nozzles and valves of tank shall be provided by the bidder.
- Drain pipe of seal pot and NaOH breather pots.

4.0 EXCLUSIONS

Tank foundation & associated civil works are excluded from bidder's scope of work. However, foundation drawing along with loading data, anchor bolt details etc. shall be furnished by the successful bidder during detailed engineering stage.

5.0 DESIGN CONSIDERATIONS

- 5.1 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** only for the followings: -

- a) Tanks shall be designed as per IS – 803 / API – 650 Good engineering practice as applicable and referred code shall be of latest edition. However, requirement of codes and standards shall be as indicated in the Datasheet for Condensate Storage Tank.
- b) Design of roof and roof structures for vertical storage tanks shall be designed based on guidelines given in the book titled "Process equipment design" by Brownell and Young.
- d) Tank stability calculation (wind load / seismic / overturning stability) shall be done as per API – 650, latest edition. However, factors / coefficients as required for the design of tank shall be obtained from BHEL by the bidder after placement of order.
- d) Vent sizing calculation shall be done as per API – 2000, latest edition
- e) Sizing calculation for vent, NaOH / KOH breather, seal pot and breather valve.

- 5.2 The successful bidder shall indicate references of all the clauses indicating their page number from respective standard in the design calculation during detail engineering stage. All calculations shall necessarily be done in SI units only. All steps including formulas and abbreviations shall be clearly shown in the calculation. All inputs / assumptions shall be indicated in the first sheet of the calculation.

5.3

- a) Bottom plate shall be 8.0 mm thick (minimum). Minimum 6 mm (excluding tolerance on plate as

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per relevant IS) thick plates including corrosion allowance shall be provided for shell plates and minimum 6 mm for roof plates for all tanks. Calculation for the plate thickness shall be got approved from BHEL /Customer during detailed engineering stage. However, if the addition / summation of calculated value of plate thickness (excluding tolerance on plate as per relevant IS) / nominal minimum thickness specified in the relevant design code / standard and corrosion allowance of 2 mm comes out more than 8 mm then the nearest available (higher side) plate thickness in the market shall be provided for bottom, shell and roof plates without any commercial implication. For calculating shell plate thickness. IS 803 to be used .

- b) Negative tolerance on plate thickness shall not be considered in the plate thickness calculation and also shall not be provided in the tank. Only positive tolerance shall be considered.
- 5.4 All appurtenances and mountings shall also be designed as per relevant clauses of IS: 803 / API – 650 and as per the design code indicated in DATA SHEET for Condensate Storage Tank.
- 5.5 Tank shall be suitably constructed for safe, proper and continuous operation under all conditions that can be expected in a plant life without undue strain, corrosion or other operating difficulties.
- 5.6 In calculating the minimum plate thickness, the specific gravity of the liquid shall not be taken less than 1.
- 5.8 Vessels seams shall be so positioned that they do not pass through vessel connections. For cylindrical vessels consisting of more than two sections longitudinal seams shall be offset.
- 5.9 Wherever possible, the inside seam weld shall be ground smooth, suitable for application of corrosion resistant primer.
- 5.10 Due consideration shall be given by the supplier for wind load and earthquake effect in the design of tanks.
- 5.11 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.
- 5.12 Staircase / access ladder and hand railing shall be provided as per the relevant codes and standards.
- 5.13 Water draw off sump shall be provided as per the relevant design code, latest editions.
- 5.14 The number & size of nozzles (including flanges, counter flanges and inside piping) indicated in the sketches attached with the data sheets are tentative and bidder guidance purpose only and the same may undergo change during detail engineering stage for which no commercial implication shall be entertained by BHEL.
- 5.15 Bidder shall furnish the STAAD calculation along with the roof structure calculation during detail engineering for checking the stability of roof.
- 5.16 Provision shall be made by the bidder to minimise the air ingress in the tank through float with arrow type level gauge and details of the same shall be furnished during detail engineering stage



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for BHEL's approval and approved arrangement shall be provided by the bidder without any commercial implication.

- 5.17 The tank shall be designed for filled water head / atmospheric pressure and design temperature for the tank shall be as specified in the DATA SHEET for Condensate Storage Tank .
- 5.18 Bidder to note that surface cleaning shall be of Blast clean type. However Grit blasting shall be decided during detail engineering for which no commercial implication shall be entertained by BHEL.
- 5.19 Bidder to note that foundation drawing along with loading data & anchor bolt details shall be provided by bidder within two weeks' time from the LOI. **Bidder to provide minimum 24 nos., M33 anchor bolts for Condensate Storage Tank , irrespective of calculation for tank stability.**

6.0 WELDING

- 6.1 Welding shall be in accordance with the requirement of IS: 803, 816, 817 and 823 or equivalent.
- 6.2 Welding sequence shall be adopted in such a way so as to minimize the distortion due to welding shrinkage. Contractor shall indicate in his drawing the sequence of welding proposed by him, which should meet prior approval of the Engineer.
- 6.3 All welders shall be BHEL / customer / consultant qualified as per the approved quality plan / field quality plan which will be submitted by the successful bidder during detail engineering stage. WPS and PQR shall be submitted by the successful bidder to BHEL / customer / consultant for review and approval.

7.0 TEST AND INSPECTION

- 7.1 The particulars of the proposed tests and the procedure for the tests shall be submitted to the Owner / Engineer for approval before conducting the tests. The successful bidder shall submit FQP (field quality plan) and demonstration test procedure for BHEL / customer / consultant's approval during detail engineering stage. In the event of any change in the field quality plan and demonstration test procedure, the same shall be incorporated by the bidder in the document and approved document shall be adhered by the bidder without any commercial implication.
- 7.2 DPT / MPI on all welds (100%).
- 7.3 All cross / Tee joints and butt welds to be 10% Radio graphed.
- 7.4 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.
- 7.5 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.



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

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

9.0.0 SUB-VENDOR ITEMS

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

10.0.0 DRAWINGS AND DOCUMENTS TO BE SUBMITTED WITH THE BID

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

11.0.0 DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

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

12.0.0 DRAWINGS ENCLOSED WITH THE SPECIFICATION

Following drawings enclosed will form part of the specification.

- a) Plot plan, **PE-DG-423-100-M002**.



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- b) Process & Instrumentation Diagram of HSD, **PE-DG-423-166-A001.**
- c) **SKETCH OF HSD DAY TANK ,PE-DG-423-166-A001**
- d) **SKETCH FOR CONDENSATE STORAGE TANK PE-DC-423-100-N127.**

The P&ID show the minimum requirement to be followed including minimum requirement of instruments. Any other item and instruments required (within the terminal points) to make the system complete in all respect and for satisfactory operation of the system shall also deemed to have been included by the bidder in their scope .The detailed P&I diagrams for FOHS in line with specification requirement shall be developed by the vendor during detail engineering for customer's approval and without any commercial implication to customer. Bidder to note that the while preparing PIDs after placement of order, successful bidder shall incorporate line numbers Instrument tag nos., KKS Numbering, equipment no, Line Spec, Line MOCs, legend / symbol chart , equipment capacity , relief valve capacity and set pressure, control valve capacity, range, fail position etc. in these drawing and same are subject to the customer approval.

13.0 PAINTING

system write up and customer specification to be referred for painting.

14.0 LIST OF COMMISSIONING SPARES

Section –I to be referred for Commissioning Spares

15.0.0 OTHER REQUIREMENTS

i) **Site Visit before submission of offer.**

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

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

iii) The O&M Manual to be submitted by the successful bidder will necessarily address the points mentioned in the checklist.

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



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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>

Viii) Bidder to review the Electrical Load list enclosed with the tender specification and give their concurrence on the same. In case of change in any load data, bidder to brought out same in their offer. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear / MCC on account of changed loads.

ix) Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor".

x) Site storage and preservation manual has been placed under section -III. Bidder to note down all the requirement of storage and preservation required for several items given under this manual. Bidder shall necessarily follow all the practices given in the manual as applicable for its items/equipment's under scope of supply.

16.0 OTHER TECHNICAL REQUIREMENTS

- 1) 15 days' time is required by BHEL to offer their comments on the drawings and documents being submitted by the bidder (during detailed engineering stage in the event of L.O.I being placed) from the date of receipt.
- 2) Bidder to depute competent designer (s) at BHEL's office during detailed engineering stage to discuss drawings and other technical documents as and when required by BHEL.

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- 3) Bidder to assess the capability of their 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. No deviations shall be entertained.
- 4) Commercial implication includes price implication as well as delivery implication.
- 5) Handrail minimum 1000 mm high (from floor/ roof level) hand railing shall be provided around all floor/roof openings, projections/balconies, walkways, platforms, steel stairs, etc. All handrails and ladder pipes shall be 50 mm nominal bore MS pipes (medium class) Conforming to IS: 1161. Spacing of handrail post shall be limited to 1200 mm as far as possible but can be adjusted to suit the length of railing.
- 6) Type of roof for vertical cylindrical storage tanks shall be either supported cone roof or self-supporting cone roof as per latest edition of relevant design code.
- 7) Commissioning of tanks will consist of installation of all accessories of tanks as per approved drawing/specification, charging of tank, water-fill test (for minimum 24 hours after complete filling of tank), satisfactory functioning of all accessories, emptying of tank, subsequent painting of complete tanks and changing of gaskets as per specification requirement.
- 8) Bidder to furnish prices and unit price of each item of proposed tanks as per BHEL's price format only along with the final price bid.
- 9) Bidder shall check that specifications of all the items are available in the NIT specification. However, in the event of absence of specification for any item, bidder will approach BHEL to furnish the specification of missing items and new specification will be adhered by the bidder for which no commercial implication shall be entertained by BHEL.
- 10) All tools and plants including welding machines, crane, hydra, fork lift, batching plant etc. and instruments as required for construction, erection and commissioning, trial run and functional demonstration test at site shall be arranged by the bidder.
- 11) Bidder to furnish list of sub-vendors based on sub-vendor list enclosed with the specification during detail engineering stage for BHEL's / Customer review and approval and items shall be procured from these suppliers only.
- 12) Dealers are not acceptable for any item of the package. Bidder shall procure all items including plates, structural, flanges, counter flanges etc. from BHEL approved sub vendor only. No argument on this account shall be entertained.



TITLE
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Section -I Date 02.02.2017

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SPECIFIC TECHNICAL REQUIREMENTS

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IB – System write up (Fuel Oil Handling System)



DM FOR FUEL OIL HANDLING SYSTEM
1x800 MW TANGEDCO NORTH CHENNAI TPP

DM. NO. PE-DC-423-166-A001

REVISION 00

DATE: 26/09/2016

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1.0 Intent

- 1) The purpose of this document is to bring out clarity with regard to the following:
 - a) Scope of Design, engineering, supply and exclusions for Fuel oil handling system
 - b) Major technical requirements of various items covered under this package
- 2) Approved copy of this document shall form the basis for subsequent approval of all drawing and documents for fuel oil handling system.

2.0 Interfacing Drawings:

1) BHEL HPVP:

- Scheme of Fuel Oil System for Auxiliary Boiler (Drawing No. 100-056-00015)

3.0 Scope of supply & services

1) Scope of Supply

Scope of supply shall comprises of following:

- a) One (1) nos. of fixed roof type Mild Steel HSD Day tank of capacity 80 cum each along with accessories as indicated in tank Sketch.
- b) Valves and Instrumentation as indicated in Sketch.

2) Scope of Services

- a) Erection & Commissioning of HSD day tank along with accessories

4.0 Demonstration Test

Water fill test shall be carried out for at least 12 hrs at site during commissioning of the tanks as demonstration test.



5.0 Painting Schedule

Painting of tanks (inside, underneath & outside), structural steel, piping, stairways & the Color coding for the same shall be as per **ANNEXURE-I** given at the end of this document.

6.0 Layout Requirements

System layout shall conform to the requirements of the Indian Petroleum Act 1934 & Petroleum Rules 2002. FOHS layout is shown in drawing titled Layout of Fuel Oil Area enclosed with this Design Memorandum. Based on this final layout during detail engineering will be prepared

As per pre bid clarification (Annexure 2.6) S. No 38, CCOE approval is in customer scope. However related document required shall be provided.

BHEL PEM	DATA SHEET FOR HSD DAY TANK FOR AUXILIARY BOILER		
	PROJECT TITLE: NORTH CHENNAI STPP, (1 x 800 MW)		REV NO: 01
1	SERVICE IDENTIFICATION	HSD DAY TANK FOR AUXILIARY BOILER	
2	CAPACITY (EFFECTIVE) (m ³)	80	
3	NUMBER REQUIRED	1 No .	
4	STORAGE MEDIUM	HSD	
5	TYPE	VERTICAL, CYLINDRICAL	
6	TENTATIVE SIZE	DIA. 6.0 MX Ht. 4.0M	
7	PRESSURE CLASS	DESIGN FOR FILLED WATER HEAD / ATOMSPHERIC	
8	MATERIAL OF CONSTRUCTION	MILD STEEL TO IS:2062	
9	DESIGN TEMPERATURE	60 °C	
10	LOCATION OF INSTALLATION	OUTDOOR	
11	DESIGN & CONSTRUCTION CODE	IS803 / API650	
12	CORROSION ALLOWANCE (CA)	2 MM	
13	MIN. PLATE THICKNESS INCLUDING CA (IN MM)	BOTTOM – 8, SHELL - 6, ROOF- 6	
14	JOINT EFFICIENCY	0.85	
15	MATERIAL OF CONSTRUCTION FOR PLATES	IS2062 GR. B	
16	MATERIAL OF CONSTRUCTION FOR STRUCTURES (ANGLE, CHANNEL, BEAM, BAR AND FLAT)	IS2062 GR. A	
17	HANDRAIL		
17.1	SIZE OF PIPE	50 NB	
17.2	MATERIAL	MS pipes (medium class) conforming to IS: 1161	
18	NOZZLE CONNECTIONS REQD /	AS PER ENCLOSED SKETCH	
19	NOZZLE MATERIAL	API 5L GR. B ERW/ASTM A 106 GR.B	
20	VALVES MATERIAL	AS PER VALVE DATASHEET	
21	MATERIAL FOR PIPES & FITTINGS	AS PER DATASHEET OF PIPES AND FITTINGS	
22	STAIRCASE FOR TANKS:	SPIRAL STAIRCASE ALONG THE SHELL OF TANKS .	
23	WIDTH OF PLATE	WIDTH OF THE PLATE CAN BE CONSIDERED OUT OF THESE 1500/1800/2000. AS PER IS803, MINIMUM COURSE WIDTH IS 1500MM UNLESS AGREED OTHERWISE MUTUALLY.	
24	SURFACE PREPARATION		
		AS PER PAINTING SCHEDULE FOR TANK	
25	INSIDE PROTECTION	→	
26	EXTERNAL PAINTING		
27	MANHOLE	TWO (2) NOS. ONE ON SHELL & OTHER ON ROOF AS PER IS803/API 650	
	NOTE : ALL OTHER GENERAL TECHNICAL REQUIREMENTS / ACCESSORIES & SPARES AS PER CUSTOMER TENDER SPECIFICATION.		



DM FOR FUEL OIL HANDLING SYSTEM
1x800 MW TANGEDCO NORTH CHENNAI TPP

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7.1 Datasheet of Float and Board type Level Indicator

- As per Tender Specification, S. No. m Volume II Section 2 Part 2.3 C & I System

7.2 Pipes, Fittings, Flanges & Accessories

S. No.	Items	Material Standard/ Other details	Dimension Standard
1.	Pipe		
A.	FUEL OIL		
	Type of end connection (Pipe to pipe & Pipe to equipment)	65 NB & above: API-5L Gr.B or A106 Gr.B Butt Welded for pipe; near equipment, this shall be of flanged type 50Nb and Below: Socket welding; near equipment this may be either socket welded or flanged.	Butt Welding - ANSI B 16.25 Socket Welding - ANSI B 16.11 Flanged- ANSI B 16.5 /BS 4504 / IS 6392
2.	FITTINGS & FLANGES		
A.	FUEL OIL		
a)	Fittings (Elbow, Tees and Reducers) 65mm NB & larger A 234 or WPB BW ENDS ANSI –B-16.25 50mm NB & below A105 socket weld ends ANSI-B16.11		
b)	Flanges		
	All sizes	Fabricated from IS 2062 plate	ANSI B16.5 Class- 150 lb.
3.	GASKETS		
a.	Fuel Oil	Teflon	
b.	Water Service	Teflon	
4.	Bolts / Studs	ASTM A 193 Gr. B7	
5.	Nuts	ASTM A 194 Gr 2H	





DM FOR FUEL OIL HANDLING SYSTEM
1x800 MW TANGEDCO NORTH CHENNAI TPP

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7.3 Datasheet of valve

Gate Valves	
	50 mm NB & large
Code	API-600
Body & bonnet	A-216 Gr. WCB
Seat/trim	11 to 13% chrome steel
Bolts for bonnet	A 193 Gr. B7
Nuts for bonnet	A 194 Gr. 2H
Globe valve	
Code	BS-1873
Body & bonnet	A216 Gr. WCB
Trim	Chrome steel (Brinell hardness B-250 min) as per AISI-431
Bolts for bonnet	A 193 Gr. B7
Nuts for bonnet	A 194 Gr. 2H
Check valves:	
Code	BS-1868
Body & bonnet; Trim	Same as per globe valves above
Seating surfaces	Same as per globe valves above
Ball valves:	
Code	BS-5351Teflon sealed full bore fire safe design
Body	A216 Gr. WCB
Ball	Stainless Steel AISI-316
Plug valves (oil service only)	
Code	API-599 self-lubricated wrench operated with an easy visible port position indicator
Body	A216 Gr. WCB
Plug	Hardened carbon steel



DM FOR FUEL OIL HANDLING SYSTEM
1x800 MW TANGEDCO NORTH CHENNAI TPP

DM. NO. PE-DC-423-166-A001

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ANNEXURE-I

Painting specification for HSD Day Oil Tank

	Tank inside surface	Tank outside surface	Tank underneath surface	Structural steel work, piping, steel floors, & stairways
Surface preparation	Blast clean to SA 2.5	Blasting cleaning to SA 2.5	Wire Brushing/ hand tool cleaning to ST-2.	Abrasive blasted to Sa 2½.
Primer	Two (2) layers of zinc phosphate epoxy primer, total DFT >75 micron	Two (2) layers of zinc phosphate epoxy, total dry film thickness 75 micron each.	2 coats of high build Coal tar epoxy suitably pigmented (2 pack), DFT: 80-100 microns each coat.	2 coat of Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each Primer shall be 60 microns.
Intermediate coat	2 pack high build epoxy, DFT 80 micron	One (1) layer 2 pack high build epoxy polyamide MIO, DFT 100µm." one layer, 2 packs of zinc phosphate epoxy, Total FT 100 microns . 	N. A.	Two intermediate MIO Epoxy paint, and one top polyurethane coating shall be applied. Dry film thickness of each intermediate coat shall be 90 microns .
Finish	Two pack silicon acrylic DFT 150 micron	Two (2) finishing coats of chlorinated rubber paint in approved shades at 50 microns DFT each coat in approved shades.	N. A.	Polyurethane coating shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint.
Total DFT	305 microns	275 microns	160 – 200 microns	330

Note: - Handrail shall be hot dip galvanizing as per IS 4736.

SUGGESTED COLOUR CODES FOR PAINTING (Ref: Vol II Sec 1 Ch-8 Painting clause No.6.9)

NO. ITEM /SERVICE	COLOUR	IS-5	COLOUR(BAND)	IS -5
Light oil (HSD)	Light brown	410	Brilliant green	221

Tank design			
			DATE: 26.09.2016
VERTICAL, CYLINDRICAL & CENTER COLUMN SUPPORTED FIXED CONE ROOF TANK AS PER IS 803/API650.			
Sl. No.	SPECIFICATIONS	UNITS	VALUES
A.1.0.	Input Design Data		
1	Quantity of Tank	Nos.	1
2	Diameter, D	m	6
3	Total Tank Height of Shell, H _t	m	4
4	Maximum Design Liquid Level, H _l	m	2.78
6	Nominal Capacity, Q _t	m ³	113.1
9	Design Specific Gravity, G	-	1
10	Design Density of liquid, ρ	kg/m ³	1000
11	Design Pressure, P	mLC	Hydrostatic Head
12	Vacuum Pressure, V _p	kg/m ²	50
13	Design Temperature, T	°C	60
14	Corrosion Allowance, C	mm	1.5
15	Joint Efficiency Factor, E	-	0.85
16	Radiography Examination		Spot Radiography
17	Material of Construction		IS 2062 Gr. B
18	Maximum Allowable working Stress, σ _a	kg/cm ²	1680
19	Width of Shell Plates, W _s	m	1.5
20	Width of Bottom Plates, W _b	m	1.5
21	Width of Roof Plates, W _r	m	1.5
22	Yield Stress Minimum, σ _y	MPa	240
B.0.	DETAILED CALCULATIONS.		
B.1.0.	Calculation of Shell Plate Thickness.		
	Minimum thickness as per specification		6
	Number of Shell Courses	Nos.	3
B.1.1	Thickness of 1 st Course, $t = (50 \times G \times D \times (H-0.3)/\sigma_a \times E) + C.A$		
	Course Under consideration from bottom of tank, n		1
	Height from the Bottom of course under consideration to the top of curb angle, $H = H_t - ((n-1) \times W_s)$	m	4
	Thickness of 1 st Course, t	mm	2.28
	Thickness for the first course is	mm	6
	However provided thickness for the first course is		6
B.1.2	Thickness of 2 nd Course, $t = (50 \times G \times D \times (H-0.3)/\sigma_a \times E) + C.A$		
	Course Under consideration from bottom of tank, n		2
	Height from the Bottom of course under consideration to the top of curb angle, $H = H_t - ((n-1) \times W_s)$	m	2.5
	Thickness of 2 nd Course, t	mm	1.97
	Thickness for the second course is.	mm	6
	However, provided thickness for the second course is.		6
B.1.3	Thickness of 3 rd Course, $t = (50 \times G \times D \times (H-0.3)/\sigma_a \times E) + C.A$		
	Course Under consideration from bottom of tank, n		3
	Height from the Bottom of course under consideration to the top of curb angle, $H = H_t - ((n-1) \times W_s)$	m	1
	Thickness of 3 rd Course, t	mm	1.65
	However provided thickness for the third course is.	mm	6
	However provided thickness for the third course is.		6
B.2.0			
	As per Clause No. 6.2.1(a), Page 17 of IS 803; All Bottom Plate of tank, uniformly resting on the ground, shall have a minimum nominal thickness of 6 mm, But 8mm thickness shall be provided for bottom plate		8
B.3.0	Roof Plate Thickness.		
	As per Clause No. 6.4.2.2, Page 36 of IS 803; Minimum nominal thickness of roof plate shall be 5 mm, But 6 mm thickness shall be provided for roof plate		6



TITLE
1x800 MW TANGEDCO NORTH CHENNAI TPP
FUEL OIL HANDLINGS SYSTEM &
MISCELLANEOUS TANKS

SPECIFICATION NO. PE-TS-423-166-A101

REV 00

Section -I Date 02.02.2017

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SPECIFIC TECHNICAL REQUIREMENTS

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IC – System write up (Condensate storage tank)



DS FOR CONDENSATE STORAGE TANK:
SITE FABRICATED
1x800 MW TANGEDCO NORTH CHENNAI TPP

DM. NO. PE-DC-423-167-A001

REVISION 02

DATE: 03/12/2016

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1.0 Intent

- 1) The purpose of this document is to bring out clarity with regard to the following:
 - a) Scope of Design, engineering, supply and exclusions for condensate storage tank – Site Fabricated
 - b) Major technical requirements of various items covered under this package
- 2) Approved copy of this document shall form the basis for subsequent approval of all drawing and documents for condensate storage Tanks – Site Fabricated at later stage.



2.0 Interfacing Drawings:

1) BHEL PEM- Mechanical System Engineering:

- a) PE-DG-423-100-N109, P&ID for condensate Transfer System

Above document will be submitted separately by PEM

3.0 Scope of supply & services

1) Scope of Supply

Scope of supply shall comprises of following:

- a) One (1) nos. of fixed roof type Mild Steel Condensate storage tank of capacity 1200 cum each along with accessories as indicated in tank Sketch.
- b) Valves and Instrumentation as indicated in Sketch.

2) Scope of Services

- a) Erection & Commissioning of Condensate storage tank along with accessories

4.0 Demonstration Test

Water fill test shall be carried out for at least 12 hrs at site during commissioning of the tanks as demonstration test.



5.0 Painting Schedule

Internal Painting shall be provided as per CI .6.7.1, Vol II, Sec-I, Chapter-8, painting, EPC Spec for BTG package.

External Painting shall be as per page 6/12 CI 6.4 Chapter 8 Design basis, painting, EPC Spec for BTG package.

Detail mentioned in Annexure -I

BHEL PEM	DATA SHEET FOR CONDENSATE STORAGE TANK		DOC NO: PE-DC-423-100-N127
			SHEET NO: 01 OF 02
	PROJECT TITLE: NORTH CHENNAI STPP, (1 x 800 MW)		REV NO: 02
1	SERVICE IDENTIFICATION	CONDENSATE STORAGE TANK	
2	P&ID NO.	PE-DG-423-100-N109	
3	SYSTEM	HOTWELL MAKE UP SYSTEM	
4	CAPACITY (EFFECTIVE) (m ³)	1200	
5	NUMBER REQUIRED	1 No .	
6	STORAGE MEDIUM	DM WATER	
7	TYPE	VERTICAL, CYLINDRICAL	
8	TENTATIVE SIZE	DIA. 13MX Ht. 10.5M	
9	PRESSURE CLASS	DESIGN FOR FILLED WATER HEAD / ATOMSPHERIC	
10	MATERIAL OF CONSTRUCTION	MILD STEEL TO IS:2062	
11	DESIGN TEMPERATURE	60 ⁰ C	
12	LOCATION OF INSTALLATION	OUTDOOR	
13	DESIGN & CONSTRUCTION CODE	IS803 / API650	
14	CORROSION ALLOWANCE (CA)	2mm	
15	MIN. PLATE THICKNESS INCLUDING CA (IN MM)	BOTTOM – 8, SHELL - 8 /6, ROOF- 6	
16	JOINT EFFICIENCY	0.85	
17	MATERIAL OF CONSTRUCTION FOR PLATES	IS2062 GR. B	
18	MATERIAL OF CONSTRUCTION FOR STRUCTURES (ANGLE, CHANNEL, BEAM, BAR AND FLAT)	IS2062 GR. A / B	
19	HANDRAIL		
19.1	SIZE OF PIPE	50 NB	
19.2	MATERIAL	MS pipes (medium class) conforming to IS: 1161.	
20	DIMENSION STANDARD	ANSI 36.10, PLAIN ENDS	
21	NOZZLE CONNECTIONS REQD /	AS PER ENCLOSED SKETCH / SOCKET WELDED FOR	
22	END CONNECTION	SIZE <= NB50 & FLANGED FOR SIZE > NB50	
23	PIPE / NOZZLE MATERIAL	STAINLESS STEEL TO SA312 TP 304	
24	VALVES MATERIAL	STAINLESS STEEL	
25	VALVES END CONNECTION	SOCKET WELDED FOR SIZE <= NB50	
26	MATERIAL FOR VALVES, PIPES & FITTINGS	AS PER DS OF VALVES, PIPES AND FITTINGS GIVEN BELOW	
27	OTHER ACCESSORIES TO BE PROVIDED WITH TANK	SEAL POT & NAOH BREATHER POTS	
28	DIP HATCH	TANK SHALL BE FITTED WITH ONE DIP HATCH. DIP HATCH SHALL HAVE SCREWED END AND SHALL BE FITTED WITH BRASS CAP AND CHAIN.	
29	STAIRCASE FOR TANKS:	SPIRAL STAIRCASE WITH HANDRAILS & GI GRATINGS SHALL BE PROVIDED OUTSIDE. HANDRAILS AT CST TOP AND INSIDE RUNG LADDERS SHALL BE PROVIDED. TWO NOS. MANHOLE I.E. ONE ON THE TANK ROOF & OTHER ONE ON TANK SHELL	
30	WIDTH OF PLATE		WIDTH OF THE PLATE CAN BE CONSIDERED OUT OF THESE 1500/1800/2000. AS PER IS803,
31	INSTRUMENTS / ACCESSORIES REQUIRED	(a) CONSERVATION VENT VALVE /NAOH BREATHER	
		(b) OVERFLOW OF 150 NB & DRAIN PIPING OF 80 NB WITH DRAIN VALVE	
		(c) SEAL POT WITH DRAIN VALVE ETC FOR OVERFLOW	
		(d) LEVEL GAUGE TO COVER ENTIRE RANGE	
		(e) 2 NOS TAPPINGS 'FOR LEVEL TRANSMITTERS (2 Nos.)	
		(f) TWO SPARE CONNECTION OF 200 NB WITH VALVES AND TWO SPARE CONNECTION OF 150 NB WITH BLIND FLANGE	
32	SURFACE PREPARATION		
33	INSIDE PROTECTION	→	AS PER PAINTING SCHEDULE
34	EXTERNAL PAINTING		
35	MANHOLE	TWO (2) NOS. ONE ON SHELL & OTHER ON ROOF	
NOTE : ALL OTHER GENERAL TECHNICAL REQUIREMENTS / ACCESSORIES & SPARES AS PER CUSTOMER TENDER SPECIFICATION.			



DS FOR CONDENSATE STORAGE TANK:
SITE FABRICATED
1x800 MW TANGEDCO NORTH CHENNAI TPP

DM. NO. PE-DC-423-167-A001

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Float and Board type Level Indicator (As per Tender Specification, S. No. m Volume II Section 2 Part 2.3 C & I System)

S.NO.	COMPONENT	DESCRIPTION
1	Type	Mechanical Type (Float Operated)
2	Float Material	SS316 having 2 nos. Guide wires
3	Float Wire Pulley	Shall comprise of 2 nos. Cast Aluminium Pulley housing Assembly with SS 304 pulley and pulley shaft. Steel ball bearings shall be provided in pulley housing for easier float movement. Float wire material shall be SS316L. Between 2 pulleys, 1" NB G.I. short pipe with tentative Length .
4	Guide wire Assembly	CS chamber with spring and adjuster having 1" Class 150 ANSI RF MS flange. Guide wire rope shall be SS316L.
5	Counter Weight	MS counter – weight with Aluminium Pointer and Brass assembly Pull Chain.
6	Scale	SS 316/Aluminium material in mm with 1 % accuracy.
7	Nozzle Details	For float wire pulley assembly, one tapping and for guide. wire assembly two tapping at the top of the tank; Size 1" NB (Top Mounting Type)
8	Process Connection	Flanged as per ANSI B 16.5 to suit 1" NB nozzle (Nozzle length - 150 mm for float wire, 100 mm for guide wire)
9	Accessories (to be supplied with the instrument)	
10	Counter flange	All mating Flanges, Nozzle
11	Mounting Accessories	All mounting accessories
12	Tag Plate	To be provided (material SS316)
13	Quantity	One (1) No.



**DS FOR CONDENSATE STORAGE TANK:
SITE FABRICATED
1x800 MW TANGEDCO NORTH CHENNAI TPP**

DM. NO. PE-DC-423-167-A001

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1) Pipes, Fittings, Flanges & Accessories

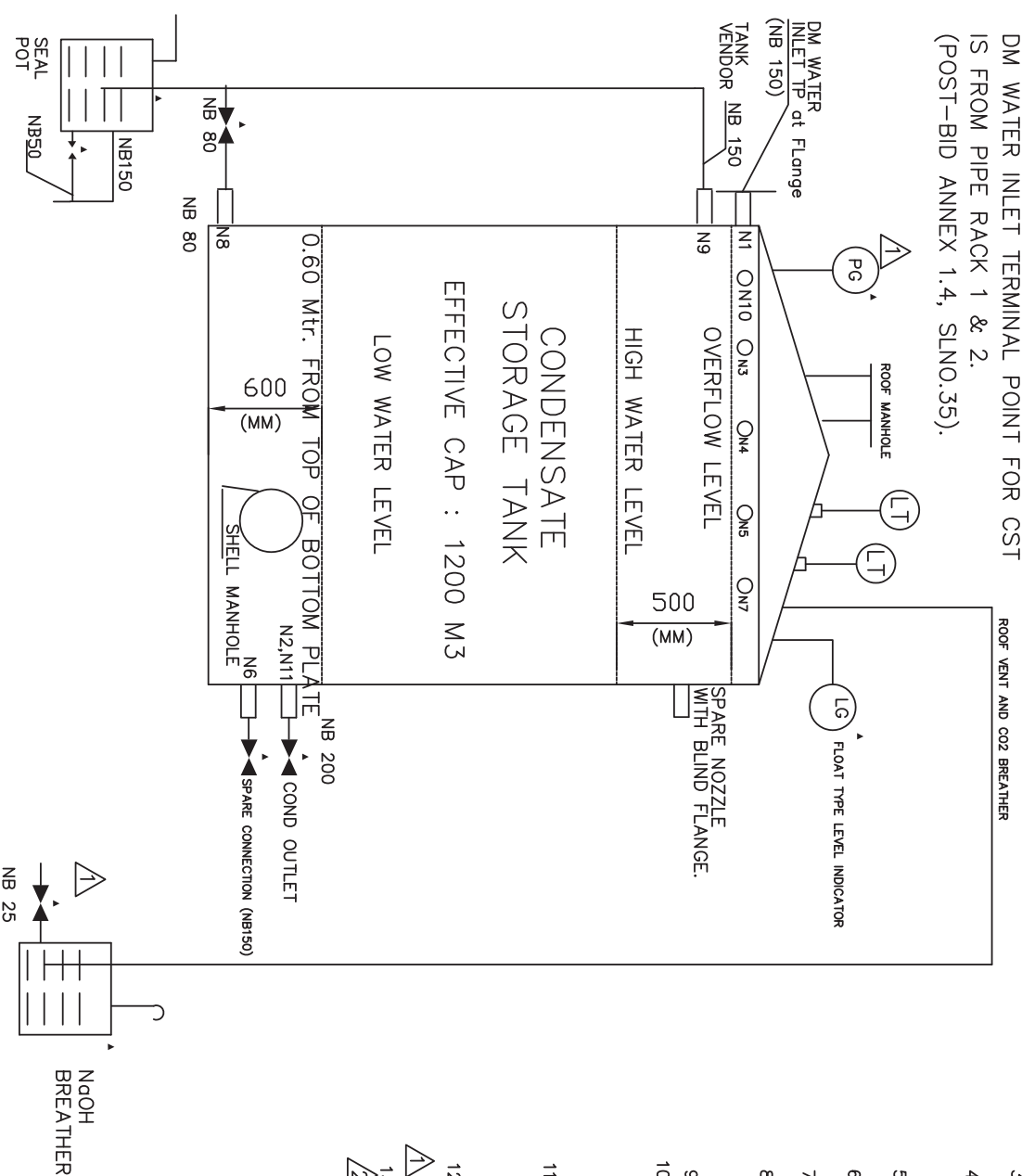
S.No.	Description	Material Standard	Dimensional Standard
1.0	SS Pipes		
1.1	50 NB and below	Stainless steel pipe as per ASTM A-312, Gr. 304 , Seamless, Sch. 40S	As per ANSI B-36.19, socket welded
1.2	65 NB and above	Stainless steel pipe as per ASTM A-312, Gr. TP-304, welded , Sch.10S	As per ANSI B-36.19, BW ends as per ANSI B16.25
2.0	SS Fittings(Elbow, Tees & Reducers)		
2.1	50 NB and below	Forged Stainless steel as per ASTM A-182, F-304	ANSI B 16.11, S/W ends
2.2	65 NB and above	Stainless Steel as per ASTM A-351, CF8	ANSI B 16.9, B/W ends
3.0	SS Flanges		
3.1	For SS Pipes up to 50 NB	ASTM A182 F304	ANSI B16.5, RF
3.2	For SS Pipes above 50 NB	ASTM A403 Gr. 304	ANSI B16.5, FF
4.0	Gasket for SS fittings		
4.1	Up to 50NB	SS jacketed CAF with superior oil / resistance	ANSI B 16.21
4.2	Above 50NB	PTFE (TEFLON)	ANSI B 16.21
5.0	Bolts & Nuts		
5.1	Wherever applicable in all the tanks.	ASTM A-193, Gr. B7 for Bolts ASTM A-194, Gr. 2H for Nuts	ASTM A-193 / A-194

Valves

S.NO.	COMPONENT	DESCRIPTION
1.	Body & Bonnet	ASTM A182 Gr.F304 (50NB & below) ASTM A351 Gr.CF8M (50NB above)
2.	Wedge & Seat ring	ASTM A182 Gr.F304 (50NB & below) ASTM A351 Gr.CF8M (50NB above)
3.	Trim	ASTM A182 Gr F304
4.	Rating	Class 800 (50NB & below) Class 150 (50NB above)
5.	Ends	SW to B16.11 (50NB &below) Flanged to B16.5 (50NB above)
6.	Design Standards	B16.34 / API600 for Gate valve B16.34 / BS1873 for Globe valve
7.	Testing standards	API 598 for all valve (All sizes)
8.	Bolts & Nuts	A193 Grb7 & A194 Gr.2H

SKETCH FOR CONDENSATE STORAGE TANK

*  DM WATER INLET TERMINAL POINT FOR CST IS FROM PIPE RACK 1 & 2. (POST-BID ANNEX 1.4, SLNO.35).



NOTES:-

- 1.0 HIGH WATER LEVEL SHALL BE MIN. 150 MM BELOW BOTTOM OF OVERFLOW NOZZLE.
- 2.0  ITEMS THUS MARKED ARE TO BE SUPPLIED ALONG WITH TANK.
- 3.0 NOZZLE ORIENTATION SHALL BE AS PER FINAL LAYOUT
- 4.0 THE NET CAPACITY OF TANK I.E 1200 CUM IS CAPACITY BETWEEN LOW AND HIGH LEVEL SHOWN IN THIS SKETCH.
- 5.0 FLOAT & BOARD TYPE LEVEL GAUGE SHALL BE PROVIDED.
- 6.0 THE LEVEL TRANSMITTERS SHALL BE OF ULTRASONIC TYPE.
- 7.0 LOW WATER LEVEL SHALL BE MIN. 150MM ABOVE TOP OF SUCTION NOZZLE.
- 8.0 ALL NOZZLES (ALONG WITH FLANGES & COUNTER FLANGES), OVERFLOW PIPE, NOZZLE FOR MOUNTING LEVEL INDICATOR, WITH ISOLATION VALVES AND SPARE VALVES SHALL BE SUPPLIED BY TANK VENDOR.
- 9.0 LOCATION OF THE TANK IS OUTDOOR.
- 10.0 A CIRCUMFERENTIAL DRAIN SHALL BE PROVIDED AROUND THE CST FOR TERMINATING THE TANK, SEAL POT & NaOH BREATHER DRAINS. THE CIRCUMFERENTIAL DRAIN SHALL THEN BE CONNECTED TO NEARBY PLANT DRAIN BY CIVIL AGENCY.
- 11.0 TRANSMITTER SHOWN ARE EXCLUDED FROM TANK VENDOR SCOPE. THESE SHALL BE SUPPLIED SEPARATELY UNDER INSTRUMENTATION PACKAGE. 25NB NOZZLE ON TANK SHELL WITH ISOLATION VALVE SHALL BE PROVIDED BY TANK VENDOR FOR MOUNTING OF LTs.
- 12.0 PRESSURE GAUGE IN TERMS OF 0-10000 MMWC OR SUITABLE RANGE HAVING DIAL SIZE OF 300MM OR BIGGER SIZE SHALL BE PROVIDED
13.  TANK SHALL BE ERECTED ON A CONCRETE BED MINIMUM 300MM ABOVE FGL.

