

**TAMILNADU GENERATION AND DISTRIBUTION
CORPORATION LIMITED.**

**2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE
OF NCTPS, CHENNAI**

VOLUME IIB & III

**TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING SYSTEM**

SPECIFICATION NO.: PE-TS-412-166-A001



BHARAT HEAVY ELECTRICALS LTD

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

INDEX

S. NO.	Description	Page no.
1.0	Volume-II B- Technical Specification	
2.0	a) Section-A, Intent of Specification	3-5
3.0	b) Section- B, Project Information	6-18
4.0	c) Section –C,	
	A. Specific Technical Requirement	19-30
	B. Annex-I- System Write Up	31-36
	C. Annex-II	37-46
	I. Equipment Design Criteria	
	II. Datasheets for Mechanical Equipments i.e. Tanks, Pipes ,Fittings, Valves and Pumps	
	D. Annex-III Quality Plans- Mechanical Systems	47-73
	E. Annex-IV Tentative List of Sub vendors	74-77
	F. Annex-V Mandatory spares for FO system	78-79
	G. Annex-VI Dwgs /Docs to be submitted with bid	80-81
	H. Annex –VII Drawings/Documents to be submitted after award of contract	82-86
	I. Annex – VIII Customer Specification	87-261
5.0	d) Section-D	
	A. Technical Specification for Tanks	262-271
	B. Electrical specification for Electrical items	272-316
	C. Control & Instrumentation specification	317-468
6.0	Volume-III, Technical Schedules & Checklist to be submitted by bidder	469-473
7.0	Drawings	474-478
	a) Plot plan, Dwg No.- PE-DG-412-100-M001	
	b) Process & Instrumentation Diagram for HFO System. Dwg No.- PE-DG-412-166-A101	
	c) Process & Instrumentation Diagram for HSD System. Dwg No.- PE-DG-412-166-A102	
	d) Process & Instrumentation Diagram for Steam and Condensate System. Dwg No.- PE-DG-412-166-A103	
8.0	Unpriced price schedule	479-487

**2X660MW ENNORE SEZ COAL BASED STPP AT ASH
DYKE OF NCTPS, CHENNAI**

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

VOLUME-IIB

SECTION – A

(INTENT OF SPECIFICATION)



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



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X600MW ENNORE SEZ COAL BASED STPP**

SPECIFICATION NO. PE-TS-412-166-A001

VOLUME II B

SECTION C

REV - 00

DATE - 20.03.2015

1.0 SCOPE OF INQUIRY / INTENT OF SPECIFICATION

- 1.1 The specification is intended to cover design, engineering, manufacture, inspection and testing at vendor's/ sub-vendor's works, painting, forwarding, proper packing and shipment and delivery at site, unloading, handling & transportation at site, Erection & Commissioning including commissioning spares(if applicable), minor civil works as required on FOR site basis, functional guarantee testing and handing over **of FUEL OIL UNLOADING & STORAGE SYSTEM** as per details in different sections / volumes of this specification for **2X600MW ENNORE SEZ COAL BASED STPP**.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor, of the responsibility of providing such facilities to complete the supply, erection and commissioning of **FUEL OIL UNLOADING & STORAGE SYSTEM**.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification **within 10 days of receipt of tender documents**. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORGAE SYSTEM
2X600MW ENNORE SEZ COAL BASED STPP**

SPECIFICATION NO. PE-TS-412-166-A001

VOLUME II B

SECTION C

REV – 00

DATE - 20.03.2015

- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.
- 1.9 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.10 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean **BHEL and /or TNAGEDCO** including their consultant as interpreted by BHEL in the relevant context.

2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE
OF NCTPS, CHENNAI

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

VOLUME-IIB

SECTION – B

(PROJECT INFORMATION)



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

**SPECIFICATION
FOR
EPC CUM DEBT FINANCING CONTRACT
VOLUME II – GENERAL & SCHEDULES**

CHAPTER 1

PROJECT SYNOPSIS

1.0 GENERAL BACKGROUND AND SALIENT FEATURES

1.1 Introduction

Tamilnadu Generation and Distribution Corporation owns the proposed green-field 1320 MW (2 units of 660 MW each) Coal Based Thermal Power Station at Katupalli. This is an expansion of North Chennai Thermal Power Station (NCTPS) and located on some portion of the ashdyke of NCTPS.

1.2 Location

The proposed site for main power plant is located near Ennore port (approx 5 kms).

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

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

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

1.3 Type of Plant

The proposed 2x660 MW Super-Critical Power Project consists of coal fired steam generator connected to a reheat type steam turbine generator along with all the required auxiliaries. Circulating cooling water system is envisaged for condenser cooling.

The description and salient technical data of the Steam Generator, Steam Turbine Generator, Auxiliary systems, Electrical, Control & Instrumentation, Civil etc. are explained elsewhere in the specification:

1.4 PROJECT INFORMATION

Project Title : **2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power Project at Ash Dyke of NCTPS**



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



Owner : **TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)**

LOCATION

The site is located near Vayalur Village, Ennore

Latitude : 13⁰17' N to 13⁰18' N

Longitude : 80⁰18' E to 80⁰19' E

Distance from Chennai City : 35 km

Nearest Airport is at Chennai at a

Distance of : 60 km

Nearest Seaport is : Ennore

Nearest Railway Station is : Athipattu Pudunagar (approx 5 kms)

Meteorological Condition

Climate : Tropical ,very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind.

Climatological data : Ambient temp. (°C)
Annual Maximum Mean Temp 41.5(°C)
Annual Minimum Mean Temp 24(°C)
Design Ambient temperature 35(°C)

Relative Humidity

Maximum 100%

Minimum 36%

Design 75%

Annual Rainfall

Maximum 2540 mm

Average 1600 mm

Minimum 1175 mm

Prevailing Wind Direction

Nov to Jan – From NW & NE



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



Feb to Mar – From East & SE
 Apr to May – From South & SE
 June – From SW
 July to Aug – From NW
 Sept to Oct – From SE & SW
 Wind Speed 11.8 kmph (avg)
 50 kmph (max)
 Seismic Zone III as per
 IS:1893-2002

1.5 Access to Site

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

1.6 Plant Rating, Capacity, Availability, PLF

Each of the two units shall have a Turbine maximum continuous rating (TMCR) of 660 MW at generator terminals based on the following site conditions.

- Ambient air temperature
- Condenser cooling water inlet temperature of 33°C and 9°C temperature rise across the condenser.
- Generator power factor of 0.85.
- Fuel specification as given elsewhere.
- Design temperature for electrical equipment is 50°C.

The VWO capacity of the steam turbine shall not be less than 105% of TMCR flow at rated parameters. Boiler maximum Continuous Rating (BMCR) will be established to match the steam flow at VWO conditions, but BMCR flow shall not be less than 108% of TMCR flow.

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%.

1.7 Power Evacuation

Power will be evacuated from the proposed thermal power station at 400 KV voltage level through 400 KV transmission lines. The power evacuation lines would be double circuit 400 KV lines which will act as Line in & Line out circuit.



2 x 660 MW Ennore SEZ Supercritical Thermal Power
 Project at Ash Dyke of NCTPS
 Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



1.8 Site Selection

The following factors which influence the project site selection have been found very favourable to establish and operate the project.

- a. Availability of fuel.
- b. Existing power plant
- c. Availability of adequate cooling water.
- d. Availability of adequate land for locating the power plant with approach roads.
- e. Suitability of land from topographical and geological aspects
- f. Proximity of National Highways, Ports & Transport of fuel & heavy equipment.
- g. Facility for interconnection with transmission and distribution system for evacuation of power.
- h. Environmental aspects.

Total land required for the project is 500 acres which is under the possession of TANGEDCO.

1.9 Fuel

1.9.1 Source of Fuel

Domestic coal requirement for the power plant will be sourced from Kalinga block of Talcher coal fields, Mahanadi and IB valley coal fields in the state of Orissa. Coal will be transported by sea. The port of dispatch and port of receipt for domestic coal would be Paradip port and Ennore port respectively. Imported coal shall be sourced from foreign countries through sea to Ennore port.

Coal can be transported from coal mines to Ennore port by sea and unloaded at proposed coal berth-III. Further the coal can be transported to the proposed power plant through pipe conveyor which shall have a system capacity of 2 x 2000TPH.

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

The analysis of fuel is given below :

1.9.2 Coal Analysis:

Coal Quality Parameters

SL.NO	DESCRIPTION	DOMESTIC COAL	IMPORTED COAL
1.	HIGHER HEATING	2800 (GCV as	6250 (GCV Air



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



	VALUE -As Fired basis given Kcal/kg	received basis)	dried basis) 5642 (as received basis)
2.	TOTAL MOISTURE %	During rainy season 20% (inherent + surface)	16.5%
3.	HGI Abrasive ness expected YGP Shale and sand stone content Feed coal size	45 to 55 Average 52 50 to 70 mg/kg 20% max. upto 50 mm.	51

DOMESTIC COAL

Sr. No.	Particulars	Units	Parameters
A.	Proximate Analysis		
1.	Moisture	%	16.00
2.	Volatile Matter	%	19.00
3.	Ash	%	45.00
4.	Fixed carbon	%	20.00
	Total	%	100
B.	ULTIMATE ANALYSIS, % (As received)		
1.	Carbon	%	27.70
2.	Hydrogen	%	2.60
3.	Nitrogen	%	0.52
4.	Oxygen	%	7.26
5.	Sulphur	%	0.50
6.	Ash	%	45.00
7.	Moisture	%	16.00
8.	Carbonates	%	0.38
9.	Phosphorous	%	0.04
10.	Others	%	-
	Total	%	100.00
C.	Ash fusion temperature	deg C	
1.	Initial deformation, IT	deg C	1100
2.	Spherical, ST	deg C	1200
3.	Hemispherical, HT	deg C	1300
4.	Fluid, FT	deg C	-
D.	Ash Analysis, %		
1.	Sio2	%	59.54
2.	Al 2 O3	%	29.00
3.	Fe2O3	%	6.42
4.	CaO	%	1.50
5.	Na2O	%	0.08



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



Sr. No.	Particulars	Units	Parameters
6.	K ₂ O	%	-
7.	TiO ₂	%	1.60
8.	SO ₃	%	0.25
9.	P ₂ O ₅	%	0.51
10.	MgO	%	0.50
11.	Others	%	0.60
12.	Total		100.00
E	Resistivity of fly ash	Ohm - cm	1.73x 10 ¹²

IMPORTED COAL

Sr. No.	Particulars	Units	Parameters
A.	Proximate Analysis (As received)		
1.	Moisture	%	16.50
2.	Volatile Matter	%	36.45
3.	Ash	%	6.62
4.	Fixed carbon	%	40.43
5.	Total	%	100.00
B.	ULTIMATE ANALYSIS, % (As received)		
1.	Carbon	%	60.12
2.	Hydrogen	%	4.38
3.	Nitrogen	%	1.48
4.	Oxygen	%	10.37
5.	Sulphur	%	0.53
6.	Ash	%	6.62
7.	Moisture	%	16.5
8.	Carbonates	%	-
9.	Phosphorous	%	-
10.	Others	%	-
	Total	%	100.00
C.	Ash fusion temperature	deg C	
1.	Initial deformation, IT	deg C	1230
2.	Spherical, ST	deg C	1270
3.	Hemispherical, HT	deg C	1320
4.	Fluid, FT	deg C	-
D.	Ash Analysis, %		
1.	SiO ₂	%	36.00
2.	Al ₂ O ₃	%	13.90
3.	Fe ₂ O ₃	%	14.80
4.	CaO	%	12.70
5.	Na ₂ O	%	0.70
6.	K ₂ O	%	1.70
7.	TiO ₂	%	0.80



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



Sr. No.	Particulars	Units	Parameters
8.	SO ₃	%	10.60
9.	P ₂ O ₅	%	0.20
10.	MgO	%	8.60
11.	Others	%	-
12.	Total	%	100.00

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

S. No.	Particulars	Unit	Parameter
1	Total Moisture (ARB)	%	Up to 23 (Max)
2	Ash (ADB)	%	Up to 20 (Max)
3	Gross Calorific Value (ADB)	Kcal / Kg	5800 - 6500
4	Sulphur (ADB)	%	Up to 1 (Max)
5	Fixed Carbon (ADB)	%	30-50
6	Volatile Matter (ADB)	%	25-45
7	HGI		45-60
8	IDT (Under Reducing Atmosphere)	Deg C	1100-1250
9	Size	mm	< 50

Note: ADB stands for “As dried Basis” and ARB for “As Received Basis”

1.9.3 Specification of LDO

Specific gravity @ 15° C	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 Vol. Max. %	0.25

1.9.4 Specification of HFO

Flash point “°C” min.	66
K. Viscosity in Centistokes @ 50° C max.	370



Ash by wt. %	0.1
Water content by volume % max	1
Sediment by weight % max	0.25
Total Sulphur by weight % max	4.5
Gross calorific value, Kcal/kg	10800

1.9.5 Fuel Linkage

TANGEDCO has approached Ministry of Coal through Ministry of Power for the long term linkage of Coal from the coal sources of Talcher or Mahanadi in Orissa.

The coal requirement has been worked as under:-

Coal required at MCR per hr. (Blended) 872 tonnes

Per day 20928 tonnes.

Annual 6.5 MTPA for 85% PLF

1.9.6 Fuel Transportation

The coal shall be received at Ennore port. The coal will be transported by pipe conveyor from coal berth 3 in Ennore Port and then through 2 x 2000 TPH pipe conveyor to the bunker directly or to stockyard.

1.10 Source Of Water

1.10.1 Source

The raw water intake shall be from the existing cooling water forebay of NCTPS PHASE-II.

1.10.2 Chemical analysis of Sea Water:

As given in Annexure-1, Volume III, Chapter- 3.

1.10.3 Requirement

The requirement of water for the plant will be for meeting the requirement of make up for the re-circulating cooling water system, dust suppression system in coal handling plants, ash disposal system and the RO/ D.M. water plant which will be supplying the power cycle make up requirements, etc. In addition the water requirements will be for drinking and service purposes. Water requirement is estimated as approx. 15523 m³/hr.



1.11 Source of Equipment

The proposed plant will be supplied, erected and commissioned on Single EPC basis.

1.12 Power Evacuation Plan

Power will be evacuated from the proposed thermal power station at 400 KV voltage level through 400 KV transmission lines . The power evacuation lines would be double circuit 400 KV lines.

1.13 400 KV GIS Switchyard

The 400 KV Switchyard is proposed to have one and a half bus arrangement and will comprise following bays/circuits :

- ◆ 2 – Generator transformer bays
- ◆ 1– Start up transformer bay
- ◆ 4 – Line Bays
- ◆ 2 – Bus VT's
- ◆ 2 – Bus Reactor Bays
- ◆ 2 – Spare bay (Equipped)
- ◆ 1 – Equipped bay for future GT
- ◆ 2 – Equipped bays for future lines

The switchyard will be complete with galvanized steel structures, lightning surge arrestors, OPGW Equipment, CTs, PTs of suitable VA burden and accuracy class as required for measurement protection and communication, insulators, bus-bars clamps & hard wares etc. The switchyard will be controlled by computerized control and data acquisition (SCADA) system.

1.14 Average Yearly Generation

The average yearly generation is calculated considering the following.

- The expected plant load factor is 85 %. With this PLF the average yearly generation will be around 11914 Million units.

1.15 INFORMATION FOR ENVIRONMENTAL APPRAISAL**1.0 GENERAL INFORMATION ABOUT THE PROJECT**

1.1	Name / Title of the Project	:	2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power Project at Ash Dyke of NCTPS
1.2	Name of Owner	:	Tamilnadu Generation and Distribution Corporation (TANGEDCO)



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



- 1.3 Location of the Project : Near Vayalur Village, Ennore, Tamil Nadu
- 1.4 Site where proposed plant is to be located : Ash dyke of NCTPS
- 1.5 Capacity of the project under consideration : 2x 660MW
- 1.5.1 Govt. land / Private land / others : TANGEDCO land
- 1.5.2 Topographical feature, demographic profile & physiography : Site has differential levels and require filling to maintain the desired grade level of +10.00 meter above MSL
- 1.5.3 Nature of soil : Clayey soil
- 1.5.4 Distance from the nearest town / city / major human settlements : Chennai -35 km
- 1.5.5 Population to be displaced : Nil
- 1.5.6 Distance from water source : Approx. 5 km (from Cooling Water Forebay of NCTPS Stage II)
- 1.5.7 Area of forest land, if involved : Nil
- 1.5.8 Distance of forest from the site : N.A
- 1.6 Is this an extension? If so indicate capacity of existing plant : No
- 1.7 What is the ultimate capacity envisaged : 2x660 MW
- 2.0 GENERAL ENVIRONMENTAL INFORMATION**
- 2.1 Area of the land proposed to be acquired : Refer Plot Plan Land already acquired
- i. Area required for plant : 500 Acres
- ii. Ash disposal : 100 % dry fly ash disposal and



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



- 100% wet bottom ash disposal is envisaged to existing ash pond.
- iii. Plant facilities : The area is adequate for locating all the required systems for 2x660 MW.
- 2.2 Area proposed to be built-up or developed : Power station will be built-up in the proposed site as indicated in the plot plan.
- 2.3 Specify site characteristics River basin/ estuarine / coastal / others : Site is close to Buckingham Canal
- 2.4 Is the site situated in the forest area? Give following details : No
- 2.4.1 Area : N.A
- 2.4.2 Type of forests : N.A
- 2.5 Is site situated near to the forests? Give the distance from the site. : N.A.
- 2.6 Give a description of the flora within 25 km of your plant site under the following heads :
- a. Crops :
 - b. Forest :
 - c. Grass land :
 - d. Endangered species :
 - e. Others (Specify) :
- } Refer details in the specification elsewhere.
- 2.6.2 Give details of the following features, if they exist, within a radius of 25 km of the proposed site? :
- i. Fisheries :
 - ii. Sanctuary / natural park biosphere reserve :
 - iii. Lakes / ponds / reservoir :
 - iv. Stream / river : Buckingham canal is close to the site
 - v. Estuary / sea : Bay of Bengal is 5 km from site



- vi. Hills / mountains :
- vii. Historic / cultural / tourist / archaeological scenic sites / defence installations :
- 2.7 Human settlement :
- 2.7.1 Total number of persons proposed to be employed :
- i. During construction : 2500
450(0.75person/MW) TANGEDCO
- ii. During operation : direct employees



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF
NCTPS, CHENNAI

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

VOLUME-IIB

SECTION – C

(SPECIFIC TECHNICAL EQUIREMENT)



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

	TECHNICAL SPECIFICATION FOR FUEL OIL UNLOADING & STORAGE SYSTEM 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI	SPECIFICATION NO. PE-TS-412-166-A001	
		VOLUME II-B	SECTION 'C'
		REVISION 00	DATE:20.03.2015
		PAGE 2 of 12	

1.0.0 SCOPE OF WORK

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

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

2.0.0 SCOPE OF SUPPLY

2.1.0 Scope of Supply

Scope of supply shall comprise of the following:

- 2.1.1 Three(3) nos, 2W+1S, HFO Horizontal twin screw unloading pump motor set each of capacity 100m³/hr with simplex type strainers at their suction. These pumps & strainers shall be electric traced.
- 2.1.2 Two (2) nos, (1W+1S), HSD twin screw unloading pump motor set each of capacity 50 m³/hr with twin simplex type strainers at their suction.
- 2.1.3 Eight (8) Nos. HFO unloading hoses, 8 Nos. HSD unloading hoses, 8 nos steam & condensate hoses with hose stand.
- 2.1.4 Two (2) nos. of fixed roof type M.S storage tanks for storage of HFO as per IS 803 of net capacity 3000 m³ each duly fitted with steam heated floor coil heaters, suction heaters and other appurtenances, accessories, instrumentation, control and fittings etc. to maintain and monitor the tank temperature.
- 2.1.5 One (1) no. fixed roof type M.S storage tank for storage of HSD as per IS 803 of net capacity 1000 m³ duly fitted with appurtenances, accessories, instrumentation, control and fittings etc.
- 2.1.6 Two (2) nos. (1 W+1S) vertical centrifugal sump pump each of capacity 30 m³/hr located inside FO Unloading Pump House.
- 2.1.7 Instrumentation & control System including instruments, interlocking & protection devices complete in all respects required for safe, efficient and reliable operation of the system.
- 2.1.8 One (1) no. Pressure Reducing and de-superheating station to reduce aux. steam from 16 kg/cm² (a) and 290°C to 4.0 kg/cm² (a) and 150°C or as required by FO System vendor during detail engineering. PRDS shall be located near Tank Dyke Area.
- 2.1.9 Complete Fuel oil piping, auxiliary steam piping, drain piping, vent piping, condensate piping, instrument air piping and valves etc as applicable to Fuel oil unloading & storage system.
- 2.1.10 Complete steam tracing / electric tracing, insulation and cladding of heavy fuel oil piping, drain oil piping, steam and condensate piping & accessories.
- 2.1.11 All foundation bolts/ anchor bolts required for any equipment foundation under the package.
- 2.1.12 Two (2) nos.(1W+1S) Vertical centrifugal type pumps of cap. 30m³/hr for pumping separated water from oil water separator to guard pond in the ETP area.
- 2.1.13 One (1) no oil water separator pit near Tank Dyke area with 10 ppm water quality at outlet.
- 2.1.14 LT transformers and LT switch gears for FO Unloading system shall be as per contract specification, Vol-IV (Electrical specification).

	TECHNICAL SPECIFICATION FOR FUEL OIL UNLOADING & STORAGE SYSTEM 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI	SPECIFICATION NO. PE-TS-412-166-A001	
		VOLUME II-B	SECTION 'C'
		REVISION 00	DATE:20.03.2015
		PAGE 3 of 12	

2.1.15 Two (2) nos (1W+1S). recovery oil pump of capacity 5 m3/hr for pumping the recovered oil from oil water separator (oil pit) to HFO tanks.

- a) **Mandatory spares** as per **Annexure-V** of specification.
- b) Initial charge of all lubricants and fluids except HFO and HSD
- c) All valves, counter- flange with nuts, bolts and gaskets at all the terminal points.
- d) All equipment Foundation bolts/ Anchor bolts etc.
- e) Flow able non- shrink grout of one grade higher than concrete used for civil work grouting below base plate for all structure/ equipment & for grouting of foundation / anchor bolts..
- f) Relevant scope of supply as per GTR, GCC & SCC.
- g) Valves in pit outside dyke as required as per latest OISD recommendation complying to requirement whichever is more stringent.
- h) Any changes required to take care of temperature effect to be considered by bidder as part of total cost quoted.
- i) Any other instrument, item required for making the installation complete in all respect and for satisfactory operation of the system for the scope within the terminal point, as well as to meet any statutory requirement relevant to the package, unless specifically EXCLUDED from scope of supply.

1.2.0 SCOPE OF SERVICES

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

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

	TECHNICAL SPECIFICATION FOR FUEL OIL UNLOADING & STORAGE SYSTEM 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI		SPECIFICATION NO. PE-TS-412-166-A001	
			VOLUME II-B	SECTION 'C'
			REVISION 00	DATE:20.03.2015
			PAGE 4 of 12	

k) Preparation of civil assignment drawings i.e. pedestals details; insert plates / embedment's plates required for supporting pipes and equipment etc. and review of civil drawing prepared by customer based on civil assignment drawing of bidder. In case any modification is required in the civil work already done based on civil inputs given by vendor, rework shall be done at the cost and risk of the vendor.

l) Preparation of all drawings as per list enclosed under **Annexure VII**.

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

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

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

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

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

2.0.0 EXCLUSION

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

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

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

b) Fire Protection system for storage tank.

c) Air Conditioning / ventilation of Fuel Oil pump house.

	TECHNICAL SPECIFICATION FOR FUEL OIL UNLOADING & STORAGE SYSTEM 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI	SPECIFICATION NO. PE-TS-412-166-A001	
		VOLUME II-B	SECTION 'C'
		REVISION 00	DATE:20.03.2015
		PAGE 5 of 12	

d) Control/IO panel for Fuel Oil pump houses

e) Lifting equipment for unloading pump house for maintenance purpose of these pumps. Capacity of lifting equipment is envisaged as 1.5 T with lift as 8.5 m. Bidder to confirm adequacy of the same.

f) DCS control. However, all logic for implementation of control and monitoring from DCS shall be provided by successful bidder during detail engineering.

g) Exclusion as indicated in Electrical & C&I portion of technical specification

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

3.0.0 SERVICES TO BE PROVIDED BY THE CUSTOMER

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

4.0.0 TERMINAL POINT

HSD

:

Near oil unloading area:

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

Near fuel oil unloading & pressurizing pump house:

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

HFO

:

Near oil unloading area:

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

Near fuel oil unloading & pressurizing pump house:

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

Aux. Steam

:

Steam header at 16 kg/cm2 by BHEL-PC at 2000mm from FO unloading & pressurizing building.

At the TP BHEL shall supply 4 MT/hr of steam. Bidder shall check the adequacy of the same. In case this is not adequate, bidder to inform the maximum aux. steam requirement at this TP along with manual calculation for the same.

Effluent from Oil Water Separators

:

Vendor’s TP at the guard pond in ETP area

Drain from dyke area

:

Page 23 of 487

	TECHNICAL SPECIFICATION FOR FUEL OIL UNLOADING & STORAGE SYSTEM 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI	SPECIFICATION NO. PE-TS-412-166-A001	
		VOLUME II-B	SECTION 'C'
		REVISION 00	DATE:20.03.2015
		PAGE 6 of 12	

To OWS during normal condition & to plant drain during rainy season through two way valve pit. Valves in the valve pit along with limit switch for the same are included in bidder's scope.

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

5.0.0 PERFORMACE REQUIREMENTS

This will comprise of:

5.0.1 PERFORMANCE requirement at shop:

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

5.0.2 Functional Guarantees at site:

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

6.0.0 LAYOUT REQUIREMENTS

	TECHNICAL SPECIFICATION FOR FUEL OIL UNLOADING & STORAGE SYSTEM 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI	SPECIFICATION NO. PE-TS-412-166-A001	
		VOLUME II-B	SECTION 'C'
		REVISION 00	DATE:20.03.2015
		PAGE 7 of 12	

a) System layout shall conform to the requirements of the Petroleum Act 1934 & Petroleum Rules 2002, OISD 118 latest edition whichever is more stringent. The layout shall also confirm to all other relevant OISD specifications

b) All established engineering practices with regard to layout of various equipment & piping shall be followed and the same shall be subject to Customer approval during detail engineering without any commercial implication.

c) The pipes between storage tank, fuel oil unloading area shall be running on Pipe rack and pedestal as applicable.

d) Tentative Location of items related to Fuel Oil handling System is shown in enclosed PLOT PLANS. This will be finalized during detail engineering based on equipment dimensions and other layout related requirements. There will however be no cost implication on account of the same.

e) For road tanker unloading of fuel oil, HSD/HFO pumps will be located above ground. Further, while selecting pipe size, velocity inside the pipe shall not overshoot the velocity criteria indicated elsewhere in the specification.

f) To the extent possible, all valves shall be located at grade level for easy operation & maintenance. Where location at grade level is not possible, suitable operating and maintenance platform made of MS grating and access ladder/ staircase/walkways to the same shall be given by the bidder. The platform and walkways will be designed by considering load of at least 750Kg/M2.

g) Where pipes are routed in a manner that it hampers man movement in that area, suitable no. of cross overs made of MS gratings shall be given across such pipes to facilitate easy man movement in such areas. Further suitable access ladder of MS construction shall be given for access to equipment/ pipes located in pit/ trench. Such structures shall be designed by considering a load of at least 750Kg/M2.

h) Expansion bellows / pipe loops shall be provided in the steam line and HFO lines to accommodate pipe expansions at suitable distances as per calculation to be furnished by the successful bidder during detail engineering.

i) For all pedestal supported pipes, BHEL scope will be limited to pedestal with insert plates. Maximum height of pedestal to be provided by BHEL shall be 300 mm from FGL/FFL in the corresponding area. Structures required above these pedestals for supporting the pipes are included in the scope of the bidder. Pipe having BOP up to 2.0m from the grade level / FFL / FGL in the corresponding area shall be pedestal supported. However, inside the pump house no pedestals / insert plate shall be provided for fixing. Bidder shall support the pipes using pipe supports and anchor fasteners inside the pump house.

j) Layout shall be prepared in a way to avoid the buried piping to the maximum possible extent.

k) Oily water collected in storage tank area, oil unloading area will normally be collected in OWS pit by gravity either through trench (limited to a depth of 0.5 m) or through buried pipe (limited to a depth of 1.0 m) . However, in case depth of pipe between the pit and OWS pit exceeds 1 m or gravity flow is not possible due to layout constraints (which can be reviewed during detail engineering), the oily water waste shall be collected by pumping to OWS pit. Necessary pumps, valves, pipes, pipe supports, and instruments etc. for the same shall be in the bidder's scope.

l) Straight length required before and after control valve s, flow element/ flow meters, shall be provided as per latest standard/ applicable codes.

Page 25 of 487

	TECHNICAL SPECIFICATION FOR FUEL OIL UNLOADING & STORAGE SYSTEM 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI	SPECIFICATION NO. PE-TS-412-166-A001	
		VOLUME II-B	SECTION 'C'
		REVISION 00	DATE:20.03.2015
		PAGE 8 of 12	

- m) Rainwater collected inside the dyke shall be diverted to storm water drain while contaminated oily waste shall be sent to OWS. All valves required in pits outside the dyke are included in bidder's scope of supply.
- n) Instruments to be mounted on tank shall be suitably located so as to have easy access from the staircase without interfering with man movement on the staircase. Wherever this is not possible, suitable platform along with access to the same shall be provided by FO System bidder.
- o) Signals from all field instruments shall be first terminated in Junction boxes before transmitting this signal either to Control panel or to I/O rack or to DCS. Junction box is included in bidder's scope. Erection of cable between field instruments to Junction Box is also included in bidder's scope. Scope of cable supply shall be as per project specific scope split sheet given under electrical portion of this specification.
- p) All piping shall be arranged to provide clearance for removal of equipment requiring maintenance and easy access to valve and other piping accessories required for operation and maintenance. The layout drawing to be submitted by the successful bidder will necessarily show the valve orientation and access to valve and accessories.
- q) Instrument/ LIE/LIR shall not be located in space meant for walkway & maintenance space across the equipment, maintenance bay of building. Location of all instruments shall be marked in layout drawing to ensure correct location of the same.

7.0.0 EQUIPMENT SELECTION & DESIGN CRITERIA

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

8.0.0 PAINTING / CORROSION PROTECTION REQUIREMENT

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

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

- a) The Quality plans / checklist for the previous executed jobs for the equipment's / instruments are attached under **Annexure III**.
- b) The successful bidder shall furnish Quality Plans/ Inspection Check Lists for various item for the package in line with minimum requirement indicated in specification during detail engineering for Customer's approval.

	TECHNICAL SPECIFICATION FOR FUEL OIL UNLOADING & STORAGE SYSTEM 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI	SPECIFICATION NO. PE-TS-412-166-A001	
		VOLUME II-B	SECTION 'C'
		REVISION 00	DATE:20.03.2015
		PAGE 9 of 12	

- c) For other items for which any specific inspection requirement is not indicated in the specification but the same included in scope of work , vendor specific QPs/ CLs shall be furnished by the successful bidder for Customer/Consultant's review and approval. All comments made by customer/ consultant shall be incorporated by the successful bidder without any commercial and delivery implication.
- d) The Field Quality Plan of bidder shall also be submitted by the successful bidder during detail engineering for customer's / consultant's approval. All comments made by customer/ consultant shall be incorporated by the successful bidder without any commercial and delivery implication.
- e) For flame proof actuator, motors, junction boxes, instruments etc. as per specification requirement, valid test certificate for the same shall be submitted by the vendor as part of QC documentation. In case valid test certificates are not available, necessary test shall be conducted in line with applicable standard in presence of customer and cost of such test shall be deemed to be included in the contract price

11.0.0 SUB-VENDOR ITEMS

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

- a) Documentation to show that the equipment /system have been supplied for a plant of similar or higher capacity.
- b) Documentation in the form of certificate that the equipment/system has been operating satisfactorily for two years as on the scheduled date of bid opening.

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

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

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

12.0.0 DRAWINGS AND DOCUMENTS TO BE SUBMITTED WITH THE BID

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

13.0.0 DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

	TECHNICAL SPECIFICATION FOR FUEL OIL UNLOADING & STORAGE SYSTEM 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI	SPECIFICATION NO. PE-TS-412-166-A001	
		VOLUME II-B	SECTION 'C'
		REVISION 00	DATE:20.03.2015
		PAGE 10 of 12	

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

14.0.0 DRAWINGS DISTRIBUTION SCHEDULE

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

15.0.0 DRAWINGS ENCLOSED WITH THE SPECIFICATION

Following drawings enclosed will form part of the specification.

- Plot plan, PE-DG-412-100-M001
- Process & Instrumentation Diagram of HFO, PE-DG-412-166-A101
- Process & Instrumentation Diagram of HSD, PE-DG-412-166-A102
- Process & Instrumentation Diagram of steam & condensate, PE-DG-412-166-A103

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

17.0.0 OTHER REQUIREMENTS

i) Site Visit before submission of offer.

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

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

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

- Complete System Description along with PIDs, write up on electrical philosophy and safety/process interlocks etc.
- Instructions for plant operation
- Commissioning procedure of the system
- Chapter on precautions to be taken during:
 - Operation

	TECHNICAL SPECIFICATION FOR FUEL OIL UNLOADING & STORAGE SYSTEM 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI	SPECIFICATION NO. PE-TS-412-166-A001	
		VOLUME II-B	SECTION 'C'
		REVISION 00	DATE:20.03.2015
		PAGE 11 of 12	

- Idle time
- Long shutdown
- e. Chapter on trouble shooting during plant operation covering:
 - Safely aspects
 - Do's and do not's
 - Maintenance schedule
 - Schedule of lubricants & consumables
- f. O & M instruction for all individual equipment which shall invariably contain but not necessarily limited to the following:
 - Equipment description/interdiction
 - Data sheet, Equipment GA & Cross Section Drawing
 - Catalogue of each equipment
 - DO's & DON'T's
 - Duty Conditions
 - Installation & Safety Recommendation
 - Start-up & shut down procedure
 - Instructions for testing and adjustment of system parameters
 - Disassembly & Assembly Instructions giving sequence no. of each component
 - List of Replacement/ Spare parts along with their drawing and catalogues and procedure for ordering spares.
 - Reason & Remedy Chart for any problem
 - Maintenance Schedules- Daily, Weekly, Monthly, Half Yearly and Annual indicating clearly the spares part and man-hour requirement for each stage.
 - Detailed specification/ Schedule of all the consumables including lubricant oils, greases, chemicals etc. required for the complete system
 - Commission procedure for equipment.

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

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

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

	TECHNICAL SPECIFICATION FOR FUEL OIL UNLOADING & STORAGE SYSTEM 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI	SPECIFICATION NO. PE-TS-412-166-A001	
		VOLUME II-B	SECTION 'C'
		REVISION 00	DATE:20.03.2015
		PAGE 12 of 12	

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

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

For quick access bidder may refer the link

<http://bhelpem.com/DMSManuals/DMSManuals.html>

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

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

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

xi) In case of any contradiction in specification, the stringent as per owner interpretation shall prevail.

**2X660MW ENNORE SEZ COAL BASED STPP AT ASH
DYKE OF NCTPS, CHENNAI**

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

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



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



**2X660MW ENNORE SEZ COAL
BASED STPP AT ASH DYKE OF
NCTPS, CHENNAI.
FUEL OIL UNLOADING & STORAGE
SYSTEM**

SPECIFICATION. No: PE-TS-412-166-A001

VOLUME – II B

SECTION-C

REVISION 00

DATE : -----

Page 2 of 6

1.0 SYSTEM DESCRIPTION

1.1.1 Light Diesel Oil (HSD) shall be used for initial start-up/ warm up fuel while heavy Fuel Oil (HFO Gr HV) shall be used for flame stabilization during low load operation. The Fuel Oil Handling System to be considered comprises unloading & storage of HSD and Heavy Fuel oil (HFO Gr HV)

1.1.2 Fuel Oil Characteristics are provided at Clause.No.3.2.14 of this document.

1.1.3 A common building for Fuel oil unloading pumps (BHEL-PEM scope) and fuel oil pressurising & forwarding pumps (BHEL-Trichy scope) is envisaged.

1.2 HEAVY FUEL OIL SYSTEM

1.2.1 Heavy Fuel Oil (HFO Gr HV) shall be delivered to power station by eight (8) nos road tankers of 20 cum capacity. The road tankers shall be unloaded through flexible neoprene unloading hoses of 8.0m length with fire safe type ball valve for isolation and a hose stand for each unloading hose. The Fuel Oil unloading header will have 8 Nos. unloading points. The unloading header shall be electric traced. Steam/ electric tracing have been envisaged in the system please refer P&IDs for scope.

1.2.2 The road tankers shall have steam heating coil arrangement dully installed for heating HFO up to min. 50°C. Steam supply to the road tankers from Aux steam header (laid by the side of Fuel Oil unloading header) shall be through metallic flexible hoses and the condensate shall be collected in a condensate header laid by the side of Fuel Oil unloading header.

1.2.3 In case, road tankers are not provided with steam coil heaters, then steam shall be directly injected into the tankers for heating purpose.

1.2.4 Heavy Fuel Oil from unloading header shall be pumped to Heavy Fuel Oil storage tank with the help of Three(3) Nos (2W+1S) unloading pumps as indicated in the HFO Unloading and Storage system flow diagram. The Heavy Fuel Oil unloading pumps are of rotary positive displacement, twin screw type (electric traced) and provided with matching capacity simplex strainers (electric traced) at their suction with interconnecting piping and valves as shown in the P&I diagrams for HFO System, Drawing No.- PE-DG-412-166-A101.

1.2.5 Two (2) nos. HFO storage tanks, each of net capacity 3000 m³ are envisaged. The HFO tank shall be provided with steam floor coil heaters at the bottom of the tank to raise the temperature of oil to handling / tank maintenance temp. of 60°C in 72 hrs. time and maintaining the temperature inside the tank at 60° C. The floor coil heater for the Fuel oil storage tanks shall have adequate nos. of sections and shall be regulated through one pneumatically operated modulating type control valve on the steam supply line. This shall be actuated from tank temperature.

1.2.6 Each HFO Storage Tank shall be insulated and cladded on the shell. Roof of the HFO tanks shall not be insulated.

1.2.7 Interconnecting piping, valves and instruments as indicated in the Process & Instrumentation diagram for HFO system (Drwg.no. PE-DG-412-166-A101) shall be provided. Piping, valves and other equipment shall be electric traced.

1.2.8 Each HFO storage tank shall also be provided with a suction heater at tank outlet to heat the outgoing HFO by 10 deg C over maintenance temp of 60°C inside the tanks. Steam shall be the heating medium for the HFO tank suction heaters.

1.3 LIGHT DIESEL SYSTEM

1.3.1 HSD shall be delivered to power station by eight (8) nos road tankers. The road tankers shall be unloaded through flexible neoprene unloading hoses of min. 8.0m length with fire safe type



**2X660MW ENNORE SEZ COAL
BASED STPP AT ASH DYKE OF
NCTPS, CHENNAI.
FUEL OIL UNLOADING & STORAGE
SYSTEM**

SPECIFICATION. No: PE-TS-412-166-A001

VOLUME – II B

SECTION-C

REVISION 00

DATE : -----

Page 3 of 6

- ball valve for isolation and a hose stand for each unloading hose. The Fuel Oil unloading header will have 8 Nos. unloading points.
- 1.3.2** HSD from unloading header shall be pumped to HSD storage tank with the help of Two(2) Nos (1W+1S) unloading pumps as indicated in the HSD Unloading and Storage system flow diagram. The HSD unloading pumps are of rotary positive displacement, twin screw type and provided with matching capacity simplex strainers at their suction with interconnecting piping and valves as shown in the P&I diagrams for HSD System, Drawing No. - PE-DG-412-166-A102.
- 1.3.3** One (1) no. HSD storage tank, of net capacity 1000 m³ is envisaged.
- 1.3.4** Interconnecting piping, valves and instruments as indicated in the Process & Instrumentation diagram for HSD system (Draw.no. PE-DG-412-166-A102) shall be provided.
- 1.4 STEAM & CONDENSATE SYSTEM**
- 1.4.1** One no. pressure reducing and de-superheating station consisting of self-regulating type control valves with safety relief valve and bypass arrangement shall be provided for reducing auxiliary steam available at 16 kg/cm² (a) and 290°C to 4.0 kg/ cm² (a) and 150°C. Reduced and de-superheated steam shall be used for HFO road tankers heating, HFO tank heating and HFO tank suction heating.
- 1.4.2** A condensate flash tank (in scope of BHEL piping centre, Chennai) of capacity 6.0 m³ will also be provided for collecting condensate from road tankers heating before discharging the same to oil water separator. Details of condensate flash tank will be covered in BHEL-PC document "Scheme of Condensate flash tank-Drg.no: 4-00-301-40586".
- 1.4.3** Condensate formed in drain oil tank shall be routed to oil water separator through sump pumps.
- 1.4.4** Condensate generated from floor coil heater and suction heaters of HFO Storage tanks shall be fed to condensate flash tank placed near tank farm area.
- 1.4.5** Interconnecting piping, valves and instruments as indicated in the Process & Instrumentation diagram for STEAM & CONDENSATE system (Draw.no. PE-DG-412-166-A103) shall be provided.
- 1.5 DRAIN OIL SYSTEM, SUMP WATER & OIL WATER SEPARATION**
- 1.5.1** The fuel oil drains from different equipment's (HSD & HFO U/L pumps, strainers) and piping etc. in common FO unloading and forwarding pump house shall be collected by gravity in a Drain Oil tank of capacity 10m³. This drain oil tank shall be supplied by BHEL-Trichy. For details of instruments and pumps on drain oil tank, BHEL-Trichy document no 0-00-056-11094 (Scheme for fuel oil system) shall be referred.
- 1.5.2** The oil drain headers for HSD & HFO U/L pumps, strainers will have a size not less than 25 NB and adequately sloped.
- 1.5.3** The oil water mixture inside common FO unloading and forwarding pump house shall be collected in a sump through gravity. Two (2) nos. vertical centrifugal type sump pumps of cap. 30m³/hr, are envisaged inside FO Unloading pump house to pump this oil water mixture to oil water separator located near tanks farm area. The oil water mixture from unloading area and dyke area shall also be collected through gravity in oil water separator located near tanks farm area.
- 1.5.4** One no. (1) Oil Water Separator is envisaged near tank farm area. Separated water from Oil Water Separator shall be discharged to guard pond in ETP area through two (2) no. vertical sump pump of cap. 30m³/hr. Recovered oil shall be pumped to HFO Storage Tank/ Drain Oil Tank through two (2) nos. vertical screw pump of cap. 5 cum/hr as per Process & Instrumentation Diagram for HFO unloading system (Draw.no. PE-DG-412-166-A101).



**2X660MW ENNORE SEZ COAL
BASED STPP AT ASH DYKE OF
NCTPS, CHENNAI.
FUEL OIL UNLOADING & STORAGE
SYSTEM**

SPECIFICATION. No: PE-TS-412-166-A001

VOLUME – II B

SECTION-C

REVISION 00

DATE : -----

Page 4 of 6

1.0 INSTRUMENTATION & CONTROL

- 1.1 Operation and Control of Fuel Oil unloading and storage system will be from main plant DCS (under customer scope).
- 1.2 Instrumentation shall be as shown in Process & Instrumentation Diagram for HFO, HSD, and Steam & Condensate system given at last of this document.
- 1.3 Following functions shall be done through main plant DCS:
- 1.3.1 Filling any of the HFO/HSD storage tanks by ensuring proper and safe selection of these tanks. Simultaneous filling and emptying of same HFO storage tanks will be avoided. Signals from Limit switches at the inlet and outlet valves of storage tanks shall be used for this purpose.
- 1.3.2 Start the HFO/HSD unloading /decanting pumps **through main plant DCS** for filling the tanks after ensuring safe start permissive. The safe start permissive shall comprise of:
- MCC healthy
 - Selected storage tank level not HI (high).
 - Pump suction header inlet pressure not LO (low).
 - DP across pump suction strainer not HI (high).
- 1.4 Stop the running unloading/decanting pump(s) **through main plant DCS** in case of annunciation for Level HI in corresponding tanks.
- 1.5 Stop/Trip the running unloading /decanting pump(s) automatically in case of Level HI-HI in corresponding tanks.
- 1.6 Stop/Trip the running unloading pump(s) automatically in case of Pressure HI in pump discharge header.
- 1.7 Stop/Trip the running unloading pump(s) automatically in case of DP across corresponding suction strainer is HI.
- 1.8 Start standby unloading pump **through main plant DCS** only in case running pumps trips due either to any mechanical or electrical failure
- 1.9 Start the drain pump through main plant DCS on receipt of level alarm-HI or if physically the level is found to be high after ensuring safe start permissive. The safe start permissive shall comprise of:
- MCC healthy
 - Levels in DOT not low.
 - Selected storage tank level for dumping of drained oil is not HI.
- 1.10 Stop the running drain oil pump automatically in case of annunciation for Level LO in drain oil tank.
- 1.11 Start standby drain oil pump **through main plant DCS** only in case running pumps trips due either to any mechanical or electrical failure
- 1.12 Start the sump pump in respective areas **through main plant DCS** on receipt of level alarm HI or if physically the level is found to be high after ensuring safe start permissive. The safe start permissive shall comprise of:
- MCC healthy
- 1.13 Stop the running sump pump automatically in case of annunciation for Level LO in sump
- 1.14 Start standby sump pump **through DCS** only in case running pump trips due either to any mechanical or electrical failure.
- 1.15 Signals (annunciation & indication) from various switches / transmitters.



**2X660MW ENNORE SEZ COAL
BASED STPP AT ASH DYKE OF
NCTPS, CHENNAI.
FUEL OIL UNLOADING & STORAGE
SYSTEM**

SPECIFICATION. No: PE-TS-412-166-A001

VOLUME – II B

SECTION-C

REVISION 00

DATE : -----

Page 5 of 6

- 1.16 Running status (on/off) of all pumps.
- 1.17 Control of steam flow to floor coil heater and suction heater of HFO storage tanks through pneumatically operated control valve as indicated in respective flow diagram.
- 2.18 All signals from the field instruments will be first terminated on a field mounted Junction box (JB) before transmitting the signals to main plant DCS.

2.0 FUE OIL CHARACTERISTICS

2.1 HEAVY FUEL OIL (HFO) ANALYSIS AS PER IS 1593, 1982 (GRADE-HV)

Sl no.	Characteristics	Heavy Furnace Oil IS-1593,(Latest Revision)-Grade HV
1.1	Total Sulphur content (by weight)	4.5% Max
1.2	Gross calorific value (Kcal/kg)	Of the order of 10,800
1.3	Flash point (Min.)	66°C
1.4	Water content by volume (Max.)	1.0%
1.5	Sediment by weight (Max.)	0.25%
1.6	Density at 15°C(Approximate), Kg/m ³	890-950
1.7	Kinematic viscosity in centistokes at 50°C (Max.)	370
1.8	Ash content by weight (Max.)	0.1%
1.9	Pour Point (Max.)	57°C

2.2 LIGHT DIESEL OIL (HSD) ANALYSIS AS PER IS 1460, 2000

Sl no.	Characteristics	Light Diesel Oil (HSD)
1.1	Kinematic Viscosity in centistokes at 50° C	7.5
1.2	Waste content percent by volume (Max.)	0.25
1.3	Sediment percent by mass (Max.)	0.10
1.4	Total Sulphur percent, Max.	0.5
1.5	Ash percentage by mass (Max.)	0.01
1.6	Water and sediment Max, % Volume	0.25
1.7	Density at 15°C(approximate), Kg/m ³	850-870
1.8	a) Flash point, Min Pensky Martens Abel b) Pour point, min:	66°C 12°C



**2X660MW ENnore SEZ COAL
BASED STPP AT ASH DYKE OF
NCTPS, CHENNAI.
FUEL OIL UNLOADING & STORAGE
SYSTEM**

SPECIFICATION. No: PE-TS-412-166-A001

VOLUME – II B

SECTION-C

REVISION 00

DATE : -----

Page 6 of 6

1.9	Gross calorific value (Kcal/kg)	Of the order of 10,400
2.0	Specific gravity @15°C	0.8348

**2X660MW ENNORE SEZ COAL BASED STPP AT ASH
DYKE OF NCTPS, CHENNAI**

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

**ANNEXURE-II
(EQUIPMENT DESIGN CRITERIA)**



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



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X660MW ENNORE SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI**

SPECIFICATION No: PE-TS-412-166-A001

VOLUME –II B

SECTION - C

REVISION-00

DATE:

Page 2 of 8

1.0 EQUIPMENT SELECTION & DESIGN CRITERIA / DATA SHEET

1.1 FO STORAGE AND DRAIN OILTANKS

S.No.		HFO STORAGE TANKS	HSD STORAGE TANKS	DRAIN OIL TANK
1	Storage Medium	HFO	HSD	HFO /HSD
2	No. of Tanks	As per scope of supply		
3	Type of Construction	Vertical Cylindrical, non-pressure type with atmospheric vents fitted with flame arrestor fixed cone roof type.		Rectangular
4	Tank Capacity (m ³)	3000	1000	10
5	Dimensions	17 m dia x 14.5 m ht	12 m dia x 10 m ht	2 m x 2 m x 2.7 m ht
6	Design & Construction Code	IS 803 / API650		IS-800/ standard hand book
7	Design Pressure	Atmospheric		Atmospheric
8	Corrosion allowance	2 mm on the bottom plate and bottom shell course, 1.5mm on rest of the shell course and roof.		
9	Material of construction	IS 2062 Gr A/B with minimum plate thickness as 6.0 mm including corrosion allowance		
10	Venting Capacity	As per API 2000/ IS 803		
13	Joint efficiency	85 % on all butt welded joints		
14	Insulation	YES, (on tank shell)	NA	YES

1.2 CONDENSATE FLASH TANK

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

1.3 FLOOR COIL HEATER OF HFO STORAGE TANKS

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



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X660MW ENNORE SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI**

SPECIFICATION No: PE-TS-412-166-A001

VOLUME –II B

SECTION - C

REVISION-00

DATE:

Page 3 of 8

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

1.4 SUCTION HEATER FOR HFO STORAGE TANKS

S.No	Characteristics	Value
1	Type of heater	U-tube, shell & tube type (Oil in shell, steam in tube).
2	Design ambient temperature	As per project information
3	Heater capacity	120 m ³ /hr
4	Differential temperature	10 degC
5	Initial temperature of oil	60 degC
6	Final temperature of oil	70 degC
7	Heating medium	Aux. steam @ 4 kg/cm ² (a) or higher as decided by FO system vendor.
8	Specific heat of oil(Kcal/kg/degC)	0.5
9	Design temperature & pressure	Seamless steel tubes to ASTM A 106 Gr.B
a	Shell side	2.5 kg/cm ² (g) , 120 degC



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X660MW ENNORE SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI**

SPECIFICATION No: PE-TS-412-166-A001

VOLUME –II B

SECTION - C

REVISION-00

DATE:

Page 4 of 8

b	Tube side	1.5 times the heating medium pressure in kg/cm ² (g), 230 degC.
10	Corrosion allowance	1.8mm
11	Oil properties	As per specification
12	Temperature of steam to be considered for thermal design	Tsat @ heating medium pressure
13	Heater Tube material	Seamless tube as per ASME SA 179 Gr.C / Equivalent
14	Design/construction	TEMA Class-C/ IS 2825 Class-2/ASME Sec-VIII, Div-I

1.5 UNLOADING PUMPS, DRAIN OIL PUMPS & SUMP PUMPS

S.No	Characteristics	HFO Unloading / Decanting Pumps	HSD Unloading Pumps	Drain oil Pumps/ recovery oil pumps	Sump Pump in Oil Water Separator pit	Sump Pumps in pump house
1	Type of Pumps	Twin Screw Positive Displacement, with electric heat tracing.	Twin Screw Positive Displacement	Vertical Single Screw positive displacement.	Vertical single screw type	Vertical single screw type
2	No. &Capacity of Pumps	As per scope of supply				
3	Type of Duty	Intermittent	Intermittent	Intermittent	Intermittent	Intermittent
4	Type of Drive	Direct driven by Electric Motor				
5	Location	Indoor	Indoor	Indoor	Outdoor	Indoor
6	Nature of Fluid to be pumped	HFO	HSD	HFO/HSD	Water with traces of oil	Water with traces of oil
7	Design Viscosity range	50-500 cST	2-20 cST	2-500 cST	5-50cST	5-50cST
8	Sealing	Manufacturer Specific				
9	Design Code	Manufacturer specific.				
10	Bearings	Antifriction type		Manufacturer specific		
11	Material of Construction					
i)	Casing	Cast Iron to IS 210 Gr FG 260/ CS Fabricated				
ii)	Casing lining, if applicable	Manufacturer specific				
iii)	Rotor/ Impeller	13% chrome SS			Cast Iron to IS 210 Gr FG 260)	
iv)	Rotor housing, if applicable	CI AS PER IS 210 GR. 260			Manufacturer specific	
v)	Shaft	13% chrome SS			BS 970 EN-8 or equivalent	
vi)	Relief valve body	CI to IS 210 Gr FG 260			NA	
vii)	Relief valve spring	Spring steel			NA	
viii)	Base Plate	Fabricated from MS to IS 2062				



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X660MW ENNORE SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI**

SPECIFICATION No: PE-TS-412-166-A001

VOLUME –II B

SECTION - C

REVISION-00

DATE:

Page 5 of 8

ix)	Coupling	Manufacturer specific

1.6 STRAINERS FOR HFO/HSD UNLOADING PUMPS

S.No.	Characteristics	Value
01	Type	Simplex Type for unloading pumps
02	Fluid	HSD/HFO
03	Flow Rate	To match pump flow rate
04	Operating Pressure, maximum kg/cm ² (g)	Bidder specific
05	Operating temperature, ° C	55
06	Design Pressure , kg/cm ² (g)	1.1 times the operating pressure , min.
07	Design Temperature, ° C	65
08	Fluid Viscosity	As per Fuel Oil Characteristics
09 a)	Pressure drop in clean condition	0.1 kg/cm ²
09 b)	Maximum permissible pressure drop under 50 % clogged condition	0.3 kg/cm ²
10	Screen basket data	
a)	Dia of perforations	40 mesh
b)	Minimum thickness	Bidder specific
11	Electric heat tracing	Applicable for HFO unloading pump suction strainer.
12	Electric heat tracing data	After finalization of system supplier
13	End Connection details	
a)	Inlet & outlet size	Shall match connected upstream and downstream pipe size
b)	Type	Flanged
c)	Details / Standard	IS: 6392 /ANSI B 16.5 /Equivalent.
14	Material of Construction	
a)	Body	Fabricated from IS 2062/ Seamless pipe to ASTM A 106
b)	Cover	Fabricated from IS 2062 PLATES
c)	Screen basket	SS 304

1.7 STEAM TRAPS

S.No.	Characteristics	Value
	Design Features	
1	Type	TD type or any other type as per trap vendor recommendation for steam heat tracing
2	Strainer	Integral with trap
3	End connection	Welded /Manufacturer Standard.
3	Material of construction	
a	Body	SA105 /Equivalent
b	Trims	SS conforming to AISI-316 /304/ Manufacture Standard Practice
c	Strainer	SS conforming to AISI-316 /304/ Manufacture Standard Practice

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



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X660MW ENNORE SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI**

SPECIFICATION No: PE-TS-412-166-A001

VOLUME –II B

SECTION - C

REVISION-00

DATE:

Page 6 of 8

1.8 DATA SHEET FOR OIL HOSES

S.No	Characteristics	Value
1	Type	Flexible rubber hose confirming to BS 1435/ IS 10733
2	Size	80 NB X 8 m long for HSD/HFO
3	Quantity	As indicated in scope of supply
4	Temperature of fluid handled, °C	Capable of handling oil Up to 85 °C temperature
5	Type of end connection	To match road tanker unloading nozzle (details to be provided by customer)

1.9 DATA SHEET FOR STEAM/CONDENSATE HOSES

S. No.	Characteristics	Value
1.	Type	Metallic Flexible Hose, Electro zinc plated, Carbon /Stainless Steel double interlocked, non- asbestos/ galvanised wire inserted hose
2	Size	50 NBx8 m long for steam service 50 NB x8 m long for condensate service.
3.	Quantity	As per scope of supply
4.	Temperature of fluid handled, °C	Capable of Handling Oil Upto 210°C Temperature
5.	Type of end connection	To Match Road Tanker Steam & Condensate Nozzle(Details to be provided by customer)

1.10 DATASHEET FOR PRESSURE REDUCING AND DE-SUPERHEATING STATION

S.No.	Characteristics	Value
1	Type	Self-actuated pilot operated
2	Steam pressure at inlet	16 kg/ cm ² (a)
3	Steam Pressure at outlet	4 kg/ cm ² (a) or more as required by FO System vendor.
4	Leakage class	Class- IV
5	Steam temperature at inlet	290 °C
6	Steam temperature at outlet	150 °C
7	Material of Construction	
a	Body	Cast Steel
b	Trim	SS

1.11 VAVES

S.No.	Characteristics	Value
	Design Features	
1	General Requirement for all valves	i) All valves shall be provided with hand wheels, extension spindles and floor stands or any other arrangement wherever



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X660MW ENNORE SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI**

SPECIFICATION No: PE-TS-412-166-A001

VOLUME –II B

SECTION - C

REVISION-00

DATE:

Page 7 of 8

		required so that they can be operated manually with ease by a single operator from the nearest operating floors either at a lower or higher elevation as the case may be. Wherever necessary for safety purpose, locking devices shall be furnished with valves. Gear Operated valve shall be provided for valves where force applied is more than 25Kgf. In the case of those valves with extended spindles, indicators will be fitted both to the extended spindles and to the valve spindles.
2	Gate Valves	i) Gate Valves shall be used for isolation purpose for all sizes in steam and condensate lines. The gate valves shall be provided with handle wheel, position indicator and draining arrangement. ii) Gate Valves for sizes up to 40 NB/50 NB (As per manufacturer's standard) shall be of class 800, forged carbon steel valves with solid wedge, OS and Y rising stem and bolted bonnet, Trim shall be of 13% chrome steel. Body material shall be to ASTM A105 and ends shall be socket welded. STEM and Disc material shall be to ASTM A182 F6a. iii) For sizes above 40 NB/ 50 NB (As per manufacturer's standard), valves shall be of class 150/300 (depending on service), Cast Carbon Steel gate valves. Face to face dimensions shall be as per ANSI B 16.10. Body material shall be ASTM A216 Gr. WCB and ends shall be flanged to ANSI 150/300 lbs rating with raised face. iv) Gate valve shall be used in the oil lines for sizes 400NB and above. v) The valves shall conform to API-600/ API-602 and shall be tested to API 598/IS: 6157 requirements.
3	Globe Valves	i) Globe valves shall be used for regulation purpose for all sizes in steam, condensate and oil lines, they shall be provided with hand wheel, position indicator and draining arrangement, if required. ii) Globe valves for sizes up to 40 NB/50 NB (As per manufacturer's standard) shall be of class 800 forged carbon steel valves with plug disc. Other particulars shall be same as 2 (ii) above. iii) For sizes above 40 NB/50 NB (As per manufacturer's standard), valves shall be class 150/300 (depending on service) Cast Carbon steel globe valves with plug or ball type disc, other particulars shall be same as 2 (iii) above. iv) The valve shall conform to BS, 1873/BS: 2995 and shall be tested to BS: 5146 requirements.
4	Check Valves.	i) Check Valves shall be used for non-return services for all sizes in steam, condensate and oil lines. ii) For sizes up to 40 NB/ 50 NB (As per manufacturer's standard), check valves shall be of class 800 forged Carbon Steel horizontal lift type, with bolted cover, Valves shall have 13% Chrome Steel trim and body material to ASTM A 105, Ends-shall be socket welded.



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X660MW ENNORE SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI**

SPECIFICATION No: PE-TS-412-166-A001

VOLUME –II B

SECTION - C

REVISION-00

DATE:

Page 8 of 8

		iii) For sizes above 50 NB, check valves shall be of class 150/300 (depending on service) Cast Carbon Steel valves of swing check type having bolted cover. Trim shall be of 13% Chromium Steel and body material to ASTM A 216 Gr. WCB. Ends shall be flanged to ANSI Class 150/300 lb rating with raised face. iv) The valves shall conform to BS: 1868 and shall be tested to BS: 5146/IS: 5312 requirements.
5	Oil Line Ball / Plug Valves	i) Ball valves shall be used for isolation purpose in oil lines. These shall have 'port' position indicators with CLOSE/OPEN indications marked on valve body. ii) Ball valves shall be of class 150 full-bore type with face to face dimension as per ANSI B 16.10. Body material for plug/Ball Valves shall be ASTM A216 Gr. WCB. The ball shall be of SS AISI 316 quality. iii) Ball valves shall be of safe patten for internal (line) & external leakage. Ball valves in general shall confirm to BS: 5351/ and to BS6755 Part-2/API 607/ Equivalent for fire safe test. iv) Plug valves shall be of fire safe pattern for external leakage only. Plug valves in general shall confirm to API 6D/ Equivalent for design & manufacturing standard and to BS6755 Part-2/ API607/ Equivalent for fire safe test.

1.12 PIPES, FITTINGS & FLANGES

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



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X660MW ENNORE SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI**

SPECIFICATION No: PE-TS-412-166-A001

VOLUME –II B

SECTION - C

REVISION-00

DATE:

Page 9 of 8

		this may be either socket welded or flanged.	suitable for intended service
b.	STEAM AND CONDENSATE SERVICE		
	All Sizes	SA 106 GR.B	IS 1239/ ASME B36.10/ Equivalent
	Type of end connection (Pipe to pipe & Pipe to equipment)	Butt welded for pipe size 65 NB & above; however, near equipment, this shall be of flanged type. Socket welded for 50 NB & below; near equipment this may be either socket welded or flanged.	Socket welding – ANSI B 16.11 Butt welding – ANSI B 16.25 Flanged- ANSI B 16.5/ BS 4504/ IS 6392; Class- As per relevant standard & suitable for intended service
c.	AIR LINE		
	25 NB & below	MS ERW PIPES TO IS1239(1) Heavy Grade (GI) , Screwed Ends, galvanized	IS 1239
	Type of end connection (Pipe to pipe & Pipe to equipment)	SOCKET WELDED	ANSI B 2.1/ IS 1239
d.	BURIED PIPE, IF ANY / PIPE CARRYING BILGE WATER (WATER WITH TRACES OF OIL)		
	Up to 150 NB	M.S ERW to IS 1239 (1) Heavy Grade	AS PER IS 1239
	Type of end connection (Pipe to pipe & Pipe to equipment)	As per standard engineering practice.	
B.	FITTINGS & FLANGES		
a.	FUEL OIL		
1.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	50 NB and below	Forged carbon steel to ASTM A 105	SW ends to ANSI B 16.11 (3000#)
	65 NB and above	Fabricated from parent pipe / Carbon Steel to ASTM A 234,Gr.WPB	BW ends to ANSI B 16.9, Sch.40
2.	Slip on Flanges / Blind Flanges	Material Standard	Dimension Standard
	All sizes	ASTM A 105/ Fabricated from IS2062 plate	As per ANSI B16.5, Class 150,/BS 4504/ IS 6392 ; class 150 lb/ equivalent to relevant standard.
b.	STEAM AND CONDENSATE SERVICE		
1.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	50 NB and below	Forged carbon steel to ASTM A 105	SW ends to ANSI B 16.11 (3000#)
	65 NB and above	Carbon Steel to ASTM A 234, Gr. WPB	BW ends to ANSI B 16.9, Sch.40
2.	Slip on Flanges/Blind Flanges	Material Standard	Dimension Standard



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X660MW ENNORE SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI**

SPECIFICATION No: PE-TS-412-166-A001

VOLUME –II B

SECTION - C

REVISION-00

DATE:

Page 10 of 8

	All sizes	Forged carbon steel to ASTM A 105	ANSI B16.5/ BS 4504/ IS 6392, class suitable for intended service.
c.	AIR LINE		
1.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	25 NB and below	IS 1239 (II) (Galvanized)	IS 1239 (II)
d.	Buried pipe/ Pipe carrying bilge water		
1.	Fitting - 150 NB and below	IS 1239 (II)	IS 1239 (II)
2.	Slip on Flanges / Blind Flanges	Material Standard	Dimension Standard
	All sizes	Fabricated from IS2062 plate	ANSI B16.5/ BS 4504/ IS 6392; Class- 150 lb /Equivalent to relevant standard

1.13 VELOCITIES FOR SELECTING PIPING

Sizes of pipelines shall be selected so that velocity in pipes may not exceed the following maximum velocities

Sr. No	Description	Maximum Velocity
A	STEAM	
1	Saturated Steam	30m/s
2	Wet Steam/Exhaust Steam	30m/s
B	Water	
1	Pump Suction	1.5m/s
2	Pump Discharge	2.5m/s
C	Air LINE	
	Compressed air	15m/s
D	Oil	
1	HSD	Suction side: 1.0m/s Discharge side: 2.0 m/s.
2	HFO	Suction side: 0.5 m/s. Discharge side: 1.0 m/s.

2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE
OF NCTPS, CHENNAI

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

SECTION – C1-D

(QUALITY ASSURANCE REQUIREMENT - MECHANICAL)



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

STANDARD CHECL LIST FOR :Insulation & Cladding PACKAGE-FULE OIL SYSTEM PROJECT- CHECL LIST NO.:PE-QP-XXX-166-A801 REV.NO. 0								
DATE: 31/03/2012								
SL. No.	TESTS/CHECKS	QUANTUM OF CHECKS	REFERENCE DOC./ ACCEPTANCE NORMS	AGENCY				REMARKS
				M	C	N	D	
1.0	Review of Manufacturer's TC for Mineral wool	Sampling as per IS:8183	Appd.Data Sheet/ IS:8183	P	V	V	√	Ref, Note 1
2.0	Review of Material TC for Aluminium sheet	One/Lot	Appd.Data Sheet/ IS:737	P	V	V	√	Ref. Note 2
2.1	Dimensional Check	At random (10%)	-do-	P	V	V	√	
3.0	Packing & Marking	100%	IS:8183/Mfr's Std.	P	V	V	√	
Legend: Records identified with "√" shall be essentially included by contractor in QA documentation M= Manufacturer, C= Main Vendor N= BHEL/Customer P= Perform, W= Witness, V= Verification Note:1.MTC Will comprise the tests in line with IS:8183 2. MTC will Comprise of chemical & mechanical properties.								
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)				REVIEWING AGENCY (SIGN WITH DATE & STAMP)		APPROVING AGENCY (SIGN WITH DATE & STAMP)		



STANDARD CHECK LIST FOR: PRESSURE REDUCING VALVE

PACKAGE-FULE OIL SYSTEM

PROJECT-

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

REV.NO. 0

DATE: 31/03/2012

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

Legend:

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

M= Manufacturer, C= Main vendor/Sub vendor

N= BHEL/Customer,

P= Perform, W= Witness, V= Verification

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

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

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)

STANDARD QUALITY PLAN FOR									QUALITY PLAN NO.:PE-QP-XXX-166-A803				
STRUCTURAL STEEL									PACKAGE-FULE OIL SYSTEM				
PEM MAUX									PROJECT-				
									REV.NO. 0		DATE:		
									SHEET 1 OF 1				
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				
1	2	3	4	5	6	7	8	9	D	M	C	CU	REMARKS
1.0	Structural	a) Chemical Composition	M	Chemical Analysis	Sample	IS:2062/Spec./Drg.	IS:2062/Spec./Drg.	Mfr's TC	✓	P	V*	V	
		b) Mechanical test	M	Mechanical Properties	-do-	-do-	-do-	Mfr's TC	✓	P	V*	V	
		c) Dimensional conformity	M	Measurement	100%	-	-	Mfr's TC	✓	P	W**	V	
* In case material is procured from dealer, and co-related TCs are not available, check test on identified sample will be carried out at recognised testing laboratory. ** In case material is despatched directly from SAIL/IISCO plant to project site, the witnessing required is waived and material will be accepted on challan & MTC of SAIL/IISCO													
LEGEND: RECORDS IDENTIFIED WITH "✓" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. M - MANUFACTURER C - MAIN VENDOR CU - BHEL/CUSTOMER/NOMINATED INSPECTION AGENCY "P" PERFORM, "W" WITNESS AND V VERIFICATION													
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)				REVIEWING AGENCY (SIGN WITH DATE & STAMP)				APPROVING AGENCY (SIGN WITH DATE & STAMP)					

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

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



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

Legend:

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

M= Manufacturer, C= Main vendor

CU=BHEL/Customer

P= Perform, W= Witness, V= Verification

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

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

REVIEWING AGENCY
 (SIGN WITH DATE & STAMP)

APPROVING AGENCY
 (SIGN WITH DATE & STAMP)

**STANDARD CHECK LIST FOR : PLUG VALVE
PACKAGE-FULE OIL SYSTEM**

PROJECT-

CHECK LIST NO.:PE-QP-XXX-166-A806

REV.NO.-0

DATE:



SL. NO.	TESTS/CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENT/ ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY				REMARKS
					D	M	C	CU	
A.	<u>RAW MATERIAL</u>								
	Valve Body & Plug:								
1	Chemical Composition	1/Heat	Appd. Data Sheet/ Relevant Std.	Material TC	✓	P	V	V	
2	Tensile, Elongation	1/Heat							
B.	<u>FINAL INSPECTION</u>								
1	Visual Exam.	100%	Appd.Drg./Data Sheet	Inspn. Report	✓	P	W	W	
2	Dimensional Check	100%	Appd.Drg./Relevant Std.	-do-	✓	P	W	W	
3	Hydro Test of Body & Seat	-do-	Appd. Data Sheet/No leakage	-do-	✓	P	W	W	
4	Pneumatic Test for Seat	-do-	Appd. Data Sheet/No leakage	-do-	✓	P	W	W	
5	Performance/Operation test	-do-	Smooth operation/ Full travel	-do-	✓	P	W	W	
6	Painting	100%	Tech. spec/Mfr's std.	-do-	✓	P	V	V	

Note:

1. All material of construction shall be as per approved drawing/Data sheet
2. For Actuator operating valves - actuator test certificates shall be furnished to BHEL for review.