NOZZLE NO.	DESCRIPTION	SIZE(NB)
N1	DM INLET	150
N2	COND OUTLET	200
N3	MIN. RECIRCULATION FROM HOT WELL MAKEUP	50
N4	MIN. RECIRCULATION FROM BOILER FILL PUMP	80
N5	EXCESS CONDENSATE RETURN	200
N6	SPARE	150
N7	SPARE	200
N8	DRAIN	80
N9	OVERFLOW	150
N10	SPARE WITH BLIND FLANGE	150
N11	SPARE WITH VALVE	200

Tank design			
			DATE: 22.08.2016
VERTICAL, CYLINDRICAL & CENTER COLUMN SUPPORTED FIXED CONE ROOF TANK AS PER IS 803/API650.			
Sl. No.	SPECIFICATIONS	UNITS	VALUES
A.1.0.	Input Design Data		
1	Quantity of Tank	Nos.	1
2	Diameter, D	m	13
3	Total Tank Height of Shell, H _t	m	10.5
4	Maximum Design Liquid Level, H _l	m	9.28
6	Nominal Capacity, Q _i	m ³	1393.68
8	Effective Capacity, Q _e	m ³	1231.74
9	Design Specific Gravity, G	-	1
10	Design Density of liquid, ρ	kg/m ³	1000
11	Design Pressure, P	mLC	Hydrostatic Head
12	Vacuum Pressure, V _b	kg/m ²	50
13	Design Temperature, T	°C	60
14	Corrosion Allowance, C	mm	1.5
15	Joint Efficiency Factor, E	-	0.85
16	Radiography Examination		Spot Radiography
17	Material of Construction		IS 2062 Gr. B
18	Maximum Allowable working Stress, σ _a	kg/cm ²	1680
19	Width of Shell Plates, W _s	m	1.5
20	Width of Bottom Plates, W _b	m	1.5
21	Width of Roof Plates, W _r	m	1.5
22	Yield Stress Minimum, σ _y	MPa	240
B.0.	DETAILED CALCULATIONS.		
B.1.0.	Calculation of Shell Plate Thickness.		
	Minimum thickness as per specification		6
	Number of Shell Courses	Nos.	7
B.1.1	Thickness of 1 st Course, t = (50 x G x D x (H-0.3)/σ _a x E) + C.A		
	Course Under consideration from bottom of tank, n		1
	Height from the Bottom of course under consideration to the top of curb angle, H = H _t - ((n-1) x W _s)	m	10.5
	Thickness of 1 st Course, t	mm	6.15
	Thickness for the first course is	mm	6.15
	However provided thickness for the first course is		8
B.1.2	Thickness of 2 nd Course, t = (50 x G x D x (H-0.3)/σ _a x E) + C.A		
	Course Under consideration from bottom of tank, n		2
	Height from the Bottom of course under consideration to the top of curb angle, H = H _t - ((n-1) x W _s)	m	9
	Thickness of 2 nd Course, t	mm	5.47
	Thickness for the second course is.	mm	6
	However, provided thickness for the second course is.		6
B.1.3	Thickness of 3 rd Course, t = (50 x G x D x (H-0.3)/σ _a x E) + C.A		
	Course Under consideration from bottom of tank, n		3
	Height from the Bottom of course under consideration to the top of curb angle, H = H _t - ((n-1) x W _s)	m	7.5
	Thickness of 3 rd Course, t	mm	4.78
	However provided thickness for the third course is.	mm	6
	However provided thickness for the third course is.		6
B.1.4	Thickness of 4 th Course, t = (50 x G x D x (H-0.3)/σ _a x E) + C.A		
	Course Under consideration from bottom of tank, n		4
	Height from the Bottom of course under consideration to the top of curb angle, H = H _t - ((n-1) x W _s)	m	6
	Thickness of 4 th Course, t	mm	4.1
	Thickness for the fourth course is.	mm	6
	However provided thickness for the fourth course is.	mm	6
B.1.5	Thickness of 5 th Course, t = (50 x G x D x (H-0.3)/σ _a x E) + C.A		
	Course Under consideration from bottom of tank, n		5
	Height from the Bottom of course under consideration to the top of curb angle, H = H _t - ((n-1) x W _s)	m	4.5
	Thickness of 5 th Course, t	mm	3.42
	Thickness for the fifth course is.	mm	6
	However provided thickness for the fifth course is.		6
B.1.6	Thickness of 6 th Course, t = (50 x G x D x (H-0.3)/σ _a x E) + C.A		
	Course Under consideration from bottom of tank, n		6
	Height from the Bottom of course under consideration to the top of curb angle, H = H _t - ((n-1) x W _s)	m	3
	Thickness of 6 th Course, t	mm	2.73
	Thickness for the sixth course is.	mm	6
	However provided thickness for the sixth course is.		6
B.1.7	Thickness of 7 th Course, t = (50 x G x D x (H-0.3)/σ _a x E) + C.A		
	Course Under consideration from bottom of tank, n		7
	Height from the Bottom of course under consideration to the top of curb angle, H = H _t - ((n-1) x W _s)	m	1.5
	Thickness of 7 th Course, t	mm	2.05
	Thickness for the seventh course is.	mm	6
	However provided thickness for the seventh course is.		6
B.2.0			
	As per Clause No. 6.2.1(a), Page 17 of IS 803; All Bottom Plate of tank, uniformly resting on the ground, shall have a minimum nominal thickness of 6 mm, But 8mm thickness shall be provided for bottom plate		8
B.3.0	Roof Plate Thickness.		
	As per Clause No. 6.4.2.2, Page 36 of IS 803; Minimum nominal thickness of roof plate shall be 5 mm, But 6 mm thickness shall be provided for roof plate		6



**DS FOR CONDENSATE STORAGE TANK:
SITE FABRICATED
1x800 MW TANGEDCO NORTH CHENNAI TPP**

DM. NO. PE-DC-423-167-A001

REVISION 02

DATE: 03/12/2016

Page 10 of 10

ANNEXURE-I**Painting specification for Condensate Storage Tank**

	Tank inside surface	Tank outside surface	Tank underneath surface	Structural steel work, piping, steel floors, & stairways
Surface preparation	Blasting according to Sa 2½ and ISO 8501-1:1988.	Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.	Wire Brushing/ hand tool cleaning to ST-2.	Wire Brushing/ hand tool cleaning to ST-2.
Pre-Treatment	Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.	Not Applicable		
Primer	Two layers of Zinc phosphate epoxy primer, total dry film thickness >75µm.	Two (2) layers of Zinc phosphate epoxy, total dry film thickness 75µm.	2 coats of high build coal tar epoxy suitably pigmented (2 pack), DFT:80-100 microns each coat.	Two (2) coats of epoxy based zinc rich primer of 35 microns.
Intermediate coat	2 pack high build epoxy, dry film thickness 80 µm.	One (1) layer 2 pack high build epoxy polyamide MIO, DFT 100µm.	N. A.	N. A.
Finish	2 pack silicon acrylic, dry film thickness of 150µm per coat.	Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 50 microns DFT each coat in approved shades.	N. A.	Two (2) coat of Acrylic polyurethane of 50 microns per coat.

Note: - Handrail shall be hot dip galvanizing as per IS 4736.

GAP OF LEVEL INDICATOR

Manufacturer's Name:				QUALITY ASSURANCE PLAN				PROJECT: PACKAGE: Misc. Tanks (Site Fabricated) LOI No. : Customer : BHEL			BHEL Doc. No.: Rev. No. : 0 Date:			SHEET 1 OF 1		
				GAP OF LEVEL INDICATOR												
SI. No.	Components and Operation	Characteristic/ Item	Class	Type of Check	Extent of Check	Reference Document	Acceptance Norm	Format of Record (D*)	Agency			Remarks				
1	2	3	4	5	6	7	8	9	M	B	C	11				
1	Level Indicator	Check for Type, Model No., Tag No.	MA	Visual	100%	Approved Data Sheet	Approved Data Sheet	Mfgr. TC	P	V	V					
2		Float Leakage Test	CR	Mechanical	100%	Approved Data Sheet	Approved Data Sheet	Mfgr. TC	P	V	V					
3		Review of TC for Material	CR	Visual	For Lot	MTC	MTC	Mfgr. TC	P	V	V					
			C: BHEL B : Vendor M. : Manufacturer				P - Perform W - Witness V - Verification									
Manufacturer / Contractor / Sub contractor							FOR BHEL			FOR CUSTOMER			APRD. BY			
Signature																

Manufacturer's Name:				MANUFACTURING QUALITY PLAN FOR VALVES				PROJECT:				BHEL Doc. No.:			
								PACKAGE: Misc. Tanks (Site Fabricated)				Rev. No. : 0			
								LOI No. :				Date:			
								Customer : BHEL				SHEET 1 OF 1			
Sl. No.	Components and Operation	Characteristic/ Item	Class	Type of Check	Quantum	Reference Document	Acceptance Norm	Format of Record (D*)	D	Agency	M	B	C	Remarks	
1.0	Material :														
1.1	Body,Bonnet,forgings/casting	1.Chemical composition	CR	Chem.test	One /heat	Approved Data Sheet/DRG	Relevant standard.	TC	✓	P		V	V		
		2.Mech properties	CR	Tensile test	One /heat HT Batch	Approved Data Sheet/DRG	Relevant standard.	TC	✓	P		V	V		
1.2	Disc & spindle	1. Mech Properties	MR	Tensile test	1 Test bar /Heat	Approved Datasheet	Relevant standard.	TC	✓	P		V	V		
		Chemical properties	MR	Chemical analysis											
2.0	In Process Inspection :-														
2.1	Body,Bonnet,Disc,spindle after Machining	Visual	MR	Visual	100%		No visual surface defect	IR	✓	P					
		Dimension	MR	Measurements	100%	Component drg	Component drg	compliance report							
2.2	Body,Seat ring ,Disc,spindle after Machining	Surface defects	MR	DPT	100%		No significant defects	mfrg.TC	✓	P		-			
3.0	TESTING & FINAL INSPECTION														
3.1	Complete valve	hydrotesting(pressure & duration as per approved datasheet/std.)	MR	Body/seat	100%	Approved datsheet	No leakage through Body/seat	TC	✓	P		W	W		
3.2		Functional test	MR	Full open & full close	100%	Approved Drg/datasheet	Smooth operation	IR	✓	P		W	W		
		LEGEND : * RECORDS IDENTIFIED WITH "TICK" SHALL BE INCLUDED													
		C: BHEL													
		B : VENDOR													
		M:Manufacturer													
		DPT=Dye penetrant test MR-MAJOR,CR-Critical , OHP-customer Hod,													
		R=review,NDT-non Destructive test,TC-test certificate, IR-inspection Report ,D-Data folder,DPT=Dye penetrant Test													
	Manufacturer / Contractor / Sub contractor	CR-Critical Characteristics MA - Major Characteristics MI- Minor Characteristics			FOR BHEL			FOR CUSTOMER		APRD. BY					
	Signature														

QAP OF MS PLATES

Manufacturer's Name: Approved sub vendor				MANUFACTURING QUALITY PLAN				PROJECT: PACKAGE: Misc.Tanks (Site Fabricated) LOI No. : Customer : BHEL				BHEL Doc. No.: Rev. No. : 0 Date: SHEET 1 OF 1			
				ITEM: MS PLATES Sub-system- Misc.tanks				Format of Record (D*)				Agency			
Sl. No.	Components and Operation	Characteristic/ Item	Class	Type of Check	Extent of Check	Reference Document	Acceptance Norm	D	M	B	C	Remarks			
1	2 RAW MATERIAL	3	4	5	6	7	8	9						12	
1	STEEL PLATES	Chemical composition and Mechanical test	MA	Review of correlated Visual and MTC	one/heat	IS:2062	IS:2062	Mfgr. TC	✓	P	V	V	Refer Note below		
2		Visual and dimensionl check	MA	measurment	100%	Mfg.TC	Mfg.TC IS1852	Mfgr. TC	✓	P	**W	**W			
3		Identification/markng	MA	Correlation establish	100%	As per manufacturing practice	As per manufacturing practice IS 2062	Mfgr. TC	✓	P	V	**W			
LEGEND : * RECORDS IDENTIFIED WITH "TICK" SHALL BE INCLUDED C: BHEL B : VENDOR M.Manufacturer														DOC. NO. : Rev No.0	
FOR BHEL 				FOR CUSTOMER				APRD. BY							
Manufacturer / Contractor / Sub contractor				Signature											

Notes ** In case material is despatched directly from Approved sub-vendor plant/stockyard or procured from dealer against co related TC's witnessing by BHEL is waived off and material will be accepted based on MTC of approved sub vendor.
In case material is procured from dealer and co related TC's are not available check on 100% quantity of plates will be performed on sample drawn from them at NABL certified/approved laboratory for chemical & physical properties,however dimensional check shall be witnessed by BHEL

QAP OF PIPE FITTINGS, FLANGES & ACCESSORIES

Manufacturer's Name:		QUALITY ASSURANCE PLAN		PROJECT: PACKAGE: Misc. Tanks (Site Fabricated) LOI No. : Customer : BHEL		BHEL Doc. No.: Rev. No. : 0 Date:		SHEET 1 OF 1	
		INSPECTION CHECK LIST FOR PIPE FITTINGS, FLANGES & ACCESSORIES							
Sl. No.	Components and Operation	Class	Type of Check	Reference Document/Acceptance Norm		Agency		Remarks	
1	2	3	4	5		M	B	C	7
1	Pipes Fittings, Flanges & Accessories	MI	Visual	As per Approved Data Sheet/Tech spec. As per Approved Data Sheet/Tech spec. As per MTC As per MTC		P	V	V	
2		MI	Dimensional			P	V	V	
3		MI	Review of TC			P	V	V	
		MA	Hydro Test			P	V	V	
		LEGEND : * RECORDS IDENTIFIED WITH "TICK" SHALL BE INCLUDED C : CUSTOMER /BHEL B. : VENDOR M. : Manufacturer							
				P - Perform W - Witness V - Verification					
Manufacturer / Contractor / Sub contractor Signature		CR-Critical Characteristics MA - Major Characteristics MI- Minor Characteristics IR-Inspection Report ,MTC- Material/Manufacturer's Test. Certificate		FOR BHEL		FOR CUSTOMER		APRD. BY	APPROVAL SEAL



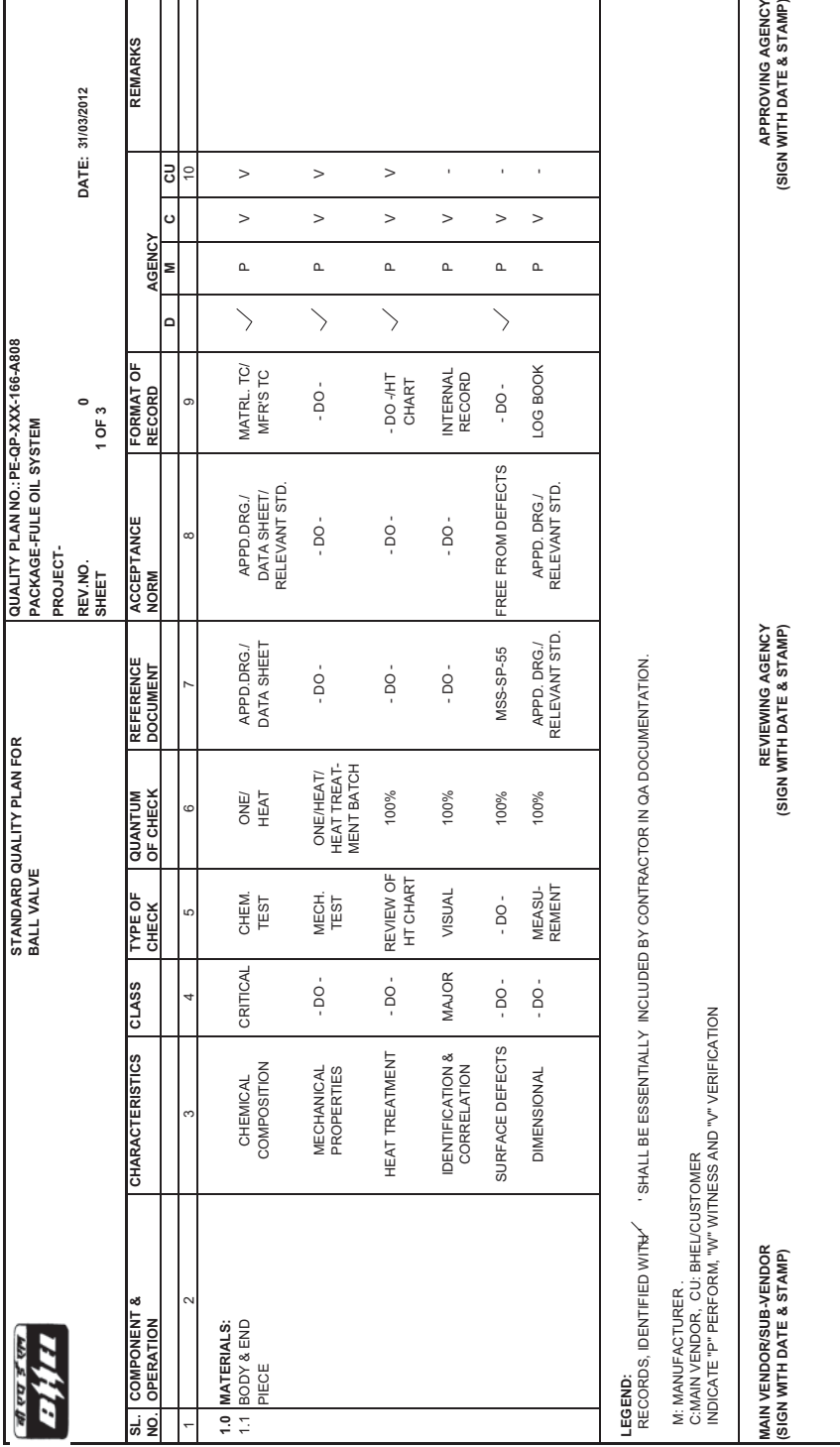
STANDARD QUALITY PLAN FOR STRUCTURAL STEEL										QUALITY PLAN NO.: PE-QP-XXX-166-A803					
PROJECT-										PACKAGE-FULE OIL SYSTEM					
REV.NO. 0										DATE: 31/03/2012					
SHEET 1 OF 1															
AGENCY															
D										M					
C										10					
REMARKS										11					
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD							
1.0	Structural	a) Chemical Composition b) Mechanical test c) Dimensional conformity	M	Chemical Analysis Mechanical Properties Measurement	Sample -do- 100%	IS:2062/ Spec./Drg. -do- -	IS:2062/ Spec./Drg. -do- -	Mfr's TC Mfr's TC Mfr's TC	✓ ✓ ✓	P P P	V* V* W**	V V V			
* In case material is procured from dealer, and co-related TCs are not available, check test on identified sample will be carried out at recognised testing laboratory. ** In case material is despatched directly from SAIL/IISCO plant to project site, the witnessing required is waived and material will be accepted on challan & MTC of SAIL/IISCO															
LEGEND: RECORDS IDENTIFIED WITH "✓" * SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. M - MANUFACTURER C - MAIN VENDOR CU - BHEL/CUSTOMER/NOMINATED INSPECTION AGENCY "P" PERFORM, "W" WITNESS AND V VERIFICATION															
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)										REVIEWING AGENCY (SIGN WITH DATE & STAMP)			APPROVING AGENCY (SIGN WITH DATE & STAMP)		



PEM MAUX

STANDARD QUALITY PLAN FOR STEEL PLATE

QUALITY PLAN NO.: PE-QP-XXX-166-A804										
PACKAGE-FULE OIL SYSTEM										
PROJECT-										
REV.NO. 0 DATE: 31/03/2012										
SHEET 1 OF 1										
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CATEGORY	TYP/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY P W V	REMARKS
1.0	Steel Plate	a) Chemical Composition	MA	Chemical Analysis	Sample	IS:2062/ Spec./Drg.	IS:2062/ Spec./Drg.	Mfr's TC	3	2*,1
		b) Mechanical test	MA	Mechanical Properties	-do-	-do-	-do-	Mfr's TC	3	2*,1
		c) Dimensional conformity	MA	Measurement	100%	-	-	Mfr's TC	3 2**	1
* In case material is procured from dealer, and co-related TCs are not available, check test on identified sample will be carried out at testing laboratory. ** In case material is despatched directly from SAIL/TISCO plant/Stock yard to project site, the witnessing required is waived and material will be accepted on MTC of SAIL/TISCO										
LEGEND CR - Critical characteristics MA - Major characteristics MI - Minor characteristics P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor 4-CUSTOMER										
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)						REVIEWING AGENCY (SIGN WITH DATE & STAMP)				
APPROVING AGENCY (SIGN WITH DATE & STAMP)						APPROVING AGENCY (SIGN WITH DATE & STAMP)				





STANDARD QUALITY PLAN FOR BALL VALVE					QUALITY PLAN NO.: PE-QP-XXX-166-A808 PACKAGE-FULE OIL SYSTEM PROJECT- REV.NO. 0 SHEET 2 OF 3 DATE: 31/03/2012							
SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD				REMARKS
								D	M	C	CU	
1	1.2 BALL, SPINDLE, GLAND, LEVER FASTENERS	CHEMICAL COMPOSITION MECHANICAL PROPERTIES HEAT TREATMENT (as applicable) SURFACE DEFECTS DIMENSIONS DIMENSIONS TEMPERATURE RESISTANCE	CRITICAL -DO - -DO - MAJOR -DO - -DO - -DO -	CHEM. TEST MECH. TEST REVIEW OF HT CHART - DO - MEASUREMENT - DO - TEMP. CHECK	ONE/ HEAT ONE/HEAT/ HEAT TREATMENT BATCH 100% 100% 100% 100% 100%	APPD.DRG./ DATA SHEET - DO - - DO - MSS-SP-55 APPD. DRG./ RELEVANT STD. - DO - PTFE /RELEVANT STD. MFG. DRG. - DO - APPD. DRG./ DATA SHEET/ TECH.SPEC. ASTM-E-165	APPD.DRG./ DATA SHEET/ RELEVANT STD. - DO - - DO - FREE FROM DEFECTS - DO - - DO - RELEVANT STD. MFG. DRG. MFG. DRG./MFG. STD. APPD. DRG./ DATA SHEET/ TECH.SPEC./MFG. STD. NO LINEAR INDICATION	TEST CERT. - DO - - DO - / HT CHART - DO - LOG BOOK INTERNAL RECORD TEST CERTIFICATE LOG BOOK - DO - TEST CERT. INTERNAL RECORD	P P P P P P P P P P P	V V V V V V V V V V V	11	
1.3	BODY SEAL, STEM SEAL, GLAND PACKING											
2.0	<u>IN-PROCESS INSPECTION:</u>											
2.1	MACHINING OF BODY END-PIECE GLAND BALL, SPINDLE											
2.2	BALL, SPINDLE											
LEGEND: RECORDS, IDENTIFIED WITH ' ' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. M: MANUFACTURER . C: MAIN VENDOR, CU: BHEL/CUSTOMER INDICATE "P" PERFORM, "W" WITNESS AND "V" VERIFICATION												
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)							REVIEWING AGENCY (SIGN WITH DATE & STAMP)				APPROVING AGENCY (SIGN WITH DATE & STAMP)	



STANDARD QUALITY PLAN FOR
BALL VALVE

QUALITY PLAN NO.: PE-QP-XXX-166-A808
 PACKAGE-FULE OIL SYSTEM
 PROJECT-
 REV.NO. 0
 SHEET 3 OF 3
 DATE: 31/03/2012

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

NOTE-1:
 100% BY MANUFACTURER
 10% BY TECHNO

For Actuator operating valves - Actuator test certificate shall be furnished to BHEL for review.
 For Fire safe valves - Valves are to be accepted based on fire test certificates

LEGEND:
 RECORDS, IDENTIFIED WITH ' / ' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.
 M: MANUFACTURER.
 C: MAIN VENDOR, CU: BHEL/CUSTOMER
 INDICATE 'P' PERFORM, 'W' WITNESS AND 'V' VERIFICATION

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

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)

STANDARD QUALITY PLAN FOR CS PIPE -ERW										QUALITY PLAN NO.:PE-QP-XXX-166-A809 PACKAGE-FULE OIL SYSTEM PROJECT- REV.NO. 0 SHEET 1 OF 1 DATE: 31/03/2012				
														
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS		
1	2	3	4	5	6	7	8	9	D	M	C	10	11	
1.0	ERW PIPE	a) Physical & Chemical test	M	Physical & Chemical Properties	Sample	IS:1239 Pt.1/ API 5L Gr. B/ Appd. Data sheet	IS:1239 Pt.1/ API 5L Gr. B/ Appd. Data sheet	MTC/ Mfr's TC	✓	P	V	V	Refer Note-1	
		b) Dimensional conformity	M	Measurement	At random	-do-	-do-	MTC/ Mfr's TC	✓	P	V	V		
		c) Hydro test	M	Leak test	100%	-do-	-do-	MTC/ Mfr's TC	✓	P	V	V		
Note-1: In case material is procured from dealer, and co-related Mfr's TCs are not available, check test on identified sample will be carried out at testing laboratory and hydro test at pressure 1.5 times of design pressure on 10% of total quantity will be witnessed by BHEL.														
LEGEND: RECORDS IDENTIFIED WITH " " SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. M - MANUFACTURER C - MAIN VENDOR CU - BHEL/CUSTOMER "P" PERFORM, "W" WITNESS AND V VERIFICATION														
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)										REVIEWING AGENCY (SIGN WITH DATE & STAMP)				APPROVING AGENCY (SIGN WITH DATE & STAMP)



STANDARD QUALITY PLAN FOR CCS /CFS GATE,GLOBE & CHECK VALVE (UP TO 50 NB-FCS #800 & 1 NO. 50 NB GLOBE VALVE #600) (65 NB & ABOVE CCS # 150)						QUALITY PLAN NO.:PE-QP-XXX-166-A810 PACKAGE-FULE OIL SYSTEM PROJECT- REV.NO. 0 SHEET 1 OF 2 DATE: 31/03/2012						
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									D	M	C	N
1			4	5	6	7	8	9			10	
1	Raw Material: Body, bonet, gld., Flange, Disc. / wedge	Chem. & mech. Test Dimensions Surface quality	CR MR MR	Chem & mech. Test Measurement Visual	Per Heat 100% 100%	Appd.Drg./ Mfg. Drg./ Data Sheet Mfg. Drg./ Data Sheet	Relevant Standard Mfg. Drg./ Data Sheet Defect Free	MTC IR IR	✓ ✓ ✓	P P P	V V V	V V V
1.1	Stem,body seat ring,gland.	Chem. & mech. Test	CR	Chem & mech. Test	Per Heat	Appd.Drg./Relevant Std.	Appd.Drg./Relevant Std.	MTC	✓	P	V	V
1.2	Fasteners	Chem. & mech. Test	MR	Chem & mech. Test	Per Heat	Appd.Drg./Relevant Std.	Appd.Drg./Relevant Std.	IR	✓	P	V	V
1.3	Gasket & gland packing	Compliance to PO	MR	Measurement	100%	Appd.Drg./Relevant Std.	Appd.Drg./Relevant Std.	IR	✓	P	V	V
2.0	In Process Inspection											
2.1	Machining of valves components	Surface quality Dimension	MR MR	Visual Measurement	100% 100%	Mfg. Drg. Mfg. Drg.	Mfg. Drg. Mfg. Drg.	IR IR	✓ ✓	P P	V V	V V
2.2	Spindle	Surface finish	MR	Measurement	100%	Mfg. Drg.	Mfg. Drg.	IR	✓	P	V	V
2.3	Wedge / disc , seating, stem & back seat	Lapping	MR	Blue Matching	100%	100% metal to metal contact	100% metal to metal contact	IR	✓	P	V	V
LEGEND: RECORDS IDENTIFIED WITH " ✓ " * SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. M MANUFACTURER/SUB-CONTRACTOR C CONTRACTOR/NOMINATED INSPECTION AGENCY. N CUSTOMER, INDICATE "P" PERFORM "W" WITNESS AND V VERIFICATION AS APPROPRIATE CHP SHALL IDENTIFIED IN COLUMN "N" IR - INSPECTION REPORT, CMT-CERTIFICATE OF MATERIAL & TEST												
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)						REVIEWING AGENCY (SIGN WITH DATE & STAMP)						APPROVING AGENCY (SIGN WITH DATE & STAMP)



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

QUALITY PLAN NO.:PE-QP-XXX-166-A810
PACKAGE/FULE OIL SYSTEM
PROJECT-
REV.NO. 0
SHEET 2 OF 2
DATE: 31/03/2012

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	AGENCY				REMARKS
								FORMAT OF RECORD	D	M	C	
1			4	5	6	7	8	9				11
3.0 Testing & Final Inspection												
3.1	Performance	Operation	CR	Manual	100%	Appd. Drg./Data Sheet	Should be smooth	IR	✓	P	W	W*
3.2	Shell & Sheet / backseat	Pr. Testing	CR	Hyd. Testing	100%	Appd. Drg./Data Sheet	Relevant Standard / Data Sheet	CMT	✓	P	W	W*
3.3	Seat	Pr. Testing	CR	Pneumatic Testing	100%	Appd. Drg./Data Sheet	Relevant Standard / Data Sheet	CMT	✓	P	W	W*
3.4	Valve Assembly	1. Chk. For completeness/ Visual Inspection 2. Dimention 3. Wear Travel / valve lift	MR	Visual	100%	Appd. Drg. / Tech. Spec./ Data Sheet	Appd. Drg./Data Sheet	IR	✓	P	W	W*
			MR	Measurement	10%	Appd. Drg./Data Sheet	Appd. Drg./Data Sheet	IR	✓	P	W	W*
			MR	Manual	100%	Appd. Drg.	Appd. Drg.	IR	✓	P	W	W*
4.0 Painting & Packaging												
		1. Painting & Packaging	MR	Manual	100%	Appd. Drg. / Tech. Spec.	Appd. Drg. / Tech. Spec.	IR		P	V	
		2. Tagging	MR	Manual	100%	Appd. Drg. / Tech. Spec.	Appd. Drg. / Tech. Spec.	PS / RS		P	V	
LEGEND: RECORDS IDENTIFIED WITH " ✓ " SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT.												
M MANUFACTURER/SUB-CONTRACTOR C CONTRACTOR/NOMINATED INSPECTION AGENCY, N CUSTOMER. INDICATE "P" PERFORM "W" WITNESS AND V VERIFICATION AS APPROPRIATE CHP SHALL IDENTIFIED IN COLUMN "N" IR - INSPECTION REPORT, CMT-CERTIFICATE OF MATERIAL & TEST												
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP) REVIEWING AGENCY (SIGN WITH DATE & STAMP) APPROVING AGENCY (SIGN WITH DATE & STAMP)												

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



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

Sheet 1 of 1

SL. NO.	TESTS/CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENT./ACCEPTANCE NORMS	AGENCY					REMARKS
				M	C	N	D		
1	2	3	4	5					6
1	Visual and Dimensional Checks for each size and type	100% by Manufacturer and 10% by BHEL	Appd. Data Sheet/ Relevant Standard	P	W	W	✓		Inspn. Report shall be furnished
2	Check for Logo mark & Specification	-do-	-do-	P	V	V	✓		
3	Check for TC of mother pipe/forgings	100%	-do-	P	V	V	✓		Manufacturer's TCs of mother pipe/forgings shall be furnished
4	Cross check for Mech/Chem properties of mother pipe/forging	One/Heat	-do-	P	V	V	✓		-do-

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

M= MANUFACTURER/SUB-CONTRACTOR
C= CONTRACTOR/NOMINATED INSPECTION AGENCY,
N= CUSTOMER
P= PERFORM; W= WITNESS; V= VERIFICATION

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

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)

CHECK LIST

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

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

Legend

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

Manufacturer's Name & Address :		QUALITY ASSURANCE PLAN					Project :			
		Item : Plug Valve		Sub-System : Fuel Oil System		Page No.: 1 OF 4		Contract Contract Sub-Contract		
Sl. No.	Components & Operations	Characteristic/Item	Class	Type of check	Extent of Check	Reference Document	Acceptance Norm	Format of Record	Agency P W V	Remarks
1	RAW MATERIAL	3	4	5	6	7	8	9	10	11
1	Castings (Body, Cover, Plug)	a) Verification	MA	Material TC	100%	Appr. Drg. Tech. Specs.	Tech. Specs.	Material TC	3 3 1.2	
		b) Size/Class	MA	Material TC	100%	Appr. Drg. Tech. Specs.	Tech. Specs.	Material TC	3 3 1.2	
		c) Material Id.	MA	Material TC	100%	Appr. Drg. Tech. Specs.	Tech. Specs.	Material TC	3 3 1.2	
		d) Heat No.	MA	Material TC	100%	Appr. Drg. Tech. Specs.	Tech. Specs.	Material TC	3 3 1.2	
		e) Surface Defect	MA	Visual	100%	MSS-SP-55	No crack acceptable	Inspection Report	3 3 1.2	
		f) Dimension	MA	Vernier scale	100%	Mfg. Drg.	Mfg. drg.	Mfg. drg.	3 3 1.2	
		g) RT on body	MA	Physical	100%	NDT Report	ANSI B16.34 ANNEX-I	NDT REPORT	3 3 1.2	
		h) Tensile Properties	MA	Verification of foundry TC	100%	Tech. Specs.	Relevant Standard		3 3 1.2	
		i) Chemical Properties	MA	Verification of foundry TC	100%	Tech. Specs.	Relevant Standard		3 3 1.2	
		j) Heat Treatment	MA	Verification of foundry TC	100%	Tech. Specs.	Relevant Standard		3 3 1.2	
		LEGEND : Records identified with "√" shall essentially be included by Contractor in QA Documents 1 - BHEL 2 - PACKAGE SUPPLIER 3 - Manufacturer CR - Critical Characteristics MA - Major Characteristics MI - Minor Characteristics IR - Inspection Report, MTC - Material/Manufacturer's Test Certificate								
SUB-CONTRACTOR SIGNATURE		CONTRACTOR SIGNATURE		P - Agency Performing the Test W - Agency Witnessing the Test V - Agency Verifying the Test		CLIENT NO		REV. : CAT.		NAME & SIGNATURE OF APPROVING AUTHORITY

Manufacturer's Name & Address:		QUALITY ASSURANCE PLAN										Project	
Item : Plug Valve		Sub-System : Fuel Oil System										Contract	
Page No.: 2 of 4												Contract Sub-Cont	
Sl. No.	Components & Operations	Characteristic/Item	Class	Type of check	Extent of Check	Reference Document	Acceptance Norm	Format of Record	Agency			Remarks	
									P	W	V		
1	Fasteners	a) Dimension	4	5	1/Lot/Size	7	Appr. Drg	9	3	10		11	
2		b) Tensile Properties	MA	Dimensional	100%	Appr. Drg	Appr. Drg	...	3	3	1.2		
		c) Chemical Properties	MA	Verification of Supplier TC	100%	Appr. Drg	Relevant Std	Mfg. TC	3	3	1.2		
		d) Heat Treatment	MA	Verification of Supplier TC	100%	Appr. Drg	Relevant Std	Mfg. TC	3	3	1.2		
3	Limit Switch	a) Dimension	MA	Dimensional	1/Lot/Size	PO	Mfg. Drg	Mfg. TC	3	3	3		
		b) Chemical properties	MA	Mfg. TC	1/Lot/Size	Relevant Std	Relevant Std	...	3	3	3		
4	Hand Wheel	a) Dimension	MA	Dimensional	1/Lot/Size	PO	Mfg. Drg	CR	3	3	1.2		
		b) Surface Defect	MA	Visual	100%	PO	Mfg. Drg	No crack acceptable	3	3	1.2		

LEGEND :

Records identified with "✓" shall essentially be included by Contractor in QA Documents

1 - BHEL
2 - PACKAGE SUPPLIER
3 - Manufacturer

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

SUB-CONTRACTOR 	CONTRACTOR 	CLIENT NO. : REV. 00 CAT.
	REVIEWED BY : NAME & SIGNATURE OF APPROVING AUTHORITY	

Manufacturer's Name & Address :			QUALITY ASSURANCE PLAN				Project :			
			Item : Plug Valve				Contract I			
			Sub-System : Fuel Oil System				Contracto			
			Page No.: 3 of 4				Sub-Contr			
Sl. No.	Components & Operations	Characteristic/Item	Class	Type of check	Extent of Check	Reference Document	Acceptance Norm	Format of Record	Agency	Remarks
									P W V	
1	IN PROCESS INSPECTION	3	4	5	6	7	8	9	10	11
1	Body / Cover	a) Mechined surface	MA	Visual	100%	Mfg. Drg.	No blow holes are acceptable	...	3	3
2	Plug	b) Dimension	MA	Dimensional	100%	Mfg. Drg.	Mfg. Drg	...	3	3
3	Component	Mechined surface	MA	Visual	100%	Mfg. Drg.	No blow holes are acceptable	...	3	3
4	Assembly	Dimension	MA	Dimensional	100%	Mfg. Drg.	Mfg. Std.	...	3	3
		Operational Test	MA	Ful opening / closing test	100%	GA Drg	Mfg. Std.	...	3	3
				Min. Stem Projection	100%	...	Mfg. Drg	...	3	3
				Smooth operation	100%	...	Mfg. Std.	...	3	3

LEGEND :

Records identified with "√" shall essentially be included by Contractor in QA Documents

1 - BHEL / DVC
2 - PACKAGE SUPPLIER
3 - Manufacturer

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

CLIENT NO.

REV. 00 CAT.

MANUFACTURE
SUB-CONTRACTOR

SIGNATURE

REVIEWED BY

NAME & SIGNATURE OF APPROVING AUTHORITY

Manufacturer's Name & Address :				QUALITY ASSURANCE PLAN				Project :			
Item : Plug Valve				Sub-System : Fuel Oil System				Contract			
Page No. : 4 of 4				Contract				Contract			
Sub-System				Page No. : 4 of 4				Sub-Contract			
Sr. No.	Components & Operations	Characteristic/Item	Class	Type of check	Extent of Check	Reference Document	Acceptance Norm	Format of Record	Agency	Remarks	
1	Complete valve	a) Dimension	MA	Fig. Drilling face to face	100%	Relevant Std	Relevant Std	Dimensional Report	3	100% Inspection by Manufacturer & 10% by Inspection Agency	
1		b) Operational Test	MA	Full opening / closing test	100%	Relevant Std	PO	Testing Register	3		
1		c) Pressure testing	MA	Hydro shell	100%	Relevant Std	Relevant Std	Testing Register	3		
1			MA	Hydro seat	100%	Relevant Std	Relevant Std	Testing Register	3		
2	Fire Safe Testing	Fire Safe	MA	Fire Safe	1/100	API 607 / BS 6755 P-II	Relevant Std	Testing Register	3		
2	Paint & Packing	Surface	MA	Visual	Dryness	PO	PO	Testing Register	3		
2			MA	Visual	Two coats of red oxide	PO	PO	Testing Register	3		
2			MA	Visual	One coat of hammer tone dark grey	PO	PO	Testing Register	3		
2			MA	Visual	Anti rust layer at machined surface	PO	PO	Testing Register	3		
2			MA	Visual	Fixing of wooden / plastic end protector	PO	PO	Testing Register	3		

BHEL

Records identified with "V"

Documents

1 - BHEL
2 - PACKAGE SUPPLIER
3 - Manufacturer

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

1 by Contractor in QA

CLIENT NO.