Legend

M= MANUFACTURER

C = MAIN VENDOR

CU= BHEL/Customer

P= PERFORM; W= WITNESS; V= VERIFICATION

✓ Marked document to be furnished along with QA Doc. Pkg.

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

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

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

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

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

		STANDARD QUALITY PLAN FOR BALL VALVE					QUALITY PLAN NO.:PE-QP-XXX-166-A808 PACKAGE-FULE OIL SYSTEM PROJECT- REV.NO. 0 SHEET 1 OF 3							DATE:	
SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY				REMARKS		
									D	M	C	CU			
1	2	3	4	5	6	7	8	9				10			
1.0	MATERIALS:														
1.1	BODY & END PIECE	CHEMICAL COMPOSITION	CRITICAL	CHEM. TEST	ONE/ HEAT	APPD.DRG./ DATA SHEET	APPD.DRG./ DATA SHEET/ RELEVANT STD.	MATRL. TC/ MFR'S TC	✓	P	V	V			
		MECHANICAL PROPERTIES	- DO -	MECH. TEST	ONE/HEAT/ HEAT TREAT- MENT BATCH	- DO -	- DO -	- DO -	✓	P	V	V			
		HEAT TREATMENT	- DO -	REVIEW OF HT CHART	100%	- DO -	- DO -	- DO -/HT CHART	✓	P	V	V			
		IDENTIFICATION & CORRELATION	MAJOR	VISUAL	100%	- DO -	- DO -	INTERNAL RECORD		P	V	-			
		SURFACE DEFECTS	- DO -	- DO -	100%	MSS-SP-55	FREE FROM DEFECTS	- DO -	✓	P	V	-			
		DIMENSIONAL	- DO -	MEASU- REMENT	100%	APPD. DRG./ RELEVANT STD.	APPD. DRG./ RELEVANT STD.	LOG BOOK		P	V	-			
LEGEND: RECORDS, IDENTIFIED WITH ✓ ' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. M: MANUFACTURER . C:MAIN VENDOR, CU: BHEL/CUSTOMER INDICATE "P" PERFORM, "W" WITNESS AND "V" VERIFICATION															
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)				REVIEWING AGENCY (SIGN WITH DATE & STAMP)				APPROVING AGENCY (SIGN WITH DATE & STAMP)							



STANDARD QUALITY PLAN FOR
BALL VALVE

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

PACKAGE-FULE OIL SYSTEM

PROJECT-

REV.NO.
SHEET

0
2 OF 3

DATE:

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

LEGEND:

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

M: MANUFACTURER .

C: MAIN VENDOR, CU: BHEL/CUSTOMER

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

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

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)

		STANDARD QUALITY PLAN FOR BALL VALVE					QUALITY PLAN NO.:PE-QP-XXX-166-A808 PACKAGE-FULE OIL SYSTEM PROJECT- REV.NO. 0 SHEET 3 OF 3 DATE:							
SL NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY				REMARKS	
									D	M	C	CU		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2.3	BALL & SEAT	BLUE MATCH	CRITICAL	BLUE MATCHING	100%	THE SURFACE WILL BE SMOOTH & WILL HAVE UNIFORM METAL TO METAL CONT- ACT	SAME AS COL.7	LOG BOOK	✓	P	V	V		
3.0	<u>ASSEMBLY</u>	DIMENSIONS	MAJOR	MEASUR- EMENT	*AS PER NOTE-1 BELOW	APPD. DRG./ RELEVANT STD.	APPD. DRG./ RELEVANT STD.	INTERNAL RECORD	✓	P	W	W		
		OPENING & CLOSING	- DO -	OPERA- TION	- DO -	SMOOTH OPERA- TION OF VALVE	- DO -	- DO -	✓	P	W	W		
4.0	<u>TESTING:</u>													
4.1	SHELL	LEAKAGE	CRITICAL	HYDRO- STATIC	*AS PER NOTE-1 BELOW	APPD. DRG./ DATA SHEET	NO LEAKAGE	TEST CER- TIFICATE	✓	P	W	W		
4.2	SEAT	- DO -	- DO -	- DO -	- DO -	- DO -	- DO -	- DO -	✓	P	W	W		
4.3	SEAT	- DO -	- DO -	AIR	- DO -	- DO -	- DO -	- DO -	✓	P	W	W		
4.4	FIRE SAFE TEST REPORT WITNESSED BY LLOYD/BV SHALL BE FURNISHED FOR REVIEW													
4.5	REVIEW OF QA DOCUMENTATION AS PER APPD. QP													
5.0	<u>PAINTING :</u>	QUALITY & THICK- NESS OF PAINT	MAJOR	VISUAL & MEASU- REMENT	100%	TECH. SPEC./ DATA SHEET/ MFG. STD.	SAME AS COL.7	INTERNAL RECORD		P	V	-		
6.0	<u>PACKING:</u>		MAJOR	VISUAL	100%			INTERNAL RECORD		P	-	-		
NOTE-1: 100% BY MANUFACTURER 10% BY TECHNO For Actuator operating valves - Actuator test certificate shall be furnished to BHEL for review. For Fire safe valves - valves are to be accepted based on fire test certificates														
LEGEND: RECORDS, IDENTIFIED WITH ' ' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. M: MANUFACTURER . C: MAIN VENDOR, CU: BHEL/CUSTOMER INDICATE "P" PERFORM, "W" WITNESS AND "V" VERIFICATION														
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)					REVIEWING AGENCY (SIGN WITH DATE & STAMP)					APPROVING AGENCY (SIGN WITH DATE & STAMP)				

STANDARD QUALITY PLAN FOR CS PIPE -ERW								QUALITY PLAN NO.:PE-QP-XXX-166-A809 PACKAGE-FULE OIL SYSTEM PROJECT- REV.NO. 0 DATE: : SHEET 1 OF 1					
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
1	2	3	4	5	6	7	8	9	D	M	C	CU	11
1.0	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

DATE:

SHEET 1 OF 2

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									D	M	C	N	
1	2	3	4	5	6	7	8	9	10	11	12	13	11
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	Body will carry the heat mark for co-relation with CMT
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 , seatring, 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:

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

LEGEND:

RECORDS 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
OIL STRAINER**

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

PROJECT-

REV.NO. 0

DATE:

SHEET 1 OF 2

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

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

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

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

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

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



**STANDARD QUALITY PLAN FOR
OIL STRAINER**

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

PROJECT-

REV.NO. 0
SHEET 2 OF 2

DATE:

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

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

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

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

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)



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

QUALITY PLAN NO.:PE-QP-XXX-166-A812
PACKAGE-FULE OIL SYSTEM
PROJECT-
REV.NO. 0 DATE: :
SHEET 1 OF 2

SL. NO. 1	COMPONENT & OPERATIONS 2	CHARACTERISTICS 3	CLASS 4	TYPE OF CHECK 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENT 7	ACCEPTANCE NORMS 8	FORMAT OF RECORD 9	AGENCY				REMARKS 11
									D	M	C	CU	
1.0	Raw Material & Bought Out Items												
1.1	Casing, stuffing box & end cover	i) Chemical test	MA	Chemical Analysis	Sample/ heat	Appd. Data Sheet/ Appd. Drg./ IS:210 FG260	Same as Cl.7	Material TC	✓	P	V	V	
		ii) Physical test	MA	Physical Properties	Sample/ heat	- do -	Same as Cl.7	Material TC	✓	P	V	V	
		iii) Hardness	MA	Meas.	At random	As per Appd. Data Sheet	- do -	Material TC	✓	P	V	V	
1.2	Shaft, Rotor,Step-up gear, Timing gear	i) Chemical test	MA	Chemical Analysis	Sample/ heat	As per Appd. Data Sheet/ Drg.	Same as Cl.7	Material TC	✓	P	V	V	
		ii) Physical test	MA	Physical Properties	- do -	- do -	Same as Cl.7	Material TC	✓	P	V	V	
		iii) Heat treatment	MA	Heat treatment	100%	- do -	- do -	HT Chart	✓	P	V	V	
		iv) Hardness	MA	Meas.	- do -	- do -	- do -	- do -	✓	P	V	V	
1.3	Bearing	Make, size & bearing No.	MA	Visual	100%	Mfg. Drawing/ Mfg.Catalogue	- do -	Log Book		P	-	-	
2.0	In Process Control												
2.1	Machining of all Components	i) Dimension	MA	Meas.	100%	- do -	- do -	- do -		P	V	V	
		ii) Surface finish	MA	Visual	100%	- do -	- do -	- do -		P	-	-	
2.2	Casing	Pressure test	MA	Hyd. Test with water	100%	1.5 x max. discharge pr. for 15 minutes.	No leakage/Seepage	Test Report	✓	P	V	V	
2.3	Shaft, Rotor/Screw, Step-up gear, timing gear	1. Internal Defects	CR	UT(after skin - machining)	100%	ASTM A388	Refer Note.1 (page2)	Test Report	✓	P	V	V	
		2. Surface Defects	CR	DPT(after - final machining)	100%	ASTM E:165	No linear indication >1.6mm	Test Report	✓	P	V	V	
		3. Case Hardness of timing gear	CR	Hardness	100%	EN-36 to BS970/ As per data sheet	After case carburising, hardened & tempered to have tooth hardness of 56 to 59 HRC	H T report	✓	P	V	V	NA
2.4	Balancing of Rotor Assly.	Static & Dynamic	CR	Balancing	100%	VDI 2060 Cl. 6.3/ ISO 1940 Gr.6.3	ISO 1940 Gr.6.3	Test Report	✓	P	V	V	only in case of Twin Screw Pump

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

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

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

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

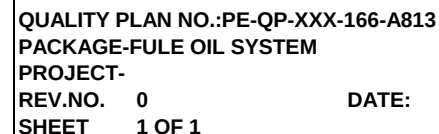
APPROVING AGENCY
(SIGN WITH DATE & STAMP)



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

QUALITY PLAN NO.:PE-QP-XXX-166-A812
PACKAGE-FULE OIL SYSTEM
PROJECT-
REV.NO. 0 DATE:
SHEET 2 OF 2

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



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

APPROVING AGENCY
(SIGN WITH DATE & STAMP)

Page 67 of 487

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

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



STANDARD CHECK LIST FOR
OIL HOSE

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

PACKAGE-FULE OIL SYSTEM

PROJECT-

REV.NO. 0

SHEET 1 OF 1

REV.NO. 0

DATE:

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

LEGEND:

"M" MANUFACTURER/SUB-CONTRACTOR

"C" CONTRACTOR/NOMINATED INSPECTION AGENCY,

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

"V" VERIFICATION AS APPROPRIATE CHP

SHALL IDENTIFIED IN COLUMN "N"

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

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)



**STANDARD CHECK LIST FOR
OIL HOSE**

**CHECK LIST NO.:PE-QP-XXX-166-A816
PACKAGE-FULE OIL SYSTEM**

PROJECT-

REV.NO. 0

SHEET 1 OF 1

REV.NO. 0

DATE:

SL. NO.	COMPONENT & 2	CHARACTERISTICS 3	TYPE OF CHECK 4	REFERENCE DOCUMENT 5	ACCEPTANCE NORMS 6	FORMAT OF RECORD 7	AGENCY			REMARKS 9
							M	C	N	
1							8			
2.6	Vulcanising	Complete Assembly	Hardness	Mfg.Std./Appd.Drg Appd.Data Sheet	Same as Cl.7	Inspn. Report	P	V	V	
3	<u>Final Inspection</u>									
	Finished Product									
	Check for completion	i) Confirmatory Test	Conformity	Appd.data sheet/ Relavent Code	- do -	T.C.	P	V	V	
		ii) Dimension (includ- ing end connection)	Measurement	Appd. Drg.	- do -	Inspn. Report	P	W	W	
		iii) Pressure Test	Hydraulic Test	Appd.data sheet/ Relavent Code	No leakage	- do -	P	W	W	
		iv) Vacuum Test	Vacuum	- do -	Same as Cl.7	- do -	P	W	W	
		v) Elongation	Measurement	- do -	- do -	- do -	P	V	V	
		vi) Electric Continuity	Elec. Cont.	- do -	- do -	- do -	P	V	V	

LEGEND:

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

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

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

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



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:

Sheet 1 of 1

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

LEGEND:

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

M= MANUFACTURER/SUB-CONTRACTOR

C= CONTRACTOR/NOMINATED INSPECTION AGENCY,

N= CUSTOMER

P= PERFORM; W= WITNESS; V= VERIFICATION

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

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)

CHECK LIST

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

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

Legend

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

SUB-VENDOR LIST FOR FUEL OIL SYSTEM - 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI				
SL. NO.	ITEM	SUB-VENDOR	PLACE	REMARK
MECHANICAL				
1	CS GATE/GLOBE/ NR VALVES (UPTO 250NB FOR CLASS 150 & UPTO 300 NB FOR CLASS 300)	LEADER	JALLANDHAR	
		FOURESS ENGG	THANE	
		FOURESS ENGG	AURANGABAD	
		WEIR BDK	HUBLI	
		L&T VALVES (AUDCO)	CHHENNAI	
		L&T VALVES	COIMBATORE	
		STEEL STRONG	NAVI MUMBAI	
		OSWAL INDUSTRIES	AHMEDABAD	
		NITON VALVE	NAVI MUMBAI / THANE	
		BHEL	GOINDWAL	
		KSB WATER PUMPS & VALVES	COIMBTORE	
		HITECH	AHMEDABAD	
		KBL	KONDHAPURI	
2	FS (CS) GATE/GLOBE/ NR VALVE UPTO 50NB (CLASS 800)	LEADER	JALLANDHAR	
		WEIR BDK	HUBLI	
		L&T VALVES (AUDCO)	CHHENNAI	
		FOURESS ENGG	MUMBAI/ AURANGABAD	
		HITECH	AHMEDABAD	
		KSB WATER PUMPS & VALVES	COIMBTORE	
		KBL	KONDHAPURI	
		STEEL STRONG	NAVI MUMBAI	
3	CS BALL VALVES (UPTO 350NB OF CLASS 150 AND UPTO 50NB OF CLASS 800)	PEC	NASHIK	
		L&T VALVES	COIMBATORE	
		L&T VALVES (AUDCO)	CHHENNAI	
		MICROFINISH	HUBLI	
		LEADER	JALLANDHAR	
		FLOWCHEM	AHMEDABAD	
		AKAY INDUSTRIES	HUBLI	
		WEIR BDK	HUBLI	
4	FS BALL VALVES (UPTO SIZE 50 NB) CLASS 800	PEC	NASHIK	
		MICROFINISH	HUBLI	
		L&T VALVES (AUDCO)	CHENNAI	
		WEIR BDK	HUBLI	
		FLOW CHEM	AHMEDABAD	
		PEC	NASHIK	
		AKAY	HUBLI	
5	CS PLUG VALVES	L&T VALVES (AUDCO)	CHENNAI	
		MICROFINISH	HUBLI	
		WEIR BDK	HUBLI	
		FISHER XOMOX	CHENNAI	
6	SUMP PUMP (VERTICAL CENTRIFUGAL)	SAM TURBO INDUSTRY LTD	COIMBATORE	
		KISHORE PUMPS	PUNE	
		SU MOTORS	MUMBAI	
		AQUA MACHINERY	AHMEDABAD	
		FLOWMORE PUMP	GHAZIABAD	
		B & C ENGG(BECON WEIR)	CHENNAI	
		M&P	PUNE	
		WPIL	GHAZIABAD	
7	SCREW PUMPS	KBL	KIRLOSKARWADI	
		ROTO PUMPS	NOIDA	
		TUSHACO	MUMBAI	
		UT PUMPS	FARIDABAD	
		ALEKTON ENGG INDUSTRIES	CHENNAI	
8	API 5L ERW PIPE	ROTOMAC INDUSTRIES (P) LTD	KANPUR	
		SURYA ROSHNI	BAHADURGARH	
		JINDAL	GHAZIABAD	
		MSL	RAIGAD	
		SAIL	ROURKELA	
9	IS:3589 ERW PIPE	RATNAMANI	KUTCH	
		SURYA ROSHNI	BAHADURGARH	
		JINDAL	GHAZIABAD	
		MSL	RAIGAD	
		SAIL	ROURKELA	
10	IS:1239 ERW PIPE (BLACK/GI)UP TO 150NB	WELSPUN	ANJAR	UP TO 400 NB
		INDUS TUBE	GAUTAM BUDDH NAGAR	UP TO 300 NB
		JINDAL	GHAZIABAD	
		SURYA ROSHNI	BAHADURGARH	
		TISCO	JAMSHEDPUR	
		INDUSE TUBE	GAUTAM BUDDH NAGAR	
		WELSPUN	ANJAR	

11	SPIRAL WELDED PIPE	PSL	CHENNAI/VIZAG/KUTCH/ DAMAN	
		LALIT PROFILE	THANE	
		SAMSHI PIPES INDUSTRIES	VADODARA	
		MUKUT PIPES	RAJPURA	
		MANN IND	INDORE	
		SURENDRA ENGG	RAJPURA	
		PRATIBHA PIPES & STRUCTURE PVT LTD	THANE	
		JCO GAS PIPE	CHINDWARA	
		NUKAT TANKS AND VESSELS	TARAPUR	
12	ASTM A 106, CS SEAMLESS PIPE	MAHARASHTRA SEAMLESS	RAIGAD	
		ISMT	AHMED NAGAR	
		MSL	RAIGAD	
		JINDAL SAW LTD	NASHIK	
13	SUCTION HEATER	ISMT	BARAMATI	
		PARKAIRE	DELHI	
		MVS	DELHI	
		MELCON	DELHI	
		GASO ENERGY	PUNE	
		INDCON	DELHI	
14	PRESSURE REDUCING VALVE & CONTROL VALVES	TEMASME	NOIDA	
		CIRCOR (EARLIER MAZDA)	AHMEDABAD	
		Daume Regelarmaturen GmbH,	Germany	
		EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	CHENNAI	
		INSTRUMENTATION LTD.	Pallakkad	
		Koso India Private Limited,	Nashik	
		LESLIE CONTROLS, INC / CIRCOR	USA	
		MIL CONTROLS LTD.	Thrissu	
		R.K.CONTROL INSTRUMENTS PVT. LTD.	THANE	
		SPIRAX MARSHALL	PUNE	
15	STRAINERS(SIMPLEX BASKET TYPE)	GENERAL MECHANICAL WORKS PVT LTD	VADODARA	
		GRAND PRIX	FARIDABAD	
		GUJARAT OTOFILT	VATVA , AHMEDABAD	
		FILTRATION ENGRS	MUMBAI	
		MULTITEX	NOIDA	
16	STEAM TRAP	SPIRAX MARSHALL	PUNE	
		UNIKLINGER	PUNE	
		LEADER	JULLANDHAR	
		CRECENT VALVE MFG CO LTD	MUMBAI	
		PENNANT ENGINEERING	PUNE	
17	THERMAL INSULATION	LLOYD INSULATION (INDIA) LTD	BHILAI	
		ROCK WOOL	MEDAK	
		LOPINUS ROCKWOOL	GWALIOR	
		MINWOOL ROCK FIBER	RAJNAND GAON	
18	ALUMINUM CLADDING	HINDALCO		
		BALCO		
		NALCO		
19	PAINT MATERIAL	ASIAN PAINTS		
		BERGER		
		SHALIMAR PAINTS LTD		
		GOODLASS NEROLAC		
20	PLATES AND STRUCTURES	SAIL		
		JSPL		
		ESSAR		
		JSW		
		RINL		
		TISCO		
21	FITTING (MS/SS)	PIPE FIT	VADODRA	
		GUJRAT INFRA PIPES	BARODA	
		MS FITTINGS	KOLKATA	
		TUBE PRODUCTS	BARODA	
		SIDDARTH & GAUTAM	FARIDABAD	
		EBY	MUMBAI	
		NL HAZRA	KOLKATA	
22	SAFETY RELIEF VALVE	SPIRAX MARSHALL	PUNE	
		FISCHER SANMAR	CHENNAI	
		LEADER	JULLANDHAR	
23	RUBBER HOSES	D WREN & CO.	KOLKATA	
		SUDEEP INDUSTRIES	KOLKATA	
		HYDROKIMP	MUMBAI	
		PRESIDENCY RUBBER	KOLKATA	
24	METALLIC HOSES	TUBEX		
ELECTRICAL AND C & I				

25	LEVEL TRANSMITTER (ULTRASONIC TYPE)	E & H	AURANGABAD	
		SIEMENS MILTRONICS	CANADA	
		NIVELCO	HUNGARY	
		HAWK	AUSTRALIA	
26	LT MOTORS	EMERSON PROCESS MGT	PAWANE	
		ABB	FARIDABAD / BANGALORE	
		KIRLOSKAR	BANGLORE/HUBLI	
		CROMPTON GREAVES LTD.	AHMEDNAGAR	
		BHARAT BIJLEE	MUMBAI	
		MARATHON	KOLKATA	
		LHP	SHOLAPUR	
		SIEMENS	MUMBAI	
		KEC	HUBLI / BANGLORE	
27	LEVEL INDICATOR (FLOAT & BOARD)	JYOTI	VADODARA	
		NGEF	BANGLORE	
		SIGMA	MUMBAI	
		LEVCON	KOLKATA	
		SBEM	PUNE	
		DK INSTRUMENTS	KOLKATA	
		V AUTOMAT	DELHI	
28	PRESSURE/DP/TEMP.SWITCH	PUNE TECHTROL	PUNE	
		FLOWSTAR ENGINEERING	FARIDABAD	
		SOR	USA	
		HERION	GERMANY	
		ITT BARTON	USA	
		DELTA CONTROL	UK	
		ASHCROFT	USA / GERMANY	
		TRAFAG	RANIPET	
		INDFOSS	GHAZIABAD	
29	PRESSURE / TEMP./ DP GAUGE(DIAL TYPE)	ASHCROFT	GANDHINAGAR	
		SWITZER	CHENNAI	EXCEPT 9000 SERIES
		H GURU (SI)	BANGALORE	
		H GURU INDUSTRIES	MUZAFFARPUR / RISHRA	
		AN INSTRUMENT	KOLKATA	
		GOA THERMOSTATIC	GOA	
		WAAREE	VAPI	
		MANOMETER	MUMBAI	
		GLUCK	MUMBAI	
		FORBES MARSHALL	HYDERABAD	
		ASHCROFT	GANDHINAGAR	
		WIKA	PUNE	
30	RTD /THERMOCOUPLE ASSEMBLY	GAGES BOURDON	MUMBAI / GOA	
		PYROELECTRIC	GOA	
		GIC(THERMAL INSTRUMENTS)	MAHARASHTRA	
		TEMPSENS	UDAIPUR	
31	LEVEL TRANSMITTER (GWR TYPE)	DETRIVE	MUMBAI	
		K TEK (ABB)	USA	
		E & H	GERMANY	
		MEGNETROL	BELGIUM	
32	ELECTRICAL ACTUATORS	EMERSON PROCESS MGT	PAWANE	
		ROTORK	BANGALORE	
		ROTORK	CHENNAI	
		AUMA	BANGALORE	
33	LEVEL SWITCH (FLOAT AND DISPLACER TYPE)	LIMITORK	FARIDABAD	
		TRAC	HYDERABAD	
		LEVCON	KOLKATA	
		DK INSTRUMENTS	KOLKATA	
		SBEM	PUNE	
34	TEMPERATURE TRANSMITTER	V AUTOMAT	DELHI	
		EMERSON PROCESS MGT	PAWANE	
		MOORE	USA	
		ABB	FARIDABAD	
35	AIR FILTER REGULATOR	YOKOGAWA	BANGLORE	MAKE YOKOGAWA, JAPAN
		PLACKA INSTRUMENT	CHENNAI	
		SHAVO NORGREN	MUMBAI	
		FISHER SANMAR	CHENNAI	
36	SOLENOID VALVE	AVCON	MUMBAI	
		ROTEX	BARODA/VV NAGAR	
		ASCO	CHENNAI	
		MIL CONTROLS LTD.		

37	CONTROL VALVE	DRESSER VALVE		
		FORBES MARSHALL		
		SAMSON		
38	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	
39	JUNCTION BOX	SWITCHING CKT	KOLKATA	
		PYROTECH	UDAIPUR	
		POSITRONICS	VADODARA	
		JACKSON	NOIDA	
		CONTROL DEVICE	KOLKATA	
		JOSPER	NOIDA	
40	CABLE LUGS (NON FLAME PROOF)	I C A	MUMBAI	
		SWITCHING CKT	KOLKATA	
		3D	UMERGAON	
41	PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER	DOWELL	MUMBAI	
		CHITRA	NASIK	
		ABB LIMITED	FARIDABAD	
		ENDRESS + HAUSER (INDIA)	NEW DELHI	
		MOORE INDUSTRIES INTERNATIONAL	USA	
		EMERSON PROCESS MANAGEMENT	MUMBAI	
		SIEMENS LIMITED	MUMBAI	
		SMART INSTRUMENTS LTD	MUMBAI	
		V. AUTOMAT & INSTRUMENTS	NEW DELHI	
		YOKOGAWA INDIA LIMITED	BANGALORE	
42	FLOW METER	HONEYWELL AUTOMATION INDIA LIMITED	NEW DELHI	
		TOSHNIWAL INDUSTRIES PVT. LTD	AJMER	
		EMERSON PROCESS	CHENNAI	
		ROCKWIN	GHAZIABAD	
43	CABLE GLANDS (NON FLAME PROOF)	KROHNE MARSHALL	PUNE	
		E&H		
		ARUP	KOLKATA	
		SUNIL	KOLKATA	
44	CABLE GLAND, LUGS, JB (FLAME PROOF)	QPIE	KOLKATA	
		COMMET	MUMBAI	
		AJMER	MUMBAI	
		BALIGA	CHENNAI	
		FLEXPRO	NAVSARI	



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X660MW ENNORE SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI**

SPECIFICATION NO. PE-TS-412-166-A001

VOLUME II B

SECTION C

REV – 00

DATE -

**2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF
NCTPS, CHENNAI**

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

ANNEXURE-V

(MANDATORY SPARES FOR FUEL OIL SYSTEM – MECHANICAL ITEMS)



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



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X660MW ENnore SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI**

SPECIFICATION NO. PE-TS-412-166-A001

VOLUME II B

SECTION C

REV – 00

DATE - - - - -

MANDATORY SPARES

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

Sl no	Name of spares	Qty
1	HFO/HSD UNLOADING PUMPS	
a	COUPLING PADS / BUSHES AND COUPLING BOLTS	ONE SET /PUMP
b	BEARINGS	TWO SETS /PUMP
c	MECHANICAL SEALS	TWO SETS/PUMP
d	COUPLINGS	ONE SET/PUMP
e	COUPLING PADS	TWO SETS/PUMP
f	SET OF SEALS, O-RINGS & GASKETS	2 SETS/PUMP
g	BEARINGS FOR PUMP	2 SETS/PUMP
h	SET OF ALL TYPES OF BUSHES SLEEVES	2 SETS/PUMP
i	CATRIDGE	1 NO EACH TYPE
2	DRAIN OIL PUMP/ RECOVERY OIL TRANSFER PUMP/ WASTE WATER PUMP/ SUMP PUMP(FOR EACH TYPE)	
a	BEARING OR BEARING METALS AND WEARING PARTS FOR EACH ROTATING UNIT.	1 COMPLETE SET
b	CONNECTING COUPLING FOR EACH ROTATING UNITS (COUPLING ASSEMBLY)	1 SET
c	PACKING AND GASKETS OF TOTAL INSTALLED	100%
d	INNER WEAR AND TEAR PARTS FOR EACH SIZE AND TYPE OF PUMP	1 SET
3	HOSES	
a	UNLOADING HOSES (HFO & HSD)	20% OF TOTAL QUANTITY
b	STEAM AND CONDENSATE HOSES	20% OF TOTAL QUANTITY

Note: - * One (1) set means total numbers as required for one complete replacement for one equipment.
For electrical and C&I items bidder to refer electrical and C&I portion of specification.



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X660MW ENNORE SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI**

SPECIFICATION NO. PE-TS-412-166-A001

VOLUME II B

SECTION C

REV – 00

DATE -

**2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF
NCTPS, CHENNAI**

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

ANNEXURE-VI

(DOC REQUIRED DURING BIDDING STAGE)



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



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X660MW ENnore SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI**

SPECIFICATION NO. PE-TS-412-166-A001

VOLUME II B

SECTION C

REV – 00

DATE -

ANNEXURE-VI

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

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

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

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

2X660MW ENNORE SEZ COAL BASED STPS

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

ANNEXURE-VII

(DRWGS/DOCS REQUIRED DURING DETAIL ENGINEERING)



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

DRAWING / DOC SUBMISSION SCHEDULE DURING DEAIL ENGINEERING

PACKAGE : FUEL OIL UNLOADING & STORAGE SYSTEM

SI No	Drawing NO	Drg Title	Sch submissi on week from LOI	Categor y	Resubmission after ancorporating comments
1	PE-V0-412-166-A001	P&ID'S OF FOHS	4	A-CUST	WITHIN 1 WEEK
2	PE-V0-412-166-A002	CONTROL PHILOSPHY OF FOHS	4	A-CUST	WITHIN 1 WEEK
3	PE-V0-412-166-A003	DESIGN CALCULATION OF TANKS FOR FOHS	6	I-CUST	WITHIN 1 WEEK
4	PE-V0-412-166-A004	SIZING CALCULATION OF UTILITIES OF FOHS	4	I-CUST	WITHIN 1 WEEK
5	PE-V0-412-166-A005	DATASHEET & GAD OF SCREW PUMPS & MOTORS FOR FOHS	12	I-CUST	WITHIN 1 WEEK
6	PE-V0-412-166-A006	NPSH AND PUMP HEAD CALULATION OF PUMPS FOR FOHS	6	I-CUST	WITHIN 1 WEEK
7	PE-V0-412-166-A007	DESIGN CALCULATION AND GAD OF SUCTION HEATER FOR FOHS	10	I-CUST	WITHIN 1 WEEK
8	PE-V0-412-166-A008	DESIGN CALCULATION OF ELECTRIC TRACING OF LINES FOR FOHS	12	I-CUST	WITHIN 1 WEEK
9	PE-V0-412-166-A010	DESIGN CALCULATION AND GAD OF OWS FOR FOHS	8	I-CUST	WITHIN 1 WEEK
10	PE-V0-412-166-A012	PAINTING SCHEDULE OF FOHS	4	I-CUST	WITHIN 1 WEEK
11	PE-V0-412-166-A013	DS AND GAD OF PRS, TCV, TRAP, INSULATION AND CLADDING FOR FOHS	14	I-CUST	WITHIN 1 WEEK

12	PE-V0-412-166-A014	DATASHEET OF FOHS INSTRUMENTS	10	I-CUST	WITHIN 1 WEEK
13	PE-V0-412-166-A016	PIPING LAYOUT IN TANK FARM AREA OF FOHS	10	A-CUST	WITHIN 1 WEEK
14	PE-V0-412-166-A017	PIPING LAYOUT IN UNLOADING PUMP HOUSE OF FOHS	10	A-CUST	WITHIN 1 WEEK
15	PE-V0-412-166-A018	GAD OF FOHS (COMPOSITE LAYOUT)	12	A-CUST	WITHIN 1 WEEK
16	PE-V0-412-166-A019	SUGGESTIVE ELECTRICAL LAYOUT DRAWING OF FOHS	10	I-G-P	WITHIN 1 WEEK
17	PE-V0-412-166-A021	GAD OF FOHS TANKS INCLUDING ROOF STRUCTURE & NOZZLE ORIENTATION	10	I-CUST	WITHIN 1 WEEK
18	PE-V0-412-166-A023	FABRICATION DRAWING OF FOHS TANKS INCLUDING ACCESSORIES	18	I-CUST	WITHIN 1 WEEK
19	PE-V0-412-166-A024	DESIGN CALCULATION & GAD OF MISCELLANEOUS TANKS FOR FOHS	10	I-CUST	WITHIN 1 WEEK
20	PE-V0-412-166-A025	CIVIL INPUT DRAWING IN TANK FARM AREA FOR FOHS	16	I-CUST	WITHIN 1 WEEK
21	PE-V0-412-166-A026	QAP OF SCREW PUMP & MOTORS FOR FOHS	14	I-CUST	WITHIN 1 WEEK
22	PE-V0-412-166-A027	QAP OF PRS, TCV, TRAP, INSULATION AND CLADDING FOR FOHS	16	I-CUST	WITHIN 1 WEEK
23	PE-V0-412-166-A028	QAP OF SUMP PUMP & MOTORS FOR FOHS	14	I-CUST	WITHIN 1 WEEK
24	PE-V0-412-166-A029	QAP OF FOHS INSTRUMENTS	16	I-CUST	WITHIN 1 WEEK
25	PE-V0-412-166-A030	QAP OF CONTROL PANEL	16	I-CUST	WITHIN 1 WEEK

26	PE-V0-412-166-A031	EQUIPMENT SCHEDULES OF FOHS	20	I-G-P	WITHIN 1 WEEK
27	PE-V0-412-166-A032	CABLE SCHEDULE OF FOHS	16	I-G-P	WITHIN 1 WEEK
28	PE-V0-412-166-A033	ELECTRICAL LOAD DATA OF FOHS	16	I-G-P	WITHIN 1 WEEK
29	PE-V0-412-166-A034	ISOMETRIC DRAWING OF FOHS	10	I-G-P	WITHIN 1 WEEK
30	PE-V0-412-166-A035	SUB-VENDOR LIST WITH INSPECTION CATEGORIZATION LIST FOR FOHS	4	A-CUST	WITHIN 1 WEEK
31	PE-V0-412-166-A036	INSTRUMENT INSTALLATION DIAGRAM OF FOHS	20	I-CUST	WITHIN 1 WEEK
32	PE-V0-412-166-A038	INSULATION AND CLADDING SCHEDULE FOR FOHS	20	I-G-P	WITHIN 1 WEEK
33	PE-V0-412-166-A039	INSULATION I& CLADDING NSTALLATION PROCEDURE FOR FOHS EQUIPMENTS	20	I-G-P	WITHIN 1 WEEK
34	PE-V0-412-166-A040	STEAM TRACING INSTALLATION PROCEDURE	20	I-G-P	WITHIN 1 WEEK
35	PE-V0-412-166-A042	COMMISSIONING PROCEDURE OF FOHS	20	I-G-P	WITHIN 1 WEEK
36	PE-V0-412-166-A044	O&M MANUAL OF FOHS	20	I-CUST	WITHIN 1 WEEK
37	PE-V0-412-166-A045	DEMONSTRATION TEST PROCEDURE OF FOHS	20	A-CUST	WITHIN 1 WEEK
38	PE-V0-412-166-A046	CONTROL SCHEME/ LOGIC DIAGRAM FOR FOHS (DCS BASED)	20	I-G-P	WITHIN 1 WEEK
39	PE-V0-412-166-A047	PROCESS MANUSCRIPT FOR IMPLEMENTATION IN DCS FOR FOHS	16	I-G-P	WITHIN 1 WEEK
40	PE-V0-412-166-A048	DATASHEET & GAD OF SUMP PUMPS & MOTORS IN FOHS	12	I-CUST	WITHIN 1 WEEK

41	PE-V0-412-166-A049	DS AND GAD OF VALVES, HOSE AND STRAINER	14	I-CUST	WITHIN 1 WEEK
42	PE-V0-412-166-A050	DS AND GAD PIPES, PLATES AND FITTINGS ETC FOR FOHS	14	I-CUST	WITHIN 1 WEEK
43	PE-V0-412-166-A051	PIPING LAYOUT IN UNLOADING AREA OF FOHS	10	A-CUST	WITHIN 1 WEEK
44	PE-V0-412-166-A053	CIVIL INPUT DRAWING IN UNLOADING PUMP HOUSE OF FOHS	16	I-CUST	WITHIN 1 WEEK
45	PE-V0-412-166-A054	CIVIL INPUT DRAWING IN UNLOADING AREA OF FOHS	16	I-CUST	WITHIN 1 WEEK
46	PE-V0-412-166-A056	QAP OF VALVES, HOSE AND STRAINER FOR FOHS	16	I-CUST	WITHIN 1 WEEK
47	PE-V0-412-166-A057	QAP OF PIPES, PLATES AND FITTINGS ETC FOR FOHS	14	I-CUST	WITHIN 1 WEEK
48	PE-V0-412-166-A062	DS OF FLOWMETER FOR FOHS	10	I-CUST	WITHIN 1 WEEK
49	PE-V0-412-166-A063	QAP OF FLOWMETER FOR FOHS	16	I-CUST	WITHIN 1 WEEK
50	PE-V0-412-166-A064	ERECTION PROCEDURE OF ALL EQUIPMENT IN FOHS SCOPE	18	I-G-P	WITHIN 1 WEEK
51	PE-V0-412-166-A065	GAD OF OTHER MISCELLANEOUS ITEMS IN FOHS	10	I-CUST	WITHIN 1 WEEK
52	PE-V0-412-166-A066	DS OF OTHER MISCELLANEOUS ITEMS IN FOHS	10	I-CUST	WITHIN 1 WEEK
53	PE-V0-412-166-A067	QAP OF OTHER MISCELLANEOUS ITEMS IN FOHS	12	I-CUST	WITHIN 1 WEEK
54	PE-V0-412-166-A068	GA AND WIRING DIAGRAM OF ELECTRICAL TRACING PANEL	12	I-CUST	WITHIN 1 WEEK

2X660 MW ENNORE SEZ COAL BASED STPS

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

**ANNEXURE-VIII
(CUSTOMER SPECIFICATION)**



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

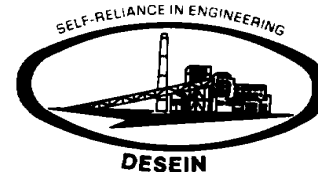
CHAPTER 15**15.0 FUEL OIL HANDLING SYSTEM****15.1 SCOPE**

The scope covers the design, engineering, manufacture, supply, assembly and testing at manufacturer's works, inspection, packing, forwarding, delivery FOR site and handling with storage at site (i.e. taking delivery of materials from carriers, transportation to site), fabrication (as needed), erection, trial run, testing and commissioning including painting protection of fuel oil handling system covering oil storage tanks with unloading pump sets and associated oil, water and air pipe work materials, electricals & control instrumentation as well as civil works as needed for the plant facilities complete in all respects within the boundary limits.

The statutory approval for fuel oil unloading, transfer and storage system from Chief Controller of Explosives shall be obtained by the bidder. It shall be a part of scope of this specification along with any fees/ inspection charges and Bidder shall be responsible for obtaining the necessary approval. Owner shall furnish the required assistance for filing application/ documents.

15.2 SYSTEM DESCRIPTION

- a) The fuel oil will be transported to the plant site by road tankers; and unloading pumps shall be used for unloading of oil and storing it in tanks. Before unloading the heavy fuel oil, it shall be heated by electric heaters in the road tankers as considered necessary to make it flowable. Fuel oil decanting pumphouse is also included in scope of bidder.
- b) The heavy fuel oil shall be heated in the storage tanks to maintain a suitable temperature by supplying steam through floor coil heaters. The steam shall be provided from auxiliary Boiler. Heavy fuel oil tanks shall also be provided with suction heaters with steam as the heating source to heat the oil before sending it to pressurizing units.
- c) There shall be pipe nozzle provisions on the storage tanks in regard to heavy fuel oil recirculation from the boiler front. An adequately sized non-return valve shall be provided in each line connecting the fuel oil unloading headers and unloading pump suction header.
- d) The heavy fuel oil will be pumped from the storage tanks to boilers front by pressurizing units. The heavy fuel oil return from pressurizing units and burner headers will be brought back to respective storage tanks. Similarly, the light diesel oil will be pumped from HSD storage tank to boiler; and to hot gas generator by pressurizing units.
- e) An oil water separator (to separate oil to the extent of max. 10 ppm oil left in the water) shall be provided close to the dyke area and unloading oil headers area to receive oil from the drain trenches, dyke area and unloading area. Oil from the oil water separator shall be returned back to the heavy fuel oil tanks by the help of two (2) 100 percent capacity oil recovery pumps. The water after suitable treatment shall be discharged to the surface drain.



- f) All the heavy fuel oil lines, oil pumps and strainers shall be electric traced.
- g) One (1) – 150 NB (min.) heavy fuel oil unloading manifold complete with eight (8) stand pipes with flexible hoses of 8 M length [each provided with universal type couplings, isolation valves and matching pieces as required for connecting to road tankers isolation valves and caps as required for connecting to road tankers. Tapping points on the oil header shall be suitably located.
- h) Heavy fuel oil road tankers shall be fitted with electric heating coils so that oil may be heated to reduce its viscosity. When the oil temperature in tanker rises to about 50°C, oil shall be drained to the oil-unloading header. When the oil unloading header and the piping at the unloading pump suction is filled up with oil and steady oil supply is ensured, the unloading pumps shall be started.
- i) One (1) 150 NB HSD unloading manifold completed with eight (8) stand pipes with flexible hoses of 8 M length each shall be provided with universal type couplings and matching pieces as required for connecting to road tankers. Tapping points on the oil header shall be suitably located.

15.3 REQUIRED EQUIPMENT AND SERVICES

The fuel oil handling system facilities to be supplied and furnished with all accessories and services under this specification shall include but be not limited to the following:

15.3.1 Oil Unloading Pump sets

- 15.3.1.1
 - a) Three (3) - 100 cum per hour capacity (2W+1S), 4 kg/cm2(g) discharge pressure, direct AC driven horizontal twin screw type heavy fuel oil unloading pump sets complete with AC electric motor drives and all other accessories as necessary. The pumps shall be electrically traced.
 - b) Two (2) – 50 cum per hour capacity (1W+1S), 4 kg/cm2(g) discharge pressure, direct AC driven horizontal twin screw type HSD unloading pump sets complete with drive motor with accessories for unloading road tankers.
 - c) Simplex type strainers (one for each pump) each having a capacity equal to that of the pump with isolating valves, drain valves, vent valves with goose neck piping and other accessories.

15.3.1.2 Common base frame skid for the pump sets, strainers and valves etc drain rim type with drip tray arrangement; and valved outlet connection, foundation bolts & nuts etc. Anchor bolts, sleeves, inserts, sole plates, lifting lugs, eye-bolts etc shall be supplied.

15.3.1.3 Bidder shall offer all parts, components etc which are necessary for efficient economic and safe operation of the pump sets skid irrespective of whether specifically mentioned herein or not.

15.3.2 Tanks & other equipment



- a) Two (2) – 3000 KL capacity vertical cylindrical heavy fuel oil storage tanks with accessories located in the oil tank dyke area. The HFO tanks shall be insulated.
 - b) One (1) – 1000 KL capacity vertical cylindrical High Speed Diesel oil storage tank with accessories located in the oil tank dyke area.
 - c) The heavy fuel oil storage tanks shall be complete with floor coil heaters and fuel oil suction heaters and other accessories as necessary.
 - d) One (1) oil water separator along with pumps as mentioned in this specification for the fuel oil unloading and storage area shall be provided with all needed accessories.
 - e) One (1) drain oil tank of 10 M³ cap with 2 x 100% capacity pumpsets.
 - f) One (1) condensate tank of suitable capacity for main tank area.
 - g) Two (2) nos. drain oil pumps, each of capacity 5 M3/hr
 - h) Two (2) nos water pumps, each of capacity 30 M3/hr.
 - i) Two (2) Nos. sump pump set, each of capacity 30 M3/hr complete with all accessories of drive and mounting in FO Unloading pump house.
 - j) One (1) nos. pressure reducing and de-superheating station for reducing steam pressure to 4 kg/cm².
- 15.3.2.1 Float type level indicators complete with accessories for each tank. All tanks should be calibrated and level indicator with scale shall be provided.
- 15.3.2.2 Adequately sized steel spiral staircases complete with grated stair treads, hand railing, etc for storage tanks for each tank.
- 15.3.2.3 Lot - Oil, water, and air pipe work materials including oil unloading heaters, pipe nozzles, stand pipes, fittings, flanges [including blind flanges as needed], bolts, nuts and gaskets for installation on tanks. This includes oil lines, valves, specialties, panels, accessories, thermal insulation materials etc as needed for satisfactory installation pipe work, valves etc.
- 15.3.2.4 Preparation of detailed fabrication & arrangement drawings.
- 15.3.2.5 The dead storage in the HSD storage tank should not exceed 30 KL.
- 15.3.2.6 The dead storage in the HFO storage tank should not exceed 100 KL.
- 15.3.2.7 Spare nozzles for suction and recirculation shall be provided in each HFO/ HSD tank for future use.
- 15.3.2.8 Lot - Pipe work materials, valves, specialties, motor operators, hangers & supports etc for -



- Connecting oil unloading headers upto oil pump sets; pumps discharge to oil tanks etc.
- Potable/ service water pipework to overhead rectangular tank and further distribution thereof.
- Providing adequately sized pipe nozzle connections on tanks for foam fire protection system.
- Service/instrument air pipe work inside the pump house and dyke area.

15.3.2.9 Heavy oil pipework, pumpsets, valves, strainers and storage tanks shall be provided with thermal insulation to prevent heat loss and safety of personnel. Thermal insulation shall be designed such that the skin temperature shall not more than 60°C under all conditions.

15.3.2.10 The waste oil/drain oil collected from various points such as unloading points, drains, strainers, tank form area etc. shall be led to waste oil tank for further transferring to ETP.

15.4 EQUIPMENT DESCRIPTION

15.4.1 Pump Sets

15.4.1.1 The fuel oil pumps shall be rotary positive displacement self-priming horizontal type, twin screw with mechanical seals. The pumps shall be direct AC motor driven through flexible coupling without any gear box.

15.4.1.2 The pump construction shall incorporate two (2) inter-meshing screws ensuring pulsation free continuous axial flow; having their thread surfaces forming a tight seal to each other as well as the surrounding stator. When the screws rotate, the seals move axially forcing the liquid between them to move forward for smooth uniform pulsation free flow.

15.4.1.3 Suction and discharge connections shall be flanged raised faced and drilled to ASA standards or approved equal.

15.4.1.4 Heavy fuel oil pumps shall have stable head capacity characteristics continuously rising towards shut-off with the highest head at shut-off.

15.4.1.5 Approved type flexible couplings shall be provided for connecting the pumps with the driving motor. A common base plate with drain pan of drain rim type for pump & motor shall be in one piece in fabricated steel construction.

15.4.1.6 The pumpsets shall be electrically traced along with the associated suction and discharge pipework, valves and specialities to avoid solidification of oil and maintain continuous flow of fuel oil.

15.4.1.7 Pumpset Motors

Each pump shall be driven by direct coupled horizontal, 415 Volts, 3-phase, 50 hertz, AC squirrel cage, single speed, totally enclosed Explosion/Flame proof fan cooled construction induction motor to IS: 2148. The nameplate KW rating of the pump motor including service factor shall be at least 115 percent of the motor power



required to drive the pump at the duty operating point, or the maximum power consumed on the characteristic curve, whichever is higher.

15.4.1.8 Accessories

All accessories required for smooth and safe operation shall be provided along with pumpsets. Approved make pressure gauges shall be furnished having 150 mm dial with black figures on white dial or range 0 to 5 kg/cm²(g); graduations 0.5 kg/cm²; and inter-graduation 0.05 kg/cm²(g), complete with isolating valves, piping and fittings as required. Approved make vacuum/pressure gauges on the pump suction side shall be provided similar to those on the discharge side having suitable range.

15.4.2 Vertical Storage Tanks

15.4.2.1 The vertical cylindrical oil storage non-pressure tanks shall be of mild steel to IS: 2062 Gr.B or approved equal welded construction designed, fabricated and installed in accordance with IS: 803. The tanks shall have sloping bottom 1 in 100 towards an adequately sized sump inside the tank to enable complete draining of the contents. Sufficient number of plugged holes shall be provided in the bottom plate of the tanks for bottom testing as per IS: 803.

Conical roof with a slope of not less than 1 in 16 to ensure drainage of rain water shall be provided supported over the tank wall periphery; and the tank shall have single central column. The roof shall be designed for a live load of 250 kg/m². Needed roof rafters and purlins shall be provided adequately designed.

15.4.2.2 All shell course plates shall be accurately bent at required radius. Care shall be taken during bending to prevent plate skewing. For butt-weld joints, edges shall be prepared which shall be uniform and smooth throughout.

Each shell course shall be of uniform height throughout longitudinal weld in any plate. Makeup for the course width shall not be permitted. Shell plates in each course width shall be so arranged that all vertical joints are staggered having a minimum of 600 mm stagger.

15.4.3 Floor Coil Heater

15.4.3.1 Each heavy fuel oil tank shall be provided with floor coil heater in one or more tiers at the bottom of the heavy fuel oil storage tanks to maintain oil within the tank at specified temperature with electricity as the heating medium. The tubes shall be seamless steel to A106 Gr. B supporting the coil within the tank bottom.

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

15.4.4 Fuel Oil Suction Heater

15.4.4.1 The heavy fuel oil suction heater as per the duty conditions indicated below shall be furnished on the outlet of each fuel oil storage tank :

i) Type : Shell and U-tube type (to supply oil at pump suction)



- ii) Heating media : Electric
- iii) Initial temp of oil : 50°C
- iv) Final temp of oil : 70°C
- v) Oil temperature rise : 20°C
- vi) Materials:
 - Shell; shell head; and tube sheet : Steel IS:2002 Gr. 2A
 - Tubes & nozzles : Seamless carbon steel to A106 Gr.B

15.4.4.2 The heater shall be designed as per applicable code. The heater shall be mounted on the side wall of the tank and properly supported. The heater shall have oil in the shell side and steam tracing in the tube side.

15.4.4.3 The bidder shall furnish the design calculations for

- arriving at electric tracing consumption, coil heat transfer area;
- maximum time required (72 hrs) to liquify the stored oil and bring it to the storing temperature under the extreme condition when the heating coil is turned on after prolonged shutdown with material stored in the tank, at the lowest ambient temperature.

15.4.5 Tank Accessories

Accessories for the tanks shall be furnished as necessary. All spare/unused flanged connections and manholes shall be provided with matching blind flanges, gaskets, bolts and nuts.

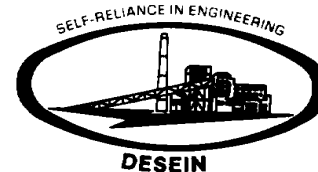
15.4.6 **Flame arrestor:** Each vent connection on oil tanks (HFO/HSD) shall be provided with a flame arrestor, design of which shall meet the approval of the Inspector of Explosives.

15.4.7 **Conservation vent valve:** Where continuous venting to atmosphere directly is not permitted for the stored fuel oil, a conservation vent valve or a breather of approved make and design shall be provided.

15.4.8 Level Indicators & Level Switches

The oil storage tanks shall be provided with flame proof float type level indicators & switches. The float type level indicators shall comprise of stainless steel enclosed float filled with approved light weight materials.

The flexible stainless steel wire attached to the float at one end and to the cast iron target at the other end shall freely roll on the bakelite pulley housed in a cast iron housing provided with bolted covers, as shown on the drawing.



The guide wire spring assembly shall be furnished complete with compression springs, pipe nipples and caps to provide required tension in the stainless steel wire connected to the float.

15.4.9 **Electricals and Control Instrumentation**

15.4.9.1 One (1) - Motor control centre/ switchgear; one lot of motor starters & push button stations for unloading pump sets with spare feeders including accessories for the heavy fuel oil pipework.

15.4.9.2 Power & control cabling with accessories for satisfactory installation of the facilities including needed interlocking facilities etc. All electrical equipments and instrumentation works including cables, cable laying, jointing, making connections from equipment to panels shall be furnished by the bidder. All the cables used shall be of FRLS type.

a) One (1) local control panel housing switches, annunciation, alarms, remote indicators etc as specified for the offered fuel oil handling facilities for control, operation and annunciation purpose of the offered plant shall be furnished. All control valves on electric and oil lines as considered necessary for safe and satisfactory operation of the system.

b) Lot - Local indicators such as pressure and temperature gauges, flow measuring indicators etc; level controlling equipment including level switches, level transmitters and other needed accessories not only for local control & indication but also for remote control operation & indication in the main plant control room [for hooking up with main plant DCS] and oil pump house control room.

c) All equipments shall be flame proof

15.4.9.3 Lightning protection; earthing; cathodic protection (as required); illumination of oil unloading pump house oil forwarding pumphouse & oil tank farm area; cable trays, conduits etc for satisfactory installation of the electrical system for the offered plant.

15.4.10 **Construction materials: Pipes, Valves & Hoses**

		Fuel Oil	Steam/ Condensate
15.4.10.1	Pipes		
	- 65 mm NB & larger	API-5L Gr.B or A106 Gr.B BW ends ANSI B16.25	A106 Gr.B BW ends ANSI-B-16.25
	- 50 mm NB & below	A106 Gr.B Socket weld ends ANSI-B-16.11	-do-
15.4.10.2	Pipe fittings:		
	- 65 mm NB & larger	A-234 or WPB BW ends ANSI-B-16.25	A-234 or WPB BW ends ANSI-B-16.25
	- 50 mm NB & below	A105 socket weld ends ANSI-B16.11	A105 socket weld ends ANSI-B16.11
15.4.10.3	Gate Valves	←Fuel Oil/Steam/Condensate→	
		50 mm NB & large	Below 50 mm NB
	- Code	API-600	API-602
	- Body & bonnet	A-216 Gr. WCB	A 181 Gr. II



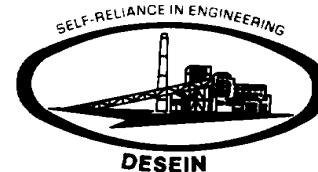
	Fuel Oil	Steam/ Condensate
15.4.10.4	- Seat/trim	← 11 to 13% chrome steel ----->
	- Bolts for bonnet	←----- A 193 Gr. B7 ----->
	- Nuts for bonnet	←----- A 194 Gr. 2H ----->
	Globe valve	
	- Code	←----- BS-1873 ----->
15.4.10.5	- Body & bonnet	A216 Gr. WCB A 181 Gr.II
	- Trim	Chrome steel (Brinell hardness B-250 min) as per AISI-431
	- Bolts for bonnet	←---A 193 Gr. B7 ----->
	- Nuts for bonnet	←--- A 194 Gr. 2H ----->
	Check valves:	
15.4.10.6	- 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
15.4.10.7	- Body	A216 Gr. WCB A181 Gr. II
	- 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 A181 Gr.II
15.4.10.8	- Plug	←Hardened carbon steel ----->
	Hoses:	
	- Oil service	Galvanised interlocked wire reinforced, type-S smooth bore with quick acting coupling fitting standard to suit road tanker/rail tanker.

Oil Strainer: The strainers with flanged inlet and outlet connections shall have basket type straining elements permitting easy removal and replacement. The open area ratio (i.e. straining area to the inlet area ratio) shall be at least 10:1.



FUEL OIL UNLOADING SYSTEM

			HSD System		HFO System	
1.0	a. Fuel Oil Transfer Pumps		Horizontal, Positive displacement, twin screw pumps			
	b. Pumps standard		VDMA/API 676			
1.1	Make		Approved vendor list subject to approval of Owner			
1.2	Quantity	Nr.	2 (1 W + 1 S)		3 (2 W + 1 S)	
1.3	Capacity	TPH	50		100	
1.4	Discharge Pressure	Bar	4.0		4.0	
1.5	Speed (synchronous)	RPM	1500		1500	
1.6	Material of construction		CI to IS 210 FG260		CI to IS 210 FG 260	
	Body		13 % Chrome steel		13 % Chrome steel	
	Screws					
1.7	Accessories		Built in pressure relief valve			
			Pressure gauges			
			Coupling guards			
			Foundation bolts			
			Drip tray			
			FLP motors			
2.0	Oil storage tanks		Vertical, cylindrical, cone roof type as per IS:803			
2.1	Rated capacity	Kl	HSD-main		HFO main	
			1000		3000	
2.2	Diameter	M	As per IS:803			
2.3	Height	M				
2.4	Material of construction		MS plate fabricated			
2.5	Accessories		Flame arrestor, float type level indicator, conservation vent valve, stand pipe with instruments			
2.6	Quantity of tanks	Nos.	1		2	
3.0	Inter connecting piping, valves, specialties					
	Piping	For sizes 150mm NB and below	Oil: ERW CS pipes to IS:1239 with suitable fittings.			
			Aux. Steam and condensate: Seamless CS pipes to IS:1239 with suitable fittings			
	Valves	For sizes 65 mm NB and above	150 # Cast carbon steel flanged end ball, plug, gate, globe, check valves			



			HSD System	HFO System
		For sizes 50 mm NB and below	800 # Forged carbon steel socket welded end ball, plug, gate, globe, check valves	
	Strainers/Filters	At pumps suction	MS fabricated basket with SS screen mesh of less than 1mm openings	
	Insulation	For HFO and aux steam services	Mineral wool mattress type with 24 G Aluminium steel cladding	
4.0	Oil Storage Tank Farm dyke			
	Capacity		To contain one large tank contents.	
	Dyke wall		As per Statutory Guidelines – However min 2 m high RCC Wall above finished floor level + 1 m high barbed wire fencing over RCC wall.	



CHAPTER – 3

GENERAL TECHNICAL REQUIREMENTS

1.00.00 INTRODUCTION

This part covers technical requirements, which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical requirements brought out in the Technical Specifications and the Technical Data Sheets.

2.00.00 BRAND NAME

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Owner to determine that the products proposed are equivalent to those named.

3.00.00 BASE OFFER & ALTERNATE PROPOSALS

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Bidder may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice may also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Owner. Sufficient amount of information for justifying such proposals shall be furnished to Owner along with the bid to enable the Owner to determine the acceptability of these proposals.

4.00.00 COMPLETENESS OF FACILITIES

4.01.00 Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure that a completely engineered plant is provided.

4.02.00 All equipment furnished by the Bidder shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation & maintenance of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.



All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with one another.

5.00.00 CODES & STANDARDS

5.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following:

- (a.) Bureau of Indian Standards (BIS)
- (b.) Indian electricity act
- (c.) Indian electricity rules
- (d.) Indian Explosives Act
- (e.) Indian Factories Act and State Factories Act
- (f.) Indian Boiler Regulations (IBR)
- (g.) Regulations of the Central Pollution Control Board, India
- (h.) Regulations of the Ministry of Environment & Forest (MoEF), Government of India
- (i.) Pollution Control Regulations of Department of Environment, Government of India
- (j.) State Pollution Control Board.
- (k.) Rules for Electrical installation by Tariff Advisory Committee (TAC).
- (l.) Any other statutory codes / standards / regulations, as may be applicable.

5.02.00 Unless covered otherwise by Indian codes & standards and in case nothing to the contrary is specifically mentioned elsewhere in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:

- (a.) Japanese Industrial Standards (JIS)
- (b.) American National Standards Institute (ANSI)
- (c.) American Society of Testing and Materials (ASTM)
- (d.) American Society of Mechanical Engineers (ASME)



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



- (e.) American Petroleum Institute (API)
- (f.) Standards of the Hydraulic Institute, U.S.A.
- (g.) International Organisation for Standardization (ISO)
- (h.) Tubular Exchanger Manufacturer's Association (TEMA)
- (i.) American Welding Society (AWS)
- (j.) National Electrical Manufacturers Association (NEMA)
- (k.) National Fire Protection Association (NFPA)
- (l.) International Electro-Technical Commission (IEC)
- (m.) Expansion Joint Manufacturers Association (EJMA)
- (n.) Heat Exchange Institute (HEI)

- 5.03.00 Other International/ National standards such as DIN, VDI, BS, etc. shall also be accepted for only material codes and manufacturing standards, subject to the Owner's approval, for which the Bidder shall furnish, alongwith the offer, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned else where in the specification together with the complete word to word translation of the standard that is normally not published in English.
- 5.04.00 As regards highly standardized equipment such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. In addition, these standards shall be referred for the design of machine foundations, wherever specifically mentioned in the specifications. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.
- 5.05.00 In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.
- 5.06.00 Two (2) English language copies of all-national and international codes and/or standards used in the design of the plant, equipment, civil and structural works shall be provided by the Bidder to the Owner within two calendar months from the date of the Notification of Award.
- 5.07.00 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Owner shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Bidder to bring to the notice of the Owner such changes and advise Owner of the resulting effect.
- 6.00.00 EQUIPMENT FUNCTIONAL GUARANTEE**



6.01.00 The Equipment and Auxiliaries shall be capable of continuous operation in frequency range of 47.5 to 51.5 Hz.

6.02.00 The functional guarantees of the equipment under the scope of the Contract is given elsewhere in the technical specification. These guarantees shall supplement the general functional guarantee provisions covered under General Conditions of Contract.

6.03.00 Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Bidder as specified elsewhere in this specification.

7.00.00 DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.01.00 Design of Facilities

All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

The Bidder shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinate performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.

7.02.00 Maintenance and Availability Considerations

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

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours, clearly defining the spare parts and man-hour requirement for each stage.

Lifting devices i.e. hoists and chain pulley jacks, etc. shall be provided by the Bidder for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities.



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

8.00.00 DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY BIDDER

8.01.00 Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required ensuring a completely engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope.

The Bidder shall furnish engineering data/drgs. in accordance with the schedule of information as specified in Technical Specification and data sheets.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of documents is given in Annexure-I attached with Chapter 3.

8.03.00 The documentation that shall be provided by the Bidder is indicated in various sections of specification. The documentation shall include but not be limited to the following:

Basic Engineering Documentation

Prior to commencement of the detailed engineering work, the Bidder shall furnish a Plant Definition Manual within 4-6 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:

- i. System description of all the mechanical, electrical, control & instrumentation & civil systems.
- ii. Technology scan for each system / sub-system & equipment.
- iii. Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.
- iv. Optimization studies including thermal cycle optimization.
- v. Sizing criteria of all the systems, sub-systems including various piping systems/ equipment/ structures/ equipment foundations along with all calculations justifying and identifying the sizing and the design margins.
- vi. Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.
- vii. Operation Philosophy and the control philosophy of the Main Plant and other plants.



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



- viii. General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Owner's scope. This drawing shall also be furnished in the form of floppy discs to the Owner for engineering of areas not included in Bidder's scope.
- ix. Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area and other areas included in the scope of the Bidder.
- x. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.
- xi. The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Owner.
- xii. After approval of Plant Definition Manual / Design Basis Report, Bidder shall furnish detailed technical specification of all system / packages of the Plant.
 - i. Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.
 - ii. Flow diagrams, Process & Instrumentation Diagrams alongwith write-up and system description.
 - iii. Start-up curves for turbine, boiler and both turbine and boiler combined together as a unit for various start-ups, viz. cold, warm and hot start-up.
 - iv. Piping isometric, composite layout and fabrication drawings.
 - v. Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.
 - vi. Technical data sheets for all bought out and manufactured items. Bidder shall use the specifications as a base for placement of orders on their sub-vendors.
 - vii. Detailed design calculations for components, system/sub-system,, piping etc., wherever applicable including sizing calculations for all auxiliaries as per criteria specified elsewhere in specification.
 - viii. Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier.
 - ix. Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes.



- x. Thermal cycle information (heat balance diagrams, boiler performance calculations, condenser and heat exchanger thermal calculations etc.).
- xi. Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters.
- xii. Comprehensive list of all terminal points which interface with Owner's facilities giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.
- xiii. Power supply single line diagram, block logics, control schematics, electrical schematics, etc.
- xiv. Protection system diagrams and relay settings.
- xv. Interconnection diagrams.
- xvi. Cable routing plan.
- xvii. Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.
- xviii. Alarm and annunciation list and alarms & trip set points.
- xix. Sequence and protection interlock schemes.
- xx. Type test reports and power system stability study report.
- xxi. Control system configuration diagrams and card circuit diagrams and maintenance details.
- xxii. Detailed software manuals & source software listing.
- xxiii. Detailed flow chart for digital control system.
- xxiv. Mimic diagram layout.
- xxv. Civil Task drawings(for the Engineering by Owner),Design and Drawings for the Civil & Structural works in the scope of the Bidder.
- xxvi. Model study reports wherever applicable.
- xxvii. Functional & guarantee test procedures and test reports.



- xxviii. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.
- xxix. Documentation in respect of commissioning as listed out elsewhere in this specification.
- xxx. The Bidder while submitting the above documents / drawings for approval / reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.

8.03.01**Instruction Manuals**

The Bidder shall submit to the Owner, draft Instruction Manuals for all the equipment covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalization and approval of the Owner the Instruction Manuals shall be submitted as indicated in Annexure-I. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Owner. The Instruction Manuals shall comprise of the following.

Erection Manuals

The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

- a) Erection strategy.
- b) Sequence of erection.
- c) Erection instructions.
- d) Critical checks and permissible deviation/tolerances.
- e) List of tool, tackles, heavy equipment like cranes, dozers, etc.
- f) Bill of Materials
- g) Procedure for erection.
- h) General safety procedures to followed during erection/installation.
- i) Procedure for initial checking after erection.
- j) Procedure for testing and acceptance norms.
- k) Procedure / Check list for pre-commissioning activities.
- l) Procedure / Check list for commissioning of the system.



- m) Safety precautions to be followed in electrical supply distribution during erection

Operation & Maintenance Manuals

- i. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall be in sufficient detail to enable the Owner to operate, maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant / equipment including, operation, maintenance, dismantling and repair including periodical activities such as chemical cleaning of the generator. Each manual shall also include a complete set of drawings together with performance/rating curves of the equipment and test certificates wherever applicable. The contract shall not be considered to be completed for purposes for taking over until these manuals have been supplied to the Owner.
- ii. If after the commissioning and initial operation of the plant, the manuals require any modification / additions / changes, the same shall be incorporated and the updated final instruction manuals shall be submitted to the Owner for records.
- iii. A separate section of the manual shall be for each size/ type of equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets and drawings.
- iv. The manuals shall include the following :
 - a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.
 - b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.
 - c) Where applicable, fault location charts shall be included to facilitate finding the cause of maloperation or break down.
- v. Detailed specifications for all the consumables including lubricant oils, greases, chemicals etc. system/equipment/assembly/sub-assembly - wise required for the complete plant.
- vi. On completion of erection, a complete list of bearings / equipment giving their location, and identification marks etc. shall also be furnished to the Owner indicating lubrication method for each type/category of bearing.

8.03.02

Plant Handbook



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



The Bidder shall submit to the Owner a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipment and systems covering the complete project including

1. Design and performance data.
2. Process & Instrumentation diagrams.
3. Single line diagrams.
4. Sequence & Protection Interlock Schemes.
5. Alarm and trip values.
6. Performance Curves.
7. General layout plan and layout of main plant building and auxiliary buildings.
8. Important Do's & Don't's

The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Owner's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03 **Project Completion Report**

The Bidder shall submit a Project Completion Report at the time of handing over the plant.

8.03.04 **Drawings**

- (a.) All documents submitted by the Bidder for Owner's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-I. The soft copies to be supplied shall be either in CDs, or through direct transfer via E-mail, etc. depending upon the nature/volume/size of the document. The drawings submitted for approval could be in the Image form.
- (b.) Final copies of the approved drawings shall be submitted on CD-ROM along with the requisite number of hard copies as per Annexure-I.
- (c.) The completed plant documentation with equipment drawings, data sheets, P&ID, BOQ, schematics, logic diagrams, test reports and quality plan, etc. shall be furnished to Owner.
- (d.) All documents/text information shall be in latest version of MS Office.



- (e.) All drawings submitted by the Bidder including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.
- (f.) Each drawing submitted by the Bidder (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Owner, Consultant, name of the Project, system designation, the specifications title, the specification number, drawing/document number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.
- (g.) The Bidder shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Owner. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY".
- (h.) Similarly, all the drawings/ documents submitted by the Bidder during detailed engineering stage shall be stamped "FOR APPROVAL" or "FOR INFORMATION" prior to submission.
- (i.) The furnishing of detailed engineering data and drawings by the Bidder shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Owner will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipment provided by others and external connections & dimensions which might affect plant layout. The review by the Owner should not be construed to be a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Owner / Project Manager shall not relieve the Bidder of any of his responsibilities and liabilities under this contract.
- (j.) After the approval of the drawings, further work by the Bidder shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Owner.
- (k.) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Bidder's risk. The Bidder is expected not to make any changes in the design of the equipment /system, once they are approved by the Owner. However, if some changes are necessitated in the design of the equipment/system at a later date, the Bidder may do so, but such



changes shall promptly be brought to the notice of the Owner indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

- (l.) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Owner prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/representative of Owner based on requirements of such piping indicated in approved / finalized Flow Scheme / Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.
- (m.) Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the Bidder well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.
- (n.) As Built Drawings

After final acceptance of individual equipment/system by the Owner, the Bidder will update all original drawings and documents for the equipment/ system to “as built” conditions.

- (o.) Drawings must be checked by the Bidder in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Owner. In case drawings are found to be submitted without proper endorsement for checking by the Bidder, the same shall not be reviewed and returned to the Bidder for re-submission. The Bidder shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/drawings at site which are needed as an input to the engineering. The Bidder shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Owner's scope and submit all necessary drawings/ documents for the same.
- (p.) The Bidder shall submit adequate prints of drawing/data/document for Owner's review and approval. The Owner shall review the drawings and return one (1) copy to the Bidder authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Bidder to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.



- (q.) All engineering data submitted by the Bidder after final process including review and approval by the Owner shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Owner in writing.

8.04.00 **Engineering Information Submission Schedule**

Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the Owner. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts.

- (a.) Information that shall be submitted for the approval of the Owner before proceeding further, and
- (b.) Information that would be submitted for Owner's information only.

The Engineering Information Schedule shall be updated monthwise.

The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

8.05.00 **Engineering Progress and Exception Report**

8.05.01 Report giving the status of each engineering information including

- (a.) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission
- (b.) Drawings which were not submitted as per agreed schedule.

8.05.02 The draft format for this report shall be furnished to the Owner within four (4) weeks of the award of the contract, which shall then be discussed and finalized with the Owner.

8.06.00 **Co-Ordination Meetings**

8.06.01 The Bidder shall be called upon to organize and attend monthly Design/ Co-ordination Meetings with the Owner/Owner's representatives, Project Consultant during the period of contract. The Bidder shall attend such meetings at his own cost at mutually agreed venue as and when required and



- fully co-operate with such persons and agencies involved during the discussions.
- 8.06.02 The Bidder should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Bidder shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Bidder will be reviewed by the Owner as far as practicable within three (3) weeks from the date of receipt of the drawing. The comments of the Owner shall then be discussed across the table during the above co-ordination Meetings wherein best efforts shall be made by both sides to ensure the approval of the drawing.
- 8.06.03 The Bidder shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Bidder shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.
- 8.06.04 Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.
- 8.06.05 Any delays arising out of failure by the Bidder to incorporate Owner's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Bidder to alter the Contract completion date.
- 8.07.00 **Design Improvements**
- The Owner or the Bidder may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.
- If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Bidder proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.
- 8.08.00 **Equipment Bases**
- A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Owner. Each base plate which support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.
- 8.09.00 **Protective Guards**
- Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.



8.10.00 Lubricants, Servo Fluids and Chemicals

8.10.01 The Bidder's scope includes all the first fill and one year's topping, requirements of consumables such as oils, lubricants including grease, servo fluids, gases and essential chemicals etc. Consumption of all these consumables during the initial operation and final filling after the initial operation shall also be included in the scope of the Bidder. Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilised during the first year of operation. This additional quantity shall be supplied in separate Containers.

8.10.02 As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible.

Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Owner along with lubrication requirements.

8.11.00 Lubrication

8.11.01 Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.

8.12.00 Material of Construction

8.12.01 All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilized for various components shall be those which have established themselves for use in such applications.

8.13.00 Rating Plates, Name Plates & Labels

8.13.01 Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Owner.

8.13.02 Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Owner or as detailed in appropriate section of the technical specifications.

8.13.03 Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering



engraved on the back. The name plates shall be suitably fixed on both front and rear sides.

- 8.13.04 Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with epoxy. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.
- 8.13.05 Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support/hanger.
- 8.13.06 Valves, steam traps and strainers shall be identified by Owner's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.
- 8.13.07 Safety and relief valves shall be provided with the following :
- (a.) Manufacturer's identification.
 - (b.) Nominal inlet and outlet sizes in mm.
 - (c.) Set pressure in Kg/cm² (abs).
 - (d.) Blowdown and accumulation as percentage of set pressure.
 - (e.) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.
- 8.13.08 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.
- 8.13.09 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system

8.14.00 **Tools and Tackles**

The Bidder shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.



The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Bidder shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Bidder should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Owner.

8.15.00 **Welding**

8.15.01 If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipment to be performed by others the requirements shall be submitted to the Owner in advance of commencement of erection work.

8.16.00 **Colour Code for all Equipment/ Pipings/ Pipe Services**

8.16.01 All equipment/ piping/ pipe services are to be painted by the Bidder in accordance with Owner's standard colour coding scheme, which will be furnished to the Bidder during detailed engineering stage.

8.17.00 **Protection and Preservative Shop Coating**

8.17.01 **Protection**

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or overground environment as the case may be.

8.17.02 **Preservative Shop Coating**

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted with atleast two coats of primer.

Transformers and other electrical equipment if included shall be shop finished with one or more coats of primer and two coats of high grade epoxy. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Owner at a later date.



- 8.17.03 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Bidder after obtaining specific approval of the Owner regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Owner.
- 8.17.04 All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Owner.
- 8.17.05 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Owner. Lube oil piping or carbon steel shall be pickled.
- 8.17.06 Painting for Civil structures shall be done as per relevant part of technical specification.

9.00.00 QUALITY ASSURANCE PROGRAMME

9.01.00 The Bidder shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Bidder's works or at his sub-Bidder's premises or at the Owner's site or at any other place of work are in accordance with the specifications. Such programs shall be outlined by the Bidder and shall be finally accepted by the Owner/authorized representative after discussions before the award of the contract. The QA programme shall be generally in line with IS/ISO-9001. A quality assurance programme of the Bidder shall generally cover the following:

- (a.) His organization structure for the management and implementation of the proposed quality assurance programme
- (b.) Quality System Manual
- (c.) Design Control System
- (d.) Documentation and Data Control System
- (e.) Qualification data for bidder's key personnel.
- (f.) The procedure for purchase of materials, parts, components and selection of sub-Bidder's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- (g.) System for shop manufacturing and site erection controls including process, fabrication and assembly.
- (h.) Control of non-conforming items and system for corrective actions and resolution of deviations.
- (i.) Inspection and test procedure both for manufacture and field activities.



- (j.) Control of calibration and testing of measuring testing equipment.
- (k.) System for Quality Audits.
- (l.) System for identification and appraisal of inspection status.
- (m.) System for authorising release of manufactured product to the Owner.
- (n.) System for handling, storage and delivery.
- (o.) System for maintenance of records, and
- (p.) Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

9.02.00 **General Requirements - Quality Assurance**

- 9.02.01 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme duly approved by the Owner. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Owner for approval. Schedule of finalisation of such quality plans will be finalised before award. Monthly progress reports on MQP/FQP submission/approval shall be furnished.
- 9.02.02 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's/ Sub-Bidder's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. Compact Disc or E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM.
- 9.02.03 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.
- 9.02.04 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference



documents/standards etc. will be subject to Owner's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Owner shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Owner's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Owner in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner along with technical justification for approval and dispositioning.

- 9.02.05 No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Owner's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).
- 9.02.06 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
- 9.02.07 The Bidder shall submit to the Owner Field Welding Schedule for field welding activities in the enclosed format No.: QS-01-QAI-P-02/F3. The field welding schedule shall be submitted to the Owner along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.
- 9.02.08 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Owner.
- All welding/brazing procedures shall be submitted to the Owner or its authorised representative for approval prior to carrying out the welding/brazing.
- 9.02.09 All brazers, welders and welding operators employed on any part of the contract either in Bidder's/sub-Bidder's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Owner.
- 9.02.10 Welding procedure qualification & Welder qualification test results shall be furnished to the Owner for approval. However, where required by the Owner, tests shall be conducted in presence of Owner/authorised representative.
- 9.02.11 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the



equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.

- 9.02.12 Unless otherwise proven and specifically agreed with the Owner, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 9.02.13 No welding shall be carried out on cast iron components for repair.
- 9.02.14 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 9.02.15 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.
- All plates of thickness above 40mm & all bar stock/Forging above 40mm dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.
- 9.02.16 The Bidder shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors bought out items (BOI). All the sub-Bidder proposed by the Bidder for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Bidder and finalised with the Owner, shall be subject to Owner's approval. The Bidder's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Owner for approval within the period agreed at the time of pre-awards discussion and identified in review category prior to any procurement. Monthly progress reports on sub-Bidder detail submission / approval shall be furnished. Such vendor approval shall not relieve the Bidder from any obligation, duty or responsibility under the contract.
- 9.02.17 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Owner, the Bidder's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-Bidder shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Owner and such approved Quality Plans shall form a part of the purchase order/contract between the Bidder and sub-Bidder. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications,



quality plans and delivery conditions shall be furnished to the Owner on the monthly basis by the Bidder along with a report of the Purchase Order placed so far for the contract.

- 9.02.18 Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their sub-Bidder's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.
- 9.02.19 The Bidder shall carry out an inspection and testing programme during manufacture in his work and that of his sub-Bidder's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Bidder shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
- 9.02.20 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Owner to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Bidder in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
- 9.02.21 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
- 9.02.22 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Owner/ authorised representative.
- 9.02.23 Burn in and Elevated Temperature Test Requirement for Electronics Solid State Equipment

All solid state electronic systems/equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours (7 Days) continuously under energized conditions prior to shipment from manufacturing works, as per the following cycle.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours of the total 168 hours of testing, the ambient temperature shall be maintained at 50 deg.C. The equipment shall be interconnected with devices which will cause it to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and



inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10 deg.C above the ambient temp. at 50 deg.C.

Burn in Test Cycle

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

In case the Bidder/ sub-Bidder is having any alternate established procedure of eliminating infant mortile components, the detail procedures followed by the Bidder/ sub- Bidder along with the statistical figures to validate the alternate procedure to be forwarded.

The Bidder/Sub-Bidder shall carry out routine test on 100% item at Bidder/sub-Bidder's works. The quantum of check/test for routine & acceptance test by Owner shall be generally as per criteria/sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check/test for routine / acceptance test shall be as agreed during detailed engineering stage.

9.03.00 QA Documentation Package

The Bidder shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (?) mark.

9.03.01 Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub- supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.

9.03.02 Typical contents of QA Documentation is as below:-

- (a.) Quality Plan
- (b.) Material mill test reports on components as specified by the specification and approved Quality Plans.



- (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
- (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- (e.) Heat Treatment Certificate/Record (Time- temperature Chart)
- (f.) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
- (g.) CHP / Inspection reports duly signed by the Inspector of the Owner and Bidder for the agreed Customer Hold Points.
- (h.) Certificate of Conformance (COC) wherever applicable.
- (i.) MDCC

9.03.03 Similarly, the Bidder shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

9.03.04 Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

- (a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
- (b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
- (c.) If a decision is made despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time. The supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of



QA documentation package shall not be later than 3 weeks after the despatch of equipment.

9.03.05 Transmission Of QA Documentation

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Owner.

For the particular case of phased deliveries, the complete quality document to the Owner shall be issued not later than 3 weeks after the date of the last delivery of equipment.

9.04.00 Project Manager's Supervision

9.04.01 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section General Conditions of Contract, the Bidder shall proceed to comply with the Project Manager's decision.

9.04.02 The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

- (a.) Interpretation of all the terms and conditions of these documents and specifications:
- (b.) Review and interpretation of all the Bidder's drawing, engineering data, etc:
- (c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract :
- (d.) Inspect, accept or reject any equipment, material and work under the contract.
- (e.) Issue certificate of acceptance and/or progressive payment and final payment certificates
- (f.) Review and suggest modifications and improvement in completion schedules from time to time, and
- (g.) Supervise Quality Assurance Programme implementation at all stages of the works.

9.05.00 Inspection, Testing And Inspection Certificates

9.05.01 The word 'Inspector' shall mean the Project Manager and/or his authorized representative and/or an outside inspection agency acting on behalf of the



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



Owner to inspect and examine the materials and workmanship of the works during its manufacture or erection.

- 9.05.02 The Project Manager or his duly authorized representative and/or an outside inspection agency acting on behalf of the Owner shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Bidder shall obtain for the Project Manager and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.
- 9.05.03 The Bidder shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Bidder's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the Bidder may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
- 9.05.04 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
- 9.05.05 When the factory tests have been completed at the Bidder's or sub-Bidder's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 9.05.06 In all cases where the contract provides for tests whether at the premises or works of the Bidder or any sub-Bidder, the Bidder, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorized representatives to carry out effectively such tests on the equipment in accordance with the Bidder and shall give facilities to the Project Manager/Inspector or to his authorized representative to accomplish testing.



- 9.05.07 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed Quality Assurance Programme forming a part of the contract.
- 9.05.08 To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- of this chapter, the Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
- 9.05.09 All inspection, measuring and test equipment used by Bidder shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by the Owner. Wherever asked specifically, the Bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager/Inspector.
- 9.06.00 **Associated document for quality assurance programme:**
- 9.06.01 List of items requiring quality plan and sub supplier approval. (Annexure-III).
- 9.06.02 Status of items requiring Quality Plan and sub supplier approval. (Annexure-IV).
- 9.06.03 Field Welding Schedule (Annexure-V).
- 9.06.04 Manufacturing Quality Plan (Annexure-VI).
- 9.06.05 Field Quality Plan (Annexure-VII).

10.00.00 PRE-COMMISSIONING AND COMMISSIONING FACILITIES

- (a.) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Owner and the Bidder for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Bidder's quality assurance programme as well as those included elsewhere in the Technical Specifications.
- (b.) The Bidder's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall



be commenced during which period the complete facilities, equipment shall be operated integral with sub-systems and supporting equipment as a complete plant.

It will be the responsibility of the Bidder to assess and furnish a list of all commissioning spares required for successful commissioning of all the equipment covered under the contract. Such a list shall be furnished by the Bidder within 12 months from the date of LOA, separately for each equipment and shall be reviewed by the Owner and discussed for mutual agreement. The commissioning spares will be so identified as not to allow the trial operation to suffer for want of such commissioning spares. The identification of commissioning spares will not in any way relieve the Bidder of any of his responsibilities of satisfactory performance under the provisions of other conditions of contract. All the commissioning spares shall be deemed to be included in scope of the Bidder as a part of the respective equipment package at no extra cost to the Owner.

- (c.) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Owner six months prior to the respective implementations. The Owner will approve final verification of cleanliness.
- (d.) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.
- (e.) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Owner's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs (Standard Check List) / TS (Testing Schedule) / CS (Commissioning Schedule)] approved by the Owner.
- (f.) The Bidder during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.
- (g.) Bidder shall furnish the commissioning organization chart for review & acceptance of Owner at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain :
 - (1.) Biodata including experience of the Commissioning Engineers.
 - (2.) Role and responsibilities of the Commissioning Organisation members.



- (3.) Expected duration of posting of the above Commissioning Engineers at site.

10.02.00 Initial Operation

- a) On completion of all pre-commissioning activities / tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.
- b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours.
- c) The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.
- d) The Bidder shall intimate the Owner about the commencement of initial operation and shall furnish adequate notice to the Owner in this respect.
- e) Any loss of generation due to constraints attributable to the Owner shall be construed as Deemed Generation.
- f) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Bidder. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Bidder to the full satisfaction of the Owner to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for withholding the aforesaid permission.

10.03.00 Guarantee Tests

- a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Bidder in presence of the Owner. The Bidder's Commissioning, Start-up Purchaser shall make the unit ready to conduct such test. Such test will be commenced and completed as per schedule indicated in Vol I GCC
- b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.



- c) For performance/ demonstration tests instrumentations, of accuracy class, to the approval of the Owner shall be used. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Owner's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.
- d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Bidder, free of cost.
- e) The Guarantee tests and specific tests to be conducted on equipment have been brought out in detail elsewhere in the specification.

11.00.00 TAKING OVER

Upon successful completion of Initial Operations and all the tests other than guarantee tests conducted to the Owner's satisfaction, the Owner shall issue to the Bidder a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Owner delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Bidder of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

12.00.00 TRAINING OF OWNER'S PERSONNEL

12.01.00 The scope of service under training of Owner shall include a training module in the areas of Operation & Maintenance.

Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Owner:

- (a.) Training for Steam Generator Equipment
- (b.) Training for TG and related equipment.
- (c.) DDCMIS
- (d.) Training for Electric Power Supply systems
- (e.) Training for HT motor
- (f.) Training for power cycle piping/critical piping.

The above training shall be provided taken by the EPC Bidder in one of the reference power plant.



12.02.00 The scope of services under training shall also necessarily include training of Owner's Engineering personnel covering a training module of upto 52 man months. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. An indicative module of the training requirement of Owner's Engineering personnel is attached as Annexure-II.

Four (4) man month and two (2) man month training for Purchasers Engineering Personnel on the offered CFD modelling code for SG & ESP including alternative geometry modelling technique to be provided.

12.03.00 Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Owner's approval. Consolidated training period included above (i.e. 35 and 52 man months respectively for O&M and Engineering) is indicative only. Owner reserves the right to reappropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.

12.04.00 Clause 12.02.00 & 12.03.00 shall be applicable for domestic bidders. For foreign bidders refer Vol I GCC.

12.05.00 Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.

12.06.00 In all the above cases, wherever the training of Owner's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Owner's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.

12.07.00 Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Owner reserves the right to include or exclude these item(s) during place of Award. All expenses except travelling expenses shall be borne by the contractor.

13.00.00 SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

- (a.) Working platforms should be fenced and shall have means of access.
- (b.) Ladders in accordance with Owner's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.



14.00.00 NOISE LEVEL

The equivalent 'A' weighted sound pressure level measured at a height of 1.0 m above floor level in elevation and at a distance of one (1) meter horizontally from the nearest surface of any equipment / machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA except for

- (a.) Safety valves and associated vent pipes for which it shall not exceed 105 dBA.
- (b.) Regulating drain valves in which case it shall be limited to 90 dBA.
- (c.) TG unit in which case it shall not exceed 90 dBA.
- (d.) For HP-LP bypass valves and other intermittently operating control valves, the noise level shall be within the limit of 85 dBA.

15.00.00 PACKAGING AND TRANSPORTATION

All the equipment & spares shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. Each spare shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such a case and other packages must be suitably marked and numbered for the purpose of identification. All cases, containers or packages, are liable to be opened for such examination as may be considered reasonable by the Engineer. In case of equipment supplied with grease/lubricants from imported origin, the supplied shall clearly indicate the indigenous equivalent of the grease/lubricant and source of supply so as to enable the Owner to procure these items from indigenous sources. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Bidder shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting dispatch of equipment. Before dispatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & pre-assembly to bare minimum. The Owner's Inspector shall have right to insist for completion of works in shops before dispatch of materials for transportation.

16.00.00 ELECTRICAL ENCLOSURE

All electrical equipment and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specification.



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



17.00.00 INSTRUMENTATION AND CONTROL

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

- 17.01.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:

a)	Temperature	-	Degree centigrade (deg C)
b)	Pressure	-	Kilograms per square centimeter (Kg/cm ²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
c)	Draught	-	Millimeters of water column (mm wc).
d)	Vacuum	-	Millimeters of mercury column (mm Hg) or water column (mm Wcl).
e)	Flow (Gas)	-	Tonnes/ hour
f)	Flow (Steam)	-	Tonnes/ hour
g)	Flow (Liquid)	-	Tonnes / hour
h)	Flow base	-	760 mm Hg. 15 deg.C
i)	Density		Grams per cubic centimeter.

- 17.02.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plug-in connection at rear.

- 17.03.00 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalized & components shall be of industrial grade or better.

18.00.00 ELECTRICAL NOISE CONTROL

The equipment furnished by the Bidder shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Bidder's equipment, which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-801- 2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems.

19.00.00 INSTRUMENT AIR SYSTEM

2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc. shall be as per the details furnished elsewhere.

Each pneumatic instrument shall have an individual air shut - off valve. The pressure-regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.

20.00.00 TAPPING POINTS FOR MEASUREMENTS

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Bidder will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Bidder.

- (a.) Temperature test pockets with stub and thermowell
- (b.) Pressure test pockets

21.00.00 ELECTRONIC MODULE/COMPONENT DETAILS

The Bidder shall have to furnish all technical details including circuit diagrams, specifications of components, etc., in respect of each and every electronic card/module as employed on the various solid state as well as microprocessor based systems and equipment including conventional instruments, peripherals etc.

It is mandatory for the Bidder to identify clearly the custom built ICs used in the package. The Bidder shall also furnish the details of any equivalents of the same.

22.00.00 ENVIRONMENTAL MONITORING & CONTROL MEASURES

Bidder to note that MOEF has declared Manali area as critically polluted area and also imposed certain restrictions on consideration of developmental projects.

Concerned authorities have been addressed to have self monitoring system (for Air, Water & Land) so as to ascertain the level of compliance of standards prescribed by MOEF and also to furnish the action plan ie., for the establishment of self monitoring system. It is also directed to undertake Environmental Audit (EA) to ascertain the compliance level of standards notified by MOEF.



In this context it is to be noted that our proposed project is also located in the said critically polluted cluster. Though environmental clearance for the said project has been obtained the Controlling Authorities will be highly keen and keep a tight vigil on the availability/provision of self monitoring system (for Air, Water & Land) so as to ascertain the level of compliance of standards prescribed by MOEF.

Environmental Clearance:

The environmental appraisal minutes are indicated below.

“Expert Appraisal Committee/MoEF has considered the project on 25th June 2012 and recommended issue of EC subject to TANGEDCO furnishing the cumulative impact on air, water and soil considering the Industries located 15km radius from the Ennore SEZ Project Site. The same is being furnished. Copy of Minutes of EAC is enclosed. Final Environmental Clearance yet to be received. For Compliance of conditions stipulated by TNPCB under section 21 of the Air (Prevention and control of Pollution) Act 1981 as amended in 1987, the following are included in the specification:

- a) RCC chimney with designed height of 275mtrs included in the specification.
- b) High efficiency ESPs (99.9% efficiency) have been proposed to ensure emission of particulate matter within 50 mg/Nm³.
- c) Bag filters have been proposed for the coal crushers to collect suspended particulate emission.
- d) Dust suppression system has been proposed for the coal yard.
- e) Equipment for continuous monitoring of Ambient Air Quality has been proposed.
- f) On line / automatic continuous stack monitor has been proposed.
- g) Port holes in the chimney and sampling facilities for the stack for the proposed Boiler, as per the Central Pollution Control Board guide lines.
- h) The unit shall have suitable sufficient acoustic measures for Generator, Turbine, Coal crusher and other sources including special anti vibration Foundation for which all the heavy rotating equipments / machines shall be erected over the Anti vibration foundations to reduce noise, vibration etc.,
- i) The unit shall have separate energy meter for the operation of the Electro Static Precipitator, the Air pollution control equipment for the proposed Boiler.



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



- j) Alternate power source will come into effect in case of power failure for the operation of Air Pollution Control measures
- k) laboratory for analysis of gaseous / particulate emissions
- l) The coal shall be stored in a completely paved area with the provisions for leach ate collection. The coal storage yard shall be provided with wind barriers of sufficient height. The height of the coal piles shall be lower than that of the wind barrier.
- m) The location of wind barriers shall be based on the predominant wind direction and shall be in consultation with TNPCB so as to avoid fugitive dust emission.
- n) Closed conveyors for coal transport and Bag filters in all the transfer points to control dust emission have been proposed
- o) Dust suppression system / water sprinklers to keep the stock pile sufficiently wet all the time to avoid carryover of dust.
- p) All the internal roads shall be well paved and be provided with water sprinkling arrangement to avoid fugitive dust emission during vehicle movement. The unit shall limit the speed of the vehicle to 10KM/hr. for heavy vehicles within the plant premises to prevent the road dust emission.
- q) Burners have been designed for low NOx.
- r) Space provision made for installation of FGD of requisite efficiency of removal of SO₂, if required at a later stage for which adequate space is provided near the chimney.
- s) The unit shall ensure that the velocity of the exit gas from the stack shall be greater than 25 m/sec and the ratio of the exit gas to wind velocity shall not be less than 1.5 to eliminate or reduce pollutant down wash.
- t) The unit shall have on line/automatic continuous stack monitors with computer recording arrangement for monitoring SPM, Sox and Nox in the boiler emission.
- u) Sewage Treatment Plant & Effluent Treatment Plant has been proposed.
- v) Natural draft cooling tower has been included in the specification.
- w) 100% Dry fly ash collection system and conventional wet bottom ash disposal is included. However ash water recovery system is included in this scope if ash slurry is disposed in the ash pond in emergencies.



- x) Ash slurry pipe lines and ash water recovery pipe lines of adequate capacity and strength are proposed to be provided. However these pipe lines will be used only during emergency, since 100% dry fly ash collection is proposed.

Hence, it is stated that the implementation of Environmental measures including self monitoring system (for air, Water and land) as per the EC granted, especially in the following areas have to be ensured by the bidder without any exception:

Continuous Air quality monitoring stations
Online monitoring system
Effluent Treatment plant
Sewage treatment plant
Optimum use of land area
100% Ash collection & utilisation
Green Belt Development.



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03 /2013-14



ANNEXURE-I

S. NO.	DESCRIPTION OF MANUALS	NO OF PRINTS (sets)	NO. OF CD- ROMs (sets)
1.	PLANT DEFINITION MANUAL-	-	3 CD-ROMs
2.	Drawings "FOR APPROVAL"	10	Soft Copy
3.	Drawings "FOR INFORMATION"	10	Soft Copy
4.	Drawings "FINAL APPROVED DRAWING"	8	Soft Copy
5.	Drawings "AS BUILT "	8	3 CD-ROMs
6	DATASHEETS,DESIGNCALCULATIONS,PURCHASE SPECIFICATIONS, etc. and Other type of documents		
	i) For Approval	10	SOFT COPY
	ii) FINAL	8	3 CD-ROMs -
	iii) Analysis reports of equipment/ piping/ structures components/ systems employing software packages as detailed in the specifications		
	a) Input	10	SOFT COPY
	b) Output	10	SOFT COPY
	c) Drawings/ Sketches	10	SOFT COPY
7	Erection manual "FINAL"	8	3CD ROMS
8	Operation & Maintenance manual	10	3CD ROMS
9	Plant Hand Book "DRAFT"	6	SOFT COPY
10	Plant Hand Book "FINAL"	15	3CD ROMS
11	Commissioning and Performance Procedure manual	10	3CD ROMS
12	Performance and Functional Guarantees test report	6	3CD ROMS
13	Progress Reports	6	3CD ROMS
14	Project completion report	10	3CD ROMS
15	QA programme including	1	



S. NO.	DESCRIPTION OF MANUALS	NO OF PRINTS (sets)	NO. OF CD- ROMs (sets)
	Organization for implementation and QA system manual (with revision-servicing)		
16	Vendor details in respect of proposed vendors including Bidder's evaluation report.	1	
17	Manufacturing QPs, Field QPs, Field welding schedules and their reference documents like test procedures, WPS, POR etc.		
	(i) For review/comment	3	
	(ii) For final approval	4	1 set CD ROMS
18	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals	4	
	Final	4	2 CD ROMS
19	Monthly Vendor Approval and QP approval status	2	1 CD ROM
20	QA Documentation Package for items / equipment manufactured and dispatched to site	2	2 CD ROMS
21	QA Documentation Package for field activities on equipment/systems at site	2	2 CD ROMS



ANNEXURE-II

(Total within 52 man months)

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
STEAM GENERATOR	Thermal design and hydraulic circulation balance	Familiarization with various system and equipment	Manufacturing processes of pressure parts, and equipment	Control philosophy operation, notices, logic & protection schemes, O&M manual familiarization O&M issues
	Combustion and Air & gas weight calculation	Performance data collection analysis and review	Welding process	
	Pressure part calculation	O&M feed back	Testing facilities	Familiarization of special maintenance techniques.
	Pressure part and strength calculation	Operation history of various equipment and system	Product development in process	Special tool and tackles familiarization
	Tube metal temp. calculation and selection.	Failure analysis	Future plan for technology induction	
	Performance calculation		R&D work inprogress	
	Duct design.			
	Pressure part			



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Equipment and system sizing and selection of mills, fans, airpreheater, soot blowers, dampers, valves heater, soot blowers, dampers, valves, feeders, burners startup system, fuel firing system, draft plant Flow scheme develop- ment of air & flue gas, fuel oil, auxiliary steam, main and reheat steam feed water.			
	Layout of over all plant, steam generator area, pressure part arrangements, platforms, equipment, piping and duct, coal pipe, flue gas ducts, bunker arrangement, valves and damper, ESP area, cable & piping tressels etc.			
	Erection strategies, erection procedures			
	Performance and demonstration tests.			
MANDAYS	120	20	20	20
CFD model development and validation for Steam Generator	Familiarisation of fundamentals and basis for the development of the CFD models.			
	Solving of set of simple problems by Employer's engineers with the help of trainer.			



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Hands on experience on the development of detailed/realistic CFD models for the steam generator and ESP. The Bidder/trainer shall develop CFD models for SG & ESPas per the Contract requirement with complete association of the Owner's engineers.			
	Validation of the above CFD model for SG & ESPby Bidder in association with the Owner's Engineers.			
MANDAYS	120 for SG and 60 for ESP	-	-	-



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
TURBINE GENERATOR AND IT'S INTEGRAL AUXILIARIES	Turbine cycle optimization and turbine performance in off design condition. Rotor design and strength calculation Rotor dynamic behavior studies wrt natural frequency, critical speed, vibration etc. Blade profile/root design and blade strength design, blade vibration analysis Casing & diaphragm design Labyrinth seal selection & design for different turbine configurations Selection of turbine type (i.e. Tandem vs cross compounding, separate HP/IP vs combined HP/IP, material of construction etc.)	Familiarization of power plants of various makes of turbines for super critical units Collection of data for analysis of availability of turbines Comparative studies for integral systems of turbine O&M history/problems related to turbine Failure analysis	Manufacturing processes of turbine Assembly of turbine Testing of turbines Product development in process Future plan for technology induction R&D work in progress	



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Design principle for Up rating/down rating of existing design/ modules for the specific project.			
	Selection of nos., type and arrangement of bearings, load calculation on bearings, bearing oil flow calculation Selection, design and control principle for Turbine governing system Performance calculation Steam path audit Layout principle of various equipment's of TG and its integral system Latest technological advancements			
MANDAYS	45	10	10	
Boiler Feed Pumps	Techno-economic syudies for Selection of BFP Configuration and its drive Criteria for selection of boiler	Familiarization of power plants of various makes of feed pumps Data collection of BFP	Manufacturing process of various components of BFP Assembly of BFP	



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Feed Pump parameters Rotor design, strength calculation and rotor dynamic behavior studies wrt critical speed, vibration etc	parameters and configuration Collection of data for analysis of availability of BFP	Testing, capabilities of BFP at works wrt performance, NPSH, thermal shock, dry run, visual cavitation, string test, axial thrust measurement	
	Impeller design and its hydraulic behavior Role of critical parameters such as NPSH(R), Suction specific speed, running clearances, speed etc. in design of feed pumps Material selection of BFP components Guiding factors for selection of BFP seals Computation of axial thrust under various flows Performance calculation Transient analysis in pump	O&M history/problems related to BFP Comparative studies for various types of BFP& its features	Product development in process Future plan for technology induction R&D work in progress	



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	suction piping wrt NPSH margin Latest technological trends in BFP design			
MANDAYS	20	5	10	
Condenser	Selection of condenser type and its optimization wrt temp rise across condenser, pressure drop in condenser, surface area etc.	Comparative studies of salient features	Manufacturing process of various components of condenser Assembly	
	Techno economic studies for Selection of condenser tube material and other parts depending on water quality Condenser support selection & design Sizing of condenser w.r.t. super critical units Latest technological trends in condenser arrangement and design Condenser vacuum system design	Collection of data for analysis of availability of Condenser O&M history/problems related to condenser	Testing capability at works Product development in process Future plan for technology induction R&D work in progress	



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
MANDAYS	10	5	5	
Feed Regenerative Equipment's	Thermal and mechanical design calculation of heaters Basis of selecting horizontal/vertical heaters Selection of TTD and DCAs for various heaters, and their effect on turbine heat rate Configuration of HP heaters (2x50% v/s100% capacity)	Comparative studies of salient features Analysis of data O&M history/problems related to heaters	Manufacturing process of various components of heaters Assembly Testing capability at works Product development in process	
	Sizing criteria for De-aerator/Heaters Selection of tube & tube sheet material of heaters Latest technological trends in heaters design		Future plan for technology induction R&D work in progress	
MANDAYS	15	10	10	
3-dimensional CFD modeling	CFD model development and validation of design data for steam turbine, BFP, CEP, condenser, heaters etc.			



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
MANDAYS	20			
Compressors	Equipment Theory & Maintenance Practice			
MANDAYS	16	-----	4	
Ash Handling System	Equipment Theory & Maintenance Practice			
MANDAYS	16	4	4	
Coal Handling System	Equipment Theory & Maintenance Practice			
MANDAYS	20	5	5	
H ₂ Plant	Equipment Theory & Maintenance Practice			
MANDAYS	10	3	3	
Condensate Polishing Unit	Equipment Theory & Maintenance Practice			
MANDAYS	15	5	5	



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
CONTROL & INSTRUMENTATION				
DDCMIS-Man Machine Interface - Hardware & Operating System	Hardware & Software organization of the system Basis of selection of H/W memory sizing Operating system features, interface with other system, openness & inter- operability Upgradability System testing features	Operational feedback		
MANDAYS	24	6		16
DDCMIS-Man Machine Interface System & Engineering Application Software	Specific system customisation	Operation feedback		
	Various system			
	modules & interface with OS			
	Database organization & development			
	Development of mimics			
	Other application like calculations, logs historical storage functionalities & use			
MANDAYS	40	6		8



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
DDCMIS - Control System Hardware	Basic design features for system & its modules System capabilities & system design techniques Communication with MMI & other system	Operation feedback	Manufacturing processes special attention to handling of the modules Maintenance facilities	
MANDAYS	24	5	10	
DDCMIS-Control system Application Software	Database structure Organisation & inter- face between application program & database	Operational feedback	System integration & System capabilities testing	
	Application for implementation of Control functions			
	Study of standard algorithms & development of new algorithms			
MANDAYS	18	4	4	
DDCMIS - Control Loop Study Loop Study	General description of closed loop controls of thermal power plant	Specific operational feedback		
	Critical analysis of few control loops e.g., TSCS Stress Control boiler startup control etc.			



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
MANDAYS	12	4		
DDCMIS-Burner Management System	Hardware logic, NFPA/ VDE requirements other safety standard Flame scanner location	Operational feedback	Manufacturing procedure & precautions for handling the system System testing facilities	
MANDAYS	16	6	6	12
DDCMIS - EHTC, Turbine stress control system, Turbine protection system & ATRS	Basic design concept & features Logics of turbine stress control system Implementation of failsafe philosophy in turbine protection system	Operational feedback	Manufacturing procedure & precautions for handling for handling the system System testing facilities	
MANDAYS	16	6	6	12
Furnace and Flame Viewing System.	Theory & principle of operation	Operational feedback		
	Details of software & methods of modification/ customisation			
Misc. systems for SG/TG C&I				



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
MANDAYS	6	3		
BOP (DDCMIS)	Hardware organization		Manufacturing process of PLC hardware	
	Operating system features		Integration & testing facilities	
	Data base organization			
	Logic/loop algorithm Development of control logic & loop s/w & MMI application development			
MANDAYS	24	-	6	
BOP System Controller				
1) Hard Ware	Equipment Theory & Maintenance Practice			
MANDAYS	30	10	10	
2) Soft Ware	Equipment Theory & Maintenance Practice			
MANDAYS	30	10	10	
VMS				
1) Hardware	Equipment Theory &			



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Maintenance Practice			
MANDAYS	12	-	6	
2)Vibration Analysis	Equipment Theory & Maintenance Practice			
MANDAYS	12	-	6	
Analyser				
Water & Gas	Equipment Theory & Maintenance Practice			
MANDAYS	20	-	8	
PADO: System Engineering	Equipment Theory & Maintenance Practice			
MANDAYS	6	3	3	
PADO: Operation & Analysis	Equipment Theory & Maintenance Practice			
MANDAYS	18	6	-	
Actuators	Equipment Theory & Maintenance Practice			
MANDAYS	18	-	6	
Simulator	Equipment Theory &			



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Maintenance Practice			
MANDAYS	16	-	4	
Networking / MIS	Equipment Theory & Maintenance Practice			
MANDAYS	12	-	4	
Electric Power Supply System	Theory & design features		Manufacturing/assembly process	
			Testing methodology	
MANDAYS	5	2		



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
(ELECTRICAL) GENERATOR	(a) Design aspects of the following areas	- Operational feed back - Familiarisation with different sub-systems	(a) Manufacturing process for	
	- Insulation system		- Core	
	- Cooling medium & arrangement		- Winding bars	
	- Winding & core support systems		- Assembly	
	b) Design aspects of other auxiliary systems		(b) Testing facilities	
MANDAYS	30	15	15	
Generator Excitation System including AVR.	Design features of various sub-systems	- Operational feed back - Familiarisation with various equipment functioning at reference plants	- Manufacturing process & testing facilities for various equipment of excitation system	
	Excitor			
	PMG			
	Transformer			
	Controllers & different limiters etc.			
	PSS & associated system studies			
MANDAYS	30	15	15	



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
Boiler Feed pump H.T. Motor	Design Criteria for the Stator core & wdg Rotor core & wdg Insulation system Cooling arrangement	Operational feed back	Manufacturing process & test facilities	
MANDAYS	20		5	
POWER TRANSFORMER	Equipment Theory & Maintenance Practice			
MANDAYS	12	-	4	4
UPS/BATTERY CHARGER	Equipment Theory & Maintenance Practice			
MANDAYS	8	-	4	4
GIS	Equipment Theory & Maintenance Practice			
MANDAYS	24	4	12	24
SAS	Equipment Theory & Maintenance Practice			
MANDAYS	12	-	6	6



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
CRITICAL PIPING & POWER CYCLE PIPING	Design familiarization for critical piping of supercritical Plant Optimization study for sizing including pressure drop calculation and selection of single or double lead together with Owner's engineers Design and stress analysis of lines with Expansion Joints together with Owner's engineers Design and stress analysis of piping systems with two phase flow involving Owner's engineers Transient analysis and optimum sizing of feed suction piping together with Owner's engineers.	Familiarization with feed back (in super critical plant) on failure analysis and vibration analysis of piping. Study of Feed back regarding hanger setting strategies and practice	Cold Setting of spring hanger Cyclic tests carried on spring hangers. Cyclic tests carried on expansion joints Manufacturing process of critical piping components and appreciation of their testing facilities at shop	



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Static and dynamic analysis of critical piping including seismic and other occasional load analysis (safety valve blowing condition). A joint activity together with Owner's engineers. Study and collection of data pertaining to special welding requirements (pre and post weld heat treatment and electrode selection criteria etc.) of materials used in high temp piping system. Study and collection of data on special requirements in case of welding dissimilar metals and electrode selection criteria			
MANDAYS	45	10	10	



ANNEXURE-III

		Project :		LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL					DOC. NO.:		
		Stage :							REV. NO.:		
		Package :		SUB-SYSTEM:					DATE :		
		Supplier :							PAGE : OF		
Bidder No. :											
S. N.	Item	QPI/ Cat.	Insp.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status/ category	Sub-supplier Details submission schedule	Remarks

LEGENDS

1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY the Owner)

A – For these items proposed vendor is acceptable to the Owner. To be indicated with letter “A” in the list alongwith the condition of approval, if any.

DR – For these items “Detailed required” for the Owner review. To be identified with letter “DR” in the list.

NOTED – For these items vendors are approved by Main Supplier and accepted by the Owner without specific vendor approval from the Owner. To be identified with “NOTED.”

2. QP/INSPN CATEGORY:

CAT-I : For these items the Quality Plans are approved by the Owner and the final acceptance will be on physical inspection witness by the Owner.

CAT-II : For these items the Quality Plans approved by the Owner. However no physical inspection shall be done by the Owner. The final acceptance by the Owner shall be on the basis review of documents as per approved QP.

CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by the Owner shall be on the basis certificate of conformance by the main supplier.

UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.



ANNEXURE-IV

[illegible]

2 x 660 MW Ennore SEZ Supercritical
Thermal Power Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03/2013-14
Vol. II:80



ANNEXURE-V

		Project :		Stage :		FIELD WELDING SCHEDULE (To be raised by the Bidder)							DOC. NO.:			
		Bidder :				Welding Code:							REV. NO.:			
		Bidder No. :											DATE :			
		System :											PAGE : OF			
Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	REF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	
NOTES:																
SIGNATURE																



ANNEXURE-VI

MFGR.'s LOGO	MANUFACTURER'S AND ADDRESS	NAME		MANUFACTURING QUALITY PLAN				PROJECT :				
		ITEM :	SUB-SYSTEM:			QP NO.:	REV.NO.:			PACKAGE :		
						DATE:	PAGE: OF....			CONTRACT NO. :		
									MAIN-SUPPLIER:			
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTIC S	CLA SS	TYPE OF CHEC K	QUANT UM OF CHECK	REFERENC E DOCUMENT	ACCEPTAN CE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.	D *	**	10.	11.
				LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: SUPPLIER/NOMINATED INSPECTION AGENCY, N: THE OWNER						DOC. NO.: REV..... CAT.....		
MANUFACTURER/ SUB-SUPPLIER		MAIN-SUPPLIER						FOR THE				



2 x 660 MW Ennore SEZ Supercritical
Thermal Power Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03/2013-14
Vol. II:82



SIGNATURE	P: PERFORM VERIFICATION. W: WITNESS AND AS APPROPRIATE, CHP: THE OWNER SHALL IDENTIFIED IN COLUMN "N"	OWNER USE	REVIEWED BY	APPROVED BY	APPROVAL SEAL



ANNEXURE-VII

MFGR.'s LOGO	SUPPLIER'S NAME AND ADDRESS		FIELD QUALITY PLAN				PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER:			
			ITEM :		QP NO.: REV.NO.: DATE: PAGE: OF....					
SL NO	ACTIVITY AND OPERATION	CHARACTERISTICS INSTRUMENTS	CLASS# OF CHECK	TYPE OF CHECK	QUANT UM OF CHECK	REFEREN CE DOCUMEN T	ACCEPTANCE NORMS	FORMAT OF RECORD		REMAR KS
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.
		LEGEND: * RECORDS , IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS #: A = CRITICAL, B=MAJOR, C=MINOR;				DOC. NO.: REV.....				
MANUFACTURER/ SUB-SUPPLIER		MAIN- SUPPLIER				FOR THE				



SIGNATURE	'A' SHALL BE WITNESSED BY THE OWNER FQA, 'B' SHALL BE WITNESSED BY OWNER'S ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY ERECTION SUPPLIER (A & B CHECK SHALL BE OWNER CHP STAGE)	OWNER USE	REVIEWED BY	APPROVED BY	APPROVAL SEAL



CHAPTER - 6

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:

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

The following surfaces and materials shall not require painting :

- a. Non-ferrous materials
- b. Austentic stainless steel
- c. Plastic and / or plastic coated materials
- d. Insulated surface of equipment and pipes except color coating wherever required.
- e. Painted equipment like blowers, pumps, valves etc. with finishing coats in good condition and with matching color 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 enamels
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
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 1100C. Blasting activity shall be performed at temperatures 30C above dew point and substrata temperature between 50C & 500C 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 (aluminum 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 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

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
a)	Dust, Loose deposits	Vacuum cleaning, brushing
b)	Adhesive deposits	Power brushing
c)	Oils, greasy impurities	Wet Blasting, Use of Detergent Additives by agreement
d)	Salt deposits	Rinsing
e)	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 shall be + 5°C 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 manufacturers 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 upto 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 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 upto 120°C as per clause 6.1 & 6.3. However

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, upto 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

Pretreatment

Dersuting 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, upto 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**Pretreatment**

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 upto < 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

(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

Pretreatment

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

Pretreatment

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 500 μm

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.

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 upto 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.

Pretreatment

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 conform 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.

6.6.2 Rubber Lining of Pipes, Valves and Tanks for DM Water**Pretreatment**

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

Rubber Lining

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

6.7 Painting for Electrical items

6.7.1 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.

6.7.2 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.

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

6.8 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	-	-



SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
3.	Crane				
3.1	Crane structure	Golden Yellow	356	Black	-
3.2	Trolley & hook	Crimson	540	-	-
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)	631/70 78 of IS 1650	-	-
9.	Turbines	Light Grey	631	-	-
10.	Generators & Exciter	Light Grey	631	-	-
11.	Transformers	Aluminum	-	-	-
12.	Machinery guards	Signal red	537	-	-
13.	Piping (without insulation and cladding)				
13.1	Water System				
a	Boiler feed	Sea Green	217	-	-



SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
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
l	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	-
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.



CHAPTER 32

32.00.00 LAYOUT REQUIREMENT

32.01.00 The general layout criteria to be adopted for this project are indicated below.

1. Minimum clear working space around equipment : 1200mm
2. Clear Head room within Main Plant Building for pipes, ducts structures & cable trays etc. : 2.5 m (Minimum)
3. No. of Fire Escape staircases in the main plant with fire doors at each landing : Min-4 Nos. per unit - However the number shall meet the requirement of insurance companies.
4. Adequate space for handling/removal of pumps, heaters, heat-exchanger, fans, Mills, during maintenance.
5. Independent floor drains with separate down comers shall be provided where sprinkler system are provided.
6. Valves in the Bidder's scope shall be located in accessible positions. All piping shall be routed at a clear height of 2500 mm (min.) from the nearest access level to clear man movement.
7. Provision of monorail beams with chain pulley blocks/HOT cranes along with hoists, as required shall be decided during detailed engineering stage and are in bidder scope.
8. Approach for removal of equipment for maintenance shall be provided.
9. A/C and Ventilation ducts, Bus ducts, and Critical Piping routes to be identified at conceptual stage.
10. Fuel oil (F.O) piping shall be routed over trestles. The headroom for F.O. Trestle in Boiler/ESP area shall be 8.0M till the road behind chimney as per the layout requirement. The headroom for F.O. trestle in outlying area shall be 3.0M except at rail/road crossing where the headroom shall be 8.0M. F.O. trestle legs or supports shall be located so as to clear the road spaces, approach to maintenance bays of different equipment buildings located in the route of F.O. trestle.
11. Routing of cable trays & piping
 - i) Trestle height in outlying area : 3 Meters(BOS/BOP)
 - ii) Trestle height from C-row to road Behind chimney /in front of XFMR Yard Boiler/ESP area : 8 Meters(BOS/BOP)
 - iii) Cable/ Pipe trestles height at rail/ road crossings shall be 8M. (BOS/BOP)
 - iv) Head room below cable / pipe rack in transformer yard area for movement of spare GT shall be 12.0 Meters.
 - v) A walkway with hand rails & toe guards of 600mm (minimum) width shall be provided all along length of the trestle for maintenance of cables & pipes. Ladders for



- approach to these platforms shall be provided near roads, passage ways and turning points.
- vi) At the crossing of pipe/ cable trestles with the dry ash pipe rack/CHP cable rack trestle, pipe/ cable trestle shall be locally raised to provide a head room of 2.5 M over the walkways of dry ash pipe rack/CHP cable trestles.
 - vii) Head room below cable/pipe rack along Mill bay shall be 12.0 Meters.
 - viii) Head room for man movement shall be 2.5 m at ground floor, over all platforms etc.
 - ix) Minimum clear hand space required for
 - a) The application of thermal insulation 100 mm
 - b) Welding work 150 mm
 - c) Bolt tightening 150 mm
12. Piping in main plant area (i.e. boiler/ESP/ID fan/chimney/transformer yard) shall be routed above ground on trestles with a height of minimum 8M. Further, piping in outlying area shall be routed over trestles with a height of 3M. However, height of trestles at approach roads to various buildings/ facilities shall be 8M.
 13. Fire water piping within the Plant boundary shall be routed above ground on pedestals. However, fire water pipes in Main Plant Island shall be routed in trenches filled with sand and covered with pre cast RCC covers. Fire water pipes shall be protected in main plant area as per TAC requirement. Fire water piping at road crossing shall be encased/culvert. Fire water pipe at rail crossing shall be on trestle of BOS 8M height from rail top.
 14. All other safety requirements as per the factories act, National Electricity code shall be observed while developing the layout.
 15. Insulation of equipment/piping for personnel protection is to be provided if the temperature exceed 60 deg C.
 16. Chequered plate edges should have continuous supports/ stiffeners.
 17. Each equipment room shall be provided with alternate exits in case of fire /accidents as per requirements of factory act and TAC.
 18. Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.
 19. Cubicle for operating personnel shall be located for all buildings at safe place near the equipment.
 20. All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified elsewhere in this specification shall be complied with.
 21. All gratings shall be of electro forged type with adequate bearing & locking on the supporting structure.



22. Approach to all elevated structures like Fans, Pumps, etc shall be through steel stairs with gratings & hand rail.
23. All cranes shall be provided with approach rung ladders at least at two places. Where ever cranes can't be maintained in situ on the carriage, facility to draw them to maintenance platforms as well as provision of suitable platforms shall be considered.
24. All fresh air ventilation louvers shall be 1000 mm from floor level and directed downward at an angle.
25. The VFD control equipment and transformers for ID fan shall be located along with the ESP control equipment in the ESP/ VFD control room.
26. Three (3) nos. of staircases per ESP of each unit shall be provided. Two (2) nos. of the staircase shall be located on the inlet side and one (1) no. on the outlet side of ESP.
27. The grating platform shall be provided in oil equipment room, control fluid room and valve room.
28. Approach platform shall be provided from ESP outlet to ID fan suction gate.
29. Minimum access opening required 3.5M wide x 4M high or, (with rolling shutter) transportation wherever entry of truck, for material more depending upon this envisaged equipment size to be handled.
30. Toilet and drinking water facility required in all buildings and on all floors wherever operating personnel are to be deployed.
31. Local Pits/trenches in Main Plant building are to be avoided. However pits/sumps which are unavoidable such as CW (Circulating Water System) pits etc shall be provided with required dewatering arrangements by means of drainage pumps and piping upto the nearest drainage network. Bidder shall provide required sump pumps/drainage pumps/submersible pumps & Piping etc.
32. Pump shall be permanently fixed in the pits/sumps. If the pit depth is shallow, vertical top mounted sump pumps shall be provided and in deep pits self priming drainage pumps (horizontal type) at floor level or alternatively submersible type pumps may be provided.
33. Each pit/sump shall be provided with two numbers (2 x 100% Capacity) of respective type pumps so that the entire pit is evacuated within 15-20 minutes and the operation of the pumps shall be interlocked through level measurement devices to be installed in the pit/sump so that the pumps shall start automatically and empty the pit.



CHAPTER – 33**POWER CYCLE PIPING, VALVES, FITTINGS & THERMAL INSULATION****33.0 POWER CYCLE PIPING, VALVES, FITTINGS & THERMAL INSULATION**

This section covers all the power cycle piping, valves and specialties which connect the different equipment like the boiler, turbine, condenser, pumps, heaters etc. to make the power cycle complete and thermal insulation to be provided for the power plant.

33.1 PERFORMANCE REQUIREMENT

The piping system acts as the pressure boundary for the fluid in circulation, water and steam in this case, which is subject to high pressure, temperature, change of phase and various types of transient and steady state operation. All the piping systems supplied shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years and shall withstand to the maximum sustained load.

33.2 Line Sizing

33.2.1 Pipelines shall be selected such that the velocity of fluid in pipes does not exceed the following limits under conditions of maximum possible volumetric flow:

Steam

(i)	Superheated Steam	:	60.0 m/s
(ii)	Saturated Steam	:	30 m/s
(iii)	Wet Steam/ Exhaust Steam	:	30 m/s
(iv)	Auxiliary Steam	:	50 m/s
(v)	Main Steam Hot & cold reheat piping	:	100 M/s
(vi)	HP Bypass Upstream	:	125 m/s
(vii)	HP Bypass Downstream	:	100 m/s
(viii)	LP Bypass Upstream	:	100 m/s
(ix)	LP Bypass Downstream	:	125 m/s

Water

(i)	Pump suction	:	1.0 m/s
(ii)	Pump delivery	:	2.5 m/s;
(iv)	Feed Water discharge	:	4 - 6 m/s
(v)	Feed Water Suction	:	2 - 3 m/s
(vi)	Condensate Discharge	:	3 – 5 m/s
(vii)	Condensate Suction	:	1.5 m/s

Oil

(i)	HFO, HSD	:	2 m/s

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

i)	Carbon steel pipe	100



ii)	CI Pipe/Ductile Iron	100
iii)	Rubber lined steel pipe	120
iv)	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.

33.3

CODES & STANDARDS

The design, manufacture and performance of the LP Piping System specified hereinafter, shall comply with the requirements of the following codes and standards and shall include all the latest amendments

ASME-B31.1 : Code for Power Piping

ASME-B16.5 : Pipe Flanges & Flanged Fittings

ASME-B16.9 : Factory-Made Wrought Steel Butt-Welding Fittings ASME-

B16.10 : Face to Face and End to End Dimension of valves. ASME-

B16.11 : Forged Steel Fittings, Socket-Welding and threaded

ANSI B-16.25: Butt Welding Ends.

ASME-B16.34 : Valves – Flanged, Threaded and Welding End

ASME-B36.19 : Stainless Steel Pipe

IBR : Indian Boiler Regulations (Latest Revision)

IS-1239 : Carbon steel tubes, tubular and other wrought steel fittings.

IS-3589 : Seamless or Electrically welded steel pipes for water, gas and sewage.

IS-11428 : Specification for Wrought Carbon Steel butt welding pipe fittings.

IS- 4736 : Hot-dip Zinc coatings on Carbon steel tubes.

IS- 2062 : Steel for general structural Purposes - Specification.

IS- 4682 : Code of practice for lining of vessels and equipments for chemical processes: Part 1 Rubber lining.

ASTM A312 : Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.



- ASTM A403 : Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
- API-594 : Check valves: Flanged, Lug, Wafer and Butt-welding.
- API-598 : Valve Inspection and Testing
- API-600 : Bolted bonnet steel gate valves for Petroleum and natural gas industries.
- API-602 : Compact Steel Gate Valve – Flanged, Threaded, Welding and Extended Body Valves.
- BS- 1873 : Steel Globe and globe stop and check valves (flanged and butt-welding ends) for Petroleum, Petrochemical and allied industries.
- BS- 1868 : Steel check valves (flanged and butt-welding ends) for Petroleum, Petrochemical and allied industries.
- IS 12709 : GRP pipes, joints and fittings for use for potable water supply
- IS 14402 : GRP pipes, joints, and fittings for use for sewerage, industrial waste and water.
- ANSI/AWWA C950-07: AWWA Standard for Fiber Glass pipes.
- AWWA M45 : AWWA manual of water Supply & Fiberglass Pipes Design.

Design, fabrication, assembly and testing of pipes, fittings shall generally conform to the requirements of ANSI B-31.1. But the portions, which come under the purview of Indian Boiler Regulations (IBR), shall completely comply the requirements of IBR, as a minimum.

Any other internationally accepted codes and standards are also acceptable. However, the compliance of ANSI codes and IBR will be considered as minimum for acceptance of the piping and all appurtenances.

33.4 Scope of Supply

Scope shall include all piping, valves & specialties as indicated in Annexure-I. of this chapter as a minimum. However all piping as required for the completeness of the system shall be supplied.

33.4.1 In general, the equipment and materials to be supplied under this specification shall include, as a minimum:

- a. Supply of all power cycle piping including bends, elbows, tees, branches, laterals, crosses, reducing union, couplings, caps, saddles, shoes, flanges, blank flanges, Y-pieces etc as required.



- b. Matching pipes, matching pieces like reducers/enlargers etc, counter flanges with bolts, nuts, washers, temporary and permanent gaskets, threaded union etc.
- c. The pipe spools shall be supplied along with necessary test certificates of the pipes, after necessary machining to the required bore, for assembly of flow nozzle element. The assembled flow nozzle shall be installed in the piping system. Additional length of pipes equal to length of all fully assembled flow nozzle & orifice plates pipe piece shall be supplied and the same shall also be erected prior to cleaning of the pipes by flushing or steam blowing or chemical cleaning or both. After completion of cleaning of piping, the assembled flow nozzles shall be erected replacing the temporary pipe spools.
- d. All motorised valves, manually operated isolating and regulating valves, non- return valves, steam traps, relief/safety valves, strainers, pressure reducing orifices, expansion joints and other flexible connections, complete with the counter flanges and matching connecting pieces as required within the entire power cycle piping system.
- e. Anchors, hangers and supports, vibration dampeners, restraints, shock absorbers etc as required.
- f. Any platform necessary for maintenance and operation of valve and equipment located 1.5 m above any permanent floor including access ladders, supporting structures etc.
- g. All secondary structural steel members required for pipe supports from building steel structures and from embedded steel including pipe supports in trenches.
- h. Funnels, tundishes for drips and drains including all miscellaneous drain piping and drain piping from tundish outlet up to drain points. All drain and vent lines shall be conveniently terminated either in Blowdown tank/flash tanks or permanent drain trenches of the Power Station. All steam and saturated water open drains shall be drained through a water seal in drain funnels/tundish with a water connection in funnels/tundish for maintaining water seal level in them. All oily effluent drains shall be separately routed and connected to separate pit.
- i. For the isolation and check valves located on the main steam, hot reheat, cold reheat, L.P. bypass and extraction lines, suitable line drains shall be provided just upstream and downstream of each of these valves. No drain is needed at the downstream of L.P. bypass isolation valve. Each of these drains shall be independently led to the condenser with branching off to atmosphere.

Line drains from Main Steam, Hot Reheat, Cold Reheat, L.P. bypass & high pressure (above 40 kg/cm²) extraction lines shall be provided with double isolation valves in series for each branch - each located at the two extreme ties of the line drain route. The valve near the condenser



shall be motorised one. The balance line drains shall be provided with only one isolation valve for each branch.

- j. Bolts, nuts, washers, temporary and permanent gaskets, fasteners as required for interconnecting piping, valves & fittings.
- k. Complete insulation material for piping, valves, specialties & auxiliary equipment specified in this specification and as called for in the specification for thermal insulation.
- l. Painting of all piping, valves & specialties at site. Coating and wrapping for buried pipes.

33.4.2 Bidder shall furnish his own technical details of piping, valves, specialties and accessories along with his offer.

Following general requirements shall however be considered:

- (a) Instrument Connections
- (b) Pipe stubs and blanking plates required for chemical cleaning and hydro testing.
- (c) Flanges, spool pieces, gaskets, ring joints, jointing materials, aluminium and stainless steel forged marking plate and temporary piping for steam blowing.
- (d) Drain/drip pockets on steam piping as per stipulation of ASME TDP – Volume I and general requirement.
- (e) Expansion marker for high temperature steam lines.
- (f) Fine threaded Radiography holes with stubs and suitable matching plugs which shall be finally seal welded for piping, more than 25 mm nominal thickness.

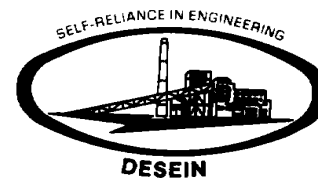
For conducting performance test of Turbo-Generator and Boiler, the required pressure, temperature, flow measurement points shall be provided.

- (g) Provision for creep measurement on the piping operating in creep region.

33.4.3 Electrodes and filler wires required for stainless steel and alloy steel welding during shop fabrication at works and erection/installation at site.

33.4.4 All temporary pipes and accessories, supporting arrangement for cleaning, flushing and steam blowing of the main steam, cold reheat and hot reheat piping including HP/LP by pass piping and auxiliary steam piping.

33.5 **SCOPE OF SERVICES**



- a) The Contractor shall design the piping system and perform necessary stress analysis of all piping and dynamic analysis as necessary for the piping systems shown in Annexure-I of this chapter as a minimum.
- b) For stress analysis purpose, individual piping systems shall be considered up to the anchor points (location to be decided during detail engineering). All anchors coming within the piping are to be designed, supplied and erected by the Contractor.
- c) Stress analysis and hanger selection for all piping specified else where, including piping attachment for hangers/supports, all auxiliary supporting structures are included in the scope of the Contractor.
- d) The Contractor shall submit the design calculations for pipe sizing, thickness with specified diameters of pipes and stress analysis data to Owner/Engineer for review/ reference/records. Pressure drop calculation for main steam, cold reheat and hot reheat piping shall be submitted by the Contractor to show the adequacy of pipe sizes to meet steam parameter at turbine inlet.
- e) Preparation of detailed fabrication drawings (isometric) of shop fabricated piping which are of size 50 NB and above should be based on the "Released for Construction" drawings pertaining to power cycle piping layout prepared by the Contractor.

"As built" drawings of the power cycle piping layout shall also be prepared by the Contractor based on any layout modifications made at site over "Released for Construction Drawings".

- f) The Contractor shall design and detail all piping supports including restraints, guides, stops, snubbers, dampers etc based on the final stress analysis and hanger load data. The Contractor's design of all supports shall be submitted to the Owner/Engineer for review.
- g) The Contractor shall furnish separate sketches for each support, restraint, anchor, snubber, dampers, spring hangers etc. These sketches shall include the location with reference to column co-ordinates, identification number, bill of material, design loads, operating load, spring stiffness, amount of spring pre-compression etc and method of attachment to the pipe and steel structure.
- h) In order to ensure that all piping, supporting elements, anchors and restraints have been installed and adjusted in accordance with the drawings and other written instructions of the Contractor, the hangers associated with the main steam, hot reheat, cold reheat, HP & LP by-pass, feed water, auxiliary steam piping etc. shall be inspected as follows :
 - After hydro test, with the piping in the cold position, with all travel stops removed, with the pipe completely insulated and in all respects ready for start-up.



- Piping in the hot position, with the unit operating at maximum load.
- Piping in the hot position after 6 months of operation.
- Piping in the cold position during first complete shutdown after at least 6 months of operation.

The contractor shall depute his personnel for this purpose to site if the plant is officially handed over to the owner before such inspection after 6 months of operation.

- i) At the time of each inspection, the Contractor shall determine the necessity for revision, adjustment or replacement of pipe supporting elements, restraints and anchors. Any changes proposed shall be incorporated by the Contractor after Owner's/Engineer's concurrence.
- j) All shop tests satisfying the requirements of Indian Boiler Regulations (IBR), ANSI standards, the standards enumerated herein and/or as specified.
- k) Furnishing drawings, data, design calculations, stress analysis results.
- l) Furnishing certified copies of test results for all tests and examinations specified in the specification and for the mandatory tests and analysis required by the ASTM material specification, for the materials used for piping and the pressure parts of the valves.
- m) Obtaining approval from Chief Inspector of Boilers as per Indian Boiler Act, including the following:
 - For all pipelines coming under the purview of Indian Boiler Regulations (IBR), necessary approval of the design and layout drawings shall be obtained from the Chief Inspector of Boilers and furnished to the Owner/Engineer. Necessary certificates of design, manufacture and tests in specified Form of IBR, for each fabricated pipe with proper identification shall be submitted.
 - For fittings and specialties, viz. valves, flanges, traps and other specialties etc of all pipelines coming under the purview of IBR, Certificate of design, manufacture and tests in specified Form of IBR with appropriate identification shall be furnished to the Owner/Engineer.
 - Erection & testing of the pipe lines coming under the purview of IBR shall meet all the requirements of IBR and certificate of manufacture & tests in specified Form of IBR, for each of the erected pipe lines shall be submitted to the Owner/Engineer prior to the application of insulation and/or flushing the line before commissioning.
- n) Steam blowing or chemical cleaning of piping systems, as specified.



- o) Omission of specific reference to any item or material or work which is necessary for completion of the piping systems shall not relieve the bidder of the responsibility of furnishing all material and services for a complete installation satisfying the operational and other requirements stated in the specifications.

Drawing indicating the layout of pipe work shall be prepared in line with the flow diagrams and shall be provided as part of the Contract. These drawings shall indicate the position of all supports, guides, restraints and anchors; all drain and vent connections and the position of all pipes. All piping systems shall be arranged to allow adequate falls in the direction of flow, except where otherwise approved by the Engineer. At the points of drainage, drain pockets of ample size and approved construction shall be fitted as per details indicated in the enclosed drawings.

33.6 POWER CYCLE PIPING

33.6.1 EQUIPMENT SIZING CRITERIA

- (a) All the piping systems and equipment supplied shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years and shall withstand the operating parameters fluctuations and cycling normally expected during this period.
- (b) The design engineering erection testing etc. of the complete piping systems shall be to the requirements of power piping code ASME B 31.1. in addition to this, requirements as laid down in Indian Boiler Regulations (latest edition) shall also be met completely.

33.6.1.1 PIPE SIZING

- (a) Inside diameters of piping shall first be calculated for the flow requirement of various systems. The velocity limits for calculating the inside diameters are indicated in clause 33.2.1.
- (b) Inside diameters thus calculated for various piping systems shall be checked for the allowable pressure drop as per HBD's.
- (c) Pipes shall be sized for the worst (maximum flow temperature & pressure values) operating conditions for each system considering the maximum occasional pressure & temperature variations. In case of BFP suction sizing "transient analysis" shall be carried out for optimum sizing of the system in order to establish the pipe inside diameter for minimum pressure drop in system to match with pump NPSH requirement under worst operating conditions. The design pressure of MS piping system from superheater outlet header upto and including boiler stop valve shall not be less than the design pressure of superheater outlet header,
- (d) The design pressure for BFP discharge piping upto and including downstream valve at feed regulating station (FRS) shall be selected such that the minimum calculated thickness for various pipes at design temperature is sufficient for the following conditions, considering allowable stresses as per ASME B 31.1.



- Discharge pressure corresponding to turbine driven BFP trip speed at shut off head flow condition, if TDBFFP characteristics is governing for calculation of boiler feed discharge piping design pressure.
- Discharge pressure corresponding to motor driven BFP trip speed (frequency 51.5 Hz) at shut off head flow condition, if MDBFFP characteristics is governing for calculation of boiler feed discharge piping design pressure

However bidder may consider 20% higher stress as per the provision of ASME B 31.1 (for the piping upto downstream valve at feed regulating station only) for which the requirement of special provision as per stipulation of clause no. 520 of IBR shall be met as a must by the bidder. The valve rating in such case shall be arrived at based on design pressure calculated as per above.

- (e) The design pressure of boiler feed discharge piping at downstream of FRs shall be 105% of pressure corresponding to the emergency point of BFP operation. However pressure relief valve across the HP heaters shall be provided so that piping & valves beyond feed regulating station are not subjected to shut off head condition.

33.6.1.2 Inside diameters this calculated for various piping systems shall be checked for the allowable pressure drop. Pressure drop in the main steam line shall not be more than 90% of the allowable pressure differential between superheater outlet header and HP turbine inlet valves at BMCR. Similarly combined pressure drop in cold & reheat piping will not exceed 90% of the pressure differential between HP turbine exhaust and IP turbine inlet valves minus pressure drop in reheater. The pressure drop in the complete reheat line from HPT exhaust to IPT inlet shall not be more than 10% of the pressure at HPT. Wherever possible 5/6 dia radius bends will be used to minimize the pressure drop. Pressure drop in CRH NRV shall be considered as furnished by supplier for calculating the pressure drop in the reheat circuit.

33.6.2 MATERIAL SELECTION

Piping system shall be of carbon steel for design temperature upto 400 Deg C and alloy steel for design temperature beyond 400 Deg C.

33.6.3 PIPE WALL THICKNESS

Thickness calculation shall be made on the basis of procedure and formula given in ANSI/ ASME B 31.1. Thickness thus calculated shall be checked based on the procedure and formula given in IBR. Then, based on the higher value of the two calculations (after adding manufacturing tolerance), the next heavier commercial wall thickness shall be selected from the thickness schedules (eg Sch 40, sch 80 etc) as contained in ASME B 36.10 for OD controlled pipes and from manufacturers schedules for ID controlled pipes.

However, in such cases where the calculated thickness for OD controlled pipes falls beyond the thickness corresponding to the listed schedule nos. as given in ANSI B 36.10 for the pipe size, both ID & OD controlled pipes to manufacturers schedules are acceptable.

OD controlled pipes shall be to dimensional standards ANSI B 36.10 for carbon steel & alloy steel pipes and ANSI B 36.19 for stainless steel pipes.

To account for losses due to erosion, corrosion etc during the plant service life, an allowance of 1.6 mm/ 0.75 mm shall be considered in the minimum wall thickness calculation of pipes as per ASME B 31.1/ IBR respectively.



Further, the design pressure and temperature, downstream of any pressure reducing valve upto and including the first block valve shall be the same as that at upstream of pressure reducing valve. The piping at downstream of de superheater shall be designed for spray failure condition. The length of piping considered for spray failure condition shall not be less than the length required for proper spray mixing as recommended by desuperheater supplier.

However in no case, the selected pipe thickness shall be less than Sch 80 for alloy steel & carbon steel pipes of sizes 50 NB & below. The selected thickness for SS pipes shall not be less than Sch 40S of ANSI B 36.19.

Further, for the piping systems likely to be subjected to two phase flow, i.e downstream of control valves on heater drain lines etc. and for length of piping which is required for the proper mixing of spray water at downstream of de-superheater the selected thickness shall not be less than :

- a. Sch 40 pipe sizes above 50 NB but below 300 NB.
- b. Sch STD for pipe sizes 300 NB & above.

33.6.4

LAYOUT

- (a) All high points in piping system shall be provided with vents. All low points shall be provided with drains. Provision of drains on steam piping shall be as per ASME code TDP-1. Drain lines shall be adequately sized so as to clear condensate in the line and prevent water hammer and damage to turbine due to water induction. All piping shall be sloped towards the system low point such that slope is maintained in both hot and cold condition.
- (b) All drain and vent lines in piping system with design pressure 40 Kg/cm² (g) and above or with vacuum service shall be double valved.
- (c) The piping routing shall be such that clear headroom of not less than 2.5 meters above the walkways /working area is available. The contractor shall ensure correct orientation of and easy access to valves and instruments etc. and sufficient clearance for removal and maintenance of the same. The piping shall not encroach on withdrawal space of various equipment and walking space.
- (d) Wherever there is possibility of ingress of rain water through floor /ceiling opening at points where any pipe passes through floor /ceiling suitable weather protection hood shall be provided.

33.6.5

STRESS ANALYSIS

- (a) Flexibility and stress analysis for various piping system shall be carried out by the contractor as per the requirement of ASME B31.1 analysis results shall satisfy the following.
 - (1.) Calculating stresses in the piping shall be within the allowable limits stipulated in ASME B 31.1 as well as in IBR for piping under the purview of IBR.
 - (2.) Calculated forces and moments on equipment nozzles/TP are not more than the allowable loading provided by respective equipment manufacturer(s) / contractors. Flexibility analysis also calculates the deflections in all directions (translational and rotational) to enable design and selection of hanger/support system.
- (b) Cold pulling is not permitted. The contractor shall so design the piping system that there will be no requirement of cold pulls for meeting allowable reaction/stress values.