REV. 00 CAT.

REVIEWED BY

NAME & SIGNATURE OF APPROVING AUTHORITY

QAP Electrical Actuator

Sl. No.	Component & operation	Characteristics	Class	Type of Check	Quantum of Check			Reference Documents	Acceptance Norms	Format of Records		Agency			Remarks
					M	C/N	6			9	D*	M	C	N	
1	2	3	4	5				7	8						11
1	RAW MATERIAL														
1.1	ACTUATOR HOUSING CASTING	MECHANICAL PROPERTIES a. TENSILE STRENGTH b. HARDNESS c. SURFACE DEFECTS	MAJOR	MECHANICAL TESTING	ONE / HEAT	-		AIPL DRG. & IS 210	FG – 260 IS 210 & AIPL DRG	SUPPLIER TC & GRN	-	P/V	-	-	HEAT NUMBER ON CASTING
			MAJOR	VISUAL	100%	-		IS 210	IS 210	GRN	-	P	-	-	
1.2	WORM WHEEL	CHEMICAL COMPOSITION MECHANICAL PROPERTIES a. TENSILE STRENGTH b. ELONGATION c. SURFACE DEFECTS	MAJOR	CHEMICAL ANALYSIS	ONE / HEAT	-		AIPL DRG, BS 1400 AB2/HTB1	AIPL DRG, BS 1400 AB2/HTB1	SUPPLIER TC & GRN	-	P/V	-	-	
			MAJOR	MECHANICAL PROPERTIES	ONE / HEAT	-				GRN	-	P/V	-	-	
			MAJOR	VISUAL	100%	-					-	P	-	-	
1.3	BEARING FLANGE CASTING	MECHANICAL PROPERTIES a. TENSILE STRENGTH b. HARDNESS c. SURFACE DEFECTS	MAJOR	MECHANICAL TESTING	ONE / HEAT	-		AIPL DRG. & IS 210	FG – 260 IS 210 & AIPL DRG	SUPPLIER TC & GRN	-	P/V	-	-	
			MAJOR	VISUAL	100%	-		IS 210	IS 210	GRN	-	p	-	-	
1.4	CLUTCH RING (FOR SA/SAR 3,6,12,15)	a. CHEMICAL COMPOSITION b. SURFACE DEFECTS	MAJOR	CHEMICAL ANALYSIS	ONE / HEAT	-		AIPL DRG. & IS 713 IS 713	ZnAl4Cu1, IS 713	SUPPLIER TC & GRN	-	P/V	-	-	
			MAJOR	VISUAL	100%	-				GRN	-	P	-	-	
1.4.1	CLUTCH RING (FOR SA/SAR 25,30,50, 60,100)	a. TENSILE STRENGTH b. HARDNESS c. ELONGATION d. SURFACE DEFECTS	MAJOR	MECHANICAL TESTING	ONE / HEAT	-		AIPL DRG. & IS 1865	SG – 400/15 SG – 500/7 IS 1865	SUPPLIER TC & GRN	-	P/V	-	-	
			MAJOR	VISUAL	100%	-		IS 1865	IS 1865	GRN	-	P	-	-	

1.5	OUTPUT DRIVE STEM NUT (A – TYPE ONLY)	a. CHEMICAL COMPOSITION b. MECHANICAL PROPERTIES b.1 TENSILE STRENGTH b.2 ELONGATION c. SURFACE DEFECTS	MAJOR MAJOR MAJOR	CHEMICAL ANALYSIS MECHANICAL TESTING VISUAL	ONE / HEAT ONE / HEAT 100%	- - -	AIPL DRG. & BS-1400 BS 1400 BS 1400	AB2/BS 1400 & AIPL DRG. AB2/BS 1400 BS 1400	SUPPLIER TC & GRN SUPPLIER TC & GRN GRN	- - P	P/V - P	- - -
1.6	BARSTOCK WORMSHAFT	a. CHEMICAL COMPOSITION b. MECHANICAL PROPERTIES c. SURFACE DEFECTS	MAJOR MAJOR MAJOR	CHEMICAL ANALYSIS HARDNESS VISUAL	ONE SAMPLE/HEAT ONE SAMPLE/HEAT 100%	- - -	4M-3532 R2 & AIPL DRG. AIPL DRG. BS 970	4M-3532 R2 & AIPL DRG. AIPL DRG. BS 970	NABL LAB / SUPP. TC / GRN GRN GRN	- - P	P/V P/V P	- - -
1.7	HOLLOW DRIVE SHAFT	a. CHEMICAL COMPOSITION b. SURFACE DEFECTS	MAJOR MAJOR	CHEMICAL ANALYSIS VISUAL	ONE SAMPLE/HEAT 100%	- -	4M-3532 R2 & AIPL DRG. BS 970	4M-3532 R2 & AIPL DRG. BS 970	SUPPLIER TC & GRN GRN	- P	P/V P	- -
1.8	PINION	a. CHEMICAL COMPOSITION b. MECHANICAL PROPERTIES c. SURFACE DEFECTS	MAJOR MAJOR MAJOR	CHEMICAL ANALYSIS HARDNESS VISUAL	ONE SAMPLE/HEAT ONE SAMPLE/HEAT 100%	- - -	4M-3532 R2 & AIPL DRG. AIPL DRG. BS 970	4M-3532 R2 & AIPL DRG. AIPL DRG. BS 970	NABL LAB / SUPP. TC / GRN GRN GRN	- - P	P/V P/V P	- - -
1.9	DRIVE SHAFT	a. CHEMICAL COMPOSITION b. MECHANICAL PROPERTIES c. SURFACE DEFECTS	MAJOR MAJOR MAJOR	CHEMICAL ANALYSIS HARDNESS VISUAL	ONE SAMPLE/HEAT ONE SAMPLE/HEAT 100%	- - -	4M-3532 R2 & AIPL DRG. AIPL DRG. BS 970	4M-3532 R2 & AIPL DRG. AIPL DRG. BS 970	NABL ACCREDITED L LAB /SUPPLIER TC GRN GRN	- - P	P/V P/V P	- - -
2	IN – PROCESS CONTROL (MACHINED ITEMS)											
2.1	ACTUATOR HOUSING	a. DIMENSIONS b. SURFACE FINISH	MAJOR MAJOR	MEASUREMENT VISUAL	One / batch 100%	- -	AIPL COMP. DRG./FIR AIPL COMP. DRG.	AIPL COMP. DRG./FIR AIPL COMP. DRG.	GRN/ MCN/FIR GRN / MCN	- P	P P	- -

No.	operation	3	4	5	6		C/N	Documents		8	9	D*	10**			11
					M			M	C				N			
1	2															
2.2	WORM WHEEL	a. DIMENSIONS b. ROLL CHECK c. SURFACE FINISH d. MATCHING	MAJOR MAJOR MAJOR MAJOR	MEASUREMENT ROLL CHECK VISUAL VISUAL	One / batch One / batch 100% One / batch	- - - -	AIPL COMP. DRG./FIR AIPL COMP. DRG./FIR AIPL COMP. DRG. 4-M-3335	AIPL COMP. DRG./FIR AIPL COMP. DRG./FIR AIPL COMP. DRG. 4-M-3335	GRN/ MCN/FIR GRN/ MCN/FIR GRN / MCN GRN / MCN	- - - -	P P P P	- - - -				
2.3	BEARING FLANGE	a. DIMENSIONS b. SURFACE FINISH	MAJOR MAJOR	MEASUREMENT VISUAL	One / batch 100%	- -	AIPL COMP. DRG./FIR AIPL COMP. DRG.	AIPL COMP. DRG./FIR AIPL COMP. DRG.	GRN/ MCN/FIR GRN / MCN	- -	P P	- -				
2.4	OUTPUT DRIVE STEM NUT (A-TYPE)	a. DIMENSIONS b. SURFACE FINISH	MAJOR MAJOR	MEASUREMENT VISUAL	One / batch 100%	- -	AIPL COMP. DRG./FIR AIPL COMP. DRG.	AIPL COMP. DRG./FIR AIPL COMP. DRG.	GRN/ MCN/FIR GRN / MCN	- -	P P	- -				
2.5	WORMSHAFT	a. DIMENSIONS b. HARDNESS AFTER NITRIDING c. SURFACE FINISH	MAJOR MAJOR MAJOR	MEASUREMENT TESTING VISUAL	One / batch One / batch 100%	- - -	AIPL COMP. DRG./FIR AIPL COMP. DRG. AIPL COMP. DRG.	AIPL COMP. DRG./FIR AIPL COMP. DRG. AIPL COMP. DRG.	GRN/ MCN/FIR SUPPLIER TC/GRN GRN	- - -	P P/V P	- - -				
2.6	HOLLOW DRIVESHAFT	a. DIMENSIONS b. SURFACE FINISH	MAJOR MAJOR	MEASUREMENT VISUAL	One / batch 100%	- -	AIPL COMP. DRG./FIR AIPL COMP. DRG.	AIPL COMP. DRG./FIR AIPL COMP. DRG.	GRN/ MCN/FIR GRN / MCN	- -	P P	- -				
2.7	PINION	a. DIMENSIONS b. SURFACE FINISH	MAJOR MAJOR	MEASUREMENT VISUAL	One / batch 100%	- -	AIPL COMP. DRG./FIR AIPL COMP. DRG.	AIPL COMP. DRG./FIR AIPL COMP. DRG.	GRN/ MCN/FIR GRN / MCN	- -	P P	- -				
2.8	DRIVE SHAFT	a. DIMENSIONS b. HARDNESS AFTER NITRIDING c. SURFACE FINISH	MAJOR MAJOR MAJOR	MEASUREMENT TESTING VISUAL	One / batch One / batch 100%	- - -	AIPL COMP. DRG./FIR AIPL COMP. DRG. AIPL COMP. DRG.	AIPL COMP. DRG./FIR AIPL COMP. DRG. AIPL COMP. DRG.	GRN/ MCN/FIR SUPPLIER TC/GRN GRN	- - -	P P/V P	- - -				

3	MOTORS (AUMA make)	a. RPM b. NO LOAD CURRENT c. IR / HV d. THERMO SWITCHES e. NOISE f. MOUNTING DIMENSIONS g. NAME PLATE i. TYPE TEST	MAJOR " " " " MAJOR " MAJOR	ELECTRICAL PERFORMANCE TEST " " " " DIMENSIONAL VISUAL TESTING	100% " " " " ONE IN LOT 100% ONE/TYPE	- - - - - - -	IS 325 " " " " AS PER DRG " IS 325	IS 325 " " " " AS PER DRG " IS 325	AIPL INS. RECORD " " " " " " Test Certificate	- - - - - - -	P " " " " " "	- - - - - - -	- - - - - - -
4	BOUGHT OUT ITEMS												
4.1	FASTENERS	a. DIMENSIONS b. GRADE	MINOR MAJOR	MEASUREMENT VISUAL	One / batch One / batch	-	IS 2269, IS 1364 IS 1363, IS 2500	IS 2269, IS 1364 IS 1363, IS 2500	GRN GRN	- -	P P	- -	- -
4.2	LIMIT & TORQUE SWITCHES	a. CONTINUITY (MAKE/BREAK)	MAJOR	PERFORMANCE	One / batch	-	QC/QW.047	QC/QW.047	GRN	-	P	-	-
4.3	POTENTIOMETER	a. RESISTANCE VALUE	MAJOR	MEASUREMENT	One / batch	-	QC/QW.031	QC/QW.031	GRN	-	P	-	-
4.4	SPACE HEATER	a. IR b. HV	MAJOR MAJOR	MEASUREMENT MEASUREMENT	One / batch One / batch	-	QC/QW.045	QC/QW.045	GRN	-	P	-	-
4.5	ELECTRONIC POSITION TRANSMITTER	a. OUTPUT MEASUREMENT	MAJOR	MEASUREMENT	One / batch	-	CATALOGUE CHECK	CATALOGUE CHECK	GRN	-	P	-	With actuator
4.6	BEARINGS	a. MAKE b. TYPE	MAJOR MAJOR	VISUAL VISUAL	One / batch One / batch	-	QC/QW-023, IS-2500 AIPL COMP. DRG	QC/QW-023	GRN	-	P	-	SKF, INA, ABC FAG, ZKL,
4.7	'O' RINGS AND QUADRINGS	a. MATERIAL IDENTIFICATION b. ELONGATION	MAJOR MAJOR	MEASUREMENT MEASUREMENT	One / batch One / batch	-	AIPL COMP. DRG AIPL COMP. DRG	QC/QW .024, IS 9975 QC/QW .024, IS 9975	GRN	-	P	-	NBR

Sl. No.	Component & operation	Characteristics	Class	Type of Check		Quantity of Check		Reference Documents	Acceptance Norms	Format of Records		Agency			Remarks	
				5	6	M	C/N			D*	P	W	M	C		N
1		3	4					7	8	9	10**			11		
	FINAL TESTING (Contd.)	m. GREASE LEAKAGE		VISUAL	100%	10%	NTPC APPRD. DATA SHEET; AIPL STD.	NTPC APPRD. DATA SHEET; AIPL STD.	QM-FINAL INSP. REPORT QC/FM.006	✓	P	W	V	Document review on 100 % basis by Contractor / TPJA and NTPC / Customer.		
		n. VISUAL INSPECTION		VISUAL OUTPUT	1 PER TYPE											
		o. ELECTRONIC POSITION TRANSMITTER		MEASUREMENT												
		p. STALL TORQUE and Current		MEASUREMENT												
		q. PAINTING and Rust Prevention		SHADE & DRY PAINT THICKNESS		One / batch									TD/QW.005 Tech.Spec. / NTPC Approved Data sheet	TD/QW.005 Tech.Spec. / NTPC Approved Data sheet
	r. MOUNTING DIMENSION	PHYSICAL	100%	1 NO. PER BATCH	AIPL DRG./CATALOGUE	AIPL DRG./CATALOGUE	DIMENSION REPORT	✓	P	V	V					
7	ACCESSORIES PLUG & SOCKET	a. VISUAL b. ELECTRICAL	MAJOR MAJOR	VISUAL HV	One / batch One / batch	- -	CATALOGUE INSPECTION REPORT	CATALOGUE INSPECTION REPORT	GRN & INSP REPORT GRN	- -	P P	- -	- -	WITH ACTUATOR		
8	ELECTRICAL TEST FOR INTEGRAL STARTERS	a. HV TEST b. BURN IN TEST c. 24V/DC OUTPUT d. OPERATIONAL CHECK	MAJOR	ELECTRICAL / FUNCTIONAL	100%	10%	AIPL STD.	AIPL STD.	SUPPLIER-TC	✓ -	P P	V W P	V V -	WITH ACTUATOR		
9	SHIPPING INSPECTION	a. NAME PLATE b. PAINTING c. Rust Prevention d. ACCESSORIES e. ANCHORING					PACKING SLIP	PACKING SLIP	PACKING SLIP	-	P	-	-			



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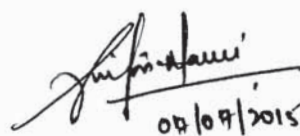
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**ANNEXURE-I
LIST OF MAKES OF SUB-VENDOR ITEMS
FUEL OIL UNLOADING AND STORAGE SYSTEM**


08/08/2015

VIPIN NAUNI
PEM-MAUX



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SUB-VENDOR LIST - FUEL OIL UNLOADING AND STORAGE SYSTEM

SL. NO	ITEM	SUB-VENDORS	PLACE	TECHNICAL LIMIT
1	MECHANICAL GATE, GLOBE AND CHECK (CARBON STEEL VALVES)	A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		M/S GM ENGINEERING	RAJKOT	
		INTERVALVE (INDIA) LTD.	PUNE	A) STEEL GATE VALVES: UPTO 50NB, #800 AND 65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C) SUPPLIER NOT REGISTERED FOR NR VALVES
		LEADER VALVES LTD.	JALANDHAR	
		NITON VALVE INDUSTRIES PVT LTD	MUMBAI	
		NSSL LIMITED.	NAGPUR	
		STEEL STRONG VALVES (I) PVT.LTD.	MUMBAI	LIMIT AS PER VD FILE AS ATTACHED IN SHEET 2
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CC/CSS-GATE-BBT-UPTO600NB CL UPTO300,GATE-PSBT UPTO250NB CL 1500,GLV-BBT-UPTO300NB CL UPTO600,SCNRV-BBT-UPTO600NB CL UPTO150,SCNRV-BBT-UPTO300NB CL 300,SCNRV-PSBT-UPTO150NB CL UPTO900
		VALTECH INDUSTRIES	MUMBAI	CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE- GV/150/900,GV/300/400, GV/600/300 , GV/GLV/NRV/900/250 , GLV/300/300,GLV/150/350/ , SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.
		V.K. VALVES PVT. LTD.,	JALANDHAR	
		WEIR BDK VALVES	NEW DELHI	
		AUDCO -L&T	CHENNAI / COIMBATORE	
		OSWAL INDUSTRIES		
		HITECH	AHMEDABAD	
		KSB WATER PUMPS / VALVES	COIMBATORE	
		KBL	KONDHAPURI	
		HAWA ENGINEERS	AHMEDABAD	
		BHEL	GOINDWAL	
		FOURESS ENGG	MUMBAI	UPTO 600 NB, CL-300 & 300NB CL-600
		FOURESS ENGG	AURANGABAD	



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2	CS BALL VALVES	A.V. VALVES LTD	AGRA	
		AKAY INDUSTRIES PVT.LTD.	DHARWAD	
		BELGAUM AQUA VALVES PVT. LTD.	BELGAUN	
		ASIAN INDUSTRIAL VALVES & INSTRUMENTS.	CHENNAI	
		ATAM VALVES PVT. LTD.	JALANDHAR	(1) BALL VALVES: FCS/FSS - 1/2" TO 2" #800 & CCS/CSS - 2.1/2" TO 4" # 150 (2) BALL VALVES: GUN METAL VALVES SIZE 15 NB TO 80 NB - UPTO PN16.0
		DEMBLA VALVES LTD.	THANE	
		M/S GM ENGINEERING	RAJKOT	
		HAWA VALVES (INDIA) PVT. LTD.	THANE	SIZE UP TO 2" & #800 WITH MOC AS FCS & FSS AND FOR SIZE FROM 65 NB TO 150 NB & #150 WITH MOC AS CCS AND CSS.
		INTERVALVE (INDIA) LTD.	PUNE	STEEL BALL VALVES UPTO 50NB, #800 AND 65NB TO 150NB. #150
		LEADER VALVES LTD.	JALANDHAR	CAST STEEL UPTO 200 MM, CLASS 150/300.
		MICROFINISH VALVES PVT LTD.	HUBLI	
		NILON VALVES PRIVATE LIMITED	AHMEDABAD	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	FOR CARBON STEEL/STAINLESS STEEL UPTO SIZE 200NB.
		UNIFLOW	CHENNAI	
		VALTECH INDUSTRIES	MUMBAI	FORGED CARBON & ALLOY STEEL BALL VALVES, SCREWED TYPE BALL VALVES RATING 800, SIZES UPTO 50 & CC& ALLOY STEEL BALL VALVES RATING 150, SIZES 65 TO 200 FLANGED TYPE.
		VAAS AUTOMATION PVT. LTD.	DELHI	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	DELHI	
		PEC	NASHIK	(UPTO 400 NB CLASS 150)
		L&T VALVES	COIMBATORE	
		L&T VALVES (AUDCO)	CHENNAI	
		FLOW CHEM	AHMEDABAD	(UPTO 350 NB CLASS 150)
		BELGUAM AQUA VALVES	BELGAUM	UPTO 200 NB, CL 150
3	CS PLUG VALVES	FLOWSERVE (AUDCO)	CHENNAI	
		MICROFINISH	HUBLI	
		WEIR BDK	HUBLI	UPTO 150 NB CLASS 300 & UPTO 400 NB CLASS 150
		FISHER XOMOX	CHENNAI	
		LEADER VALVES LTD.	JALANDHAR	
4	SUMP PUMP (VERTICAL)	DARLING PUMPS PVT. LTD	INDORE	
		FLOWMORE LTD.	GURGAON	



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	CENTRIFUGAL)	SU MOTORS PVT. LTD.	MUMBAI	
		VARAT PUMP AND MACHINERY PVT. LTD.	KOLKATA	
		WPIL LIMITED	KOLKATA	
		SAM TURBO INDUSTRY LTD	COIMBATORE	
		KISHORE	PUNE	
		AQUA MACHINERY	AHMEDABAD	
		FLOWMORE PUMP	GHAZIABAD	
		M&P	PUNE	
		B & C ENGG(BECON WEIR)	CHENNAI	
5	SCREW PUMPS	ROTO PUMPS	NOIDA	
		TUSHACO	MUMBAI	
		UT PUMPS	FARIDABAD	
6	API 5L ERW PIPE	TISCO	JAMSHEDPUR	
		SURYA ROSHNI	BAHADURGARH	UP TO 400 NB
		JINDAL	GHAZIABAD	UP TO 350 NB
		MSL	RAIGAD	200 TO 500 NB
		SAIL	ROURKELA	
		RATNAMANI	KUTCH	UP TO 400 NB
7	ASTM A 106, CS SEAMLESS PIPE	ISMT	AHMED NAGAR	UP TO 150 NB
		MSL	RAIGAD	UP TO 350 NB
		JINDAL SAW LTD	NASHIK	
		REMI METAL GUJRAT LTD	BHARUCH	UP TO 150 NB HOT FINISH & UPTO 100NB COLD FINISH
		ISMT	BARAMATI	UP TO 200 NB
8	CS ERW PIPE (IS 1239 / 3589)	SURYA ROSHNI	BAHADURGARH	UPTO 400 NB ERW PIPES AS PER IS 1239/3589 AND SAW AS PER IS 3589
		JINDAL	GHAZIABAD/HISSA R	UP TO 350 NB
		MSL	RAIGAD	200-500 NB ERW PIPES AS PER IS 3589
		SAIL	ROURKELA	
		WELSPUN	ANJAR/BHARUCH	UPTO 400 NB ERW PIPES AS PER IS 1239/3589 AND SAW AS PER IS 3589
		INDUS TUBE	GAUTAM BUDDH NAGAR	UP TO 300 NB
		RATNAMANI	KUTCH /AHMEDABAD / CHHATRAL	UPTO 400 NB ERW PIPES AS PER IS 3589 AND SAW AS PER IS 3589
		TATA TUBE	JAMSHEDPUR	UPTO 150 NB ERW PIPES AS PER IS 1239
		PSL	CHENNAI/VIZAG/ KUTCH/DAMAN	SPIRAL WELD SAW AS PER IS 3589
		LALIT PROFILE	THANE	SPIRAL WELD SAW AS PER IS 3589
		SAMSHI PIPES INDUSTRIES	VADODARA	SPIRAL WELD SAW AS PER IS 3589



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		MUKUT PIPES	RAJPURA	LONGITUDINAL SAW (SINGLE SIDE WELD) AS PER IS 3589
		INDUS TUBES	G B NAGAR	UPTO 300 NB ERW PIPES AS PER IS 1239/3589
		MANN IND	INDORE	SPIRAL WELD SAW AS PER IS 3589
		SURENDRA ENGG	RAJPURA	SPIRAL WELD SAW AS PER IS 3589
		PRATIBHA PIPES & STRUCTURE PVT LTD	THANE	SPIRAL WELD SAW AS PER IS 3589
		JCO GAS PIPE	CHINDWARA	SPIRAL WELD SAW AS PER IS 3589
		NUKAT TANKS AND VESSELS	TARAPUR	LONGITUDINAL SAW (SINGLE SIDE WELD) AS PER IS 3589
		DADU PIPES	SIKRANDRABAD	UPTO 300 NB ERW PIPES AS PER IS 1239/3589
		APL APOLLO TUBES LTD	SIKRANDRABAD	IS3589 UPTO 250 NB
9	SUCTION HEATER	PARKAIRE	DELHI	
		MVS	DELHI	
		MELCON	DELHI	
		GASO ENERGY	PUNE	
		INDCON	DELHI	
		TEMASME	NOIDA	
10	PRESSURE REDUCING VALVE & DESUPERHEATER	CIRCOR (EARLIER MAZDA)	AHMEDABAD	
		SPIRAX MARSHALL	PUNE	
		LEADER VALVES LTD.	JALANDHAR	
		SPX CORPORATION, USA	M/S SPX FLOW TECHNOLOGY INDIA PVT. LTD, GUJARAT	
		CONTROL COMPONENT INDIA PVT. LTD.	NOIDA	
		DAUME REGELARMATUREN GMBH,	GERMANY	
		HOLTER REGELARMATUREN GMBH & CO.	GERMANY	
		INSTRUMENTATION LTD.	PALAKKAD	
11	STRAINERS (DUPLEX / SIMPLEX BASKET TYPE)	GENERAL MECHANICAL WORKS PVT LTD	VADODARA	
		GRAND PRIX	FARIDABAD	
		GUJARAT OTOFILT	VATVA , AHMEDABAD	
		FILTRATION ENGRS	MUMBAI	
		JAYPEE INDUSTRIES PVT. LTD.	NEW DELHI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI	
		OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		BHATIA ENGINEERING CO.	NEW DELHI	SIMPLEX ONLY
		FILTRATION ENGINEERS (I) PVT. LTD.	MUMBAI	SIMPLEX ONLY
		SUNGOV ENGINEERING PVT. LTD.	CHENNAI	



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		SAROJINI ENTERPRISE	HOWRA	SIMPLEX ONLY
12	CONTROL VALVE	SPX CORPORATION, USA	M/S SPX FLOW TECHNOLOGY INDIA PVT. LTD. (AHMEDABAD)	
		CONTROL COMPONENT INC.	USA	
		DRESSER VALVE INDIA PVT. LTD	COIMBATORE	
		DAUME REGELARMATUREN GMBH,	GERMANY	
		EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	CHENNAI	
		FORBES MARSHALL ARCA PVT.LTD.	PUNE	
		WEIR VALVES & CONTROLS UK LTD.	UK	
		HOLTER REGELARMATUREN GMBH & CO.KG	GERMANY	
		INSTRUMENTATION LTD.	PALAKKAD	
		KOSO INDIA PRIVATE LIMITED,	NASHIK	
		LESLIE CONTROLS, INC	USA	
		MIL CONTROLS LTD.	THRISSUR	
		METSO SINGAPORE PTE. LTD.,	SINGAPORE	
		PARCOL S.P.A	ITALY	
		R.K.CONTROL INSTRUMENTS PVT. LTD.	THANE	
		RINGO VALVULAS S.L,	SPAIN	
		SEVERN GLOCON INDIA PVT. LTD.	CHENNAI	
		SHENJIANG VALVE CO. LTD.	CHINA	
		VALVITALIA S.P.A. ,	ITALY	
		WALDEMAR PRUSS ARMATURENFABRIK GMBH	GERMANY	
13	STEAM TRAP	SPIRAX MARSHALL	PUNE	MAIN CONTRACTOR COC +MANUFACTURER STANDARD TC SHALL BE SUBMITTED FOR ISSUING DESPATCH CLEARANCE
		UNIKLINGER	PUNE	
		LEADER	JULLANDHAR	
		CRECENT VALVE MFG CO LTD	MUMBAI	
		PENNANT ENGINEERING	PUNE	
14	THERMAL INSULATION	GOENKA ROCKWOOL (INDIA) PVT.LTD.	RAIPUR	
		LLOYD INSULATIONS (INDIA) LTD.	NEW DELHI	
		MINWOOL ROCK FIBRES LTD.	RAJNANDGAON	
		POLYBOND INSULATION PRIVATE LIMITED,	BHILAI	
		ROCKWOOL (INDIA) PVT. LTD.	HYDERABAD	
		SHREERAM EQUITECH PRIVATE LIMITED	DURG	
		THERMOCARE ROCKWOOL INDIA PRIVATE LTD.	CHATTISGARH	



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		LOPINUS ROCKWOOL	GWALIOR	
		SAIL		
		ESSAR STEEL		
		TISCO		
		RINL		
		JINDAL		
		M/S UTTAM VALUE STEEL (LLOYDS)		
		ISPAT		
		JSW		
		INDIAN IRON & STEEL CO. LTD		
		SPIRAX MARSHALL	PUNE	
		FISCHER SANMAR	CHENNAI	
		BHEL	TRICHY	
		KEYSTONE	BARODA	
		LEADER	JULLANDHAR	
		ASIAN PAINT		
		BERGER		
		KANSAI NEROLAC		
		JOTUN		
		SHALIMAR		
		JENSON & NICHOLSON (I) LTD		
		CDC CARBOLINE (I) LTD.		
		ADDISON PAINTS LTD		
		GRAND POLYCOAT		
		BOMBAY PAINTS		
		HEMPLE PAINTS (SINGAPORE)		
		AKZONOBEL COATINGS		
		PIPE FIT ENGINEERS	VADODARA	
		GUJRAT INFRA PIPES	VADODARA	
		MS FITTINGS	KOLKATA	
		TUBE PRODUCT	VADODARA	
		SIDDARTH & GAUTAM	FARIDABAD	
		EBY	MUMBAI	
		NL HAZRA	KOLKATA	
		EXCEL METAL		
		INTERTECH		
		FITTECH		
		METAL LLOYDS	MUMBAI	
		TRUE FORGE	FARIDABAD	
		D WREN & CO	KOLKATA	
		SUDEEP INDUSTRIES	KOLKATA	
		HYDROKRIMP	MUMBAI	
		PRESIDENCY RUBBER	KOLKATA	



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20	STEAM AND CONDENSATE HOSE	ALLZFLEX ENGINEERS	VADODARA	
		SUDEEP INDUSTRIES	KOLKATA	
21	FLOWMETER (CORIOLIS TYPE)	EMERSON PROCESS MANAGEMENT	CHENNAI	
		E&H	CHENNAI	
		KROHNE MARSHALL	PUNE	
22	ALUMINUM CLADDING	BHARAT ALUMINIUM COMPANY LTD	DELHI	
		CHONGQING LANREN ALUMINIUM CO. LTD., CHINA	CHINA	
		HINDALCO INDUSTRIES LTD	MUMBAI	
		NATIONAL ALUMINIUM COMPANY LTD.	ODISHA	
23	METALLIC EXPANSION BELLOWS	AEROSUN TOLA EXPANSION JOINT CO. LTD.,	CHINA	
		B. D. ENGINEERS	AHMEDABAD	
		FLEXICAN BELLOWS AND HOSES PVT. LTD.	BARODA	
		FLEXATHERM EXPANLLOW PVT. LTD.	VADODARA	
		LONESTAR INDUSTRIES	CHENNAI	
		MB METALLIC BELLOWS PVT. LTD.	CHENNAI	
		METALLIC BELOWS INDIA PVT. LTD.	CHENNAI	
		QINHUANGDAO NORTH METAL HOSE CO. LTD.,	CHINA	
		TEDDINGTON ENGINEERED SOLUTIONS LTD.	UK	
ELECTRICAL AND C&I				
24	LEVEL TRANSMITTER (RADAR AND ULTRASONIC TYPE)	K TEK (ABB)	FARIDABAD	
		E & H	AURANGABAD	
		MEGNETROL	BELGIUM	ONLY RADAR TYPE
		EMERSON PROCESS MGT	PAWANE	
		MOORE INDUSTRIES INTERNATIONAL INC.	USA	
		SIEMENS LIMITED	MUMBAI	
		SMART INSTRUMENTS LTD, BRAZIL	MUMBAI	LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.
		HONEYWELL AUTOMATION INDIA LIMITED	DELHI	
		TOSHNIWAL INDUSTRIES PVT. LTD.,	AJMER	
		V. AUTOMAT & INSTRUMENTS (P) LTD.	DELHI	
		YOKOGAWA INDIA LIMITED,	BANGALORE	
		SIEMENS MILTRONICS	CANADA	ONLY RADAR TYPE
		NIVELCO	HUNGARY	ONLY RADAR TYPE
		HAWK	AUSTRALIA	ONLY RADAR TYPE
25	LT MOTORS	CROMPTON GREAVES LIMITED	AHMEDNAGAR	
		KIRLOSKAR ELECTRIC COMPANY	BANGALORE /	



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	LT MOTORS	SIEMENS	HUBLI	
		ABB	MUMBAI	
		BHARAT BIJLEE	BANGALORE / FARADABAD	
		JYOTI	MUMBAI	
		MARATHON	VADODARA	
		NGEF	KOLKATA	
		BHARAT ELECTRIC (BHEL)	BANDALORE / HUBLI	
		LHP		
			SOLAPUR	
26	PRESSURE / DP / TEMP.SWITCH	SOR	USA	
		GIC(GAUGES BOURDON)	PANVEL	
		HERION	GERMANY	
		ITT BARTON	USA	
		DELTA CONTROL	UK	
		ASHCROFT	USA / GERMANY	
		TRAFAG	RANIPET	
		INDFOSS	GHAZIABAD	
		ASHCROFT	GANDHINAGAR	
		SWITZER	CHENNAI	EXCEPT 9000 SERIES
27	LEVEL INDIATOR FLOAT AND BOARD TYPE	FLOW STAR	FARIDABAD	
		SCIENTIFIC DEVICES	MUMBAI	
		GAUGES BOURDEN	PANVEL	
		PUNE TECH TROL	PUNE	
		SBEM	PUNE	
		LEVCON	KOLKATA	
		SIGMA	MUMBAI	
		CHEMTROL		
		DK INSTRUMENT	KOLKATA	
		V AUTOMAT	DELHI	
28	PRESSURER / DP GAUGE / TEMPERATURE GAUGE (DIAL TYPE)	H GURU (SI)	BANGALORE	
		H GURU INDUSTRIES	MUZAFFARPUR / RISHRA	
		AN INSTRUMENT	KOLKATA	
		GOA THERMOSTATIC	GOA	
		WAAREE	VAPI	
		MANOMETER	MUMBAI	
		GLUCK	MUMBAI	
		FORBES MARSHALL	HYDERABAD	
		ASHCROFT	GANDHINAGAR	
		WIKA	PUNE	
		GAGES BOURDON	MUMBAI / GOA	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	



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		BOSE PANDA INSTRUMENTS PVT.LTD.	KOLKARA	ONLY PRESSURE AND DP GAUGE
		BUDENBERG GUAGE CO.LTD.	UK	ONLY TEMPERATURE GAUGE
		GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	GOA	
29	RTD /THERMOCOUPLE ASSEMBLY	PYROELECTRIC	GOA	
		GIC(THERMAL INSTRUMENTS)	MAHARASHTRA	
		TEMPSENS	UDAIPUR	
		DETRIVE	MUMBAI	
		TECHNO INSTRUMENTS	GUJRAT	
		TEMPSENS INSTRUMENT (I) PVT LTD	UDAIPUR	
		TM TECNOMATIC SPA	ITALY	
		TOSHNIWAL INDUSTRIES PVT. LTD.,	AJMER	
		THERMAL INSTRUMENT INDIA PVT. LTD.	MUMBAI	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
		GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	GOA	
30	ELECTRICAL ACTUATORS	ROTORK	BANGALORE	
		ROTORK	CHENNAI	
		AUMA	BANGALORE	
		LIMITORK	FARIDABAD	
31	LEVEL SWITCH (FLOAT AND DISPLACER TYPE)	TRAC	HYDERABAD	
		I EVCON	KOLKATA	
		DK INSTRUMENTS	KOLKATA	
		SBEM	PUNE	
		SBEM	PUNE	
		FLOW STAR	FARIDABAD	
		SIGMA	MUMBAI	
		V AUTOMAT	DELHI	
32	TEMPERATURE TRANSMITTER	EMERSON PROCESS MGT	PAWANE	
		MOORE	USA	
		ABB	FARIDABAD	
		YOKOGAWA	BANGLORE	MAKE YOKOGAWA, JAPAN
		ABB LIMITED	FARIDABAD	
		ENDRESS + HAUSER (INDIA) PVT. LTD.,	DELHI	
		MOORE INDUSTRIES INTERNATIONAL INC.	USA	
		SIEMENS LIMITED	MUMBAI	
		SMART INSTRUMENTS LTD, BRAZIL	MUMBAI	
		HONEYWELL AUTOMATION INDIA LIMITED	DELHI	
		TOSHNIWAL INDUSTRIES PVT. LTD.,	AJMER	
		YOKOGAWA INDIA LIMITED,	BANGALORE	



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33	AIR FILTER REGULATOR	PLACKA INSTRUMENT	CHENNAI	
		SHAVO NORGEN	MUMBAI	
		FISHER SANMAR	CHENNAI	
34	SOLENOID VALVE	AVCON	MUMBAI	
		ROTEX	BARODA/VV NAGAR	
		SMC	NOIDA	
		NUCON	HYDERABAD	
		ASCO	CHENNAI	
35	LOCAL CONTROL PANEL	PYROTECH	UDAIPUR	
		POSITRONICS	VADODARA	
		JACKSON	NOIDA	
		CONTROL DEVICE	KOLKATA	
		ROCKWELL AUTOMATION INDIA LTD	GHAZIABAD	
		SIEMENS LIMITED	DELHI	
		SCHNEIDER ELECTRIC INDIA PVT.LTD.	DELHI	
		JOSPER	NOIDA	
		I C A	MUMBAI	
		INDIAN SWITCH GEAR	VADODARA	
36	JUNCTION BOX	SWITCHING CKT	KOLKATA	
		PYROTECH	UDAIPUR	
		POSITRONICS	VADODARA	
		JACKSON	NOIDA	
		CONTROL DEVICE	KOLKATA	
		JOSPER	NOIDA	
		I C A	MUMBAI	
		AJMERIA INDUSTRIAL & ENGINEERING WORKS	MUMBAI	
		FLEXPRO ELECTRICALS PVT. LTD.	GUJARAT	
		K.S.INSTRUMENTS PVT.LTD.	BANGALORE	
		SUCHITRA INDUSTRIES	BANGALORE	
		SHRENIK & COMPANY,	AHMEDABAD	
		HOFFMAN	BANGALORE	
37	CABLE LUGS (NON FLAME PROOF)	RITTAL	BANGALORE	
		SWITCHING CKT	KOLKATA	
		3D	UMERGAON	
38	CABLE GLANDS (NON FLAME PROOF)	DOWELL	MUMBAI	
		CHITRA	NASIK	
		ARUP	KOLKATA	
		SUNIL	KOLKATA	
39	CABLE GLAND,	QPIE	KOLKATA	
		COMMET	MUMBAI	
		AJMERIA	MUMBAI	