33.6.6

HANGERS AND SUPPORTS

All hangers and supports shall be erected such that they are vertical when piping is in hot condition (rated parameters). However in piping system connected to the rotating equipment nozzles, it may be required to design and erect the hangers/supports in the piping near the equipment nozzle as per the requirements/ recommendations, if any of rotating equipment manufacture(s).

All the hangers/supports shall be of reputed make, approved/tested quality and shall have proven performance record for similar application. They shall be designed to provide the required supporting efforts and allow pipeline movement with thermal changes without causing overstress. The design shall also prevent complete release of the piping load in the event of spring failure or misalignment and all parts of supporting equipment shall be fabricated and assembled so that they will not be disengaged due to movement of the supported piping. Necessary guides, anchors, braces and structural steel to be attached to building/boiler structure as well as any braces and/or dampeners required to eliminate piping vibration and seismic loading shall be provided.

The design of the pipe supports and hangers and their locations shall be guided by the following general principles:

- (a) Criteria of loading.
- (b) Design loads for anchors, restraints, hanger supporting structures.
- (c) Supports shall be adequate for extra loading due to hydrostatic tests and when piping system is full of water during chemical cleaning.
- (d) Supports for relief valve stacks shall be adequate for both the pipe weight and the thrust developed when the valve is open.

Besides vibration elimination, hangers shall ensure that the amplitude of oscillations in the pipe work owing to shock and vibration due to variation of fluid flow from zero to full capacity remains within approved limits.

33.6.7

THERMAL INSULATION

- (a) Thermal insulation shall be provided mainly for the following reasons.
 - (1) Conservation of heat and maintenance of temperature as per design cycle.
 - (2) Personal protection/
- (b) Design for personal protection
For the piping and the equipment with surface operating temperature of 60 °C and above the personal protection insulated shall be applied such that the temperature of protective cladding shall be below 60 °C
- (c) The contractor shall prepare an insulation thickness schedule covering both the cases of heat conservation and personnel protection based on the following design data.

Design ambient temperature	40°C for inside and 45°C for outside the main plant building.



Maximum cladding temperature	60°C
Wind speed	0.5m/sec. for inside and 0.25m/sec. outside the main plant building.
Emissivity of cladding	0.2
Pipe/equipment wall temp.	maximum operating temperature.
Thickness calculation	as per ASTM C-680 or equivalent

33.6.8

FLASH TANKS

- (a) The flash tanks shall be adequately sized to take care of the total drains in the complete power cycle piping system. There shall be sufficient margin to accommodate the possible variation in drains quantities as well as flash steam. Flash tanks shall be designed as per the requirement of ASME boiler and Pressure vessels (B&PV) codes, & ANSI standard. The contractor shall selection for employer's review.
- (b) However the minimum design pressure and temperature for the flash tanks shall be 3.5 Kg/cm² (g) and 210°C respectively. Flash tanks shall also be designed for full vacuum condition.
- (c) Corrosion allowance of 3.0 mm shall be added to the design thickness of the shell and head of the vessels. The minimum thickness of the vessels including corrosion allowance shall not be less than 8 mm.
- (d) The flash tanks and manifolds shall be designed to take care of the impact forces due to incoming drains.
- (e) In case the spray is in manifold, the material for the flash tank manifold shall conform to ASTM A335 Gr. P22 or better and its thickness shall not be less than SCH 100 of ANSI B36.10 irrespective of temperature of the fluid handled
- (f) The temperature in the flash tanks shall be maintained by using condensate /feed water spray, as the case may be and in whichever case applicable. The spray shall be automatically controlled. However for flash tanks open to atmosphere continuous spray through an orifice shall also be acceptable.

33.6.9

SPECIFIC REQUIREMENTS – PIPES & FITTING

Manufacturing tolerances on pipe diameter (both ID & OD controlled pipes) and thickness shall be as per ASTM-A530/ A999M, as applicable.

Bend thinning allowance shall be provided for all bends as per the recommendations of ASME B 31.1. The finished bends wall thickness at any point of the bend shall not be less than the calculated minimum straight wall pipe thickness.

Steel pipes & fittings shall in general be provided with butt welding ends as per ANSI B 16.25. Pipe fittings of size 50 NB & below shall be socket welded as per ANSI B 16.11. However in certain cases the preparations of welding end for the pipe may be required to be done to match equipment terminals, valves etc.

All stubs welded to the pipe including welded thermo wells and instrument source shall be installed on the pipe prior to stress relieving.

Instrument tubing up to and including the root valves and all drains & vents shall be generally of the same pipe material as that of the main pipe which they are located unless & until specified otherwise elsewhere.

Wherever ASTM A 106 Gr B/ Gr C or A – 105 material are used the maximum carbon content shall be limited to 0.3% (max)

Wherever mitered bends are used the thickness of pipe from which they are fabricated shall conform to the requirements of regulations 361 (C) of IBR. The angle between axes of adjoining pipe sections shall not exceed 22.5 Deg C.

Non destructive examinations for butt weld of NPS over 50 mm and for welded branch connections of branch size over 100 mm NPS shall be specified elsewhere. For smaller sizes the mandatory minimum requirements shall be as per Table 136.4 of ANSI B 31.1 for non IBR piping as per regulation 360 of IBR or table 136.4 of ANSI B 31.1, whichever is more stringent, for piping under the purview of IBR.

33.6.10

SPECIFIC REQUIREMENTS – VALVES & SPECIALTIES

For all globe and check valves, the direction of flow shall be clearly stamped on the body of the valve.

All globe valves shall be capable of being closed against the design pressure.

Where globe valves have been specified for regulation purpose, the disc shall be tapered plug type and suitable for controlling throughout its lift.

All gate and globe valves shall have bonnet back seating arrangement.

Check valves shall have full floating and accurately guided discs.

All gate, globe & check valves shall be designed for reconditioning seating surfaces and replacement of stem and disc without removing the valve body from the line.

Hand wheels for all the valves shall close the valve in clockwise direction when viewing from the top. All hand wheels shall be clearly marked indicating the direction of opening/ closing.

Manual gear operators shall be provided to open/ close the valve against the maximum differential pressure across the valve such that the effort required to operate the valve does not exceed 25 Kgf.

Valves 65 NB & above with rising stem shall be provided with position indicator/ visual indication either through plastic stem covers or through metallic stem covers. All gate and globe valves of size 50 NB and below in vacuum service shall have extra deep gland packing without requiring water gland sealing. All gate & globe valves of size 65 NB & above in vacuum services shall have adequately deep gland packing and shall be equipped with lantern rings to admit pressurized water for gland sealing.

Where floors and extension spindle arrangement is required for valves, the height of floor stand shall be about one meter from the floor/ platform. The floor stand shall be sturdy condition with column, nut plate and hand wheel made of cast iron conforming to ASTM-A-126 Grade B. Suitable thrust bearing shall be provided/ between the hand wheel and floor stand. The connection of the extension spindle to the valve stem shall be through a flexible coupling and shall be designed to permit valve thermal movements. Necessary nuts, bolts etc. For mounting the floor stand platform shall be provided.

33.6.11

INTEGRAL BYPASS VALVES

The requirement of integral bypass valves shown in flow diagrams is the minimum required. The final requirement shall be worked out as per the process requirement during detailed engineering.

If integral bypass valve selected is of size 50 NB & below, then the gate or globe type of forged construction with socket weld end as per ANSI B 16.11 shall be provided. For integral bypass valves of size 65 mm and above only cast steel gate valves with butt weld ends as per ANSI B 16.25 shall be provided.

Bypass pipe shall be of seamless construction and thickness corresponding to minimum of schedule 80 and shall be of same material class as the main pipe.

Integral bypass shall be motor operated if main valve is motor operated.

33.6.12 SPECIFIC REQUIREMENTS: FABRICATION

- 33.6.12.1 Piping system fabrication shall be in accordance with the requirement of ANSI B 31.1 however for system under purview of IBR, the requirements of IBR, shall also be complied with. All dissimilar material piping connection shall be subjected to the acceptance and approval of the employer. Complete document shall be submitted by the contractor in addition to the fulfillment of IBR requirement.
- 33.6.12.2 Where welded pipes and fittings are used the longitudinal weld seams of adjoining sections shall be staggered by 90 deg.
- 33.6.12.3 Access holes for radiography at shop for piping requiring 100 % radiography shall be provided only if the area to be radio graphed is not accessible from pipe ends. Access holes for field radiography shall be provided.
- 33.6.12.4 Except where otherwise specified, all piping shall have butt-welded connections with a minimum of flanged joints, if necessary. All high pressure steam valves and accessories shall have welded connections. Where flanges are adjacent to welded fittings, weld neck flanges shall be used.
- 33.6.12.5 Branches shall, in general, be formed by welding. Standard fittings may be used in positions and for sizes where approval has been given in detail drawings. Pipe bends and tees shall be truly cylindrical and of uniform section. All welded branches shall be reinforced where needed as per the applicable codes/regulations.
- 33.6.12.6 Unless otherwise specified, for all welded lines with pressure above 7 kg/ cm²(g) and/or temperature above 2000C, branch connections for branch sizes upto 25% of welded mains shall be made with special forged steel welded fittings.

Piping shall be fabricated in the shop in the largest transportable sections to minimise the number of field weld joints. The choice of field weld joints locations shall be based on the traverse of the pipe through walls, floors, sleeves or other restrictive areas. Support attachments for major piping shall be done at shop.

All workmanship shall be carried out using methods and procedures of best recognised pipe fabrication practice and must be done in a good and workman like manner in accordance with ANSI standards, ASME Codes, PFI standards and IBR as applicable.



All high-pressure steam valves and accessories shall have welded connections.

Mitred bends and elbows will not be accepted unless otherwise specified. Only forged tees, 90° elbows and 45° elbows are acceptable. In case the Bidder wants to deviate from this requirement on the ground of non-availability of such forged items, he may submit his alternative offer for Owner's consideration with sufficient documents to justify the same. In such a case, the concerned fittings shall be manufactured with necessary reinforcing pads, bend thinning allowance etc to satisfy code requirements.

All pipes bends shall be made true to angle with no negative tolerance and shall have a smooth surface free of flat spots, crease and corrugations.

A cross section through any bend portion of the pipe shall be true in diameter. All pipe bends shall have a radius of not less than 3 times the nominal pipe size unless otherwise mentioned. Pipe bends shall be made from straight pipe pieces of sufficiently higher thickness so that after thinning, the minimum thickness of bends shall not be less than the minimum thickness required for the straight pipe. Thinning allowance shall be considered as per ANSI B 31.1. The ends of pipe and welded fittings shall be bevelled according to details shown in the relevant piping codes.

For bends in pipes, straight piece of pipes shall be bent to required bend radius. However, forged bends (Bend radius = 1.5 x pipe diameter) wherever required shall be provided at no extra cost.

The ends of Pipe and welded fittings shall be bevelled according to details shown in the relevant piping code. All welding shall be made in such a manner that complete fusion and penetration are obtained without an excessive amount of filler metal beyond root area. The reinforcement shall be applied in such a manner that it shall have a smooth contour merging gradually with the surface of adjacent pipe and welded fittings. Backing rings shall not be used on any pipe welds, unless otherwise approved by the Engineer.

Pipes of size 50 NB and above shall be shop fabricated and of size 40 NB and below shall be field run.

All welding shall be made in such a manner that complete fusion and penetration are obtained without any excessive amount of filler metal beyond root area. The reinforcement shall be applied in such a manner that it shall have a smooth contour merging gradually with the surface of adjacent pipe and welded fittings. Backing rings shall not be used on any pipe welds, unless otherwise approved by the Engineer.

Pipe and attachments shall be properly aligned prior to welding. If tack welds are used, the tacks shall be either fused into the first layer of weld or else chipped out.

All welding for steam and feed pipe work shall be electrical welding using the shielded arc process and electrodes in accordance with the relevant code.



For pipes up to and including 100 NB, provided the pipe does not exceed 12.7 mm in thickness, gas welded butt joints will be accepted without backing rings.

Welded joints in pipe work shall be pre-heated to a temperature as required by the agreed standard or code or to the approval of the Engineer. The temperature shall be maintained during the welding operation and a record of metal temperature shall be obtained by means of a recording thermometer throughout the welding operation.

All welds shall be built-up by the application of multiple layers or passes. The thickness of metal applied for each layer or pass shall not exceed 3 mm. Each layer shall be cleaned and lightly peeled before the next layer is applied. Before being assigned to welding work, each operator shall have passed a qualification test as prescribed in the applicable Code/ Regulations. Each approved welder shall have an identification number which shall be indicated on all welds.

Welded joints shall be stress relieved as per ANSI B31.1/IBR. Stress relieving temperature shall be measured by thermocouple pyrometers or other suitable equipment. Readings of temperature against time shall be recorded.

33.6.13

BENDS AND ELBOWS

- (a) Elbows shall be generally of long radius type.
- (b) Bends for piping 65mm NB and above shall be made hot and for piping 50mm NB and smaller may be made cold.
- (c) Bends shall be made in accordance with PFI-ES-24. Bends shall be supplied with the minimum tangents except where the piping layout necessitates shorter lengths in which case the tangents shall be suitably reduced after the bending operation to suit the requirements of the piping layout.
- (d) Heat treatment of bends shall be done as per material specification.
- (e) Where examinations of bends indicates that wall thinning has resulted in thickness less than the minimum specified, repair by weld deposition shall be allowed only where the length of the affected area is 150mm or less as measured along the outside arc of the bend. Repairs in excess of this amount shall not be allowed. All repairs shall be carried out only after approval of the employer.
- (f) Circumferential butt weld shall not be used in the area of the bend. Longitudinal welds, where bends are formed from welded pipe shall be located on the bend's neutral axis.
- (g) Bend thinning allowance on straight pipe prior to bending shall be applied as per ANSI B 31.1. For bends of 5D or higher radius, the difference between maximum and minimum diameters shall not exceed 8 percent of average measured outside diameter of the pipe before bending.
- (h) All bends in 50 NB and larger piping shall be made hot. Bends in 40 NB and smaller piping may be made cold only when commercially available bending



shoes are used. Finished bends shall be smooth in contour and free from buckles and distortion.

- (i) Pipe bends may be fabricated by the incremental induction heating process. Circumferential butt welds or longitudinal welds (where seamless piping has been specified) shall not be used in the arc of the pipe bends, without Engineer's permission. After bending, such welds, where permitted, shall be re-examined and re-inspected.
- (j) All piping bends are subject to heat treatment as required by the original material specification unless otherwise approved by the Engineer.
- (k) All pipe bends in 50 NB and larger piping shall be examined ultrasonically after fabrication for wall thickness conformance. Measurements shall be taken in accordance with PFI Standard ES-20 using the "Pulse Echo" method. Data reports containing information as recommended in PFI Standard ES-20 shall be forwarded to the Engineer for record purposes.
- (l) Where examination of pipe bends indicates that wall thinning has resulted in less than code required minimum wall thickness repair by weld deposit shall be allowed only where the affected area is 150 mm or less as measured along the outside arc and with Engineer's approval. Repairs in excess of this amount shall not be permitted.

33.6.14 End Preparation, Cutting etc.

- (a) For steel pipes, end preparation for butt-welding shall be done by machining/flame cutting.
- (b) Socket weld end preparation shall be saw/machine cut
- (c) For tees, laterals and other irregularities details, cutting template shall be used for accurate cutting and cutting shall follow the outline of the template.

Alignment Considerations

- The pipes joined by welding shall be aligned correctly within the existing tolerances on diameter, wall thickness and out of roundness, which shall be preserved during welding.
- All flange facings shall be true and perpendicular to the axis of the pipe with boltholes being off centre.

33.6.14.1 Branch connections shall conform to the requirements of ASME B 31.1. All branch connection welds shall be full penetration welds, except as permitted by ASME B 31.1/IBR. The branch connections shall generally conform to the following :

- Socket welding and threaded connections on pipelines shall be made by forged outlet fittings. The holes in pipe headers made for these connections shall be drilled to the same size as the fitting inside diameter. All burrs shall be removed and threaded fitting shall be repeated after welding.



- For branch connection, additional reinforcements shall be provided wherever necessary by the applicable codes including supply of necessary material by the contractor at his own cost.
- The design and fabrication details for the instrument stub connection are included in Tenderer's scope. Materials for instrument connection shall be the same as that of the pipe to which it is attached. Fittings ratings shall be in accordance with those specified for the main process pipe.

33.6.14.2 All materials that are bent, forged or informed shall be subjected to heat treatment after the forming operations as required by the original material specification. For ally steel materials the preferred heat treatment process is full annealing.

33.6.15 SPECIFIC REQUIREMENTS: WELDING

In addition to the requirements spelt out elsewhere, the followings shall be taken into consideration:

33.6.15.1 Welding Process

- (a) Welding under this specification shall be done by one of the following processes :
 - (i) Manual oxy-acetylene welding process
 - (ii) Manual shielded metal arc process (SMAW)
 - (iii) Manual inert gas tungsten arc process (TIG)
- (b) Automatic or semi-automatic welding shall be done only with the specific approval of the Owner/Consultant.
- (c) Socket weld joint shall be done with low hydrogen type covered electrodes with manual shielded metal arc process.
- (d) Welding at any joint should be completed uninterrupted. If this procedure cannot be followed for some reason, the weld shall be insulated for slow and uniform cooling.
- (e) As far as possible welding shall be carried out in flat position. If not possible, welding shall be done in a position as close to flat position as possible.
- (f) As a rule no backing ring shall be used for circumferential butt welds.

33.6.15.2 Alignment and Spacing

- (a) Components to be welded shall be aligned and spaced. Root opening shall be as under :



(i)	For wall thickness 2.5 mm or under and for all thickness in oxy-acetylene welding	1.0 mm - 2.0 mm
(ii)	For wall thickness over 2.4 mm	2.0 mm - 3.0 mm

Special care shall be taken for fitting and alignment in case of inert gas tungsten arc welding. Flame heating for adjustment of ends is not permitted without the approval of the Owner/Consultant.

- (b) A wire spacer of proper diameter may be used for the weld root opening but must be removed after tack welding and before application in root pass.
- (c) Tack welding for the alignment of pipe joints shall be executed carefully and shall be free from defects since tack welds form a part of final welding. Defective welds shall be removed prior to the welding of joints. Electrode size for tack welding shall be selected depending upon the root opening.
- (d) Tacks should be equally spaced as follows:
- | | | |
|-------|-----------------------------|---------|
| (i) | For 65 NB pipe and smaller | 2 tacks |
| (ii) | For 80 NB to 300 NB pipe | 4 tacks |
| (iii) | For 350 NB and larger pipes | 6 tacks |

33.6.15.3 Welding Technique

- (a) Root pass shall be made with respective electrodes/filler wires. The size of the electrodes shall not be greater than 3.25 mm (10 SWG). Welding shall be done with direct current values recommended by the electrode manufacturers.
- (b) Upward technique shall be adopted for welding pipes in horizontally fixed position. For pipes with wall thickness less than 3 mm, oxy-acetylene welding is recommended.

33.6.17 CLEANING AND PROTECTION

- (a) All fabricated piping shall be cleaned as per relevant SSPC cleaning technique/practice such that both inside and outside surface of the piping are free of sand, loosely adhering scale, dirt and other foreign matters.
- (b) After cleaning outside surface shall be coated with enamel or other protective paint, the weld end preparation shall be coated with deoxyaluminate paint and protected adequately. Use of grease or oil. Other than light grade mineral oil is not allowed.



- (c) After desiccating and preservation, the fabricated sections shall be covered, boxed, capped, or others shielded from further contamination or corrosion.

33.6.18 MARKING

- 33.6.18.1 All piping shall be marked clearly and legibly at the shop with its identifying pipeline description and piece no. as per the appropriate component or spool piece fabrication drawing.
- 33.6.18.2 Marking shall be by any method which does not produce sharp discontinuities and the marking does not get erased until the piping is erected. Piping 6 mm and thicker may be marked by stamping using round nose or dot interrupted die stamps with minimum nose radius of 0.8mm.
- 33.6.18.3 Item too small to be marked shall have metal tags securely attached to each bundle or container of such items such that it does not get erased until the item has been erected.

33. 6.19 SPECIFIC REQUIREMENTS- ERECTION

- 33.6.19.1 Where control valves, flow nozzles, orifices and other piping appurtenances are to be installed, they shall be installed only after steam blowing and chemical cleaning operation. After the completion of the steam blowing / chemical cleaning the contractor shall cut spool pieces of required length and install the components.
- 33.6.19.2 Field run piping shall be erected only after completion of the erection of all other piping system structures and equipment unless otherwise approved/directed by the employer.
- 33.6.19.3 when C clamps are tack welded to the pipe for the purpose for the alignments of a joint, preheating for the lack welding shall be performed if the main joint adjacent to it to be preheated as per the requirement of this specification, otherwise preheating for the tack weld may be omitted after the joint is completed, all tack weld shall be removes, flushed with the adjacent of pipe by chipping and /or grinding. The areas where C clamps were attached shall be subjects to stress reliving as required.
- 33.6.19.4 The hydrostatic testing of the piping system shall be done after proper installation of all permanent hangers/supports. Springs hangers shall be locked during hydrostatic test. Prior to steam blowing all hangers which had been locked for the hydrostatic testing shall be unlocked.
- 33.6.19.5 The setting and logging of all supports, restraints/limit stop, spring hangers, etc, is the responsibility of the contractor. The initial setting on all hangers and supports and clearance on restrains and limit stops shall correspond to the design cold values. The contractor shall check all readings after completion of erection of piping system and application of insulation and carry out readjustment as necessary to be in line with the design cold values. After satisfactory setting of all hangers/restraints. Hangers reading / clearance shall be logged by the contractor in proper format and a joint protocol be made.
- 33.6.19.6 The contractor shall monitor the behavior of all hangers, supports, restrains etc. during the initial stage of plant operation. When the piping system(s) have attained their rated temperature the contractor shall log, hanger reading, snubber deflection, restrains/limits stop clearances as specified elsewhere.



33.6.19.7 All gaskets shall be asbestos free material and suitable for the service application.

33.6.20 SPECIFICATION FOR POWER CYCLE PIPING & FITTINGS

S. No.	Description	Alloy Steel	Carbon Steel
A	PIPES		
	Material	X20 Cr Mo V 121 to DIN 17175 or ASTM A335 Gr P91 (For all temp above 510 deg C) ASTM A 335 Gr P22	ASTM A 106 Gr B/ ASTM 106 Gr C (A 106 Gr C for BFD design parameters, CRH design parameters & above) ASTM A 672 Gr B 60 CLASS-12/ 22
	Construction	Seamless	Seamless
B	FITTINGS		
	Material for 65 NB & Above	X20 Cr Mo V 121 to DIN 17175 or ASTM A 234 Gr WP91 (for temp above 510 Deg C) ASTM A 234 Gr WP 22	ASTM A 234 Gr WPB with A 106 gr B piping
	Material for 50 NB & Below	ASTM A 182 Gr F 91 (For all temp above 510 deg C) ASTM A 182 Gr F 22	ASTM A 105
	Construction	Seamless (forged for 50 NB & below)	Seamless (forged for 50 NB & below)
	Basic Standards	ANSI B 16.9 ANSI B 16.11 ANSI B 16.25 ANSI B 16.28	ANSI B 16.9 ANSI B 16.11 ANSI B 16.25 ANSI B 16.28
	Rating/wall/thickness	To match with that of pipe	To match with that of pipe
C	WELDING		
	Backing rings	Not permitted	Not permitted
D	MATERIAL ANALYSIS		
	MANDATORY REQUIRMENTS	All tests, as given in respective material code (other than supplementary requirements). Shall be carried out as minimum. This includes the tests wherein it is specified in the respective material code that "the test is to carried out when specified by the purchaser" or any such indication, in the code.	

E. HYDROSTATIC TEST PRESSURE

(1) Piping system under IBR purview:

At shop

All piping including fabricated piping shall be hydro tested at 1.5 times the design pressure subjected to regulation 374 of IBR. However, non-destructive testing in lieu of hydro test is also acceptable subject to regulation 343 (3) of IBR

After erection

All piping system shall be hydro tested at 1.5 times the design pressure subjected to regulation 374 of IBR. However for such systems where it is practically not possible to do hydro tests. The test as called for in ANSI B 31.1 & IBR in lieu of hydro test



2 x 660 MW Ennore SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14

Vol. III : 836 Page 201 of 487



shall also be acceptable.

Hydro test of boiler feed piping: since isolating valve is not provided at economizer inlet, contractor to make all necessary arrangement of hydro testing of BFD piping beyond HP heater downstream heating isolating valve upto TP either by blanking or providing a temporary valve. NDT as per the provision of IBR & ASME B 31.1 can be carried out for the joint at TP between SG & TG contractor.

(2) Non- IBR piping system:-

At shop	All piping including fabricated piping shall be hydro tested at 1.5 times the design pressure subjected to regulation 374 of IBR. However, non-destructive testing in lieu of hydro test is also acceptable subject to regulation 343 (3) of IBR
After erection	All piping system shall be hydro tested at 1.5 times the design pressure subjected to regulation 374 of IBR. However for such systems where it is practically not possible to do hydro tests. The test as called for in ANSI B 31.1 & IBR in lieu of hydro test shall also be acceptable.

Note:

1. EFW pipes as per A 672 are acceptable if the design pressure and design temperature are such that it calls for ASME 300 class & below piping and size is 550NB and above. The fitting shall correspond to ASTM A 234 with grade corresponding to the pipe. Material. Welded construction fitting are also acceptable with A672 piping. However all requirements as per ASME B31.1 including the requirements given in mandatory appendix-D, IBR & respective material code shall be fully complied with, in respect of welded firings
2. In case the design temperature is above 545 deg C, then P91 material only shall be applicable for both pipes as well as fittings.

Materials for fittings, specialties and valves shall be corresponding to piping material.

33.6.21 SPECIFICATION FOR POWER CYCLE VALVES

33.6.21.1 General Requirements

33.6.21.1.1 All the control station configuration shall be as follows.

(a) For Continuous Service requirement:

- (i) One (1) pneumatically/hydraulically operated control valve.
- (ii) One (1) motor operated isolation valve at the upstream side of control valve.
- (iii) One (1) manual operated isolation valve at the downstream side of the control valve.



- (iv) One (1) pneumatically/hydraulically operated bypass control valve.
 - (v) One (1) motor operated isolation valve at the upstream side of the bypass control valve.
 - (vi) One (1) manual operated isolation valve at the downstream side of the bypass control valve.
 - (vii) Non return valve in the common downstream line, for spray piping.
 - (viii) Drain valves at upstream and downstream of the control valves.
- (b) For Intermittent Service requirement:
- (i) One (1) pneumatically/hydraulically operated control valve.
 - (ii) One (1) motor operated isolation valve at the upstream side of control valve.
 - (iii) One (1) manual operated isolation valve at the downstream side of the control valve.
 - (iv) One (1) motor operated inching type regulating bypass valve.
 - (v) One (1) motor operated isolation valve at the upstream side of the bypass valve.
 - (vi) One (1) manual operated isolation valve at the downstream side of the bypass valve.
 - (vii) Non return valve in the common downstream line, for spray piping.
 - (viii) Drain valves at upstream and downstream of the control valves.

All valves shall have cast/forged steel bodies with covers and glands of approved construction. The valves shall be provided with electric motors/solenoids and actuators as required.

Locating the valves on vertical runs shall be avoided as far as possible

All valves shall, unless otherwise approved, have ends prepared for butt-welding and the internal diameter shall be the same as the internal diameter of the pipes to be joined.



All valves shall receive tests at Manufacturer's or Contractor's works in accordance with the specific requirements of the approved Codes of Practice so that the same is acceptable to IBR where applicable. Valves shall be rising stem or otherwise as approved by the Owner.

All valves shall function smoothly without sticking, rubbing or vibration on opening or closing.

Material, design, manufacture, testing etc. for all valves and specialties along with the accessories shall conform to the codes as specified or approved equivalent and acceptable to IBR.

By-pass valves shall be provided for high pressure and larger size valves (including control valves) as per standards followed and as felt necessary for smooth and easy operation, even though not specifically mentioned in the specification.

Valves subjected to vacuum shall have sufficient long deep-seated packing. Valves in general shall preferably be of such design as to permit repacking while in service by providing back seating arrangement duly tested during manufacture.

All valves shall have outside screwed spindles and screwed thread of spindle shall not pass through or into the stuffing box. Where valves are exposed to the weather, protective covers shall be provided for the spindles, which shall be subject to approval.

Valves requiring sealing water shall be adequately deep and shall be equipped with lantern ring to admit pressurised water for gland-sealing. Gland sealing water shall be tapped from one tapping point on the condensate extraction pumps discharge header and shall be reduced in pressure as per the requirement.

The stops which limit the travel of any valve in the "Open" or "Shut" position shall be arranged exterior to the valve body.

All regulating valves shall be designed to prevent erosion of the valve plugs and seats when the valves are operated partially opened. The valves shall have contoured plug.

Approved access arrangements shall be provided for all valves and particular attention shall be given to those valves fitted with gearing, which require lubrication of the valve itself.

Valves which cannot be operated from the floor or walkways shall be provided with suitable extension rods and linkages. If such a valve is provided with integral bypass then similar arrangement shall be done for the bypass valve also. The extension shall be such that the hand wheel is at a height of approximately one metre above the level of the floor or platform from which the valve is to be operated. Where required, valves shall be provided with head-stocks and pedestals of rigid construction and where gears or level wheels are used, these shall be of cast steel or suitable quality cast iron with



machine cut teeth. Where extension spindles are fitted, all thrust when opening or closing the valves shall be taken directly on the valve body. The extension linkage shall be so designed to take care of the thermal movements of the valve body with the pipe on which the valve is installed. The connection of the extension spindle to the valve stem shall be through a flexible coupling.

The extension spindle shall be of the same material as that of the valve stem. The floor stands shall have column, not less than Group-B of ASTM-126. Necessary nuts and bolts for mounting the floor stands on foundation shall have to be provided. Adequate means of easy lubrication shall have to be provided for valves and operating extension components.

Stems shall preferably be arranged vertically with gland at the top, however, in no circumstances must the stem be inclined downward from horizontal or gland be at the bottom. Globe valves shall be installed with the pressure under the disc. Valves shall not be fitted in inverted position.

Where necessary, for accessibility, grease nipples shall be fitted at the end of extension piping and where possible these shall be grouped together and mounted on a common panel situated at a convenient position. A separate nipple shall be provided to lubricate each point. The Contractor shall supply the first fill of oil or grease for these parts. The Contractor shall supply a suitable manually operated grease gun for the standard type of nipple provided.

The spindles for all valves for use outside the building shall have weatherproof protection covers of approved construction.

All valves shall be fitted with indicators so that it may be readily seen whether the valves are open or shut. In the case of those valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.

Plastic or bakelite valve hand wheels are not permitted.

All valves shall be closed by rotating the hand wheel in a clockwise direction when looking at the faces of the hand wheel. The face of each hand wheel shall be clearly marked with the words 'Open' and 'Shut' with arrows adjacent to indicate the direction of rotation to which each refers.

Each valve hand wheel shall be fitted with a circular nameplate of approved material indicating the valve tag number, duty or service intended and the function of the valve. The nameplates shall incorporate the colour code corresponding to the service of the piping.

Wherever practicable, heavy valves of total weight including actuator, drive motor, integral by-pass etc equal to or greater than 500 kg shall be provided with suitable lugs to permit direct suspension by hanger rods or direct resting on bottom support, as applicable.



Special attention shall be given to the operating mechanism for large size valves in order that quick and easy operation is obtained and maintenance is kept to a minimum.

Eyebolts shall be provided where necessary to facilitate handling heavy valves or parts of valves.

The Bidder shall supply during the course of the Contract, comprehensive drawings showing the design of valves, test pressure and working pressure /temperatures. They should include a parts list referring to the various materials used in the valve construction.

Gate valves below 100 NB shall be solid wedge/Flexible wedge type. Valves of 150/300 and size 100 NB and above shall be flexible wedge type. However, for sizes 100 NB and above for temperature 300oC above, parallel slide gate valves shall be used.

All sampling and root valves shall be of integral body bonnet type.

For butterfly valves, Contractor shall guarantee that in the closed position and with a disc differential pressure as specified, the valves shall be water tight.

Contractor shall guarantee that the operating mechanism shall open and close the valve under the specified maximum differential pressure within the time specified.



A. CAST STEEL VALVES (GATE/ GLOBE/ CHECK 65 NB & Above)

S. No.	Description	Alloy Steel		Carbon Steel		Stainless Steel
		600 lbs & below	600 lbs & above	600 lbs & below	600 lbs & above	400 lbs & below
1.0	Basic Standard	ANSI B 16.34				
2.0	Construction					
a	Bonnet/ cover	Bolted Type	Pressure Type	Bolted Type	Pressure Type	Bolted Type
b	Disc					
	Globe Valves	Throttling Type Plug				
	Check Valves	Twilting/ swing type				
	Gate Valves	Solid/ flexible wedge below 100 NB				
		Flexible Wedge for 100 NB & above				
c	Seat	Integral Type				
3.0	Material					
a	Body, Bonnet & Cover	ASTM 216 Gr WCB	ASTM 216 Gr WCC	ASTM A 217 WC9 ASTM A 217 Gr C 12A		ASTM A 351 CF 8
b	Stem	13% Chrome Steel ASTM A 182 Gr F6A				ASTM 182 F316/ F 304
c	Hinge Pin (for check valves)	13% Chrome Steel ASTM A 182 Gr F6A				ASTM 182 F316/ F 304
d	Disc & Seat ring (heat treated & hardened)	ASTM A 216 Gr WCB minimum	ASTM A 216 Gr WCC	ASTM A 217 Gr WC9 ASTM A 217 Gr C12A		ASTM 182 F316/ F 304
		Hardness 250 BHN	Seating surface hard faced with satellite 350 BHN			
e	Back seat/ stem guide bushing	ASTM A 182 gr F6a 13% Cr SS with stellite hard facing				ASTM 182 F316/ F 304

B. FORGED STEEL VALVES (GATE/ GLOBE/ CHECK 50 NB & Below)

S. No.	Description	Carbon Steel	Alloy Steel	Stainless Steel
1.0	Basic Standard	ANSI B 16.34		
2.0	Construction			
a	Bonnet/ cover	Bolted Type for 600/ 800 lbs Seal welded for 900 lbs & above		Seal Welded/ Bolted Type for 600/ 800 lbs Seal welded for above 800 lbs
b	Disc			
	Gate Valves	Solid Wedge Type		
	Globe Valves	As per mfg std		
	Check Valves	Piston Lift		
c	Seat	Integral Type		
3.0	Material			
a	Body, Bonnet & Cover	ASTM A 105	ASTM A 182 Gr F22 ASTM A 182 Gr F91	ASTM 182 F316/ 304
b	Stem	13% Chrome Steel ASTM A 182 Gr F6A		ASTM 182 F316/ F 304
c	Hinge Pin (for check valves)	13% Chrome Steel ASTM A 182 Gr F6A		ASTM 182 F316/ F 304
d	Disc & Seat ring	ASTM A 105 with stellite minimum Hardness 350 BHN	ASTM A 182 Gr F22/ F 91 hard faced with satellite minimum hardness 350 BHN	ASTM 182 F316/ F 304 hard faced with satellite minimum hardness 350 BHN

C.ANGLE GLOBE VALVE

S. No.	Description	Alloy Steel	Carbon Steel
1.0	Design Standard	ASME B 16.34	
2.0	Material		
a	Body & Bonnet	A 182 Gr F22/ F 91 or better	A 105 or better
b	Spindle/ disc	Stellited	
c	Body Seat & Back Seat	Stellited	
d.	Gland Packing	Graphite	
3.0	Construction		
a	Valve Type	Outside Screw & yoke Type	
b	Body & Bonnet	Forged body with integral/ welded bonnet connection	
c	Disc type	Taper plug or parabolic type to suit system requirement	
d	End connection	Socket weld (ANSI B 16.11) for sizes 50 Nb & below Butt weld (ANSI B 16.25) for sizes 65 NB & above	
e	Pressure rating	To suit the service condition. However minimum pressure rating shall be corresponding to ANSI Class 1500	

D OTHER VALVES (65 Nb & Above)

S. No	Description	Safety Valve		Relief Valve	BF Valve
		Alloy Steel	Carbon Steel		
1.0	Design Standard	ASME B 16.34			AWWA C 504
2.0	Pressure Class	400 lbs & below			75 B & above
3.0	Accumulation	10% (max)			
4.0	Blowdown	5% (max)		10% to 15%	
5.0	Construction				
a	General	Spring loaded with weld end inlet, pop up type		Spring loaded with flanged inlet & outlet	Long body butt welded
b	Bonnet	Bolted type			
c	Seat bushing	Renewable type screwed on and held in position type			
d	Shaft seat				O ring type
6.0	Material				
a	Body & Bonnet cover	ASTM A 217 WC 9/ C 12A	ASTM A 216 Gr WCB/ WCC		ASTM A 216 Gr WCB
b	Spindle/ Shaft	Stainless Steel			ASTM A 182 Gr 304
c	Disc, nozzle, seat ring	ASTM A 182 F 316			ASTM A 216 Gr WCB Seal & O Ring : EOT/ BUNA – N/ Neoprene for water service EOPT/ EPDM for steam service
d	Spindle Guide	17% Chrome steel or monel, heat treated and hardened to minimum hardness 250 BHN			
e	Spring	Stainless Steel or Tungsten Steel	Carbon Steel		
f	Retainer Rings and Internal Bolts				SS 304
g	Bearing				Sleeve type self lubricated

Note the material of body, bonnet/ cover & disc shall be corresponding to that of pipe material on which valve is installed.

33.6.22 SPECIFIC REQUIREMENTS

- Valve of size 65 NB and above shall have butt welded ends as per ANSI B16.25 and valves 50 NB and below shall have socket weld ends as per ANSI B16.11
- Locking arrangement, wherever specified shall be of non-detachable type.
- Valve shall be tested in accordance to ANSI B 16.34, however, for butterfly valves; the requirements of AWWA C-504 shall also be met.



4. All gates and globe valves shall be without side screw and yoke with rising stem.
5. Gate valve below 100 NB shall be solid wedge/flexible wedge type, valve of size 100 NB and above shall be of flexible wedge type. However, for sized 100mm NB and above for temperature above 300 °C, parallel slide valves are also acceptable.
6. Specification for valve shall be as indicated in C&I subsection.
7. Stem for all valves shall be heat treated and hardened- minimum, hardness 200HB and surface finish of 16 RMS or better in area of stem packing.
8. Gland packing for gate and globe valves shall be alloy steel/SS wire reinforced graphite with stem corrosion inhibitor.
9. All bolts and nuts shall be ASTM A-193 Gr. B 7 and ASTM A-194 Gr. 2H respectively.
10. Hand wheel for valves shall be of malleable iron / carbon steel.
11. Minimum differential hardness between seat and other disc material shall be 50 HB in case of 13 % chrome hardened with heat treatment of steel.
12. Valves closure test shall be as per supplied complete with discharge elbow and drip pan along with drain.
13. For valve of size 65 NB and above in vacuum service, water gland-sealing arrangement shall be provided. For valve of size 50 NB and below, deep gland packing shall be provided. Butterfly valves, subjected to vacuum, shall be tested for vacuum as per relevant code.

33.6.23

SPECIFICATION FOR HANGERS/SUPPORTS

Design and manufacture of hangers/supports shall conform to ANSI B 31.1 MSS-SP-58, MSS-SP-89

Where hangers rod angularity exceed 4 degree from cold to hot position (at rated parameters), the hanger and structural attachments shall be offset in the cold position in such a manner that the hanger rod is vertical in hot position unless otherwise specified.

The contractor shall furnish, detailed arrangement sketches for each support, restrains, anchor, etc. the sketches shall include the key plan identification no. bill of quantities, design load , operating load, spring stiffness, amount of precompression, centre line elevation of pipe, spring box position/orientation, etc.

Hangers support tag no. shall be marked on all pipe hangers/support, restrains and anchor assemblies, the design loads, hot and /or cold loads shall be stamped on respective constant and variable springs.

33.6.24

TECHNICAL REQUIREMENTS

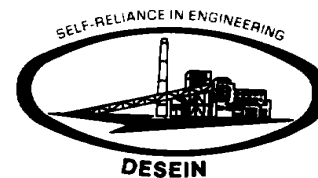
- (a) Each threaded connection and adjustable rod shall be provided with lock nuts.
- (b) Each rod of a double rod hanger support shall be designed for the full hydro test load coming on the double rod hanger assembly.



- (c) Hanger support rods of less than 10mm diameter for supporting pipes of 50 NB and smaller and less than 12mm diameter for supporting pipes of 65 mm NB and larger, shall not be used.
- (d) Parts of the hanger or support which move relative to the pipes during operation shall be connected to the pipe attachments in such a manner that they lie entirely outside the pipe thermal insulation.
- (e) Attachment to piping shall be as far as possible by clamps.
- (f) Where axial movement is to be restricted or riser clamps are used, suitable lug stops to prevent pipe movement shall be designed for welding on to pipe.
- (g) Bolted pipe clamps shall have a minimum thickness of 5mm for weather protected locations and 6 mm for locations exposed to weather.
- (h) Beam clamps shall be forged steel equipment with a rod to fix a nut.
- (i) All sliding surface of supports and restrains shall have Teflon lining on one surface coming in contact with stainless steel lining on the other surface.
- (j) All piping hangers and supports shall be designed to carry the weight of the piping fitting, thermal insulation, self weight of the hanger assembly and medium transported or test medium whichever is heavier. In addition all rigid rod hangers and variable spring shall be designed to carry the operation load in hot condition.
- (k) All design and fabrication including loading and allowable stresses shall be in accordance with ANSI B31.1. Note shall be taken of the requirements against earthquake at site. Hangers and supports for systems shall be completely engineered and prefabricated for all piping 50 NB and above. Sufficient random materials shall be furnished for field support of all lines of smaller diameter.
- (l) For pipes of design temperature 1000C and more, bottom supports shall be avoided as far as possible and hanger type supports shall only be used. However, where bottom support cannot be avoided, the same shall be provided with suitable shoes along with balls/rollers/rockers (if movement is more than 50 mm) and SS/Graphite is to be used (if the movement is more than 20 mm) to minimise frictional resistance against thermal movements. The material of shoe as well as the ball/rockers/rollers shall be suitable for the design temperature of the supported pipe and shall be of sufficient hardness so as to permit a reasonably long life keeping its roundness and maintaining a low friction factor. Where a constant load type support is required, the bottom support shall also be of constant load type.
- (m) Provision shall be made for support of piping which may be disconnected during maintenance work.
- (n) Support steel shall be of structural quality. Perforated strap, wire or chain shall not be used. Support components shall be connected to support steel by welding, by bolting or by beam clamps. Bolt holes shall be drilled, not burned. Support components may be bolted to concrete using approved concrete anchors.
- (o) Double nuts or lock-nuts shall be used on hanger rods and bolts in all cases.
- (p) Variable springs shall be furnished with travel stops. The travel stops shall be factory installed at the "cold" position.



- (q) Spring hangers should not be loaded more than 80% of the spring travel range.
- (r) Both constant load and variable spring support/hanger shall be provided with outside indicators for deflection and load. Provision for the site adjustment of load at least $\pm 10\%$ shall be incorporated. Also spring locking arrangement and turnbuckles of load/position adjustment shall be provided for all hangers.
- (s) Constant load type spring support/hangers shall be so selected as to permit, for the specific load, an over-travel of at least 25 mm or 20% (whichever is greater) of the specified range of vertical travel. The initial setting of the hangers/supports shall be such that half of the "over-travel" is allowed in either direction. Constant support hangers shall have a support variation of not more than 6% throughout the total travel range.
- (t) Rigid hangers & restraints shall be judiciously selected, without exceeding the stipulated limits of terminal forces & moments & stress level. Struts shall be considered where compressive load is expected.
- (u) Where the piping system is subject to shock loads, such as thrust imposed by the actuation of safety valves (SV), hanger design shall include provision for shock absorbing devices of approved design.
- (v) Vertical restraints near safety valves shall be preferred for taking SV discharge thrust, provided equipment terminal reactions remains within allowable limit.
- (w) Attempts shall be made to avoid use of shock absorbers, dampers etc as far as possible to take care of occasional loading like seismic effect etc by proper engineering of the piping design and effective use of restraints. However, shock absorbers, VISCO- dampers, wherever felt necessary are to be supplied and erected by the bidder.
- (x) Layout of piping shall be properly designed to avoid excessive vibration by effective use of restraints. However, wherever felt necessary, shock absorbers, VISCO- dampers may be employed.
- (y) Hanger rods (except rigid hangers where both tension and compression may occur) shall be subjected to tensile loading only. At hanger locations where lateral movement is anticipated, suitable linkage and rocking washers shall be provided to permit swing.
- (z) For all hangers, the length of suspension shall be so selected that the hanger rod may never make an angle of more than 40 with vertical due to horizontal pipe movements. If this cannot be avoided by erecting the hanger vertically for cold condition, it shall be suitably off set so that the above requirement is fulfilled in cold as well as hot conditions. Hangers shall be designed so that they cannot become disengaged by movements of the supported pipe.
- (aa) Hanger support rods of less than 10 mm diameter for supporting pipes 40 NB and smaller and less than 13 mm diameter for supporting pipes of 50 NB and larger, shall not be used.
- (bb) Supports, guides and anchors shall be so designed that excess heat will not be transmitted to the building steel.
- (cc) Tie rods/struts shall preferably be used for restraints to achieve low friction restraining.



- (dd) The Tie-rods/struts shall have proper arrangement and adequate length, so that, thermal movements in other directions, which are intended to be free are not constrained and there is no appreciable shift in centreline of pipe or the elevation of the supporting point on pipe due to sway. The design shall have provisions for adjusting the length to take up any slack and securely locking in position permanently once adjustment is done.
- (ee) Snubbers & dampers shall be designed to take seismic/dynamic loads, thrust due to safety valve discharge. Effort shall be made to limit its use by judicious placement of rigid hangers.
- (ff) Bottom support spring hangers to be avoided as far as possible.

33.6.25

SPRING HANGERS

Constant load hangers shall generally be used when vertical displacement exceeds 40 mm or where the supporting effort variation of available variable spring exceeds 25%.

Constant load hanger shall be of moment coil spring counter balanced design or cam & spring type. Variable spring hangers shall be of helical spring design. Spring hanger/ assembly shall be constructed such that complete release of piping load is impossible in case of spring miss alignment or failure.

Constant load hangers shall have a minimum field adjustment range of 15% of the load. The total travel for constant speed load hangers shall be design travel plus 20% but in no case shall be difference between total travel and design travel be less than 15 mm. The supporting effort variation throughout the travel range of constant load hangers shall not exceed 6%.

Variable spring hangers shall have supporting effort variation of not more than 25% throughout the total travel range.

All springs shall remain under compression throughout their operating regime and never under tension.

Spring hangers shall have provision of rlocking the hangers in any position of the travel.

Spring hangers shall be adjusted to the cold position before shipment and locked in that position. The cold and hot position shall be clearly marked on the travel indicator scales.

All spring hangers shall be locked before performing the hydro test. The locking shall be removed before the line is placed under operation.

33.6.26

SNUBBERS

Snubbers shall be designed to allow normal movement of pipe due to thermal expansion and shall require minimum maintenance.

Snubbers shall be of hydraulic type of Lisega/ ITT Girnell, Germany or owner approved eqvt.

Axes of anubbers/ restraints shall be parallel to the direction of the expected reaction force in operating condition.



33.6.27 RESTRAINTS & ANCHORS

All anchors shall be designed for direct rigid fastening to the structural steel member.

Anchors, guides and restraints shall be capable of withstanding the forces and moments due to thermal expansion and dynamic effects.

33.6.28 STEAM STRAPS & STRAINERS

Steam traps shall be of inverted bucket/ thermostatic type with integral or separate Y type strainers.

Traps shall have stainless steel internals.

All Y type strainers shall have stainless steel screen of not more than 20 mesh size. Screen open area shall be at least four (4) times the pipe cross sectional area.

Strainer shall have screwed blow off connection with removable plug.

Y type strainers shall be provided along with each steam trap in case the strainer does not form an integral part of the trap.

33.6.29 SPECIFICATION FOR THERMAL INSULATION

Insulation materials, cladding and accessories

- (a) The insulating material and cladding material shall be as per the tables of material given in the subsequent clauses.
- (b) All insulating materials, accessories and protective covering shall be non-sulphurous, incombustible, low chloride content, chemically rot proof, non-hygroscopic and shall be guaranteed to withstand continuous use and without deterioration the maximum temperature to which they will be subjected under the specification conditions.
- (c) The use of insulation of finishing materials containing asbestos in any form is not permitted.
- (d) Insulation mattress/section shall be supplied in thickness of 25,40,50 and 75 mm. insulation of higher thickness shall be made up in multiple layer using mattress/slabs of thickness specified above. However; if the required thickness is not achieved, the mattress/slabs in increment of 5mm shall be acceptable. The min. & the innermost layer shall be thickest.

33.6.30 INSULATION MATERIALS

- (a) Rock/glass insulation mattress shall be of long fibered rock or glass processed into fibrous form bonded with a binder. No kind of slag wool inclusion is acceptable.
- (b) Calcium silicate pipe insulation shall be composed principally of hydrous calcium silicate reinforced with mineral fibre. It should be asbestos free.



- (c) All insulation shall conform to the quality requirements laid down below and test certificates on samples from the lot to be supplied shall be furnished to employer for approval.

33.6.31 OTHER ACCESSORIES

The contractor shall also provide other accessories such as ceramic boards. Sealants and washers as required.

33.6.32 INSTALLATION

- (a) All surface to be installed shall be cleaned of all foreign materials such as dirt, grease, rust etc, and shall be dry before the application of insulation.
- (b) Before applying the insulation the contractor shall check that all instrument tappings, clamps, lugs and other connections on the surface to be insulated have been properly installed as per the relevant erection drawing.
- (c) All flanged joints shall be insulated only after the final tightening and testing.
- (d) The insulation shall be applied to all surfaces when they are at ambient temp. ample provision shall be made for the maximum possible thermal movement and the insulation shall be applied so as to avoid breaking/ telescoping due to alternate periods of expansion and contraction
- (e) All cracks voids and depressions shall be filled with finishing cement suitable for the equipment operating temp. so as to form a smooth base for the application of cladding.

33.6.33 INSULATION MATERIALS

	Type#1	Type#2	Type#3	Type#4	Type#5	Type#6
Type	Lightly resin bonded mineral (rock) wool	Lightly resin bonded mineral (rock) wool	Bonded glass wool	Resin bonded mineral (rock) wool performed pipe section	Resin bonded glass mineral wool performed pipe section	Calcium silicate performed block type
Apparent density	120-150 Kg/m ³	100 Kg/m ³	64Kg/m ³	140-150Kg/m ³	60-80 Kg/m ³	20-25 Kg/m ³
Mtl. standards	IS: 8183	IS: 8183	IS: 8183	IS: 9842	IS: 9842	IS: 8154
Applicable service	Piping system & equipment with operating temp. above 400°C	Piping system & equipment with operating temp. in range of 60- 400°C	Piping system & equipment with operating temp. in range of 60- 400°C	Piping system of 350 NB and below with operating temp. in range of 60- 650°C	Piping system of 350 NB and below with operating temp. in range of 60- 400°C	Piping system & equipment with operating temp. in range of 400- 600°C

Testing requirement	As per IS:8183	8183	8183	8183	IS:9842	IS:8154

33.6.34 **CLADDING MATERIAL & ACCESSORIES SHALL BE AS SPECIFIED HERE UNDER:**

Sl. No.	Item	Basic specification	Description
1.	cladding	Aluminium ASTM B-209-1060 temper H14 or IS:737 Gr.19000/H2	Thickness of sheathing (a) 18SWG (1.219) for diameter for insulated surface 450mm and above and for flat surfaces. (b) 20 SWG (0.91mm) for diameter of insulated surface 150mm and above upto 450mm. (c) 22 SWG (0.71mm) for diameter of insulated surface 150mm and below.
2.	Binding & lacing wire	Galvanized steel wire to IS: 280 for temp. below 400°C and stainless to IS:6528 for temp above 400°C	20 SAWG for all insulation interface temperature.
3.	Straps & brands	(i) Aluminium where interface temperature are below 400°C (ii) Stainless steel where temperature are above 400°C	Band shall be 20 mm wide & 0.6 mm for securing aluminium sheathing anodized aluminium bends shall be used.
4.	screws	Stainless steel	Self tapping, chese headed
5.	Hexagonal wire mesh	(i) Galvanized wire to IS :280 mesh for interface temperature upto 400°C (ii) Stainless steel wire for temperature above 400°C	Wire mesh netting shall be 10 to 13mm aperture at least 0.56 mm diameter wire

33.6.35 **INSTALLATION ON PIPING**

- All vertical pipes shall be provided with the suitable insulation supports to prevent collapsing/ crushing of insulation due to its self weight. Support rings shall be provided on all vertical piping with a difference in elevation of 4 meter or above, and there shall not be more than 3 meter straight length between support ring.
- Longitudinal joints of insulation mattresses section of horizontal piping shall be on the bottom or at the sides of the pipe.
- When more than one layer of insulation mattress/section is required on piping the circumferential joints on adjacent layer shall be staggered by atleast 150mm and longitudinal joints shall be fitted on pipe using binding wires.



- (d) The mattress type insulation shall be formed to fit the pipe and applied with the mattress edges drawn together at the longitudinal joints and secured by lacing wire pipe section insulation shall be fitted on pipe using binding wires.
- (e) The mattress type insulation is applied in two or more layers each layer of mattress shall be backed with hexagonal wire mesh. For the first layer of insulation and in case of single layer insulation, hexagonal wire mesh shall be provided on both the surface of the mattress. For pipe sections, the sections shall be held in place by binding wires without any wire mesh.
- (f) The ends of all wire loops shall be firmly twisted together with pliers, bent over and carefully pressed into the surface of insulation. Any gap in the insulation shall be filled with loose mineral wool or finishing cement.
- (g) Insulation mattress/section ends shall be terminated at a sufficient distance from the flanges to facilitate removal of bolts.
- (h) The insulation shall be held in place by fastening over with binding wire for insulation surface with diameter upto and including 550mm and with metal bends for insulation surfaces with diameter over 550mm. the fastening shall be done at intervals of 250mm except where specified otherwise. The ends of the binding wire shall be hooked and embedded in the insulation the straps shall be mechanically starched and fastened with metallic clamping seals of the same materials as the strap.
- (i) Insulation for the application on bends and elbows shall be cut into mitred segments, sufficiently short to form a reasonably smooth internal surface. after the application of insulation material in place, insulating cement shall be applied as required to obtain a smooth surface.
- (j) Weather hoods shall be provided for insulated piping passing through floors/walls.
- (k) All pipe attachments coming on horizontal pipes, included pipes and bends shall be insulated along with pipe such that there will be no insulation applied to hanger rod and the component connecting hanger rod to pipe attachment. All pipe attachments exposed to weather shall be provided with weather proof.
- (l) Upstream of all drain lines and the lines connected to steam traps, shall be insulated upto and including first isolating valve for heat conservation. Rest of such lines such as downstream of the drain valves, traps etc. and other lines such as safety valve discharges, vents, etc. shall be insulated for personal protection.

33.6.36

INSTALLATION ON VALVES AND FITTINGS

- (a) All valves fittings and specialties shall be insulated with the same type and thickness of insulation as specified for the connected piping with the special provision and or exceptions as given below.
- (b) All valves and flanges shall be provided with removable box type of insulation covered with box fabricated from aluminum sheets of thickness same as the connected pipe cladding. Adjoining pipe insulation shall be believed back to permit removal bolts and nuts or bends. The portion of the valve which can not be covered by box type insulation shall be filled by loose insulating material of packing density at least equal to that of the insulating material of adjoining pipe. The insulation for valve/flanges shall be applied after the finishing has been applied over the connected piping. The cladding shall be applied in such a



manner that the bonnet flange can be exposed easily without disturbing the complete insulation and cladding.

- (c) Expansion joints, metallic or rubber shall not be insulated unless otherwise specifically indicated.

33.6.37

INSULATION ON EQUIPMENT

a	The insulation applied to the equipment shall be reinforced with hexagonal wire mesh. One layer of wire mesh shall be provided on the equipment surface prior to application of insulation.
b	Installation on horizontal cylindrical vessel/tanks (including heaters, deaerator, heat exchanger etc.)
c	All the surface of insulation layer, applied on horizontal cylindrical vessel shall be securely fastened by bands upto vessel/tanks outer diameter of 1500mm and below. Where vessel/tank outer diameter exceeds 1500mm, binding wire passing through insulation clip provided both longitudinally and circumferentially at 500 centers shall be used. Gaps in the insulation shall be filled with insulation mineral wool and finished with finishing cement so as to obtain a smooth surface for the application of cladding. The contractor shall provide a support ribs/lugs on the surface of the vessel/tank as necessary. The contractor shall obtain the approval of the employer and the equipment supplier's field engineering representative before performing any welding on equipment. Any heat treatment equipment as per recommendation of equipment supplier shall be performed by the contractor.
d	Installation on vertical cylindrical vessel/tanks (including flash tanks etc.)
e	All vertical vessels/tanks shall be provided with support rings/ribs with other necessary frame work to take up the weight of the insulation prior to HT. the contractor shall obtain the approval of the employer and the equipment supplier's field engineering representative before performing any welding on equipment. Any heat treatment of vessel/equipment that is required after welding of rings/ribs on the vessel/equipment shall be as per recommendation of equipment supplier and shall be as per recommendation of equipment supplier and shall be performed by the contractor.
f	The mattresses shall be held in position by means of 9 SWG steel wire nails, the nails being 25 mm longer than the thickness of insulation to be applied. After the mattresses have been placed over the nails, the nails shall be bent and embedded in the insulation. Alternative, wire loops may be tack welded at 250mm centers to hold the insulation in place.

33.6.38

INSTALLATION OF CLADDING

- (a) All insulation shall be protected by means of an outer covering of aluminium sheathing. All insulation/cladding joints shall be sealed and made effectively weather and waterproof. All flat surfaces shall be given suitable slope to prevent collection of pools of water on the cladding surface. All sheathing shall be protected internally by the application of two coats of bitumenastic paint.
- (b) All longitudinal joints shall have a minimum overlap of 50mm and shall be located at 45° or more below the horizontal for horizontal equipment joints shall be made with cheese headed self tapping galvanized steel screws at 150mm centers.



- (c) All circumferential joints shall have a minimum overlap of 100mm and shall be held in position by stainless steel or anodized aluminium bands, stretched and clamped.
- (d) Removable box type cladding for valves and flanges shall be fitted on the connected pipe cladding, with bands.
- (e) Aluminium cladding shall not come directly into contact with either the equipment surface or with the supporting arrangement on the equipment surface. to this end, adequate layers of 3 mm thick ceramic board shall be provided between the cladding and any supporting arrangement equipment surface, and fitted with self tapping screws/metal bands, as applicable.
- (f) For bends, fittings etc. the cladding shall be provided in segments as to ensure a smooth finish of the cladding.
- (g) For cladding on vertical pipes/equipment, provision for load take up shall be made at every 2 to 4 meters along pipe/equipment axis.
- (h) All joints shall be sealed with acrylic emulsion weather barrier.
- (i) Galvanic corrosion shall be prevented by carefully avoiding permanent contact of aluminium cladding with copper, copper alloys, tin, lead, nickel or nickel alloys including monal metal.

33.6.39

TESTING AND GUARANTEE

- (a) All tests, as per the applicable material standards and as specified shall be carried out in accordance with the methods prescribed. Employer shall have the right to witness any or all of the tests conducted by the contractor at the shop or laboratory.
- (b) The contractor shall guarantee that if on actual measurement the specified maximum insulation surface temperatures are exceeded, the contractor shall either replace the insulation with a superior material or provide additional insulation thickness at no extra cost.

33.6.40

SPECIFICATION FOR HYDROSTATIC TEST OF PIPING SYSTEM

33.6.40.1

on completion of insulation/erection of the piping systems a hydraulic test in accordance with the requirements of the Indian boiler regulations, shall be performed by the contractor, the procedure adopted for hydraulic test shall have the prior approval of the employer, the detailed schemes and procedure for carrying out hydraulic testing shall be prepared and furnished by the contractor and it shall be discusses and finalized during detailed engineering stage.

33.6.40.2

Cutting /welding/edge preparation and re-welding required for blanking, temporary piping connection and /or for replacements by spool pieces including reinstallation of components after hydraulic testing shall be the responsibility of contractor.

33.6.40.3

The water for the hydraulic test shall be made alkaline by addition of suitable chemicals. After the test, the steam generator and high pressure external piping shall be suitably drained and preserved.

33.6.40.4

all the valves, high pressure piping and interconnected pipes connecting the pressure parts, shall be subjected to hydraulic test along with the pressure parts, all blank flanges, removable plugs, temporary valves, piping and fittings, spools other



accessories and services required for carrying out hydraulic testing of piping shall be furnished by the contractor, the the pressurization equipment including water piping from the supply, needed for the above test shall also be furnished b the contractor, any defect noticed during the testing shall be rectified and the unit shall be retested by the contractor.

33.6.40.5 The hydraulic test shall be considered successful only on certification to that effect by the concerned inspecting authority as per the provision of the IBR and the project manager.

33.6.41 **SPECIFICATION FOR CHEMICAL CLEANING OF PIPING SYSTEM AND EQUIPMENTS**

33.6.41.1 It is indented to chemically clean the following piping system

- (a) boiler feed piping
- (b) heater drains piping
- (c) main condensate piping
- (d) extraction steam piping
- (e) The following equipment which form a part of the above system shall also be included in the cleaning operation.
 - i. H.P. heater
 - ii. L.P. heater
 - iii. Deaerator
 - iv. Gland steam cooler
 - v. Drain cooler

33.6.41.2 Before including chemicals, all the piping system and equipment listed above shall be water flushed, water flushing will be followed by alkaline cleaning acid cleaning and passivation.

33.6.41.3 How ever the bidder shall submit along with the offer his usual procedure and practices for chemical cleaning of the piping and equipment specified. The bidder shall submit all schematics, write-up, details of chemical to be used etc. and detailed procedures he intends to follow, these schematics and procedures shall be subjected to the approval of the employer.

33.6.42 **PRE-CLEANING PROCEDURE**

Prior to starting any phase of cleaning operation the following procedure shall be ensured.

- (a) Installation of all temporary piping valves, pumps and equipments as required for the flushing and chemical cleaning operations.
- (b) Temporary piping shall be routed at floor level as far as possible and secured in place to prevent movement /vibration beyond applicable limits.
- (c) Installation of the instruments as required to ensure satisfactory monitoring and control of the cleaning process. The contractor shall also determine and arrange location for sampling of the cleaning solution during cleaning.



- (d) Bypassing all regulation/control valves coming in the cleaning circuit or installation of temporary spool pieces.
- (e) Installation of special end covers and temporary suction strainers, for boiler feed pumps and condensate pumps. Pump internals shall not be installed.
- (f) Installation of the plastic seal in the condenser neck to protect the turbine from alkaline fumes.
- (g) Blocking and securing of all spring hangers in the steam lines which may be flooded during the cleaning operation.
- (h) Hand cleaning of the interiors of all vessels which are included in the cleaning operation.

33.6.43

GENERAL CLEANING PROCEDURE

- (a) Seal water lines to pump shall be broken and flushed.
- (b) Where pipe lines terminate in spray headers, these headers shall be inspected after each phase of the cleaning operation and cleaned if necessary.
- (c) All strainers shall be observed closely during the cleaning operation by reading differential pressure gauges, and shall be cleaned when the differential pressure exceeds a predetermined value.
- (d) All high points, vents shall be opened periodically to ensure full system flow.
- (e) Upon completion of each stage of cleaning, the waste products shall be drained and transferred to the waste treatment basins, the contractor shall then supply and add the necessary chemicals to the basin to neutralize all waste solutions and rinses generated by the cleaning process, and arrange for its disposal to an area to be indicated by the employer/engineer.
- (f) Strictest safety precautions shall be exercised at all times during the chemical cleaning and during storage and handling of the chemicals, the contractor shall ensure provision of all protective clothing, apparatus and equipment along with necessary first aid kits as required for handling the chemical and for carrying out the cleaning operation.

33.6.44

SPECIFICATION FOR FLASH TANKS

33.6.44.1

The flash tanks and accessories shall be designed, manufactured and tested in accordance with ASME boiler and pressure vessels (B&PV) codes (latest) and other applicable ANSI standards referenced in the above codes.

33.6.44.2

NUMBER AND SIZING

Flash tank shall be provided into which all recoverable drains from turbine casing extraction lines, valves, strainers, main steam, CRH and HRH line drains, cascaded drains from heaters etc. shall be led. Number of flash tanks shall be as per tender drg. Requirement/details of various flash tanks are given below.



- (a) High pressure HP flash tank for accommodating high pressure (above and including hot reheat design pressure) steam drain and HP heater emergency drains, as included in the tender drawing.
- (b) Low pressure LP flash tank for accommodating low pressure (below hot reheat design pressure) steam drain and LP heater emergency drains, as included in the tender drawing.
- (c) Atmospheric flash tank to accommodate alternate drains of steam lines, feed water safety valve discharge and aux. steam line drains, as indicated in the tender drawing.

33.6.44.3 CONSTRUCTIONAL FEATURES

- (a) Flash tanks shall be vertical cylindrical design and of welded construction with torispherical or hemi spherical heads.
- (b) Drains/hot water inlet nozzles shall be tangential to the vessel periphery. Suitable vortex breaker arrangement shall be made at the liquid outlet to the vessel. In the contractor finds better alternative arrangement, the same can be submitted for the employer acceptance & approval.
- (c) The drain & the vent of the flash tanks shall be adequately sized and lead to the condenser. There shall not be any valve on the drain and vent lines. Loop seal shall be provided on the drain if required.
- (d) A man hole shall be provided on the flash tanks for inspection purpose, it shall be diameter of 500mm minimum. The man hole shall be of davit type and shall be provided with grip.
- (e) The flash tanks shall be located on the ground/mezzanine floor of the power house. Necessary structural supports including anchor bolts shall be provided. Three (3) support lags at 120 degree spacing shall be provided on each flash tank. Necessary lugs for handling by the TG hall EOT crane shall be provided.
- (f) The flash tanks shall be provided with a full length level including gauge glass complete with protective rods. Isolation valves and drains. Temperature indicator and temperature switches shall be provided on the flash tanks.
- (g) The flash tanks shall be provided with access ladders. If required for the access to the instruments, valves, main holes etc.

33.6.45 SCHEDULE OF MATERIAL

Shell and head	ASTM A 285 Gr.C
Wear plate/baffle	ASTM A 285 Gr.C
Nozzle neck	ASTM A 106 Gr.B
Manhole nozzle flange and cover	ASTM A 285 Gr.C
Couplings	ASTM A 105
Bolts and studs	ASTM A 193 Gr.B7
Nuts	ASTM A 194 Gr.2 H
Gaskets	spiral wound SS 316 with graphite

However the material as per ASTM A 516 Gr. B shall be acceptable subject to the relevant codes / standards permitting so for the design parameters of various flash tanks.



33.6.46 SPECIFICATION FOR METALLIC EXPANSION JOINTS

33.6.46.1 The expansion joint shall be metallic multi-bellows construction shall be used to reduce the reactions (force and moments) at the connected equipment terminals due to thermal expansion / contraction and/or vibration of connected equipment and piping.

33.6.46.2 the design material, construction, manufacture, inspection testing and performance of the expansion joints shall comply with the currently applicable requirement of EJMA, boiler and pressure vessel code section III, ANSI B-31.1 and all statutes, regulations and safety codes.

33.6.47 CONSTRUCTION DETAILS**(a) Bellows**

- i. The bellow shall be hydraulically or roll formed from perfect cylinders of single ply, 304 grade stainless steel.
- ii. The number of longitudinal weld seams shall be minimum and there shall be no circumferential weld seam.
- iii. Cold formed stainless steel bellows shall not be heat treated.
- iv. All bellow elements shall be pickled after forming.
- v. Equalizing rings, where required, shall be either from high quality casting or from fabrication metal.
- vi. Flanged expansion joints shall be provided with adequate pipe stubs.
- vii. Butt welded expansion joints shall have adequate length of pipe so that site welding does not impair or reduce the joints efficiency.

(b) sleeves

- i. Expansion joints will be furnished with internal sleeves of the same material as the bellows and installed with sufficient clearance to allow full rated deflection. The sleeves shall be welded on the flow inlet end of the joint only.
- ii. Bellow shall have external sleeves with an arrow indicating the direction of flow on the outside. The external steel covers provided to protect bellows from physical damages, shall be suitable for supporting insulation where necessary and shall be detachable.

(c) Tie bars

- i. Joints shall be shipped at neutral length. They shall be provided with suitable erection and knock-off type temporary tie bars to prevent damage and misalignment during transit and also with permanent tie bars along with necessary nuts, bolts, etc.
- ii. The rod on pressure balanced type expansion joints shall be adequately sized to prevent buckling in vacuum services or services either other external loads.



33.6.48 TYPE TEST OF METALLIC EXPANSION JOINT

Following tests (type tests) shall be carried out for metallic expansion joints as per the procedures given in EJMA.

- (a) Life cycle test
- (b) Meridonal yields-rupture testing
- (c) Squirm testing

33.6.49 for the purpose of carrying out type tests: metallic bellows shall be grouped based on the parameters as give below. The bellows conforming to the same combination of these parameters shall constitute one group. Type test shall be carried out on one or specific above.

- i. Material of bellow: based on material of bellow, bellow shall be categorized in to three category namely carbon steel, stainless steel (Eg. SS304,316,321 etc.) & high alloy steel (Eg. inconal).
- ii. Profile of convolutions: each profile shall be considered as separate category (e.g. U profile, V profile & Lyra profile etc.)
- iii. Dimension of bellows: based on the size, the categories shall be as under:
 - Nominal diameter of metallic expansion joint up to and including 800mm NB.
 - Nominal diameter of metallic expansion joint greater than 800mm NB up to and including 1600mm NB.
 - Each size above 1600mm NB shall be a separate category.
- iv. Design pressure: based on the design pressure, bellows shall be categorized as under:
 - Deign pressure from full vacuum up to 5Kg/sq.cm(g).
 - Design pressure above 5Kg/sq.cm(g) and up to 10Kg/sq.cm(g) with or without vacuum.