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	LUGS, JB (FLAME PROOF)	BALIGA	CHENNAI	
		FLEXPRO	NAVSARI	
40	BATTERY CHARGER FOR PLC	CHLORIDE POWER	KOLKATA	
		CHABBI	JALGAON	
		AMAR RAJA	TIRUPATI	
		STATCON	NOIDA	
		HBL POWER SYSTEM	HYDERABAD	
		JEMA ENERGY	SPAIN	
		MASS-TECH CONTROLS PVT.LTD.	MUMBAI	
		DUBAS	BANGALORE	
		CALDYNE	KOLKATA	
41	DC LEAD ACID / NI- CD BATTERIES	AMCO SAFT INDIA LTD	BANGALORE	NI-CD BATTERIES ONLY
		EXIDE INDUSTRIES LTD	DELHI	LEAD ACID BATTERIES ONLY.
		HBL POWER SYSTEMS LTD	HYDERABAD	NI/CD AND TUBULAR TYPE FOR LEAD ACID
		HOPPECKE BATTERIEN GMBH & CO.KG,	GERMANY	
		AMAR RAJA	TIRUPATI	
		SAFT	FRANCE/SWEDEN	
42	CONTROL / POWER CABLE	CORDS CABLE	BHIWADI	
		RADIANT CABLES	HYDERABAD	
		POLYCAB	DAMAN	
		KEI	BHIWADI	
		NICCO	KOLKATA	
		RAVIN CABLES	PUNE	
		INCAB	PUNE	
		HVPL	FARIDABAD	
		TORRENT CABLE	NADIAD	
		HAVELLS	ALWAR	
		PARAMOUNT	KHUSHKHERA	
		SRI RAM CABLES	BHIWADI	
		THERMOCABLES	HYDERABAD	
		TORRENT CABLE	NADIAD	
		UNIVERSAL CABLES	SATNA	
		GEMSCAB	BHIWADI	
		DELTON	FARIDABAD	
43	PLC BASED PANELS	SIEMENS	NASIK	
		SCHNEIDER	NASIK	
		ROCKWELL	SAHIBABAD	
		GE INTELLIGENT PLATFORM	BANGALORE	
		HONEYWELL AUTOMATION INDIA LIMITED ,	PUNE	
		ABB	BANGALORE	
44	OWS/PC	HP/COMPAQ /DELL/HCL/IBM/LENOVO		



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45	PRINTER	HP/CANNON/EPSON/XEROX/IBM/L EXMARK		
6	INSTRUMENT FITTINGS	AURA INCORPORATED	DELHI	
		ASTEC VALVES & FITTINGS PVT. LTD.,	MUMBAI	
		ARYA CRAFTS & ENGINEERING PVT. LTD.	MUMBAI	
		COMFIT & VALVE PVT. LTD.	NANDASAN	
		FLUIDFIT ENGINEERS PVT. LTD.	MUMBAI	REGISTERED AS PER 22ND ELECTRICAL AND C&I MISCC MEETING DTD. 15.01.2014
		FLUID CONTROLS PVT. LTD.	MUMBAI	NAME CHANGED FROM M/S HYD- AIR VALVES PVT. LTD. TO M/S FLUID CONTROLS PVT. LTD. AS PER 25TH MISCC-ELECTRICAL AND C&I DTD. 20.02.2014
		HP VALVES & FITTINGS INDIA PVT. LTD.	CHENNAI	
		PRECISION ENGINEERING INDUSTRIES	MUMBAI	
		PANAM ENGINEERS,	MUMBAI	
		PERFECT INSTRUMENTATION CONTROL (INDIA) PVT. LTD.	MUMBAI	
47	CABLE TRAY SUPPORT SYSTEM - BOLTABLE	VIKAS INDUSTRIAL PRODUCTS	NOIDA	FINANCIAL LIMIT REVIEWED ON 05.06.2014
		AM-TECH ENGG.SERVICES	PUNE	
		INDUSTRIAL PERFORATION (I) PVT. LTD.	KOLKATA	
		INDMARK FORMTECH PVT. LTD.	PUNE	
		PREMIER POWER PRODUCTS (CAL) PVT. LTD.	KOLKATA	GALVANISATION TO BE DONE AT ITS OWN PLANT OR FROM BHEL- PEM APPROVED GALVANIZERS.
		RATAN PROJECTS & ENGINEERING CO. PVT.LTD.	KOLKATA	
48	CABLE TRAY SUPPORT SYSTEM- WELDED(GALV)	STEELITE ENGINEERING LTD.	MUMBAI	
		ASSOCIATED POWER STRUCTURES PVT. LTD.	G. I. D. C., MAKARPURA, VADODARA- GUJARAT	WORKS ADDRESSES ARE APPLICABLE FOR MANUFACTURING AND GALVANISING.
		INDUSTRIAL PERFORATION (I) PVT.LTD.	DUM DUM KOLKATA-WEST BENGAL	
		INDMARK FORMTECH PVT. LTD.	MIDC BHOSARI PUNE- MAHARASHTRA	GALVANIZING UNIT LOCATED AT PHAS-3, E-11/1, MIDC, PUNE ,
		JAMNA METAL COMPANY	DSIDC, NARLA INDL. AREA DELHI	
		PREMIER POWER PRODUCTS (CAL) PVT. LTD.	KOLKATA,-WEST BENGAL	GALVANISATION TO BE DONE AT ITS OWN PLANT OR FROM BHEL- PEM APPROVED GALVANIZERS.
		PATNY SYSTEMS (P) LTD	SARDAR PATEL	



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	CABLE TRAY SUPPORT SYSTEM- WELDED(GALV)		ROAD SEUNDRABAD	
		PASSIVE INFRA PROJECTS PVT. LTD.	VAISHALI, PITAMPURA DELHI-	
		RUKMANI ELECTRICAL & COMPONENTS PVT LTD	KOLKATA-WEST BENGAL-INDIA	GALVANISATION TO BE DONE AT ITS OWN PLANT OR FROM BHEL- PEM APPROVED GALVANIZERS.
		RATAN PROJECTS & ENGINEERING CO. PVT.LTD.	P.K. TAGORE STREET, MAIN BUILDING KOLKATA-WEST BENGAL	GALVANISATION TO BE DONE AT ITS OWN PLANT OR FROM BHEL- PEM APPROVED GALVANIZERS. ADDITIONAL WORKS AT "SANKRAIL INDUSTRIAL PARK, BHAGABATIPUR MAUJA, DHULAGARH, HOWRAH- 711302" APPROVED
		RABI ENGINEERING WORKS PVT. LTD.	R.N. GUHA ROAD, DUM DUM, KOLKATA- WEST BENGAL	GALVANISATION TO BE DONE AT ITS OWN PLANT OR FROM BHEL- PEM APPROVED GALVANIZERS.
		SARAL INDUSTRIES	INDUSTRIAL AREA-1 SULTANPUR ROAD RAE BARELI-UTTAR PRADESH	REGISTERED IN PERMANENT CATEGORY ALONG WITH GALVANIZER M/S SARAL PROJECTS AND PROCESSORS , ,
		UNITECH FABRICATORS AND ENGINEERS PVT LTD	M.B.RAOD , BIRATI KALABAGAN KOLKATA KOLKATA-WEST BENGAL	GALVANISATION TO BE DONE AT ITS OWN PLANT OR FROM BHEL- PEM APPROVED GALVANIZERS.
49	CABLE TRAY SUPPORT SYSTEM- WELDED(UNGALV)	RASHTRIYA ISPAT NIGAM LIMITED	AMBAWADI AHMEDABAD-	
		STEEL AUTHORITY OF INDIA LTD.	ISPAT BHAWAN LODI ROAD NEW DELHI-	
50	CABLE TERM.& JOINT KITS	3M ELECTRO AND COMMUNICATION INDIA P.LTD	RAJENDRA PLACE, DELHI	
		HARI CONSOLIDATED PVT.LTD.,NEW DELHI	JHANDEWALAN, NEW DELHI-DELHI	HEAT SHRINKABLE TYPE ONLY.
		RAYCHEM RPG PRIVATE LIMITED	JANAKPURI NEW DELHI	
		YAMUNA CABLE ACCESSORIES PVT. LTD.	AMBALA ROAD, JAGADHRI YAMUNANAGAR- HARYANA	
51	LIMIT SWITCH	BCH	NEW DELHI	
		SIEMENS	NEW DELHI	
		JAIBALAJI	NEWDELHI	
52	ANNUNCIATOR	IIC	MUMBAI	
		MINILEC	AHEMDABAD	
		PROCON	CHENNAI	



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53	INTERPOSING RELAY	ECONIX	MUMBAI	
		PHEONIX	DELHI	
54	SELECTOR SWITCH	SCHENIDER	INDIA	
		SIEMENS	INDIA	
		L&T	INDIA	
		KAYCEE	INDIA	
55	INDICATION LAMPS, PUSHBUTTON, AUX. CONTACTOR, AUX. RELAYS	SCHENIDER	INDIA	
		SIEMENS	INDIA	
		ABB	INDIA	
		L&T	INDIA	
56	TIMER	BCH	INDIA	
		EAPL	INDIA	
57	PNEUMATIC ACTUATOR/CYLINDER(METALLIC)	SCHRADDER	MUMBAI	
		NUCON	HYDERABAD	
		ROTEX	MUMBAI	
		VAAS	CHENNAI	

The make of Sub-vendor items shall be generally as indicated above which is subject to customer / BHEL approval during detail engineering.

Make of any unlisted items shall be subject to customer / BHEL approval during detail engineering. For such items, bidder to furnish list of sub-vendors during detail engineering stage for Customer / BHEL's review and approval. Bidder shall furnish following supporting documentation within 1 month of placement of LOI. Thereafter no request for additional sub-vendor shall be entertained.

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



**TECHNICAL SPECIFICATION FOR
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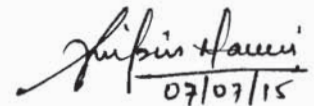
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**ANNEXURE-I
LIST OF MAKES OF SUB-VENDOR ITEMS
MISCELLANEOUS TANKS**


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VIPIN NAUNI
PEM - NOIDA



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SUB-VENDORS - MISCELLANEOUS TANKS

S.NO	ITEM	SUB-VENDORS	PLACE	TECHNICAL LIMIT
1	CS PIPES ERW	TISCO	JAMSHEDPUR	UP TO 350 NB
		SAIL	ROURKELA	
		SURYA ROSHNI	BAHADURGARH	UP TO 400 NB
		JINDAL	GHAZIABAD	UP TO 350 NB
		RATNAMANI	KUTCH	UP TO 400 NB
		MAHARASHTRA SEAMLESS	RAIGARH	UP TO 500 NB
		WELSPUN	ANJAR	UP TO 400 NB (IS 3589)
2	CS PIPES SEAMLESS	MAHARASHTRA SEAMLESS	RAIGARH	UP TO 350 NB
		ISMT	AHMEDNAGAR	UP TO 150 NB
		JINDAL SAW	NASHIK	
		REMI METAL GUJRAT LTD	BHARUCH	UP TO 150 NB HOT FINISH & UPTO 100NB COLD FINISH
		ISMT	BARAMATI	UP TO 200 NB
3	SS PIPES	REMI	TARAPUR	
		RATNAMANI	KUTCH	
		APEX TUBES	BEHROR (ALWAR)	
		PRAKASH STEELAGE LTD	MUMBAI	SS SEAMLESS PIPE UPTO 50MM
		SUMITAMO	JAPAN	
4	STRUCTURAL STEEL / MS PLATE	SAIL		
		ESSAR STEEL		
		TISCO		
		RINL		
		JINDAL		
		M/S UTTAM VALUE STEEL (LLOYDS)		
		ISPAT		
		JSW		
		INDIAN IRON & STEEL CO. LTD		
		A.V. VALVES LTD	AGRA	
5	GATE, GLOBE AND CHECK (STAINLESS STEEL VALVES)	FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		M/S GM ENGINEERING	RAJKOT	
		INTERVALVE (INDIA) LTD.	PUNE	A) STEEL GATE VALVES: UPTO 50NB, #800 AND 65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C) SUPPLIER NOT REGISTERED FOR NR VALVES
		LEADER VALVES LTD.	JALANDHAR	
		NITON VALVE INDUSTRIES PVT LTD	MUMBAI	
		NSSL LIMITED.	NAGPUR	
		STEEL STRONG VALVES (I) PVT.LTD.,	MUMBAI	LIMIT AS PER VD FILE AS ATTACHED IN SHEET 2
		VALTECH INDUSTRIES	MUMBAI	CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE- GV/150/900, GV/300/400, GV/600/300, GV/GLV/NRV/900/250, GLV/300/300, GLV/150/350/, SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.



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6	GATE, GLOBE AND CHECK (CS STEEL VALVES)	V.K. VALVES PVT. LTD.,	JALANDHAR	
		WEIR BDK VALVES	NEW DELHI	
		AUDCO		
		OSWAL INDUSTRIES		
		A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		M/S GM ENGINEERING	RAJKOT	
		INTERVALVE (INDIA) LTD.	PUNE	A) STEEL GATE VALVES: UPTO 50NB, #800 AND 65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C) SUPPLIER NOT REGISTERED FOR NR VALVES
		LEADER VALVES LTD.	JALANDHAR	
		NITON VALVE INDUSTRIES PVT LTD	MUMBAI	
		NSSL LIMITED.	NAGPUR	
		STEEL STRONG VALVES (I) PVT.LTD.,	MUMBAI	LIMIT AS PER VD FILE AS ATTACHED IN SHEET 2
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CC/CSS-GATE-BBT-UPTO600NB CL UPTO300,GATE-PSBT UPTO250NB CL 1500, GLV-BBT-UPTO300NB CL UPTO600, SCNRV-BBT-UPTO600NB CL UPTO150, SCNRV-BBT-UPTO300NB CL 300, SCNRV-PSBT-UPTO150NB CL UPTO900
		VALTECH INDUSTRIES	MUMBAI	CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE- GV/150/900, GV/300/400, GV/600/300 , GV/GLV/NRV/900/250 , GLV/300/300, GLV/150/350/ , SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.
		V.K. VALVES PVT. LTD.,	JALANDHAR	
		WEIR BDK VALVES	NEW DELHI	
		AUDCO -L&T	CHENNAI / COIMBATORE	
		OSWAL INDUSTRIES		
7	LEVEL INDIATOR FLOAT AND BOARD TYPE	HITECH	AHMEDABAD	
		KSB WATER PUMPS / VALVES	COIMBATORE	
		KBL	KONDHAPURI	
		HAWA ENGINEERS	AHMEDABAD	
		BHEL	GOINDWAL	
		FOURESS ENGG	MUMBAI	UPTO 600 NB, CL-300 & 300NB CL-600
		FOURESS ENGG	AURANGABAD	
		FLOW STAR	FARIDABAD	
		SCIENTIFIC DEVICES	MUMBAI	
		GAUGES BOURDEN	PANVEL	
		PUNE TECHTROL	PUNE	
		SBEM	PUNE	
		LEVCON	KOLKATA	
		SIGMA	MUMBAI	



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		CHEMTROL		
		DK INSTRUMENT	KOLKATA	
		V AUTOMAT	DELHI	
8	PAINT	ASIAN PAINT		
		BERGER		
		KANSAI NEROLAC		
		JOTUN		
		SHALIMAR		
		JENSON & NICHOLSON (I) LTD		
		CDC CARBOLINE (I) LTD.		
		ADDISON PAINTS LTD		
		GRAND POLYCOAT		
		BOMBAY PAINTS		
		HEMPLE PAINTS (SINGAPORE)		
		AKZONOBEL COATINGS		
9	FITTINGS (MS/SS)	PIPE FIT ENGINEERS	VADODARA	
		GUJRAT INFRA PIPES	VADODARA	
		MS FITTINGS	KOLKATA	
		TUBE PRODUCT	VADODARA	
		SIDDARTH & GAUTAM	FARIDABAD	
		EBY	MUMBAI	
		NL HAZRA	KOLKATA	
		EXCEL METAL		
		INTERTECH		
		FITTECH		
		METAL LLOYDS	MUMBAI	
		TRUE FORGE	FARIDABAD	
10	SEAL POT / NAOH BREATHER	SELF MANUFACTURED ITEM		
	INSPECTION CATEGORIZATION			
1. CAT I :INSPECTION BY OWNER, BHEL/BHEL NOMINATED TPIA & VENDOR .MDCC WILL BE ISSUED BASED ON INSPECTION REPORT IN LINE ITH APPROVED QAP.				
2. CAT II:INSPECTION BY BHEL/BHEL NOMINATED TPIA & VENDOR. MDCC WILL BE ISSUED BASED ON INSPECTION REPORT IN LINE ITH APPROVED QAP.				
3. CAT III: MDCC WILL BE ISSUED BASED COC & MTC ISSUSD BY VENDOR AND VERIFICATION BY BHEL/OWNER IN LINE WITH APPROVED QAP/CHECK LIST				

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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.

	1x800 MW TANGEDCO NORTH CHENNAI TPP FUEL OIL HANDLINGS SYSTEM & MISCELLANEOUS TANKS	SPECIFICATION NO. PE-TS-423-166-A101	
		SECTION : IA	
		REV 00	DATE: 02/02/2017

MANDATORY SPARE LIST

	1x800 MW TANGEDCO NORTH CHENNAI TPP FUEL OIL HANDLINGS SYSTEM & MISCELLANEOUS TANKS	SPECIFICATION NO. PE-TS-423-166-A101	
		SECTION : IA	
		REV 00	DATE: 02/02/2017

MANDATORY SPARE

- **Condensate storage tank** : One (1) No. level gauge for condensate storage tank and one (1) No. pressure gauge.
- **HSD day oil tank** : One (1No.) level gauge ,One (1) No. Level transmitter, One (1) No. actuator for motorized valve. Bidder to refer C&I specification for applicable mandatory spares.

	1x800 MW TANGEDCO NORTH CHENNAI TPP FUEL OIL HANDLINGS SYSTEM & MISCELLANEOUS TANKS	SPECIFICATION No: PE-TS-423-166-A101	
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		REV 00	

LIST OF COMMISIONING SPARES



**1x800 MW TANGEDCO NORTH
CHENNAI TPP
FUEL OIL HANDLINGS SYSTEM &
MISCELLANEOUS TANKS**

SPECIFICATION No: PE-TS-423-166-A101

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REV 00

LIST OF COMMISSIONING SPARES

SL. NO.	DESCRIPTION OF ITEMS	QUANTITY
1	CAF Gasket of size 1.5m X1.5m X 3 mm thk	2no.
2	Nuts, bolts & washers of each size (nos. of bolts, nuts & washers as required for each nozzle) as per approved Drg.	1lot
3	Any other item required for successful commissioning of the tanks (to be specified clearly by bidder)	

DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE

DRAWING AND DOCUMENTS FOR SUBMISSION

S.N.	Drawings and documents	Soft and Hard Prints
1.0	<i>DRAWING FOR APPROVAL</i>	
1.1	For approval	Soft+2 Hard Print
1.2	For customer approval	Soft+2 Hard Print
1.3	For final distribution	Soft+2 CD +5 Hard Print
2.0	DRAWING FOR REFERENCE	
2.1	For reference	Soft+2 Hard Print
2.2	For final distribution	Soft+2 CD+5 Hard Print
3.0	CERTIFICATE, REPORTS ETC.	Soft+2 Hard Print
4.0	AS BUILT DRAWINGS (IF REQUIRED)	Soft+2 CD+8 Hard Print
5.0	O&M MANUAL	
5.1	Draft for approval	Soft +3 CD+ 5 Hard Print
5.2	For final distribution	Soft +3 CD + 8 Hard Print
6.0	QUALITY PLAN / Field quality plan / PG test	Soft + 2 Hard Print

DRAWINGS DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

S. NO	DOCUMENT NO.	DOCUMENT TITLE	SCH. DATE OF SUB. FROM LOI (IN WEEKS)	PURPOSE
1	PE-V0-423-167-A001	FABRICATION DRAWING OF CONDENSATE STORAGE TANK **	5	APPROVAL
2	PE-V0-423-167-A002	DESIGN CALCULATION OF CONDENSATE STORAGE TANK**	3	APPROVAL
3	PE-V0-423-167-A003	GA DRAWING OF CONDENSATE STORAGE TANK INCLUDING ROOF STRUCTURE AND NOZZLE ORIENTATION **	3	APPROVAL
4	PE-V0-423-167-A005	DATASHEET & GA DRAWING OF COMPONENTS OF CONDENSATE STORAGE TANK **	6	APPROVAL
5	PE-V0-423-167-A007	QAP OF COMPONENTS OF CONDENSATE STORAGE TANK	6	APPROVAL
6	PE-V0-423-167-A008	SUB VENDOR LIST WITH INSPECTION CATEGORY FOR CS TANK**	3	APPROVAL

NOTE:

1. Drawing / Document shall be uploaded by the successful bidder on WRENCH /DMS. Procedure for the same will be informed after award of contract.
2. Resubmission of drawing/ documents shall be done within 10 days upon receipt of customer/BHEL comments by Bidder.

SIGNATURE: _____

NAME: _____

DESIGNATION: _____

COMPANY _____

DATE: _____

COMPANY SEAL

Fuel Oil Handling system

sl_no	Bhel_no	Colu mn1	org_tittle	sch_week1
1	PE-V0-423-166-A003	0	DESIGN CALCULATION OF TANKS FOR FOHS	6
2	PE-V0-423-166-A004	0	SIZING CALCULATION OF UTILITIES OF FOHS	4
3	PE-V0-423-166-A029	0	QAP OF FOHS INSTRUMENTS	16
4	PE-V0-423-166-A035	0	SUB-VENDOR LIST WITH INSPECTION CATEGORIZATION LIST FOR FOHS	4
5	PE-V0-423-166-A012	0	PAINTING SCHEDULE OF FOHS	10
6	PE-V0-423-166-A025	0	CIVIL INPUT DRAWING IN TANK FARM AREA FOR FOHS	16
7	PE-V0-423-166-A024	0	DESIGN CALCULATION & GAD OF MISCELLANEOUS TANKS FOR FOHS	10
8	PE-V0-423-166-A067	0	QAP OF OTHER MISCELLANEOUS ITEMS IN FOHS	20
9	PE-V0-423-166-A045	0	DEMONSTRATION TEST PROCEDURE OF FOHS	16
10	PE-V0-423-166-A019	0	SUGGESTIVE ELECTRICAL LAYOUT DRAWING OF FOHS	10
11	PE-V0-423-166-A018	0	GAD OF FOHS (COMPOSITE LAYOUT)	12
12	PE-V0-423-166-A016	0	PIPING LAYOUT IN TANK FARM AREA OF FOHS	8
13	PE-V0-423-166-A042	0	COMMISSIONING PROCEDURE OF FOHS	20
14	PE-V0-423-166-A021	0	GAD OF FOHS TANKS INCLUDING ROOF STRUCTURE & NOZZLE ORIENTATION	10
15	PE-V0-423-166-A032	0	CABLE SCHEDULE OF FOHS	18
16	PE-V0-423-166-A033	0	ELECTRICAL LOAD DATA OF FOHS	16
17	PE-V0-423-166-A056	0	QAP OF VALVES,	12
18	PE-V0-423-166-A034	0	ISOMETRIC DRAWING OF FOHS	10
19	PE-V0-423-166-A050	0	DS AND GAD PIPES, PLATES AND FITTINGS ETC FOR FOHS	8
20	PE-V0-423-166-A014	0	DATASHEET OF FOHS INSTRUMENTS	10
21	PE-V0-423-166-A010	0	DESIGN CALCULATION AND GAD OF OWS FOR FOHS	14
22	PE-V0-423-166-A036	0	INSTRUMENT INSTALLATION DIAGRAM OF FOHS	20
23	PE-V0-423-166-A049	0	DS AND GAD OF VALVES	10
24	PE-V0-423-166-A057	0	QAP OF PIPES, PLATES AND FITTINGS ETC FOR FOHS	8
25	PE-V0-423-166-A001	0	P&ID'S OF FOHS	4
26	PE-V0-423-166-A044	0	O&M MANUAL OF FOHS	20
27	PE-V0-423-166-A065	0	GAD OF OTHER MISCELLANEOUS ITEMS IN FOHS	20
28	PE-V0-423-166-A043	0	PG TEST PROCEDURE OF FOHS	16
29	PE-V0-423-166-A023	0	FABRICATION DRAWING OF FOHS TANKS INCLUDING ACCESSORIES	18

Other points to be considered while preparing drawings:

- a) Data sheets of various items shall be prepared by the bidder for storage tanks and shall be submitted to BHEL / customer / consultant for approval after placement of order and any changes required by BHEL / customer / consultant for the same shall be incorporated and adhered by the bidder without any commercial implications.
- b) GA drawing, nozzle schedule, design data, material of construction etc. shall be prepared by the bidder during detail engineering stage based on specification / contractual requirement and there should be no commercial implication on account of finalization of the drawings and documents.
- c) GA drawing covering all details shown in data sheets like design data, dimensions, material of construction, list of appurtenances, lists of specifications, details of paints, standards & codes, general notes including details of test to be conducted on tank in accordance with specification and brand-name of welding electrodes to be used etc.
- d) Field quality plan / quality assurance plan / check list shall be prepared by the bidder for storage tanks / each instrument / item and shall be submitted to BHEL / customer / consultant for approval after placement of order and any changes required by BHEL / customer / consultant for the same shall be incorporated and adhered by the bidder without any commercial implications.
- e) Bar chart, list of drawings and documents including data sheet, manual calculation, quality plan, field quality plan, PG test procedure, list of sub-vendors, technical specification and material of construction, painting specification / schedule, dispatch schedule etc. of various items as required by BHEL / customer / consultant shall be submitted to BHEL / customer / consultant during detail engineering stage for approval and the approved drawings / documents shall be adhered by the bidder without any commercial implication.
- f) All possible efforts shall be made by the bidder to get the approval of drawings and documents from BHEL / customer / consultant at the earliest and the documents prepared / generated by them or their sub-vendors shall be checked by their competent authority before submission to BHEL.
- g) Revision made by the bidder in any drawings and documents shall be highlighted by indicating the no. of revisions in a triangle without fail so that the minimum time is required by BHEL to review the drawings and documents.
- h) Any other drawings and documents in addition to the list of drawings and documents indicated in the NIT specification as required by BHEL for the execution of the project shall be furnished by them during detailed engineering stage and no commercial implication shall be entertained by BHEL for the same.
- i) Bidder to note that all the drawings shall be prepared in Auto Cad - 2010 version or later and required number of hardcopies and soft copies shall be furnished to BHEL during detailed engineering stage. Exact requirement of number of hard copies and soft copies of all drawings and documents as required by BHEL / customer / consultant shall be informed to the successful bidder during detail engineering stage and bidder to furnish the same for which no additional cost shall be entertained.
- j) Bidder to provide AutoCAD copy of drawing / document for review and interfacing with our facilities.

- k) Civil works will be done by BHEL based on civil inputs furnished by the bidder during detail engineering. In case of any changes in the civil input drawing after civil work is completed. Necessary prices on account of modification of the civil work shall be deducted from bidder's account or rectification in civil work to be done by bidder.
- l) Bidder to furnish the civil foundation drawing of the tanks / seal pots / NaOH or KOH breather along with the loading data for approval during detailed engineering stage showing / indicating the followings:-
- Scope of work by BHEL and bidder shall be indicated with different legend or in the form of note.
 - Recommended locations of earthing pads.
 - Civil loads shall be furnished and the detailed calculation showing weights of roof, bottom, and shell plates, all accessories and nozzles etc.
 - Details of pockets as required for anchor bolts.
- m) All drawings and documents including general arrangement drawing, data sheet, calculation etc. shall be furnished to BHEL during detailed engineering stage and shall include / indicate the following details for clarity w.r.t. inspection, construction, erection and maintenance etc.:-
- All drawings and documents shall bear BHEL's title block and drawing / document number. However, BHEL's drawing / document numbering scheme shall be furnished to the successful bidder after the placement of L.O.I.
 - All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view etc. All major self-manufactured and bought out items shall be labelled and included in BOQ / BOM in tabular form indicating all components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
 - Specification / schedule of painting shall be made as a part of general arrangement drawing of each item indicating at least 3 make.
- n) All text/ numeric in the document / drawings to be generated by the successful bidder will be in English language only.



TITLE
1x800 MW TANGEDCO NORTH CHENNAI TPP
FUEL OIL HANDLINGS SYSTEM &
MISCELLANEOUS TANKS

SPECIFICATION NO. PE-TS-423-166-A101

REV 00

Section -I Date 02.02.2017

Page 1 of 1

SPECIFIC TECHNICAL REQUIREMENTS

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

SUB SECTION – ID Customer specification



**1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III**



EPC TENDER SPECIFICATION FOR BTG PACKAGE

LOW PRESSURE PIPING SYSTEM



EPC TENDER SPECIFICATION FOR BTG PACKAGE

2.1.6 LP PIPING, VALVES & SPECIALITIES

2.1.6.1 Equipment sizing Criteria

- a. All the piping systems and equipment supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.
- b. For all LP piping system covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated elsewhere. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.
- c. Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following.
 - i. Water Application

Sl.No.	Pipe Size	Below 50mm	50-150 mm	200 mm & above
1	Pump suction	-	1.2-1.5	1.2-1.8
2	Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5
3	Header	-	1.5-2.4	2.1-2.4

The pipes in CW, ACW & DMCW system shall be designed to maintain a maximum velocity of 2 m/s inside the pipelines at pump discharge. Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.

- ii. WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following “C” value.

1	Carbon steel pipe	100
2	CI Pipe/Ductile Iron	100
3	Rubber lined steel pipe	120
4	Stainless steel pipe	100

For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/sump/reservoir from which the pumps draw water

- iii. Compressed Air Application
Compressed air – 15.0 m/sec. (under Average Pressure & Temp. conditions)



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- d. The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.
- e. Based on the inside dia. so established, thickness calculation shall be made as per ANSI B 31.1 OD and thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B 36.19 as the case may be.
- f. Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered.
- g. Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.
- h. High points in piping system shall be provided with vents along with valves as per the system requirement. Low points shall be provided with drains along with drain valves as per the system requirement. Drain lines shall be adequately sized so as to clear condensate in the lines. Material for drain and vent lines shall be compatible with that of the parent pipe material.
- i. Material of construction for pipes carrying various fluids shall be as specified elsewhere.
- j. Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic locations in the piping systems.
- k. Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before dispatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.
- l. Threaded joints shall be provided with Teflon sealant tapes.
- m. Following types of valves shall be used for the system/service indicated.

System	Type of Valves					
	Butterfly	Gate	Globe	Check	Ball	Plug
Water	x	x	x	x	x	
Air		x	x	x	x	
Drains & Vents		x	x	x		
Fuel oil		x	x	x	x	x

In water service, valves above 200 NB size shall be butterfly valves.

- n. Recirculation pipes along with valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30% design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.



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- o. All Piping 450 NB & Above shall be designated as Large dia Piping.

2.1.6.2 Technical Specification

2.1.6.2.1 General

Specific technical requirements of low-pressure piping, fittings, supports, valves, specialties and tanks etc. have been covered under this Sub-section. It includes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on over ground piping. It also includes detailed technical requirement of laying underground/buried piping including water proofing/anti corrosive protection. It also covers design, engineering, manufacturing, fabrication, technical details of piping, valves, specialties, piping hangers/supports, tanks etc.

2.1.6.2.2 Pipes and fittings

- a. All low pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness as adhered to. The bidder shall furnish the pipe sizing / thickness calculation as per the criteria mentioned above under LP piping equipment sizing criteria of this Technical Specification.
- b. Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.
- c. Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the Bidder and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localized bending stresses.
- d. Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M).
- e. Wherever Bidder's piping coming under this specification, terminates at an equipments or terminal point not included in this specification, the reaction and the thermal movement imposed by bidder's piping on equipment terminal point shall be within limits to be approved by the Employer.
- f. The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/expansion joint etc. shall be provided as may be necessary depending on layout.



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- g. Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.
- h. For rubber lined ERW pipes, beads shall be removed.
- i. Inspection holes shall be provided at suitable locations for pipes 800 NB and above as required for periodic observations and inspection purposes.
- j. At all intersection joints, it is Bidder's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.
- k. For large size pipes/duct, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1:8. Requirement shall be decided as per relevant code. Transient analysis / surge analysis wherever specified and required shall be conducted in order to determine the location, number and size of the Air-Release valve on certain long distance/high volume piping systems such as CW/ ACW/ Raw Water etc.

2.1.6.2.3 Material

- a. Alternate materials offered by Bidder against those specified shall either be equal to or superior to those specified, the responsibility for establishing equality or superiority of the alternate materials offered rests entirely with the Bidder and any standard code required for establishing the same shall be in English language.
- b. No extra credit would be given to offers containing materials superior to those specified. Likewise no extra credit would be given to offers containing pipe thickness more than specified.
- c. All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockiest are not acceptable.
- d. All materials shall be certified by proper material test certificates. All material test certificates shall carry proper heat number or other acceptable reference to enable identification of the certificate that certifies the material.
- e. Material of construction for pipes carrying various fluids shall be as follows:

1	Circulating Water (CW) – Pump Discharge, condenser risers including header near condenser and cooling tower rise	IS 3589 FABRICATED FROM IS 2062 PLATES –INTERNALLY LINED WITH CORROCOAT OR POLYUREA COATING OF 1500 MICRONS DFT /GRP/ FRP
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2	ACW	UPTO 150 NB - ASTM A 312 TP 316 L (ERW)/ DUPLEX SS 200 NB & ABOVE - ERW IS 1978 (OR) API5L (OR) IS 3589 FABRICATED FROM IS 2062- Internally lined with Corrocoat or polyureA Coating inside of 1500 microns DFT
3	RO Stage II Permeate, Dematerialized water, (condenser Make up water, Boiler fill and Deaerator Fill water) & DMCW overhead tank make-up water	Stainless steel to ASTM A-312, Gr. 304 welded for sizes above 50mm NB Stainless steel to ASTM A312, Gr. 304 sch. 40 Seamless for sizes 50 mm and below
4	Drinking water	ASTM A-53 type E Gr. B galvanized /IS 1239 heavy galvanized/IS 3589 Gr 410 Galvanized to SI-4736 or equivalent.
5	Instrument air & plant air.	ASTM A-53 type E Gr. B galvanized /IS 1239 heavy galvanized/IS 3589 Gr 410 Galvanized to SI-4736 or equivalent.
6	Fuel Oil piping	API5L
7	FUEL OIL PUMP DISCHARGE LINES	ASTM A 106 GR B
8	Sodium Hypochlorite (pipes & Fittings)	CPVC Sch 80 ASTM

- f. In water lines, pipes upto 150 mm NB shall conform to ANSI B36.10/ASTM-A-53, Type-E Gr. B/IS:1239 Gr. Heavy and minimum selected thickness shall not be less than IS: 1239 Grade heavy except for dematerialized water and condensate spill lines.
- g. Pipes of above 150 mm NB shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589 Gr. 410. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr. B/ASTM-A-36. However, larger pipes, i.e. 1000 mm NB and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr. B and shall meet the requirements of AWWA-M-11(for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/ surge conditions, truck- load, rail-load and weight density for compacted soil or any other load as the case may be).
- h. In dematerialized water service, the pipes up to 50 NB shall be of stainless steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipes shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65 mm NB up to and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness.
- i. Bidder shall note that pipes offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.



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- j. Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410/IS: 1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanized to IS 4736 or any equivalent internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B/IS: 3589, Gr. 410/IS: 1239 Gr. Heavy. The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanized).
- k. Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses.
- l. Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.
- m. If carbon steel plates of thickness more than 12 mm are used for manufacture of pipes, fittings and other appurtenances, then the same shall be control-cooled or normalized as the case may be following the guidelines of the governing code.

2.1.6.2.4 Piping Wall Thickness

- a. The calculation of wall thickness required for pipelines subject to internal and/or external pressure shall be based on the formulae and recommendations as given in the applicable codes. Adequate allowances shall be made towards thinning due to bending, weakening at branch connections, threading, commercial tolerances on pipe wall thickness, corrosion and erosion, etc., and the same shall be subject to approval by Purchaser. In any case a minimum corrosion allowance of 1.0 mm shall be considered while selecting the thickness.
- b. In case of carbon steel materials, the nominal wall thickness of pipeline shall not be less than the minimum acceptable values given below:

NB mm (inch)	15 (1/2)	30 (3/4)	25 (1)	32 (1¼)	40 (1.5)	50 (2)	65 (2.5)	80 (3)	100 (4)	125 (5)
Min. thickness, mm	3.2	3.2	3.6	3.6	3.6	3.6	3.6	4	4.5	5.4
NB mm (inch)	150 (6)	200 (8)	250 (10)	300 (12)	350 (14)	400 (16)	450 (18)	500 (20)	600 (24)	600 (24)
Min. thickness, mm	5.4	6.35	6.35	6.35	7.1	7.1	7.1	8	8	8

> NB 600 mm to NB 900 mm	-	8.0 mm
> NB 900 mm to NB 1200 mm	-	10.0 mm
> NB 1200 mm to 1400 mm	-	12.0 mm
> NB 1400 mm to 1600 mm	-	14.0 mm
> NB 1600 mm to NB 2200 mm	-	16.0 mm



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> NB 2200 mm - 18.0 mm

2.1.6.2.5 Piping Layout

- a. Piping shall be grouped together where practicable and routed to present a neat appearance.
- b. Piping routing shall be such as to provide sufficient clearance for removal and maintenance of equipment, easy access to valves, instruments and other accessories. The piping shall not encroach on the withdrawal space of various equipment.
- c. Over head piping shall have a normal minimum vertical clearance of 2.5 meters above walkways and working areas and 8 m above roadways/railways. When several pipelines are laid parallel, flanged joints must be staggered. Welded and flanged joints should as far as possible be located at one third span from supports. If the support is situated right under the welded joints this joint must be reinforced with a strap. Flanged and welded joints must be avoided in the middle of the span. Valves should be located in such a manner so as to ensure their convenient operation from the floor or the nearest platform.
- d. Pipelines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run-pipe and submit to Employer for approval.
- e. All piping shall be routed so as to avoid interference with other pipes and their hangers and supports, electrical cable trays, ventilation ducting, structural members, equipment etc.
- f. Adequate clearance shall be ensured with respect to the above to accommodate insulation and pipe movements, if any.
- g. Piping shall generally be routed above ground but where specifically indicated / approved by the project Manager the pipes may be arranged in trenches or buried. Pipes at working temperature above the ambient shall however not be buried.
- h. Sufficient upstream and downstream lengths shall be provided for flow measuring devices, control valves and other specialties.
- i. All local instruments shall be located on pipelines as to render them observable from the nearest available platforms.
- j. Openings provided in the wall for pipelines must be closed with bricks and mortar with 10-12 mm clearance between brick work and pipe after taking care of insulation and thermal movement, if any. The clear space must be filled with felt or asbestos or approved filling compound.

2.1.6.2.6 Slope/Drains and Vents



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- a. Suitable slope shall be provided for all pipelines towards drain points. It is Bidder responsibility to identify the requirements of drains and vents, and supply the necessary pipe work, valves, fittings, hangers and supports etc. As per the system requirement low points in the pipelines shall be provided with suitable draining arrangement and high points shall be provided with vent connections where air or gas pockets may occur. Vent shall not be less than 15 mm size. Drains shall be provided at low points and at pockets in piping such that complete drainage of all systems is possible. Drain shall not be less than 15 mm for line size up to 150 mm, not less than 20 mm up to 300 mm and not less than 25 mm for 350 mm to 600 mm pipes and not less than 50 mm for 600 mm and above pipes.
- b. Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.

2.1.6.2.7 Pipe Joints

In general all water lines 65 mm NB and above, are to be joined generally by butt welding except the locations where valves/fittings are to be installed with flanged connections and 50 mm and below by socket welding unless mentioned otherwise specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections.

- a. Screwed
 - i. Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT/IS:554 unless specified otherwise.
 - ii. Galvanized pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanized pipes shall not be joined by welding. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanized, or in case match pipes and fittings are already galvanized before the above mentioned fabrication then suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & out side) after welding with zinc rich electrode, along with the nascent threaded metal portion at both free ends given the same application of Zinc Silicate paste. Alternatively flanged jointing may be employed for pipe sizes 100 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydro test.
 - iii. Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed and



all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately.

- iv. For pipe sizes from 350 mm NB to 550 mm NB (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanized. Any site welding done on galvanized pipes shall be done with zinc-rich special electrodes and the welded surfaces whether inside or outside shall be coated with zinc-silicate pasts. Seal welding of flanges with zinc-rich electrode will be permitted only when any flange is leak-prone during hydro testing.
- v. For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection (with zinc-rich special electrodes) followed by application of zinc silicate coating at welded surfaces both inside and outside the pipe, except for the last blank/blind flange, or, equipment connection where application of zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.

b. Welded

- i. For making up welded joints (butt weld or socket weld) the welding shall be performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.

c. Flanged

- i. Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only.
- ii. All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification.
- iii. Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.

2.1.6.2.8 Bends/elbows/mitre bends/Tees/Reducers & other fittings

- a. Unless otherwise specified elbows shall be of long radius type.
- b. For pipe sizes up to 65 Nb, long radius forged elbows or seamless pipe bends shall be used. Pipe bends, if used, shall be cold bent to a radius measured to the centre line of pipe of 3 to 5 times the pipe diameter.
- c. For steel pipes 80 Nb and above, seamless long radius forged elbows shall be used. For pipe size 250 Nb and above mitre bends may be used for all pipes except rubber lined pipes. The bend radius



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shall be 1½ times the nominal pipe diameter. 90 deg. Bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.

- d. Mitre bends are not acceptable in case of rubber lined mild steel pipes.
- e. For pipe fittings such as reducers and tees, the material shall be to ASTM-A-234 Gr. WPB up to 300 NB. For pipe reducers and tees above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fittings shall conform to the dimensional standard of ANSI B-16.9. However, for pipes up to 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239. For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.
- f. Stainless steel fittings shall conform to either ASTM-A-182, Gr. 304 (316 for Sea water application, if any) or ASTM-A-403, Gr. WP 304 (316 for Sea Water application, if any) Class-S, for sizes up to and including 50 mm NB, i.e. the fitting shall be of seamless construction. However, for stainless steel fittings above 50mm NB, the same shall conform to ASTM-A-403, Gr. WP 304 (316 for Sea water application, if any), Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.
- g. In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.

2.1.6.2.9 Flanges

- a. Flanges shall be slip on type. Welding of flanges in tension is not permitted.
- b. All flanges and-flanged drilling shall be to ANSI B 16.5/BS EN-1092 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 (316 for Sea water application, if any) or equivalent. For all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water (Sea water) etc flanges & bolts & nuts shall be SS 316 L construction.

2.1.6.2.10 Specific technical requirement of laying buried pipe with anti corrosive treatment

The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) meter below finished general ground level.

- a. Trenching
 - i. The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822.
 - ii. Free access shall be provided for the welding of the circumferential joints by increasing the width and depth of the trench at these points. There should be no obstruction to the welder from any side so that good welded joint is obtained.



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- iii. The free working space shall conform to IS: 5822. The trench shall be excavated so as to provide minimum cover of 1000 mm between the top of the pipe and finished grade.
 - iv. Prior to lowering and laying pipe in any trench, the bidder shall backfill and compact the bottom of the trench or excavation in accordance with IS: 5822 to provide an acceptable bed for placing the pipe.
 - v. Coating and Wrapping shall be done as under.
- b. Preparation and cleaning of piping
- i. The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Kerosene will not be permitted for cleaning. This cleaning operation shall be immediately followed by priming with the mechanical priming machine.
 - ii. Certain inaccessible portions of the pipeline (which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager.
 - iii. The cleaning and priming operation shall be carried out at site. The entire pipe length shall be cleaned but the ends of the pipes shall be left without coating for a distance of 230 mm for joints, which shall be coating manually at site after laying, welding and testing the pipe.
- c. Trench bed preparation and back filling
- Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS: 5822.
- d. Laying of galvanized steel (GI) pipes
- All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing Threaded portion on either side of the socket joints shall be applied with Zinc silicate paste.

All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of buried piping" and "anti corrosive protection for buried piping" are applicable for buried galvanized steel (GI) pipes also.

2.1.6.2.11 Cleaning and Flushing

- a. All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.
- b. Before erection all pipe work, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and



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followed by air-blowing. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done in such a manner that the coating on MS pipe is not affected.

- c. After erection, all water lines shall be 1.2-1.5 times the operating velocities in the pipelines.
- d. All compressed air pipe work shall be cleaned by blowing compressed air.

2.1.6.2.12 Painting of Pipes

a. Buried Piping

Internal surfaces

- i. Surface cleaning by sand blasting.
- ii. Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- iii. Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns. The total dry film thickness of 150 microns. Tests to be carried out after application : Bond/ Adhesion test, Holiday test

External surfaces

- i. Surface cleaning by Sand Blasting.
- ii. Coal tar primer compatible with coal tar enamel grade. The number of coats shall be two with a DFT of 35 microns each.
- iii. Coal tar enamel shall be applied. A single spiral inner wrap of glass fibre tissues shall be applied overlapping at least 25 mm ensuring impregnation of glass fibre tissues in the first coat. The second coat of enamel and second outer wrap of glass fibre felt, Type – I to IS: 7193-1974 will be applied in the same way confirming to Table – 10 of IS – 10221 – 1982The total thickness of the coating will not be less than 4.0 mm
- iv. Alternatively Wrapping with coal tar based anticorrosion tape conforming to IS 15337: 2003 is also acceptable in lieu of s.no. (iii) above. Wrapping thickness shall be 4.0 mm. Tests to be carried out after application : Bond/ Adhesion test, Holiday test

b. Overground Piping

Internal surfaces

- i. Surface cleaning by sand blasting.
- ii. Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- iii. Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns. The total dry film thickness of 150 microns.

External surfaces

- i. Surface cleaning by Sand Blasting.



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- ii. Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- iii. Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.
- c. **Other requirements**
 - i. Paint manufacturers instructions shall be followed in method of application, handling, drying time etc.
 - ii. The color of the finish paint shall be as per approved color-coding.
 - iii. If finish paint was applied in shop, one coat of finish paint shall be applied at site.
 - iv. The dry film thickness of paint shall not be less than 0.15 mm.
- d. **Colour code for identification**

The pipes shall be color painted/banded for identification as per the approved color-coding scheme and shall be generally as per IS-9404.

2.1.6.2.13 Specification for hangers and supports

- a. All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.
- b. While designing supports for rubber lined pipes special consideration should be given. Any kind of welding on these pipes is not allowed after rubber lining
- c. Hanger for piping 65 mm Nb and larger and all spring support assemblies regardless of size shall be completely engineered in conformance with the provisions of power piping code ANSI B 31.1.
- d. Hangers, saddles, supports etc. shall be fabricated from plates/pipes sections conforming to ASTM A 53/IS: 2062/IS:226/ or equivalent. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. The structural steel work shall be as per IS: 800/BS:4360. Insulation protection saddles shall be used at support point of all insulated piping.
- e. The support shall be so interspaced as to minimize sagging of the pipes and to keep them within permissible limits where pipes are full with the conveying media.
- f. The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.
- g. All pipe supports shall be designed to provide an absolute minimum head room of 2.5 m from floor in passages/walkways.
- h. At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.



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- i. All components of hangers/support shall be provided with two coats of primer (red oxide paint) at shop before dispatch to site. After erection they shall be given finish coat of Long Oil Synthetic enamel to IS: 2932 of total DFT 100 to 140 microns. CLH & VLH will be primed with Epoxy Zinc rich primer of 50 micron followed by finish painting of Aliphatic Acrylic Polyurethane or equivalent of DFT 65 microns.

2.1.6.2.14 Design/Construction/Material Particulars of Gate/Globe/Check Valves/Globe Stop Valve/Butterfly Valve

a. General

- i. All valves shall be suitable for the service conditions i.e. flow, temperature and pressure, at which they are required to operate.
- ii. The valves as well as all accessories shall be designed for easy disassembly and maintenance.
- iii. Valves to be installed outside shall be required to have the stem properly protected against atmospheric corrosion.
- iv. All rising stem valves shall be provided with back seat to permit repacking (of glands) with valves in operation. All valves shall preferably be of outside screw and yoke type.
- v. All valves shall be closed by rotating the hand wheel in the clockwise direction when looking at the face of the hand wheel. In case where the hand wheel is not directly attached to the valve spindle suitable gearing shall be introduced.
- vi. All valves shall have indicators or direction clearly marked on the hand- wheel so that the valves opening/closing can be readily determined.
- vii. Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required. For valves of size 350 mm and above either bevel or spur gearing shall be provided to facilitate manual operation. (h) The valves coming in vacuum lines shall be of extended gland type and / or water sealed.
- viii. The actuator-operated valves shall be designed on the basis of the following:
 - 1. The internal parts shall be suitable to support the pressure caused by the actuators.
 - 2. The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc.
 - 3. All actuator-operated valves shall be provided with hand operated gearing mechanism also.
 - 4. All actuators operated valves shall open/close fully within time required by the process.
- ix. Valves coming under the purview of IBR shall meet IBR requirements.
- x. Gate/sluice valves shall be used for isolation of flow. Gate valves shall be provided with the following accessories in addition to other standard items:
 - 1. Hand wheel
 - 2. Position indicator (for above 50 mm NB valve size)
 - 3. Draining arrangement wherever required.
- xi. Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction.
- xii. Check valves shall be used for non-return service. They shall be swing check type or double door (Dual plate) check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate



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- check valves are preferable for its spring controlled opening/closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600 mm NB.
- xiii. All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing.
 - xiv. All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form an integral part of the valve. Stop-gap arrangement in this respect is not acceptable.
 - xv. All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.
 - xvi. Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the Bidder wherever necessary in consultation with project manager within the bid price at no extra cost to employer.
 - xvii. All valves except those with rising stems shall be provided with continuous mechanical position indicator; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.
 - xviii. For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS-1538 for fitting shall be applicable.
- b. Valve Body Material
- Valve body material for various services shall be as follows: Valve body material for water application like DM Cooling Water (Passivated DM Water) (DMCW), RO Stage I Permeate, AHP Seal Water, APH/ ESP Wash, Service Water, Potable Water, HVAC Make UP shall be cast iron for sizes 65 NB and above; gun-metal/ Forged Carbon Steel for sizes 50 Nb and below.
- Valve body material for sea water application like Circulating Water. Auxiliary Cooling water, Blowdown, CT make up, sea water Intake, Guard pond inlet & Discharge, Ash Water using sea water, RO Stage II reject, RO Stage I reject, Reject Sump discharge and all other sea water applications shall be SS 316 L for all sizes.
- For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below. DM water: SS body and disc along with SS internals. Condensate: Cast Carbon Steel/Forged Carbon Steel.
- i. The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.

AWWA-C-504	Rubber seated butterfly valves
BS-5155/EN-593	Cast iron and steel body butterfly valves for general purpose.
IS-778	Gun-metal gate, globe and check valves for general purpose.



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BS-5154	Copper alloy globe/globe stop and check and gate valves for general purpose.
IS-780	Sluice valves for water works purpose (50-300 mm size)
IS-2906	Sluice valves for water works purpose (350-1200 mm size)
IS-5150	Cast iron wedge and double disc gate for general purpose.
BS-5152	Specification for cast iron globe valve
BS-5153	Cast iron check valves for general purpose.
IS-5312	Swing check type reflux (non-return) valves
ANSI B 16.34	Standard for valves
API-594	Standard for Dual-check valves
API-600	Steel gate valves
ANSI-B-16.10	Valves face to face and other relevant dimension
API-598	Valves inspection test

ii. End Connections

The end connections, shall comply with the following:

Socket welding (SW) – ANSI B 16.11

Butt Welding (BW) – ANSI B 16.25

Threaded (SC) – ANSI B 2.1

Flanged (FL) – ANSI B 16.5 & AWWA-C-207 (steel flanges), ANSI B 16.1 (Cast Iron flanges)

- iii. All cast iron body valves (gate, globe and non-return) shall have flanged end connections; (screwed ends for Ductile D.2NI body valves are not acceptable).
- iv. All steel and stainless steel body valves of sizes 65 mm and above shall have flanged or butt welding ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a prerequisite in case of butt-welded joints.
- v. All gun metal body valves shall have screwed ends.
- vi. All flanged end valves/specialties shall be furnished along with matching counter flanges, fasteners, gaskets etc. as required to complete the joints

2.1.6.2.15 Check Valves

- a. Check valves shall comply with the following characteristics:
- For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal);
 - For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position.
 - In the case of swing check valves, the body seat shall be inclined at such an angle from the vertical as will facilitate closing and prevent chatter.
- b. Drilling on flanges of flanged valves must correspond to the drilling on flanges of the piping system on which the valves are to be installed.
- c. All flanged valves intended for installation in steel piping systems shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class.
- d. Counter flanges to be installed on air pipes shall be screwed-on type irrespective of size.



2.1.6.2.16 Globe Valves

- a. The globe valves shall have the following characteristics; Straight conveyed flow Right angle Preferably, the valves shall be of the vertical stem type.
- b. Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle.
- c. The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided
 - i. No possibility exists that flow from above the disc can remove either the disc from stem or component from disc
 - ii. Manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened.
- d. For the regulating valves, valves with regulating plug & parabolic outline disc type is preferred.
- e. All motorized globe valves with regulating plug for which indication of percentage (%) opening are required in the control room shall be provided with necessary position transmitter.

2.1.6.2.17 Gate valves

All gate valves shall be of the full-way type, and when in the full open position the bore of the valve shall not be constricted by any part of the gate Gate valves shall be of the solid/elastic or articulated wedge disc and rising stem type.

2.1.6.2.18 Air Release Valve

- a. The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint.
- b. The valve shall efficiently discharge the displaced air automatically from ducts/pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure.
- c. Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS: 210 Gr. FG 260 and spindle shall conform to high tensile brass.
- d. Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/butterfly valve.

2.1.6.2.19 Butterfly Valves

- a. Design/Construction
 - (a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN- 593 or any other approved equivalent standard latest edition. Fabricated steel (IS: 2062 GR. B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm diameter. In such a case, however, the bidder will have to necessarily submit thickness calculations, in order to establish the integrity of the fabricated valve body under the system operating pressure condition.
 - i. The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However for sizes 600 NB and below the valves of Wafer construction are also acceptable.



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- ii. The seals, both on the body (sleeve) and on the disc shall be of the material specified. Necessary shaft seal shall be provided and adequately designed to ensure no leakage across the seal. This seal shall be designed so that they will allow replacement without removal of the valve shaft. The sealing ring on the disk shall be continuous type and easily replaceable.
 - iii. For all types of valves, the design with shaft eccentric to the disc is preferred. The shaft shall be solid type and shall pivot on bushings. Bushings/sleeve type bearings shall be contained in the hub of valve body. The bearing shall be self-lubricated type with low coefficient of friction and should not have any harmful effect on water and on valve components.
 - iv. The design of the shaft shall be such that it will safely sustain maximum differential pressure across the closed valve. The shaft and any key (taper pin etc.) for transmitting the torque between shaft and disc shall be capable of withstanding the maximum torque required to operate the valve. However, the shaft diameter shall not be less than the minimum shaft diameter specified in relevant code. Necessary Torque Calculation and the torque class selected on the basis of the same shall be furnished to the Employer for information.
 - v. The disc shall rotate from the full open to the tight shut position. The disc shall be contoured to ensure the least possible resistance to flow and shall be suitable for throttling operation. While the disc is in the throttled position, valve shall not create any noise or vibration.
 - vi. The operating mechanism shall be mounted directly on or supported from the valve body.
 - vii. All valves shall be complete with: Position indicator (located in a visible place) Arrow indicating the flow direction; Adjustable mechanical stop limiting devices to prevent over Travel of valve disc in open/close position. All valves shall be "tight shut off"
 - viii. Hand operated valves shall have the following Local hand controls the hand controls shall close the valve with clockwise rotation. The hand controls shall be dimensioned to guarantee an easy maneuver under most severe conditions. The hand controls shall be provided with locking systems suitable to avoid the disc assuming a non-desirable position during the operation. Hand wheel shall be made of malleable iron with arms and rims of adequate strength. The hand wheel of diameters 300 mm or less shall be provided with handles for ease of operation. The pulling force required on the hand wheel rim shall not exceed 25 Kgf when operating the valve under full flow and operating pressure. Valves-350 Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same. Valves-350 Nb and above shall also be provided with gear operator arrangement suitable for manual operation. Manual operation of valve shall be through worm and gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction. Limit and torque switches (if applicable) shall be enclosed in water tight enclosures along with suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.
- b. Material of Construction (Butterfly Valves)
- Materials and other design details shall be as indicated below:
- i. Cast Iron Butterfly valves

Body & Disc	ASTM A48, Gr. 40 with 2% Ni/IS: 210. Gr. FG-260, with 2% Ni and epoxy coated
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Shaft	BS 970 431 S: 291/EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.
Seat ring	18-8 Stainless steel
Seal	Nitrile Rubber
Companion Flanges	IS 2062
External hardware	SS 316
Internal hardware	SS 316

- ii. Duplex Stainless Steel Butterfly valves (All Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water (Sea water) etc.)

Body & Disc	SS 316 L
Shaft	SS 316 L.
Seat ring	SS 316 L
Seal	Nitrile Rubber
Companion Flanges	SS 316 L
External hardware	SS 316 L
Internal hardware	SS 316 L

- iii. Stainless Steel Butterfly Valves

Body & Disc	ASTM A 351, Gr. CF8M/ASTM-A-182-Gr. 304
Shaft	ASTM A 182, Gr. 316/ASTM-A-479 Gr. 316/Equivalent
Disc & Seat ring	EPT/BUNA-N/Neoprene
Companion Flanges	SS 304
External hardware	SS 316
Internal hardware	SS 316

- iv. Carbon Steel Butterfly Valve

Body & Disc	ASTM A 216, Gr. WCB
Shaft	ASTM A 182, Gr. 304/ASTM-A-479 Gr. 304/Equivalent
Disc & Seat ring	EPT/BUNA-N/Neoprene



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Companion Flanges	IS 2062
External hardware	SS 316
Internal hardware	SS 316

c. Proof of Design Test (Type Test) for Butterfly Valves

Proof of Design (POD) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual POD test shall be conducted by the bidder in the presence of Employer's representative. All valves that are designed and manufactured as per AWWA-C-504 shall be governed by the relevant clauses of POD test in AWWA-C-504. For Butterfly valves designed and manufactured to EN-593 or equivalent, the POD test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of POD test of AWWA-C-504.

2.1.6.2.20 MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)

a. The materials shall generally comply with the following:

i. Cast Steel Valves

Body & bonnet	ASTM A 216 Gr. WCB/ASTM A 105
Disc for non-return Valves	ASTM A 216 Gr. WCB/ASTM A 105
Trim.	ASTM A 182 Gr. F6 or Equivalent
Companion Flanges	IS 2062
External hardware	SS 316
Internal hardware	SS 316
Internal hardware	SS 316

ii. Stainless Steel Valves

Body & bonnet	ASTM A 351 Gr. CF 8M/ASTM A 182 Gr. 304
Disc	-
Trim.	ASTM 182 Gr. F. 316 /ASTM-A-479 Gr. 316 or Integral with body
Companion Flanges	SS 304
External hardware	SS 316
Internal hardware	SS 316

iii. Cast Iron Valves

Body & bonnet 260	BS 1452 Gr. 14/IS-210 Gr. FG
Seating surfaces and rings	13% chromium steel/13% Chrome overlay
Disc for non-return valves	BS 1452 Gr. 14/IS-210 Gr FG 260



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Hinge pin for non-return valves	AISI 316
Stem for gate globe valves	13% chromium steel or Equivalent
Back Seat	13% chromium steel / 13% Chrome overlay
Companion Flanges	IS 2062
External hardware	SS 316
Internal hardware	SS 316

iv. Gun Metal Valves

v.

Body & bonnet	IS 318 Gr. 2/Equivalent Standard
Trim.	-
Companion Flanges	IS 2062
External hardware	SS 316
Internal hardware	SS 316

vi. Duplex Stainless Steel (All Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc)

Body & bonnet	SS 316 L
Disc for non-return	SS 316 L
Stem	SS 316 L
Trim.	SS 316 L
Companion Flanges	SS 316 L
External hardware	SS 316 L
Internal hardware	SS 316 L

b. Cast iron body valves shall have high alloy steel stem and seat.

c. Material for counter flanges shall be the same as for the piping except for sea water application.

2.1.6.2.21 Float Operated Valves

a. Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.

b. Design and Construction Features

The following design and construction feature of the valve shall be the minimum acceptable.

- Valves shall be right-angled or globe pattern.
- Valves shall be balance piston type with float ball.
- Leather liner shall not be provided.
- The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or Is: 210 Grade 200 or equivalent, and float shall be of copper with epoxy painting of two (2) coats. For all sea water applications the complete valve shall be SS 316 L construction.
- Valves shall be suitable for flow velocities of 2 to 2.5m/sec.



- vi. The valves shall have flanged connections.

2.1.6.2.22 Painting of valves

Two (2) coats of primer followed by three (3) coats of epoxy of approved colour code/shade (usually same as that of connected piping) shall be applied to all exposed surfaces except stainless steel surface, Galvanized steel surface and gun metal surface at shop as required to prevent corrosion, before dispatch. The use of grease/oil other than light grade mineral oil, for corrosion protection is prohibited. The total DFT of painting shall be 150 micron (minimum). If during transport, unloading/unpacking or erection at site any part of the painted surface gets damaged, the same shall be made good by the Bidder by repainting with compatible painting primer and enamel to the satisfaction of the project manager.

2.1.6.2.23 Rubber Expansion Joints

- a. All parts of expansion joints shall be suitably designed for all stresses that may occur during continuous operation and for any additional stresses that may occur during installation and also during transient condition.
- b. The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.
- c. The tube (i.e. inner cover) and the cover (outer) shall be made of natural or synthetic rubber of adequate hardness. The shore hardness shall not be less than 60 deg. A for outer and 50 deg. A for inner cover.
- d. The carcass between the tube and the cover shall be made of high quality cotton duck, preferably, square woven to provide equal strength in both directions of the weave. The fabric plies shall be impregnated with age resistant rubber or synthetic compound and laminated into a unit.
- e. Reinforcement, consisting of solid metal rings embedded in carcass shall be provided.
- f. Expansion joints shall be complete with stretcher bolt assembly. The expansion joints shall be suitable to absorb piping movements and accommodate mismatch between pipelines.
- g. The expansion joints shall be of heavy duty construction made of high grade abrasion-resistant natural or synthetic rubber compound. The basic fabric for the 'duck' shall be either a superior quality braided cotton or synthetic fibre having maximum flexibility and non-set characteristic.
- h. The expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.
- i. All expansion joints shall be provided with stainless steel retaining rings for DM water application and IS 2062 Gr. B galvanized steel retaining rings for ordinary water for use on the inner face of the rubber flanges, to prevent any possibility of damage to the rubber when the bolts are tightened. These rings shall be split and beveled type for easy installation and replacement and shall be drilled to match the drilling on the end rubber flanges and shall be in two or more pieces.
- j. The expansion joints shall have integral fabric reinforced full-face rubber flanges. The bolt on one flange shall have no eccentricity in relation to the corresponding bolt hole on the flange on the other face. The end rubber flanges shall be drilled to suit the companion pipe flanges.
- k. All exposed surfaces of the expansion joint shall be given a 3 mm thick coating of neoprene. This surface shall be reasonably uniform and free from any blisters, porosity and other surface defects.
- l. Each control unit shall consist of two (2) numbers of triangular stretcher bolt plates, a stretcher bolt with washers, nuts, and lock nuts. Each plate shall be drilled with three holes, two for fixing the plate on to the companion steel flange and the third for fixing the stretcher bolt.



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- m. Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.
- n. Bidder to note that any metallic part which comes in contact with DM / Corrosive water shall be of stainless steel material.
- o. For all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc. the bolts & nuts, stretcher plates and companion flanges shall be SS 316 L.

2.1.6.2.24 STRAINERS

a. Simplex type

The strainers shall be basket type and of simplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe lines. The strainer element shall be 20 mesh. Pressure drop across the strainers in new condition fitted with a removable plug. The material of construction of various parts shall be as follows:

1	Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/ -Body: AISI 316 or equivalent) SS 316 L (all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc)
2	Strainer Element	Stainless steel (AISI 316) SS 316 L (all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc)
3	End connection	Screwed upto 50 mm Nb, and flanged above 50 mm Nb

b. Duplex type

- i. The strainers shall be basket type and of duplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe. The mesh of strainer element shall be commensurate with the actual service required. Pressure drop across the strainer in new condition shall not exceed 4.0 MWC at full flow.
- ii. Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows.

1	Body	IS: 318, Gr. 2 Up to 50 mm Nb, and IS:210, Gr. FG 260 of ASTM-A-515 Gr. 75/IS-2062 Gr. B and internally epoxy-painted above 50 NB.SS 316 L (all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc.)
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2	Strainer element	Stainless steel (AISI 316)/ SS 316 L (all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc)
3	End connection	Screwed up to 50 mm NB, and Flanged above 50 NB. Gasket shall be of full face type

- iii. The strainer will have a permanent stainless steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data.
 - iv. The size of the strainer and the flow direction will be indicated on the strainer body casting.
 - v. Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100% clogged condition exerting shut-off pressure on the element.
- c. Three shop coats of paint preceded by two coats of primer shall be applied to all exposed surfaces as required to prevent corrosion. All parts shall be adequately protected for rust prevention. The use of grease or oil other than light grade mineral oils for corrosion protection is prohibited.



CHAPTER 8

PAINTING

1.0 SCOPE

This section defines the technical requirements for surface preparation, selection and application of paints on equipment, vessels, machinery, piping, ducts etc. However, manufacturers shall follow their standard procedures for painting their equipment. The bidder shall submit a detailed painting procedure for approval of owner/ owner's representative after the award of contract.

The following surface and material shall require painting:

- All un-insulated carbon steel and alloy steel equipment like columns, vessels, storage tanks, pumps, heat exchangers etc.
- All un-insulated carbon steel and low alloy piping, fitting and valves (including painting of identification marks).
- All pipe structural steel supports, walkways, platforms, handrails, ladders etc.

The following surfaces and materials shall not require painting:

- Non-ferrous materials
- Austenitic stainless steel
- Plastic and / or plastic coated materials
- Insulated surface of equipment and pipes except colour coating wherever required.
- Painted equipment like blowers, pumps, valves etc. with finishing coats in good condition and with matching colour code.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job:

IS:5	Colours for ready mixed paints and enamel
IS:1303	Glossary of terms relating to paints
IS:2379	Colour code for identification of pipelines
IS:1477	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524 :	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS:2074	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	Ready mixed paint, brushing, Zinc Chrome, priming



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IS:2932	Enamel Synthetic exterior (a) Undercoating (b) finishing
IS:4682	Code of practice for lining of vessels & equipment
SIS 559000	Swedish standard for blasting
ISO 8504-2	Preparation of steel substrates before application of paints and related products. Surface preparation methods Part 2 Abrasive blast cleaning
ISO 8501-1	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
SIS 05 5800	Surface preparation by acid pickling
SSPC SP08	Surface preparation by acid pickling
IS 2629	Recommended practice for hot dip galvanizing of iron and steel
ASTM A780	Standard practice for repair of damaged galvanized coatings
SSPC	Steel structures painting council
NACE	National association of Corrosion Engineers
DIN	Deutsehes Institute for Normung
BS	British Standard
ASTM	American Society for Testing material
AWWA	American Water works association

3.0 SURFACE PREPARATION

The surface shall be prepared in a manner suitable for coatings. Chemical derusters or rust converters shall not be applied. Acid cleaning is subject to approval of Purchaser/ Purchaser's representative.

3.1 BLASTING

The surface of the part/ component shall be blasted before the coating material is applied. Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air above 1100°C. Blasting activity shall be performed at temperatures 30°C above dew point and substrate temperature between 50°C & 500°C and relative humidity not exceeding 85% shall be maintained during painting. Necessary safety precautions for equipment and operator shall be adhered to and shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work. Abrasive used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives are chilled iron grit, shot steel, malleable iron grit and shots of non-metallic abrasive (aluminium oxide, copper slag, garnet etc.).

The grade of blasting shall be performed in line with the approved painting scheme. The nature, quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the required surface profile depth and cleanliness. Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and



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commencement of painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

The grades of surface finish

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial Blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting

- a. Blasting according to SIS 055900, Grade Sa 2½
- b. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer coat shall be 15-25 µm.

3.2 Manual Rust Removal

Manual rust removal shall be allowed for welded zones and for touching up installed components.

3.3 Cleaning

Removal of impurity

Impurity	Removal
Dust, Loose deposits	Vacuum cleaning, brushing
Adhesive deposits	Power brushing
Oils, greasy impurities	Wet Blasting, Use of Detergent Additives by agreement
Salt deposits	Rinsing
Markings (eg felt up pen)	Organic solvents to manufacturer's specifications eg Trichloro trifluoro ethane and solvents containing acetone (renew solvent and rag frequently)

3.4 Acid Pickling

Prior to galvanizing the surface preparation shall be done by acid pickling as per SSPC-SP-08.

4.0 PROCESSING

4.1. General Application Conditions

The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature °C shall be + 5 and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3°C above dew point.



4.2. Application Procedure

The primer shall be applied by means of brush or by spary. The top coats shall be applied by means of brush, roller or spray.

At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed.

4.3. Touching Up

Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning according coating manufacturer's specification. The final top shall be reapplies completely.

4.4. Uncoated Surfaces

Moving parts of machines (e.g stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating up to a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.

4.5. Bond Strength

The pill off stress determined using the pull off test method for adhesion shall not be less than 1.5 N/mm², according to ISO 4624.

5.0 SURFACE CONDITIONS OF COATING SURFACES

The coating surface shall have a uniform film thickness, shade and gloss and shall be free from inclusions, sags and wrinkles.

6.0 COATING SYSTEMS

6.1 General Requirements for Coating Systems

Coating materials according to SSPC, BS 5493 or DIN 55 928 shall be used. Intermediate coats are to be pigmented with micaceous iron oxide. The materials shall be matched with each other so that they are compatible. Coatings deviating this specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.

The colour and gloss of top coats shall be in accordance with sub clause suggested colour codes for painting (Sub Clause 6.8)

6.2 Standard Coating System (External Coatings)

(a) Steel Surfaces

- i. All steel structures shall receive two primer coats and two sandwich coat of MIO Epoxy paint and one finish coat of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two intermediate coats and one finished coat shall also be applied after erection.
- ii. Steel surface which is to be painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The



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surface shall be abrasive blasted as explained in clause 3.1 to Sa 2½ finish as per SIS05-5900. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer shall be 60 microns.

- iii. Two intermediate MIO Epoxy paint, and one top polyurethane coating of approved brand shall be applied. Dry film thickness of each intermediate coat shall be 90 microns and top polyurethane coating shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 330 microns. All paints shall be of approved brand and shade as per owner's requirement.
- iv. Joints to be site welded shall have weldable primer applied within 100 mm of welding zone. Similarly where friction grip fasteners are to be used removable anti corrosive coating shall be provided. On completion of the joint the surfaces shall receive the paint as specified.
- v. Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams, supporting gratings or chequered plate shall receive one additional coat of finish paint over the above number of coats specified before erection. Portion of steel member embedded/ to be encased in concrete shall not be painted.

(b) Gratings and Step Threads

- i. Surface Preparation
Gratings and step threads shall be cleared by acid pickling as per SSPC-SP-08
- ii. Hot Dip galvanizing
The hot dip galvanizing shall be done as per IS 2629. The average mass of coating shall be 610 gm/m²
- iii. Post Treatment
Immediately after galvanizing post treatment such as chromating shall be applied to retard white rust attack.
- iv. Touch up mechanical damages
The repair of damages coatings shall be done as per the recommended practice ASTM A780.

6.3 Painting of Indoor components such as valves, pumps, motors, electrical parts, tanks etc.

At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry film thickness 75µm.



At Site

Thorough cleaning to remove oil, grease, dirt and any other contaminants. Derusting of all mechanical damages according to SIS 055900 Grade ST3. Touch up with dry film thickness 50 µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 30-40 microns DFT each coat in approved shades.

Remarks

Equipment coated with a standard application system can be accepted if the quality of this application system is corresponding with the quality of the above mentioned system.

6.4 Painting of Outdoor equipment (external surfaces) such as piping, valves, pumps, motors, electrical parts, tanks etc.

Weather exposure, weather resistance, temperature up to 120°C as per clause 6.1 & 6.3.

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry film thickness 75µm.

Intermediate Coat

One (1) layer 2 pack high build epoxy polyamide MIO, DFT 100µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 50 microns DFT each coat in approved shades.

6.5 Special Coating

(a) Parts exposed to temperatures above 120°C, up to 200°C, not insulated

i. **At Works**

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½ and ISO 8501-1:1958. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm.

ii. **At Site**

Pre-treatment

Derusting of all mechanical damages, according to ISO 8501-1:1989, grade St 3 touch up with 1 pack inorganic ethyl zinc silicate, dry film thickness 50µm.



Intermediate Coat

1 pack silicon acrylic dry film thickness 35 µm.

Final Coat

1 pack silicon acrylic, dry film thickness as 35µm. Total system dry film thickness 145µm. Final coat according to colour code

- (b) Parts exposed to temperatures above 200°C, up to 400°C, not insulated

i. **At Works**

Surface Preparation

Blasting according to ISO 8501-1:1958 grade Sa-2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm.

ii. **At Site**

Pre-treatment

Derusting of all mechanical damages, according to standard Sa 2½ to ISO 8501-1:1988. Touch up with coating system according to manufacturer's recommendations.

- (c) Insulated parts continuously exposed to condensing water or parts exposed to temperatures For parts that are provided with insulation on site.

i. **Insulated parts exposed to condensing water**

At Works

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm

ii. **Insulated parts exposed to temperatures**

Parts exposed to temperatures up to < 400°C

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used. Parts exposed to temperature above 400°C at works (Steam pipes, pressure tubes and parts for the HRSG, such as heating surfaces, heaters and superheaters, reheaters etc)

Temporary Primer

Varnish



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(d) Intermittent exposure due to condensing water/ chemicals (Indoors)

(i) **At Works**

Surface Preparation

Blasting according to Sa 2½ and ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two layers of Zinc phosphate primer, total dry film thickness 75µm.

(ii) **At Site**

Pre-treatment

Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 50µm. Total system dry film thickness 205µm. When exposed o weathering, weather resistance finish coat shall be applied.

(e) Water Exposure

i. **At Site/ Works**

Pre-treatment

Removal of all welding pearls. Blasting according to Sa 3 to ISO 8501-1:1988

Coat

4 coats 2 pack coal tar epoxy, dry film thickness 125 µm each. Total system dry film thickness 500µm Touch up after erection as required.

6.6 Painting of Pipes

6.6.1. Buried Piping

Internal surfaces

- i. Surface cleaning by sand blasting.
- ii. Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- iii. Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note: All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.



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Tests to be carried out after application : Bond/ Adhesion test, Holiday test

External surfaces

- i. Surface cleaning by Sand Blasting.
- ii. Coal tar primer compatible with coal tar enamel grade. The number of coats shall be two with a DFT of 35 microns each.
- iii. Coal tar enamel shall be applied. A single spiral inner wrap of glass fibre tissues shall be applied overlapping at least 25 mm ensuring impregnation of glass fibre tissues in the first coat. The second coat of enamel and second outer wrap of glass fibre felt, Type – I to IS: 7193-1974 will be applied in the same way confirming to Table – 10 of IS – 10221 – 1982. The total thickness of the coating will not be less than 4.0 mm
- iv. Alternatively Wrapping with coal tar based anticorrosion tape conforming to IS 15337: 2003 is also acceptable in lieu of s.no. (iii) above. Wrapping thickness shall be 4.0 mm. Tests to be carried out after application: Bond/ Adhesion test, Holiday test

6.6.2. Overground Piping

Internal surfaces

- i. Surface cleaning by sand blasting.
- ii. Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- iii. Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns. The total dry film thickness of 150 microns.
Note: All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

External surfaces

- i. Surface cleaning by Sand Blasting.
- ii. Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- iii. Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

6.7 Internal Coatings

6.7.1. Tanks (Internal surfaces) as specified in relevant sections of specification

Industrial deionised, demineralised and potable water up to 60°C pH range 4.5-9.5 Blasting according to Sa 2½ and ISO 8501-1:1988.

Prime Coat

Two layers of Zinc phosphate epoxy primer, total dry film thickness >75µm.

Pre-treatment



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Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501- 1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 150µm per coat. In case of service or potable water tanks, the coating material selected shall not taint the water. The paint system shall confirm to regulations issued by Food & drug administration/ National Public Health service/ AWWA/ OSHA and comply with applicable laws, regulations, ordinances etc. of the local authority, state or the nation pertains to work. QA/ QC Procedure including pinhole inspection, shall be submitted for approval by Owner/ Owner's representative.

6.7.2. Rubber Lining of Pipes, Valves and Tanks for DM Water

Pre-treatment

Blasting according to Sa 2½ and ISO 8501-1:1988

Rubber Lining

Hard rubber 5 mm for DM water applications as IS – 4682

6.8 Painting for Electrical items

6.8.1. All the steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and swarf by pickling, emulsion cleaning etc. The sheet steel shall be phosphate/ oven dried and then painted with two coats of zinc rich primer paint. After application of the primer, two coats of finishing epoxy paint shall be applied. The colour of the finishing coats inside shall be glossy white and exterior of the treated sheet steel shall be shade 631 of IS-5/ RAL 7032 for all switchboard/ MCC/ Distribution boards, control panels etc.

6.8.2. All electrical equipment shall be given tropical and fungicidal treatment and outdoor equipment shall be provided with rain hood to prevent entry of rain water into the equipment.

6.8.3. Painting of I & C equipment: Epoxy coating required for all I & C equipment.

6.9 SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
1	Structures, platforms, galleries, ladders and handrails	Dark Admiralty Grey	632	-	-
2	Boiler casing, ducting	Nut Brown	413	-	-
3	Crane				
3.1	Crane structure	Golden Yellow	356	Black	-
3.2	Trolley & hook	Crimson	540	-	-



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SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
4	Fans, pumps, motors, compressors	Light Grey	631	-	-
5	Tanks (without insulation and cladding)				
5.1	Outdoor	Aluminium	-	-	-
5.2	Indoor	Light grey	631	-	-
6	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
7	Switchgear	Light grey (Powder coated)		-	-
8	Control & relay panels	Light grey (Powder coated)	631/7078 of IS 1650	-	-
9	Turbines	Light grey	631	-	-
10	Generators & Exciter	Light grey	631	-	-
11	Transformers	Aluminium	-	-	-
12	Machinery guards	Signal red	537	-	-
13	Piping (without insulation and cladding)				
13.1	Water System				
a	Boiler feed	Sea Green	217	-	-
b	Condensate	Sea Green	217	Light Brown	410
c	DM Water	Sea Green	217	Light Orange	557
d	Soft Water	Sea Green	217	French Blue	166
e	Bearing Cooling Water	Sea Green	217	French Blue	166
f	Potable & filtered Water	Sea Green	217	French Blue	166
g	Service and clarified water	Sea Green	217	French Blue	166
h	Cooling water	Sea Green	217	French Blue	166
i	Sea Water	Sea Green	217	White	-
14	Ash Transmitting Vessels and pipe lines	Aluminium	-	-	
15	Air System				
15.1	Station air	Sky blue	101	-	-
15.2	Control air	Sky blue	101	White	-



**1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III**



EPC TENDER SPECIFICATION FOR BTG PACKAGE

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
16	Oil system				
16.1	Fuel oil	Light brown	410	French	166
16.2	Light oil (HSD)	Light brown	410	Brilliant green	221
16.3	Lubricating oil	Light brown	410	Light grey	631
16.4	Transformer oil	Light brown	410	Light orange	557
17	Gas System				
17.1	Carbon dioxide	Canary yellow	309	Light grey	631
17.2	Hydrogen	Canary yellow	309	Signal red	537
18	Fire services	Fire red	536	-	-
19	Effluent pipes	Black	-	-	-
20	Vacuum pipes	Sky blue	101	Black	-

Notes:

1. This colour code basically refers to IS: 2379 for piping with necessary modifications
2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

Bidder shall furnish his painting specification to suit corrosive atmosphere of coastal area along with the bid. The specification shall in general be in line with the above requirements.