33.6.50 NUMBER OF CYCLES

For the life cycle test, the number of test cycles shall be minimum 10,000 cycles.

Other tests for the metallic expansion joint shall be carried out as per the approval QP/QA section. Further, other terms and conditions for type test shall be as specified elsewhere in the specification.

33.6.51 SPECIFICATION FOR SURFACE PREPARATION & PAINTING

33.6.51.1 Surface preparation methods and paint/ primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified specific approval shall be obtained by the contractor in writing from the employer for using substitute material.

33.6.52.2 All paints shall be delivered to job site in manufactures sealed containers, each container shall be labeled by the manufacture with the manufacture's name type of paint , batch no. and color.

33.6.52.3 unless specified otherwise paint shall not be applied to surface of insulation, surface of stainless /nickel/copper/brass/monal/aluminum/hastelloy/lead/galvanized steel items, valve stem, pump rod, shaft gauges, bearing and contact surface, lined or clad surfaces.

33.6.52.4 All pipelines shall be colour coded for identification as per the colour-coding scheme indicated in Volume II and which will be furnished to the contractor during detailed engineering.

33.6.53 SURFACE PREPARTION

33.6.53.1 All surfaces to be paints shall be thoroughly cleaned of oil, grease and other foreign matter, surfaces shall be free of moisture and contamination from chemicals and solvents.

33.6.53.2 the following surfaces scheme are envisaged here, depending upon requirement any one or a combination of these may be used for surface preparation before application of primer.

SP1	solvent cleaning
SP2	application of rust converter (Ruskil or equivalent grade)
SP3	power tool cleaning
SP4	shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer)
SP4*	shot blast cloning /abrasive blast cleaning to SA 21/2 (near white metal) 35-50 microns
SP5	phosphating
SP6	Emery sheet cleaning/ manual wire brush cleaning.

33.6.54 APPICATION OF PRIMER /PAINT

33.6.54.1 The paint /primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The dry film thickness (DFT) of primer / paint shall be as specification herein.

33.6.54.2 Surface prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surface

33.6.54.3 Where primer coat has been applied in the shop, the primer coat shall be carefully delaminated, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day as the surface is prepared, primer coat shall be applied prior to intermediate and finish coats.

33.6.54.4 Steel surface that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be premed and finish painted before the grating is permanently secured.

- 33.6.54.5 Following are the primer/painting schemes envisaged herein:
- | | | |
|------|---|---|
| PS3 | - | zinc chrome primer (Alkyd base) by brush/Spray to IS104. |
| PS3* | - | zinc chrome primer (Alkyd base) by dip coat. |
| PS4 | - | synthetic Enamel (long oil alkyd) to IS2932. |
| PS5 | - | red oxide zinc phosphate to IS-12744. |
| PS9 | - | aluminum paint to IS 2339. |
| PS9* | - | heat resistant aluminium paint to IS-13183 Gr.-I (for temperature 400 °C – 600 °C) , IS -13183 Gr.-II (for temperature 200°C -400°C) and IS-13183 Gr.-III (for temperature up to 200°C) |
| PS13 | - | rust preventive fluid by spray, dip or brush. |
| PS14 | - | weldable primer-Deoxaluminate or equivalent. |
| PS16 | - | high build Epoxy CDC mastic `15'. |
| PS17 | - | aliphatic acrylic polyurethane CDE134, %V=40.0 (min.) |
| PS18 | - | Epoxy based TiO2 pigmented coat. |
| PS19 | - | Epoxy based zinc phosphate primer (92% zinc in dry film (min.)%VS=35.0 (min.) |
| PS20 | - | Epoxy based finish paint. |
- 33.6.54.6 All weld edge preparation for site welding shall be applied with one coat of weldable.
- 33.6.54.7 For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.

33.6.55 Primer/painting schedule

Sl. No	Description		Surface preparation	Primer coat			Intermediate coat			Finish coat			Total min. (microns)	Colour shade
				System	Coat	Min. DFT/coat (microns)								
1	All insulated piping's. Fittings/ componentes, pipe clamps, vessels/tanks, equipments etc.		SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	as per NTPC colour shade/ coding scheme
2	All insulated piping's. Fittings/ componentes, pipe clamps, vessels/tanks, equipments etc.	Design temperature <60 ⁰ C	SP3/SP4	PS 5	2	25	-	-	-	PS4	3\$	35\$	155\$	
		Design temperature 60 ⁰ C-200 ⁰ C	SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
		Design temperature >200 ⁰ C	SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
3	Constant load hanger (CLH). Variable load hanger (VLH) and other supports		SP4*	PS 19	1	40	-	-	-	PS17	1	30	70	
4	Valves													
	Cast/forged	Design temperature <95 ⁰ C	SP1/SP2/S P3	PS 9	1	20	-	-	-	PS9	1	20	40	
		Design temperature 95 ⁰ C-200 ⁰ C	SP1/SP2/S P3	PS 9*	1	20	-	-	-	PS9*	1	20	40	
		Design temperature >200 ⁰ C	SP1/SP2/S P3	PS 9*	1	20	-	-	-	PS9*	1	20	40	



2 x 660 MW Ennore SEZ Supercritical Thermal Power Project at
Ash Dyke of NCTPS

Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14

Vol. III : 862



Sl. No	Description		Surface preparation	Primer Coat			Intermediate coat			Finish coat			Total min. (microns)	Colour shade
				System	Coat									
5	All structural steel componants	outside TG building and in SG envelope	SP4*	Inorganic Ethyle Zinc Silicate	1	75	PS18	1	75	a)) epoxy coat b)) final coat of paint PS1	2	25	250	
											1	30		
		Within TG building	SP4*	---do---	1	35	PS18	1	35	a)) epoxy coat b)) final coat of paint PS1	2	25	150	
											1	30		
6	Weld edges		SP6(hand cleaning by wire brushing)	PS13 (wieldable primer)	1	25	-	-	-	-	-	-	-	
§ The first 2 finished coats (total min. DFT of 70 microns) shall be done at shop and the 3 rd finish coat (min. DFT 35 microns) shall be applied at site.														



2 x 660 MW Ennore SEZ Supercritical Thermal Power Project at
Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14
Vol. III : 863



33.6.56 Testing requirements:

The detailed testing requirements for power cycle piping and its components are given in the subsection for quality Assurance (QA). The requirements pertaining to testing given in this subsection if in variance with that given in QA subsection, then the more stringent of the two shall be followed.



2 x 660 MW Ennore SEZ Supercritical Thermal Power Project at
Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14
Vol. III : 864



ANNEXURE – 1**LIST OF POWER CYCLE PIPING**

The following list of power cycle piping is an indicative one and is provided for the guidance of the Bidder only. Items not mentioned but deemed necessary for making the system complete shall also be included.

SR. NO.	NAME		DESCRIPTION
1.0	Main Steam lines	:	From SH outlet to inlet of turbine
2.0	Main Steam Equalising line	:	Between RHS and LHS Main Steam lines
3.0	HP By-pass line	:	Between Main Steam line and CRH line
4.0	Cold Reheat line	:	Between HP turbine outlet and Reheater
5.0	Extraction line from CRH	:	Between CRH and Deaerator
6.0	Extraction line from CRH	:	Between CRH and H.P. heater
7.0	Extraction line from MS equalising line	:	From MS equalising line to auxiliary steam header
8.0	Steam supply to BFP Turbine	:	From the main and alternative source point to BFP Turbine Inlet
9.0	Extraction from BFP discharge	:	1. Between BFP discharge and H.P. By-pass 2. Between BFP discharge and PRDS
10.0	Warm up line for HP By-pass	:	Between MS line and H.P. By-pass line
11.0	Hot Reheat lines	:	Between Reheater and I.P. turbine
12.0	HRH equalising line	:	Between LHS and RHS Hot Reheat lines
13.0	LP By-pass line	:	Between HR line and condenser
14.0	Warm up line for LP By-pass	:	Between LP By-pass line and HR line
15.0	CEP Suction line	:	Between condenser hot well and CEP.
16.0	Main condensate line	:	Between CEP outlet and Deaerator through GSC, CPU, Drain Cooler, L.P. heaters.



SR. NO.	NAME		DESCRIPTION
17.0	CEP Minimum Recirculation line	:	Between main condensate line after CEP to condenser.
18.0	GSC Minimum Recirculation line	:	Between main condensate line after GSC to condenser.
19.0	Deaerator filling line	:	Between Condensate Transfer pump discharge and deaerator
20.0	Boiler filling line	:	Between Condensate Transfer pump discharge and Boiler bottom ring header /economiser inlet.
21.0	Fill up and Emergency	:	From Condensate Transfer pump discharge to make-up to condenser.
22.0	DMCW make-up tank	:	From Cycle make-up pump discharge to DMCW make-up tank.
23.0	Gravity Make-up to condenser	:	From condensate storage tank to condenser.
24.0	Condensate Dump Line	:	Between M.C. line after GSC and condensate storage tank.
25.0	Cycle make-up Pump Recirculation	:	Between Cycle make-up pump discharge header and Condensate Storage Tank.
26.0	Cycle make-up Pump Suction Line	:	From condensate storage tanks to Cycle make-up pump suction header.
27.0	By-pass line	:	For all control valves
28.0	By-pass lines for heaters (group bypass/individual bypass)	:	GSC, LP Heaters and HP Heaters.
29.0	CEP sealing line	:	Bidder's choice.
30.0	All extractions from main condensate line	:	For
			(a) Exhaust Hood spray
			(b) Turbine Flash Tank spray
			(c) L.P. By-pass spray



SR. NO.	NAME		DESCRIPTION
			(d) Water sealing of valves
			(e) Vacuum breaker line sealing
			(f) CEP sealing
			(g) Analytical measurements
			(h) Alkali flushing
			(i) Spray water to GSC desuperheater
			(j) Sampling
			(k) Instrument seal pot
			(l) Water sealing of valves & water washing of BFP Turbine
			(m) Spares
31.0	Turbine flash tank drain and vent line	:	From turbine Flash Tank drains to condenser hot well From flash vessels vent to condenser steam space
32.0	BFP Suction lines	:	Between Deaerator and individual BFP suction
33.0	Main Feed Water Line	:	From BFP discharge through HP heaters, control station up to economiser inlet header
34.0	Steam turbine drive for BFP	:	Associated piping
35.0	Inlet line to attemperation water header	:	From main feed water line to attemperation water header
36.0	Extraction from BFP	:	From BFP suction to sample cooler suction, BFP warm-up & Balance Leak-off line.
37.0	All extraction from Main Feed Water line	:	(a) To Auxiliary Steam pressure reducing de-superheating station



SR. NO.	NAME		DESCRIPTION
			(b) Stub for alkali flushing
			(c) HP By-pass spray
			(d) Blind Stub
			(e) Minimum re-circulation lines
38.0	Extraction lines	:	From various stage of turbine/CRH to L.P. Heaters, H.P. heaters, Deaerator and BFP Turbines.
39.0	All vents of H.P and L.P. heaters	:	(a) L.P. Heater vents to Condenser
			(b) H.P. Heater vents to Condenser
40.0	All cascade drain connection between heaters		(a) From each HP Heater to next lower pressure HP Heater
			(b) From the lowest pressure H.P. heater to Dearator
			(c) From each L.P. Heater to next lower pressure L.P. heater
			(d) From lowest pressure L.P. heater to flash vessel through drain cooler.
41.0	All Drip connections to Flash Tanks	:	(a) From H.P. Heaters
			(b) From L.P. Heaters (except the lowest pressure L.P. heater)
			(c) From Gland Steam condenser
42.0	Air Steam mixture line from Turbine Glands	:	(a) To GSC
			(b) To Atmosphere
43.0	Vapour extraction line for GSC	:	From GSC through vapour extractors to atmosphere
44.0	By pass Line to GSC	:	Through desuperheater to atmosphere



SR. NO.	NAME		DESCRIPTION
45.0	Air steam mixture line from condenser	:	To vacuum pumps
46.0	Drip connections to Deaerator	:	From H.P. Heaters
47.0	Connections for air outlet from vacuum pump	:	From vacuum pumps to atmosphere
48.0	Steam connection to Auxiliary steam header	:	From final superheater outlet
49.0	High Temperature Auxiliary Steam Header	:	One with interconnection
50.0	Auxiliary Steam from High Temperature Header	:	(a) To Gland Sealing unit
			(b) For mill inerting (if required)
			(c) For soot blowing
51.0	Low Temperature Auxiliary Steam Header	:	One with interconnection
52.0	Auxiliary Steam from Low Temperature Header	:	(a) For Deaerator pegging
			(b) For atomizing
			(c) For F.O. Heating
53.0	Extraction line from CRH line	:	From CRH line to auxiliary steam header



CHAPTER 13

13.0 LP PIPING, VALVES & SPECIALITIES**13.1 Equipment sizing Criteria**

- 13.1.1 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.
- 13.1.2 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.
- 13.1.3 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.

a) Water Application

		Water Velocity in m/sec		
	Pipe Size	Below 50 mm	50-150 mm	200 mm & above
a)	Pump suction	-----	1.2-1.5	1.2-1.8
b)	Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5
c)	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.

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

i)	Carbon steel pipe	100
ii)	CI Pipe/Ductile Iron	100
iii)	Rubber lined steel pipe	120
iv)	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.

b) Compressed Air Application

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

- 13.1.4 The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.
- 13.1.5 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.
- 13.1.6 Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered.
- 13.1.7 Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.
- 13.1.8 High points in piping system shall be provided with vents alongwith valves as per the system requirement. Low points shall be provided with drains alongwith 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.
- 13.1.9 Material of construction for pipes carrying various fluids shall be as specified elsewhere.
- 13.1.10 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.
- 13.1.11 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.
- 13.1.12 Threaded joints shall be provided with Teflon sealant tapes.
- 13.1.13 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.

- 13.1.14 Recirculation pipes alongwith 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.

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

13.2.00 TECHNICAL SPECIFICATION

13.1.00 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.

13.2.00 Pipes and fittings

13.2.1 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.

13.2.2 Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.

13.2.3 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 contractor 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.

13.2.4 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).

13.2.5 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.

13.2.6 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.

13.2.7 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.



- 13.2.8 For rubber lined ERW pipes, beads shall be removed.
- 13.2.9 Inspection holes shall be provided at suitable locations for pipes 800 NB and above as required for periodic observations and inspection purposes.
- 13.2.10 At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.
- 13.2.11 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.

13.3.00 Material

- 13.3.1 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.
- 13.3.2 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.
- 13.3.4 All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockiest are not acceptable.
- 13.3.5 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.
- 13.3.6 Material of construction for pipes carrying various fluids shall be as follows:

1.	Circulating Water (CW) – CW Pumphouse to Condenser & Condenser to Cooling Tower	RCC DUCT WITH INSIDE PROTECTIVE COATING AS INDICATED IN VOLUME VI
2.	Circulating Water (CW) – Pump Discharge, condenser risers including header near condenser and cooling tower riser.	IS 3589 FABRICATED FROM IS 2062 PLATES –INTERNALLY LINED WITH CORROCOAT OR POLYUREA COATING OF 1500 MICRONS DFT /GRP/ FRP
3.	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
4.	RO Stage I reject, RO Stage II	UPTO 150 NB - ASTM A 312 TP 316



	Reject, Guard pond inlet & discharge, Piping from Reject sump,. Ash water piping using sea water and all other sea water applications.	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/ GRP/ FRP
5.	Sea Water Intake Pipe, CT Make up, Make up upto clarifier & CT Blowdown Pipe	GRP
6.	RO Stage I Permeate, Filtered Water, service water, AHP Seal Water, HVAC Make up, Air Pre-Heater Wash water, Passivated DM Water and clarifier sludge.	IS-2062 Gr. B/ASTM-A-36/ASTM A-53 type 'E' Gr. B/IS-3589 Gr. 410/IS-1239 Heavy. 150 NB & above pipes shall be spiral welded.
7.	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
8.	Drinking water	ASTM A-53 type E Gr. B galvanized /IS 1239 heavy galvanized/IS 3589 Gr 410 Galvanized to SI-4736 or equivalent.
9.	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.
10.	Fuel Oil piping	API5L
11.	HOSES FOR HFO TANKER HEATING (STEAM/ CONDENSATE)	CARBON STEEL – ELECTRO ZINC PLATED
12.	FUEL OIL UNLOADING LINES	IS1239 / IS1978 / API5L Gr.B (ERW) / IS3589 FABRICATED FROM IS 2062 PLATES
13.	FUEL OIL PUMP DISCHARGE LINES	ASTM A 106 GR B
14.	UF Feed/ Chemical Backwash (Upto 150 NB) (Pipes & Fittings)	CPVC ON 10 Sch 40
15.	UF Feed/ Chemical Backwash (> 150 NB)	GRP
16.	Sodium Hypochlorite (pipes & Fittings)	CPVC Sch 80 ASTM
17.	RO High pressuer Discharge (Pipes & Fittings)	Dupless SS
18.	Cleaning Solution Line (Pipes & Fittings)	CPVC ON 10 Sch 40

13.3.7

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.

- 13.3.9 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).
- 13.3.10 In dematerialized water service, the pipes upto 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 upto 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.
- 13.3.11 Bidder/Contractor 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.
- 13.3.12 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).
- 13.3.13 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.
- 13.3.14 Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.
- 13.3.15 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.

13.4.0 Piping Wall Thickness

- 13.4.1 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.
- 13.4.2 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	4.0	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)	
Min. thickness, mm	5.4	6.35	6.35	6.35	7.1	7.1	7.1	8.0	8.0	

> 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
> NB 2200 mm	-	18.0 mm

13.5.00 Piping Layout

- 13.5.1 Piping shall be grouped together where practicable and routed to present a neat appearance.
- 13.5.2 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 equipments.
- 13.5.3 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.
- 13.5.4 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.
- 13.5.5 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.
- 13.5.6 Adequate clearance shall be ensured with respect to the above to accommodate insulation and pipe movements, if any.
- 13.5.7 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.



13.5.8 Sufficient up stream and down stream lengths shall be provided for flow measuring devices, control valves and other specialties.

13.5.9 All local instruments shall be located on pipelines as to render them observable from the nearest available platforms.

13.5.10 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.

13.6.00 Slope/Drains and Vents

13.6.1 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.

13.6.2 Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.

13.7.0 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.

13.7.1 Screwed

- (a) 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.
- (b) 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, alongwith 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.

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

13.7.2 Welded

- (a) 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.

13.7.3 Flanged

- (a) 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.
- (b) 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.
- (c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.

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



- 13.8.1 Unless otherwise specified elbows shall be of long radius type.
- 13.8.2 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.
- 13.8.3 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 shall be $1\frac{1}{2}$ 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 $22\frac{1}{2}$ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.
- 13.8.4 Mitre bends are not acceptable in case of rubber lined mild steel pipes.
- 13.8.5 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 upto 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.
- 13.8.6 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 upto 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.
- 13.8.7 In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.

13.9.00 Flanges

- 13.9.1 Flanges shall be slip on type. Welding of flanges in tension is not permitted.
- 13.9.2 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.

13.10.00 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.

13.10.1 Trenching

- (a) 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.
- (b) 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.
- (c) 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.
- (d) 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.
- (e) Coating and Wrapping shall be done as under.

13.10.2 Preparation and cleaning of piping

- (a) 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.
- (b) 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.
- (c) 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.

13.10.4 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.

13.10.5 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.

13.11.00 Cleaning and Flushing

13.11.1 All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.

13.11.2 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 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.

13.11.3 After erection, all water lines shall be 1.2-1.5 times the operating velocities in the pipelines.

13.11.4 All compressed air pipe work shall be cleaned by blowing compressed air.

13.12.00 Painting of Pipes

13.12.1 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.

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

13.12.2 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.

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.

13.12.3 Other requirements

- (a) Paint manufacturers instructions shall be followed in method of application, handling, drying time etc.
- (b) The color of the finish paint shall be as per approved color-coding.
- (c) If finish paint was applied in shop, one coat of finish paint shall be applied at site.
- (d) The dry film thickness of paint shall not be less than 0.15 mm.

13.12.4 Color 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.

13.13.00 Specification for hangers and supports

13.13.1 All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.

13.13.2 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.



- 13.13.3 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.
- 13.13.4 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.
- 13.13.5 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.
- 13.13.6 The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.
- 13.13.7 All pipe supports shall be designed to provide an absolute minimum head room of 2.5 m from floor in passages/walkways.
- 13.13.8 At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.
- 13.13.9 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.

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

13.14.1 GENERAL

- (a) All valves shall be suitable for the service conditions i.e. flow, temperature and pressure, at which they are required to operate.
- (b) The valves as well as all accessories shall be designed for easy disassembly and maintenance.
- (c) Valves to be installed outside shall be required to have the stem properly protected against atmospheric corrosion.
- (d) 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.
- (e) 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.
- (f) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined.
- (g) 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.
 - (i) 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.
 - (j) Valves coming under the purview of IBR shall meet IBR requirements.
 - (k) Gate/slucice 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.
 - (l) 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.
 - (m) 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 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.
 - (n) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing.
 - (o) 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.
 - (p) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.



- (q) 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 contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer.
- (r) 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.
- (s) 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.

13.14.2**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 alongwith SS internals.

Condensate: Cast Carbon Steel/Forged Carbon Steel.

13.14.2.1

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.

Standards and Codes

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.



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 valves
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

13.14.2.2 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)

- 13.14.2.3 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).
- 13.14.2.4 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 pre-requisite in case of butt-welded joints.
- 13.14.2.5 All gun metal body valves shall have screwed ends.
- 13.14.2.6 All flanged end valves/specialties shall be furnished alongwith matching counter flanges, fasteners, gaskets etc. as required to complete the joints



13.15.00 Check Valves

13.15.1 Check valves shall comply with the following characteristics:

- (a) 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);
- (b) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position.
- (c) 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.

13.15.2 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.

13.15.3 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.

13.15.4 Counter flanges to be installed on air pipes shall be screwed-on type irrespective of size.

13.16.00 Globe Valves

13.16.1 The globe valves shall have the following characteristics;

Straight conveyed flow

Right angle

Preferably, the valves shall be of the vertical stem type.

13.16.2 Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle.

13.16.3 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.

13.16.4 For the regulating valves, valves with regulating plug & parabolic outline disc type is preferred.

13.16.5 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.

13.17.00 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.

13.18.00 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.

13.19.00 Butterfly Valves

13.19.1 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 nb 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.
 - (1) 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.
 - (2) 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.
 - (3) 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.
 - (4) 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.

- (5) 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.

- (6) The operating mechanism shall be mounted directly on or supported from the valve body.

- (7) 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"

- (8) 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 alongwith suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.

13.19.2 Material of Construction (Butterfly Valves)

Materials and other design details shall be as indicated below:

(a) Cast Iron Butterfly valves

Body & Disc	ASTM A48, Gr. 40 with 2% Ni/ IS: 210. Gr. FG-260, with 2% Ni and epoxy coated
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

(b) 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

(c) 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 Rings	EPT/BUNA-N/Neoprene
Companion Flanges	SS 304
External hardware	SS 316
Internal hardware	SS 316
(d) Carbon Steel Butterfly Valves	
Body & Disc	ASTM A 216, Gr. WCB
Shaft	ASTM A 182, Gr. 304/ASTM-A-479 Gr. 304/Equivalent
Disc & Seat Rings	EPT/BUNA-N/Neoprene
Companion Flanges	IS 2062
External hardware	SS 316
Internal hardware	SS 316

13.19.3 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.

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

(a) The materials shall generally comply with the following:

(1) 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
(2)	Stainless Steel Valves	
	Body & Bonnet	ASTM A 351 Gr. CF 8M/ ASTM A 182 Gr. 304
	Disc	-do-
	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
(3)	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 Hinge pin for non-return valves	BS 1452 Gr. 14/IS-210 Gr FG 260 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
(4)	Gun Metal Valves	
	Body and bonnet	IS 318 Gr. 2/Equivalent Standard
	Trim	-do-
	Companion Flanges	IS 2062
	External hardware	SS 316
	Internal hardware	SS 316
(5)	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 316L
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.

13.21.00 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.

- (c) Valves shall be right-angled or globe pattern.
- (d) Valves shall be balance piston type with float ball.
- (e) Leather liner shall not be provided.
- (f) 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.
- (g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec.
- (h) The valves shall have flanged connections.

13.22.00 PAINTING OF VALVES:

Two (2) coats of primer followed by three (3) coats of epoxy of approved color 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 contractor by repainting with compatible painting primer and enamel to the satisfaction of the project manager.

13.23.00 RUBBER EXPANSION JOINTS

- 13.23.1 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.
- 13.23.2 The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.
- 13.23.3 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.
- 13.23.4 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.
- 13.23.5 Reinforcement, consisting of solid metal rings embedded in carcass shall be provided.
- 13.23.6 Expansion joints shall be complete with stretcher bolt assembly. The expansion joints shall be suitable to absorb piping movements and accommodate mismatch between pipelines.
- 13.23.7 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.
- 13.23.8 The expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.
- 13.23.9 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.
- 13.23.10 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.
- 13.23.11 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.
- 13.23.12 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.



13.23.13 Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.

13.23.14 Bidder to note that any metallic part which comes in contact with DM / Corrosive water shall be of stainless steel material.

13.23.15 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.

13.24.00 STRAINERS

13.24.1 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:

(a)	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)
(b)	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)
(c)	End connection	Screwed upto 50 mm Nb, and flanged above 50 mm Nb

13.24.2 Duplex type

- (a) 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.
- (b) Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows.

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)

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)

End connection Screwed up to 50 mm NB, and Flanged above 50 NB. Gasket shall be of full face type

- (c) 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.
- (d) The size of the strainer and the flow direction will be indicated on the strainer body casting.
- (e) 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.

13.24.3

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.



PROJECT
2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE
OF NCTPS, CHENNAI

SECTION-D
STANDARD TECHNICAL REQUIREMENT



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



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

1.0 SCOPE

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

2.0 CODES & STANDARDS

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

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

3.0 DESIGN REQUIREMENT

3.1 General Requirement



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

- 3.1.1 All tanks will be mild steel tanks. The tanks will be of welded construction and will be designed to withstand satisfactorily the internal forces due to the liquid these tanks have to hold as specified and external forces due to wind and seismic forces without deformation or undue strain. The plates will be cold rolled through plate bending machines by several no. of passes to the curvature.
- 3.1.2 All tanks will be designed for the capacities, dimensions and working conditions as specified in **TANKS DATA SHEET** given under section-C. These tanks will be provided with all necessary connections as specified. The design of tanks will be such as to allow easy inspection, cleaning and repair. Due consideration will be given to wind loading and adequate stiffening will be provided to prevent failure of tank due to buckling when it is empty. A 2.0 mm corrosion allowance until unless specified in **DATASHEET-TANKS** for shells, bottom and roof and beyond the required thickness shall be provided.
- 3.1.3 Vessel seams shall be so positioned that they do not pass through vessel connections.
- 3.1.4 The inside seam should be ground smooth, suitable for application of corrosion resistant primer. Except where otherwise indicated in the specification, if the stiffening of shell and/ or roof is necessary, tanks will be stiffened from outside.
- 3.1.5 Flange faces of all nozzles shall be machined and squared with the vessel center line.
- 3.1.6 All roofs and supporting structures shall be designed to support dead load plus a uniform live load of not less than 150 kg/m² of projected area.
- 3.1.7 The tanks shall be designed to have all courses truly vertical. Adequate distance between vertical joints in adjacent courses shall be taken so that the distortion is reduced to minimum.
- 3.1.8 When removing temporary attachments from shell plates, care should be taken that parent plate is not damaged. Holes in plate work to assist in fabrication / erection should be avoided as far as possible. The location of holes and method of filling shall be indicated in the fabrication drawing. Any projection of metal shall be chipped and ground flush with the plate surface .The plate shall not be gouged or torn in process of removing lugs.
- 3.1.9 In the construction of shell, very care shall be taken to minimize distortion or lack of circularity due to welding or for any other reason.
- 3.1.10 The successful bidder shall furnish design calculations to BHEL during detailed engineering stage for approval along with the Xerox copies of relevant pages of authentic supporting literature e.g. Code, Hand book, National / international Standards etc. Calculation shall be necessarily done in SI UNITS for the followings: -
- The tanks shall be designed as per good engineering practice as applicable and referred code shall be of latest edition.
 - Plate thickness calculation (different courses of shell plate, bottom plate and roof plate thickness), roof curb angle, top wind girder, intermediate wind girder, tank internal pressure vis –a-vis. allowable value.
 - Design of roof and roof structures for vertical storage tanks shall be designed based on guidelines given in the book titled “Process equipment design” by Brownell and Young.



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

- d) Tank stability calculation (wind load / seismic / overturning stability) shall be done as per good engineering practice as applicable and referred code shall be of latest edition. However, factors / coefficients as required for the design of tank shall be obtained from BHEL by the bidder after placement of order.
- e) Vent sizing calculation shall be done as per good engineering practice as applicable and referred code shall be of latest edition.
- f) Sizing calculation for vent, NaOH / KOH breather, seal pot and breather valve.
- g) Weight calculation of plates, appurtenances & structures separately shall be included in the design calculation/GA.
- h) Staircase / access ladder and hand railing shall be provided as per the relevant codes and standards.

3.1.11 **Alignment**

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

3.1.12 **WELDING**

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



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

protection covers , tank vent connection etc all complete with needed accessories for the completeness of the tanks and as specified in data sheet -A .

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

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

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

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

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

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

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

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

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

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

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

3.2 **VERTICAL CYLINDRICAL STORAGE TANKS**



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

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



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

- 3.2.12 The manhole shall be of hinged & bolted type with nuts, bolts and gaskets with minimum size of 600 mm.
- 3.2.13 NaOH / KOH breather and seal pot shall be located in the bottom / ground level and necessary connection from tank vent to NaOH / KOH breather shall be provided through 200 NB SS pipe. The sizing of NaOH breather and Seal pot shall be decided based on emptying and filling rate of tanks. A tentative rate of 5 cum/hr may be considered for both emptying and filling of tank. However, the complete information shall be provided to vendor during detail engineering.
- 3.2.14 Material of construction of all pipes, fittings, valves, nozzles, flanges and counter flanges shall be as per datasheets given at the end of this section.
- 3.2.15 Material of construction for standpipe (if applicable) shall be stainless steel (SS) and size shall not be less than NB 100 unless otherwise specified in Datasheet-A for tanks given at the end of section.
- 3.2.16 Two (2) nos NaOH / KOH breather shall be provided by the bidder for each tank, out of which one shall be used for in-breathing purpose and the other shall be used for out-breathing purpose.
- 3.2.17 The size of the drain and vent valve of standpipes shall be 25 NB and size of the isolating valves (2 nos) for standpipe shall be 50 NB unless otherwise specified in the specification.
- 3.2.18 The overflow pipe from overflow nozzle shall be connected to seal pot.
- 3.2.19 All stair treads and platforms shall be made from gratings
- 3.3.0 RECTANGULAR TANKS**
- 3.3.1 Rectangular tanks shall be fabricated from steel material and shall be designed to withstand internal hydrostatic pressure. In addition these shall be checked for a wind pressure and seismic coefficient as specified wherever applicable. While worst of these two shall be considered, the permissible stress shall be increased as per IS when their effect considered with tank load.
- 3.3.2 Tank bottom and / or side plates shall be of minimum 6 mm thick plate. Corrosion margin of at least 2 mm shall be provided over the design thickness of bottom and / or side plates.
- 3.3.3 To support tank plates and to maintain required unsupported plate length, adequately sized and spaced steel structural closed frame shall be provided inside the tank. Longitudinal and / or vertical structural members to connect and adequately support these frames shall be provided at corners. Horizontal diagonal members / sway bracings at corner shall also be provided.
- 3.3.4 Tank plates cut to size shall be welded on these frames. Plate butt weld joints at other locations shall be eliminated to avoid warping of the plates at free joints. Adequate openings in the structural frames, particularly at the bottom shall be provided to ensure complete unrestricted drainage of tank at one point.
- 3.3.5 Complete assembled tank shall have at its bottom longitudinal steel fabricated bearer beams welded to it. The tank with bearer will rest over number of concrete blocks to be provided by purchaser. The tank shall be adequately bolted / welded to the concrete blocks. Needed inserts / anchor bolts shall be furnished by the bidders. Grouting of tank over concrete blocks in approved manner shall be included in bidder's scope of work, if erection is also awarded to the bidder.



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

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

3.4 **HORIZONTAL CYLINDRICAL TANK**

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

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

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

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

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

4.1 **General**

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

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

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

4.2 **TESTING AND INSPECTION FOR TANKS**

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

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

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



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

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

4.2.2 NON - PRESSURE TANKS

FIELD TESTING

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

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



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

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

4.2.3 REPAIR OF LEAKS

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

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

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

5.0 PAINTING REQUIREMENT

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

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

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

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

6.0 OTHER TECHNICAL REQUIREMENTS

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

2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF
NCTPS, CHENNAI

FUEL OIL UNLOADING & STORAGE SYSTEM

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



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

बी एच ई एल 	TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR FUEL OIL HANDLING SYSTEM 2X660MW ENNORE TPS	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION : C
		REV NO. : 00 DATE :
		SHEET : OF

1.0

EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

a)

Services and equipment as per “Electrical Scope between BHEL and Vendor”.

b)

Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.

c)

Supply of mandatory spares as specified in the specifications of mechanical equipments.

d)

Electrical load requirement for Fuel Oil Handling System.

e)

All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

f)

Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL

g)

Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.

h)

Motor shall meet minimum requirement of motor specification.

i)

Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.

j)

Cable BOQ worked out based on routing of cable listing provided by the vendor for “ both end equipment in vendor’s scope”shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0

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

Refer “Electrical Scope between BHEL and Vendor”.

3.0

DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1

The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

3.2

No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0

List of enclosures :

a)

Electrical scope between BHEL & vendor (Annexure –I)

b)

Technical specification for motors.

c)

Datasheets & quality plan for motors.

Page 273 of 487



TITLE :
ELECTRICAL EQUIPMENT SPECIFICATION
FOR
FUEL OIL HANDLING SYSTEM
2X660MW ENNORE TPS

SPECIFICATION NO.
VOLUME NO. : II-B
SECTION : C
REV NO. : 00 DATE :
SHEET : OF

- d) *Electrical Load data format (Annexure –II)*
- e) *BHEL cable listing format (Annexure –III)*
- f) *Electrical mandatory spares (Annexure IV)*

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE : FUEL OIL SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2 X 660 MW ENNORE TPS

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

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE : FUEL OIL SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2 X 660 MW ENNORE TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	Since vendor's Fuel oil pump house building is located as combined with Heating & Pumping building (BHEL-TRICHY), cable tray/trench layout inside combined building shall be prepared by BHEL-PEM. Vendor to furnish drawing (both in print form as well as in AUTOCAD) of Fuel oil pump house layout clearly indicating all pumps, panels, JB's etc. which require cabling along with their terminal box/location/ Foundation etc. Vendor to ensure the cable tray lay out shall confirm to NFPA (National fire prevention act)/TAC (Tariff advisory committee) applicable for hazardous area classification.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE : FUEL OIL SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2 X 660 MW ENnore TPS

3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

Motor Annexure

CHAPTER – 12

MOTORS

1.00.00 DESIGN CRITERIA

1.00.01 For the purpose of design of equipments /systems, an ambient temperature of 50 °C and relative humidity of 85% shall be considered. The equipment shall operate in a highly polluted environment.

1.00.02 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.

1.00.03 Rating

The motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher, considering highest system frequency.

All motors shall be continuously rated (S1 duty). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.

Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

1.00.04 Starting Voltage requirement for all motors (except mill motors):

1. 85 % of rated voltage for motors up to 1000 kW
2. 80 % of rated voltage for above 1000 kW and up to 4000 kW
3. 75 % of rated voltage for above 4000 kW

For Mill Motors:

1. 85 % of rated voltage for motors above 1000 kW
2. 90 % of rated voltage for motors up to 1000 kW

1.00.05 Canopy shall be provided for outdoor motors.

1.01.00 Contractor shall provide fully compatible electrical system, equipments, accessories and services.



1.02.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

1.03.00 Voltage and frequency variations:

Frequency: (+) 3% and (-) 5%

Voltage : **i. AC**

a. $\pm 6\%$ for 11 kV/3.3 kV

b. $\pm 10\%$ for 415 V

Combined 10 % (absolute sum)

ii. DC- +10% to -15% for 220 V DC

1.04.00 All LV motors above 10 kW with S1 duty shall be compulsorily of Energy efficient level IE 2 as per IS 12615: 2011.

1.05.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances shall be of the contractor.

1.06.00 Type

AC Motors:

(a.) Squirrel cage induction motor suitable for direct-on-line starting.

(b.) Crane duty motors shall be slip ring type induction motor

DC Motors

(a.) Shunt wound.

1.07.00 Temperature Rise

Air cooled motors

70°C by resistance method

Water cooled

80° C over inlet cooling water temperature mentioned elsewhere, by resistance method.

1.08.00 Degree of Protection

Degree of protection for various enclosures shall be as follows :

i) Indoor motors – IP 54



ii)	Outdoor motors	–	IP 55
iii)	CW motors (in case of screen prot. Drip proof)	–	IP 23
iv)	Cable box – indoor area	–	IP 54
v)	Cable box – outdoor area	–	IP 55

2.00.00 CODES AND STANDARDS

2.01.00 All motors shall confirm to the latest editions including all applicable amendment of relevant IS, IEC and CBIP standards/Publications. In case any other standard is followed that ensures equal or better quality, may be accepted. However the English version of the Standard adopted shall be submitted.

2.02.00 Major Standards, which shall be followed, are listed below. Any other applicable Indian standards for any component part even if not covered in the list shall also be followed

1.)	Three phase induction motors	:	IS:325, IEC:60034
2.)	Single phase AC motors	:	IS:996, IEC:60034
3.)	Crane duty motors	:	IS:3177, IEC:60034
4.)	DC motors/generators	:	IS:4722
5.)	Degree of protection by enclosures for rotating electrical machines	:	IS: 4691 IS: 4728 IS: 6362 IS: 2253
6.)	Noise levels for rotating electrical machines	:	IS: 12065
	Mechanical Vibrations for rotating electrical machines	:	IS: 12075

3.00.00 OPERATIONAL REQUIREMENTS

3.01.00 Starting Time

3.01.01 For motors with starting time up to 20 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs more than starting time .



- 3.01.02 For motors with starting time more than 20 secs and up to 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs more than starting time.
- 3.01.03 For motors with starting time more than 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
- 3.01.04 Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
- 3.01.05 Motors shall be capable of restarting under full load after a momentary loss of voltage with the possibility of 150 % nominal voltage during fast bus transfer.
- 3.02.00 Torque Requirements
- 3.02.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
- 3.02.02 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

4.00.00 DESIGN AND CONSTRUCTIONAL FEATURES

- 4.00.01 Suitable single phase space heaters shall be provided on motors rated 30 kW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.
- 4.00.02 All motors shall be suitable for direct on line starting through any type of breaker.
- L All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below

- (a) Fuel oil area : Group - IIB
- (b) Hydrogen generation plant Group - IIC
area :

4.00.03 Winding and Insulation

- (a) Type : Non-hygroscopic, oil resistant, flame resistant



- (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature
- (c) 11 kV / 3.3 kV AC motors : Class F: with winding temperature rise limited to class B. They shall withstand 1.2/50 micro sec switching surges of $4U+5$ KV (U=Line voltage in KV). The coil inter-turn insulation shall be suitable for 0.3/3 micro sec. surge of 32 KVp and 12 kVp for 11 kV and 3.3 kV system respectively followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation.
- (d) 415V AC & 220V DC motors : Class 'F' with temperature rise limited to class 'B'
- 4.00.04 Motors rated above 1000 kW shall have insulated bearings to prevent flow of shaft currents.
- 4.00.05 Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
- 4.00.06 Noise level and vibration shall be limited within the limits prescribed in IS: 12065 & IS: 12075 respectively. Motors shall withstand vibrations produced by driven equipment.
- 4.00.07 In MV/HV motors, 12 nos. simplex or 6 nos. duplex RTDs (two per phase), each having D.C. resistance of 100 ohms at 0°C, embedded in the stator winding at locations where highest temperatures may be expected, shall be provided. The material of the ETD's shall be platinum. Each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. All HV motors shall be provided with shaft grounding rings for bearing protection and earthing shaft current.
- 4.00.08 MV/HV motors shall also be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage and shall be capable of either two starts in quick succession with third start after 5 minutes in cold condition or two starts at 15 minutes intervals in hot condition, both cases with voltage and frequency variation within specified limits.
- 4.00.09 Locked rotor current of the MV motors shall be limited to 600% (subject to IS tolerance) of the full load current of the motors and for HV motor shall be limited to 450% (inclusive of IS tolerance) of full load current of the motor.



Locked rotor current of the LV motor shall not exceed 600% of full load current inclusive of IS tolerance.

- 4.00.10 MV Motors shall be provided with differential protection. These motors shall be provided with star connected stator windings. The 3 nos. current transformers, one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. These differential protection CTs shall be supplied loose by 11/ 3.3 kV switchgear manufacturer.
- 4.00.11 Motor body shall be grounded at two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.
- 4.00.12 HV motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.
- 4.00.13 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
- 4.00.14 The motors shall be suitable for bus transfer schemes provided on the 11 kV, 3.3 kV/415V systems without any injurious effect on its life.
- 4.00.15 All motors below 15 kW shall be provided with sealed ZZ bearings.
- 4.00.16 For motors rated 1000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
- 4.00.17 All motors shall be provided with an emergency stop push button near the motor as per the Indian Statutory regulations.
- 4.00.18 The motor terminal box shall be suitable for withstanding the maximum system fault current for a duration of at least 0.25 seconds.
- 4.00.19 Neutral in case of HV motors shall be kept accessible.



- 4.00.20 Motors shall be designed to easy access for drilling holes through motor feed of mounting flange for installation of dowel pins after assembly of the motor and driven equipment.
- 4.00.21 Well spacious working platforms shall be provided around the motor area for carrying out maintenance & testing works. Platform shall be minimum of 300 mm below the level of motor base plate.
- 4.00.22 Flow switches shall be provided for monitoring oil flow of forced lubrication bearings, if used. Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
- 4.00.23 For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired up to the terminal box..
- 4.00.24 Lube oil pressure transmitters shall be provided to DCS for remote monitoring. Lube oil pressure very low trip to HV equipment shall be 2 out of 3 logic.
- 4.00.25 Capillary type temperature gauge cum switch shall be provided for DE / NDE of HV Motors
- 4.00.26 Motors with CACA/CACW heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate the following:
- Hot and cold air temperatures of the closed air circuit for CACA motors.
 - Hot and cold, air and water temperatures for CACW motors.
- The Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.

4.00.27 Lifting Provisions

Motor weighing 25 kg or more shall be provided with eye bolt or other adequate provision for shifting. Electrical hoists shall be provided for motors above 1000 kgs for maintenance of the same.

4.00.28 DC MOTORS

DC motors shall be provided where specified/required. DC Motors shall be sized for operation with fixed resistance starting for reliability. DC motors shall be shunt wound type. Motors shall be capable of delivering the rated output at 220 V DC with (+) 10% and (-) 15% variations without exceeding its guaranteed temperature limits. 220 V DC



system shall be unearthed. Starting current of the DC motors shall be limited to 200% of the full load current of the motor, and is subject to IS tolerance. DC Motors shall be similar to AC Motors with respect to other features like enclosure type, cooling and class of insulation

4.00.30 Painting

Motor including fan shall be painted with corrosion proof paints of colour shade Siemens grey (RAL 7032).

4.00.31 Local Push Button Stations

The LPBS shall be installed near the motors to be controlled. Individual channel supports shall be used for each LPBS. These shall be installed as per approved erection detail drawing. LPBS for hazardous areas shall be CMRS certified and CCE approved.

All LPBS shall have necessary canopies. Wiring of LPBS shall be checked before giving control supply.

5.00.00 LIST OF TESTS TO BE CONDUCTED FOR HV, MV and LV MOTORS

5.01.00 TYPE TESTS

- (a) No load saturation and loss curves up to approximately 115% of rated voltage
- (b) Momentary overload test
- (c) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., core temp., coolant flow and its temperature shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.
- (d) Surge withstand test on the sample coil after placing it in stator core at $(4U + 5 \text{ KV})$ and with at least five impulse of 1.2/50 micro sec. wave, for HV motors only, where U is the line to line voltage in kV.
- (e) Surge-withstand test with 0.3/3 micro sec. wave on each type of 3.3/11 kV motor coils with at least five such impulses, followed by one minute power frequency high voltage test on turn to turn insulation, after cutting the coil and bringing out



the turns suitably. The power frequency test voltage shall be decided during detailed engineering.

- f) Dimensions (for motors covered by IS 1231:1974 and IS 2223:1983 only)
- g) Measurement of resistance of windings of stator and wound rotor.
- h) Reduced voltage running up test at no load (for squirrel cage motors up to 37kw only)
- i) Full load test to determine efficiency, power factor and slip.
- j) Insulation resistance test
- k) Test for vibration severity of motor
- l) Test for noise levels of motor
- m) Test for degree of protection by enclosure
- n) Temperature rise test at limiting values of voltage and frequency variations
- o) Over speed test

5.02.00 ROUTINE TESTS

The following shall constitute the routine tests.

- a) Insulation resistance test
- b) Measurement of resistance of windings of stator and wound rotor.
- c) No load test
- d) Locked rotor readings of voltage, current and power input at a suitable reduced voltage
- e) Reduced voltage running up test (for squirrel cage motor)
- f) Open circuit voltage ratio of stator and rotor windings (for slip ring motors); rotor;
- g) High voltage test

6.00.00 INSPECTION AND TESTING AT SITE

6.01.01 Insulation resistance of 415V motors shall be measured between the winding of the machine and its frame by means of a 500/1000V megger. A minimum value of 1 mega ohm for 415V motors shall be considered a safe value. In case of lower I.R. Value, the insulation value shall be brought up by any of the following methods as desired by the Site Engineer:

- (a.) Blowing hot air in case of big motors.
- (b.) Putting the motor in electric oven in case of smaller motors.
- (c.) Placing heaters or lamps around and inside in case of small motors after making suitable guarding and covering arrangements so as to conserve the heat.



6.01.02 Site Test

- (a.) Measurement of vibration.
- (b.) Measurement of insulation resistance and polarization index.
- (c.) Measurement of full load current.
- (d.) Test running of the motors, checking the temperature rise and identifying the hot spot etc.

6.01.03 3.3 kV motors shall be tested for insulation by 500/1000V megger and its value should not be less than the safe minimum insulation of $\geq 20 \text{ M}\Omega$ resistance at 60 deg. C. In case the insulation is low, the following method of drying has to be adopted:

- a. By locking the motor so that it cannot rotate and then applying such a low voltage to the stator terminals that full load current flows in the stator, keeping the stator winding temperature below 90 deg. C. In this a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. Value becomes steady.
- b. By blasting hot air from external source, Maximum temperature of winding while drying should be 70 deg. C to 80 deg. C. (Thermometer) or 90 deg. C. to 95 deg. C. by resistance method. Heating should be done slowly till steady temperature of winding is reached after 4 to 5 hours and for large machines after 10 hours. A record has to be kept for drying process, with half an hour readings and, after steady temperature is reached, at an interval of 2 hours. In case it is essential, the drying process can be supplemented by blower.



**TAMIL NADU GENERATION & DISTRIBUTION
CORPORATION LIMITED**

2 X 660 MW ENNORE SEZ SUPERCRITICAL TPP

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

(FOR BHEL-PEM SCOPE PACKAGES)

DOC. NO. PE-DC-412-565-E003

REVISION 0



BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

POWER PROJECT ENGINEERING INSTITUTE

NOIDA (U.P), INDIA



2 x 660 MW ENNORE SEZ STPP
BASIC TECHNICAL FEATURES
FOR HT / LT MOTORS
(FOR BHEL-PEM SCOPE PACKAGES)

Doc. No.	PE-DC-412-565-E003
Rev. No.	0
Dated	13-01-2014
Page	1 of 6

1.0 This document covers the basic technical features of high tension (HT) and low tension (LT) squirrel cage induction AC motors employed for driving auxiliaries of BHEL-PEM scope packages in **2 x 660 MW ENNORE SEZ STPP**.

2.0 CODES AND STANDARDS

The motors shall generally conform to IS 325/IEC-60034. LT motors above 10 kW with continuous duty (S1) shall be energy efficient IE2 conforming to IS-12615: 2011.

3.0 DESIGN REQUIREMENTS

3.1 General Requirements

The design ambient temperature shall be 50 deg C.

3.2 Supply system and rated voltage of motors

KW rating	Supply system	Rated voltage of motor
Above 1500 kW	11 KV	11 KV
Above 160 kW up to & including 1500 kW	3.3 KV	3.3 KV
From 200W up to & including 160 kW	415 V	415 V
Below 200W	240V	240V

3.2.1 Supply voltage & variations shall be as follows:-

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

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

3.3 Motor Rating

Motor ratings shall be adequate to meet the requirements of the drive equipment. Motors shall be continuously rated at the design ambient temperature of 50 degree C and relative humidity of 85%. Maximum continuous motor ratings shall have at least a 10% margin above the maximum load demand of the driven equipment under entire operating range including voltage & frequency variation.

3.4 Starting Requirements

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



2 x 660 MW ENNORE SEZ STPP
BASIC TECHNICAL FEATURES
FOR HT / LT MOTORS
(FOR BHEL-PEM SCOPE PACKAGES)

Doc. No.	PE-DC-412-565-E003
Rev. No.	0
Dated	
Page	2 of 6

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

Minimum Starting Voltage requirement for all motors (except mill motors):

1. 85 % of rated voltage for motors up to 1000 kW
2. 80 % of rated voltage for above 1000 kW and up to 4000 kW
3. 75 % of rated voltage for above 4000 kW

3.4.3 The locked rotor current of the HV (11 kV) motors (except MDBFP motors) shall not exceed 650% of full load current inclusive of tolerance as per IS: 325 and for MV (3.3 kV) motors locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT motors (except energy efficient motors) locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT energy efficient motors above 10kW with S1 duty, locked rotor current shall be as per IS: 12615-2011.

3.4.4 The following frequency of starts shall apply

- i) Two nos. consecutive cold starts in quick succession with third start after 5 minutes in cold condition.
- ii) Two nos. consecutive hot starts in the interval of 15 minutes in hot condition.

3.4.5 Locked motor withstand time of motors under hot condition at highest voltage limit shall be as follows:

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

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

3.5 Running Requirements

3.5.1 Motors shall run satisfactorily at a supply voltage of 80% of rated voltage for 5 minutes with full load without injurious heating to the motor.

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



2 x 660 MW ENNORE SEZ STPP
BASIC TECHNICAL FEATURES
FOR HT / LT MOTORS
(FOR BHEL-PEM SCOPE PACKAGES)

Doc. No.	PE-DC-412-565-E003
Rev. No.	0
Dated	13-01-2014
Page	3 of 6

3.6 Stress during bus Transfer

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

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

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

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

3.7 Noise level

The maximum noise level for motors shall be in line with IS 12065.

3.8 Vibration

The maximum vibration for motors shall be in line with IS: 12075.

4.0 CONSTRUCTIONAL FEATURES

4.1 Degree of Protection

4.1.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. CW motors (in case of screen prot. Drip proof) shall conform to degree of protection IP: 23 as per IS: 4691. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.

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

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

4.2 Enclosure and Cooling

4.2.1 Motors shall generally have totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) enclosures or Closed Air circuit Air (CACA), the method of cooling conforming to IC-0141 or IC-0151 or IC-0161 of IS: 6362 up to 3000 kW motor. CW Motors may be screen protected drip proof (SPDP).



2 x 660 MW ENNORE SEZ STPP
BASIC TECHNICAL FEATURES
FOR HT / LT MOTORS
(FOR BHEL-PEM SCOPE PACKAGES)

Doc. No.	PE-DC-412-565-E003
Rev. No.	0
Dated	13-01-2014
Page	4 of 6

4.2.2 Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.2.3 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.3 Class of Insulation

HT/LT motors shall have class F insulation. The temperature rise of all motors shall be limited to the limits applicable to Class 'B' insulation. In case of continuous operation at extreme voltage limits, 10deg C rise above the temperature limits specified in IS: 325 shall be permissible.

4.4 Bearings

4.4.1 Horizontally mounted motors shall have grease lubricated ball/roller or sleeve bearings. For HV/MV motors, the bearings shall be regreasable type and for LV motors, these bearings can be either sealed life lubricated type or regreasable type as per manufacturer's standard.

4.4.2 The vertical motors shall have a combined thrust and guide bearing on top and guide bearing at bottom. If the ball or roller bearings can take vertical thrust, thrust and guide bearing need not be provided.

4.4.3 After taking all motor driven equipment loads and thrust (if any) into account, the bearings shall be suitable for min. 20,000 working hours. Re-greasable bearings shall be provided with grease nipples and relief holes for on-line re-greasing and shall be suitable for 8000 working hours without changing of the grease.

4.4.4 The bearings of solidly coupled motors shall be of the same type as those of the driven equipment.

4.4.5 For motors up to 2 kW, double sealed type bearings shall be provided.

4.4.6 Motors rated above 1000kW shall be provided with insulated end shield on non-driving end to prevent flow of shaft current.

4.5 Terminals and Terminal Boxes

4.5.1 Motors of rating 90 kW and up to 160kW will be controlled by air circuit breaker with numerical protection. For all motors of rating up to 90kW shall be provided with MCCBs. The terminal box of motors shall be designed for the maximum fault current for a duration of at least 0.25 secs.

4.5.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.5.3 For HV/MV motors, the main terminal box shall be of phase-segregated type with clamping arrangement for the terminals.

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



2 x 660 MW ENNORE SEZ STPP

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

Doc. No.	PE-DC-412-565-E003
Rev. No.	0
Dated	13-01-2014
Page	5 of 6

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

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

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

4.5.8 Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 180 and 90 degree for HT and LT motors respectively.

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

4.6 Grounding

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

4.7 General

4.7.1 Motors provided for similar drives shall be interchangeable.

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

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

a) Fuel oil area: Group - IIB.

b) Hydrogen generation plant area: Group - IIC

5.0 ACCESSORIES

5.1 SPACE HEATERS

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

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

	2 x 660 MW ENnore SEZ STPP BASIC TECHNICAL FEATURES FOR HT / LT MOTORS (FOR BHEL-PEM SCOPE PACKAGES)	Doc. No.	PE-DC-412-565-E003
		Rev. No.	0
		Dated	13-01-2014
		Page	6 of 6

5.2 RESISTANCE TEMPERATURE DETECTORS (RTDs)

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

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

5.3 DIAL TYPE TEMP. INDICATORS

5.3.1 For HV/MV motors, each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. The indicators shall have 2 nos. NO contacts rated for 5A, 240 V AC and 0.5 A, 220 V DC for alarm/trip purpose.

5.4 Vibration monitoring pads

5.4.1 Provision shall be made in all HV/MV motors for mounting vibration detectors.

6.0 NAME PLATE

Motors shall have stainless steel name plate with all particulars as per IS: 325. In addition bearing identification number and type of lubricant is to be indicated.

7.0 PAINTING

Motor including fan shall be painted with corrosion proof paints of colour shade Siemens grey (RAL 7032).

8.0 TESTING

8.1 Type Tests

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

8.2 Routine Tests

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

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		SHEET 1 OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		SHEET 2 OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :				
				BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 1 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 2 OF 9		CUSTOMER :		PROJECT TITLE			SPECIFICATION :			
				BIDDER/ :		QUALITY PLAN			SPECIFICATION :			
				VENDOR		NUMBER PED-506-00-Q-007, REV-03			TITLE			
		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE		SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
		SHEET 3 OF 9					ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC. 2. OTHER CHARACTERISTICS	MA MA	VISUAL TEST	100% SAMPLE	- MANUF'S SPEC.	NO VISUAL DEFECTS MANUF'S SPEC.	INSPT. REPORT LOG BOOK AND OR SUPPLIER'S TC	3 3	- -	2 2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2.DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA MA MA	VISUAL MEASUREMENT ELECT. & MECH TESTS	100% SAMPLE -DO-	- MANUFR'S DRG. . MANUF'S SPEC./ RELEVANT IS	NO VISUAL DEFECTS (FREE FROM BURS) MANUFR'S DRG. RELEVANT IS	LOG BOOK -DO- SUPPLIER'S TC	3 3 3	- - -	- 2 2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
1.9	CONDUCTORS	1. SURFACE FINISH 2.ELECT. PROP. & MECH. PROP	MA MA	VISUAL ELECT. & MECH.TEST	100% SAMPLES	- RELEVANT IS/ BS OR OTHER STANDARDS	FREE FROM VISUAL DEFECTS RELEVANT IS/ BS OR OTHER STANDARDS	LOG BOOK SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3* 3	- -	2* 2	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 4 OF 9		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION :			
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			TITLE			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION			VOLUME III
									P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
									BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
		SHEET 5 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNES	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC./BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

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

		QUALITY PLAN SHEET 7 OF 9		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
				SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL

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

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

		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :				
				BIDDER/ :		TITLE		NUMBER :				
				VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01		SPECIFICATION TITLE				
SHEET 1 OF 2		SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)		SECTION		VOLUME III				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
		SHEET 2 OF 2		SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS		BIDDER/VENDOR					BIDDER'S/VENDORS COMPANY SEAL		
			NAME									
			SIGNATURE									
			DATE									

CABLE TRAY ANNEXURE

- 3.05.04 For CHP following shall also be applicable.
- a) All cable routes shall be overhead along the route of the conveyor gallery by separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600 mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 3.0 M above the grade level except for rail/road crossings where it shall be at 8.0 M above grade level. However in bunker area the bottom of the cable trestle shall be 10 to 14 M depending on boiler/bunker layout.
 - b) Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches receptacles etc.
 - c) Cables for Pull cord switches and belt sway switches shall be taken in cable trays. The trailing cables of the mobile machines shall also be laid in cable trays.
- 3.05.05 Cable trench shall be allowed only between switchyard control room and 'A' row column of TG building.
- 4.00.00 EQUIPMENT DESCRIPTION**
- 4.01.00 Cable trays, Fittings & Accessories**
- 4.01.01 Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.), accessories (like side coupler plates, etc.) and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.
- 4.01.02 These shall be either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron trays free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.
- 4.01.03 Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Minimum thickness of mild steel sheets used for fabrication of



4.02.00	Support System for Cable Trays
4.02.01	Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".
4.02.02	Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types: (i) C1:- having provision of supporting cable trays on one side and (ii) C2:- having provision of supporting cable trays on both sides. The support system shall be the type described hereunder



- a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardware such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.
- b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardware's fittings and accessories shall be prefabricated factory galvanised.
- c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanized surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.
- d. All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation.
- e. The main support channel and cantilever arms shall be fabricated out of minimum 2.5 thick rolled steel sheets conforming to IS.
- f. Cantilever arms of 300 mm, 600 mm and 750 mm in length are required. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.
- g. Cable trays in areas subjected to excessive coal dust or mechanical damage shall have hot dip galvanized sheet steel metal trays cover installed on front tray in vertical run and inverted 'V' type on upper tray in horizontal run with consideration for ventilation.
- h. FRP Cable trays shall be used for areas like intake raw water pump house, Desalination plant, CHP, Battery room, NDCT and chemical house.

4.02.03

The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above are indicative only. Nevertheless, the support system shall be designed by the contractor to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Contractor without any



additional cost. The contractor shall submit the detailed drawings of the system offered by him along with the bid.

4.03.00 Pipes, Fittings & Accessories

4.03.01 Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

4.03.02 GI Pipes shall be of medium duty as per IS: 1239

4.03.03 Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

4.04.00 Junction Boxes

4.04.01 Junction Boxes shall comprise of a case with hinged door constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the boxes shall be arranged to slope towards rear of the box. Gland plate shall be 3 mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanised as per relevant IS, and suitable for mounting on wall, columns, structures etc. The boxes shall include brackets, bolts, nuts, screws M8 earthing stud etc. required for installation.

4.04.02 Glass Fibre Reinforced Junction Boxes

No. of Ways: 12/24/36/48 with 20% spares terminals.

4.04.03 Junction boxes shall be Glass Fibre Reinforced with saturated polyester conforming to standards like DIN 16911 type 803/16913 type 834, 5 self extinguishing in accordance with ASTM D635/UL 94 VO.

Junction boxes for use in outdoor or damp locations shall be sturdy construction. Temperature resistance shall be between – 10 to 100°C. Impact resistance shall be greater than 7 Nm, (EN 50014). Protective insulation shall be in line with VDE 0100, dielectric strength shall be greater than 10 KV/mm, halogen free toxicity, the enclosure and door cover shall be painted and electro statically power coated (preferably in RAL 7032). Earth connection (studs size shall be M 6) shall be provided on the cover as well as door.



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

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

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

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V

(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

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

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

CABLE SCHEDULE FORMAT

ANNEXURE III

[illegible]

Electrical mandatory spares (Annexure IV)			
2 X 660 MW ENnore SEZ COAL BASED STPS, FUEL OIL UNLOADING & STORAGE			
S.No	Details of Works or Equipment/System	Unit	Qty (Nos)
1.6	415 V Motors		
1.6.1	Terminal plates		10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW
1.6.2	Heaters		2 sets
1.6.3	Greasing arrangements		4 sets each type of motor
1.6.4	Motor of each type and rating		10% of the installed quantity or minimum 1 number whichever be higher
1.6.5	Bearings (DE and NDE) for each type and rating of motor		4 sets
1.7	BATTERY		
1.7.1	Battery cell		10
1.7.2	MT cell container of each type		10
1.7.3	Level indicator		6
1.7.4	Vent plugs		12
1.7.5	Inter-cell connector		10
1.7.6	Set of nuts, bolts and washer		12
1.8	BATTERY CHARGERS		
1.9	For Float cum boost Charger of Unit Batteries.		
1.9.1	Electronic Cards (with all components mounted)		1 set of each type and rating.
1.9.2	Fuses		4 nos of each type and rating
1.9.3	SCR		6 nos of each type and rating
1.9.4	Blocking Diode		6 sets of each type and rating
1.9.5	Potentiometer		3 sets of each type and rating.
1.10	For Float cum boost Charger of Switchyard Batteries.		
1.10.1	Electronic Cards (with all components mounted)		1 set of each type and rating.
1.10.2	Fuses		4 nos of each type and rating
1.10.3	SCR		6 nos of each type and rating
1.10.4	Blocking Diode		6 sets of each type and rating
1.10.5	Potentiometer		3 sets of each type and rating.
1.10.6	Each type of lamps, PBs, ILPBs, fuse, MCB, MCCB used in the equipment/system.	Nos.	20 % of Installed of each type.
NOTE:- ELECTRICAL Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.			

2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF
NCTPS, CHENNAI

FUEL OIL UNLOADING & STORAGE SYSTEM

TECHNICAL SPECIFICATION FOR C&I PORTION OF FO
SYSTEM



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

C & I SPECIFICATIONS FOR DCS BASED FUEL OIL UNLOADING & STORAGE SYSTEM

	TANDECO			
	2X660 MW ENNORE SEZ STPP		DESG	CM
	JOB NO: 412		CHKD	SCS
	REV. NO. 00	DATE: 23.03.15	APPD	SCS

INDEX

S. No.	DESCRIPTION
1	TITLE SHEET
2	INDEX SHEET
3	C&I SCOPE SHEET
4	C&I GENERAL REQUIREMENT
5	LIST OF DOCUMENTS/DELIVERABLES
6	INSTRUMENT HOOK-UP DIAGRAM
7	SIGNAL EXCHANGE BETWEEN DRIVES & DCS (DCP)
8	CUSTOMER SPECIFICATION-INSTRUMENTS, CONTROL VALVES, ELECTRIC ACTUATORS
9	QUALITY ASSURANCE-INSTRUMENTS/PANELS/ACTUATORS
10	C&I MANDATORY SPARES
11	APPROVED VENDOR LIST-BHEL

2X660 MW ENNORE SEZ Supercritical Thermal Power Project

SCOPE OF C&I FOR FUEL OIL UNLOADING & STORAGE SYSTEM

1. FUEL OIL UNLOADING & STORAGE SYSTEM shall be operated from DCS (BHEL's scope).
2. The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire FOHS. The requirements given are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial implication.
3. The make/model of various instruments/items/systems shall be as per the Customer/BHEL's approved vendor list. List of BHEL approved vendors has been enclosed which shall be subject to Customer's approval. No commercial and delivery 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.
4. All instruments shall be terminated on JB/LCP in field and both instrument and JB/LCP are in bidder scope.
5. For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.
6. Bidder to provide mandatory spares as per mandatory spares list enclosed in the specification.
7. Electrical Actuators with integral starter shall be provided for all on/off and inching type valves along with necessary interface units for linking to corresponding Control System as applicable, typical Hook-up diagram of drives is included for reference
8. The specifications for instruments mentioned in the specification are minimum requirements. The detail specifications shall be finalized during detail engineering.
9. All transmitters & electronics items will be explosion proof / intrinsically safe as per hazardous area classification.
10. PG/DPG/PS/PT/LT shall have chemical/diaphragm seal.
11. The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of any deviation a No deviation certificate is to be furnished.
12. The quantity of instruments for the system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.
13. Bidder to terminate all instrumentation and control elements in junction boxes. bidder to provide input/output list, drives list, junction box schedule and termination details, recommended control logics / write-up etc. the list of documents to be submitted after award of contract is to be referred by bidder.
14. All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible.
15. Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication.

2X660 MW ENNORE SEZ Supercritical Thermal Power Project

16. Instrument installation and accessories required for the same shall be in Bidder's scope and shall be submitted after award of contract. However any instrument/ analyzer installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering.
17. Bidder to furnish electrical load data during detailed engineering
18. Bidder to provide temperature transmitter along with compensating cable, JB/Rack & other erection hardware
19. 415 V AC/230 V AC supply shall be provided by BHEL at a single point, further distribution to various instruments/Equipment of the system shall be in bidder scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Bidder to submit the power requirement along with the bid.
20. Bidder's presence is required for 3 Man days (Excluding travel time) at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic. Intimation to attained FAT shall be informed in 2 days advance. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.
21. Contractor's C&I representative shall be present at BHEL-PEM for 3 man-days, for preparation of Control scheme of FOHS. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.
22. Bidder's presence is required for 15 Man days (in three visit) at site during commissioning of DDCMIS for assistance related to process correctness. Three visit with total 15 Man days (Excluding travel time) in which one visit shall be of 5 Man days each. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.
23. Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection, JB grouping, Annunciation list, SOE list, List of Instruments/devices for HART in BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.
24. Interface of MCC, HT SWGR, field instruments, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.
25. Local control panel if any required for operation shall be in bidder's scope.
26. All the instruments/equipments/electrical items supplied by vendor 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.
27. All primary Instruments, hardwares & JB's etc used for measurement for HFO and LDO/ HSD shall be flame proof (IEC-79.1, Part I).
28. For binary and analog inputs required for other modulating control, protection and interlock purpose of other equipment and other critical monitoring application etc., min. dual sensors shall be provided.
Dual sensors shall be provided for instruments required for auto starting of LT driven pumps or LT driven pump tripping due to very low level of water/discharge pressure very low.
Dual sensors shall be provided for instruments required for Heat rate measurements & PADO calculations.
Dual measurement scheme for analog inputs employing two independent transmitters/ temperature element, connected to separate tapping points shall be employed for the remaining measurements used for analog control functions. All the instruments provided by the vendor shall meet the requirements stipulated above.
29. Valve end position (Open & Close) shall be monitored for the manual critical valves, wherever provided.

2X660 MW ENNORE SEZ Supercritical Thermal Power Project

30. Bidder to provide temperature transmitters, wherever temperature is required 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/PLC using instrumentation & Extension cables respectively.

31. Bidder to provide instruments for all process parameters (i.e. pressure, temperature & flow) even though not specifically mentioned or indicated in the P&IDs or technical specification on all important process lines.

~~Auto Start of high pressure pumps of RO plants shall be implemented by designing remote operated pneumatic valves~~

~~The provision of Start and Stop of various sump pumps shall be provided in the control system.~~

~~Flow transmitters shall be provided at the outlet of ACID unloading pumps.~~

~~The Operation of Disk filter system along with status in the RO-DM plant OWS shall be provided.~~

~~Flow transmitter shall be provided at the Outlet of disk filter system including a separate flow transmitter for disk filter reject.~~

~~pH measurements at the outlet of neutralization pumps shall be provided.~~

~~The necessary link through gateway as detailed in Annexure A shall be provided.~~

5.00.01 LAY OUT OF CONTROL ROOM

~~Separate battery room and UPS room shall be provided~~

~~The control room shall be Air conditioned~~

~~The control room shall be provided with pantry room, Locker room , Toilet etc.,~~

6.00.00 FUEL OIL PRESSURISING AND HEATING SYSTEM

The Fuel oil system is designed for fully automatic operation through the **DPU of plant DDCMIS** system housed in the Fuel oil pump house air conditioned control room.. All necessary interlocks, control panels, MCCs, mimic diagrams etc shall be provided in the main control room for safe and reliable operation of the fuel oil system.

6.00.01 CONTROL AND OPERATION PHILOSOPHY

The sequential control of HFO and HSD (LDO) pressurizing pumps shall be made available in DDCMIS. Local start/stop facility shall be provided through DDCMIS.

The stand by pressurizing pump shall be automatically started in the event of either low pressure in respective pump discharge header or tripping of any of the running pumps.

Open and Close limit switch feed backs of valves are to be connected to DDCMIS for remote viewing and for interlocks and protection.

Remote and local indications of various parameters to the process requirement shall be provided. (The same can be decided during detailed engineering)

The OLCs and CLCS philosophy shall be as per the chapter 4 of this volume.