~~Rolling shutter with area up to 9 sq.m shall be push and pull type manually operated while for area above 9 sq.m. Rolling shutter will be mechanically / electrically operated, as per IS specifications.~~

P. Hand Railing

- a) Minimum 1000 mm high (from floor/ roof level) hand railing shall be provided around all floor/roof openings, projections/balconies, walkways, platforms, steel stairs, etc. All handrails and ladder pipes shall be 50 mm nominal bore MS pipes (medium class) conforming to IS: 1161.
- b) Spacing of handrail post shall be limited to 1200 mm as far as possible but can be adjusted to suit the length of railing.
- c) For RCC stairs, except service building and around all floor openings, 1000 mm high hand railing with 32 NB (polished) stainless steel pipe shall be provided.

Q. Lifts and Elevators

Refer Volume II, Section 2, Part 2.1.

R. Roof Drainage

The system shall be provided for removal of rainwater from roof surface without over flow to avoid damage to the roof structure of all buildings and shall consist of the following

- a) Roof drain heads
- b) Rain water down comers
- c) Fixture

Multiple drains (minimum 2 No's) shall be provided for all roof areas. The roof drain shall be sized for the roof run off for a maximum rainfall per hour at site. Minimum 100 mm dia pipe shall be provided to drain out 40 sq.m of roof surface area and minimum 150 mm dia pipe to drain out 80 sq.m of roof surface area.

Rain water down take pipes and fitting shall be of PVC with sockets free from cracks and flaws. The pipe and fittings shall be fixed perfectly vertical, secured to wall or column with flat headed nails.

S. Parapets

Parapets shall be provided to all RCC roofs. Parapets wall shall be 600 mm high for inaccessible roofs and 1000 mm high for accessible roofs. 100 mm thick concrete parapet will be provided unless otherwise mentioned.

T. Paving

RCC paving minimum 150 mm thick of M20 over an under bed as specified here in shall be provided. RCC paving shall be designed as rigid reinforced concrete pavements for the crane / vehicular / equipment movement loads which the paving has to bear. The under bed for



TITLE
1x800 MW TANGEDCO NORTH CHENNAI TPP
FUEL OIL HANDLINGS SYSTEM &
MISCELLANEOUS TANKS

SPECIFICATION NO. PE-TS-423-166-A101

REV 00

Section -I Date 02.02.2017

Page 1 of 1

SPECIFIC TECHNICAL REQUIREMENTS

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IE- Specific Technical Requirement (C&I)

TANGEDCO

1X800 MW NORTH CHENNAI TPP STAGE III IN THE PREMISES OF EXISTING NCTPS TAMILNADU, INDIA

C&I TECHNICAL SPECIFICATION FOR FUEL OIL HANDLING



BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT DIVISION
NOIDA, INDIA

PREPARED BY: SEEMA KHATRI/ Dy Mgr. (C & I)	CHECKED BY: SURESH CHAND SHARMA Sr. Mgr. (C & I)	APPROVED BY: SURESH CHAND SHARMA Sr. Mgr. (C & I)
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TABLE OF CONTENT

- A. Specific Technical requirements
- B. List of deliverables
- C. Specification for motorized valve actuator
- D. Specification for field instruments
- E. Specification for Quality assurance & Testing
- F. Mandatory spares
- G. Vendor List

SPECIFIC TECHNICAL REQUIREMENT

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Specific Technical Requirements

- 1.1 The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- 1.2 Drawings/Documents and data to be furnished after award of the contract as per deliverables list.
- 1.3 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 under the scope of specification shall be provided. The necessary root valves, impulse piping, drain cock, 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. 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 tapping where the pressure exceeds 40 Kg / Cm².
- 1.4 All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC article 500, class 1, Division 1 area & flame proof) and an anticorrosive paint shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange shall also be included wherever required with the field instruments.
- 1.5 Components of instruments, control devices, accessories, piping etc. Which contact with steam, condensate or boiler feed water shall be manufactured from copper free materials which do not react with media at operating parameters.
- 1.6 All wetted parts of instrument shall be suitable for sea water application (Duplex stainless steel or better) if applicable. Instruments, fittings, valves etc. shall be suitable for the hazardous area application.

- 1.7 Painting of I & C equipment: Epoxy coating required for all I & C equipment.
- 1.8 All valve actuator shall be provided with conventional actuators with integral starter for ON/OFF valves. Non-contact type electronic 2-wire position transmitters shall be provided for all inching type motorised valves and dampers. The detailed specification of actuator is given in detail as below.
- 1.9 All motorised valves of 200NB or more than 200NB size shall be provided with integral motorized bypass valves on all process lines.
- 1.10 DPG, DPT & DPS, if applicable across the filters/strainers.
- 1.11 All Field Instruments used in acid or alkaline atmosphere shall be with standard Anti corrosion coating i.e. the combination of Polyurethane and epoxy resin baked coating (ANSI/ISA-71.04).
- 1.12 All the instruments/equipments/electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply.
- 1.13 All primary instruments installed at “Minus level or Floor” shall be with protection class of IP 68.
- 1.14 All field mounted push button, selector switch etc. shall be as per IEC or NEMA 4X protection.
- 1.15 All limit switch shall be conform to IEC-60947-5-1 and shall have minimum 2SPDT/DPDT contacts.
- 1.16 Each switching element including the limit and torque switches of valve actuators shall be provided with minimum two contacts i.e. 2SPDT OR DPDT.
- 1.17 All instruments should be supplied with valid calibration and test certificates provided by OEM. All transmitters shall be HART compatible.
- 1.18 Canopy/Enclosure shall be provided for field instruments like transmitters, switches & flow meters, etc and any other equipment to protect from direct sun light, lightning & rain.
- 1.19 For plug in type instruments, the plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections.

- 1.20 Signal/Electrical connection shall be screwed connection with double compression type Nickel-plated brass cable glands for Explosion proof area, Flame proof area and high vibration prone area.
- 1.21 These requirements are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement 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.

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LIST OF DOCUMENTS/DELIVERABLES

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C&I DELIVERABLES LIST

C&I DELIVERABLES LIST FOR FO HANDLING		
SI.No	DRAWING NO.	DRAWING/DOCUMENT TITLE
INSTRUMENTATION		
1	PE-V9-423-165-I901A	INSTRUMENT DATA SHEETS
2	PE-V9-423-165-I902A	BOQ
3	PE-V9-423-165-I903A	INSTRUMENT QP / CHECK LIST

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ACTUATORS

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	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-SS-423-145-I007	
			VOLUME II B	
			SECTION D	
			REV. NO. 00	DATE: 05.10.16
			SHEET 1 OF 3	
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL*	* PROJECT	1x 800 MW NORTH CHENNAI PROJECT		
	OFFER REFERENCE			
	* TAG NO. SERVICE			
	* DUTY	☒ ON / OFF ☒ INCHING		
	* LINE SIZE (inlet/outlet): MATERIAL			
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY		
	* OPENING / CLOSING TIME			
	* WORKING PRESSURE			
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%		
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY		
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:68		
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL		
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.		
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.		
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.		
HANDWHEEL	* REQUIRED	☒ YES ☐ NO		
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED		
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.			
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY		
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY		
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF I.S. TOLERANCE		
	ACTUATOR APPLICABLE WIRING DIAGRAM	☒ ENCLOSED (BIDDER TO CONFIRM) A: ☒ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram		
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐		
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☐ EPOXY ☐		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY		
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V		

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-SS-423-145-I007				
			VOLUME II B				
			SECTION D				
			REV. NO.	00	DATE: 05.10.16		
		SHEET	2 OF	3			
Data Sheet A & B							
DATA SHEET-A (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)			
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 68 ☐ FLAME PROOF					
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B					
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☐					
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED					
INTEGRAL STARTER	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED					
	TYPE OF SWITCHING DEVICE	☒ CONTACTORS ☐ THYRISTORS					
	TYPE	☒ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)					
	IF SMART						
	a) SERIAL LINK INTERFACE			☐ INTEGRAL ☐ FIELD MOUNTED			
	b) SERIAL LINK PROTOCOL			☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐			
	c) SERIAL LINK MEDIA			☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC			
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED					
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐					
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED					
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP					
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED					
	STEP DOWN CONT. TRANSFORMER	☒ REQUIRED					
	OPEN / CLOSE PB	☒ REQUIRED ☐ NOT REQUIRED					
	STOP PB	☒ REQUIRED ☐ NOT REQUIRED					
	INDICATING LAMPS	☒ REQUIRED ☐ NOT REQUIRED					
	LOCAL REMOTE S/S	☒ REQUIRED ☐ NOT REQUIRED					
	STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED					
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL or OFF MODE/STOP PB OPTD, TORQUE SWITCH OPTD. MID WAY/MOTOR THERMOSTAT TRIP)					
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☒ OPTO COUPLER ☐ EITHER					
	QUANTITY	☐ 2 NOs. ☐ 3 NOs.					
	DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC					
	DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX					
	LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms					
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY					
	OPEN / CLOSE	☒ 1 No. ☐ 2Nos. / ☒ 1 No. ☐ 2Nos					
	CONTACT TYPE	2 NO + 2 NC					
	RATING	5A 240V AC AND 0.5A 220V DC					
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE					
	ACCURACY	+3% OF SET VALUE					
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY					
	OPEN : INT : CLOSE	☐ 1 No ☒ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☒ 2Nos.			
	CONTACT TYPE	2 NO + 2 NC					
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC					

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.: PE-SS-423-145-I007	
		VOLUME II B	
		SECTION D	
		REV. NO. 00	DATE: 05.10.16
		SHEET 3 OF 3	
Data Sheet A & B			
DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	☒ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☒ ELECTRONIC (2 WIRE) R/I CONVERTER ☐ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	☒ 24V DC ☐	
	OUTPUT	☒ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC, 1 PH., 50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☒ IP 68 @ ☐	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET (9 PIN) (FOR COMM, LS/TS FEED BACK, PoT)	☐ REQUIRED ☒ NOT REQUIRED ☐ 2 NOS. ☐	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE: suitable for 3Cx2.5sq mm for motor rating 3.7 kW, 3Cx10 sq mm fr motor from 3.7 kW to 5.5 kW.	
	@ SPACE HEATER CABLE GLAND	SIZE:-Space heater cable gland to be derived internally.	
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP (Cable size 2Px1.5mm ²)	
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :----- (8Px0.5 sq mm)----- -	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

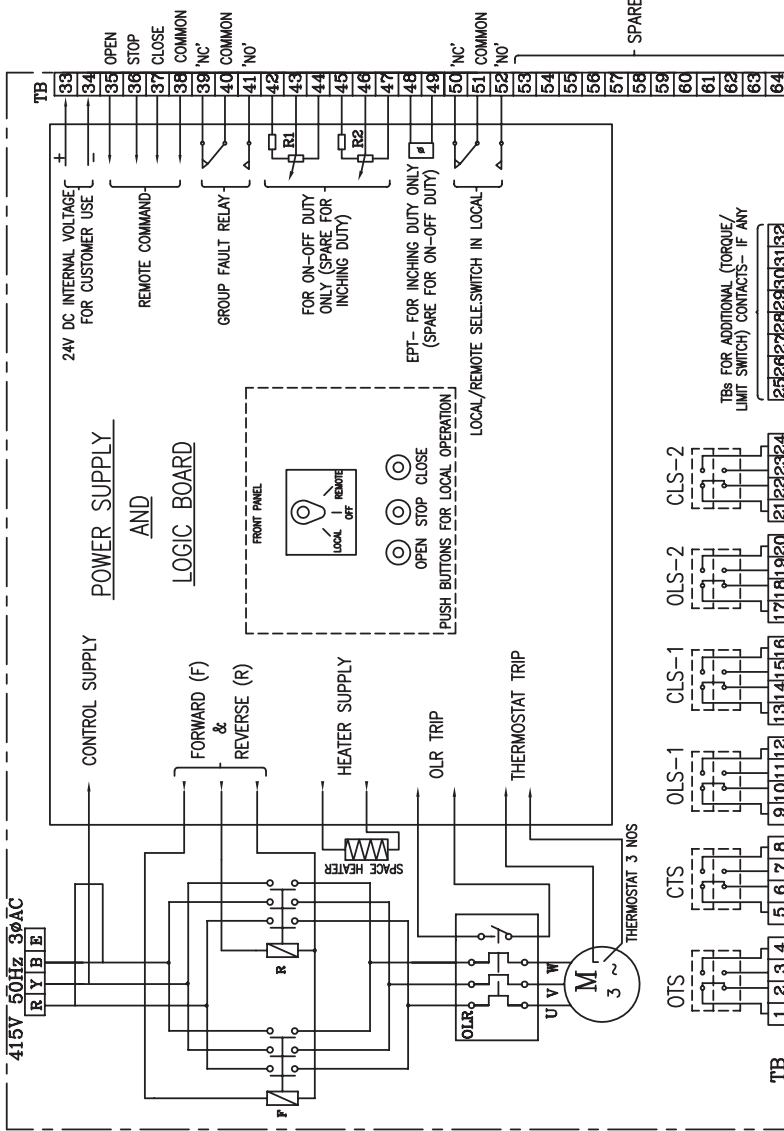
NOTES:

- SCOPE:** DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
 - CODES & STANDARDS:** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
 - TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
 - CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
 - THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
 - THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
 - THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
- \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.**
- ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.**

NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
	SEEMA KHATRI	SURESH CHAND SHARMA	SURESH CHAND SHARMA	NAME
	05.10.2016 05.	10.2016	05.10.2016	SIGNATURE
	05.10.2016 05.	10.2016	05.10.2016	DATE

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ES

DRAWING NO. 3-V-MISC-24227



SWITCH TERMINALS FOR CUSTOMER USE

- NOTE:-
1. ALL TORQUE AND LIMIT SWITCHES (OTS, CTS, OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE. ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
 2. CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
 3. OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
 4. OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
 5. CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
 6. EPT - ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
 7. R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
 8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
 9. M - MOTOR 3Ø 415V 50 Hz AC SUPPLY

CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	OPEN
	11-12	STOP
CLS-1	13-14	CLOSE
	15-16	COMMON
OLS-2	17-18	OPEN
	19-20	STOP
CLS-2	21-22	CLOSE
	23-24	COMMON
SWITCH NO.	TERMINAL NO.	INTERMEDIATE POSITION
	a	b
FULL OPEN	FULL CLOSE	FULL CLOSE

INDICATES CONTACT CLOSED
INDICATES CONTACT OPEN

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH					
VALVES	OPEN		CLOSE		#
	MAIN	BACK UP	MAIN	BACK UP	
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS	
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS		
# – CLS NOT TO BE CONNECTED IN TRIP CIRCUIT					
* – BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)					

TYPE OF PRODUCT ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS
OR NAME OF CUSTOMER/PROJECT (DRAWN FOR INTERMEDIATE POSITION OF VALVES)



BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT,
TRUCHIRAPALLI-620014.

DRN	N.P.ESWAR	SIGN	N.P.	DATE	07.10.04
CHD	D.DINAKARAN	SIGN	D.D.	DATE	07.10.04
APPD	KARUNACHALAM	SIGN	K.A.	DATE	07.10.04

REFERENCE INFORMATION

DEPT	VL	SCALE	WEIGHT (KG)	NO. OF TUBES
CODE				

WIRING DIAGRAM (TERMINAL PLAN)

DRAWING NO. 3-V-MISC-24227

FOR ACTUATOR WITH INTEGRAL STARTER



EPC TENDER SPECIFICATION FOR BTG PACKAGE

2.2.13 ACTUATORS

2.2.13.1 SCOPE

This Specification covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.2.13.2 CODES & STANDARDS

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and / or supplemented by this specification.

Code	Name of standard
IS: 325	Specification for three phase induction motor
IS: 900	Code of Practice for installation and maintenance of induction motors.
IS: 996	Single Phase AC Motor
IS: 1271	Thermal evaluation and classification of electrical insulation.
IS:2223	Dimensions of flange mounted AC induction motors.
IS: 3043	Code of practice for earthing
IS: 4029	Guide for testing three phase induction motors.
IS: 4691	Degree of protection for enclosures of rotating electrical machinery.
IS: 4722	Specification for rotating electrical machinery.
IS: 4728	Terminal marking and direction of rotation for rotating electrical machinery.
IS: 4889	Methods of determination of efficiency of rotating electrical machines.
IS: 5571	Guide for selection of electrical equipment for hazardous areas.
IS:6362	Designation of Method of Cooling of Rotating electrical machines.
IS: 8789	Values of performance characteristics for three phase



EPC TENDER SPECIFICATION FOR BTG PACKAGE

	induction motors.
IS: 9334	Electrical Motor Operated Actuators
IS: 12065	Noise level of motors.
IS: 12075	Measurement and evaluation of vibration of rotating electrical machines.
IS: 12615	Induction motors-Energy efficient, three-phase, squirrel cage – Specification
IS: 12802	Temperature rise measurement of rotating electrical machines.
IS: 12824	Type of duty and classes of rating assigned.
IEC: 60034-1	Rotating electrical machines
NEMA, MG-1	Motors and Generators

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be furnished during detail engineering.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

2.2.13.3 General

- The Actuators shall be integral starters along with overload relays with built in SPP (Single Phase Preventer) with provision for operation from Control room, Local and by wireless set.
- The actuator motors shall be suitable for use on 415 Volt 3 phase 50Hz power supply. The actuator comprising motor, integral reversing starter, local control facilities and terminals for remote control and indication shall be housed within a self contained, sealed enclosure.
- Actuator working platforms shall be provided for maintenance purpose.
- Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage/authorized release. In addition, provision shall be made for the protection of configured actuator settings by a means independent access to the commissioning tool.
- For some specific applications, integral starter shall also be separately mountable



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casting type and plug-in. Such applications shall be decided during detail engineering.

2.2.13.4 Actuator Sizing

The actuator shall be sized to guarantee valve closure at the specified differential pressure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. The operating speed shall be such as to give valve closing and opening at approximately 4 to 5 mm per second unless otherwise stated in the job specification. Transient voltage dip on starting of the largest motor with DOL shall be limited to 20% of the nominal system voltage at the voltage terminals.

2.2.13.5 Environmental

Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from 10°C to 50°C, upto 95% relative humidity. Actuators for explosion-hazardous applications shall in addition be certified Flameproof for Zones 1 and 2 (Divisions 1 and 2 Group gases).

2.2.13.6 Enclosure

Actuators shall be 'O' ring sealed, watertight to IP68 degree of protection. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed at site for cabling.

2.2.13.7 SPECIFIC REQUIREMENT

- i) The actuator shall essentially comprise the drive motor, torque/ Position limit switches, gear train, clutch, hand wheel, position indicator and transmitter, inbuilt thermostat for overload protection, space heater and internal wiring. Actuator shall be integral type. Integral starters shall have facility to hook-up with plant DCS for positioning of limit and torque switches.
- ii) The actuator enclosure shall be totally enclosed, dust tight, weather proof (NEMA-6/IP-68) suitable for outdoor use without necessity of any canopy.
- iii) All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- iv) The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.
- v) A lockable local/remote selector switch shall also be provided for selecting mode of operation.



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- vi) Gear Train:-Metal (Fibre gears are not acceptable) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energised.
- vii) Manual Wheel:- Shall disengage automatically during motor operation.
- viii) Duty cycle of actuators shall suit the system requirement. The actuators shall be capable of giving the required torque at the output shaft. The actuators shall be designed to take the full thrust
- ix) The integral starter which shall have sophisticated electronic controls with field programming feature. It shall be designed for remote control from DCS/Respective control system. Required interposing relays for receiving open/close/stop command from DCS/Respective control system shall be provided. Potential free contacts and transducers shall be provided to provide status indication at remote DCS/Respective control system.
- x) A three position selector switch (marked as LOCAL-OFF-REMOTE) and push buttons OPEN-STOP-CLOSE (for local operation) with indication lamps for running OPEN and running CLOSE shall be provided.
- xi) The Remote command signal (OPEN-STOP-CLOSE) from DCS/Respective control system/Control panel shall be isolated from control electronics through opto-isolator.
- xii) The following individual status annunciation LED's (Colour-Green) shall be provided locally (Integral to actuator) to annunciate the following for easy local monitoring.
 - 1. Actuator in local mode
 - 2. Actuator in remote mode
 - 3. Actuator running in OPEN direction
 - 4. Actuator running in CLOSE direction
 - 5. Actuator in inching mode.
 - 6. Actuator in self-retaining mode
 - 7. Limit switch OPEN trip
 - 8. Limit switch CLOSE trip
 - 9. Control voltage availability
- xiii) The following individual fault annunciation LED's (Colour-Red) shall be provided locally. (Integral to Actuator)
 - 1. Torque switch OPEN
 - 2. Torque switch CLOSE
 - 3. Thermo switch trip
 - 4. Electronic overload relay trip
 - 5. Motor single phasing
 - 6. Common fault (Inclusive of any one or combination of above fault)



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- xiv) View port shall be provided on integral starter unit to monitor the above status annunciation and fault annunciation.
- xv) Electronic overload relay shall be provided to trip actuator in case of overload. Plug in connections/design shall be provided between:-
 - 1. Integral starter unit and basic actuator
 - 2. Between external customer connections and actuator
- xvi) OPEN-CLOSE indication /LED shall be provided for indication of full open/close position.
- xvii) Automatic phase correction facility and potential free contact for annunciation of power failure shall be provided.

2.2.13.8 Motor

The electric motor shall be Class F insulated, with a time rating of at least 15 minutes at 50°C or twice the valve stroking time, whichever is more, at an average load of at least 33% of maximum valve torque.

- i) The squirrel cage induction motor shall be designed for full voltage direct-on-line start, with starting current limited to 6 times full-load current. The motor shall be capable of starting at 85% of rated voltage and running at 80% of rated voltage at rated torque and also at 85% of rated voltage at 33% excess rated torque for a period of 5 minutes each. The motors shall otherwise generally conform with technical specification for motors mentioned elsewhere in this specification.
- ii) The actuators shall be sized so as to open or close valves/ dampers at rated speed enclosure shall not be more than 70 degree 'C' over ambient temp. of 70 deg.C as these are subjected to higher ambient conditions due to their vicinity to operate fluid on continuous load operation. The actuators shall be suitable for a relative humidity of 95%. Class of insulation shall be class-F and type of enclosure shall be IP-615.0
- iii) Insulation:- The motor winding shall be insulated with class-F insulation having temperature rise limited to Class-B.
- iv) Performance:-The motor shall be capable of:
 - a) Starting at 85% of rated voltage
 - b) Running at 80% of rated voltage at rated torque for 5 minutes
 - c) Running at 85% rated voltage at 33% excess rated torque for 5 minutes.
- v) Maximum continuous motor rating shall be atleast 10% above the maximum load derived of the driven equipment under entire operating range including voltage & frequency variation.



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Vi) Bearing

The motor bearing shall be double shielded, grease lubricated and antifriction type.

vii) Earthing

At least two earthing terminals shall be provided for the motor body. Separate earthing terminal should be provided for terminal box.

2.2.13.9 Motor Protection

Protection shall be provided for the motor as follows:

- i. The motor shall be de-energized in the event of a stall when attempting to unseat a jammed valve.
- ii. Motor temperature shall be sensed by a thermostat de-energising the motor in case of overheating.
- iii. Lost phase protection.
- iv. Overload protection.
- v. Short circuit protection by suitably rated long acting fuse.

2.2.13.10 Gearing

The actuator gearing shall be totally enclosed in an oil-filled gear casing suitable for operation at any angle. All drive gearing and components must be of metal construction and incorporate a lost-motion hammer blow feature. For rising spindle valves the output shaft shall be hollow to accept a rising stem, and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design should be such as to permit the opening of the gear casing for inspection or disassembling without releasing the stem thrust or taking the valve out of service.

2.2.13.11 Hand Operation

A hand wheel shall be provided for emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to power automatically by starting the motor. The hand wheel or selection lever shall not move on restoration of motor drive. Provision shall be made for the hand/auto selection lever to be locked in both hand and auto positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in hand without damage to the drive train.

The hand wheel drive must be mechanically independent of the motor drive and any hand wheel gearing should be such as to permit emergency manual operation in a



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reasonable time. Clockwise operation of the hand wheel shall give closing movement of the valve unless otherwise stated in the job specification.

2.2.13.12 Drive Bushing

The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. Normally the drive bush shall be positioned in a detachable base of the actuator. Thrust bearings, when housed in a separate thrust base should be of the sealed for life type.

2.2.13.13 Limit Switches

- a) Each motor actuator shall have Six (6) rotary drum position limit switches with two for open each with 2 NO + 2NC contacts and two for close each with 2 NO + 2 NC contacts positions, each with adjustable setting between fully open and fully closed positions. Each rotary drum limit switch shall have two (2) limit switches for intermediate open position each with 2 NO + 2 NC contacts. The limit switches shall have capacity of 5A at 240V AC or 0.5A at 220V DC.
- b) Each motor actuator shall also have two (2) torque limit switches with two (2) normally opened and two (2) normally closed contacts each.
- c) The torque switches shall have a minimum accuracy of 3% of set value. The torque switches shall be provided with calibrated knobs for setting desired torque and separate knobs shall be provided for open and close torque switches. The torque and position limit switches shall be housed in a separate enclosure with protection class as that of actuator.
- d) The motor operators/actuators shall be capable of meeting 150 percent of unseating torque at specified voltage.
- e) The motor actuators shall have 2 nos. potentiometric type transmitters of 100 ohm rating.
- f) Torque switches shall function to stop the motor on closing/opening. Upon actuation by the torque clutch it is restricted its attempt to open or close, thereby causing an overloading torque. Torque switches shall be self-resetting type only (i.e.) once a particular direction torque switch operates, it shall get resetted only when the equipment is operated in other direction.
- g) All six (6) limit switches shall be changeover type and adjustable besides having the snap facility. All limit switches, contacts shall be wired up independently upto the terminal block.

2.2.13.14 Remote Valve Position/Actuator Status Indication



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- iv. Four contacts shall be provided which can be selected to indicate any position of the valve. Provision shall be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during hand wheel operation when all external power to the actuator is isolated.
- v. The contacts shall be rated at 5A for 240V AC, 0.5A for 220V DC.
- vi. As an alternative to providing valve position any of the four above contacts shall be selectable to signal one of the following:
 - a. Valve opening, closing or moving
 - b. Thermostat tripped, lost phase
 - c. Motor tripped on torque in mid travel, motor stalled
 - d. Remote selected
 - e. Actuator being operated by hand wheel
- vii. Position feedback has to be provided for all inching type applications. These shall be interfaced with plant DDCMIS.
- viii. Actuator local and remote indications shall be grouped and taken separately

2.2.13.15 Local Position Indication

The actuator shall include a digital position indicator with a display from fully open to fully close in 1% increments. Red, green and yellow lights corresponding to open closed and intermediate position shall be included on the indicator. End of travel indication colours shall be reversible. The digital display shall be maintained and updated during handwheel operation when all external power to the actuator is isolated. The display shall incorporate valve, actuator and control status indication. Provision shall be made to orientate the display through increments of 90°.

Provision shall be made in the design for the addition of a contactless transmitter to give a 4-20mA analogue signal corresponding to valve travel for remote indication when required.

2.2.13.16 Integral Starter and Transformer

The reversing starter, control transformer and local controls shall be integral with the valve actuator suitably housed to prevent breathing and condensation. The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. The starter logic shall be microprocessor- based. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It shall have the necessary tapings and be adequately rated to provide power for the following functions:



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- i. Energization of the contactor coils.
- ii. DC output where required for remote controls.
- iii. Supply for all the internal electrical circuits.

2.2.13.17 Integral Local Control and Control Mode Selector

The actuator shall incorporate local controls for Open, Close and Stop and a local/ Stop/ Remote mode selector switch lockable in any one of the following three positions: local control only, stop (no electrical operation), remote control plus local stop only. It shall be possible to select maintained or non-maintained local control.

The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

Provision shall be made to orientate the local controls through increments of 90°.

2.2.13.18 Control Facilities

- i. The necessary wiring and terminals shall be provided in the actuator for the following control functions:
- ii. Open and close external interlocks to inhibit local and remote valve opening and/or closing control. Provision shall be made to configure the interlocks to be active in remote control only.
- iii. Remote controls fed from an internal 24V DC supply and/or from an external supply rated 110V AC to be suitable for any one or more of the following methods of control:

Open, close and stop control :

- a. Open and close maintained or 'push to run' (inching) control
- b. Overriding Emergency Shut-down to Close (or Open) valve from a normally closed or open contact .
- iv. The following individual potential free relay contacts shall be provided in the actuator for remote annunciation to facilitate continuous monitoring of the actuator.
 - a. Actuator in local mode
 - b. Actuator in remote mode
 - c. Actuator (valve) running in OPEN direction.



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- d. Actuator (valve) running in CLOSE direction.
 - e. Limit switch OPEN trip
 - f. Limit switch CLOSE trip
 - g. Actuator in local mode.
 - h. Actuator in inching mode.
 - i. Actuator in self-retaining mode.
 - j. Actuator power switched off /single phasing.
 - k. Torque switch trip, thermo switch trip and overload relay trip (or close)
- v. Automatic phase correction facility and potential free contact for annunciation of power failure shall be provided.
- vi. It shall be possible to reverse valve travel without the necessity of stopping the actuator. The starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energization of the contactor coils.

2.2.13.19 Monitoring Facilities

Facilities shall be provided for monitoring actuator operation and availability as follows:

- i. Monitor (availability) relay, having one changeover contact, the relay being energised from the control transformer only when the Local/Off/Remote selector is in the Remote position to indicate that the actuator is available for remote (control room) operation.
- ii. Where required, it shall be possible to provide indication of Thermostat trip and Remote selected as discreet signals. The actuator shall include a diagnostic module, which will store and enable download of historical actuator operation and torque data to permit analysis of actuator and valve in-service performance. Data download shall be carried out without removing any covers and all shall be available locally to the actuator or remotely via telecom data transfer.
- iii. Diagnostic and configuration software shall be made available in a Lap Top PC for user.

2.2.13.20 Wiring and Terminals

- i. Internal wiring shall be tropical grade PVC insulated stranded cable of appropriate size for the control and 3-phase power. Each wire shall be clearly identified at each end.
- ii. The terminals shall be embedded in a terminal block of high tracking resistance compound.



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- iii. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight sea land shall be provided with a minimum of 3 threaded cable entries with provision for a minimum of 4.
- iv. All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.
- v. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:
 - a. Serial number
 - b. External voltage values
 - c. Wiring diagram number
 - d. Terminal layout
- vi. This must be suitable for the contractor to inscribe cable core identification along side terminal numbers.

2.2.13.21 Startup Kit

Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

2.2.13.22 Performance Test Certificate

- i. Each actuator must be performance tested and individual test certificates shall be supplied free of charge. The test equipment should simulate a typical valve load, and the following parameters should be recorded:
 - a. Current at maximum torque setting
 - b. Torque at max. torque setting
 - c. Flash test voltage
 - d. Actuator output speed or operating time
- ii. In addition, the test certificate should record details of specification such as gear ratios for both manual and automatic and second stage gearing if provided, drive closing direction, wiring diagram number.

- 2.2.13.23** The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out.
- a. Measurement of insulation resistance.
 - b. Measurement of full load current.



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c. Test running of the motors.

2.2.13.24 Drawing and Manuals

Following drawings/ data and Manuals to be submitted for approval:-

- i) Instruction manuals on Installation, tests
- ii) Actuator Data sheet.
- iii) Internal wiring diagram and control schematic.
- iv) Torque switch and Limit switch contact development.
- v) QAP for Test reports.
- vi) Manufacturers Catalogue
- vii) Instruction manuals on installation methods. tests etc.
- viii) Motor sizing calculation
- ix) Integral starter details
- x) General arrangement drawings
- xi) Test reports
- xii) Manufacturing quality plan
- xiii) Field quality plan

FIELD & MEASURING INSTRUMENTS

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CHAPTER-3

FIELD AND MEASURING INSTRUMENTS

2.3.3 Field & Measuring Instruments (Primary & Secondary Instruments)

2.3.3.1 General requirements

Instruments, control devices and other equipment accessories covered under this specification shall be furnished in accordance with I&C specification sheets and drawings enclosed herewith and the requirements of all applicable clauses of this specification.

The instrumentation and control equipment shall conform to all applicable codes and standards including those referred in Cl. no. 2.3.1.6 in this Volume. All equipment and systems shall also fully comply with the design criteria stated in chapter-2 of this part.

The instrumentation/control equipment and accessories shall be from the latest proven design for which the performance and high availability have been demonstrated by a considerable record of successful operation in power station service for similar applications. The bidder shall furnish sufficient evidence to fully satisfy the Owner in this regard.

For plug in type instruments, the plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections.

Signal/Electrical connection shall be screwed connection with double compression type Nickel-plated brass cable glands for Explosion proof area, Flame proof area and high vibration prone area.

Every instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuse of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC article 500, class 1, Division 1 area & flame proof) and an anticorrosive paint shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange shall also be included wherever required with the field instruments.

Following minimum requirement of field instruments shall be fulfilled by Bidder (In addition, Redundancy criteria for field instruments shall be as specified elsewhere in specification): -

- a. Level switches / pressure switches / flow switches/any other process switches etc. for OLCS / Alarms / Interlocks / Protection. Pressure switches at inlet, outlet of individual pumps and discharge header of pumps for protection and auto start / stop & alarms.
- b. Level switches (Type as per Owner approval) for sump/tank level high/normal/ low/very low interlocks.
- c. Level Transmitters (Type as per Owner approval) for open sump/ tank/bunker/vessel/heaters.
- d. Stand pipes on both side of tank for all level instruments (LT, LS & LG).
- e. Flow elements (Type as per Owner approval) with flow transmitter & Flow meter for flow measurement of process medium like Steam, Water, Air, Flue Gas, Fuel oil, open channel liquid, solid fuel, ash flow, DM water, Raw water, Instrument and Service air etc. as decided by owner.
- f. Pressure gauges and temp. Gauges at inlet and outlet of each heat exchanger and cooler.
- g. DPG, DPT & DPS across the filters/strainers.
- h. Tapping points/test points shall be provided.
- i. All primary Instruments, hardwares & JB's etc. used for measurement for HFO, LDO & Turbine Lube Oil system shall be flame proof (IEC-79.1, Part I). All primary Instruments, hardwares & JB's etc. used for measurement for Hydrogen shall be intrinsically safe and explosion proof as per NEC article 500, class 1, Division 1 area I.
- j. All Thermocouples & RTDs (Type as per Owner approval) shall be Duplex. Thermocouples shall be provided for Services with Temperature > 200 deg C.
- k. All Field Instruments used in acid or alkaline atmosphere shall be with standard Anti corrosion coating i.e. the combination of Polyurethane and epoxy resin baked coating (ANSI/ISA-71.04).
- l. All primary instruments installed at "Minus level or Floor" shall be with protection class of IP 68.
- m. Transmitters (all type) for monitoring & controls purpose.
- n. Bidder shall provide electronics weighing in motion system as per IS-11547, hermitically sealed load cell of precision strain gauge type, 100% over load protection of cell and 250% overload protection for the construction; one calibrator attachment with two Weigher.
- o. All field mounted push button, selector switch etc. shall be as per IEC or NEMA 4X protection.

- p. All limit switch shall be conform to IEC-60947-5-1 and shall have minimum 2SPDT/DPDT contacts.
- q. At APH, temperature measuring device of different lengths forming grid shall be provided to have average temperature for variable flow of flue gas, secondary air and primary air. These temperatures may be connected to nearest remote I/O panel.
- r. On both left and right sides of furnace, separate lines shall be laid and provided with furnace pressure transmitters having wide range than the furnace pressure transmitters used for modulating control.
- s. Temp. Transmitters are envisaged with RTD & Thermocouples for monitoring services / application only. However any RTD & Thermocouples are used for control, interlock & protection application, same shall be directly wired to DDCMIS/DCS using instrumentation & Extension cables respectively.
- t. As for the water flow/ steam flow measurements, necessary flow elements/ transmitters are chosen in the process line and supplied such that their algebraic summation shall be mass balanced for calculating the system efficiency.
- u. Non-contact type electronic 2-wire position transmitters shall be provided for all inching type motorised valves and dampers.
- v. For CW sump level, Turbine oil tank, Ash Silo, LDO/HFO tank, DM water tanks, CS tank, Acid and alkali applications, only noncontact type level transmitters like Acoustic, Ultrasonic, and Radar based (Type as per Owner approval) shall be provided by bidders as specified in Tender Specification and as approved by owner.
- w. For Turbine oil, HFO/LDO applications & H₂ Gas application, Zener protection on power supplies shall be included.
- x. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. 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. For HFO, LFO Applications, SS capillary with thin wafer element with ANSI RF flanged ends are to be provided. For hazardous area, explosions proof enclosure as described in NEC article 500 shall be provided.
- y. Considering the type of application, wireless technology to bring signals to DDCMIS may be adopted by interfacing with OPC gateway to avoid cabling for smart level transmitters specified above at sr. no. xxi, in case used for monitoring only. However Wireless technology as adopted by Bidder shall be reliable and field proven in power plants and same shall be approved by Owner. Wirelss transmitters shall have the same minimum specification/ parameters as mentioned for wired transmitters.

- z. Gauges (all type) for local monitoring in field.
- aa. Each switching element including the limit and torque switches of valve actuators shall be provided with minimum two contacts i.e. 2SPDT OR DPDT.
- bb. All instruments should be supplied with valid calibration and test certificates provided by OEM.
- cc. Canopy/Enclosure shall be provided for field instruments like transmitters, switches & flow meters, etc and any other equipment to protect from direct sun light, lightning & rain.

Field instruments shall be supplied & offered as per data sheets specified below:

2.3.3.2 Transmitters, Switches, Gauges and Panel Mounted Instruments

i) Pressure, Differential Pressure, DP type Level and Flow Transmitters (PT, DPT, LT & FT)

Smart Transmitters of the electronic type shall be furnished. All Transmitter shall be installed in closed LIE in the boiler area. Similarly transmitter for TG shall also be in LIE except the transmitters located in covered area on TG floor and these shall be mounted in LIR. Transmitters shall be equipped with mounting brackets suitable for a mounting in transmitter enclosures.

In general, Transmitters are envisaged to be grouped at several places as to be decided during detailed engg. Stage. For this purpose, suitable enclosures complete with all tubing, fittings, purge meters, loop cable trays etc. shall be provided.

S.No	Features	Essential / Minimum Requirements
1	Type/Construction	Sealed capacitance/ Inductance/ Silicon resonance type
2	Material	
	Body	Die cast Aluminium with epoxy coating for air & flue gas, SS316 for other services
	Diaphragm	SS316 With Teflon seal for process requirement/process media for other services
	Measurement element	316 SS (Suitable material/coating for Hydrogen pressure transmitters/Differential pressure transmitters) the suitable material/coating shall be chosen as per the suggestion of transmitter manufacturer.
	Valves	Carbon steel for non-corrosive applications & SS316 for corrosive applications
3	Output Signal	4 to 20 m Amp. DC (Two wires) HART Compatible
4	Local Indicator	LCD indicator (5 digit) with scale of Engg. unit
5	Overall Accuracy	± 0.04% or better of Span for BTG package ± 0.065% or better of Span for BOP packages ± 0.2% or better of span for remote seal type transmitter.
6	Turn down ratio	100:1 in general

13	Supply voltage	240V AC, 50Hz / 24V DC
14	Response time	100 m sec or better
15	Cable connection	¾" ET
16	Accessories	Counter flange, Cable gland, prefab cable if any
17	Preferable features	Alarm output contacts with adjustable set point facility

d) Guided wave Radar / Radar Level Transmitter

S.No	Features	Essential / Minimum Requirements
1	Type	Guided wave Radar (Contact type)/Radar (Noncontact type) as finalized by owner.
2	Application	a) For Turbine Lube oil tank, HFO & LDO tank level, Condenser Hot well, LP heaters, CBD tank level, Stator water expansion level, and other Low pressure, Vacuum vessels. b) HP Heaters, Deaerators are to be appended in the existing list c) Also Bulb type with Teflon coating & drop antenna shall be used acid /chemical tank applications d) For oil tank applications, four wire transmitter shall be supplied with zener barrier protection for power supply connected to level transmitters.
3	Environment Class	Highly abrasive with Gases and Fumes
4	Orientation	Vertical
5	Probe Type	Flexible Single lead with chuck
6	Probe Material	SS 316L
7	Connection Size & Type	2" Flanged ANSI 300 lb SS316L material
8	Connection material	SS 316L
9	Accuracy	+/- 5 mm
10	Resolution	+/- 1 mm
11	Type (Transmitter)	SMART, 2 Wire
12	Operating Principle	Time Domain Reflectometry
13	Output	4-20 mA, DC with HART protocol and 600 Ω output load.
14	Electrical Connection	½" NPT
15	Enclosure Class	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
16	Electrical Power	11-42 V DC
17	Housing material	Die Cast Aluminium
18	Vent & Drain Plug material	SS
19	Side Flange Material	SS
20	Local Display	Provided (LCD Digital)
21	Units of Measurement	Length M
22	Electromagnetic compatibility	EN-61326

7	Ambient temperature	0-60 °C.
8	Mounting	On Top
9	Supply voltage	240V AC, 50Hz from UPS/ 24V DC
10	Relay output	2SPDT
11	Contact rating	5A min. at 240V AC on resistive load
12	Response time	100 m sec or better
13	Cable connection	¾" ET
14	Accessories	Counter flange, Cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.

k) RF type level switch

S.No	Features	Essential / Minimum Requirements
A	Electronic Controller	
1	Input supply	240 V AC from UPS
2	Construction	Cast Aluminium Housing
3	Relay Output	2 Nos. Relay Changeover Potential Free Contacts(2SPDT)
4	Contact Rating:	5A at 240 V AC & 0.25 at 220 V DC
5	Class of Protection	IP-66
6	Ambient Temperature	55 Deg. C(Max)
7	Local Indication	Local LED Indications
	Green	Normal Level
	Red	Alarm Level
	Yellow	Probe Healthy
8	Cable Connection	3/4" ET(2 Nos.) for Supply and Output & 5/8" ET(1 No.) for Probe Connection
9	Repeatability	100%
B	Sensing Probe	
1	Type of Probe	Rigid
2	Material	Stainless steel SS 316
3	Probe Head Housing	Cast Aluminium
4	Insulation (B/W Active & Shield And Shield & Ground)	PTFE
5	Probe Head Protection	IP-66
6	Mounting	Side Mounted
7	Cable Connection	5/8" ET (1No.)
8	Process Connection	40 NB BSP THREADED
9	Signal Cable	Coaxial cable for Connection Between Sensing probe and electronic Controller (@ 10 Metres. Per Level Probe)
10	Application	Ash Silos

l) Level Indicators (Gauge Glass)

S.No	Features	Essential / Minimum Requirements
1	Type/Construction	a) Reflex b) Tubular (For tanks open to atmosphere only)
2	Material:	

S.No	Features	Essential / Minimum Requirements
a)	Glass	Tempered borosilicate resistant to thermal shock
b)	Case	Carbon steel
c)	Integral cocks	i) Forged carbon steel with drain valves stainless steel internals ii) Rubber lined corrosion resistant 316 stainless steel (for Demineralised and Osmosis water service)
d)	Fittings	i) Forged carbon steel ii) Rubber lined 316 steel/PVC for corrosive liquids Demineralised and Osmosis water service) iii) 304 Stainless Steel for non-corrosive liquids
e)	Packing	Teflon
3	Dial size/scale	150 mm /1.5 Meters maximum length with
4	Scale details	Aluminium/SS316 scale Graduated in mmwcl
5	Connection	25 Nb/40 Nb ANSI Flanged
6	Accessories	a) Integral cocks b) Drain valves c) Bolts, nuts and gaskets d) Illuminating lamps as required e) Periscope as required
7	Tests	Tested at two hundred (200) percent of the maximum process pressure
8	Other details	For larger lengths, additional gauge glasses shall be provided with minimum of 50 mm overlap.

m) Float & Board type level gauge

S.No	Features	Essential / Minimum Requirements
1	Type of Instrument	Mechanical Type (Float Operated)
2	Service/ Application	As per service requirement
3	Measuring Range	as per requirement
4	Material Specification	
a	Float Material	SS316 having 2 nos. Guide wires
b	Float Wire Pulley	Shall comprise of 2 nos. Cast Aluminium Pulley housing Assembly with SS 304 pulley and pulley shaft. Steel ball bearings shall be provided in pulley housing for easier float movement. Float wire material shall be SS316L. Between 2 pulleys, 1" NB G.I. short pipe with tentative length as per P&ID
c	Guide wire Assembly	CS chamber with spring and adjuster having 1" Class 150 ANSI RF MS flange. Guide wire rope shall be SS316L.
d	Counter Weight	MS counter – weight with Aluminium Pointer and Brass assembly Pull Chain.
e	Scale	SS 316/Aluminium material in mm with 1 % accuracy.
5	Nozzle Details	For float wire pulley assembly, one tapping and for guide

S.No	Features	Essential / Minimum Requirements
		wire assembly two tapping at the top of the tank; Size 1" NB (Top Mounting Type)
6	Process Connection	Flanged as per ANSI B 16.5 to suit 1" NB nozzle (Nozzle length - 150 mm for float wire, 100 mm for guide wire)
7	Accessories (to be supplied with the instrument)	
a	Counter flange	All mating Flanges, Nozzle
b	Mounting Accessories	All mounting accessories
c	Tag Plate	To be provided (material SS316)

2.3.3.5 Flow Instruments

a) Mass flow meter

S.No	Features	Essential / Minimum Requirements
	Sensor	
1	Measuring Principle	Coriolis Mass flow.
2	Primary Element	Flow Tube of 316SS or better
3	Heating Arrangement	Integral with Flow meter
4	Temperature Control	To be provided.
5	For Heating Process Connection	ANSI RF Flanged and rating as per process requirement.
6	Drain	Self-draining facility
7	Accessories	Counter flanges, Mounting nuts, bolts, gaskets etc.
	Transmitter	
8	Measured quantities	Mass Flow rate, Total Mass Flow, Density, Temperature as minimum.
9	Input Signal Processing	Digital Processing.
10	Display	Digital Display (LCD)
11	Output	2 Nos. isolated output of HART, 4-20mA DC selectable from four measured quantities
12	Load	< 600 ohms
13	Power supply	240V AC, 50 Hz. From UPS
14	Accuracy	0.15% of measured value for Liquid & 0.5% of measured value for Gas
15	Repeatability	0.05%
16	Housing	IP 65 (Explosion proof for NEC Class-1, Division 1 area)
17	Hazardous duty Version	FM Standards.
18	Nameplate	Tag number, service engraved in stainless steel tag plate
19	Accessories	a) As required for field mounting, Handheld configurator & complete Software, External zero adjustment facility b) Mounting U-bolts, nuts, bolts, prefab cable etc.
20	Application	HFO main line, LDO lines, HFO recirculation lines etc.
21	Fault Signal	Instrument fault signal through DPDT/2 SPDT for Diagnostics shall be provided and connected to DDCMIS.

S.No	Features	Essential / Minimum Requirements
		operation.
5	Casing	IP-65.
6	Accessories (as required)	a) Air lock relay b) Hand wheel. c) Air filter regulator with gauge. d) Volume Booster. e) Limit Switches. f) Positioner with Input, Output and supply pressure gauges. g) Pilot Solenoid Valve (Double Coil type) h) Position Transmitter (4-20 mA DC linear output, LVDT or non-contact type).
7	Fail-safe operation	Stay put, open or close position on pneumatic / electrical power supply failure as per process safety criteria.
8	Repeatability	Better than 0.5% of full travel.
9	Hysteresis	Less than 1% of full travel.
10	Material	Internal part's material and material of accessories shall be SS316 only.
	In case of loss of mA signal. Manual adjustment shall be made through available manual knob and locked at required position for sufficient required process fluid flow.	

2.3.3.11 Non - Nucleonic (Vibration) type Density Meter (For DM Plant)

S.No	Features	Essential / Minimum Requirements
1	Type	Non - Nuclear type radiation
2	Application	Liquid Density measurement
	Detector	
3	Orientation	As per requirement
4	Case Material	SS 316/ Cast Aluminium alloy
5	Wetted part material	SS 316
6	Operating Principle	Vibration Density measurement
	Convertor	
7	Output	4-20 mA DC isolated.
8	Electrical Connection	½" NPT
9	Enclosure Class	IP 65
10	Local Display	Digital 5 digit, density display with temp. Compensation.
11	Accuracy	+/- 1%
12	Response time	< 1 minute
13	Power Supply	240 V AC, +/- 10%, 50 Hz. From UPS

2.3.3.12 Junction Box

S.No.	Features	Essential/Minimum Requirements
1	Type of Enclosure	Dust tight, Flame Proof / Weatherproof and Waterproof, generally conforming to IP 65.

S.No.	Features	Essential/Minimum Requirements
2	Material	16 SWG sheet steel hot-dip galvanized / Cast aluminium LM6.
3	Type of Cover	Solid unhinged with retention chain
4	Mounting	Indoor / Outdoor
5	Cable Entry	Downwards
6	Cable Glands	Double compression type – Nickel plated brass with PVC hoods.
7	Terminals	Phoenix / Wago (screw less cage clamp type spring loaded)
8	Gasket	Neoprene
9	Grounding	Two terminals for body and shield ground
10	Number of Drain Holes	Two at bottom capped.
11	Door	Hinged, lockable type
12	Color	In General same as provided for control panels, and for special services, To be decided during detailed engineering & subject to owner's approval.
13	Note: i. Suitable mounting clamps and other accessories shall be in scope of bidder. ii. The brackets, bolts, nuts, screws, glands, lugs required for erection shall be of brass, included in bidder scope of supply. High voltage & insulation resistance test shall also be conducted. iii. M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.) iv. Gasket (Normal)- Neoprene thickness 6.0 mm	

2.3.3.13 Interposing Relays (IPR)

Electromagnetic type IPRs with modular design, plug-in type connections, suitable for channel/DIN rail mounting in cabinets; coil rating 24V D.C; 2 set of silver plated change over contacts rated for 0.5A 220 V DC/8 A 240 V AC. Freewheeling diode across relay copper coil and self reset type status LED indicator flag (electronic) shall be provided. Manual forcing/override facility is required. The test voltage for relay shall not be less than 4 KV with operating temperature from as per ambient temperature condition at site. The relay shall have the necessary approvals like V0 inflammability class in accordance with UL94", IEC60664/IEC60664A/DIN VDE 0110. Facility to stimulate IPR manually shall be provided. The VA burden of relays shall be suitable to match the capacity of output modules. Interposing relay & sockets for mounting the interposing relay shall be of same make only.

The operating temperature of the Relay & Sockets shall be from –20 deg. C to 60 deg. C. The operating/release time of the relay shall not be more than 10/5 ms respectively.

The relay and DIN Rail sockets shall have the necessary approvals like UL/VDE and V0/V2 inflammability class in accordance with UL94", IEC60664/IEC60664A/ DINVDE0110.

Facility to stimulate IPR manually shall be provided. The VA burden of relays shall be suitable to match the capacity of output modules. Interposing relay & sockets for mounting the interposing

- a) Soft carrying case with adjustable shoulder straps & lead compartments.
- b) HART lead set.
- c) Rechargeable batteries.
- d) Battery charger.
- e) Power adaptor.
- f) Universal plug kit for power adaptor.
- g) Load resistor.
- h) Interfacing cables of each type as per requirements.
- i) Protective boot.
- j) Standard banana jack.
- k) Operation manual & software CD.
- l) Analysis & Diagnostic Software.

For flanged remote seal diaphragm:

- a) Maximum pressure rating : To meet 200 percent of process pressure
- b) Availability of seals : for both high and low pressure sides with capillary connection in case of differential pressure transmitters and
- c) Single Capillary connection for pressure transmitters.
- d) Capillary length : 6.0 m
- e) Fill fluid : Suitable oil
- f) Process connection size : 1 inch
- g) Flange size and Accessories : As per process requirement. Flange pressure rating : Required Class (ANSI)
- h) Process liquid : Sea water, Ash water, chemical, hydrogen gas, seal oil etc.,
- i) Process fluid temperature : 25°C to 60°C
- j) Diaphragm and wetted part material : Suitable for sea water, ash water and chemical applications.(offered material to be specified)
- k) Flushing option : To be made available with 1/4 inch (necessary drain and gasket suitable for sea water application to be provided)

ii) Pressure Switches (PS) & Differential Pressure Switches (DPS)

S.No	Features	Essential / Minimum Requirements
1	Applicable Standards	IS3624 - 1966/ISA-RP-8.1 except as modified in spec.
2	Materials	
	Bellows	316SS
	Bourdon tube	316SS
	Movement	316SS
	Enclosure	Die-cast aluminium with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.
3	Type/Construction	Bourdon/Sealed Diaphragm Piston Actuated preferable. Indicators with contacts are not acceptable.
4	Protective Diaphragm	Teflon
5	Accuracy	± One (1) percent or better of full range

S.No	Features	Essential / Minimum Requirements
6	Repeatability	± 0.5(half) percent or better of full range
7	Setting & Differential	Adjustable
8	Contact	
	Number	DPDT /2 SPDT
	Type	Auto reset with internal Adjustable snap action micro switch
9	Rating	5 Amp, 240V AC / 0.2 Amp, 220V DC
10	End connection	½" NPT (F) / Manufactures Standards
11	Connection - instrument	Half (1/2) inch NPT Male Process
12	Electrical	Suitable for Plug in type connection. All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.
13	Over range protection	One Fifty (150) percent of full scale
14	Enclosure Class	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
15	Dead band adjustment	Adjustment up to 10% at set points.
16	Accessories	
	3 / 5 valve manifold	As applicable for all switches
	Self cleaning type pulsation dampners / Snubbers (Material SS316)	Pump and compressor
	Syphon	For all steam lines
	Protective separating diaphragm	For fuel oil & corrosive liquid lines.
	Mounting	Local (in LIE/LIR for BTG package)
17	IBR Requirement	For high pressure service, Process tapping and root valves are as per IBR rules and regulations

iii) **Pressure & Differential Pressure Gauges (PG & DPG)**

S.No	Features	Essential / Minimum Requirements
1	Applicable Standards	IS:3602-1966, IS/3624, ASME B 40.1
2	Type / construction	
	760 mm to 1.0Kg/cm ²	Bellows/Diaphragm
	Above 1.0Kg/cm ²	Bourdon Tube
	Suction side of pumps	Compound gauge
3	Materials	
	Bellows	316SS
	Bourdon tube	316SS
	Movement	316SS
	Case Enclosure	SS 316 / Die-cast aluminium with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.
4	End connection	½" NPT (M)
5	Protective Diaphragm	Teflon
6	Dial Size	150mm with shatter proof glass

S.No	Features	Essential / Minimum Requirements
7	Scale Details	Graduations in black lines on white dial, on white dial, 270 Deg. pointer deflection scale provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges.
8	Range Selection	Cover 125% of max. of scale
9	Accuracy	± One (1) percent or better
10	Instrument process connection	½" NPT Male (Back Entry)
11	Mounting Type	Local / 1/2 inch NPT Male (Back entry) mounted on local gauge board.
12	Protection Class	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
13	Accessories	
	3 way needle valve / manifolds	For all gauges
	Self cleaning type	Pump and compressor discharge (Pulsation dampener / Snubbers (S316) lines
	Syphon	For all steam lines
	Protective separating	For fuel oil and corrosive liquid lines
14	Other Particulars	
	External Zero adjustment / Safety device	For all gauges
	Ranges 5 to 20 Kg/cm2	Rubber blow out disc with open front construction.
	Ranges above 20 Kg/cm2	Neoprene safety diaphragm at the back with solid front construction.
16	Over range protection	One Fifty (150) percent of full scale
17	Over Range Test	Test pr. For the assembly shall be 1.5 to the max. Design pr. At 38°C
18	Other Requirements	Movement mechanism shall be glycerine filled for oil services & vibration prone area.
		For Fuel oil & corrosive liquid lines diaphragm type sensors required. Armoured capillary of 10 M for Fuel oil & Corrosive liquid service.
		Contact type pressure gauges are not acceptable for interlock & protection.
		For condensate storage tank the pressure gauge in terms of 0-10000 mmwcl or suitable range having dial size of 300mm or bigger size shall be provided.
19	IBR Requirement	For high pressure service, Process tapping and root valves are as per IBR rules and regulations

2.3.3.3 Temperature Related Instruments

a) Temperature Transmitters (TT)

S.No	Features	Essential / Minimum Requirements
1	Type	SMART type configurable from control room through HART protocol (HMS System).
2	Display type	Indicating type (5 digit LCD Display),
3	Accuracy	±0.10%,

S.No	Features	Essential / Minimum Requirements
21	Packing glands	Yes
22	IBR Certification	For high pressure service, Steam Temp, Fuel oil temp. measurement as per IBR rules and regulations
23	N.B	Switches designed for cross ambient operation shall be used in applications where the ambient temperature will approximate or exceed the switch set point.

f) Temperature Gauges (TG)

S.No	Features	Essential / Minimum Requirements
1	Applicable Standard	IS : 3602,BS:5235 ISA:RP:8.1 except as modified in this specification
	Type/Construction	
2	Thermometer	Industrial type, Gas in Filled type with separable thermo well
3	Thermo well	Bar stock
	Material	
4	Bulb	316 SS
5	Capillary	Armoured SS (Applicable for capillary Type)
6	Casing	SS 316/ Die-cast aluminium with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere
7	Dial Size	150mm with shatter proof glass
8	Scale Details	270 degree dial rotation/deflection. Graduations in black lines on white dial provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller .Pointer stop for all gauges
9	Accuracy	± One (1) percent or better
10	Response time	Maximum 15 seconds without thermo well and 30 seconds with thermo well
	Connection	
11	Pipe	M33 x 2
12	Thermo well	To suit instrument with same design criteria specified for RTDs.
13	Process Connection	M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, fasteners, gaskets etc.
14	Extension	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
15	Other Particulars	
16	Capillary length	5Meters/10 Meters as required
17	Immersion Length	Within + ten (10) mm of centre line of pipe with adjustable nuts.
18	Extension neck length	Minimum 50 mm above insulation of pipe /As per approved hook up drawings.
19	Stop at Maximum value	For all gauges of scale
20	Pointer	i) Externally adjustable

QUALITY ASSURANCE PLAN

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

CHECK LIST FOR PRESSURE SWITCH

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

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

Note :

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



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

CHECK LIST FOR TRANSMITTER

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

Legend :

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Note :

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



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

CHECK LIST FOR TEMPERATURE GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	DIAL SIZE						
	MODEL NO./TAG NO./TYPE						
	RANGE/SCALE						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	HYSTERESIS						
3	OVER TEMP. TEST			P	W	V	
4	AMBIENT TEMP. COMPENSATION CHECK	1 OF TYPE	P	V	V		
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT	V	V	V		
	SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	THERMOWELL						
	HOUSING		V	V	V		
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V		
7	THERMOWELL	SEE NOTE-1 BELOW	AS PER APPD DWG		V	V	
	MATERIAL TC & DIMN. CHECK						
	HYD.TEST						
	OVER RANGE TEST						

Legend :

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Note :

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



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

CHECK LIST FOR PRESSURE & DP GAUGE

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

Legend :

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Note :

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



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

CHECK LIST FOR LEVEL GAUGE

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

Legend :

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Note :

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

QUALITY ASSURANCE AND TESTING AND GUARANTEES

2.5 Quality Assurance Plan

2.5.3 General Requirement

All equipment furnished under this specification shall be subject to test by authorized quality assurance personnel of the Bidder, representatives of the Owner during manufacture, erection and on completion. Bidder's 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 or passing of such inspection of tests will not, however, prejudice the right of the owner to reject the equipment if it does not comply with the specifications when erected or fails to give complete satisfaction in service.

The Bidder 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. Bidder shall also furnish details of his proposed shop and site quality assurance organization for this contract. Bidder shall prepare a detailed shop and site 'Quality Assurance Programme' to meet the requirements of these specifications for Owner'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.

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 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.

The Bidder 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 on demand.

The cost of all tests as per the requirements of this specification and approved quality assurance programme shall be included in Bidder's lump sum price for this package and no extra price shall be payable by the Owner for conducting any test as per the intent and requirements of this specification.

All approval/Inspection are to be carried out by the Owner only.

2.5.3.1 Testing Method

i) Shop Test

Shop tests shall include all tests to be carried out at Bidder's works at of this sub-bidder and at works where raw materials used for manufacture of equipment is produced.

Individual components, instruments and devices furnished in accordance with specification sheets, and I&C device list enclosed with these specifications shall be shop tested by manufacturer prior to shipment. The manufacturer shall conduct these tests for certifying compliance with published specifications for the equipment and provide test results to the Owner in writing. These tests and test certificates shall be in accordance with the agreed 'QA' programme for major systems/equipments. However, manufacturer's standard methods shall be followed if details of tests for any equipment are not covered under this agreed 'QA Programme'. Whenever tested quality material is specified and wherever called upon by Indian Boilers Regulations or by the design code, the test pieces are to be prepared and tested to Owner's satisfaction.

In the event of Owner being furnished with certified particulars of tests, which have been carried out by the suppliers of material, the Owner may, at his discretion, dispense with these tests.

ii) Material Tests

Whenever tested quality material specified and whenever called upon by Indian Boilers Regulations or by design code, the test pieces, are to be prepared and tested to Owner's satisfaction.

In the event of Owner being furnished with certified particulars of tests, which have been carried out by the suppliers of material, the Owner may, at his discretion, dispense with these tests.

iii) Test at Manufacturer's Works

Works tests are to include electrical, mechanical performance and hydraulic tests in accordance with relevant IS, IBR or any other approved standard or any other tests called for by the Owner under these specifications to ensure that the equipment being supplied fulfils the requirements of these specifications. For equipments not covered by any IS or other approved standards, the tests to be carried out shall be in accordance with Bidders' quality assurance programme approved by the Owner.

Control systems, monitoring systems, control panels instrument enclosures, and power supply systems shall be shop tested according to unique requirements specified in the applicable section of these specifications for each item and quality assurance program approved by the owner.

All shop tests shall be performed prior to shipment and the Owner shall be given the opportunity to witness these tests. The Bidder shall notify the Owner regarding readiness for shop test at least 10 days before the scheduled date if the tests to be conducted within Indian and at least 60 days before the schedule date if the test is to be conducted abroad.

iv) Factory Tests

2.5.3.6 Calibration of Instruments

The Bidder shall carry out the calibration of instruments as indicated below by submitting the test procedure and quality assurance plan for the Owner's approval. Bidder shall also prepare detailed checklist/calibration sheets for each of the systems/equipment clearly indicating the step-by-step procedures to be carried out for calibration pre commissioning, loop checking, powering and commissioning.

The calibration of all instruments shall be checked and calibration records prepared for the Owner's use. If the instruments require recalibration, Bidder shall recalibrate the instruments and revise the calibration records and submit to the Owner.

2.5.3.7 Tests to be performed for Field Instruments

S.No	Tests to be performed
1.	Pressure Gauges
	Calibration Hydro test (1.5 times max. pr.)
2.	Pressure switches
	Calibration test / Hydro test / Contact rating test / Accuracy test / Repeatability
3.	Differential Pressure Gauges
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
4.	Differential Pressure Switches
	Calibration test / Hydro test / Contact rating test / Leak test / Accuracy test / Repeatability test.
5.	Thermometers
	Calibration / Material test / Accuracy test / Bore concentricity : $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)
6.	Temperature switch
	Calibration / Material test / Accuracy test / Bore concentricity: 1.5% of wall thickness / Hydrostatic test for TW (1.5 times max. pr.) / Contact rating test.
7.	Resistance temperature detector assembly.
	Calibration / Material test / Bore concentricity test / Insulation test ($\leq 500 \text{ M}\Omega$ at 500V DC) As per ISA, Hydro test for TW. Bore concentricity: $\pm 5\%$ of wall thickness, Accuracy test.
8.	Thermocouple assembly
	Calibration / Material test, Insulation test ($\geq 500 \text{ }\Omega$ at 500 V, DC) as per ISA, Hydro static test (1.5 times max. pr.), Bore concentricity: $\pm 5\%$ of wall thickness.
9.	Thermo wells
	Material test / Bore concentricity: $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)
10.	Level Gauges

S.No	Tests to be performed
	Hydrostatic test / Material test / Seat leakage test / Ball check test.
11.	Level switches (Magnetic)
	Material test / Contact rating test / Hydro test / Calibration test.
12.	Flow Switch
	Material test / Hydro static test (1.5 times max. pr.) / function test.
13.	Flow glasses
	Material test / Hydrostatic test (1.5 times max. pr.) / function test.
14.	Variable area flow meters
	Calibration test / Material test / Hydrostatic test (1.5 times max. pr.)
15.	Flow element
	100% Radiography test / Hydro test / Calibration test, IBR Certificate.
	Calibration test for flow element shall be witnessed by Owner.
16.	Control valves / Pneumatic block valve / Pressure regulating valve – Refer chapter 10.
17.	Position transmitters
	Calibration / hysteresis and Accuracy test
18.	Electro Pneumatic Convertors
	Calibration test / Accuracy test
19.	Solenoid valves
	Hydro test / Seat leakage test / CV test / Coil insulation test
20.	Air filter regulators
	Calibration test / Accuracy test
21.	Junction Boxes
	Test for degree of protection / Material test
22.	Tests for terminal blocks
	Test for moulding for flame resistant, Non-hygroscopic and Decarbonised / Insulation test between terminals / Insulation between terminal block and frame.
23.	Thermocouple extension cable
	Thermo-e.m.f characteristic / Continuity test / Measurement on capacitance, inductance and loop resistance / Insulation resistance / High voltage test as per latest IS / Tensile and elongation test / Oxygen index test / Any other test applicable.
24.	Mass flow meter
	Performance test / Calibration test / Hydrostatic test.
25.	Boiler Level Gauge
	Hydrostatic test / Material test / Seat leakage test / IBR Certificate
26.	pH / Conductivity measurement / Silica / Dissolved oxygen analysers:
	Calibration test, Accuracy test
27.	Sample cooler :

S.No	Tests to be performed
	Hydro test, IBR Certificate
28.	Sampling racks :
	Hydro test, IBR Certificate for tubes and fittings.
29.	SO2 / NOx analyser / SPM analyser:
	Calibration test, accuracy test
30.	Interposing relay
	Functional test, temperature rise test, H.V test, Insulation test
31.	Transmitter Racks :
	Hydro test, air leak test for piping / tubing and fittings. IBR certification as required for tubing / piping and fittings.
32.	Pressure Transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
33.	Differential pressure transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
34.	Temperature Transmitter
	Calibration test / Accuracy test / Ambient temperature error test
35	Pneumatic Block Valves
	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 Deg.C) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 Deg.C) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
36.	Pressure Regulating Valve
	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 Deg.C) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 Deg.C) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
37.	Local Panels :
	Visual inspection, wiring & continuity check, H.V. and I.R. tests on panels, checking of bill of materials, functional tests.
38	Wiring Termination & Accessories

S.No	Tests to be performed
	Routine test: Conductor resistance test / High voltage test / Impulse dielectric test / insulation test / Humidity test / Temperature rise test on power circuits / short time current test on power circuits.
	Type test: Annealing test / Test for insulation and sheath / Flame retardency test - a) Oxygen index, b) Flammability / Test for acid gas generation / test for water absorption / wet dielectric test
39	Marshalling / System cabinets
	Verification of degree of protection / Electrical tests as detailed under wiring Termination & accessories / Type test and routine test as per relevant Indian standards.
	Notes:
	1. Test Certificates in addition to inspection at manufacturers works shall be furnished for all the instruments for Owner's review. 2. Above Test to be witnessed shall be finalized by Owner. 3. In addition to above test, test as per approved QAP shall also be witnessed by owner

i) Testing Types

The BIDDER shall furnish the Type test reports of all type tests as per relevant standards and codes. As well as other specifics test indicated in the specification. A list of such test are given for various equipment in table titled, Type Test Requirement for C&I System and under the item special requirement for solid state requirements/systems. For the balance equipments/instruments type test may be conducted as per manufacturer standards or if required by relevant standards.

- 1) Out of these test listed, the bidder / sub vendor / manufacturer is required to conduct certain type test specifically for this contract (and witnessed by employer or his authorized representative). Even if the same have been conducted earlier as clearly indicated subsequently such tests.
- 2) For the rest, submission of type test, results, and certificates shall be acceptable provided following points
 - a) The same have been carried out by the bidder/ sub vendor on exactly the same model/rating of equipment. (For control valves this shall be same size, type & design).
 - b) There has been no change in the components from the offered equipments and tested equipments.
 - c) The test has been carried out as per the latest standards along with amendments as on the date of bid opening.
- 3) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the bidder/sub-vendor within the quoted price and no extra cost will be payable by the owner on this account.

As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main bidder or his authorized representative and balanced have to be approved by the employer. The schedule of conduction of type test/submission of reports shall be submitted and finalized during preaward discussion.

For the type test to be conducted, bidder shall submit detailed test procedure for approval by owner. This shall clearly specify test setup, instruments to be used, procedure, and acceptance norms (wherever applicable). , recording of different parameters, intervals of recording precaution to be taken etc. for the test to be carried out.

ii) **Special Requirements for Solid State Equipments /Systems**

The minimum type test report, over and above the requirements of above clause which are to be submitted for each of the major C&I systems like DDCMIS, DCS etc. shall be as indicated below:

Surge Withstand Capability (SWC) for solid state equipments/equipments

1. All solid state systems/equipments shall be able to withstand the electrical noise and the surges as encountered in actual service conditions and inherent in the power plant. All the solid states systems /equipments shall be provided with all required protection that needs the surge withstand capability as defined in ANSI 37.90.1/IEEE 472. Hence, all front end cards which receive external signals like analog input and output modules, Binary input and output modules etc. including power supply, data highway, data links shall be provided with protection that meets the surge withstand capability as defined in ANSI 37.90.1/IEEE 472. Complete details of the features incorporated in the electronic system to meet this requirement the relevant test carried out, the test certificates, etc. shall be submitted along with the proposal. As an alternative to the above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/IEEE 472 may also be adapted for SWC test.
2. The dry heat test as per IEC-68-2-2 or equivalent
3. Damp heat test as per IEC 68-2-3 or equivalent
4. Vibration test as per IEC 68-2-6 or equivalent
5. Electrostatic Discharge test as per EN 61000-4-2 or equivalent
6. Radio frequency immunity test as per EN 61000-4-6 or equivalent
7. Electromagnetic Field Immunity test as per EN 61000-4-3 or equivalent

Test listed at Item no 5, 6, 7 above are applicable for electronic cards only as defined under item no. 1 Above

iii) **Type Test Requirements for C&I Systems**

S.No	Item	Test Requirement	Standard	Test to be specifically conducted	Owners approval required on test certificate
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S.No	Item	Test Requirement	Standard	Test to be specifically conducted	Owners approval required on test certificate
1	Electrical metering instruments	As per standards	IS 1248	No	Yes
2	Thermocouple	Degree of Protection Test	IS - 13947	No	No.
3	Junction Box	Degree of Protection Test	IS - 13947	Yes	Yes
4	RTD	As per standards	IEC-60751	No	No
5	Electronic Transmitter	As per standards	BS 6447 / IEC 60770	No	Yes
6	E / P convertor	As per standards	Manufacturing standard	No	Yes
7	Instrumentation cable (Twisted and shielded) (Refer Vol. II, Chapter 8)				
8	Battery	As per standard	IS 10918	Yes	YES
9.	Voltage stabiliser	Over load test	Approved procedure	No	YES
		Temp. rise test without redundant fans	Approved procedure	No	YES
		Input voltage variation test	Approved procedure	No	YES
10	DDCMIS				
	CLCS system	Model Test	Approved procedure	No	No
	BMS & MFT	Safety requirement	VDE0116, SEC 8.7	No	YES
11	Conductivity type level switch	Degree of protection test	IS 13947	No	No
12	Local gauges	Degree of protection test	IS 13947	No	No
13	Process actuated switches	Degree of protection test	IS 13947	No	No
14	Control valves	CV test	ISA 75.02	No	YES
15	LIE / LIR	Degree of	IS 13947	YES	YES
16	Flue gas O2 analyser, other Flue	Degree of protection test	IS 13947	No	YES
17	Flow nozzles & Orifice plates	calibration	ASMEPTC BS 1042	YES	YES

Note:

VENDOR LIST

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PEM REGISTERED VENDOR

Package Code	Package Name	Vendor Name	Vendor Address
145-45000-A	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
145-45000-A	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
145-45000-A	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI-Tamilnadu-INDIA Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com
145-45000-A	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai-Maharashtra-INDIA Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com
145-45000-A	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai,-Maharashtra,-India, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
145-45000-A	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan-Gujarat-INDIA Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com
145-45000-A	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
145-45000-A	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai-Maharashtra-INDIA Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com

145-45000-A	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI- MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
145-45000-A	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai-Maharashtra-India Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI- MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI- INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA- INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91- 9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
145-32000-A	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91- 9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
145-32000-A	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA- INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
145-32000-A	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI- INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com

145-32000-A	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
145-25000-A	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari-Gujarat-India Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com
145-25000-A	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI-MAHARASHTRA-INDIA Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com
145-25000-A	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore-Karnataka-India Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net
145-25000-A	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE - Phone- Pincode : Email : suchitra.industriesblr@gmail.com
145-25000-A	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad-Gujarat-India Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI- Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,-Maharashtra,-India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,

145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA-WEST BENGAL-INDIA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE-KARNATAKA-www.hgurusouth.com Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD-TELANGANA-INDIA Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata-West Bengal-India Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,-INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA-WEST BENGAL-INDIA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,-INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim--Germany Phone- +91- 9999107840 Pincode : D-61203 Email : msingh@barksdale.de
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat-India Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com

145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai-TamilNadu-INDIA Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai-Maharashtra-India Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune,-Maharashtra,-India, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD-UP-INDIA Phone- 0120-2712016 Pincode : Email : mktg@indfos.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	B Kannan/V S Jayaprakash 9, SOUTH BOAG ROAD, II FLOOR, PB NO-1423, T.NAGAR, CHENNAI-TAMIL NADU-INDIA Phone- 044-24340999 / 24344 Pincode : 600017 Email : marketing@switzerinstrument.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA-KANSAS-USA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
145-14000-A	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI-DELHI-INDIA Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com
145-14000-A	TRANSMITTERS	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
145-14000-A	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer,- Rajasthan,-India, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
145-14000-A	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE,-KARNATAKA,-INDIA, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,

145-14000-A	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai-Maharashtra-INDIA Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com
145-14000-A	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI-MAHARASHTRA-INDIA Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com
145-14000-A	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI-MAHARASHTRA-INDIA Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in
145-14000-A	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE,-MAHARASHTRA-INDIA Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
145-14000-A	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune-Maharashtra-INDIA Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
145-14000-A	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai,-Maharashtra,-India, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
145-14000-A	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore-M.P.-India Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com
145-14000-A	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills-CALIFORNIA-USA Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com
145-14000-A	TRANSMITTERS	ABB LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD-HARYANA-INDIA Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com
145-14000-A	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi,-New Delhi,-India, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,

PEM REGISTERED VENDOR

145-10000-A	TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI- Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
145-10000-A	TEMPERATURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA-WEST BENGAL-INDIA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
145-10000-A	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,- Maharashtra,-India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
145-10000-A	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE-KARNATAKA-www.hgurusouth.com Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
145-10000-A	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa,-MAHARASHTRA-INDIA Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,
145-10000-A	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA-GOA-INDIA Phone- Pincode : 403525 Email : qtilworks@pyro-electric.in
145-10000-A	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD-TELANGANA-INDIA Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
145-10000-A	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol- Gujarat,-INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
145-10000-A	TEMPERATURE GAUGE	BUDENBERG GUAGE CO.LTD.	PO BOX-5, ALTRINCHAM CHESHIRE-UK-UK Phone- 0161-9285441 Pincode : WA14 4ER Email : dhbdelhi@vsnl.net
145-10000-A	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA-WEST BENGAL-INDIA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in

Notes :- 1) The above sub-vendor list is tentative & reference only. However sub-vendor list is subject to BHEL/end user approval without any commercial/delivery implication. 2) New subvendor, if proposed by vendor during contract stage shall be subject to BHEL/end user approval without any commercial implication.

SI No.	Package Name	Vendor Name	LOCATION
1	LOCAL CONTROL PANELS	C and S ELECTRIC LTD.	New Delhi
		PYROTECH ELECTRONICS PVT. LTD.	Udaipur
		PROCON INSTRUMENTATION PVT. LTD.	Chennai
		INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	Mumbai
2	ANALYSERS (ALL TYPES)	ABB INDUSTRIES AG	SWITZERLAND.
		ROSEMOUNT ANALYTICAL INC	IRVINE
		ENDRESS + HAUSER INDIA PVT. LTD.	MUMBAI
		HACH LANGE S.A.R.L CH-1222,	VESENAZ
		SWAN Analytische Instrumente AG, CH-8340	Hinwii
		METTLER-TOLEDO INDIA PVT. LTD.,	MUMBAI
		THERMO ORION INC	BEVERLY
3	UPS	EMERSON NETWORK POWER,	AMBERNATH
		EMERSON NETWORK POWER	PUNE
		HITACHI-HIREL,	GANDHINAGAR
		KELTRON,	TRIVANDRUM
		CONSUL NEOWATT POWER SOLUTIONS,	PUNE
5	MOTORISED ACTUATOR	ROTARK	UK
		AUMA	Bengaluru
		WEIR BDK VALVES	Hubli
		LIMITORQUE	Faridabad
6	AIR FILTER REGULATOR	PLACKA	Chennai
		SHAVO-NORGREN	Mumbai
		SCHRADER SCHORILL DUNCAN LTD.	Mumbai
		FAIRCHILD	USA
		SMC PNEUMATICS	Noida
7	SOLENOID VALVE	ASCO	USA
		ROTEX	Vadodra
		SCHRADER	Pune
		AVCON	Mumbai
		HERION-NORGREN	Germany
		IMI-NORGREN	Germany
		JAFFERSON	Argentina

Notes :-

1) The above sub-vendor list is tentative & reference only. However sub-vendor list is subject to BHEL/end user approval without any commercial/delivery implication.

2) New subvendor, if proposed by vendor during contract stage shall be subject to BHEL/end user approval without any commercial implication.