Steam flow to each HFO heater shall be independently regulated through DDCMIS by means of automatic control valve on steam line and actuated from heater outlet oil



temperature. The motorized valves on steam supply lines to HFO heaters shall have start/stop facilities.

Individual recirculation control valve shall be provided for each HFO and each HSD (LDO) pressurizing pump to maintain the pump discharge. This control shall be made available in DDCMIS DPU and not thru local pneumatic controller

The fuel oil tank heating and oil decanting pumps operation shall also be controlled from the DDCMIS.

The signals from the instruments for fuel oil tanks level, temperature, HFO/HSD flow from during decanting operation and other miscellaneous instruments shall be hooked up to the DDCMIS

The Decanting pumps controls / Status, Oil tanks level transmitters, Tank heating, Drain oil tank level and control & miscellaneous instruments which will be provided by bidder shall be hooked up in the FOPH control panel for monitoring and control

The HFO pumps shall be controlled by VFD.

Remote & local station DP measurement, pressure low, very low switches for auto start & alarm shall be provided for both HFO/HSD (LDO) system. Discharge pressure gauges for individual pump shall be provided at pump house for both HFO & HSD (LDO) system. Common header pressure transmitter at FOPH for both the HSD (LDO) & HFO shall be provided.

6.00.02 LOCAL CONTROL PANEL

The local control panel for control and monitoring of the fuel Oil shall be located in the Fuel oil pressurizing pump area and shall house all necessary start/stop push buttons, auxiliary relays, control switches, meters, indicators, status indication lamps etc. to achieve the control philosophy described above. This panel shall also include all the annunciation described below.

For safe and reliable operation control of the Fuel Oil System, Following minimum instruments / control function shall be carried out in addition to process requirement

- a) Remote and Local differential pressure across each strainer in HSD (LDO), HFO line at pressurizing pump suction and at heater outlet.
- b) Remote and Local differential pressure across strainer at pressurizing pump suction in HSD (LDO) line.
- c) Remote and Local pressure at discharge of each HFO pressurizing pump
- d) Remote and Local pressure at discharge of each HSD (LDO) pressurizing pump
- e) Remote and Local pressure at suction and discharge header of HFO heaters



- f) Remote and Local pressure at discharge header of HSD (LDO) pressuring pumps
- g) Remote and Local temperature of steam & HFO at inlet/outlet of each HFO heater
- h) Remote and Local temperature in the connected fuel oil tanks
- i) Remote and Local pump suction temperature (for HFO only).
- j) Redundant radar type Level Transmitters for each fuel oil tank.

6.00.03 LAY OUT OF CONTROL ROOM

Separate battery room and UPS room shall be provided

The control room shall be Air conditioned

The control room shall be provided with pantry room , Locker room , Toilet etc.,

7.00.00 CONDENSATE POLISHING UNIT

The Condensate polishing unit is designed for fully automatic / manual operation through the DPU of Plant DDCMIS or redundant PLC system housed in the respective panel. This PLC shall have interface module for redundant and bi-directional OPC connectivity with DDCMIS. Taking the equipment into service and regeneration of mixed-bed units shall be initiated manually from the OWS of control system or local panel and balance operation shall be carried out sequentially by the control system. Manual override facility is also provided for all operations.

The PLC shall be preferably from plant DDCMIS family.

The PLC system shall be provided as detailed in chapter 4 of this specification..

Open and Close limit switch feed backs of valves are to be connected to PLC for remote viewing and for interlocks and protection.

Remote and local indications of various parameters to the process requirement shall be provided. (The same can be decided during detailed engineering)

The OLCs and CLCS philosophy shall be as per the chapter 4 of this volume.

The instruments shall be offered as per the process requirement for complete auto operation.

Necessary instruments pressure gauges, Temperature gauges, DP instruments, Pressure transmitters, Radar Level transmitters, Differential pressure transmitters, Temperature Elements Various analysers, Magnetic type level indicators, shall be provided. The junction boxes and instruments / electronics housing used shall be Non – corrosive material.

Flow transmitters for each stream of CPU are to be provided for monitoring the performance and accountability

The bidder shall furnish required list and type of instruments during detail



C&I GENERAL REQUIREMENT

	SPECIFICATION FOR CONTROL & INSTRUMENTATION FOR AUX PACKAGES	SPECIFICATION NO.:	
		VOLUME	
		SUB SECTION	
		REV. NO.	DATE :
		SHEET	OF

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0 The quantity of instruments for auxiliary system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.

C&I List of Documents, Deliverables

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR FOHS 2X660 MW ENNORESEZ Supercritical Thermal Power Plant

DOCUMENT NUMBER PE-GL-412-145-I100

SHEET 1 of 1

SI.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-412-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
2	PE-V0-412-145-I902	CONTROL SCHEME/LOGIC DIAGRAM(TO BE IMPLEMENTED IN DDCMIS)	A
3	PE-V0-412-145-I903	HMI PICTURES/PLANT SCHEMATICS	A
4	PE-V0-412-145-I904	INSTRUMENT SCHEDULE with set points	A
5	PE-V0-412-145-I905	I/O LIST (ANALOG & BINARY)	A
6	PE-V0-412-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
7	PE-V0-412-145-I907	FIELD JB/LIE/LIR TERMINATIONS	A
8	PE-V0-412-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V0-412-145-I909	QUALITY PLANS (INSTRUMENTS,VMS, etc.)	A
10	PE-V0-412-145-I910	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
11	PE-V0-412-145-I911	THERMOWELL SIZING CALCULATION	A
13	PE-V0-412-145-I913	CABLE SCHEDULE & INTERCONNECTION	A
14	PE-V0-412-145-I914	ANNUNCIATION & SOE LIST	A

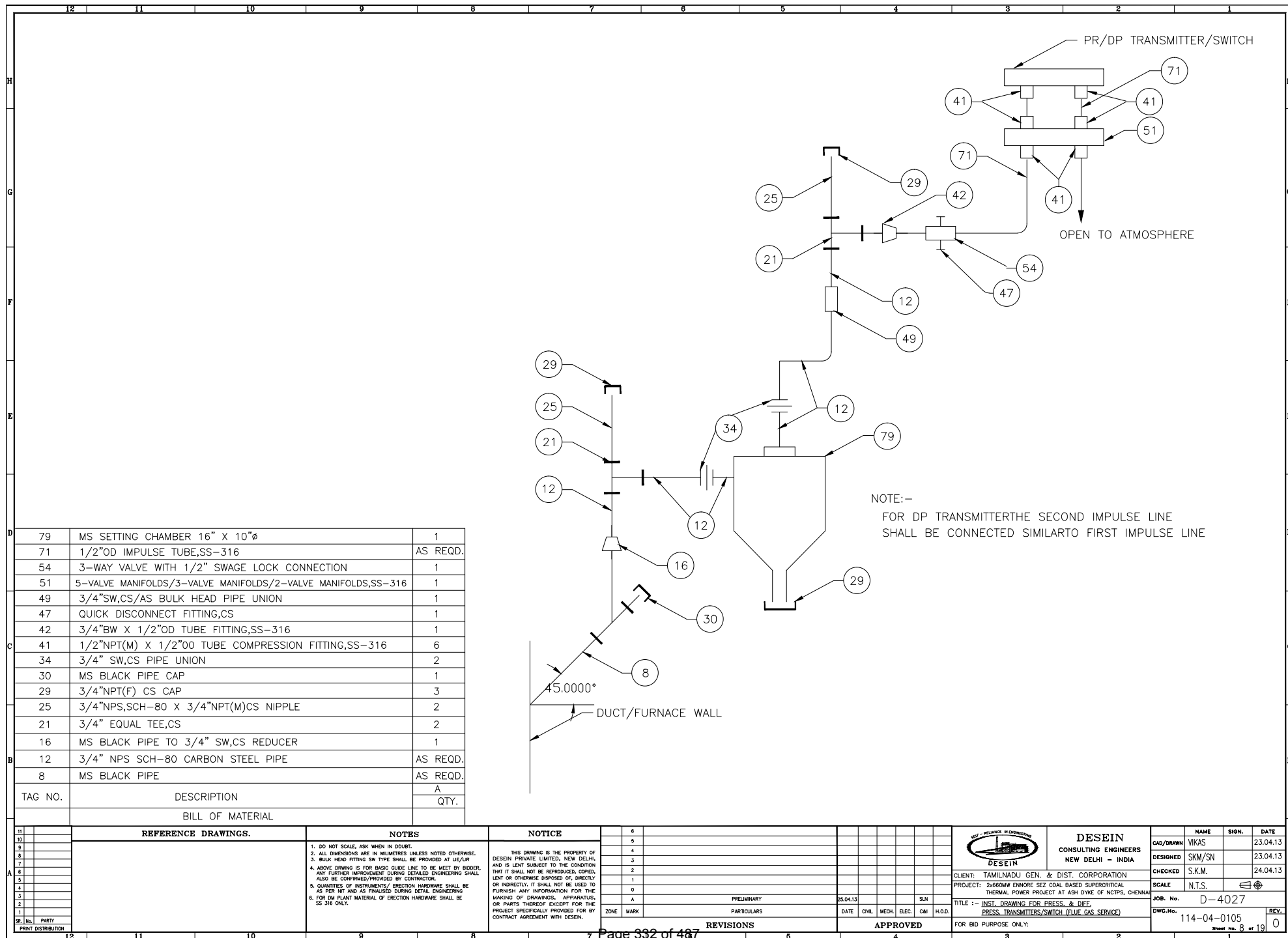
NOTES:

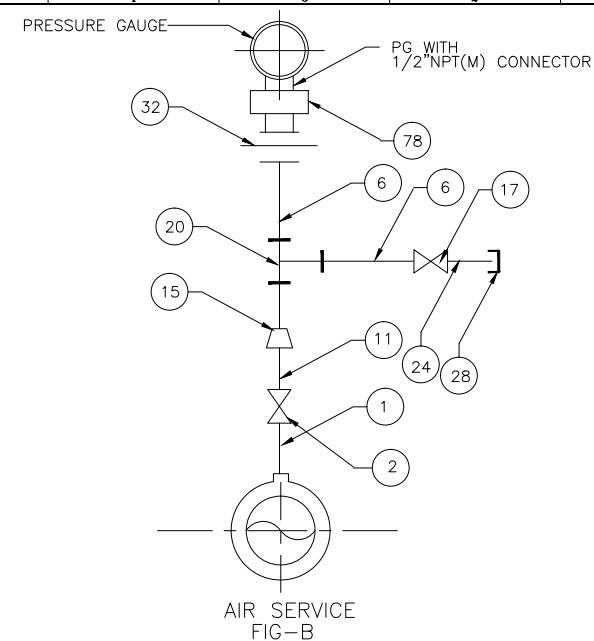
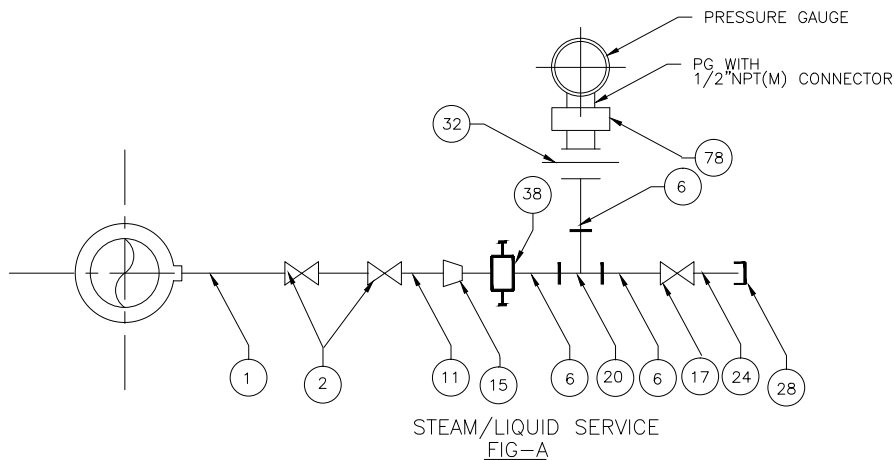
1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.

2. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/NTPC APPROVED FORMATS LIKE MS EXCEL,MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST,FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc.

SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.

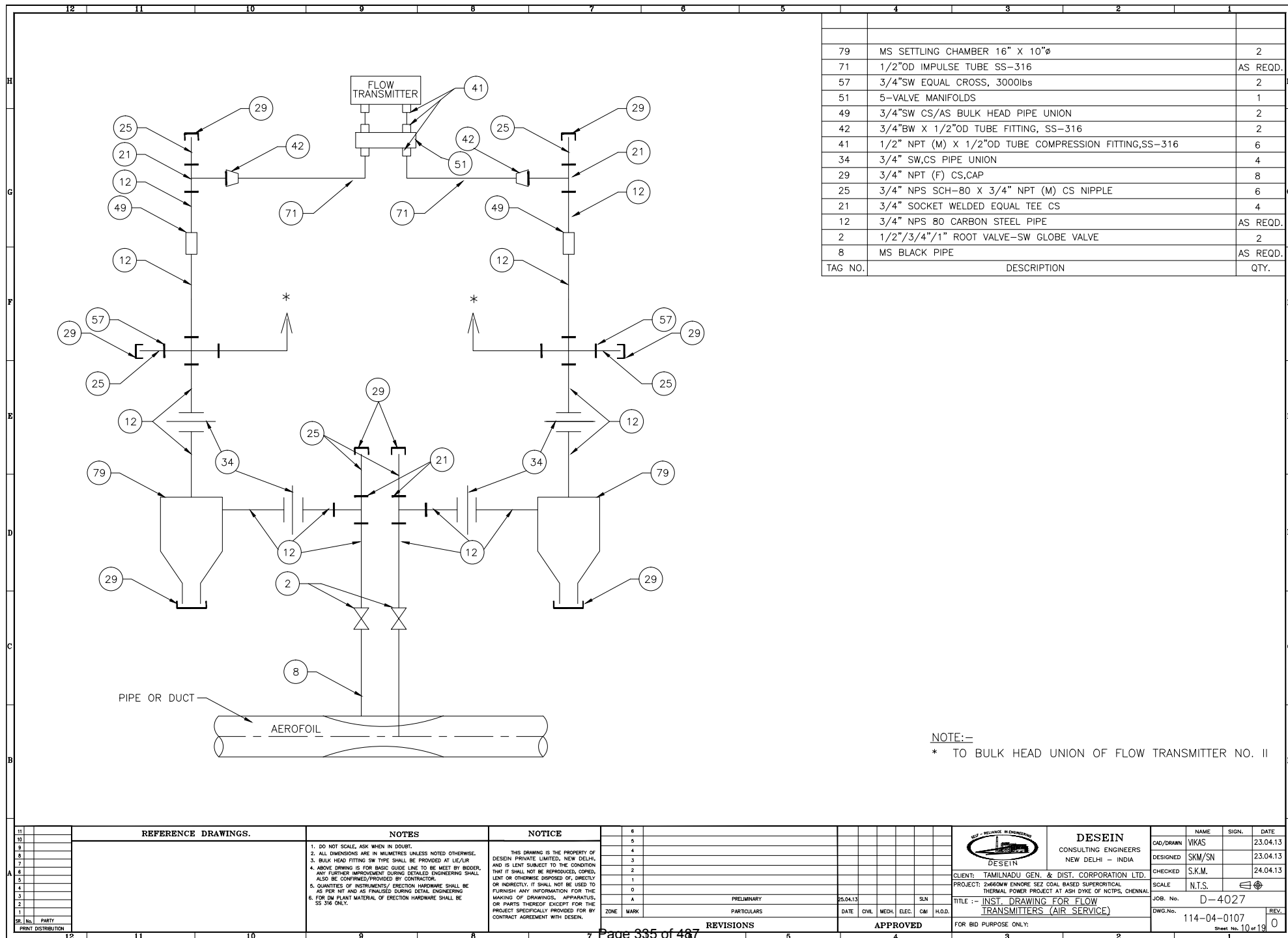
Instrument Hook-up Diagram





78	1/2"NPT(F)X1/2"NPT(M) SNUBBER/PULSATION DAMPER	1	1
59	1/2"SW, STRAIGHT PIPE CONNECTOR, CS/AS	—	—
38	3 WAY GAUGE VALVE 1/2" NB SW	1	—
37	6" COILED SYPHON SCH 80/160 1/2"NB CS/SS	—	—
32	1/2"NPS,3PIECE PIPE UNION WITH 1/2"NPT(F) SCREWED	1	1
28	1/2"NPT (F) CS CAP	1	1
24	1/2"NPS,SCH-80/160X1/2"NPT(M)CS/AS NIPPLE	1	1
20	1/2"SW EQUAL TEE, CS/AS	1	1
17	1/2" SW CS/AS GLOBE VALVE	1	1
15	1" TO 1/2" SOCKET WELDED REDUCER	1	1
11	1" NPS SCH-80/160 CS/AS NIPPLE	1	1
6	1/2" NPS. SCH-80/160 CS/ AS PIPE	AS REQD.	
2	1/2"/3/4"/1" ROOT VALVE-SW GLOBE VALVE	2	1
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.	
TAG NO.	DESCRIPTION	A	B
		QTY.	
BILL OF MATERIAL			

REFERENCE DRAWINGS. 11 10 9 8 7 6 5 4 3 2 1 SHEET No. PART PRINT DISTRIBUTION		NOTES 1. DO NOT SCALE, ASK WHEN IN DOUBT. 2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE. 3. ABOVE DRAWING IS FOR BASIC GUIDE LINE TO BE MET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR. 4. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER NIT AND AS FINALISED DURING DETAIL ENGINEERING. 5. PRESSURE GAUGE SHALL BE PROVIDED WITH SS-316 MANIFOLDS IN WTO SYSTEM. 6. FOR DW PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.		NOTICE THIS DRAWING IS THE PROPERTY OF DESEIN PRIVATE LIMITED, NEW DELHI, AND IS LENT SUBJECT TO THE CONDITION THAT IT SHALL NOT BE REPRODUCED, COPIED, LENT OR OTHERWISE DISPOSED OF, DIRECTLY OR INDIRECTLY. IT SHALL NOT BE USED TO FURNISH ANY INFORMATION FOR THE MAKING OF DRAWINGS, APPARATUS, OR PARTS THEREOF EXCEPT FOR THE PROJECT SPECIFICALLY PROVIDED FOR BY CONTRACT AGREEMENT WITH DESEIN.		REVISIONS PRELIMINARY DATE 25.04.13 CIVIL MEDH. ELEC. CM H.O.D.		APPROVED DATE 25.04.13 CIVIL MEDH. ELEC. CM H.O.D.		 DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA CLIENT: TAMILNADU GEN. & DIST. CORPORATION PROJECT: 2x660MW ENCORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCPS, CHENNAI. TITLE :- INST. DRAWING FOR LOCAL PRESSURE GAUGE FOR BID PURPOSE ONLY		<table border="1"> <tr> <th>NAME</th> <th>SIGN.</th> <th>DATE</th> </tr> <tr> <td>CAD/DRAWN VIKAS</td> <td></td> <td>23.04.13</td> </tr> <tr> <td>DESIGNED SKM/SN</td> <td></td> <td>23.04.13</td> </tr> <tr> <td>CHECKED S.K.M.</td> <td></td> <td>24.04.13</td> </tr> <tr> <td>SCALE N.T.S.</td> <td></td> <td></td> </tr> <tr> <td colspan="3">JOB. No. D-4027</td> </tr> <tr> <td colspan="3">DWG.No. 114-04-0106</td> </tr> <tr> <td colspan="3">REV. 0</td> </tr> </table>		NAME	SIGN.	DATE	CAD/DRAWN VIKAS		23.04.13	DESIGNED SKM/SN		23.04.13	CHECKED S.K.M.		24.04.13	SCALE N.T.S.			JOB. No. D-4027			DWG.No. 114-04-0106			REV. 0		
NAME	SIGN.	DATE																																			
CAD/DRAWN VIKAS		23.04.13																																			
DESIGNED SKM/SN		23.04.13																																			
CHECKED S.K.M.		24.04.13																																			
SCALE N.T.S.																																					
JOB. No. D-4027																																					
DWG.No. 114-04-0106																																					
REV. 0																																					

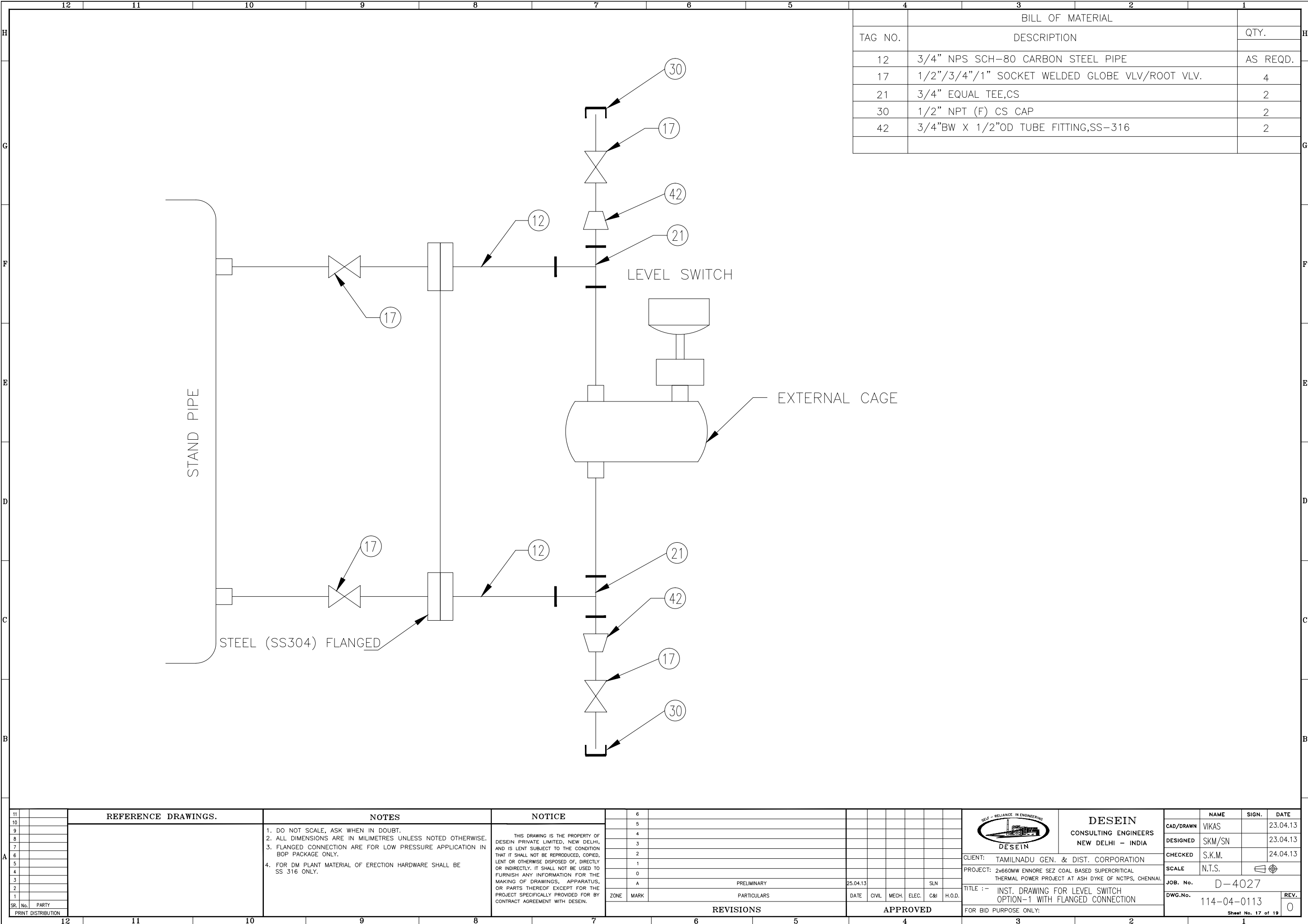


TAG NO.	DESCRIPTION	QTY.
79	MS SETTLING CHAMBER 16" X 10"Ø	2
71	1/2"OD IMPULSE TUBE SS-316	AS REQD.
57	3/4"SW EQUAL CROSS, 3000lbs	2
51	5-VALVE MANIFOLDS	1
49	3/4"SW CS/AS BULK HEAD PIPE UNION	2
42	3/4"BW X 1/2"OD TUBE FITTING, SS-316	2
41	1/2" NPT (M) X 1/2"OD TUBE COMPRESSION FITTING,SS-316	6
34	3/4" SW,CS PIPE UNION	4
29	3/4" NPT (F) CS,CAP	8
25	3/4" NPS SCH-80 X 3/4" NPT (M) CS NIPPLE	6
21	3/4" SOCKET WELDED EQUAL TEE CS	4
12	3/4" NPS 80 CARBON STEEL PIPE	AS REQD.
2	1/2"/3/4"/1" ROOT VALVE-SW GLOBE VALVE	2
8	MS BLACK PIPE	AS REQD.

NOTE:-

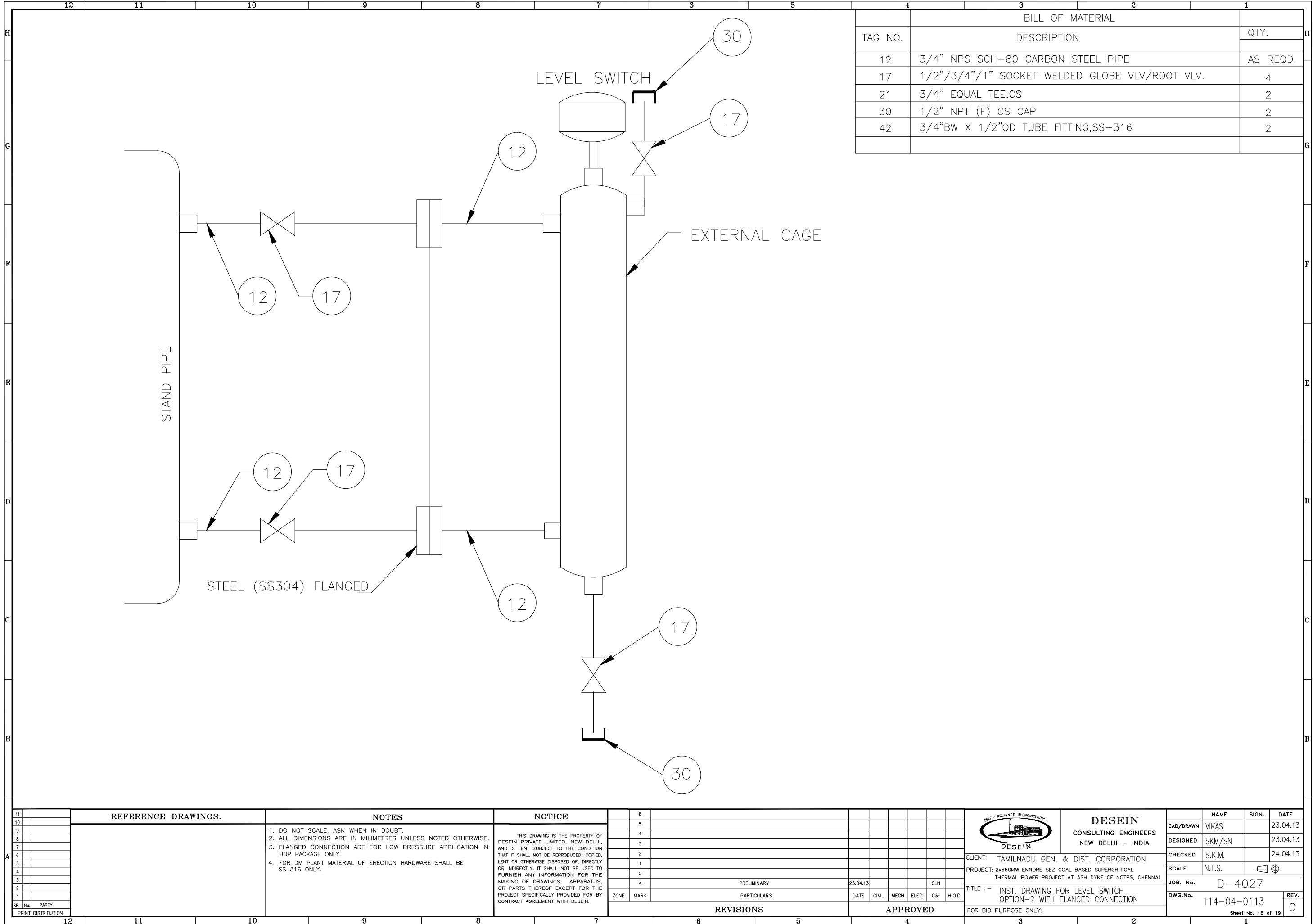
* TO BULK HEAD UNION OF FLOW TRANSMITTER NO. II

11	10	9	8	7	6	5	4	3	2	1
11	10	9	8	7	6	5	4	3	2	1
10	9	8	7	6	5	4	3	2	1	
9	8	7	6	5	4	3	2	1		
8	7	6	5	4	3	2	1			
7	6	5	4	3	2	1				
6	5	4	3	2	1					
5	4	3	2	1						
4	3	2	1							
3	2	1								
2	1									
1										
SE. No.	PARTY									
PRINT	DISTRIBUTION									



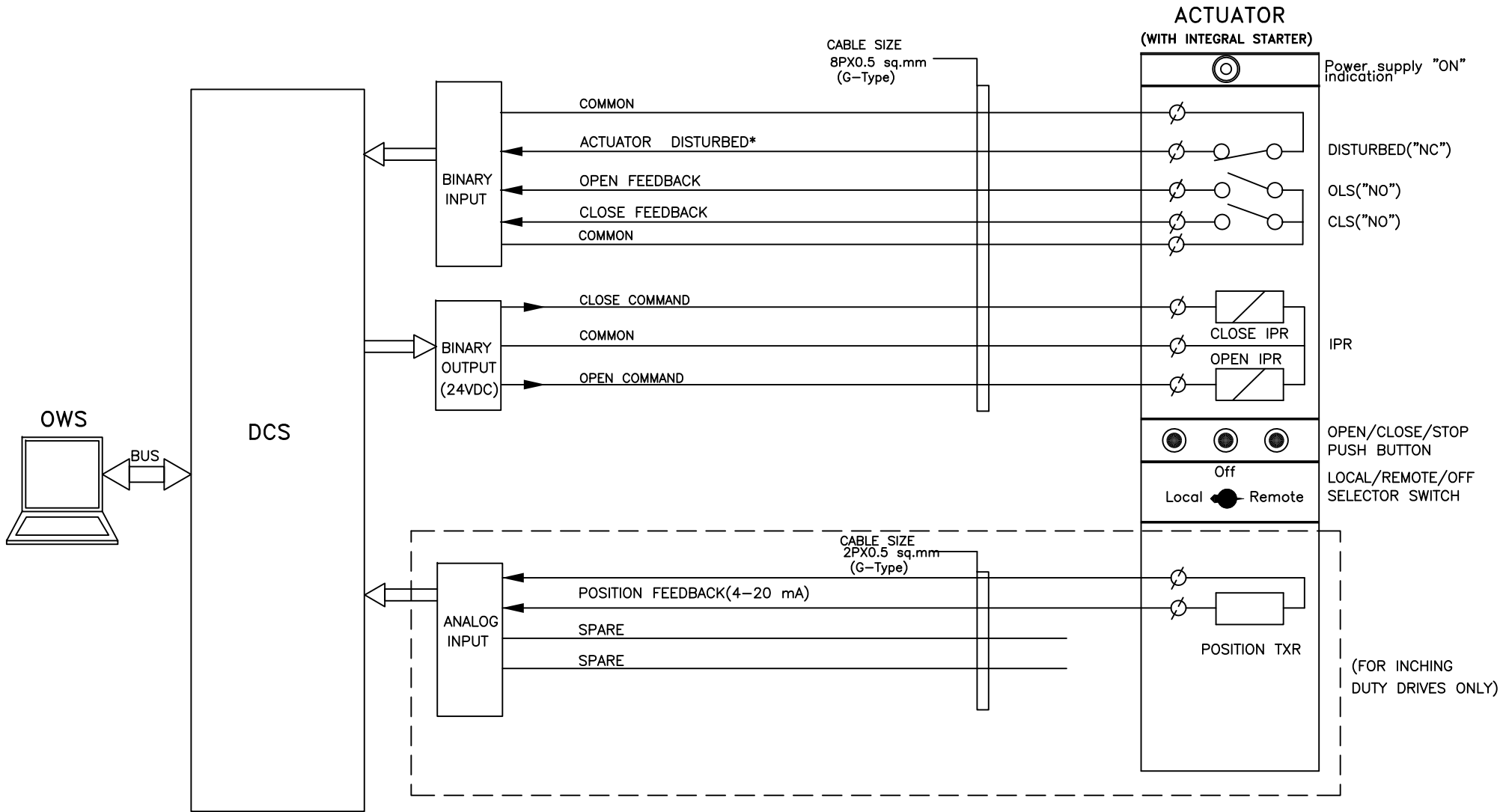
BILL OF MATERIAL		
TAG NO.	DESCRIPTION	QTY.
12	3/4" NPS SCH-80 CARBON STEEL PIPE	AS REQD.
17	1/2"/3/4"/1" SOCKET WELDED GLOBE VLV/ROOT VLV.	4
21	3/4" EQUAL TEE,CS	2
30	1/2" NPT (F) CS CAP	2
42	3/4"BW X 1/2"OD TUBE FITTING,SS-316	2

11	REFERENCE DRAWINGS.		NOTES		NOTICE		6												DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA				NAME		SIGN.		DATE	
10							5												CAD/DRAWN		VIKAS						23.04.13	
9							4												DESIGNED		SKM/SN						23.04.13	
8							3												CHECKED		S.K.M.						24.04.13	
7							2												SCALE		N.T.S.							
6							1												JOB. No.		D-4027							
5							0												DWG.No.		114-04-0113						REV.	
4							A		PRELIMINARY		25.04.13				SLN				TITLE :-		INST. DRAWING FOR LEVEL SWITCH OPTION-1 WITH FLANGED CONNECTION							
3							ZONE		MARK		DATE		CIVIL		MECH.		ELEC.		C&I		H.O.D.							
2																												
1																												
SR. No.	PARTY																											
PRINT DISTRIBUTION																												
12	11		10		9		8		7		6		5		4		3		2		1							



C&I Signal Exchange between Drives and DCS

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)

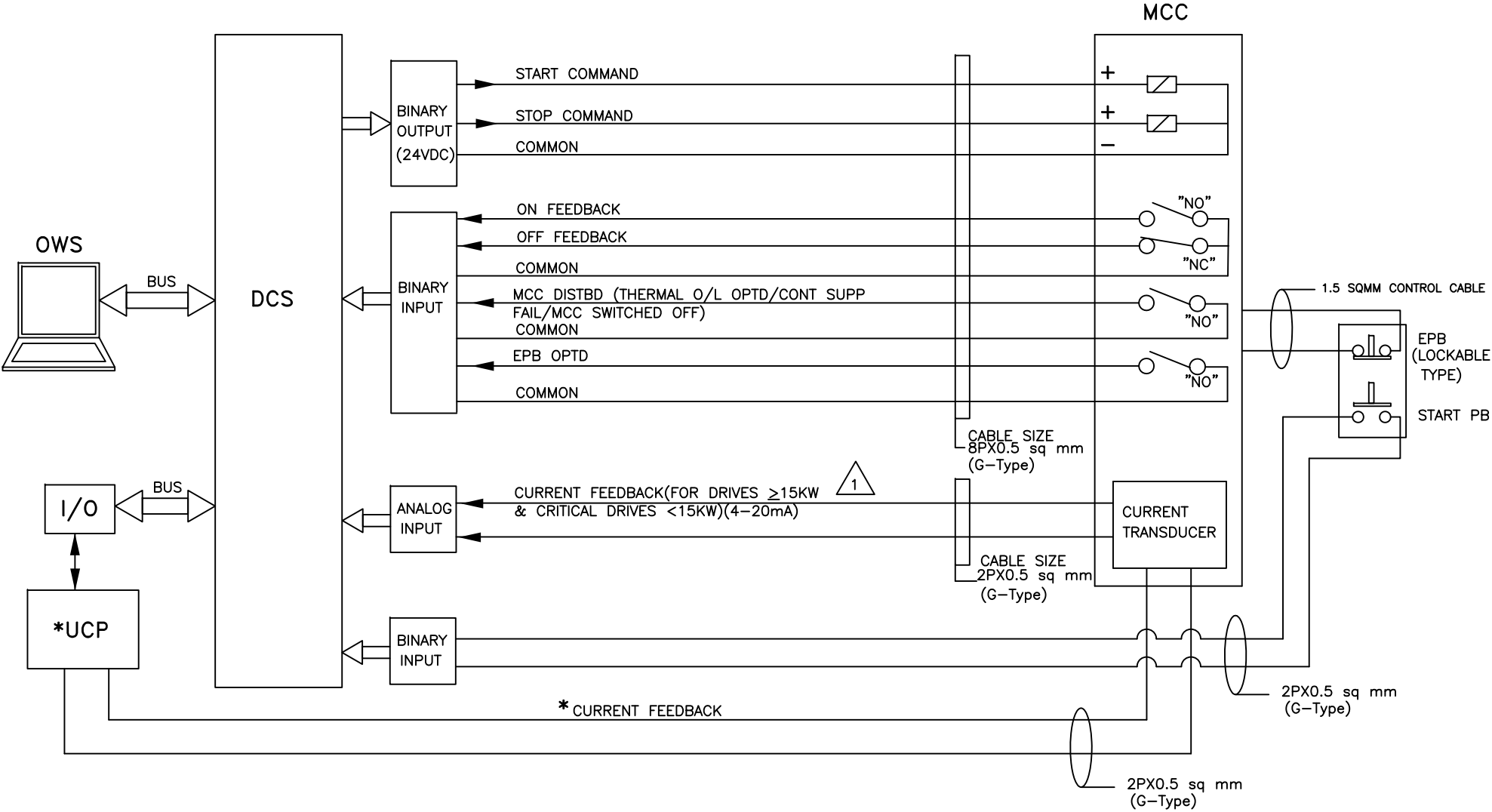


NOTE:

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

	PROJECT: 2X660 MW ENNORE SEZ STPP		DRG.NO.	PE-DM-412-145-I002
	TITLE		DATE	12.02.2015
	DDCMIS INTERFACE FOR		REV.NO.	01
	BIDIRECTIONAL DRIVE		SHT	7 OF 11

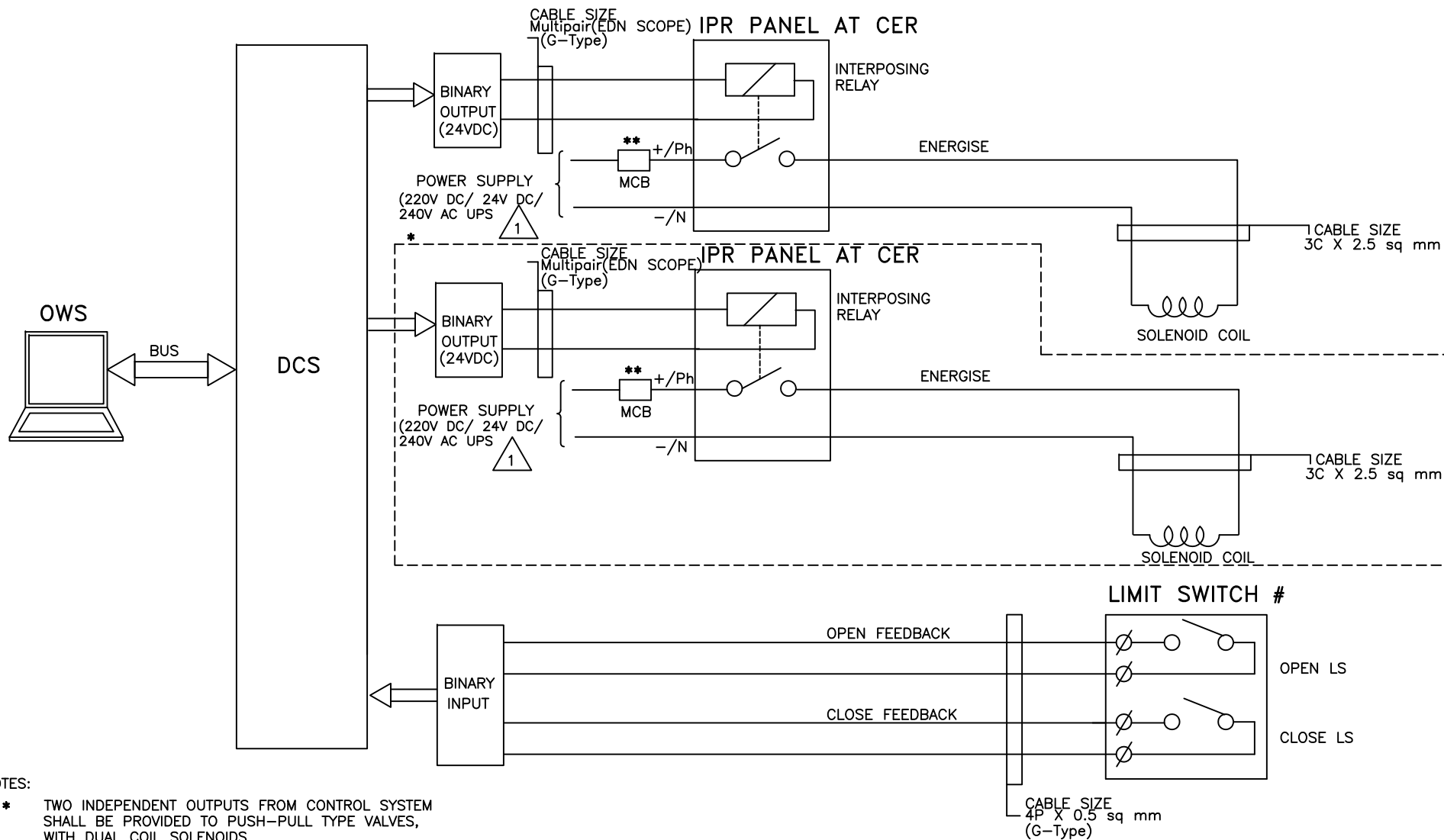
DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



NOTE:
*WHEREVER APPLICABLE

	PROJECT: 2X660 MW ENNORE SEZ STPP		DRG.NO.	PE-DM-412-145-I002
	TITLE		DATE	12.02.2015
	DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE		REV.NO.	01
			SHT	8 OF 11

DCS INTERFACE FOR SOLENOID DRIVE (220V DC/ 24V DC / 240V AC UPS)



NOTES:

* TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

FOR ON/OFF TYPE, SOLENOID ACTUATED VALVE. RELAY CONTACTS SHALL BE WIRED AS FEEDBACK WHEREVER LIMIT SWITCH FEEDBACKS ARE NOT AVAILABLE.

*** BHEL WILL TAKE CARE OF DE-ENERGISE TO TRIP PHILOSOPHY FOR FAIL SAFE CONTROL SYSTEM (WHEREVER REQUIRED)



PROJECT: 2X660 MW ENNORE SEZ STPP

TITLE

DDCMIS INTERFACE FOR
SOLENOID DRIVE

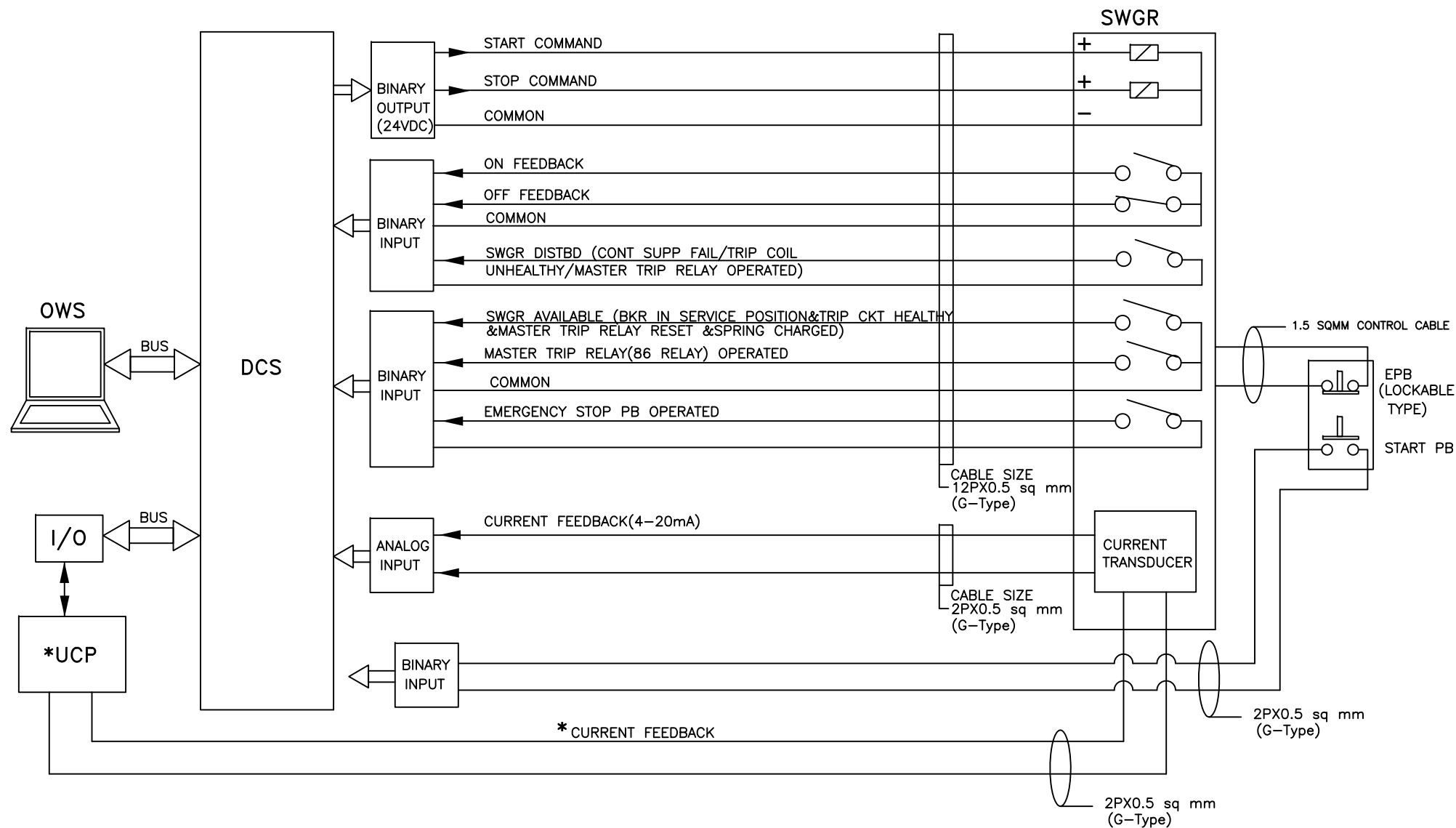
DRG.NO. PE-DM-412-145-I002

DATE 12.02.2015

REV.NO. 01

SHT 9 OF 11

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



NOTE:

* WHEREVER APPLICABLE

1 # VIBRATION, WINDING & BEARING SIGNALS SHALL BE INTERFACED WITH DDCMIS AND INCLUDED IN EDN'S DOCUMENT.



PROJECT: 2X660 MW ENNORE SEZ STPP

TITLE

DDCMIS INTERFACE FOR
UNIDIRECTIONAL HT DRIVE

DRG.NO.	PE-DM-412-145-I002

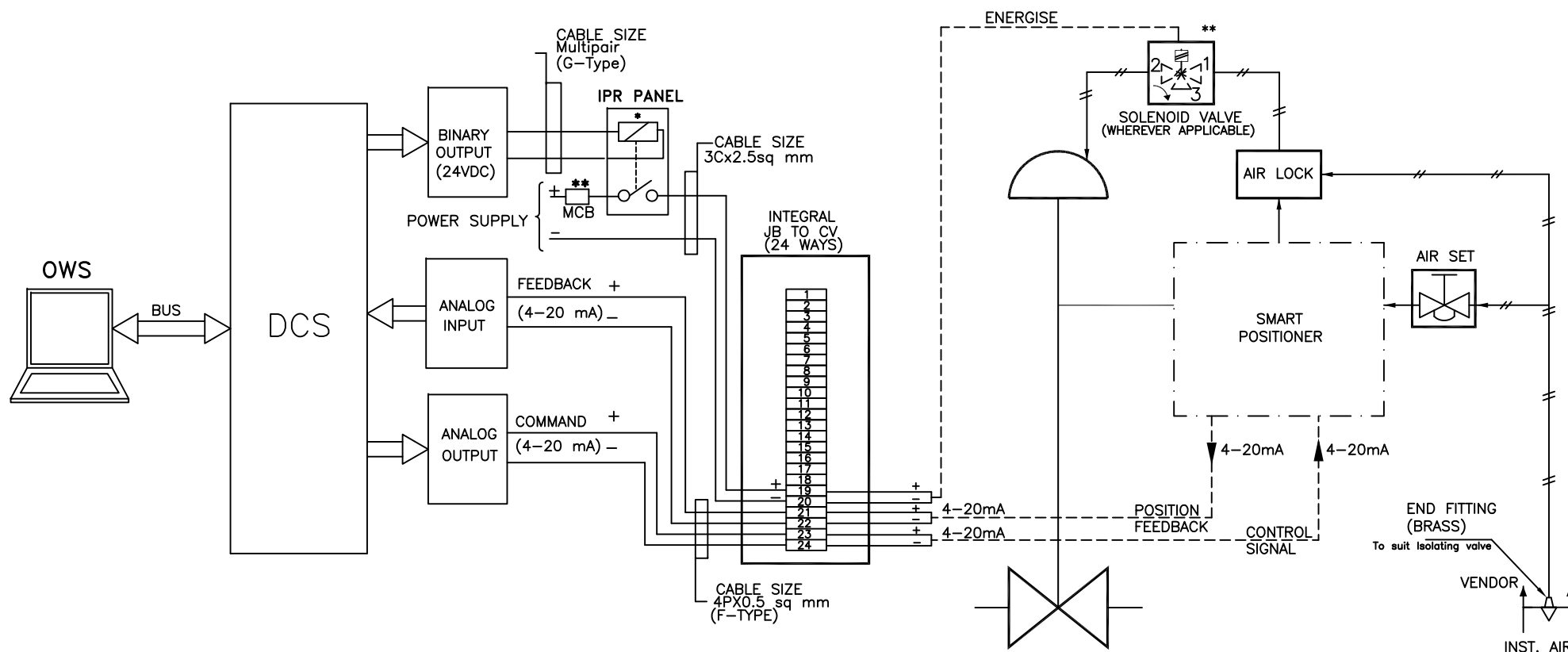
DATE	12.02.2015

REV.NO.	01

01	

SHT	10	OF	11

DCS INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



PROJECT: 2X660 MW ENNORE SEZ STPP

TITLE

TYPICAL HOOK-UP DIAGRAM
ANALOG DRIVE (WITH SMART POSITIONER)

DRG.NO. PE-DM-412-145-I002

DATE 12.02.2015

REV.NO. 01

SHT 11 OF 11

C&I Customer Spec-Instruments, Control Valves,
Electric Actuators

3.03.00 TRANSMITTERS, SWITCHES, GAUGES AND PANEL MOUNTED INSTRUMENTS**3.03.01 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.

Type/Construction	:	Sealed capacitance/ Inductance/ Silicon resonance type
Material		
- Body	:	Die cast Aluminum with epoxy coating for air & flue gas SS316 for other services
- Diaphragm	:	316 SS
- Measurement element	:	Teflon seal
- Valves	:	Carbon steel for non-corrosive Applications SS316 for corrosive applications.
Output signal	:	4 to 20 mA Amp. DC (Two wires) HART Compatible
Local Indicator	:	LCD indicator (5 digit) with scale of Engg. unit
Overall Accuracy	:	$\pm 0.04\%$ or better of Span for BTG package $\pm 0.065\%$ or better of Span for BO P packages $\pm 0.2\%$ or better of span for remote seal type transmitter.
Turn down ratio	:	100:1 in general
Stability	:	$\pm 0.15\%$ of URL for 5 years.
Response time	:	150 msec.
Power supply	:	24V DC nominal
Drive capability	:	600 Ohms nominal
Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Span and Zero	:	Locally adjustable, non-interacting



Zero suppression / elevation : At least 100% of Span

Connection

- Process : 1. Half (1/2) inch NPT (F)
Quarter (1/4) inch NPT
with/without oval flanges

- Electrical : Suitable for Plug in type connection (Both side of transmitter), unused entry with blind plug.

Accessories

- For Absolute Pressure Transmitters: Two (2) valve SS316 manifold

- For Gauge & Vacuum pressure transmitter : Three (3) valve SS316 manifold

- For DP, level & flow transmitter : Five (5) valve SS316 manifold

- For oil and corrosive liquids : Separator diaphragm seals

- For all transmitters : Mounting bracket

Manifold should not be mounted on the transmitter, Manifold shall be on integral and standalone type. Snubbers/Pulsation dampers shall be used where the process media is unstable for measurement such as the discharge of a pump. Over range protection shall be used where necessary. The coil syphons & condensate pots shall be used for steam services. Transmitters shall be provided with suitable drain & vent points.

3.03.01.01 Transmitters & other HART based instruments shall be supplied along with 3 Nos. of universal type hand held/portable pressure calibrators. Temperature transmitters shall be supplied along with 3 Nos. of hand held/portable mV source generators.

3.03.02 PRESSURE SWITCHES (PS) & DIFFERENTIAL PRESSURE SWITCHES (DPS)

Applicable Standards : IS3624 - 1966/ISA-RP-8.1 except as modified in spec.

Type/Construction : Bourdon/Sealed Diaphragm Piston
Actuated preferable. Indicators with contacts are not acceptable.

Materials

- Bellows : 316 SS

- Bourdon tube : 316 SS

- Movement : 316 SS

- Encloser : Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.

- Protective Diaphragm : Teflon



Accuracy	:	$\pm$ One (1) percent or better
Repeatability	:	$\pm$ 0.5(half) percent or better
Setting & Differential	:	Adjustable

Contact

- Number	:	DPDT /2 SPDT
- Type	:	Auto reset with internal Adjustable snap action micro switch
- Rating	:	5 Amp, 240V AC / 0.2 Amp, 220V DC
Connection - instrument	:	Half (1/2) inch NPT Male Process
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 be terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.
- Over range protection	:	One Fifty (150) percent of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

Accessories

- 3 / 5 valve manifold	:	As applicable for all switches
- Self cleaning type pulsation dampers/Snubber (Material SS316)	:	Pump and compressor discharge lines
- Syphon	:	For all steam lines
- Protective separating diaphragm	:	For fuel oil & corrosive liquid lines.
Mounting	:	Local (in LIE/LIR for BTG package).

3.03.03**PRESSURE & DIFFERENTIAL PRESSURE GAUGES (PG & DPG)**

Applicable standard	:	IS:3602-1966, IS/3624, ASME B 40.1
Type/Construction	:	
-760 mm to 1.0Kg/cm ²	:	Bellows/Diaphragm
-Above1.0Kg/cm ²	:	Bourdon Tube
- Suction side of pumps	:	Compound gauge

Materials

- Bourdon tube	:	316 SS
- Bellows	:	316 SS
- Movement	:	316 SS
- Case	:	SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating



		shall be provided for corrosive atmosphere.
- Protective Diaphragm	:	Teflon
Dial size	:	150mm with shatter proof glass
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.
Accuracy	:	$\pm$ One (1) percent or better
Connection - Instrument Process	:	1/2 inch NPT Male Bottom
Mounting	:	Local
	:	1/2 inch NPT Male (Back entry) mounted on local gauge board.
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

Accessories

- 3 way needle valve/manifolds	:	For all gauges
- Self cleaning type	:	Pump and compressor discharge lines
Pulsation dampener/snubber (S316)	:	
- Syphon	:	For all steam lines
- Protective separating	:	For fuel oil and corrosive liquid lines

Other particulars

- External Zero adjustment	:	For all gauges
- Safety device	:	

Ranges 5 to 20 Kg/cm ²	:	Rubber blow out disc with open front construction.
Ranges above 20 Kg/cm ²	:	Neoprene safety diaphragm at the back with solid front construction.
- Over range protection	:	One Fifty (150) percent of full scale

Other Requirments	:	Movement mechanism shall be glycerin filled for oil services & vibration prone area.
	:	For Fuel oil & corrosive liquid lines diaphragm type sensors required. Armored 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 mm wc or suitable range having **dial size of 300mm or bigger size** shall be provided.

3.03.04

TEMPERATURE TRANSMITTERS

Type	:	SMART type configurable from control room through HART protocol (HMS System).
Display type	:	Indicating type (5 digit LCD Display),
Accuracy	:	$\pm 0.10\%$,
Ambient temperature error	:	0.1% per 10°C change
Output	:	4-20 mA DC (2 wire system) HART compatible signals for analogue monitoring inputs to the distributed control system (DDCMIS), DCS & PLC.
Protection class	:	NEMA 4/IP66 or equivalent degree of protection for enclosure/ (Explosion/Flame proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable).
Material of accessories	:	SS316.
Stability	:	$\pm 0.1\%$ or ± 0.1 deg C of reading (whichever is great) for 2 years in case of RTD inputs and for 1 year in case of Thermocouples inputs.
Operating Voltage	:	16 – 48 V DC
Calibration	:	as per NIST monograph 125 for T/C & European Curve Alpha = 0.00385 for RTD .
Ref. Junction compensation	:	Provided
Span/zero adjustment	:	Locally adjustable, Non interacting
Auto calibration	:	Provided
Burn out protection upscale	:	Provided
Input - output isolation	:	Provided
Circuit ungrounded	:	Provided

Any RTD & Thermocouples shall be directly wired to DDCMIS/DCS/PLC for metal temperature application, bearing & winding temp application only.

The Temperature transmitter shall accept Universal dual inputs of all types of thermocouples & RTD, 0-5V input signals etc.



Temp. Transmitter shall be extremely stable against Ambient temperature variation, The accuracy figure shall be inclusive of effect due to ambient temperature variation.

Considering the application & distance involved for monitoring parameters **wireless technology** shall be adopted by interfacing with DDCMIS through OPC connectivity. However Wireless technology as adopted by Bidder shall be reliable and field proven in power plants and same shall be approved by Owner.

3.03.05 RESISTANCE TEMPERATURE SENSORS WITH THERMOWELLS

Applicable Standard	:	ASME PTC 19.3 - Latest Revision DIN EN 60751: 1996, BSEN/IEC60751: 2008
Element	:	Platinum, R0=100 ohm 4-wire Duplex for Process Temp. Measurement Platinum, R0=100 ohm 3-wire Duplex for Bearing & Winding Temp. Measurement
Sheath Material/ Insulation	:	316SS/Compacted Magnesium Oxide
Sheath O D	:	8 MM
- Gauge	:	18 AWG
Terminals	:	Spring loaded high temperature ceramic base with silver plated brass for high vibrating locations.
Calibration	:	As per DIN Standard – 43760, Class A
Head	:	Hex Head, Die Cast Aluminum (Screwed) with galvanized SS chain
Response Time	:	6-10 Sec bare & 30 Sec. With protective sheath/thermowell
Accuracy	:	± 0.35 degree C or Class-A whichever is better.
Electrical connection	:	Gold plated Plug in type. Double entry – one unused entry with blind plug
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

THERMOWELL

Applicable Standard	:	ASME PTC 19.3 TW - 2010
- Construction	:	Tapered drilled from Bar stock (Straight for Air & Gas systems)
- Material	:	- 316 SS/F11/F22/F91 - water and steam Services depending upon process parameters. - Inconel for air & flue gas services For furnace zone, impervious ceramic protecting tube of suitable material along



with Incoloy supporting tubes and adjustable flanges.

For Mill classifier outlet long life solid sintered tungsten carbide material or better of high abrasion resistance.

Bidder shall provide calculation for thermowell as per ASME – PTC-19.3 2010. “All Thermowells in high velocity steam service shall be checked for Strouhal’s frequency limit to arrive at a safer size and design of Thermowells”.

- Process Connection	:	(i) M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, fasteners, gaskets etc.
- Extension	:	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
Immersion length	:	Within ± 10 mm of center line of pipe and as per ASME – PTC-19.3 - 2010
Extension neck length	:	Minimum 100 mm above insulation of pipe and Minimum 160 mm when there is no insulation on pipe.
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations
Note	:	Extension /Compensating/paired cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of mill or due to coal burning. Hence The terminals of temperature sensors shall not be at the top of mills itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

3.03.06 THERMOCOUPLES WITH THERMOWELLS

Applicable standard	:	ASME PTC 19.3- Latest Revision ANSI-MC 96.1 – 1982, IEC 584-2
Element	:	Duplex
- Sheath	:	8 MM OD
- Sheath Material	:	316 SS
- Spring Loaded	:	Yes
- Nipple/Union	:	Yes
- Packed connector	:	Compacted magnesium Oxide ungrounded



- Type : i. Type K (Chromel - Alumel)
ii. Type S/R (Platinum Rhodium-Platinum)
iii. Type T (Cu-CuNi)
with special limits of error according to ANSI-96.1 - 1982.
- Gauge : 16 AWG
- Head : Die Cast Aluminum
- Electrical connection : Gold plated Plug in type. Double entry – one unused entry with blind plug
- Enclosure Class : IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

Thermowell

- Construction : Tapered Drilled from Bar stock
(Straight for Air & Gas systems)
- Material : - 316 SS/F11/F22/F91 - water and steam Services depending upon process parameters.
- Inconel for air & flue gas services
For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.

For Mill classifier outlet long life solid sintered tungsten carbide material or better of high abrasion resistance.

Bidder shall provide calculation for thermowell as per ASME – PTC-19.3 2010.

“All Thermowells in high velocity steam service shall be checked for Strouhal’s frequency limit to arrive at a safer size and design of Thermowells”.

- Process Connection : (i) M 33 x 2
(ii) SS316 Flanged, for Air & Gas systems, with mating flanges, gaskets, fasteners etc.
- Extension : Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends

Accuracy (Special Class as per IEC-751/ANSI-C-96.1)

- (For Type K T/C) : ± 1.1 deg.C (for 0 to 277 deg.C)
 ± 0.4 percent (for 277 to 1280 deg.C) Class-A



For Type S & R T/C	:	± 0.6 deg.C or $\pm 0.1\%$
For Type T T/C	:	± 0.5 deg.C or $\pm 0.4\%$
Accessories	:	Bolts, nuts and gaskets for flanged connections.

Response Time (Bare Thermocouple)

- For SH & RH Temp. Control	:	4-6 Sec.
- All other applications	:	10 Sec.
Immersion length	:	Within ± 10 mm of center line of pipe and as per ASME – PTC-19.3 - 2010
Extension neck length	:	minimum 100 mm above insulation of Pipe and minimum 160 mm when there is no insulation on pipe.
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations.
Note	:	Extension/Compensating cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of mill or due to coal burning. Hence The terminals of temperature sensors shall not be at the top of mills itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

Thermocouples provided for steam services like super heater / de super heater area, where the process pipe is inside the insulation of boiler penthouse, Thermowells are inaccessible and terminal head and connecting cable cannot withstand high temperature, for such services thermocouples shall be provided with flexible extension SS316 Sheath of 10-15 meters.

3.03.07 Metal Temperature Thermocouples

Measuring Medium	:	Metal Temperature
Material of Thermocouple.	:	Chromel Alumel Type K
Type of Thermocouple	:	Duplex with separate hot junctions, ungrounded
Insulation	:	Mineral Insulation Magnesium Oxide.
Thermocouple wire gauge	:	16 AWG
Protective sheath	:	SS 321
Protective sheath dia	:	8 mm O.D



Characteristics of Thermocouple	:	Special limits of error as in ANSI thermocouple MC 96.01.1975
Mounting accessories	:	1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310.
Cold end sealing	:	SS pot weld with colour coded PTFE headed sleeve Insulated flexible tails. Sealing compound- Epoxy resin.
Minimum bending radius	:	30 mm
Length of T/C	:	30 Mtr. (minimum)
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

3.03.08 TEMPERATURE SWITCHES (TS)

Type/Construction

- Switch : Industrial type inert gas filled with capillary and separable thermowell and contacts directly connected to Bourdon element/vapor pressure sensing, gas filled bellows type preferred.

- Thermowell : Bar stock

Material

- Bulb : 316 SS
 - Capillary : Armored Stainless Steel
 - Bourdon : 316 SS
 - Bourdon Movement : SS 316
 - Casing : Die-cast aluminum with stoved enamel black finish Epoxy coating shall be provided for corrosive atmosphere.

Setting and Differential : Adjustable
 Accuracy : $\pm$ One (1) percent of setting and differential
 Repeatability : One half(1/2) percent of setting.

Contacts

- Number : DPDT/2 SPDT
 - Type : Auto reset with internal Adjustable snap action micro switch
 - Rating : 5 Amp, 240V AC / 0.2 Amp, 220V DC

Connection

Pipe : M33 x 2
 - Extension : Threaded union (SS316) 1/2" NPT (F)



with two nipples of SS 316 having 1/2"NPT(M) threads at both ends

Thermowell : To suit Temp. switch with same design criteria as specified for RTDs.
Electrical : Suitable for Plug in type.

All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not be terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.

Other Particulars

- Capillary length : As per requirement (min 10 meters)
- Immersion Length : Within + ten (10) mm of center line of pipe with adjustable nuts.
- Extension neck length : Minimum 50 mm above insulation of pipe /As per approved hookup drawings.
- Packing glands : Yes
IBR Certification : For high pressure service, Steam Temp, Fuel oil temp. measurement as per IBR rules and regulations
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.

3.03.09 TEMPERATURE GAUGES (TG)

Applicable standard : IS : 3602,BS:5235 ISA:RP:8.1 except as modified in this specification

Type/Construction

- Thermometer : Industrial type, Gas in Filled type with separable thermowell
- Thermowell : Bar stock

Material

- Bulb : 316 SS
- Capillary : Armoured SS (Applicable for capillary Type)
- Casing : SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating



		shall be provided for corrosive atmosphere
Dial Size	:	150mm with shatter proof glass
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
Accuracy	:	$\pm$ One (1) percent or better
Response time	:	Maximum 15 seconds without thermowell and 30 seconds with thermowell
Connection		
- Pipe	:	M33 x 2
- Thermowell	:	To suit instrument with same design criteria specified for RTDs.
- Process Connection	:	(i) M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, fasteners, gaskets etc.
- Extension	:	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
Other Particulars		
- Capillary length	:	5Meters/10 Meters as required
- Immersion Length	:	Within + ten (10) mm of center line of pipe with adjustable nuts.
- Extension neck length	:	Minimum 50 mm above insulation of pipe /As per approved hookup drawings.
- Stop at Maximum value	:	For all gauges of scale
- Pointer	:	Externally adjustable
	:	In general, Contact type Temp. gauges are not acceptable for interlock & protection.
		Contact type Temp. gauges are acceptable for interlock & protection in case of bearing temp. only.
- Over range protection	:	150 percent (%) of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
IBR Certification	:	For high pressure service, Steam



Temp., Fuel oil temp. measurement
as per IBR rules and regulations

3.03.10 TEST THERMOWELLS (TW)

Applicable Standard	:	ASME PTC 19.3 TW - 2010
Type/Construction	:	Machined from Bar Stock
Material	:	316 SS/F11/F22/F91
Connection	:	
- Pipe	:	M33 x 2
- Test Instrument	:	To suit test instruments
Accessories	:	Plug with chain
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations Bidder shall provide calculation for thermowell as per ASME – PTC- 19.3 TW - 2010.

Test wells shall be provided on main steam, reheat steam, extraction steam, feed water, condensate, spray water lines and other piping as required to meet ASME test requirements.

3.03.11 DIRECT MOUNTED LEVEL TRANSMITTERS (LT)

Displacer type level transmitter shall not be used in the process anywhere in the plant.

3.03.12 Ultrasonic Level Transmitter (for Water sump/Tank level, Raw water reservoir level, Cooling water fore bay level measurements)

Principle of Operation	:	Detection of reflected ultrasonic pulse
Measuring Ranges	:	Up to 30 meters (typical)
Signal Processing	:	Microprocessor Controlled Signal Processing
Operating Freq.	:	10 KHz to 50 KHz (typical)
Display	:	Head mounted alpha-numeric back lit LCD/LED
Calibration & Configuration	:	Accessible from front of panel & HART calibrator.
Diagnosis	:	On-line
Status	:	For power, Hi / Lo / V. Hi / V. Lo- level indication, fault etc.
Construction	:	Plug-on board
Power supply	:	240 V AC 50 Hz / 24V DC
Signal Output	:	4-20 mA DC with HART (isolated) - 600 Ohm load.
Hysteresis	:	Fully adjustable preferred
Output contacts	:	2SPDT Potential free changeover contacts @ 8A 230V AC.
Accuracy & Repeatability	:	± 0.25% of span or better
Resolution	:	± 0.1% of span
Temperature Compensation: To be provided with Transducer.		



Operating temp.	:	Transmitter-50 deg C and Sensor – 80 deg C
MOC Sensor	:	Body- PVDF and Face – Polyurethane
Humidity	:	1% to 95% non condensing.
Enclosure	:	IP-67 Epoxy painted die cast Aluminum or SS316L housing.
Cable Connection	:	3/4" ET
Mounting	:	2" – 4" NPT or flanged
Accessories	:	Cable gland, prefab cable, mounting accessories like EPDM seal, SS316 flanged etc.
		Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided during detailed engineering.

3.03.13 CAPACITANCE TYPE LEVEL TRANSMITTER

The total system shall consist of capacitance probe, pre-amplifier and transmitter

Type	:	Capacitance type
Probe	:	a) Rod or suspended electrode. b) Rope type probes may be used only where required probe length is greater than 3 meters
Probe Mounting	:	Stainless steel 1-1/2 ANSI RF Flange / 3/4" NPT (M)
Material of construction	:	316 SS
Insulation	:	PTFE Part/Full as per service.
Transmitter	:	The transmitter shall receive output of the preamplifier and convert it into 4-20 mA DC output signal.
Accuracy	:	± 1% of Full scale
Repeatability	:	± 0.5 % of Full scale
Load	:	Min 600 Ohms
Enclosure	:	Powder/Epoxy coated Die cast aluminum. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
Ambient temperature	:	0-60 °C.
Mounting	:	Wall / Surface
Supply voltage	:	240V AC, 50Hz / 24V DC
Response time	:	100 m sec or better
Cable connection	:	3/4" ET
Accessories	:	Counter flange, Cable gland, prefab cable if any
Preferable features	:	Alarm output contacts with adjustable set point facility

3.03.14 GUIDED WAVE RADAR/RADAR LEVEL TRANSMITTER

Type	:	Guided wave Radar (Contact type)/Radar (Non contact type) as finalized by owner.
Application	:	For Turbine Lube oil tank, HFO & LDO tank level,



		Condenser Hotwell, LP heaters, C.B.D tank level, Stator water expansion level, and other Low pressure, Vacuum vessels.
Environment Class	:	Highly abrasive with Gases and Fumes
Orientation	:	Vertical
Probe Type	:	Flexible Single lead with chuck
Probe Material	:	SS 316L
Connection Size & Type	:	2" Flanged ANSI 300 lb SS316L material
Connection material	:	SS 316L
Accuracy	:	+/- 5 mm
Resolution	:	± 1 mm
Type (Transmitter)	:	SMART, 2 Wire
Operating Principle	:	Time Domain Reflectometry
Output	:	4-20 mA, DC with HART protocol and 600 Ω output load.
Electrical Connection	:	½" NPT
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
Electrical Power	:	11-42 V DC
Housing material	:	Die Cast Aluminum
Vent & Drain Plug material	:	SS
Side Flange Material	:	SS
Local Display	:	Provided (LCD Digital)
Units of Measurement	:	Length M
Electromagnetic compatibility:	:	EN-61326

3.03.15 3 D TYPE ACOUSTIC WAVE LEVEL TRANSMITTER

Type	:	Acoustic Wave Level Transmitter (3 D type)
Application	:	Coal and Ash Bunker Level, Volume & Mass.
Temperature compensation	:	Required for high temp applications
Operating Principle	:	Non - Intrusive acoustic wave transmission & Reflection
Frequency Range	:	3 – 10 KHz
Accuracy	:	+/- 0.25 % for even surface & ± 0.5% for uneven surface.
Resolution	:	1 mm
Output	:	4-20mA DC with HART
Display Unit:		
Type	:	Head mounted LCD Display with Engg. Units
Location	:	Suitable location at bunker / Silo operating floor area
Protection Class	:	IP 65 or better// flame proof (IEC-79.1, Part I) As applicable).
Material Of construction:		



Housing	:	Polypropylene
Flange	:	Polypropylene
Sizes:		
Flange Size	:	2" ANSI 300 # RF SS
Electrical connection size	:	½" NPT (F)
Accessories	:	i. Double compression type Nickel Plated Cable glands
		ii. Suitable Mating Flange, necessary gaskets,
		iii. Local display unit and Suitable mounting brackets, necessary mounting hardware for Local display unit.
		iv. Complete software as required to have 3 D view on monitors.

3.03.16 Electronic Water Level Indicator

Application - HP heaters & Boiler Separator Storage tank

This electronic level indicator shall be provided by bidder, **in addition to continuous level transmitter** used for modulating control of respective level.

Electronic Remote level Monitoring System working on principle of difference in electrical conductivity between steam and water. The Monitoring System shall meet the requirements as indicated below.

The sensing electrodes shall be placed in equal pitch. The maximum distance (gap) between two electrode shall be 50 mm and the electrodes shall be arranged in such a way that the last and the first electrode shall not be at any alarm or trip level.

Both indication and validation system shall be supplied with double isolation valves in water, steam, drain and vent lines.

Each electronics unit shall be provided with 2 x 100% redundant power supply pack converters to be fed from two feeders of 24V DC or 240V AC UPS system as per system requirement. These two power supplies shall be internally fused and failure of one power supply shall not affect the performance of the system. Self-monitoring facility to detect and alarm the loss of power supply shall be provided.

The detector unit, logic units, 2x 100% redundant power supply units/packs shall be housed in separate and independent cubicles for pressure vessel on each side of the tank. The Electronic unit mounted locally should have detector units, logic units etc. & shall be independent for each pressure vessel. The minimum enclosure rating IP 65.

Indication shall be provided at field for both indication and validation system. Remote indication is to be provided for indication system at unit control panel in CCR. Local Indication should be inbuilt in local electronic unit.



Electrode assembly shall have blow out and leakage proof sealing arrangement. Field proven ceramic/zirconia probes with insulation suitable for design pressure and temperature are to be provided.

The system design shall be such that it shall ensure that failure of one probe circuit shall not affect another probe circuit and failure of any electrode will not hamper the system function and operation. Further the entire system shall be of proven fail-safe design.

The logic shall be such that the trip and alarm relay circuits shall be independent for each for Low, Low-Low, High and High-High levels of tank. Monitoring of set time for trip generation and provision of setting time delay shall be available in the system. Trip logic shall be independent and separate from faultfinding logic.

The system shall have fault diagnostic features such as process fault, system hardware fault, probe failure, circuit board failure, shorted wire etc. Further the system shall be able to distinguish between a cable fault and an electrode fault.

The necessary relays and relay modules for the Output Contacts shall be of proven design and each contact shall be rated for 5A, 240V AC/0.25A 220V DC rating. All these contacts shall be 2SPDT type. The **vessel** holding electrodes **shall be IBR certified**. The system shall be proven and approved by Factory mutual, USA of equivalent, IBR etc.

3.03.17 LEVEL SWITCHES (LS)

Type/Construction	:	a) External float cage type with magnetic switch actuator for tanks and vessels. b) Electrode/Capacitance (for oil tanks) c) Displacer -Top mounted for all clean water sumps. d) Conductivity type for high Pressure and high temperature enclosed vessel like drain pot, HP heaters etc.
Materials		
- Body	:	Cast Carbon Steel/Die cast Aluminum suitable for specified pressure and temperature ratings
	:	For corrosive liquids suitable anti-corrosive coat/lining shall be provided.
- Float/Displacer	:	316 SS
- Wire rope	:	316 SS
Differential	:	± 12 mm minimum (Adjustable)
Contacts		
- Number	:	DPDT/2 SPDT
- Type	:	Snap action micro switch Auto reset with internal Adjustable
- Rating	:	5 Amp 240V AC 0.2 Amp 220V DC
Connection - Process	:	One (1) inch SCRD NPT Female Or One (1) inch ANSI Flanged Four(4) inch ANSI Flange for sump services.
Electrical	:	Suitable for Plug in type connection



Temperature/pressure rating : As per service conditions
 Accessories : Counter flanges, still pipe of requisite length with anticorrosive coating for sump services.

Nuclear, capacitance, or ultrasonic type level switch for bulk material applications shall be provided.

3.03.17.01 Conductivity Type Level Switch

Type	:	Conductivity discrimination.
Mounting	:	Flanged – on standpipe.
Probe MOC	:	Stainless steel with high purity ceramic.
Probe rating	:	> Maximum design pressure of vessel.
Input	:	Four independent channel with selectable switching threshold for water conductivity.
Relay Output	:	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
Contact type & rating	:	2SPDT or 1 DPDT @ 5A 30V DC.
Faults Detection	:	Power Fail/Electrode Connection Open circuit/short circuit to ground, Ground failure. In built Fail Safe Logic.
Indicator	:	One Red LED for steam/ one Green LED for water/ Two no. LED one each for Process & system fault.
Power supply	:	Dual 240V AC, 50 Hz, 1Ph. From UPS
Enclosure	:	IP-65, corrosion resistant & wall mounting type.
Accessories	:	i. PTFE cable from probe to electronics unit. Electronic unit shall be separate. Head mounted electronic unit is not preferred. ii. Mounting accessories iii. standpipe iv. Washer & gasket
Test pressure	:	Two times rated pressure

3.03.17.02 Capacitance Type Level Switch

Type	:	Capacitance type
Probe	:	a) Rod or suspended electrode b) Rope type probes may be used only where required probe length is greater than 3 meters.
Probe Mounting	:	Stainless steel 1-1/2 ANSI RF Flange / 3/4" NPT (M)
Material of construction	:	316 SS
Insulation	:	PTFE Part/Full as per service.



Enclosure	:	Powder/Epoxy coated Die cast Aluminium. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
Ambient temperature	:	0-60 °C.
Mounting	:	On Top
Supply voltage	:	240V AC, 50Hz from UPS/ 24V DC
Relay output	:	2SPDT
Contact rating	:	5A min. at 240V AC on resistive load
Response time	:	100 m sec or better
Cable connection	:	3/4" ET
Accessories	:	Counter flange, Cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.

3.03.17.03 RF TYPE LEVEL SWITCH

A. Electronic Controller

1.	Input Supply	:	240 V AC from UPS
2.	Construction	:	Cast Aluminum 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 Aluminum
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
C.	Signal Cable	:	Coaxial cable for Connection Between Sensing probe and electronic Controller(@ 10 Mtrs. Per Level Probe)



D. Application : Ash Silos

3.03.18 LEVEL INDICATORS (Gauge Glass) (LI)

Type/Construction	:	a) Reflex b) Tubular (For tanks open to atmosphere only)
Material:		
a) Glass	:	Tempered borosilicate resistant to thermal shock
b) Case	:	Carbon steel
c) Integral cocks and	:	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
Dial size/scale	:	150 mm /1.5 Meters maximum length with
Scale details	:	Aluminum/SS316 scale Graduated in mmwc
Connection	:	25 Nb/40 Nb ANSI Flanged
Accessories	:	a) Integral cocks b) Drain valves c) Bolts, nuts and gaskets d) Illuminating lamps as required e) Periscope as required
Tests	:	Tested at two hundred (200) percent of the maximum process pressure
Other details	:	For larger lengths, additional gauge glasses shall be provided with minimum of 50 mm overlap.

3.03.19 FLOAT & BOARD TYPE LEVEL GAUGE

Type of Instrument	:	Mechanical Type (Float Operated)
Service/ Application	:	As per service requirement
Measuring Range	:	as per requirement
Material Specification		
a) Float Material	:	SS316 having 2 nos. Guide wires
b) Float Wire Pulley	:	Shall comprise of 2 nos. Cast Aluminum 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 Aluminum Pointer and Brass assembly Pull Chain.
e) Scale	:	SS 316/Aluminum material in mm with 1 % accuracy.
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)
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)
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)

3.03.20 MASS FLOW METER

Sensor

Measuring Principle	:	Coriolis Mass flow.
Primary Element	:	Flow Tube of 316SS or better
Heating Arrangement	:	Integral with Flow meter.
Temperature Control For Heating	:	To be provided.
Process Connection	:	ANSI RF Flanged and rating as per process requirement.
Drain	:	Self-draining facility
Accessories	:	Counter flanges, Mounting nuts, bolts, gaskets etc.

Transmitter

Measured quantities	:	Mass Flow rate, Total Mass Flow, Density, Temperature as minimum.
Input Signal Processing	:	Digital Processing.
Display	:	Digital Display (LCD).
Output	:	2 Nos. isolated output of 4-20mA DC selectable from four measured quantities.
Load	:	< 750 ohms.
Power supply	:	240V AC, 50 Hz. From UPS
Accuracy	:	0.15% of measured value for Liquid 0.5% of measured value for Gas
Repeatability	:	0.05%
Housing	:	IP 65 (Explosion proof for NEC Class-1, Division 1 area)
Hazardous duty Version	:	FM Standards.



Nameplate	:	Tag number, service engraved in stainless steel tag plate
Accessories	:	a) As required for field mounting, Handheld configurator & complete Software, External zero adjustment facility b) Mounting U-bolts, nuts, bolts, prefab cable etc.
Application	:	HFO main line, LDO lines, HFO recirculation lines etc.

3.03.21 Turbine Flow meter**Sensor**

Type	:	Turbine (in line full-bore, based on magnetic pick of pulses)
Output Signal	:	Pulse
Material of Construction	:	a) Body : AISI 316 b) Rotor: AISI 431 or 410 c) Bearings: Tungsten Carbide / Stellite Sleeve
Flow rate range	:	As required.
Linearity	:	0.25% or better.
Repeatability	:	0.02% or better.
Ambient temperature	:	50 deg C
Mounting	:	On-Line mounting with ANSI RF flanges of stainless steel.
Enclosure	:	IP 65
Transmitter		
Electronics	:	Solid State
Power Supply	:	240V AC, 50Hz. UPS
Input	:	Input from Sensor
Display	:	4 1/2 digit LCD
Output	:	Isolated 4-20mA DC HART
Measuring Accuracy	:	0.5% of full scale range
Totalized Value	:	Required
Housing	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Nameplate	:	Tag number, service engraved in stainless steel tag plate
Accessories	:	a) clamping strip, bracket, prefab cable etc. and Calibration or configurator kit.

3.03.22 VORTEX FLOW METER**Sensor**

Type	:	Vortex



Output Signal	:	Pulse
Material of Construction	:	AISI 316
Sensor Seal	:	PTFE / higher based on temperature
Flow range	:	As required.
Linearity	:	0.25% or better.
Repeatability	:	0.02% or better.
Ambient temperature	:	50 deg C
Mounting	:	On-Line mounting with flanges of stainless steel.
Enclosure	:	IP 65
Accessories	:	Nuts, bolts, gaskets etc.

Transmitter

Electronics	:	Solid State
Power Supply	:	240V AC, 50Hz. UPS
Input	:	Input from Sensor
Display	:	4 1/2 digit LCD
Output	:	Isolated 4-20mA DC HART
Measuring Accuracy	:	0.5% of full scale range
Totalized Value	:	Required
Housing	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Nameplate	:	Tag number, service engraved in stainless steel tag plate
Accessories	:	Clamping strip, bracket, prefab cable etc. Special tool kit for calibration/ configuration .

3.03.23 Flow Transmitter (Ultrasonic)

Type	:	ULTRA SONIC, 2-wired
Sensing element	:	Non-contact
Output	:	4-20mA with HART Protocol
Accuracy	:	± 0.1% FS
Supply	:	24 V DC
Enclosure class	:	IP-65

Transmitter

Mounting	:	On Nozzle
Mounting position	:	Top mounted
Housing	:	Plastic
Display	:	Head mounted LCD Display and remote LCD display
Process connection	:	NPT/Flanged
Electrical connection :	:	NPT
Turn Down ratio	:	1:100
Measuring range	:	Adjustable (as per process requirement)
Totaliser	:	Required
Accessories	:	As per process requirement Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided during



detailed engineering.

3.03.24 Positive Displacement Flow Transmitter

Positive displacement flow transmitters shall be offered. An electronic totalizer shall be provided for each flowmeter and the location of the totalizers shall be acceptable to the Owner. Air eliminators shall also be provided to ensure maximum accuracy.

Type	:	Hall Effect Sensor
Body Material	:	AISI 316L/Die Cast Aluminium.
Wetted part Material (Like Piston, Bearing, gear etc)	:	AISI 316L/Die Cast Aluminium.
O ring material	:	PTFE / higher based on temperature
Flow range	:	As required.
Accuracy	:	$\pm 0.5\%$ or better of reading
Repeatability	:	$\pm 0.03\%$ or better.
Ambient temperature	:	50 deg C
Mounting	:	On-Line mounting with flanges of stainless steel.
Electronics	:	Solid State
Power Supply	:	230V AC, 50Hz. UPS
Display	:	4 1/2 digit LCD for Flow rate & totalized value.
Output	:	Isolated 4-20mA DC
Turn Down ratio	:	1:30
Totalized Value	:	Required
Housing	:	IP-65/ (Explosion proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable).
Nameplate	:	Tag number, service engraved in stainless steel tag plate
Accessories	:	a) Clamping strip, bracket, prefab cable, battery etc.



- b) Nuts, bolts, gaskets, mesh etc.
Special tool kit for calibration/configuration.

3.03.25 Electromagnetic Flow meter

Electromagnetic flow meters shall have separate transmitter having accuracy $\pm 0.2\%$ with zero stability feature, suitable for process medium with ≤ 5 micron Siemens conductivity, flanges material SS-316, electrode & measuring tube material SS-316, liner material Teflon and enclosure IP-66, local digital display configurable as totaliser, 4-20 mA output signal HART compatible with zero and span field adjustable. Application – DM Water and for other application as decided by owner.

3.03.26 FLOW GAUGES (FG)

- Type/Construction :
- a) On-line type Rotameter for 50 Nb and below lines
 - b) Bypass type Rotameter for above 50 Nb lines.

Material

- For On-line type

- Metering Tube : Borosilicate glass
Float : 316 SS
Packing : Teflon
End fittings : 304 SS

-For Bypass type

- Metering Tube : Borosilicate glass
Float : 316 SS
Packing : Teflon
End Fittings : 304 SS
Orifice Plate : 316 SS
Carrier ring : 304 SS
Flanges & Mating flanges : Same as pipe material, 200 lbs ANSI - RF
- Impulse pipe : Same as pipe material
- Fittings : 2000 ANSI, SW ends to match with pipe material.
- Dial Size/Scale length : 250 mm
Scale Details : Direct reading type engraved on detachable Aluminum scale
- Accuracy : $\pm$ Two (2) percent
Reproducibility : Half (1/2) percent
Rangeability : 1:10
Connection : SCRD NPT



Accessories	:	a) Isolating valves (for Bypass type only)
		b) Bolts, Nuts and Gaskets as required
Tests	:	Shall be tested at two hundred (200) percent of the maximum process pressure

3.03.27 SIGHT FLOW GLASS INDICATORS

Type/Construction	:	Flapper type.
Materials	:	
Body	:	Carbon steel/SS316 as per process requirement
Glass	:	Toughened Borosilicate
Gaskets	:	Neoprene
Bolts & nuts	:	SS
Flappers / Rotating Wheel	:	316 SS
Flappers / Rotating Wheel holder	:	304 SS
Process Connection	:	SW (Socket Welded)
Accessories	:	Scale, Bolts, Nuts, Cover plates and Gaskets as required
Tests	:	Tested at two hundred (200) percent of the maximum process pressure.

3.03.28 SOLID FLOWMETER

Type	:	Online Impact type Microprocessor Based
Measuring Principle	:	The system measurement is basically pertains to the measurement of horizontal deflection using LVDT, created by the impact of solid flow upon online sensing plate. The horizontal deflection being proportional to the impact forces, LVDT convert this horizontal movement into electrical signal. The inbuilt integrator convert this signal into time based flow rate indication & provide totalized flow also.
Sensing plate	:	316 SS
Sensing head	:	Sensing mechanism shall be mounted outside the process flow line.
Enclosure	:	316 SS
Enclosure protection	:	IP 67 class
Accuracy	:	+/-1%
Repeatability	:	+/- 0.2%
Drift	:	Both zero & span $\pm$ 2% / month
Output	:	4-20mA DC isolated, load 600 ohm (min)
Digital communication	:	yes, (HART) facility
Power supply	:	240 V AC, 50Hz. UPS
Ambient condition	:	Temperature -60 ⁰ C, RH-95% Environment – Highly Dusty



Accessories : Shall be complete with all the accessories including digital display for flow rate, integral vents, baffles for air separation, etc. which ever required for satisfactory operation.

Note:-

1. The above on line flow meter shall not create any obstruction on flow.
2. User's list shall be submitted to support on proven satisfactory performance for similar process application.

3.03.29

Instrument Air System

The instrument Air Supply System for various pneumatic Control & Instrumentation devices like pneumatic actuators, power cylinders, I/P converters, pneumatically operated valves etc. shall be complete in all respect with necessary Air Filter Regulators, valves, piping/tubing etc.. Each pneumatic instrument shall have an individual air shut off valve. The pressure-regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built in filter-housing blow down valve.

Filter shall be of minimum 5-micron size & sintered bronze material.

On collection of water in the drains of instrument air lines, mechanical automatic drains and periodically solenoid operated drains (with electronic timer - 15m, 30m, 60m and 2 Hours & Timing adjustable) are to be provided.

For mechanical type & Electrical type, the locations to be provided in the instrument air lines of boiler area, Chimney area, turbine area etc., shall be decided during detailed Engineering.

Bulk header nearby the crowded applications shall be provided and from this bulk header individual air lines with necessary isolation valves are laid to the application.

These bulk header are to be provided with **mechanical / electronic based automatic Drains**.

Individual moisture separator for O₂ analyzer or vital application shall be provided nearby the instrument so as to enhance the cell life or the performance of vital final control elements.

3.03.30

Air Filter Regulator (AFR)

Constant bleed type AFR with an accuracy of ± 1.0 % inlet pressure range of 5-8 kg/ cm² and suitable spring ranges (AFR) for use with positioners in control valves, control damper, E /P converters and shut off valves for phosphor bronze filter element; Filtering particles above five microns. Weather and water proof enclosure. Material of accessories will be SS316.

Air filter regulators shall be provided in the :

- (a) Air supply line to valve positioners / power cylinders
- (b) Air supply line to electric to pneumatic converters.



- (c) Air supply line to pneumatic interlocked block valves.
- (d) For each instrument rack, field instruments enclosure for purging.

3.03.31 Electro-Pneumatic Convertors (E/P)

Two wire type E/P convertors with an accuracy of $\pm 0.25\%$ accepting 4-20 mA dc signals from control system and converting to 0.2 to 1 kg/cm² air pressure to operate valve positioner of all final control elements; Housed in cast aluminum casing (with polyurethane paint); NEMA 4 or equivalent degree of protection for enclosure. Material of accessories will be S.S. E/P convertors shall have fail freeze (stay put) feature also. Process connection shall be 1/4" NPT (F) and Electrical connection shall be 1/2" NPT (F). Zero/span adjustment facility shall be provided. The E to P converters shall **retain the pneumatic signal (last value) even in failure of control signal** and shall have **self volume boosters**. Necessary air lock devices and pressure switches for air pressure low alarming shall be provided.

3.03.32 Solenoid Valves

Solenoid valves shall be provided with control valves / pneumatic control valves hooked up with process interlock requirements and where direct tripping is involved. The number of ways for solenoid valve shall be provided as indicated below:

- (a) Two (2) way solenoid valves shall be provided, where process line of less than 50 mm with low pressure and temperature application.
- (b) Three (3) way solenoid valve shall be provided commonly, where the pressure is admitted or exhausted from a diaphragm valve or single acting cylinder, e.g., Pneumatic operated spray water block valve.
- (c) Four (4) way solenoid valve shall be provided for operating double acting cylinders, e.g., Pneumatically operated on-off type dampers.
- (d) For operation of the fuel oil corner nozzle valves, fuel oil trip valves etc., **double coil solenoid valve** (latch coil & relatch coil) shall be adopted.
Single coil usage requires always power and loss of power leads to closure of above valves resulting the unit trip or loss of generation.
- (e) Solenoid Valve coils shall be Class-H high-temperature or Class-F construction as applicable and shall be designed for continuous duty. Three-way solenoid valves shall be designed for universal operation so that the supply air may be connected to any port. Solenoid enclosures shall be NEMA-4/ (Explosion proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I) As applicable). Body material of solenoid valve shall be Die Cast Aluminum or SS316.
- (f) All solenoid shall be with varistor, LED indication, surge suppress diode and circuits.

3.03.33 Power Cylinders (Pneumatic)

Mounting Type	:	a) Fixed position mounting (End mounting).
	:	b) Trunnion mounting
Control Signal	:	0.2 to 1 Kg/Sq. cm. from I/P converter for modulating purposes. 24V/48VDC operated solenoid valve operating on pneumatic line.



		The Pilot solenoid will have separate coils for open closing purpose.
Supply Air	:	0-7 Kg / Cm ² .
Selection	:	Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation.
Casing	:	IP-65.
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).
Fail-safe operation	:	Stay put, open or close position on pneumatic / electrical power supply failure as per process safety criteria.
Repeatability	:	Better than 0.5% of full travel.
Hysteresis	:	Less than 1% of full travel.

3.03.34 Nucleonic Type Density Meter (For Ash Handling Plant):-

Type	:	Nuclear type radiation
Application	:	Abrasive Slurries & Corrosive Chemicals
Accuracy	:	< 1% of Span
Orientation	:	As per requirement.
System Type	:	Radiation Source & Scintillation Detector
Meter Material	:	SS 316L/ Aluminium with PVC coating
Connection material	:	SS 316L
Compensation	:	Temp. Compensation required
Type (Transmitter)	:	SMART, 2 Wire HART based
Operating Principle	:	As the density increase, the lower the radiation field at detector and vice versa.
Output	:	With photomultiplier, 4-20 mA, DC
Electrical Connection	:	½" NPT
Enclosure Class	:	IP 66
Local Display	:	Provided
Accessories	:	Radiation Survey Meter and all erection/installation hardware

3.03.35 Non - Nucleonic (Vibration) Type Density Meter (For DM & AHP Plant):-

Application	:	Liquid Density measurement
Detector		



1.	Orientation	:	As per requirement.
2.	Case Material	:	SS 316/ Cast Aluminium alloy
3.	Wetted part material	:	SS 316
4.	Operating Principle	:	Vibration Density measurement

Converter

1.	Output	:	4-20 mA DC isolated.
2.	Electrical Connection	:	½" NPT
3.	Enclosure Class	:	IP 65
4.	Local Display	:	Digital 5 digit, density display with temp. compensation.
5.	Accuracy	:	+/- 1%
6.	Response time	:	< 1 minute.
7.	Power Supply	:	240 V AC, +/- 10%, 50 Hz. From UPS

3.03.36**PULL CORD SWITCH**

Type	:	Addressable Type
Body	:	Cast Iron
Contact rating	:	Continuous 10 Amp, Breaking 2 Amp. (240 V AC)
No. of contact	:	2 NO + 2 NC
Reset facility	:	Manual Reset
Type of enclosure	:	Die Cast Aluminum
Degree of protection	:	Flame proof/Explosion proof for NEC class 1, Division 1 area
Local trip indication	:	Required
Accessories	:	1. Canopy over lever of pull Cord switch. 2. Linking of switches through a single cable for each section. 3. Each pull cord switch shall be provided with red LED indication lamp for prominent visible indication of tripping. 4. "One number indicator panel which shall display the exact number of safety switches (pull cord and belt sway switches) operated in a loop of conveyor. It shall also monitor the condition of field cable connecting the switches in series & generate signal if field cable is found broken or short. The indicator panel shall display the operated switch number. The same indication shall also be available in C H P P L C operator station.

3.03.37**BELT SWAY SWITCH**

Type	:	Addressable Type
Body	:	Cast Iron
Contact rating	:	Continuous 10 Amp, Breaking 2 Amp. (240 V AC)
No. of contact	:	2 NO + 2 NC
Reset facility	:	Auto Reset
Type of enclosure	:	Die Cast Aluminum
Degree of protection	:	Flame proof/Explosion proof for NEC class 1, Division 1 area
Accessories	:	1. Canopy 2. The beltway switches shall be provided with a common bridging push button which may be kept pressed to bypass the limit switch before restarting the conveyor. 3. Same as above 3.03.36 (4).

3.03.38 ZERO SPEED SWITCH

Type	:	Microprocessor Based
Body	:	Cast Iron
Contact rating	:	Continuous 10 Amp. (240 V AC)
No. of contact	:	2 NO + 2 NC
Reset facility	:	Manual Reset
Type of enclosure	:	Die Cast Aluminum
Degree of protection	:	Flame proof/Explosion proof for NEC class 1, Division 1 area
Accuracy	:	+/- 5%
Repeatability	:	+/- 1%
Differential	:	+/- 5%
Accessories	:	Canopy

3.03.39 CHUTE BLOCK SWITCH

Type	:	RF Based
Sensor Material	:	SS 316
Mounting	:	Flanged
Insulation Material	:	PTFE
Contacts	:	2 NO + 2 NC
Type of enclosure	:	Die Cast Aluminum
Degree of protection	:	IP 66
Electrical Connection	:	¾ " ET
Repeatability	:	0.05%
Local Indication	:	To be provided
Accessories	:	a) Neoprene Gasket and Stud Bolt b) SS Tag plate, Nickel plated brass double Compression type cable gland

3.03.40 Humidity & Temperature Sensor with LCD display for AC Plant

Humidity Sensor		



Measurement range	:	0-100%r.h.
Range of use	:	0-100%r.h.
Measurement accuracy at 23° C 0-100% r.h.	:	±2%
Temperature dependency	:	≤0.05% r.h./ ° C
Output signal, linear (terminal I1)	:	DC4-20mA = 0-100%r.h.
Temperature Sensor		
Range of use	:	0-50° C & -35 to 35° C
Sensing element	:	Pt1000 class A
Measurement accuracy at 15-35° C	:	±0.5K
Output signal, linear (terminal I2)	:	DC4-20mA = 0-50° C & -35 to 35° C
General Sensor Data		
Power supply	:	
Operating voltage	:	AC 24V ±20%
Degree of Protection & Safety Class		
Degree of protection of housing	:	
With enclosed cable gland	:	IP 65 to IEC 529
Safety class	:	III to EN 60 730
Environmental Condition		
Temperature (housing with electronics)	:	-40 to 70° C
Humidity	:	5 to 95% r .h. (non condensing)
Location	:	In each A HU room and Control room

3.03.41

DEW POINT METER

Type	:	2 Wire Loop Powered Dew point Transmitter
Overall Range	:	-60°C to +20°C Dew point
Accuracy	:	± 2°C Dew point
Material	:	SS316 (wetted parts)
Features	:	AUTOMATIC CALIBRATION
		- Can be Configured for Linear 4-20mA signal in °C & °F Dew point, ppm(v), ppb(v), g/m3 - Temperature Compensation



2 x 660 MW ENNORE SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03/2013-14

Vol. V /Sheet - 72

Page 377 of 487



- Failure Diagnostics
- Long Term Stability
- Fast Response
- IP 66 / NEMA4X Protection
- Supplied with Calibration Certificate Traceable to National & International Humidity Standards
- Sensor protection with sintered filter
- Local LCD Display for Dew Point

3.03.42

Junction Boxes

v.	Type	:	Flame proof/weather proof
vi.	Enclosure	:	IP-65/Explosion/Flame Proof as per area classification.
vii.	Material	:	FRP with protective Coating
viii.	Cable entry	:	Bottom or Side
ix.	Cable glands	:	Double compression type – Nickel plated brass with PVC hoods.
x.	Mounting	:	Indoor/Outdoor
xi.	No. of terminals	:	As required with standardization with 20% spare of each size & type.
xii.	Terminals	:	Phoenix/Wago (screw less cage clamp type spring loaded)
xiii.	Grounding	:	Two terminals for body and shield ground
xiv.	Door	:	Hinged, lockable type.
xi.	Suitable mounting clamps and other accessories shall be in scope of bidder.		
xii	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.		
Xiii	M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.)		
xiv	Gasket (Normal)- Neoprene thickness 6.0 mm		

3.03.43

Interposing Relays (IPR)

Electro magnetic 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. Free wheeling 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 –20 deg. C to 60 deg. C. The relay shall have the necessary approvals like V O inflammability class in accordance with UL94”, IEC60664/IEC60664A/DIN VDE 0110. Facility to stimulate IPR manually shall be provided. The V A 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.

3.03.44

RECORDERS (CHARTLESS)

Type	:	Micro-processor based, Digital TFT display type
- No. of Channels	:	Forty Eight (48) point).



6 Nos. of recorders shall be supplied with BTG packages and the parameters shall be decided during detailed Engineering. Quantities of recorders for BOP packages shall be decided during detailed Engineering.

(Simultaneous parameter display preferred)

Input Signal	:	Fully configurable multi range
Recording method	:	(Programmable) universal (input)
Display colour	:	Continuous with different colour, for each channel
Bar graph facility	:	Selectable from 30 Colours
Digital indication	:	To be provided
Accuracy	:	To be provided
Programmability	:	+/- 0.1 % for reading for DC V
Data Storage	:	Input And 0.1 Deg for TC/RTD input
Data Retrieval	:	Front key board
Scan rate	:	hard disk/ Flash Memory
	:	Compact 4 GB flash Memory card and USB port with 8 GB USB drive.
	:	≤ 20 m second for individual channel.
	:	Selection of scan time for individual channel is required.
Power Supply	:	240 VAC 1 Phase UPS
Ambient Temperature	:	0-50 Degrees
Mounting	:	Front panel mounted weather & Dust proof IP 65
Application software	:	Yes, To be provided
Internal Memory	:	400 MB or more
Screen	:	≥ 10.5" colour LCD TFT
Resolution	:	≥ 640 X 480 Pixels
Type of Display	:	i) Trends
	:	ii) Bar Graph
	:	iii) Digital display/ values
Event Sampling	:	1/2/5/10/30/60/120 sec.
Zoom & Scroll Facility	:	Required
OWS and printer connectivity port	:	Required
	:	Necessary software shall be supplied for uploading the data.
Communication	:	Additional MODBUS/PROFIBUS ports connectivity between recorder and third party systems.

3.03.45 DIGITAL INDICATOR

Type	:	Programmable electronic digital indicator with floating point decimal.
Input	:	4-20 mA DC/1-5V DC/RTD/T/C.
Number of inputs	:	One
Range	:	As per requirement/adjustable by end user



		through key pad available on the indicator.
Number of digits	:	Four plus sign
Digit height	:	20 mm or larger
Display	:	Fluorescent red
Input over range/open sensor (T/C)	:	All digits to flash
Input hold time	:	0.7 seconds max.
Accuracy	:	$\pm 0.25\%$ of span
Power supply	:	240V AC, 50Hz
Mounting	:	Flush panel, compatible for mounting on mosaic grid panel
Size	:	96x48 mm
Other Particular	:	Indicator receiving thermocouple signal shall have automatic cold junction compensation.
	:	Retransmission Output 4 -20 mA isolated required.
	:	24 V DC inbuilt power supply
	:	Alarm contact with 2 NO/NC contact (rating 5A/230 V AC)

3.03.46 RECEIVER INDICATORS (SINGLE/DUAL CHANNEL)

Type	:	Analogue indicator
Input Signal	:	Universal input (T/C, RTD, 4-20 mA, Voltage)
Scale	:	Range fully configurable and programmable
Measurement Accuracy	:	$\pm 0.2\%$ of span ± 1 count
Resolution	:	0.5% Span
Dead band	:	$\pm 0.2\%$ of span
Repeatability	:	0.2% of span
Full scale response time	:	Less than two(2)seconds
Power Supply	:	240V AC, 50 Hz
Connection	:	Plug in type
Accessories	:	Mounting Bracket for Bins
Other Particulars	:	Indicator receiving thermocouple signal shall have automatic cold junction compensation.
	:	Retransmission Output 4 -20 mA isolated required.

3.03.47 Temperature Scanner

Type	:	Microprocessor based Electronic Digital Scanner.
No. of channels	:	16/24 (as per the application)
Input	:	RTD /Thermocouple/4-20mA
Accuracy	:	± 0.1 of FS ± 1 count
Number of digits	:	4 digit (7 segment display with Engg. Units)
Digit height	:	12 mm or larger
Display color	:	Fluorescent red/green
Display mode for	:	



Input over range/open sensor	:	All digits to flash
Mounting	:	Panel mounting
Zero and Span	:	Adjustable by digital calibration
Serial communication communication	:	Isolated RS232/485 for modbus-RTU
Memory Capacity	:	5MB Flash
Alarm output	:	Required
Contact rating	:	2A at 220 V AC
Power supply	:	240 V AC/24 V DC
Properties	:	i. Any channel shall be configured for Data Logging
		ii. Channel to Channel online Isolation shall be provided
		iii. Real Time RTC Interface for Printer shall be provided
Operation Modes	:	Auto/manual mode, Run mode, Verify mode, Calibration Mode, Program mode.

3.03.48 AMMETERS (AMM)

Input	:	4-20 mA DC
Mounting	:	Flush panel, compatible for mounting on mosaic grid panel
Face Dimensions	:	96 x 96 mm
Scale/Type	:	Moving coil, circular, FSD 240 deg. With six times suppression scale
Zero adjustment	:	Screw on meter face
Accuracy	:	± 1 percent (class 1)
Indication	:	Pointer with scale
Magnetic Shield	:	Shielded Case
Quantities	:	For all HT Motors & LT motor with rating ≥ 30 KW and other critical application motors/drives.

3.03.49 VOLTMETER:

Input	:	4 - 20 mA DC
Mounting	:	Flush Panel, compatible for mounting on mosaic grid panel
Face Dimension	:	96x96 mm
Range	:	As per requirement
Accuracy	:	$\pm < 0.5$ %
Indication	:	Digital type 4 1/2 digit
Magnetic Shield	:	Shielded Case
Connection	:	Plug in type
Quantities	:	For 230 V AC input power supply, UPS power supply, 24 V DC interrogation voltage & 220 V DC.

3.03.50 FREQUENCY METER/MW METER (DIGITAL)

2 x 660 MW ENNORE SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03/2013-14



Type	:	Electronic digital 7- segment with fluorescent display
Input	:	4 - 20 mA DC
Mounting	:	Flush Panel compatible for mounting On mosaic grid panel
Number of digits	:	4 1/2 digit
Face Dimension	:	192X192 mm
Digit size	:	Approximately 40 mm
Range	:	As per requirements
Accuracy	:	± 0.2 Hz
Display	:	Red LED display.
Connection	:	Plug in type
Magnetic Shield	:	Shielded Case

3.03.51 AC CURRENT TRANSDUCERS

Input	:	0 - 1 A CT current
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.52 DC CURRENT TRANSDUCERS

Input	:	0 - 75 mV
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.53 AC VOLTAGE TRANSDUCERS

Input	:	0 - 110 V PT, Volts
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.54 DC VOLT TRANSDUCERS

Input	:	System Voltage
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.55 TRANSDUCERS FOR POWER

Input	:	CT and PT (1A) (110V)
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.56 TRANSDUCERS FOR FREQUENCY

Input	:	110 V PT Volts
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.57 TRANSDUCERS FOR POWER FACTOR

Input	:	PT (110V)
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.58 TRANSDUCERS FOR MVAR

Input	:	CT & PT (110V/1A)
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.59 DIFFERENTIAL FREQUENCY TRANSDUCERS (FOR SYNCHRONIZATION)

Input	:	110 V PT
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.60 DIFFERENTIAL VOLT TRANSDUCERS (FOR SYNCHRONIZATION)

Input	:	System voltage
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.61 PUSH BUTTONS (PB)/ ILPBs FOR ON/OFF, OPEN/CLOSE, START/STOP

Type	:	Momentary/Miniaturised Suitable for mosaic grid 24x48 Mm with 2 PB and 3 coloured LED.
Contact Configuration	:	2 NO + 2 NC
Contact Material	:	Hard Silver Alloy
Contact Rating	:	500V / 10 A
Insulation Voltage terminals and earth	:	2 KV for 1 minute between
Lamp Rating :-		
a) Voltage	:	240 V AC
b) Watt	:	2 Watt (approx.)
Colour		



Red	– ON/Start/Open ILPB
Green	– OFF/Stop/Close ILPB
Red	- energized, running, Start, valve open LED/Lamp
Green	- de-energized, stopped, valve closed LED/Lamp
Light yellow	- abnormal, discrepancy LED/Lamp
Red	– OFF/Stop/Close PB
Green	– ON/Start/Open PB
Red	- Emergency trip push buttons with red flap / hinged Transperent arylc cover.

3.03.62	PUSH BUTTON FOR Control DESK:	Momentary mosaic grid mounted 24x48 mm size, single PB 18x40 mm Colours for DESK RELEASE - Yellow, Desk Lamp test - Blue, Desk Ack - Green
3.03.63	PUSH BUTTON FOR SEQUENCE START/RELEASE :	Momentary (Miniaturised) suitable for mosaic grid 24x48 mm 3 PB + 5 LED
3.03.64	PUSH BUTTON FOR ANNUNCIATION	

Contacts

- Number & Type	:	As per requirement
- Breaking capacity	:	1 Amp, 220V DC 10 Amp, 600V AC Different colours for Accept/Ack - Green, reset Grey, Lamp test – Blue, System Test – Yellow & Audio Ack - Black.

3.03.65	<u>BELT WEIGHING SYSTEM</u>
3.03.65.1	General
	The mechanical design and constructional features for belt weigher has been described under mechanical section, hence not repeated here, Similarly motor specifications for the same has been covered under electrical specification, hence not repeated here.
	The belt weighing system shall have its own local control panel to be located in electrical equipment room. The local panel shall include: (a) Local flow rate indication (b) Integrated flow rate indications (c) System alarm annunciation (d) Local Calibration facility (e) Power on/off All these above display shall be backlit LCD type with 12mm character height. Ni Cd Battery back up (60 minutes backup) shall be provided for the measurement system. (a)Application : Bulk material, Powder material (b)Drive Protection : Reverse Polarity, Communication failure



3.03.65.2	Load Sensing Cell	
	(a)Type	Strain Gauge/Compression type
	(b)Enclosure Protection	NEMA 4X (IP 66)
	(c)Load	
	(i)Nominal Load	Bidder to specify in tabular form.
	(ii)Rated Load	Bidder to specify in tabular form.
	(iii)Destructive Load	Bidder to specify in tabular form.
	(d)Supply Voltage	24V DC
	(e)Sensing	Resistance bridge
	(f)Temp. Effect on Zero & span	+/- 0.015%/10K
	(g)Basic Resistance	Manufacture's Standard
	(h)No. Of Load Sensors	Single
	(i)Mounting Type	Four idler
	(j)Accessories	Mounting plate kit, cable etc.
	(k)Accuracy	+/- 0.015% FSD
	(l)Speed Sensor	Tacho/encoder
	(m)Speed Output	Pulse train to be distributed tp
		(i)Local control panel for own use
		(ii)4-20 mA DC signal to PLC
	(n)Load Sensor Output	4-20 mA DC isolated signal for PLC along with provision for serial communication link standard protocol
	(o)Computed Flow rate	
	(i)Hardware	4-20 mA DC isolated 2 numbers
	(ii)Serial Link	In Compliance with standard protocol
	(p)Protection class for measuring cell	NEMA 4X (IP 66)
	(q)Accessories	Special cables, electronics, cabinets etc. As required to make the system complete, with bar/chain.
	(r)Range	Application dependent
	(s)Range increment	0.1% of this selected range
	(t)Operating Temperature	0-70 degC
	(u)Accuracy	+/-0.25 % FS range
3.03.66	Hydrogen Gas System Instruments/Analysers	
3.03.66.01	Hydrogen Gas Hygrometer	



A	Performance	
1	Measuring Range	-80 C to 20 C
2	Response Time for 63% Step Change	<5 sec.
3	Output Resolution	0.01 mA
4	Storage Temp: Max	70°C
5	Operating Ambient Relative Humidity	<95%
6	Sensitivity	< 5 se conds for 63% s tep ch ange i n moisture content
B	Construction	
7	Measuring Principal	Thin Film Alum Oxide
8	Enclosure Protection class	intrinsically safe and explosion proof as per NEC article 500, class 1, Division 1 area I.
9	Display	3-1/2" Digit LCD
10	Mounting	In Explosion Proof Box
11	Location (Hazardous)	Hydrogen delivery after compressors.
12	Service	Measures Moisture co ntent i n t he Hydrogen Delivery
13	Code & Standard	EMC di rective 89/ 336/EEC and P ED 97/23/EC f or DN<25 - FM Standard 6320
14	Analog Output	4-20 mA, HART.
15	Type of Transmitter	4 to 20 mA loop powered 24 VDC
16	Certification	CE
17	Calibration	Required ev ery 12 m onths, C alibrator shall be supplied by bidder.
3.03.66.02	TRACE OXYGEN (O2) in Hydrogen gas Analyser	
A	Performance	
1	Nature of Fluid	Oxygen in Hydrogen
2	Response Time for 90% step change	< 10 sec.
3	Relative Humidity	0-99 %
4	Measuring Range	0-100 ppm
5	Accuracy	+ 2%
6	Repeatability	+ 0.1 ppm
7	Sensitivity	0 - 10 ppm < 45 seconds
B.	Construction	
8	Measuring Principle	Electrochemical Fuel Cell
9	Display	3-1/2" Digit LCD
10	Enclosure Protection class	intrinsically safe and explosion proof as per NEC article 500, class 1, Division 1 area I.
11	Mounting	On Panel with Sample System
12	Service	Measure t race oxy gen i n t he pr oduct hydrogen
13	Location (Hazardous)	Hydrogen delivery after compressors.
14	Code & Standard	ATEX Approved. II 1/2 G Ex ia II c T4
15	Output Current	4-20 mA, HART
16	Type of Transmitter	4 to 20 mA Loop powered 24 VDC
17	Calibration	Every 12 m onths with c alibration gas,



		Calibrator shall be supplied by bidder.	
18	Calibration Gas	5ppm O2 in N2, shall be provided by bidder for one year after commissioning of plant.	
3.03.66.03	Combined Gas Sensor for Hydrogen Gas System		
A	Performance		
1	Nature of Fluid	Hydrogen /Air	
2	Measuring Range	0 to 100% LEL	
3	Response 50%	<10 sec.	
4	Recovery to 10%	<30 sec.	
5	Accuracy	0-50%LEL range	51-100% LEL range
		$\pm 1\%$	$\pm 2\%$
6	Repeatability	$\pm 1\%$	
7	Calibration frequency	180 days	
8	Output Range: 0-100 LEL	4-20 mA, HART	
9	Humidity RH	<99%	
10	Sensitivity	<12 seconds to 60% full scale	
11	Measuring Range	0-100 ppm	
B.	Construction		
12	Measuring Principle	Catalytically bead	
13	Enclosure Protection class	intrinsically safe and explosion proof as per NEC article 500, class 1, Division 1 area I.	
14	Display	3-1/2" Digit LCD	
15	Mounting	4 mtrs above respective instruments supporting Conduit	
16	Service	Monitor combustible mixture in the atmosphere of each room where hydrogen may be present.	
17	Location (Hazardous) (one in each), Any other location as finalised by owner during detailed engineering.	Roof -H2 Generation room	
		Roof - Compressor Room	
		Roof - H2 Storage Room	
18	Code & Standard	FM Standard 6320 FM Standard 3600	
19	Type of Transmitter	4 to 20 mA Loop powered 24 VDC	
20	Calibration Gas	2% H2 in N2, shall be provided by bidder for one year after commissioning of plant.	
21	Calibration	Every 6 months with calibration gas , Calibrator shall be supplied by bidder.	
3.03.66.04	Hydrogen Gas purity measurement Analyser		
A	Performance		
1	Range	80% to 100 % H2 in air	
		0 to 100 % H2 in pure gas *	
		0 to 100 % air in pure gas *	
2	Accuracy/Linearity	$\pm 1\%$ of FSD	
3	Resolution/Repeatability	$\pm 0.5\%$	
4	Response Time for 90% step change	< 5 sec.	



5	Stability/Drift	< ± 1 % of FSD/month
B.	Construction	
6	Measuring Principle	Thermal Conductivity or Multi mode Oscillation type
7	Enclosure Protection class	Intrinsically safe and explosion proof as per N E C article 500, class 1, Division 1 area I.
8	Display	3-1/2" Digit LCD
9	Safety & EMC Standards	Safety Standards EN 61010-1 EMC Standard EN 61326
10	Output	2 nos. 4 – 20 mA DC, isolated from input
11	H ₂ Purity	99.99%
12	Calibration Gas	shall be provided by bidder for one year after commissioning of plant.
13	Calibration	Every 6 months with calibration gas, Calibrator shall be supplied by bidder.
14	Note: * Pure Gas options: CO ₂ , N ₂ , Argon	

CHAPTER-6**SUPERVISORY CONTROL PANELS, SUPERVISORY CONTROL DESKS,
EQUIPMENT PANELS****6.00.00 PANEL AND DESKS****6.01.00 GENERAL REQUIREMENTS**

All DDCMIS/PLC/any other control system's electronic modules, power supply components, other control devices (except field mounted sensors/transmitters) and required for completeness of the system shall be housed in cabinets furnished by the Bidder. All equipment and dedicated cabinets required for termination, marshalling and proper interface within Bidder's system and also with other systems shall also be provided by the Bidder.

The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings in the manufacturing works of a qualified manufacturer prior to shipment to the project site. The Bidder shall ensure that the cabinets are complete and ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets should only involve connections through multi pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to UCD/UCP/BUP.

The Control cabinets shall house all types of modules / hardware to achieve all functions of Control System including signal conditioning modules, controller modules, I/O modules, communication controller modules, and all other requisite hardware for a complete system.

6.02.00 SUPERVISORY CONTROL PANELS AND DESKS**6.02.01 Control Desks & Other Furnitures**

Supervisory control desks for DDCMIS and other systems shall be supplied for mounting the required operating station as specified else where in the specification. Also control desk will be provided for balance work stations – located in computer room, supervisor room etc. All furniture including chairs and tables for printers etc. shall also be provided by the bidder.

Also control desk & complete furniture will be provided for work stations & printers – located in respective control room for BOP packages.

Industry standard Cushioned revolving, wheel, independently, adjustable seat and back chairs with provision for adjustment of height shall be provided for the operator & unit in charge & other personnel in central control room area & BOP's control rooms, simulator rooms, Conference room, meeting room, documentation room, staff room, CAAQMS shelters, CAAQMS room etc. These shall be designed for sitting for long duration such that these are comfortable for the back. The exact details shall be finalised & approved by Owner during detailed engg.

The actual nos., placement and profile of the main plant control room desk shall be decided during the detailed Engineering.



The tentative layout of central control desk, LVS & consoles are shown in the Drg. No. 114-05-0108, 0105 & 0111.

Control Desk for programmer's, Maintenance Engineer's, EWS, Serves, PC & diagnostic OWSs: -

Required numbers of control desks for accommodating programmer's/main-tenance engineer's/diagnostic etc shall be supplied. These shall preferably have the same dimension as that of supervisory control desks. Also required nos. of control desk will be provided for work stations & printers – located in respective control room for BOP packages.

Desks for accommodating printer:

Adequate number of table/desks/stands for accommodating printers in bidder's scope shall be supplied. Each printer shall be on a separate table / stand.

Care shall be taken to ensure ergonomically aspects so as to create ergonomically ideal work place considering physical aspects such as an average Indian person's size and reach, physiological aspects such as line of sight and field of vision and cognitive factors such as concentration and perceptivity. Extreme care shall be taken to design the desks with correct angles and dimensions.

Glass top teak wood offie table with lockable drawers shall be provided for Chief Enginner room and all other executive rooms.

6.02.02

Supervisory Panel Unit Control Panel

In addition to the LVS and OWS, a limited operation from backup unit control panel is envisaged for emergency operation and to provide safe shut down of plant. The Unit control panel shall housed Conventional Push-button (ILPB) stations, Console inserts (for SG, TG & Generator like FSSS, HPBP, SADC, APRDS, ATRS, ATT, DEHC, LPBP etc), Trip Push Buttons, EWLI, Ammeters, chartless recorders, & min. 15 nos. programmable digital display units for Boiler, Turbine & Generator's parameters. The mosaic grid shall be heat resistant, flame retardant, self extinguishing, and shrinkage free, non reflecting type. Finish of mosaic grid shall be mat type with out flaring. Hard wired emergency trip pushbuttons shall be arranged on operator station desk & in parallel on UCP.

Unit control Panel (UCP), shall be located suitably in the CCR.

In addition to above, 21 nos. Programmable digital display units common for both units showing total MW shall be provided by bidder at different locations of plant. The data to this DDU will be fed from DDCMIS through MOD BUS/PROFI BUS /RS 485 protocol and not hard wired. The **digit size** of the display unit will be **300 mm for 6 Nos.** and **200 mm for 15 Nos.** The placements/locations shall be decided during detailed Engineering.

Control panel cum desk with HW annunciation windows, ILPBs, Ammeters, Annunciation & desk PBs, mimic, lamps, Indicators, recorders, etc. shall be provided as per Annexure A – Control System Philosophy for BOP packages.



(Exact service & quantities will be worked out & approved during detailed engineering by owner).

- 6.02.03 Two (2) nos. vertical Steel Almirahs shall be provided for keeping documents in each BOP package's control room. Glass doors for each rack shall be provided such that the documents are visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed engg.

Suitable lockers (min. 24 nos. per unit) shall be provided in the room adjacent to the each central unit control room for storing of personal articles of control room personnel. Similarly suitable lockers (min. 8 nos in each control room) shall be provided in BOP package control rooms for storing of personal articles of control room personnel. Also, vertical steel almirahs (min. 4 nos. per unit) shall be provided in Documentation Room for storing of documents.

Vertical Steel Almirahs shall also be provided for the following rooms, wherein final quantity may be decided by owner during detailed engineering

- a. Maintenance room – 6 nos. min. (per Unit)
- b. ERP room – 2 nos. min (Common for both unit).
- c. PADO Room – One (1) no. min.(per unit)
- d. Station In charge room – One (1) no. min (common for both unit).
- e. Simulator room – 4 nos. min. (per Unit)

Thickness of steel almirah sheet shall be 18 gauges.

In addition to above, All industry grade furniture including chairs, control tables, tables for printers etc. & Almirahs for storage of consumables/catalogues/manuals shall also be provided by the bidder as on required basis and finalized by owner any where in power plant. Details shall be finalised and approved by Owner during detailed engineering.

- 6.02.04 Control panels for service system like C.W. Pumps etc. will be located in the respective control room. In addition ,some local panels will be provided near respective system/equipment such as Boiler Feed Pump, Hydrogen seal oil system, Electrostatic precipitator etc.

6.03.00 **TERMINATION/Marshalling CABINETS & Interposing Relay Panel**

Marshalling/Termination cabinets for the control system shall be supplied for terminating all cables originating from the field, MCC/SWGR or any other source of signal and for distributing the signals to different functional panels, MCC/SWGR and control cubicles.

Incoming cables from the field, MCC/SWGR or any other source of signal shall be terminated in suitable terminal blocks in logical sequence.

Prefabricated cables with plug in connectors at both ends shall be used for extending the signals to the functional panels. Matching plug sockets shall be provided in the termination cabinets for terminating the plugs.



Interposing relay panels for the system shall be supplied for mounting interposing relays & terminating all cables originating from the DO cards in case of solenoid valves, and other required services etc. IPR panels shall be placed in CER and LCR.

Interposing relay shall be mounted in respective SWGR/MCC/integral starter required for commands signals of HT/LT unidirectional drives and bidirectional drives, breakers, isolators & bus couplers etc from DDCMIS/DCS/PLC or any control system.

Terminal blocks shall be located inside the cabinets on support wings fabricated of metal plates.

The plug socket shall be mounted on hinged plates to provide an access to the rear pins of the plugs.

General features of termination cabinets and accessories shall conform to the general design and construction specification of panels. Terminal blocks shall be Rail mounted Terminal blocks (Screw less cage clamp type) with markers.

6.04.00

CONSTRUCTIONAL FEATURES OF PANELS, CONSOLES, CONTROL DESK, CUBICLES & ENCLOSURES

All panels, cubicles, consoles, SOV panels and enclosures furnished as per this specification shall be of free standing type and shall be constructed of specified gauge of steel plates. The panel sheet thickness shall be not less than 2 mm unless otherwise specified herein.

The panels, consoles/desks shall be reinforced as required to ensure true surfaces and adequate support for instruments mounted thereon. All instrument cutouts, mounting studs, and support brackets shall be accurately located. All welds on the exposed panel surfaces shall be ground smooth. Finished panel surfaces shall be free from waves, bellies, or other imperfections. Unless specified, otherwise, panel doors shall be 4 points hinged and shall have turned back edges and additional bracing where required to ensure rigidity. Door hinges shall be of the concealed type. Door latches shall be of the three-point type to ensure tight closing. Door locks shall be furnished which will allow actuation of all locks by a single master key. All panels shall have removable lifting eyebolts for safe lifting from top during storage and installation handling.

Cabinet doors shall be hinged and shall have turned back edges and additional bracing where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three/four-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is equal or more than 800 mm, double doors shall be provided.

All panels shall be mounted on vibration dampers, which are secured to channels mounted on the floor. The channels shall be field welded to steel plates set into the concrete flooring. The steel plates shall be located such as to approximate the outline of panel bases. The exact mounting details shall be as approved by the owner during detailed engineering stage. All panels shall be provided with adequate ventilation and packaging density of components shall be restricted so as to limit the temperature rise



above ambient to 10°C under the worst conditions. All panels shall have auto on/off switch for internal lighting. All the power supply circuit for control panels shall be provided with auto changeover circuitry.

In each panel /cabinet, a 24 VDC Voltmeter digital type shall be provided to check the Field Interrogation voltage.

Exhaust Fans with louvers & filters shall be provided on door's (front & Rear) upper side to remove hot air in all consoles, control desk and panels.

Fire/Smoke detectors shall be provided inside the Control room mounted system/control cabinets.

UPS, 24 V DC & non UPS's Feeder failure/ healthy indication shall be provided in each cabinet & remote indication shall be hooked up to DDCMIS/ PLC/annunciation & suitably grouped.

All the panels shall be equipped with Anti vibration pad of min. 15 mm size. Cable gland plate thickness shall be 3 mm.

Doors shall be provided with neoprene/polyurethane gasket only.

All the cable entries shall be at the bottom of electronic cubicles/control panels.

Protection class of panels shall be as specified at Vol. V, chapter 2.

6.04.01 Operator Control Desk

6.04.01.1 In CCR, Operator work station consoles/desk shall be of granite top of curved nature with powder coated frame. OWS consoles shall be provided with the facility for locating the CPU, document etc with all required utilities.

Unit In charge desk/consoles shall be of granite top of curved nature with powder coated frame. OWS consoles shall be provided with the facility for locating the CPU, document etc with all required utilities.

Station In charge desk/consoles shall be of granite top of curved nature with powder coated frame. OWS consoles shall be provided with the facility for locating the CPU, document etc with all required utilities.

6.04.01.2 Engineer work station and all other consoles/desk shall be ergonomically designed industrial grade type with swivel chairs for use at the various Programming stations and all other plant locations. All the equipment like Programmers stations, PC's, various peripherals & similar devices shall be complete with desks and they shall be of industrial grade stands and other mounting accessories and the same shall be completely erected & commissioned by the bidder. Details for other operating and engineering stations shall be as below:

- i. Operator Control desk shall be free standing table top type with doors at the back and shall be constructed of 3 mm thick CRCA steel plates. It shall have concealed cable & wire way management system. The top surface of control



CHAPTER-11**CONTROL VALVES WITH ACTUATORS****11.00.00 CONTROL VALVES, ACTUATORS AND ACCESSORIES****11.01.00 GENERAL REQUIREMENTS**

11.01.01 This section covers the design and construction requirements of Control Valves, their Actuators and Accessories. Except as otherwise specified herein, the Control Valves and accessory equipment furnished under this specification shall be designed, constructed and tested in accordance with the latest applicable requirements of code for Pressure Piping ANSI B 31.1, the ASME Boiler and pressure vessel code, Indian Boiler Regulation (IBR) and other standards referenced herein as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA", or acceptable equal standards.

11.01.02 The design of Control Valves shall comply with relevant codes and standards, account for relevant design criteria viz. environmental conditions, power and air supply, established reliability (reliability target and life expectancy), design of enclosures as specified in Sections earlier.

11.01.03 All Control Valves and accessories furnished under the Section shall be of Owner approved make, fully meeting the qualifying requirements.

11.01.04 Each control valve station shall be provided with pneumatic bypass control valve or Inching type motorised bypass valve as per process requirement and subject to owner approval. In addition each control valve shall also have upstream motorised valve. Downstream motorised valve shall also be provided as per process requirement and as finalized during detailed engineering.

11.02.00 CONTROL VALVE CONSTRUCTION AND SIZING**11.02.01 General**

1. Valve Construction shall be in accordance with the requirements specified herein. (Bidder to also refer NIT drawing # 114-18-0100).
2. The design of all valve bodies shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.
3. The valve sizing shall be suitable for obtaining maximum operating conditions with valve opening at approximately 80% of total travel. Valves shall be open not less than 15 % of full opening for minimum flow condition and shall be capable of handling at least 120% of the required maximum flow at full open condition. Actual pressure drop is indicated in the specification sheets. Permissible pressure drop shall be calculated and



used by the Bidder for sizing calculations. Valve sizing shall be in compliance with the latest edition of ISA Handbook on control valves, ISA standards "ANSI/ISA-75.01.01, Flow Equations for Sizing of Control Valves" with due consideration for the measures to avoid choked flow. Bidder shall ensure that the valve outlet velocity does not exceed 8 meters/second for liquid services, 150 m /second for steam services and 50% of sonic velocity for flashing services by selecting proper body size for the required Cv.

4. a. The Bidder shall provide valves designed to prevent cavitations, wire drawing, flashing on the downstream side of valve and in downstream piping, when operating through full range under the specified conditions.

For cavitating services, valves with anti cavitation trims shall be offered. This shall ensure cavitation prevention by multiple stages of pressure drops. Detailed calculations shall be furnished by bidder to establish cavitations occurrence or otherwise for various process conditions each service wise.

For flashing services such as heater drains, control valve design shall be specially effected to ensure suitability for the adverse high pressure drops and minimise its detrimental effects on control valve parts.

Bidder shall furnish detailed catalogue, calculations, write ups to establish compliance to these stipulations with the selection of each valve. No price implications during engineering stage would be admissible to comply with these stipulations and intents of specification.

- b. The Liquid pressure recovery factor (FL) shall be 0.995 or better for severe flashing/cavitation services.
 - c. The Liquid pressure recovery factor (FL) shall be 0.985 or better for low flashing/cavitation services.
5. Each valve shall be designed for tight shut-off against pressure, the valves shall have maximum permissible leakage rate as per ISA RP 39.6 Leakage Class IV (0.01% of rated valve capacity) or specified other wise.

Control Valves for Application such as HP/LP heaters emergency level control, SH spray & RH Spray control, Emergency makeup to Hotwell, Deaerator drain to condenser hotwell & heavy oil heating, HFO & LDO and Pressurizing control system, condenser normal make up control valve shall have permissible leakage rate as per leakage class V (ANSI/FCI).

All SH/RH block valves, shut off valve of LDO & HFO and BFP recirculation valve shall have leakage class MSS-SP-61.



6. The valve design shall take into account noise abatement considerations. The design objective will be to limit the generation of valve induced noise to 85 dBA at 1 Meter from the valve surface under actual operating conditions. The noise abatement shall be obtained by valve body and trim design and piping arrangement and not by the use of silencers.
7. The Bidder shall be responsible for proper sizing of the valve and selection of appropriate model and materials of constructions for meeting the operating requirements specified herein and details subsequently furnished during the detailed engineering stage.
8. The valve travel time shall be less than 10 second for non critical services valves.
9. Rangeability should be 50 to 1 (min.) for non critical services valves.
10. Control Valve's Linearity, Hysteresis, Accuracy shall be $\leq \pm 1\%$ and Sensitivity shall be $\leq \pm 0.5\%$.

Bidder shall furnish the Control Valve data sheets and sizing calculations with the proposal which will be subjected to owner approval during detailed engineering. The bidder shall furnish all valves as per Owner approved data sheets and drawings.

11.02.02 Valve Construction

1. All valves shall be of globe body design and straightway pattern. Straightway pattern valves shall be either single or double ported as specified. Double ported and single ported valves shall have high lift cage guided plugs, unless otherwise specified.
2. Where specified, valves with cage guided plugs and quick change trim shall be supplied. The quick change trim shall consist of a cage and seat ring clamped in the valve body by the valve bonnet and sealed with a spiral wound stainless steel asbestos gasket. The trim shall be removable through the top after bonnet removal without any cutting or welding of the valve. Where applicable, plugs shall be designed to include pressure balancing for cage guided valves.
3. Direct acting and self-contained pilot type valves may have low lift plugs.
4. Cast iron valves are not acceptable.
5. Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Owner. Bonnet joints shall be designed for easy disassembly and for assurance of correct valve stem alignment. Bonnet joints of the internal threaded or union type will not be acceptable.
6. Plugs shall be of one-piece construction either cast, forged, or machined from solid bar stock. Plugs shall be screwed and pinned to valve stems or shall be integral with the valve stems.



7. When Teflon packing is used, the lower valve stem which passes through the stuffing box shall be polished to at least 2×10^{-4} millimeters r.m.s.
8. Valves gland packing shall normally be Teflon on liquid and gas services up to 100 kg/cm^2 and 230 Deg.C Teflon impregnated asbestos shall be used above 230 Deg.C and graphite impregnated asbestos with lubrication shall be used for steam services.
9. All valves shall be arranged so that the plugs may be removed from the valve bodies from the bonnet side.
10. Each valve shall have an arrow permanently fixed on the valve body to indicate the correct direction of flow.
11. Each valve shall have a stainless steel name plate permanently fastened to the yoke which shall be visible when the valve is in service. The name plate shall include
 - a. Tag No. and Valve Serial No.
 - b. Body material, size and pressure rating
 - c. Trim material, size characteristics
 - d. Action on air failure
 - e. Spring range
 - f. Stem travel
 - g. Valve action, etc.

11.02.03

Valve Materials

1. Valve material shall be as specified in Supplier's approved Control Valve Specification sheets. The following table defines abbreviations used for valve materials:

S.No.	Abbreviations	Description
a	BR	Bronze ASTM B 61
b	CS	Carbon Steel Forged - ASTM A 105 Cast - ASTM A 216 Grade WCC
c	1- ¼ CR	1-1/4 % Chromium Alloy Steel Forged – ASTM A 182 Grade F11 Cast – ASTM A 217 Grade WC6
d	2- ¼ CR	2-1/4 % Chromium Alloy Steel Forged – ASTM A 182 Grade F22 Cast – ASTM A 217 Grade WC9
e	5 CR	5% Chromium Alloy Steel Forged – ASTM A 182 Grade



		F5 Cast – ASTM A 217 Grade C5
f.	SS	Stainless Steel AISI Type 316 ASTMA 351 Grade CF8M

2. Body material shall be selected by the Bidder to be compatible with the nature of the fluid, service conditions, and piping material to which it is welded and shall be subjected to Owner approval. In general, cast or forged carbon steel bodies shall be provided for non-corrosive process applications up to 275 Deg.C. Alloy Steel castings shall be provided when the media is non-corrosive and the temperature exceeds 275 Deg.C and is within 550 Deg.C. Stainless Steel of suitable grade shall be provided when media is corrosive and the temperature is below 300 Deg.C.

Sr. No.	Service	Body Material
1.	Non Corrosive, Non Flashing, and non cavitations service for process temp. up to 275 deg. C like Aux. steam flow to Deaerator, Cond. Flow to deaerator, Fuel Oil, Atomising steam service etc.	Cast Carbon Steel ASTM A216 Gr. WCB/WCC
2.	Non Corrosive, Non Flashing, and non cavitations service for process temp. above 275 deg. C. and up to 550 deg. C. and for CRH flow to Deaerator.	Cast Alloy Steel ASTM A217 Gr. WC9
3.	Severe Flashing/ cavitations service like Feed Control Valve, Spray Control valves, LP/HP heater emergency level control valve, HP BP spray control valve, Deaerator Overflow control valve etc.	Cast Alloy Steel ASTM A217 Gr. WC9
4.	Low Flashing/ cavitations service like LP/HP heater normal level control & Condensate/feed water below 275 deg. C.	Cast Alloy Steel ASTM A217 Gr. WC6
5.	DM Water Application (Condenser Hotwell normal & Emergency make up etc.)	Cast type 316 Stainless Steel ASTM A351 Gr. CF8M

3. Unless otherwise specified, all control valves shall have stems, guide bushings, plugs, seat rings, stem lock pins, stuffing box parts, and other trim, all made of stainless steel. Valve guide posts and bushings shall be stellite faced for valves where specified. Stellite faced guide posts and bushings shall be differential hardened. For applications involving high pressure drop as also for flashing and cavitation services, trim material shall be properly chosen to ensure required degree of hard facing (such as 17-4 PH SS) so as to avoid erosion.

Sr. No.	Service	Trim Material
1.	Non Corrosive, Non Flashing, and non cavitations service for process temp. up to 275 deg. C. like Aux. steam flow to Deaerator, Cond. Flow to deaerator, Fuel Oil, Atomising steam service etc.	SS316 Stellite
2.	Non Corrosive, Non Flashing, and non cavitations service for process temp. above 275 deg. C. and up	SS316 Stellite



	to 550 deg. C. and for CRH flow to Deaerator.	
3.	Severe Flushing/ cavitations service like Feed Control Valve, Spray Control valves, LP/HP heater emergency level control valve, HP BP spray control valve, Deaerator Overflow control valve etc.	440 SS
4.	Low Flushing/ cavitations service like LP/HP heater normal level control & Condensate/feed water below 275 deg. C.	17-4 PH SS
5.	DM Water Application (Condenser Hotwell normal & Emergency make up etc.)	17-4 PH SS

4. Where stellite facing is not specified, hardened stainless steel shall be furnished for all surfaces subject to wear.
5. Manufacturer recommended materials for cage guided valves may be substituted for materials specified provided they satisfy the specified service conditions. Also where substitutions are made, the manufacturer shall guarantee performance of recommended materials to be equal to or better than the specified materials for conditions specified.

Bidder may offer valve with body and trim material better than the specified material and in such case, bidder shall furnish the comparisons of properties including cavitations resistance, corrosion resistance, temp. resistance, erosion resistance, hardness etc. of the offered material vis a vis specified material for owner approval.

11.02.04 **End Preparation**

1. Valve body ends shall be butt-welded type.
2. Flanged ends shall be of a pressure class equal or greater in pressure-temperature rating to the body design pressure and temperature indicated on the control valve. Unless otherwise specified, steel flanges shall be raised face type. Flanged ends for valves shall be in accordance with ANSI B 16.5.
3. Welded end for control valves where specified shall be socket-weld per ANSI B 16.11 for control valves of sizes 50 mm (2") and below and Butt welded connections per ANSI B16.25 for control valves 65 mm (2-1/2") and above. The end preparation for butt welded control valves shall be matched to the corresponding details for the piping on which the valve is installed.
4. All end preparations shall be as per Owners requirements indicated during Contract stage.