MANDATORY SPARES

|

1X800MW NORTH CHENNAI SUPERCRITICAL THERMAL POWER PROJECT
STAGE III IN THE EXISTING PREMISES OF NCTPS

ANNEXURE IV
MANDATORY SPARES

III. MANDATORY SPARES (C & I):

S No	Name/ Description of Spares	Unit	Qty
	The quantity of following spares includes a minimum of 20 % spares for replacement of each type of lamps, PBs, ILPBs, fuse, MCB, MCCB used in the equipment/system offered by him even if this is not detailed below.		
i)	Measuring Instruments - Indicators, Recorders, Electrical Metering and Skid Mounted Instruments	Lot	1
1	10% of the number of indicators, recorders and meters offered from each model for the project or a minimum of one number per model, whichever is more. These instruments shall be supplied with three sets of blank scales.		
2	For skid mounted instruments (if any) - 10% of total number of instruments for each model and type for the project or a minimum of one number for each model and type, whichever is more.		
ii)	Temperature Elements and Thermowells	Lot	1
1	10% spare thermocouple/RTD elements, suitable for replacement for each type and length of element furnished with thermocouple/RTD assemblies, or a minimum of one number of each type & length, whichever is more.	%	10%

1X800MW NORTH CHENNAI SUPERCRITICAL THERMAL POWER PROJECT
STAGE III IN THE EXISTING PREMISES OF NCTPS

ANNEXURE IV
MANDATORY SPARES

S No	Name/ Description of Spares	Unit	Qty
2	10% thermo wells for each type of temperature sensors or a minimum of one for each type, whichever is more	%	10%
3	Temperature Transmitters and Electronic Transmitters (For Pressure, DP, Temp, Flow, Level), Temperature, Pressure, Flow & Level Switch, safety switches, Gauges, meters, Transducer or any other instrument etc.		
	10% of total number of instruments/transducers offered for each model and type for the project or a minimum of one number, whichever is more.	Lot.	1
iii)	Flue Gas Analyzers & CEMS	Lot	1
	Spare parts shall be furnished in accordance with manufacturer's recommendations for five years continuous operation or minimum quantities indicated as below (whichever is more)		
1	One set of electronic modules comprising of at least one number of each type of module for each analyzer type.		
2	A spare cooling and purging air blower unit and set of air filters shall be furnished for each stack analysis system.		
3	One set of light source and detector unit for smoke density analyzer.		

1X800MW NORTH CHENNAI SUPERCRITICAL THERMAL POWER PROJECT
STAGE III IN THE EXISTING PREMISES OF NCTPS

ANNEXURE IV
MANDATORY SPARES

S No	Name/ Description of Spares	Unit	Qty
9	Three (3) No of each type Primary coolers/secondary coolers.		
vi)	Relay Based Control Panels	Sets	1
1	10% LEDs for indicating lights shall be furnished.		
2	Three times, the one hundred percent (300% of installed) spare replacement control circuit fuses/MCB/MCCB of each current rating required shall be furnished.		
3	20% spare replacement relays modules & contactors of each type.		
vii)	Alarm Annunciation System	Sets	1
1	20% spares of each type installed shall be provided for logic modules, group card modules, power supply modules, Hooters and any other electronic module.		
2	5% spares of each size shall be provided for un-engraved window boxes complete with LED etc.		
3	20% of installed LEDs for annunciation facia windows and LEDs box assemblies offered for the project shall be provided as mandatory spares.		
4	One (1) spare annunciator hooter of each type.		
viii)	Erection hardware	Sets	1
1	Ten (10) percent of each type & Size installed instrument valve, manifold for each type, rating, model number and size of devices supplied for the project.		
2	Ten (10) percent of total number of condensate pots or four numbers whichever is higher of each type & Size installed.		
3	Ten (10) percent of each type & Size installed Fittings		
iv)	LVS	Sets	1
1	20% spare LEDs of each type & size		
2	50% spare or min 6 nos. LVS Filters		

1X800MW NORTH CHENNAI SUPERCRITICAL THERMAL POWER PROJECT
STAGE III IN THE EXISTING PREMISES OF NCTPS

ANNEXURE IV
MANDATORY SPARES

S No	Name/ Description of Spares	Unit	Qty
2	Electronic positioner 2 NOS.		
3	Proportional Valve 2 NOS.		
4	Quick opening device 2 NOS.		
5	Seal sets 4 Sets		
6	Solenoid Valves 2 NOS.		
7	Filters for Oil Units 1 set		
8	Supply manifold for oil units 1 No		
9	Hose for each service 1 each		
10	Seal set for oil unit 1 Set		
11	Complete actuator for each 1 set type and model		
e	1 NO of flow Nozzle for each PRDS De Super heater & Spray water Desuperheater and Orifice plate for CEP flow.		
xv)	Mandatory Spares for Boiler Tube leak Detection System	Lot	1
	Following mandatory spares along with their individual price required for maintaining boiler tube leak detection system to supply along with the package.		
1	2nos. acoustic transducer with rear connector sealed to IP-65		
2	2 nos. flexible high temperatures lead, 3metre long for acoustic transducer.		
3	2 nos. acoustic s field amplifier / processor mounted in a die cast aluminum or polycarbonate box sealed to IP-65 with mounting brackets, pairs.		
4	1 no. A/D Convertor cards/field signal interface module for 32 or more channels.		
5	1 no. Alarm relay output card.		
6	Consumables like batteries, fuses etc. for two years operation of boiler tube leak detection system		
xvi)	Mandatory spares not covered above	Lot	1

1X800MW NORTH CHENNAI SUPERCRITICAL THERMAL POWER PROJECT
STAGE III IN THE EXISTING PREMISES OF NCTPS

ANNEXURE IV
MANDATORY SPARES

S No	Name/ Description of Spares	Unit	Qty
	Bidder to supply 10% or 1 no. (whichever is more) of each type of sensor/instrument, analyzers /special instruments/Electronic card, instrumentation/mechanical fittings etc. for any other electronic system, feeder control cabinets, hydra step (EWLI), Vibration Monitoring System, CCTV, C&I Lab Instruments, On line Carbon in Ash analyzer system, On line Coal mass flow/speed measurement system, On line secondary air flow measurement system Mass Flow meter, Solid flow meter, 3 D Acoustic type level transmitters, Nucleonic & non nucleonic density transmitter etc.		
xvii)	Other Related Control and Instrumentation Systems/Equipments		
	Other SG related sub-systems		
1	Flame Monitoring System	Lot.	1
(i)	Complete Flame Scanner Assembly including scanner head assembly, scanner housing, and fiber optic cables.		20% or 4 nos. whichever is more.
(ii)	Flame Scanner Lens.		100%
(iii)	Electronic cards for scanners		10% or 2 nos. of each type whichever is more.
(iv)	Power Supply Modules		10% or 2 nos. of each type whichever is more.
2	Coal Feeders	Lot.	
(i)	Calibration Motor		10% or 2 nos. whichever is more.

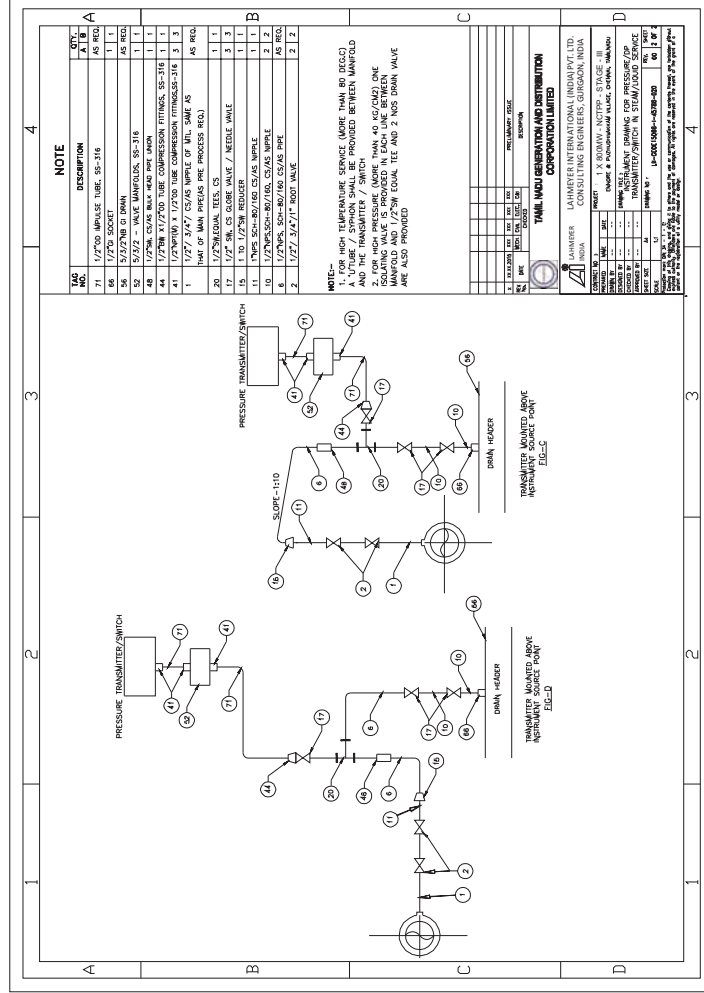
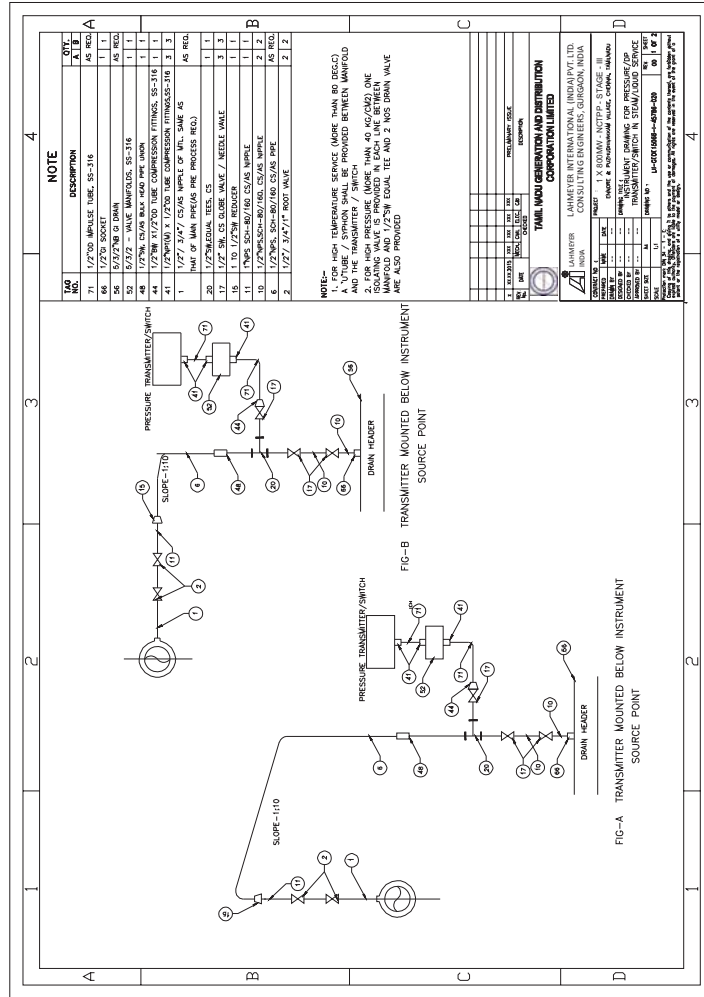
1X800MW NORTH CHENNAI SUPERCRITICAL THERMAL POWER PROJECT
STAGE III IN THE EXISTING PREMISES OF NCTPS

ANNEXURE IV
MANDATORY SPARES

S.No	Name/ Description of Spares	Unit	Qty
4	Mechanical seal	Set	1
5	Wear rings	Set	1
R	CPU	Lot.	1
1	Service & regeneration vessels(for each type & size)		
2	Diffuser, distributors & nozzle	%	10
3	Perforated laterals & under drain collectors	%	10
4	Gaskets etc.,	Set	2
5	Nut & bolts etc.,	Set	1
6	Valves	%	20 % of each type & size
7	Pumps & blowers along with drive motors		1 no each type & size
8	Ejector & dozing pump		1 no each type & size
9	Resin trap		1 no each type & size
S	Debris filter	Lot	1
1	Actuator along with motors	Set	1
2	Debris discharge valve	Set	1
T	DMCCW pump for TG	Lot.	1
1	Impeller wear ring, pump bearings, pump shaft, mech seal, shaft sleeves, nut & bolts	Set	1 set reqd for assembling for 1 pump
U	DMCCW pump for SG	Lot	1
1	Impeller wear ring, pump bearings, pump shaft, mech seal, shaft sleeves, nut & bolts	Set	1 set reqd for assembling for 1 pump
V	HP/LP chemical dozing system	Lot.	1

INSTRUMENT INSTALLATION DRAWING

|



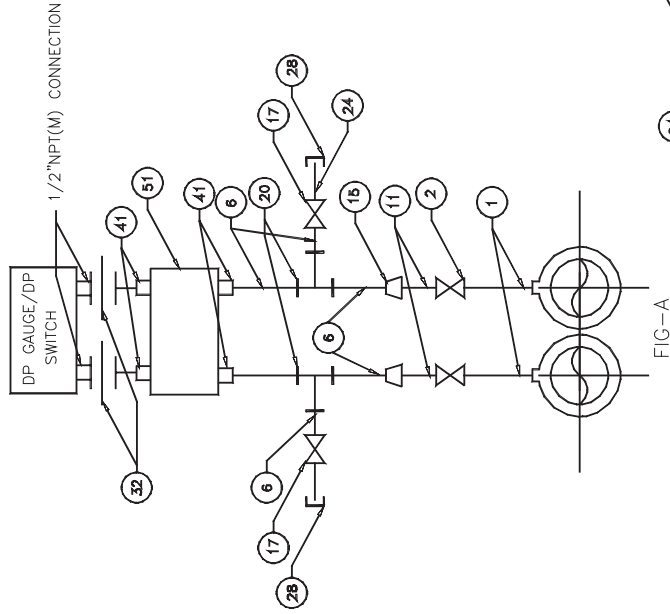


FIG-A

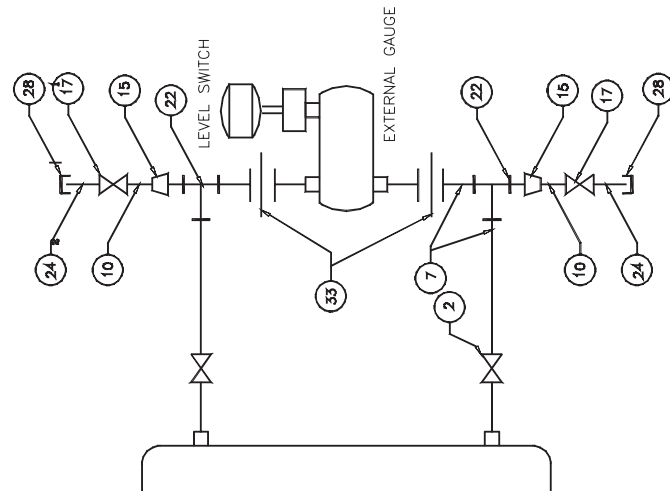


FIG-C

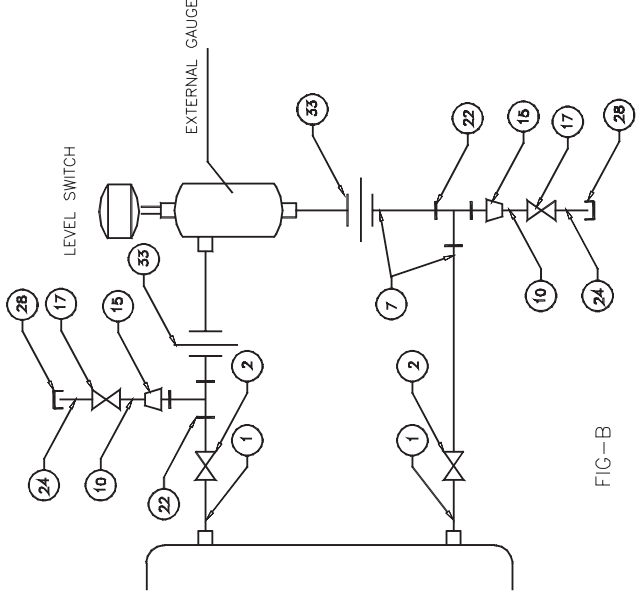


FIG-B

NOTE

TAG NO.	DESCRIPTION	QTY.		
		A	B	C
78	1/2"NPT(F)X1/2"NPT(M) SNUBBER/ PULSATION DAMPER	1	-	-
38	3-WAY GAUGE VALVE WITH 1/2" NB SW	1	-	-
32	1/2"NPS, 3 PIECE PIPE UNION WITH 1/2"NPT(F) SCREWED	1	-	-
28	1/2"NPT (I) CS CAP	1	2	2
24	1/2"NPS, SCH--80/160 X 1/2"NPT(M) CS/AS NIPPLE	1	2	2
17	1/2"SW EQUAL TEE, CS/AS	1	-	-
20	1/2"SW CS/AS GLOBE VALVE	1	2	2
1	1/2" / 3/4" / CS/AS NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PRE PROCESS REQ.)	AS REQ.		
15	1"TO 1/2"SW REDUCER	1	2	2
11	1"NPS SCH--80/160 CS/AS PIPE	1	-	-
6	1/2"NPS, SCH--80/160 CS/AS PIPE	AS REQ.		
2	1/2"/3/4"/1"ROOT VALVE - SW GLOBE VALVE	2	2	2
33	1"SW EQUAL PIPE UNION	-	2	2
22	1"SW EQUAL TEE CS/AS	-	1	2
10	1/2"NPS, SCH 80/160 CS/AS NIPPLE	-	2	2
7	1"NPS, SCH 80/160 CS / AS PIPE	AS REQ.		
33	1"SW EQUAL PIPE UNION	2	2	2

NOTE:--

WITH VALVE SIZE 1/2"SW NIPPLE PIECE IS NOT REQUIRED

TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED

LAHMEYER INDIA		LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, GURGAON, INDIA	
CONTRACT NO. :		PROJECT : 1 X 800MW - NCTPP - STAGE - III	
PREPARED BY :		ENQUIRE & PUZHODHAKKAM VILLAGE, CHENNAI, TAMILNADU	
DESIGNED BY :		DRAWING TITLE :	
CHECKED BY :		INSTRUMENT DRAWING FOR DP GAUGE/ SWITCH & LEVEL SWITCH	
APPROVED BY :		DRAWING NO. :	
SHEET SIZE :		LI-GE015066-I-45786-013	
SCALE :		REV. : 00	
SHEET NO. :		1 OF 1	

Protection must be provided for the DP Gauge and Level Switch. It is the responsibility of the user to ensure that the DP Gauge and Level Switch are protected from damage. The user must ensure that the DP Gauge and Level Switch are protected from damage. The user must ensure that the DP Gauge and Level Switch are protected from damage.



TITLE
1x800 MW TANGEDCO NORTH CHENNAI TPP
FUEL OIL HANDLINGS SYSTEM &
MISCELLANEOUS TANKS
SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION NO. PE-TS-423-166-A001

REV 00

Section –II

Date

Page 1 of 1

SECTION – II

STANDARD TECHNICAL SPECIFICATION

SUB-SECTION IIA – Standard Technical Requirement (Mechanical)

	TECHNICAL SPECIFICATION FOR MISCELLANEOUS TANKS AND FUEL OIL HANDLING SYSTEM (STANDARD TANK SPECIFICATION)	SPECIFICATION NO. PE-TS-423-166-A001	
			SECTION IIA
		REVISION 00	DATE: 02/02/2017
		PAGE 1 of 10	

1.0

SCOPE

This specification covers design, engineering, supply of material, fabrication, assembly, inspection and testing at shop as well as at site, erection and commissioning, painting and functional demonstration testing at site.

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 applicable, out of the following standards.

1.

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

2.

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

3.

IS-804 Specification for rectangular pressed steel tanks

4.

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

5.

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

6.

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

7.

IS-2825 Code of practice for unfired pressure vessel

8.

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

9.

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

12.

Indian Factories Act

13.

American code for oil tanks API 650

14.

Material Specification as per relevant IS / or approved equal

15.

American water works association standards (AWWA D100)

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	TECHNICAL SPECIFICATION FOR MISCELLANEOUS TANKS AND FUEL OIL HANDLING SYSTEM (STANDARD TANK SPECIFICATION)	SPECIFICATION NO. PE-TS-423-166-A001	
			SECTION IIA
		REVISION 00	DATE: 02/02/2017
		PAGE 2 of 10	
3.0	<u>DESIGN REQUIREMENT</u>		
3.1	<u>General Requirement</u>		
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 which these tanks have to hold as specified and external forces due to wind and seismic forces without deformation or undue strain. The plates will be cold rolled through plate bending machines by several no. of passes to the curvature.		
3.1.2	Tank thickness shall be calculated as per IS803 latest edition. Intermediary wind girder design, Wind Design, Seismic design, anchor bolt design / selection etc. shall be done as per API 650 latest edition, latest addendum available at the time of detail engineering.		
3.1.3	All tanks will be designed for the capacities, dimensions and working conditions as specified in DATA SHEET for DM & Condensate Storage Tank . 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 for shells, bottom and roofs above and beyond the required thickness / calculated thickness / nominal thickness as specified in the design code shall be provided.		
3.1.4	Vessel seams shall be so positioned that they do not pass through nozzle connections on vessel. For vessels consisting of more than two sections, longitudinal seams shall be offset.		
3.1.5	The inside seam should be ground smooth, suitable for application of corrosion resistant primer. If the stiffening of shell, bottom and / or roof is necessary, tanks will be stiffened from outside.		
3.1.6	Flange faces of all nozzles shall be machined and squared with the vessel center line.		
3.1.7	All roofs and supporting structures shall be designed to support dead load plus a uniform live load of not less than 150 kg/m ² of projected area.		
3.1.8	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.		
3.1.9	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.		
3.1.10	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.		
Page 222 of 261			

	TECHNICAL SPECIFICATION FOR MISCELLANEOUS TANKS AND FUEL OIL HANDLING SYSTEM (STANDARD TANK SPECIFICATION)	SPECIFICATION NO. PE-TS-423-166-A001	
			SECTION IIA
		REVISION 00	DATE: 02/02/2017
		PAGE 3 of 10	

3.1.11

Material of construction of all tanks shall be mild steel conforms to IS – 2062 grade – B unless otherwise specified in the **DATA SHEET for DM & Condensate Storage Tank.**

3.1.10

Alignment

3.1.10.1

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.

3.1.10.2

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.

3.1.10.3

Each tank shall be properly constructed ensuring perfect vertical alignment with 5 mm or as specified in the relevant code / standard and tank circularity within 5 mm on diameter or as specified in the relevant code / standard. Local bulging and / or depressions at any location of tank particularly shell shall not be permitted.

3.1.11

WELDING

3.1.11.1

Tanks and other attachments shall be welded as per IS-816.

3.1.11.2

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.

3.1.11.3

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.

3.1.11.4

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.

3.1.12

Each tank shall be complete with access staircase, ladder and safety cage 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 for DM & Condensate Storage Tank.**

3.1.13

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

3.1.14

STAIRCASE / ACCESS LADDER AND HAND RAILING

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3.1.14.1 All cylindrical vertical tanks shall be provided with spiral staircase and shall conform to the requirements specified in design codes / standards unless specified otherwise. All stair treads shall be 32 mm steel fabricated gratings or 8mm thk. chequered plate which will be decided during detail engineering stage. 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 800 mm clear width.

3.1.14.2 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 diameter rods spaced at not more than 30 mm 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.

3.1.14.3 All staircase and roofs of vertical cylindrical tanks shall be provided with pipe hand railings of effective height as indicated in the relevant code / standard throughout. Handrails shall be constructed out of 32 mm medium class galvanized steel pipe conforming to IS- 1239: 1968. 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 and installed in an approved manner as directed by purchaser in accordance with approved drawings.

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

3.1.16 Unless otherwise specified, bolts and nuts shall be hexagonal head conforming to bolts and nuts shall be SA 193 & 194 respectively.

3.1.17 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.

3.1.18 Float level indicators other than float and arrow type level indicator, gauge glass shall be provided.

3.1.19 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.

3.2 **VERTICAL CYLINDRICAL STORAGE TANKS**

3.2.1 The vertical cylindrical storage (non- pressure) tanks shall be of mild steel welded construction and shall be designed in accordance with codes and standards as specified in the **DATA SHEET for Condensate Storage Tank**. 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.

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3.2.2	Conical roof shall be either self-supported or supporting. The roof shall have a slope as specified in the relevant design code 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 be 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 8 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 either self-supported or supported over rafters / 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	Openings needed for mounting various specified accessories shall be well reinforced in accordance with application codes and as approved. Manhole shall be bolted and hinged covers unless otherwise specified.		
3.2.11	All inlet pipe nozzles located at the top of tanks shall be provided with internal piping up to 500 mm high above the tank's bottom inside with suitable weir plate at bottom. The inside piping shall be adequately supported and shall be provided with adequately sized vent connection at pipe top.		
3.3.0	<u>RECTANGULAR TANKS</u>		

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3.3.1	Rectangular tanks shall be fabricated in 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 good engineering practice when their effect considered with tank load.		
3.3.2	Tank bottom and / or side plates shall be of minimum 8 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. Suitable sized drain valve of size minimum 25 NB unless otherwise specified in the DATA SHEET for DM & Condensate Storage Tank shall be provided below the tank bottom for proper draining of the tank.		
3.3.5	Complete assembled tank shall have at its bottom longitudinal steel fabricated bearer beams welded to it. The tank with bearer will rest over number of concrete blocks to be provided by purchaser. The tank shall be adequately bolted / welded to the concrete blocks. Needed inserts / anchor bolts shall be furnished by the bidders. Grouting of tank over concrete blocks in approved manner shall be included in bidder's scope of work, if erection is also awarded to the bidder.		
3.3.6	Where rectangular tanks are flushed in dual compartments the inside partition plate shall be well reinforced to withstand hydrostatic test pressure completely on one side throughout the full height.		
3.3.7	The rectangular tank shall be designed as per good engineering practice and reference shall be taken from the book named "Theory of plates and shells" by Timoshenko. Design calculation shall be done in accordance with the above mentioned book.		
3.3.8	Suitable steel structural e.g. channels shall be provided below the bottom plate so that tank can rest on the foundation / slabs through the structural supports.		
3.4	<u>HORIZONTAL CYLINDRICAL TANK</u>		
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 / IS – 2825 / ASME as specified in the DATA SHEET for DM & Condensate Storage Tank . 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 relevant code / standard.		

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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 center line.

3.4.4

All tank shall be supplied with integral saddle support and shall be designed in accordance with BS- 2594 / IS – 2825 / ASME as specified in the **DATA SHEET for DM & Condensate Storage Tank.**

4.0

TESTING AND INSPECTION AT MANUFACTURERER’S WORKS

4.1

General

4.1.1

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

4.1.2

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

4.1.3

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

4.1.4

All materials including valves, instruments, pipings, flanges, counter flanges etc. shall be procured from BHEL approved manufacturer’s only. Dealers are not acceptable.

4.2

TESTING AND INSPECTION FOR TANKS

4.2.1

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

i)

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

ii)

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

iii)

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

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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.

xiv)

All tanks under this specification shall be tested as per the relevant design and testing code / standard. Supplier shall submit the detailed testing procedure for the tanks during detail engineering stage for BHEL / customer / consultant’s approval and approved document shall be adhered by them and testing shall be done accordingly without any commercial implication.

4.2.2

NON - PRESSURE TANKS

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

i)

Identification of materials to manufacturer’s test certificates.

ii)

Inspection of plate edges after edge preparation and checking curvature against templates if shell plates sent after rolling.

iii)

Checking of dimension and match marking.

iv)

Bottom testing

a.

After the bottom and bottom course of shell plates have been welded, the bottom shall be tested by pumping air beneath the bottom plates to a pressure just sufficient to lift them off

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the foundation and in any case not less than 100 mm water gauge. The pressure shall be held by construction of a temporary dam of clay or other suitable material around the tank periphery. Soap suds or other suitable material shall be applied to all joints for detection of leaks.

b. Fuel oil may be used instead of air and soap suds to test for leaks, subject to prior agreement and approval of purchaser.

c. Alternatively, the bottom seams may be tested by vacuum box method subject to prior agreement and approval of the purchaser. The vacuum box used shall comply with IS- 803, 1976 (figure-24)

v) Shell testing

The shell of fixed roof non - pressure tanks shall be tested after completion of roof. Testing shall be done by filling the tank with water to the level of the top leg of the top curb angle and noting any leaks.

vi) Roof testing

The roof of the tank shall be tested by pumping air under the roof plates while the tank is still full of water. In the non - pressure tank, the roof shall be tested to a pressure of 75 mm of water gauge and in case of pressure roof tanks, to a pressure of one and a quarter times the pressure at which the pressure sides of the pressure / vacuum relief valve is designed to open. Soap suds or other suitable material shall be applied to all joints for detection of leaks.

vii) All field-testing shall be performed prior to any painting or coating application.

4.3 REPAIR OF LEAKS

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

4.3.2 In the joints between roof plates only, pin hole leaks may be repaired by mechanical caulking. 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.

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

4.3.4 When the tank is filled with water for testing, defects in the shell joints shall be repaired with the water level at least 300 mm below the joint being repaired.

4.3.5 No welding shall be done on any tank unless all lines connecting thereto have been completely blanked off. No repairs shall attempted on tanks while filled with oil, nor any tanks which have contained oil until the tanks have been emptied, cleaned and freed from gas in a safe manner. No repair shall be attempted by the on a tank which has contained oil

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**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS TANKS AND FUEL OIL
HANDLING SYSTEM
(STANDARD TANK SPECIFICATION)**

SPECIFICATION NO. PE-TS-423-166-A001

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except in a manner approved in writing by the purchaser, and in absence of the purchaser's inspector.

Format for Operation & Maintenance Manual

Project name :

Project number :

Package Name :

PO reference :

Document number :

Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	Cover page				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	Description of Plant/System				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				

4.0	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/user/operator				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair , Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				

6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

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- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

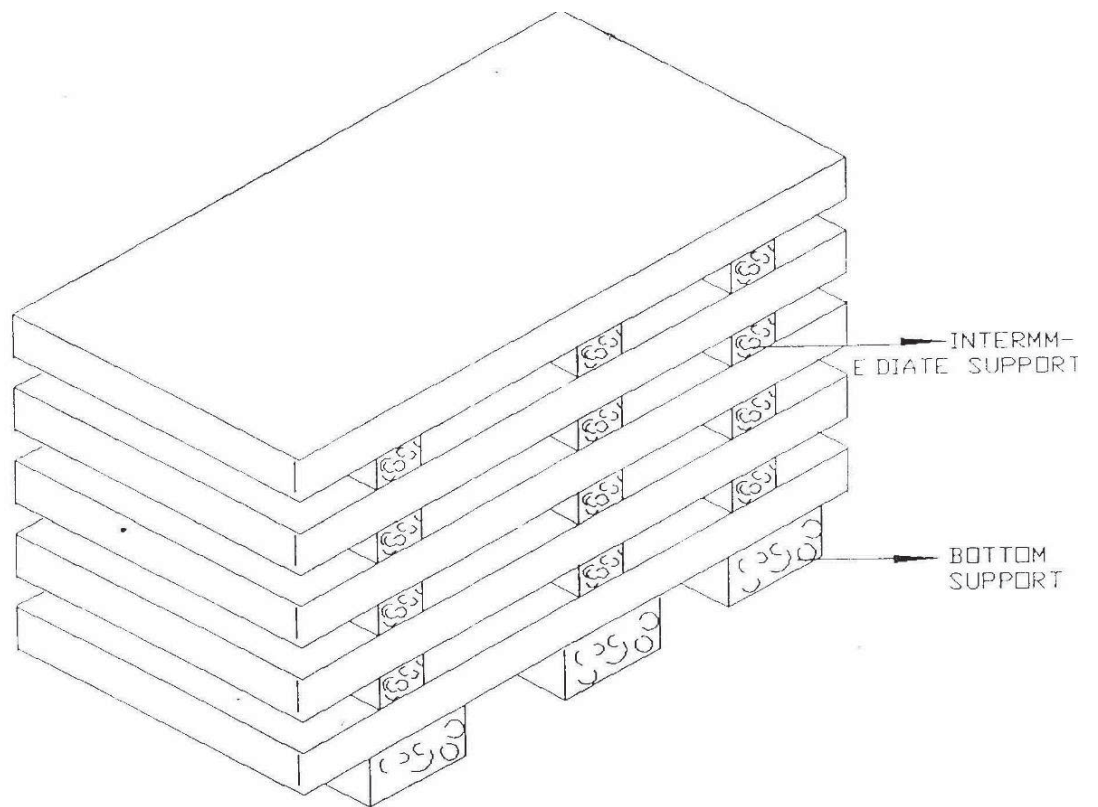


Figure – 1 – PLATE STACKING ARRANGEMENT

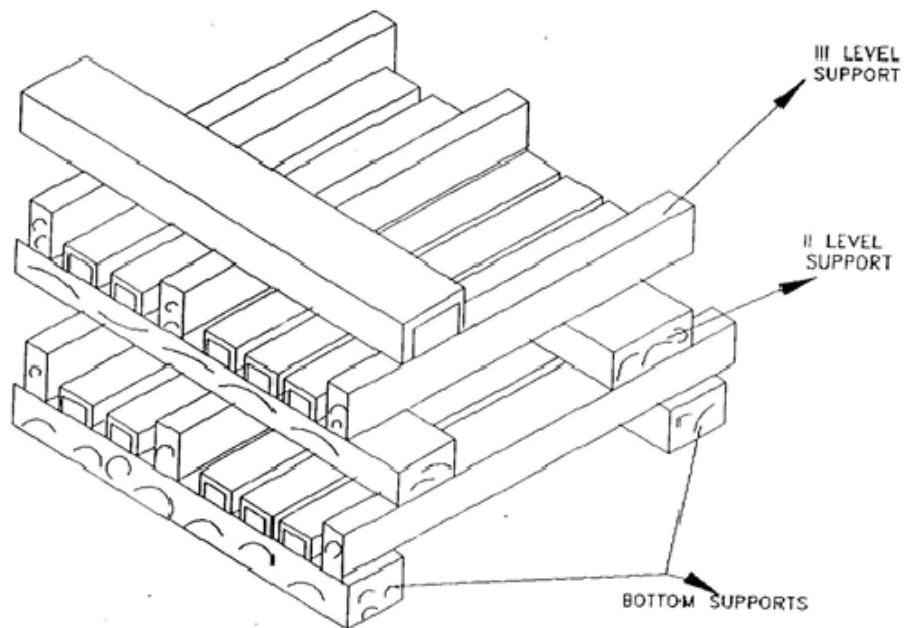


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



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SECTION – III

DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID



TITLE

STANDARD TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM AND MISC TANKS

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

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SHEET OF

DRAWINGS AND DOCUMENTS TO BE SUBMITTED WITH THE BID

The bidder must submit the following drawings and documents along with their bid in **4 sets** so as to enable BHEL to evaluate their offer. In absence of any of these documents, BHEL reserves right not to evaluate the offer of the concerned bidder.

- a. All the relevant documents and certificates required to establish/meet PQR criteria, If applicable as given in tender documents
- b. Deviation schedule, strictly as per enclosed format under Sec-III.
- c. Un-priced copy of price format indicating quoted/ not quoted against each row & column.
- d. Recommended Foundation drawing of tank along with loading data, anchor bolt details etc.
- e. Compliance cum Confirmation certificate duly stamped and signed, attached under section -III of this Specification.

In the absence of any one of the documents mentioned above, bidder's offer is liable to be rejected. Further any documents submitted by bidder other than above shall not be taken cognizance of and these shall not form part of contract.



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SECTION – III

SUB-SECTION-IIIB - Electrical Load data



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SECTION – III

SUB-SECTION-IIIC - Compliance cum confirmation



TITLE:

TECHNICAL SPECIFICATION

COMPLIANCE CUM CONFIRMATION CERTIFICATE

SPEC. NO.: PE-TS-STD-166-A001

SECTION: III

REV. NO.

DATE

SHEET 1 OF 2

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificates (every sheet) and furnish the same with 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" in section C 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) The tank functional guarantees shall stand valid till at least eighteen (18) months from Hydro test of tank as per technical specification or commercial terms and conditions, whichever is later.
- 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

COMPLIANCE CUM CONFIRMATION CERTIFICATE

SPEC. NO.: PE-TS-STD-166-A001

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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



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SECTION – III

SUB-SECTION-IIID - Deviation Schedule

DEVIATION SHEET (COST OF WITHDRAWAL)



PACKAGE:- MISCELLANEOUS TANKS

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.



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SECTION – III

SUB-SECTION-IIIE - Pre-bid clarification schedule



TITLE

PRE-BID CLARIFICATION SCHEDULE

MISCELLANEOUS TANKS

SPECIFICATION NO. PE-TS-STD -167-A001

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PRE-BID CLARIFICATION SCHEDULE

S.No.	Section/Clause/ Page No.	Statement of the referred clause	Clarification required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL



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SECTION – III

SUB-SECTION-IIIF - Suggestive BBU

INDICATIVE BILLING BREAK UP FOR MISC. TANKS AND FUEL OIL HANDLING SYTEM -SUPPLY					
1X800 MW North chennai TPP					
	DESCRIPTION OF EQUIPMENT / ITEM	QTY.	UNIT	Allocations percent of Total price(For site)	
1	2	3	4	5	
1.0.0	Total Lumpsum firm price on FOR site basis for design and engineering, manufacturing, inspection/testing at vendor's/sub-vendor's works/site, duly packed, supply/delivery to site including freight, unloading, storage and handling at site, commissioning spares, complete with all accessories including instruments required ,in line with drawings/ documents/ test procedures approved by BHEL/ customer, for the total scope defined in technical specification (spec.No. PE-TS-423-166-A101) and terms & conditions of tender, taking into account all clarifications, confirmations and agreements till date, inclusive of all prevailing taxes, duties and other levies, for 1No. Condensate Storage tanks AND 1No. HSD day Tank for 1X800 MW NOTH CHENNAI TPP.	1	LOT		
2.0.0	Break Up Prices				
2.1.0	Lump sum price of total CS plates for the tanks		TON	57-62 % of total price of clause 1.0.0	
2.2.0	Lump sum price of all structures including hand-railings etc. for the tanks		TON	8-12 % of total price of clause 1.0.0	
2.3.0	Lump sum price of total number of valves required for the tanks		NOS	8-12 % of total price of clause 1.0.0	
2.4.0	Lump sum price of total length of the piping for the tanks		MTR	12-16 % of total price of clause 1.0.0	
2.5.0	Lump sum price of total no. of level gauges required for the tanks		NOS		
2.6.0	Lump sum price of NaOH breathers for the tank		SET		
2.7.0	Lump sum price of seal pots for the tank		NOS	5-8 % of total price of clause 1.0.0	
2.8.0	Total amount for commissioning spares		LOT		
2.9.0	Lump sum price of painting for the tank		LOT		
3.0.0	Total of 2.0.0 (Total of 2.1.0 to 2.9.0) should match with of 1.0.0.			100 % of Total price of clause 1.0.0	
Note: The percentage of individual items shall be maintained by the successful bidder during submission of the BBU for the Misc. Tank and fuel oil handling system package during the detail engineering stage.					
Bidder's / bidder's representative signature					