11.02.05 **Miscellaneous Parts**

1. Extension bonnets shall be used on all valves when the maximum temperature of the flowing fluid is greater than 275 deg. C or when specifically required in the control valve.
2. Stem travel indicators shall be provided on all valves.



11.03.00 VALVE OPERATIONS

- 11.03.01 All control valves shall be furnished with pneumatic spring opposed diaphragm, spring less diaphragm, or piston operators as specified herein.
- 11.03.02 The bidder shall be responsible for proper selection and sizing of valve operators in accordance with the pressure drop and maximum shut-off pressures.
- 11.03.03 Valve operators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance of stem force, at least 0.15 kg/sq. cm per linear millimeter of seating surface, shall be provided in the selection of the operator to assure tight seating unless otherwise specified. The operators shall be designed to produce the required stem force with supply air pressure of 3.5 kg/sq. cm maximum unless otherwise specified.
- 11.03.04 Diaphragms shall be moulded synthetic rubber and diaphragm housing shall be of pressed steel construction. Diaphragms shall not be fabricated of natural rubber.
- 11.03.05 Piston operators shall use cast pistons and cylinders with O-ring seals. Operators shall be supplied with name plates which indicate the diaphragm air pressure at full open and full closed positions. for single seated valves the pressures shall be listed for maximum differential and for zero differential across the valve.
- 11.03.06 Pistons and cylinders shall be cast aluminum. Piston rod and extension shall be chrome plated stainless steel. Cylinder seal bushings shall be brass and seal rings shall be nitrile. Yoke shall be cast iron.
- 11.03.07 Valve operators shall be capable of operating at 60 °C continuously.

11.04.00 CONTROL VALVE ACCESSORIES & DEVICES

The following accessory equipment shall be provided for control valves:

- 11.04.01 **Air Locks:** Air locks shall be designed to shut off the diaphragm loading air line if the supply air pressure to the associated pilot or Positioner fails. Air locks shall be of the automatic reset type and shall be furnished with alarms.
- 11.04.02 **Hand Wheels:** Hand Wheels shall be provided. Hand wheels shall be side mounted unless specified to be top mounted. However the mounting shall be as decided during engineering to offer maximum accessibility.
- 11.04.03 **Limit Switches:** Each control Valves shall be provided with limit switches for monitoring of end position in DDCMIS/DCS/PLC. Switches shall have not less than two normally open and two normally closed contacts in both open and close directions. Electrical rating of the limit switch contacts shall be 240V AC, 5 amp or 220V DC, 0.5 amp. Limit switches should be National Acme Co., or Honeywell micro switch type or Owner approved equal. The enclosures of the limit switches



shall be as per NEMA-4 Standard. Limit switches shall be constructed to withstand the temperatures encountered in the actual service. Explosion proof construction shall be furnished where required by applicable code or these specifications. Limit switches shall be factory mounted on the valves with provisions for adjusting the mounting. The Bidder shall stroke the valves to check limit switch operation prior to shipment.

Limit/micro switches can be offered as an integral part of Smart valve positioner.

- 11.04.04 **Smart Valve Positioner:** Control valve actuators for modulating and throttling services shall be provided with HART protocol based smart electro pneumatic valve Positioner to ensure accuracy & repeatability of response. The valve Positioner shall be designed suitable for vibration and service conditions of a steam electric power station.

The Positioner shall have the following features:

- a) Shall provide a pneumatic output signal of range 0.2 to 1.0 kg/cm² or as desired for the actuator.
- b) Shall have integral type position transmitter, input & output gauges, local keypad, display, 4-20 mA input and 4-20 mA output for position indication in DDCMIS/CCR/PLC.
- c) Shall be suitable for direct mounting on control valve assembly both for rotary & linear valves.
- d) Shall be capable of functioning under hot, humid & vibrating conditions.
- e) Shall have dust tight, corrosion resistant & weather proof IP 65 metal casing.
- f) Shall be operated at signal range of 4-20 mA for full travel of the valve. Split range operation in few cases may be required. This facility shall also be available in positioner.
- g) Shall have in built mechanical position indicator.
- h) Shall have fail safe & fail freeze function as per loop process requirement.
- i) Shall have in built auto tune facility.

- 11.04.05 **Solenoid Valves:** Solenoid Valve will be provided for the following

- i. **ON / OFF Duty type Control Valve**
- ii. For over-riding the controller signal with Modulating type Control valves.
- iii. For control valve stay put position requirement on controller signal failure with Modulating type Control valves.
- iv. For construction and detailed specification of Solenoid valve, Chapter 3, Vol. V shall be referred by bidder.

- 11.04.06 **Diffusers** : Diffusers shall be provided as per service application requirements. The diffuser shall be designed to reduce the pressure drop across the control valve below the critical value and reduce the sound pressure level. Details of the diffusers shall be submitted.



- 11.04.07 **External Volume Chambers:** External volume chambers with adjustable bleed valves shall be provided for Control Valve. Volume chambers shall be furnished, mounted on the control valve yoke assembly.
- 11.04.08 **Position Transmitters:** Position transmitters shall be provided for control valves as a part of smart positioner. The signal shall be 4-20 mA DC range, 24 V DC. For non smart positioners applications and power cylinders, contactless position transmitter shall be provided by bidder.
- 11.04.09 **Tubing and Air Sets:** All pneumatic tubing required to interconnect devices assembled together shall be furnished complete with each control valve. The tubing shall be fully annealed soft temper copper tubing conforming to ASTM B68 to B75 (USA). Swage lock flareless tubing fittings shall be used for tubing connections (Swage lock or approved equal).
- Each device requiring an air supply shall be equipped with a combination filter-regulator. Devices mounted together on a valve yoke may be served by a single regulator, provided the supply pressure is satisfactory and the regulator capacity is not exceeded. Filter-regulators shall be mounted on the device served.
- Filter-regulators shall be suitable for a 10 kg/sq. cm maximum inlet pressure. Filter-regulators shall have built-in housing blow down valves and a 2 inch pressure gauge. The filter shall be of size not more than 5 microns and shall be made of sintered bronze.
- 11.04.10 **Pressure Switch**
- Pressure switch suitable for the above the pneumatic system shall be provided. The contact rating shall be 2 A for 240 AC, 2 A, 220 VDC 2 SPDT Contact. Enclosure IP 65.
- 11.04.11 **I/P Converter**
- For non smart positioners applications and power cylinders i/p converters shall be required and owner approval shall be obtained for the use of i/p converter for such applications.
- Electro-pneumatic, outdoor type, field mounted Linear. 4-20 MA DC input and 0.2 – 1.0 kg /Cm² output. Die cast aluminum casing with IP65 or equivalent enclosure class. Accuracy of $\pm 0.5\%$ of span or better and repeatability of $\pm 0.5\%$ of span or better will be provided. Easily accessible span and zero adjustment will be provided I/P converter shall be provided with all accessories and erection hardware. The I to P converters shall retain the pneumatic signal (last value) even in failure of control signal and shall have self volume boosters.
- 11.04.12 **Separate moisture separator unit** for ensuring dryness of air entering I/P as well as the power cylinder is to be supplied **with each control valve and control damper.**
- 11.05.00 **FOR FOLLOWING CRITICAL APPLICATION SPECIAL CONTROL VALVES ARE REQUIRED.:**



1. HP & LP Bypass Valves and Control System
2. BFP – Minimum Re-circulation Valve
3. Feed Water Control Valve
4. SH & RH spray Control Valves
5. APRDS System
6. Soot Blower control valve

11.05.01 **General Requirements for Critical Application Control Valves for -**

- i) The valve accessories shall include hand wheels, limit switches, smart valve positioner (4-20mA D C t ype), el ectro pneum atic converter, A ir l ock r elay, Solenoid valve and a ll other i tems required for t he co mpleteness and t he accessories shall be explosion proof type as per hazardous area classification wherever applicable.
- ii) Control valves shall be furnished with IBR certification wherever required.
 1. **Noise:** The maximum allowable noise level shall be 85 dba or less at 1 m. distance from the downstream bare pipe surface. T he specified noise l evel sh all be at tained w ithout t he use of or ifices, mufflers, diffusers. No credit for thermal or acoustical insulations shall be taken.
 2. **Valve Trim:** Valve shall have quick change type trim utilizing top entry. No components shall be screwed or welded into the body. The valve shall have equal pressure distribution around the plug to avoid chattering / vibration.

Trim of severe/critical service valve shall be of multi stage & multi path design with sufficient no. of discrete pressure drop stage to eliminate the ch ance o f er osion, cavitations, noi se, v ibration t hrough out the control range of valve.
 3. **Leakage Class:** The valve shall have minimum class-V leakage for all steam appl ications including APRDS, H P/LP bypass spray co ntrol valves & Low Load feed water control valve.

In case of minimum boiler feed pump re-circulation applications, RH/SH sp ray co ntrol v alves and H P/LP B ypass control v alve application, the leakage class should be MSS-SP 61 (block valve leakage).
 4. **Actuator:** Actuator type should be pneumatic double acting piston/Hydraulic.

11.06.00 **Specific Requirements / Specifications for Different Valves:**

11. 06.01 Design Criteria for selection of Feed Water Control Valve :

The v alve t rim sh ould be m ulti – stage, m ulti – path, m ulti – disk de sign hav ing sufficient no.'s of discrete pressure reductions (turns / stages) to ensure elimination



of vibration, cavitations, erosion and noise effects. Pressure reduction / drop achieved by valve designs incorporating single or multistage orificed cage, diffusers are not acceptable. Bidder should work out no. of pressure drop turns in the trim of the valve and should provide calculations of trim exit velocity. Seat ring and trim fitment should not have any part screwed or welded. It should be easily replaceable type.

Flow vs. valve opening characteristic: The trim is to be so designed that the min. flow indicated in the bid specifications of the valve is achieved with min. lift of 20mm of valve plug from "Close" position. Subsequent characteristic should be "equal percentage" i.e. corresponding to the parabolic characteristics. Characterizing the cam of the positioner to minimise the required flow char is not acceptable.

Rangeability should be 50 to 1 (min.). Each pressure - reducing element should have a uniform pressure distribution around the plug to avoid mechanical vibrations (pressure equalizing rings / grooves). To prevent flow induced vibrations and the line trash damage to seat, the flow direction should be over the plug. During throttle opening of the control valve, flow should be diverted away from the body seat.

Required leakage should be better than ANSI – B - 16 – 104 Class – V with metal to metal seating. Soft seat is not acceptable. Requisite calculations in support of above leakage class to be submitted with the offer. The bidder should indicate how this will be achieved in their valves and actuators. Actuators should be pneumatic double acting piston type. Diaphragm type actuators are not acceptable.

The seating force on the valve seats to achieve the required leakage class (better than ANSI – B - 16 – 104 Class – V) should be about 180 kg / cm on seat ring. Pl. indicates the closing force on the seat in Kgf / cm of seat circumference applied for actuator. Trim exit velocity should be less than 22.5 M / sec. Calculation sheet should be attached demonstrating satisfactory compliance of this requirement.

Noise level at 1 meter distance from the valve should be less than 85 dB without insulation, orifices, silencers, mufflers etc. Calculation sheet to be attached for each valve offered. Critical cavitation index (Kc) for all control valves should be 1 (one). This is specific requirement to avoid even remote possibility of cavitational damage to valve internals. Material of the valve internals should be as under:

Guide	:	400 series SS
Plug / Seat ring	:	400 series SS
Stem	:	17 – 4 PH

11.06.02 Control Valve Specifications For Turbine By Pass System

11.06.02.01 Turbine Bypass Control System: Standalone turbine by pass control system for each unit shall be provided. The control system shall include operator selectable manual or automatic modes with bumpless transfer between modes. The turbine bypass system shall be included in the plant automation sequence for unit start-up and bypass operation.



Complete operational design for the control system, including logic, modulating controls, schematics and wiring shall be provided. The design shall integrate the operation of both the HP & LP bypass stations into a single coordinated operation. The bypass system shall be operationally tested to assure acceptable functional performance of the bypass control system.

Hardware, instrumentation, wiring interconnections and accessory devices necessary to be interfaced and will be implemented in the DDCMIS for control.

The turbine bypass system shall be utilized to warm up the boiler and main steam lines after an appropriate vacuum is established.

The HP/LP bypass system shall cut in operation automatically in case of (a) generator breaker opening, (b) Turbine trip (i.e.) E SV/CV close, and (c) sudden reduction in load.

11.06.02.02 The bypass system shall comprise of the following:

HP BYPASS: Angle body high pressure bypass valve complete with hydraulic actuator spray valve --- 1 No. for each HP bypass valve complete with hydraulic actuator Isolation valve --- a common isolation valve complete hydraulic actuator.

Hydraulic power Unit (HPU) complete with main pump and a redundant main pump.

On – Line filter pump as well as an automatic cooling fan to keep the oil temperature below 60 degree C.

LP BYPASS: having angle body complete with hydraulic actuator

Spray valve for each LP bypass valve complete with hydraulic actuator

Isolation valve – with hydraulic actuator

Common hydraulic catering to HP & LP bypass valves as referred to above

The HP bypass will have desuperheating function in the valve body, however, in case of LP bypass, the desuperheater may be placed downstream of the valve.

Control systems with State Controller with Observer techniques shall be implemented in the DDCMIS.

- All the actuators shall be fitted with proportional valves and smart positioner for fast positioning. This will also have safety control unit with additional accumulator to provide sufficient movement / stroking.

11.06.02.03 HP-Bypass Steam Conditioning Valve: The HP-Bypass valve shall be angle body flow to open design so that valve internals and bonnet are all on the low-pressure side. Bypass from main steam to cold reheat line shall have integral steam assisted desuperheater. Bypass valve body shall be protected from damage due to water injection by means of multi-function contoured cage minimizing vibration compared to a cylindrical cage. The cage shall be firmly attached at one end, and located radially at the other end to provide good guiding and allow axial growth due to thermal differential. Cage material shall be X20CrMo V121 or equal for good thermal cycling and erosion resistance. Plug shall be of channel slotted type design for acoustic attenuation.

Spray water shall be injected directly downstream of the seat/plug in the area of maximum velocity and turbulence to ensure excellent atomisation and mixing of the



injected spray water. Water shall not be injected through the stem due to leakage potential past internal seals and to eliminate possibility of stem cracking due to thermal shocks. Water spray should be fully atomised within a meter of valve outlet to ensure uniform reheater temperature and to allow pipe bends directly after the valve and to allow carbon steel piping downstream of the valve.

Packing shall be compressed by means of a bolted flange, design, screwed gland type packing retainers shall not be provided. Bolted bonnets are preferred. If pressure seal bonnets are used, seal areas shall be inlaid with corrosion resistant materials to minimise leakage potential. Valve shall be mounted with actuator in vertical direction for ease of maintenance.

- 11.06.02.04 LP-Bypass Steam Conditioning Valves: The steam conditioning valves shall be angle flow to close type combination pressure reduction and desuperheating control valves. Multi-hole plugs shall not be used due to potential for contamination sticking between plug and seat. A combination of cage guiding and top guiding for plugs shall be provided to eliminate possibility of vibration. Conical diffusers as required shall be of wrought construction provided with higher mechanical strength and to allow for optimum velocity distribution downstream of the diffusers. The diffusers shall be removable through bonnet to allow for inspection and maintenance. No components may be screwed or welded inside the valve body for easy maintenance. Packing shall be compressed by means of a bolted flange design. Screwed gland type packing retainers shall not be provided. Bolted bonnets are preferred. If pressure seal bonnets are used, seal areas shall be inlaid with corrosion resistant materials to minimise leakage potential. The valve body shall be 2-1/4 percent chromium alloy steel with martensitic chromium steel internal trim steel. Valve packing shall be pure graphite.

The spray water injection shall be downstream of the seat but part of the valve. Spring-loaded nozzles shall be used to ensure good atomisation and good penetration of the spray water into the steam. The outlet cage shall be shaped that it guides the steam towards the injected water for good mixing of the steam and the spray water. Spray through stem shall not be provided due to leakage potential past internal seals and to eliminate possibility of stem cracking due to thermal shocks. No downstream pipe liner shall be required and thus carbon steel materials can be used on the downstream of the valve. The steam conditioning valve shall have a quick closing emergency function with a completely independent solenoid valve on the actuator. The quick closing shall still be equipped with a separate accumulator for operation independent from the Hydraulic Supply unit. The valves shall be provided with body taps upstream of the valve seat; and piping, valves and orifices as required for providing a pre-warming flow path.

- 11.06.02.05 Spray Water Control Valves: Trim exit velocity of liquid shall not exceed 30 m/s to prevent flow induced vibration. To protect the valve internals from foreign particles such as weld slag, flow direction shall be "flow to close" (over the plug) configuration for liquid applications. Valve shall have quick change type trim utilising top entry. No components shall be screwed or welded into the body. The valve shall have equal pressure distribution around the plug to avoid chattering / vibration. The leakage class shall be minimum class-V.



a) HP-Bypass Spray:

The trim for pressure reducing stages shall be of multistage type to ensure elimination of erosion, cavitation, noise and vibration throughout the stroke length of the valve. Bidder shall indicate the number of pressure erection stages in the proposed valve by furnishing calculations demonstrating compliance to the trim exit velocity.

b) LP-Bypass Spray:

The spray water control valve shall be cage guided valves sized as required to provide spray water to the steam conditioning valves. The spray water valve shall be carbon steel with stainless steel internal trim. Velocity of water at trim exit shall not exceed 30 ms/ Valves shall be free of cavitation.

11.06.02.06 Valve Operators: The steam conditioning valves and the spray water control valves shall be provided with double acting electro-hydraulic piston operators. All valves shall be quick opening and closing and shall be modulating valves with positioners designed to receive a 4 to 20 milli-ampere signal. The LP-Bypass steam conditioning valve shall have a quick closing emergency stop function with a completely independent solenoid valve on the actuator and a separate accumulator for operation independent from the hydraulic supply unit. The operator time shall be as required to protect the condenser from overpressure and temperature.

A single hydraulic power unit shall be provided and sized to operate and control all the steam conditioning valves, and spray water control valves for each unit. The hydraulic unit shall be complete with 2x100% capacity motor driven pumps, valves, piping instrumentation, tubing, reservoir and a accumulator(s), control cabinet with accessories all mounted on a common base. The motors shall be connected two (2) different power supplies. The hydraulic system shall have online filtration arrangement to keep hydraulic oil clean. The system shall have automatic temperature control device mounted on the tank to maintain hydraulic oil temperature below 60 deg. C.

11.06.03 Specification of BFP Recirculation Control Valve :

Trim should be of multistage, multipath, multiturn type having sufficient number of discrete pressure drop stages to ensure elimination of erosion, cavitation, noise and vibration throughout the stroke length of the valve.

Supplier shall identify the number of pressure drop stages in opposed valve and shall also provide calculations demonstrating compliance to the trim exit velocity.

The trim exit velocity for liquid (water) shall not exceed 22.5M/sec. The supplier shall provide calculations demonstrating satisfactory compliance to the above criteria.

For liquid service, the flow direction shall be ' OVER THE PLUG " i.e. FLOW TO CLOSE to prevent flow induced vibration and to protect damage on the valve internals from foreign particles such as weld slag etc.



The flow path shall be radial and each disk element should be capable of reducing the entire pressure independency. No orifice, No mufflers / diffusers are permitted.

The maximum allowable noise level shall be less than 85 dba at 1 meter distance on bare pipe surface. No orifice Plate downstream of the control valve should be used for pressure reduction.

The specified noise level shall be achieved without the use of orifices, mufflers or diffusers. No credit for thermal or acoustical insulations shall be given.

No orifice Plate downstream of the control valve should be used for pressure reduction.

The supplier shall provide calculations demonstrating compliance to the noise requirement.

The valve shall have minimum **MSS-SP-61 Leakage class** in metal to metal seating with minimum seating force of 180kgf per linear mm of seat ring circumference. Soft seat is not acceptable.

Vendor to provide calculations to indicate close force on the seat applied by actuator.

Vendor shall confirm that the proposed valve shall maintain tight shut-off leakage class even after 3 years of field service.

The valve shall have quick change type trim utilizing top entry. No components shall be screwed or welded into the body.

The valve shall have equal pressure distribution around the plug to avoid chattering/vibration.

Pneumatic double acting piston actuator shall be preferred.

11.06.04

SH/RH Spray Control Valves (Technical Requirement) :

- a) Seat ring and trim fitment should not have any part screwed or welded. It should be easily replaceable type.
- b) The valve trim should be multi – stage, multi – path design having sufficient numbers of discrete pressure reductions (turns/ stages) to ensure elimination of vibration, cavitation, erosion and noise effects.

Pressure reduction/ drop achieved by valve designs incorporating single or multistage orificed cage, diffusers are not acceptable because of our bad experience with this type of design.

Bidder should work out number of pressure drop turns in the trim of the valve and should provide calculations of trim exit velocity.

- c) Flow Vs. Valve opening characteristic:



The trim is to be so designed that the minimum flow indicated in the bid specifications of the valve is achieved with minimum lift of 8 mm of valve plug from "close" position. Subsequent characteristic should be "EQUAL PERCENTAGE" i.e. corresponding to the parabolic characteristics. Characterizing the cam of the positioner to mimic the required flow characteristics is not acceptable.

- d) Rangeability should be 30 to 1 (minimum) for valves up to 2", 50:1 for valves from 2" to 4" and for bigger valves it should be minimum 100:1. Valve should be able to throttle even below 5% opening without trim erosion.
- e) One single valve should handle zero to 100 per cent boiler feed water flow requirements. The valve should be designed for high range ability and total flow characterization from low flow to the maximum flow required.
- f) Each pressure reducing element should have a uniform pressure distribution around the plug to avoid mechanical vibrations (pressure equalizing rings / grooves).
- g) To prevent flow induced vibrations and the line trash damage to seat, the flow direction should be over the plug (for water) and under the plug for steam.
- h) During throttle opening of the control valve, flow should be diverted away from the body seat.
- i) Required leakage of MSS-SP-61 better than ANSI-B-16-104 Class-V equivalent class is achieved with metal seat. Soft seat is not acceptable. Requisite calculations in support of above leakage class to be submitted with the offer.
- j) Leakage class for these control valves required is MSS-SP-61 better than ANSI-B16-104 Class-V or equivalent as the control valves are to work as block valves when in 'CLOSE' condition. The bidder should indicate how this will be achieved in their valves and actuators. Actuators should be pneumatic double acting piston type. Diaphragm type actuators are not acceptable.

The seating force on the valve seats to achieve the leakage class of MSS-SP-61 better than ANSI-B-16-104 class-V or equivalent should be about 180kg/cm on seat ring circumference. Bidder to indicate the closing force on the seat in Kgf/mm of seat circumference applied for actuator.

- k) Trim exit velocity in both minimum and maximum flow conditions should be less than 30M/sec. in case of water and 22.5M/sec in case of flashing water conditions. Calculation sheet should be attached demonstrating satisfactory compliance of this requirement.
- l) Noise level at 1 meter distance from the valve should be less than 85dB without insulation. Orifices, silencers mufflers etc. Calculation sheet to be attached for each valve offered.



- m) Critical cavitations index(Kc) for all control valves should be 1 (one). This is specific requirement to avoid even remote possibility of cavitational damage to valve internals.

11.06.05 **SPECIFICATION FOR APRDS System:**

Brief System Description

Auxiliary steam system is to be designed to provide steam for turbine auxiliaries, Boiler auxiliaries and fuel oil heating system during start-up, low loads and normal running of units.

The system comprises of one auxiliary steam stations capable of meeting 'High capacity' and 'Low capacity requirements' by a single system to meet auxiliary steam requirements during unit start-up, Low loads and for fuel oil system and during normal running. Spray water required for desuperheating will be tapped off from boiler feed pump discharge.

The above stations will reduce the pressure and temperature of the steam tapped off from main steam line. A suitable desuperheater should be considered for reducing the temperature.

Equipment To Be Provided by Bidder:

Combined high capacity and low capacity Auxiliary PRDS comprising of:

a) Control Valves and accessories:

a) Pressure reducing valve:	Having multiturn, multistage, multipath radial trim valve as per specification.
b) Spray control station:	Dedicated to Desuper-heater. The spray water control station should have multiturn, multistage, and flow trim & the same should be a combination of pressure and temperature control valve and a high rangeability desuperheater.

Each control valve shall be supplied with the accessories as specified in the approved data sheets.

Desuperheater:

1. Direct mixing type desuperheater :

The desuperheater shall be completed with spray nozzle along with necessary attachments.

Spares, Consumables and Special Tools and Tackles:



Commissioning spares and consumables:

The bidder shall supply spares and consumables for all the above valves and desuperheaters required during start-up. A list of all spares and consumables to be supplied shall be submitted along with the bid.

Specific Technical Requirements for Control Valves, Actuators and Accessories:

Seat ring and trim fitment should not have any part screwed or welded. It should be easily replaceable type.

The valve trim should be multistage, multipath design having sufficient numbers of discrete pressure reductions (turns/stages) to ensure elimination of vibration, cavitations, erosion and noise effects.

Pressure reduction/drop achieved by valve designs incorporating single or multistage orificed cage, diffusers are not acceptable.

Bidder should work out number of pressure drop turns in the trim of the valve and should provide calculations of trim exit velocity.

Flow Vs. valve opening characteristics: the trim is to be so designed that the minimum flow indicated in the bid specifications of the valve is achieved with minimum lift of 8mm. of valve plug from 'close' position. Subsequent characteristics should be 'Equal Percentage' i.e. corresponding to the parabolic characteristics. Characterising the cam of the positioner to mimic the required flow characteristics is not acceptable.

Rangeability should be 50 to 1 (minimum). Valves should be able to throttle even below 5% opening without trim erosion.

Each pressure reducing element should have a uniform pressure distribution around the plug to avoid mechanical vibrations (pressure equalizing rings/ grooves).

To prevent flow induced vibrations and the line trace damage to seat, the flow direction should be over the plug for water and under the plug for steam.

During throttle opening of the control valve, flow should be diverted away from the body seat.

The valves shall have minimum ANSI B-16-104 class-V leakage class in metal to metal seating for all applications with minimum seating force of 125kgf per linear mm of seat ring circumference. Soft seat is not acceptable. Vendor shall confirm that the proposed valve shall maintain tight shutoff leakage class even after 3 years of field service.

The bidder should indicate how this will be achieved in their valves and actuators. Actuators should be pneumatic double acting piston type. Diaphragm type actuators are not acceptable.



Bidder to indicate the closing force on the seat in kg f/mm of seat circumference applied for actuator.

Trim exit velocity in both minimum and maximum flow conditions should be less than 30M/Sec. in case of water and 22.5M/sec in case of flashing water conditions. Calculation sheet should be attached demonstrating satisfactory compliance of this requirement.

Noise level at 1 meter distance from the valve should be less than 85dB without insulation, Orifices, silencers mufflers etc. Calculation sheet to be attached for each valve offered.

Critical cavitations index (Kc) for all control valves should be 1 (one). This is specific requirement to avoid even remote possibility of cavitation damage to valve internals.

To avoid problems associated with the piston rings provided in valves of balanced design, unbalanced design for port size upto 25mm. is required. Bidder to indicate the compliance clearly.

Material of the valve internals should be as under:

Guide	:	Inconel 718
Plug/stem	:	Inconel 718
Seat ring	:	SS 316 stellited

Valve actuators:

- i) Piston actuators shall be used for all valves.
- ii) Valve actuators shall be capable of operating at 70 Degree C ambient continuously.
- iii) Castings shall be of the type to suite individual area environments.
- iv) All fix connection size shall be 1/4" NPT (Female)
- v) Bidder shall guarantee that the size of the actuator is adequate to meet the operating thrust requirement for the control valve under extreme condition. Bidder shall indicate the stroking time of the valve assemblies with positioner.

Accessories:

Control valve actuators shall be equipped with air supply filter regulator, gauges and valve positioners alongwith boosters for typical applications wherever required, local poison indicator with scale and pointer, position transmitter, limit switch and hand wheel, air lock relay, solenoid valve etc.

Performance:

All control valves shall confirm to MSS-SP-61 leakage class.

11.06.06

SPECIFICATION FOR SOOT BLOWER VALVES:



2 x 660 MW ENNORE SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03/2013-14

Vol. V/Sheet - 373

Page 412 of 487



Trim should be of multistage, multipath, multiturn type having **sufficient number of discrete pressure drop stages** to ensure elimination of erosion, cavitation, noise and vibration throughout the stroke length of the valve. Supplier shall **identify the number of pressure drop stages in proposed valve** and shall also provide calculations demonstrating compliance to the trim exit velocity.

The trim exit velocity for liquid (water) shall not exceed 23M/sec. The velocity head in case of steam / gas services shall be less than 480 Kpa (70 P sia). The supplier shall provide calculations demonstrating satisfactory compliance to the above criteria.

To maximize noise attenuation benefits and to allow for constant fluid expansion, flow direction shall be **'UNDER THE PLUG', i.e. FLOW TO OPEN.**

The flow path shall be radial and each disk element should be capable of reducing the entire pressure independently. No orifice, No mufflers / diffusers are permitted.

The maximum allowable noise level shall be less than 85 dba at 1 meter distance on bare pipe surface. **No orifice Plate downstream of the control valve should be used for pressure reduction.**

The specified noise level shall be achieved without the use of orifices, mufflers or diffusers. **No credit for thermal or acoustical insulations. The supplier shall provide calculations demonstrating compliance to the above noise requirement.**

The valve shall have minimum Ansi B-16-104 class-V leakage class in metal to metal seating for all applications with minimum seating force of 125 kgf per linear mm of seat ring circumference. Soft seat is not acceptable. Vendor shall confirm that the proposed valve shall maintain tight shutoff leakage class even after 3 years of field service.

The valve shall have quick change type trim utilizing top entry. No components shall be screwed or welded into the body.

The valve shall have equal pressure distribution around the plug to avoid chattering/vibration.

The valve should have high rangeability to meet low flow and high flow requirements satisfactorily with high% show at low flow condition

Pneumatic double acting piston actuator shall be preferred.

11.07.00 **TESTING AND COMMISSIONING:**

11. 07.01 All valves shall be tested in accordance with the quality assurance programme agreed between the owner and the bidder as specified in chapter 14 which shall meet the requirements of IBR and other applicable codes mentioned in chapter 1 clause-1.09.00. The tests shall include but not be limited to the following.



Valves for high pressure high temperature applications shall be subjected to 100% radiography examination test. Results shall be owner approved prior to dispatch. All castings and forging shall be visually inspected. The casting shall be radiographically examined. Ultrasonic examination, liquid penetration examination, magnetic particle examination etc. as applicable shall be performed as per applicable standards and codes. The mechanical and chemical testing shall also be performed in accordance with applicable ASTM material specification.

11.07.02 Non-destructive examinations shall be performed as required by ANSI B81.1 (Power Piping) and ANSI B16.34 (Steel Valves).

11. 07.03 Hydrostatic Test:

- ii) Valve shall be subjected to hydrostatic shell test in accordance with ANSI-B16.34 prior to seat leakage test. If the valves are reworked on the pressure parts for any reason after hydrostatic test, they must be retested.
- iii) Valves shall be hydrostatically tested in manufacturers works in accordance with code requirements. All hydrostatic testing and inspection shall be completed before any paint is applied to valve body. Certificates of inspection shall be executed in accordance with the latest codes and required codes shall be forwarded to the engineer.

All gaskets used for test shall be of the same material and design as specified for the finished product. Where mechanical gasket joints are broken following tests, new gaskets shall be furnished with the equipment, and the joints shall be retested.

11. 07.04 Leakage Test:

- i) Unless otherwise noted in the specification sheets, valve closure test and seat leakage tests shall be performed in accordance with ANSI B16.104, Leakage Class II/class IV as the case may be.
- ii) The leakage from packing shall be zero or bubble tight. For valve designs which are not covered by ANSI B16.104, the bidder shall submit the expected leakage rate with his proposal for review by Owner / Technical Specialist.
- iii) If valves are disassembled after the completion of the valve closure and seat leakage tests, these tests shall be repeated.

11. 07.05 Hysteresis Test :

The hysteresis test shall be run on completely assembled valves. The stuffing box shall be fully packed and made up hand tight. The allowable value of hysteresis specified by the bidder shall be achieved.

11.07.06 Tests for special class valves:

All valves supplied with the special class ratings per ANSI B16.34 "Steel Valves" (except flanged valves) shall be subject to the required examinations as per paragraph 8.3 of ANSI B16.34. the acceptance criteria shall be same as these given in Annexure B,C,D and E of ANSI B16.34 for the applicable examinations expect for the following.



Magnetic particle examination of castings, the linear indication shall not exceed 3/16 inch in length.

11.07.07

Functional Tests:

The fully assembled or completed valves including the operators control devices and accessories shall be functionally tested to demonstrate the operability of the valve and the operation. This may be done by cycling the valves 3 or 4 times from open to close position. The same controller can be used to test each valve. Control valve FI (Liquid pressure recovery factor) in operation test on completed valve (final inspection).



2 x 660 MW ENNORE SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03/2013-14

Vol. V/Sheet - 376

Page 415 of 487



CHAPTER – 13

ACTUATORS

1.00.00 ELECTRICAL ACTUATORS WITH INTEGRAL STARTERS

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.

1.01.00 General

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

1.02.00 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.

1.03.00 Environmental

Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in a 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).

1.04.00 Enclosure

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

1.05.00 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.

1.06.00 Motor Protection

Protection shall be provided for the motor as follows:

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

1.07.00 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.

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

1.09.00 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.

1.10.00 Torque and Turns Limitation

Torque and turns limitation to be adjustable as follows:

- Position setting range 2.5 to 100,000 turns, with resolution to 0.15 deg. of actuator output
- Torque setting 40% to 100% rated torque.

“Latching” to be provided for the torque sensing system to inhibit torque off during unseating or during starting in mid travel against high inertia loads.

The electrical circuit diagram of the actuator should not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit. Spare 1 NO + 1 NC Limit switch and Torque switch shall be provided in each Actuator.

1.11.00 Remote Valve Position/Actuator Status Indication

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.

The contacts shall be rated at 5A, 250V AC, 30V DC.

As an alternative to providing valve position any of the four above contacts shall be selectable to signal one of the following:



- Valve opening, closing or moving
- Thermostat tripped, lost phase
- Motor tripped on torque in mid travel, motor stalled
- Remote selected
- Actuator being operated by hand wheel
- Position feedback has to be provided for all inching type applications. These shall be interfaced with plant DDCMIS

1.12.00 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 positions 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.

1.13.00 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:

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

1.14.00 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°.

1.15.00

Control Facilities

The necessary wiring and terminals shall be provided in the actuator for the following control functions:

- 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.
- 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

The following individual potential free relay contacts shall be provided in the actuator for remote annunciation to facilitate continuous monitoring of the actuator.

- Actuator in local mode
- Actuator in remote mode
- Actuator (valve) running in OPEN direction.
- Actuator (valve) running in CLOSE direction.
- Limit switch OPEN trip
- Limit switch CLOSE trip
- Actuator in local mode.
- Actuator in inching mode.
- Actuator in self-retaining mode
- Actuator power switched off /single phasing.
- Torque switch trip, thermo switch trip and overload relay trip



(or close)

Automatic phase correction facility and potential free contact for annunciation of power failure shall be provided

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.

1.16.00 Monitoring Facilities

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

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.

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.

Diagnostic and configuration software shall be made available in a Lap Top PC for user.

1.17.00 Wiring and Terminals

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.

The terminals shall be embedded in a terminal block of high tracking resistance compound.

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.



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.

A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:

- Serial number
- External voltage values
- Wiring diagram number
- Terminal layout

This must be suitable for the contractor to inscribe cable core identification alongside terminal numbers.

1.18.00 Startup Kit

Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and covers 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.

1.19.00 Performance Test Certificate

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:

- Current at maximum torque setting
- Torque at max. torque setting
- Flash test voltage
- Actuator output speed or operating time.

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.



1.20.00 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.

- Measurement of insulation resistance.
- Measurement of full load current.
- Test running of the motors



C&I Quality Assurance



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						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	THERMOWELL	SEE NOTE-1 BELOW	AS PER APPD DWG		V	V	
	MATERIAL TC & DIMN. CHECK						
	HYD.TEST						
	OVER RANGE TEST						

Legend :

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

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- 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	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION	ONE		P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST	FOR LOT	P	W	V		
4	OPERATION OF PRESSURE. RELIEF DEVICE		P	W	V		
5	REVIEW OF TC FOR		V	V	V		
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST	V	V	V		
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW	V	V	V		

Legend :

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

Note :

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



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

CHECK LIST FOR FLOAT OPERATED LEVEL 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	
	MODEL NO/TAG NO						
	TYPE						
	END CONNECTION						
2	ON/OFF DIFFL			P	W	V	
3	REPEATABILITY	SEE NOTE-5	---	P	W	V	
4	IR TEST			P	W	V	
5	HV TEST			P	V	V	
6	PR. TEST ON CHAMBER	FOR LOT	---	P	V	V	
7	MATL. TC FOR CHAMBER & FLOAT	TYPE TEST	---	V	V	V	
8	CONTACT CONFIG. & RATING FOR MICROSWITCH	---	---	V	V	V	
9	TC FOR DEGREE OF PROTECTION	---	---	V	V	V	
10	MANUFACTURER TO ENSURE WELDING PROCEDURE, WELDERS & NDT AS PER ASME FOR PR >40 KG/CM2	SEE NOTE-1 BELOW	---	P	V	V	
11	CHECK FOR TEMP. SUITABILITY FOR MICROSWITCH AND LEAD WIRE	SEE NOTE-1 BELOW	---	V	V	V	
12	ACCESSORIES AS APPLICABLE		APPROVED SPEC./ DATA SHEETS	V	V	V	

Legend :

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

Note :

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

बीएचएल PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		01		DATE: 22-02-2008	
								SHEET		1		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks	
									P	W	V		
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2		
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---		
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---		
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---		
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---		
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1		
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---		
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---		
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---		
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	1		
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---		
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---		
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													

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056				
								VOLUME	IIB			
								SECTION	D			
								REV. NO.	01	DATE: 22-02-2008		
								SHEET	2	OF	7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	--- --- --- --- --- 1 ---	+ for relay & contactors only @ for all components except relays & contactors.
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												

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01 DATE: 22-02-2008				
								SHEET 3 OF 7				
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
LEGEND: * CR - Critical characteristics \$ P - Agency Performing the Test. 1 - BHEL MA - Major characteristics W - Agency Witnessing the Test. 2 - Vendor MI - Minor characteristics V - Agency Verifying the Test. 3 - Sub-vendor												

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		01		DATE: 22-02-2008	
								SHEET		4		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks	
									P	W	V		
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
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													

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL							STD QUALITY PLAN NO.: PE-QP-999-145-I056					
									VOLUME		IIB			
									SECTION		D			
									REV. NO.		01		DATE: 22-02-2008	
									SHEET		5		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks		
									P	W	V			
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---			
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---			
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---			
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1			
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1			
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---			
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---			
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.		
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1			
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1			
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														

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		01		DATE: 22-02-2008	
								SHEET		6		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks	
									P	W	V		
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.	
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1		
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1		
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1		
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1		

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

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056				
								VOLUME	IIB			
								SECTION	D			
								REV. NO.	01	DATE: 22-02-2008		
								SHEET	7	OF	7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1	
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibration	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

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

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

completion of integration / manufacturing of the system. The shipment of I&C equipment to site will be effected only after the FAT has been accepted by Owner.

2. FAT procedure shall be prepared by vendor and to be submitted for Owners approval well in advance prior to the commencement of FAT.

14.02.04.21 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.

i TESTS TO BE PERFORMED FOR FIELD INSTRUMENTS

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 ($\geq 500 \Omega$ at 500 V, DC) as per ISA, Hydro static test (1.5 times max. pr.), Bore concentricity : $\pm 5\%$ of wall thickness.
9.	Thermowells
	Material test / Bore concentricity : $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)



10.	Level Guages
	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 11.
17.	Position transmitters
	Calibration / hysteresis and Accuracy test
18.	Electro Pneumatic Convertors
	Calibration test / Accuracy test
19.	Solenoid valves
	Hydrotest / 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-emf 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 :



	Hydro test, IBR Certificate
28.	Sampling racks :
	Hydro test, IBR Certificate for tubes and fittings.
29.	S02 / 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 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) 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 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) 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
	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 retardance 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.

17.02.05 TYPE TESTING

The BIDDER shall furnish the Type test reports of all type tests as per relevant standards and codes. As well as other specific tests indicated in the specification. A list of such tests 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.

A. Out of these test listed, the bidder /subvendor/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.

- B. For the rest, submission of type test, results, and certificates shall be acceptable provided following points
- i. The same have been carried out by the bidder/ subvendor on exactly the same model/rating of equipment. (For control valves this shall be same size, type & design).
 - ii. There has been no change in the components from the offered equipments and tested equipments.
 - iii. The test has been carried out as per the latest standards along with amendments as on the date of bid opening.
- C. 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.

17.02.05.1 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 pre award discussion.

17.02.05.2 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, acceptance norms (wherever applicable), recording of different parameters, intervals of recording precaution to be taken etc. for the test to be carried out.

17.02.05.3 SPECIAL REQUIREMENTS FOR SOLID STATE EQUIPEMNTS /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, PLC etc shall be as indicated below:

- i. Surge Withstand Capability (SWC) for solid state equipments/equipments

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 A NSI 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.

- ii. The dry heat test as per IEC-68-2-2 or equivalent
- iii. Damp heat test as per IEC 68-2-3 or equivalent
- iv. Vibration test as per IEC 68-2-6 or equivalent
- v. Electrostatic Discharge test as per EN 61000-4-2 or equivalent
- vi. Radio frequency immunity test as per EN 61000-4-6 or equivalent
- vii. Electromagnetic Field Immunity test as per EN 61000-4-3 or equivalent

Test listed at Item no v, vi, vii above are applicable for electronic cards only as defined under item no. (i) above

17.02.05.4 TYPE TEST REQUIREMENTS FOR C&I SYSTEMS

S.No.	Item	Test requirement	Standard	Test to be specifically conducted	Owner's 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. V, Chapter 9)				
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	Model Test	Approved	No	No



	system		procedure		
	BMS & MFT	Safety requirement	VDE 0116, 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	PLCs	As per Standard	IEC 1131	No	YES
16	LIE/LIR	Degree of protection test	IS 13947	YES	YES
17	Flue gas O ₂ analyser, other Flue gas Analysers	Degree of protection test	IS 13947	No	YES
18	Flow nozzles & Orifice plates	calibration	ASME PT C BS 1042	YES	YES

Note:

Type test are to be conducted only for the items, which are being supplied as part of this package.

- A. For batteries with electric power supply system of main plant C&I, the bidder shall submit for owner's approval the reports of all the type tests as per IS-10918 carried out within last 5 years from the date of bid opening and the test should have been either conducted at an independent laboratory or should have been witnessed by a owner/client. The complete type test report shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier.

For batteries with electric power system of auxiliary plants, type test reports for batteries shall be as per standard –practice of manufacturer.

14.02.06 Testing at Site [Prior to commercial operation]

- a. All equipment shall be checked thoroughly in respect of the following:
 - i. Visual and mechanical testing
 - ii. Complete system configuration loading functions; system diagnostics; system proper operation specified power supply specifications.



C&I Mandatory Spares

2x660 MW ENNORE SEZ PROJECT OF TANGEDCO					
MANDATORY SPARES					
III.	CONTROL & INSTRUMENTATION PACKAGES				
TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
1.0.0		INSTRUMENTATION			
(I)	Each type of lamps, PBs, ILPBs, fuse, MCB, MCCB used in the equipment/system.	Nos.	20 % of Installed of each type.		
1.00.01	Measuring Instruments				
1.00.01.01	Indicators, Recorders, Electrical Metering and Skid Mounted Instruments				
(i)	Indicators, recorders and meters offered from each model for the project. These instruments shall be supplied with three sets of blank scales.	Nos.	10 % of Installed of each type/Model or a minimum of one number for each model and type, whichever is more		
(ii)	For skid mounted instruments	Nos.	10% of total number of instruments for each Type and model or a minimum of one number for each model and type, whichever is more		
1.00.01.02	Temperature Elements and Thermowells				

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
(i)	Thermocouple/RTD elements	Nos.	10% spare 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.		
(ii)	Thermowells	Nos.	10% for each type of temperature sensors or a minimum of one for each type, whichever is more		
1.00.01.03	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.	Nos.	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.		
~~1.00.01.04~~	~~Flue Gas Analyzers & CEMS (Spareparts shall be furnished in accordance with manufacturer's recommendations for five years continuous operation or minimum quantities indicated as below (whichever is more))~~				

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
a)	Electronic Module/Mother Board	Nos.	10% of installed or at Least one number of each type of module for each analyser type.		price included at s.no. 1.00.01 above
b)	Cooling and purging air blower unit	Nos.	One No. for each analyser type		price included at s.no. 1.00.01 above
c)	Light source and detector unit for smoke density analyser.	Set	One set for each analyser type		price included at s.no. 1.00.01 above
d)	Infrared source and detector unit for CO analyser	set	One set for each analyser type		price included at s.no. 1.00.01 above
e)	Zirconia Cell, ceramic filters, heater & thermo couple assembly for flue gas oxygen analyzer.	Nos.	Two Nos. of each type		price included at s.no. 1.00.01 above
f)	of chopper motor, two nos. protection window, one no. of heater cartridge for CO analyser	Nos.	Two No. of each type		price included at s.no. 1.00.01 above price included at s.no. 1.00.01 above
g)	Power supply module	Nos.	1 no. of each type for each analyser type.		price included at s.no. 1.00.01 above
h)	UV Lamp with adopter with SO2 analyser	Nos.	2 no. of each type.		price included at s.no. 1.00.01 above
i)	Light source and detector unit for SPM, and NOX/SOX analyser.	Nos.	1 no. of each type for each analyser type.		price included at s.no. 1.00.01 above
j)	Set of filters	Nos.	1 No. of each type for each analyser type.		price included at s.no. 1.00.01 above
k)	Analysers spares like transmitter lens and receiver lens, protection windows for transmitter & receiver, intergral pressure and temperature sensors, signal processing unit, electronic modules	Nos.	1 No. of each type for each type of flue gas analyser.		price included at s.no. 1.00.01 above
1.00.02	DDCMIS/PLC system, Master slave clock system, Hart Management System, Vibration Monitoring system, CAAQMS, ERP/MIS/LAN/Simulator/ WAN, CCTV, Microprocessor based control system, and other Control System/Sub-systems/electronic system listed in NIT.				price included at s.no. 1.00.01 above

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
1.00.02.01	I/O cards				
a.	Analog Input module	Nos.	10% of qty Installed of each category/model or at least 2 No. of each type/model (Whichever is more)		
b.	Analog output module	Nos.	10% of qty Installed of each category/ model or at least 2 No. of each type/model (Whichever is more)		
c.	RTD/TC cards/modules	Nos.	10% of qty Installed of each category/model or at least 2 No. of each type/model (Whichever is more)		
d.	Digital input module	Nos.	10% of qty Installed of each category/model or at least 2 No. of each type/model (Whichever is more)		
e.	Digital output module	Nos.	10% of qty Installed of each category/model or at least 2 No. of each type/model (Whichever is more)		
1.00.02.02	All types of electronic modules, controllers, function modules, cards, terminal boards, relay boards, power supply cards etc for above mentioned system and other Control System/Sub- systems and any other type of PCB not covered above	Nos.	10% of qty Installed of each category/model or at least 2 No. of each type/model (Whichever is more)		

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
1.00.02.03	Electronic Cards/modules	Nos.	10% of number for each type or minimum of 2 number for each type whichever is high.		
1.00.02.04	Auto/Manual stations, set-point/bias stations etc	Nos.	10% of the number of stations offered for the project from each type or a minimum of 2 number from each model, whichever is more.		
1.00.02.05	Control logic power supply fuses, MCB,MCCB, at each current rating required for the project.	Nos.	20% spare for each type/Model		
1.00.02.06	Electronic cards of each type used for each type of Servers supplied with any control system	Nos.	Ten (10) percent or 2 no. (Whichever is more)		
1.00.02.07	Electric to pneumatic converters of each type utilized with automatic control system using pneumatic drives	Nos.	Ten (10) percent of each type or a minimum of one of each type, whichever is more.		
1.00.02.08	Plug-in type keyboard	Nos.	Not Applicable for this package		
1.00.02.09	Control OWS	Nos.	Two No. of each type with complete accessories & monitors.		
1.00.02.10	Utility/Engineering OWS	Nos.	Not Applicable for this package		
1.00.02.11	DVD/CD	Nos.			
1.00.02.12	Data highway cable with adequate connectors of each type	set.	200 mts. each		
1.00.02.13	Hard disc drive unit	Nos.	Not Applicable for this package		
1.00.02.14	Prefab cable connectors	Nos.	10% or 5 nos (whichever is more) of each type of Installed		
1.00.02.15	Cubicle power supply power supply modules	Nos.	Ten (10) percent or 5 nos (whichever is more) of Installed of each type and rating		
1.00.02.16	Interposing/coupling relays.	Nos.	Ten (10) percent Installed of each type and rating		

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
1.00.02.17	Ethernet Switches, Routers & other communication hardware	Nos.	10% of qty Installed of each type or a minimum of 2 numbers from each model, whichever is more.		
1.00.02.18	Sensors with special cables, Power supply modules, Relay, Interface Module, and electronic modules used for vibration monitoring system	Nos.	10% of qty installed or Five no. (Whichever is more) of each type)		
1.00.02.19	Printer toners for all printers	Nos.	Not Applicable for this package		
1.00.02.20	DMP printer head of the total quantity	Nos.			
1.00.02.21	Drum for A3 sized scanner cum copies, printer	Nos.			
1.00.02.22	24" LED monitor,	Nos.	Not Applicable. OWS shall be supplied as per applicability.		
1.00.02.23	29" LED monitor	Nos.			
1.00.02.24	22" LED monitors.	Nos.			
1.00.02.25	RJ 45 connector with box of each type	Nos.			
			Twenty (20) percent or 2 no. (Whichever is more)		
1.00.02.26	Hooters, Buzzers, Cooling fans of each type.	Nos.	Ten (10) percent or 2 no. (Whichever is more)		
1.00.02.27	Interface cables	Set	2 sets of each type/model		
1.00.02.28	Power supply modules (AC to DC convertors)	Nos.	10% or Five no. (Whichever is more) of each type/model		
1.00.02.29	DVD/CD drive unit of each type	Nos.	Not Applicable for this package		

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
1.00.02.30	Mouse	Nos.	Not Applicable for this package		
1.00.03	Steam and Water Analysis System (SWAS)			50,56,170	Lot price has been given for items under SI no. 10.00.03
1.00.03.01	High pressure reducing elements for sample flow.	Nos.	10% spare of qty installed.		
1.00.03.02	Ion exchange columns with resin as utilized with cation conductivity analysers	Nos.	Four No		
1.00.03.03	Conductivity cells as utilised with conductivity monitors	Nos.	Two nos of each type		
1.00.03.04	pH flow-through type cells used with pH monitors	Nos.	Two nos. of each type		
1.00.03.05	Chemical reagents for all analysers	Set	12 months continuous operation of all analysers from date of taking over.		
1.00.03.06	Chemical reagents for colorimetric silica analyzers	Set	12 months continuous operation of all analysers from date of taking over.		
1.00.03.07	Electronic Modules	Nos.	One (1) no. for each type of Analyser.		
1.00.03.08	Pressure gauge, solenoid valves, temperature gauge, Back Pressure regulating valves, 3 way grab valves, needle valves, isolation valves, PRV, flow switch, flow indicator and temperature switch, erection hardware's, valves in SWAS.	Nos.	Two (2) no. of each type		
1.00.03.09	Primary coolers/secondary coolers.	Nos.	Three (3) No of each type		
1.00.04	Relay based Control Panels				
1.00.04.01	LEDs for indicating lights	Nos.	10% of qty installed.		
1.00.04.02	Control circuit fuses/MCB/MCCB/ Semiconductor Fuses	Nos.	300% of installed of each type, current rating.		
1.00.04.03	Relays modules & contactors.	Nos.	20% spare of qty Installed of each type & rating.		

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
1.00.05	Alarm Annunciation System				
1.00.05.01	logic modules, group card modules, power supply modules, Hooters and any other electronic module.	Nos.	20% spares of each type installed		
1.00.05.02	un-engraved window boxes complete with LED etc.	Nos.	5% spares of each size installed		
1.00.05.03	LEDs for annunciation facia windows and LEDs box assemblies offered for the project	Nos.	20% of qty installed		
1.00.05.04	Annunciator hooter	Nos.	One (1) No. of each type		
1.00.06	Un-interrupted Power Supply System and DC Control Power Supply System				
1.00.06.01	As per Manufacturer's Recommendation for Three Years Continuous Operation or minimum quantities indicated as below (whichever is more)				
1.00.06.02	Fuses/Semiconductor Fuses	Nos.	300% of installed of each type, current rating with each panel /board		
1.00.06.03	Miscellaneous parts for the power supplies such as SCRS, transistors, resistors, diodes, light bulbs, static switches, blocking diodes etc	Nos.	Minimum of 10% or atleast two (which ever is more) of each type		
1.00.06.04	Battery cells complete with contactor,cover plates etc	Nos.	10% of qty installed		
1.00.06.05	Electronic Modules like Rectifier control card, inverter control card, Driver card, IGBT Module, DC-DC converter card or any other card as listed in approved BOM for UPS, AC supply & 24 V DC supply etc.	Set	1 Set of each type & rating		

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
1.00.06.06	Miniature Circuit breakers for AC and DC supply.	Nos.	20 % of installed or 10 Nos of each type (which ever is more) for ACDB and DCDB.		
1.00.06.07	Digital/analog panel meters/indicators	Nos.	5% or 2 no. of each type (whichever is more)		
1.00.06.08	CT's, CVT's VT's chokes, AC/DC isolators, contactors, timers, relays.	Nos.	10% or 2 nos. of each type and rating, (whichever is more)		
1.00.06.09	Cooling Fans in UPS & 24 V DC charger panels	Nos.	10% or 2 nos. of each type and rating, (whichever is more)		
1.00.06.10	following accessory equipment for the battery shall be furnished : a) Cell lifting facilities b) Assembly wrenches c) Vent plug hydrometer d) Vent plug thermometer e) Supply of corrosion-preventive grease. f) 10% spare cells.	Set	Two sets		
1.00.06.11	Electronic modules of each type & rating for UPS and DC control power supply system.	Set	One set of with each set consisting of at least one number of each type of electronic module for inverters, chargers, static switch, stabiliser etc. as per approved BOM.		
1.00.06.12	MCCB for UPS & 24 V DC charger panels, ACDB, DCDB.	Nos.	20 % of installed or 5 Nos of each type (which ever is more)		
1.00.07	Erection hardware				
1.00.07.01	Instrument valves	Nos.	Ten (10) percent of each type & Size installed		

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
1.00.07.02	Condensate pots of each type & Size installed	Nos.	Ten (10) percent of total number of Installed or four numbers whichever is higher.		
1.00.07.03	Manifold	Nos.	Ten (10) percent of each type & Size installed		
1.00.07.04	Fittings	Nos.	Ten (10) percent of each type & Size installed		
1.00.08	LVS			8,58,305	EDN-Lot price has been given for items SI no 1.00.08
1.00.08.01	LEDs	Nos.	20% (Installed) spares of each type & size.		
1.00.08.02	LVS Filters	Nos.	50% spare or min 6 nos.		
1.00.08.03	Electronic cards of each type for LVS	Nos.	3 nos. or 20% whichever is more		
1.00.08.04	Interfacing cables	Set	Two Set of each type & size.		
1.00.08.05	Power supply modules of each type for LVS	Nos.	3 nos. or 20% whichever is more		
1.00.08.06	Cooling modules of each type for LVS	Nos.	3 nos. or 20% whichever is more		
1.00.08.07	LVS Controller of each type for LVS	Nos.	2 nos.		
1.00.09	Master Slave Clock system			1,45,950	EDN-Lot price has been given for items SI no 1.00.09
(i)	As per Manufacturer's Recommendation for Three Years Continuous Operation or minimum quantities indicated as below (whichever is more)	Set			
(ii)	Electronic cards	Nos.	One No. of each type & model		
(iii)	Signal Conditioner cards	Nos.	One No. of each type & model		
(iv)	Slave clocks of each type used for Master slave clock system	Nos.	Two No. of each type & model		
(v)	Cubicle power supply power supply modules	Nos.	Ten (10) percent or 2 nos (whichever is more) of Installed of each type and rating		
1.00.10	Plant Security and surveillance system			5,10,020	EDN-Lot price has been given for items SI no 1.00.10

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
1.00.10.01	As per Manufacturer's Recommendation for Three Years Continuous Operation or minimum quantities indicated as below (whichever is more)				
1.00.10.02	Electronic cards	Nos.	One No. of each type		
1.00.10.03	PTZ controller	Nos.	One No. of each type		
1.00.10.04	Electronic modules used for server system	Nos.	10% or Two No. of each type (whichever is more)		
1.00.10.05	Special cables & connector	Set	(5 sets) of each type		
1.00.10.06	Cartridges for air filter	Nos.	Two No. of each type		
1.00.10.07	Relay	Nos.	5 nos. of each type		
1.00.10.08	Power supply modules of each type	Nos.	5 nos. of each type		
1.00.10.09	Camera of each type used for Plant Security and surveillance system.	Nos.	Two no. of each type		
1.00.10.10	Automatic door sensors	Nos.	10% or 2 nos. min whichever is more		
1.00.10.11	Card reader.	Nos.	10% or 2 nos. min whichever is more		
1.00.11	AAQMS			27,12,500	Lot price for applicable items
1.00.11.01	As per Manufacturer's Recommendation for Three Years Continuous Operation or minimum quantities indicated as below (whichever is more)				
1.00.11.02	Electronic cards/Module/Mother Board /Signal Processing Unit for each type of Analyzer	Nos.	One no. of each type		
1.00.11.03	Power supply module	Nos.	One no. of each type for each analyser		
1.00.11.04	UV Lamp with adopter with SO2 analyser.	Nos.	One no. of each type		
1.00.11.05	Light source and detector unit for SPM, and NOX/SOX analyser.	Nos.	One no. of each type for each analyser		
1.00.11.06	Pump for SPM Analyser	Nos.	One no. of each type		
1.00.11.07	Conference hall mic.	Nos.	Two no. of each type		
1.00.11.08	Conference hall speakers.	Nos.	Two no. of each type		
1.00.12	HMS			90,475	
1.00.12.01	As per Manufacturer's Recommendation for Three Years Continuous Operation	Set			
1.00.12.02	Electronic cards	Nos.	One no. of each type		

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
1.00.13	Mandatory Spares for Control valves, Power Cylinder, Control Dampers, Actuators and Accessories				
(A)	Following spares shall be furnished for control valves, Power Cylinder, Control Dampers as applicable.				
	One set of spare control valve stem packing for each control valve.				
	Two moulded rubber diaphragms for each control valve.				
	One sets of each of O-rings and rubber gaskets for each control valve.				
d)	100 percent qty. of lubricants for gaskets for each control valve on one year consumption basis.				

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
	2 sets of limit switches and 1 set of valve positioner for each control valve.				
f)	20 percent of position transmitter (4-20mA) for total qty. of control valve.				
g)	One (1) set of valve trims (such as plug, stem, seat ring /cage, guide bushing, stem lock pin, packing retaining ring, etc) for each control valve.				
h)	One completes actuator of each type or min 10% for each type and size whichever is more.				
i)	20 percent of Solenoid valves or min 2 no. of each type for total qty. of control valves.				
j)	20% of I to P converters, Pressure regulators.				
B)	Mandatory spares for each critical applications special control valves as specified in NIT			1,17,72,635	PEM-For APRDS AND For Fuel Oil Unloading System, included under clause Fuel oil system of Mech. List of mandatory spares AND For Air Conditioning system, price included under clause Air Conditioning system of Mech. List of mandatory spares
C)					

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
a.	Soft Goods Kit Valve	1 set		65,16,048	PEM-For Fuel Oil Unloading System, included under clause Fuel oil system of Mech. List of mandatory spares AND For Air Conditioning system, price included under clause Air Conditioning system of Mech. List of mandatory spares HYD-Lot price has been given for items under SL no.1.00.13 (C) Items applicable for Pumps shall be supplied. For C&I control valves included above under clause no A1 -1.0013 of C&I list AND For Fuel Oil Unloading System, included under clause Fuel oil system of Mech. List of mandatory spares AND For Air Conditioning system, price included under clause Air Conditioning system of Mech. List of mandatory spares
b.	Metal seat	1 set			
c.	Seat Ring	1 set			
d.	Spindle	1 set			
e.	Actuator Soft Goods kit	1 set			
i.	Feed back transmitter unit	2 Nos.			
ii.	Electronic Position Transmitter	2 Nos.			
iii.	Solenoid valves	2 Nos.			
iv.	Air filter regulators	2 Nos.			
v.	Air Lock Relay	2 Nos.			
vi.	Complete Actuator for each type and model	1 set			
C)	Following spares shall be supplied for each of the HP/LP By Pass & Spray control valves				TRY-V: Price already Quoted in Mechanical section under HP BYPASS SYSTEM
i)	Stem	1 NO.			
ii)	Jet Cage	1 NO.			
iii)	Nozzle Body	1 NO.			
iv)	Seat	1 NO.			
v)	Guide bushing	1 NO.			
vi)	Valve Packing	1 Set			
vii)	Valve Gaskets	1Set			
viii)	Actuator seal set	1 Set			
D)	Common spares for HP/LP By Pass & Spray control valves:				TRY-V: Price already Quoted in Mechanical section

TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
i)	Feedback transmitter	2 NOS.			under HP BYPASS SYSTEM
ii)	Electronic positioner	2 NOS.			
iii)	Proportional Valve	2 NOS.			
iv)	Quick opening device	2 NOS.			
v)	Seal sets	4 Sets			
vi)	Solenoid Valves	2 NOS.			
vii)	Filters for Oil Units	1 set			
viii)	Supply manifold for oil units	1 No			
ix)	Hose for each service	1 each			
x)	Seal set for oil unit	1 Set			
	Complete actuator for each type and model	1 set			
E)	1 NO of Nozzle for each PRDS De Super heater & Spray water desuperheater and orifice plate for CEP flow.				1 No. Nozzle for Spray water Desuperheater is included in our price. Rest of the flow nozzles not included in our offer as 'Mandatory spares' are provided for items or components that require replacement during plant operation. Flow nozzles and orifice plates do not require replacement and hence are not provided as mandatory spares. We have never supplied nozzles and orifice plate as mandatory spares in any of the existing as well as previous projects.
1.00.14	Mandatory Spares for Boiler Tube leak Detection System			17,81,920	LOT PRICE FOR THE APPLICABLE ITEMS UNDER THIS SERIAL NO 1.00.14
	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.				

TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
b)	Consumables like batteries, fuses etc. for two years operation of boiler tube leak detection system.				
1.00.15	Mandatory spares not covered above				
	Bidder to supply 10% or 1 no. (whichever is more) of each type of sensor/instrument, instrumentation/mechanical fittings etc for any other electronic system, feeder control cabinets, hydrastep (EWLI), Vibration Monitoring System, CCTV, C&I Lab Instruments, On line Carbon in Ash analyser 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.				
1.00.16	OTHER RELATED CONTROL AND INSTRUMENTATION SYSTEMS/EQUIPMENTS				
1.00.16.01	Other SG related sub-systems				
	1 Flame Monitoring System				
(i)	Complete Flame Scanner Assembly including scanner head assembly, scanner housing, and fibre optic cables.	20% or 4 nos. whichever is more.		39,05,356	
(ii)	Flame Scanner Lens.	100%		1,08,570	
(iii)	Electronic cards for scanners	10% or 2 nos. of each type whichever is more.		17,69,852	
(iv)	Power Supply Modules	10% or 2 nos. of each type whichever is more.			INCLUDED IN SL NO (III) ABOVE
	2 Coal Feeders				
(i)	Calibration Motor	10% or 2 nos. whichever is more.			NOT APPLICABLE
(ii)	Correction Motor	10% or 2 nos. whichever is more.			NOT APPLICABLE

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
(iii)	Motion monitor	10% or 2 nos. whichever is more.		8,14,275	
(iv)	Speed pick-up	10% or 2 nos. whichever is more.		5,69,989	
(v)	Torque switch	10% or 2 nos. whichever is more.		15,30,746	
(vi)	Load Cell	10% or 2 nos. whichever is more.		62,19,969	
(vii)	Electronic cards & Power Supply cards	10% or 2 nos. whichever is more.		12,15,725	
(viii)	Clutch (if applicable)	10% or 2 nos. whichever is more.		8,14,275	
(ix)	Local indication lamps	200% .		4,14,316	
(x)	Panel meters	10% or 2 nos. whichever is more.			NOT APPLICABLE
(xi)	Limit switch assembly for coal-on-belt, no coal flow, shear pin failure, etc.	10% or 2 nos. whichever is more.		3,79,995	
(xii)	Coupling (eddy current type etc., if applicable)	10% or 2 nos. whichever is more.		3,79,995	
	3 Electromatic Safety Valves				
(a)	Pressure switches, local PB stations and solenoid Valves.	10% or 2 nos. of each type whichever is more.		4,07,498	
	4 Furnace Temperature Probes				
(a)	Thermocouple	2 Nos. of each type		67,900	
	5 Acoustic Pyrometers				NOT APPLICABLE
(a)	Signal Processor and interface modules	10% or 2 nos. of each type and model whichever is more			NOT APPLICABLE
(b)	Sensors and Transceivers	20% or 2 nos. of each type and model which is more.			NOT APPLICABLE
	6 Furnace and Flame Viewing System			40,25,000	LOT PRICE FOR THE APPLICABLE ITEMS UNDER THIS SL NO
(a)	Flame Cameras	10% or 2 nos. of each type whichever is more.			
(b)	Electronic Modules	10% or 2 nos. of each type whichever is more.			
	7 Coal Bunker Level Indicating System			1,69,680	EDN -lot price has been given for the itmes under SI no 7 to 8
(i)	Sensors of each type	20% or 2 nos. of each type whichever is more.			

TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
(ii)	Electronic Cards of each types, model	10% or 2 nos. of each type and model whichever is more.			
(iii)	Panel indicators/displaysfor Bunker Level	20% or 2 nos. of each type whichever is more.			
8 (i)	Solenoids for SG pneumatic drives/valves.	20% or 2 nos. of each type whichever is more.			
(ii)	Solenoid valves.	20% or 2 nos. of each type whichever is more.			
(iii)	Diaphragms	20% or 2 nos. of each type whichever is more.			
9 Conductivity type level monitoring system					NOT APPLICABLE
(i)	Electrodes	50% of population of each type and model.			NOT APPLICABLE
(ii)	Electronic Cards	20% or 2 nos. of each type and model whichever is more.			NOT APPLICABLE
(iii)	Lamps/LEDs of display units	100%			NOT APPLICABLE
10	Mill and Air heater Fire detection system.			63,672	Included in SI No 1.00.01 & 1.00.02 for EDN scope of supply and lot price indicated here is for Trichy's scope of supply.
(a)	Thermocouple	10% or 2 nos. whichever is more		-	
(b)	Process actuated switches	10% or 1 no. whichever is more			NOT APPLICABLE
(c)	Electronic cards	20% or 2 nos. whichever is more			NOT APPLICABLE
1.00.16.02	Other TG Related Sub-Systems				
	Turbine Supervisory System/EHTC/TSC/ATT/ATRS/GSPC/TDBFP etc.				EDN portion is Included in SI No 1.00.01 & 1.00.0
(i)	Power Supply assemblies of all types	10% or 2 nos. of each type whichever is more		11,81,034	HYD- Lot price for items under for the SI no (i) to (viii)
	Temperature Sensing elements	10% or 2 nos. of each type whichever is more			Already covered under S.No.1.00.01.02 (i) above, Hence,not offered again.
(iii)	CJC assemblies of all types	10% or 2 nos. of each type whichever is more			
(iv)	Local gauges/transmitters of all types, range, model no. etc. For Temperature, pressure, DP, differential expansion, axial shift etc.	5% or 1 no. of each type whichever is more			Already covered under S.No.1.00.01.03 above. Hence,not offered again.

TANGEDCO				Total Ex-Works price	*Remarks
SI no	Name of spares	Unit	Qty	in INR	
(v)	Process Actuated Switch Devices of all types, range, model no. etc. for pressure, DP, temperature, flow, level, proximity/speed etc.	5% or 1 no. of each type whichever is more			Already covered under S.No.1.00.01.03 above. Hence,not offered again.
(vi)	Electronic Cards/PCB's/interface units/special cables etc. of each type of measurement used in TSI.	10% or 2 nos. of each type whichever is more.			
(vii)	Instrument valves of all types like isolating, 2/3/5 way valve manifolds, hi pressure reducing, safety relief, each type of solenoid valves etc.	5% or 2 nos. of each type, model etc.; whichever is more.		1,74,230	
(viii)	Sensors of all types, range, model etc. for vibration, eccentricity, proximity, differential expansion, axial shift , EHC position, Stop/Control valve position and any other measurements etc.	10% or 2 nos. of each type whichever is more.			Sensors for Stop/ control valve position are already covered above under C&I spares. Hence,same are not offered again. For rest of measurements, the senors are "Not applicable"..
(ix)	Electro Hydraulic Converter.	1 complete unit of each type.		5,74,276	
			C& I TOTAL	26,12,61,835	

C&I BHEL's Approved Vendor List

PEM APPROVED LIST

Sl No	Package Code	Package Name	Vendor Code	Vendor Name	Reg Status	Vendor Address
1	145-14000-A	TRANSMITTERS	B049	ABB LIMITED	REGULAR	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vijin.swami@in.abb.com
2	145-14000-A	TRANSMITTERS	E057	Endress + Hauser (India) Pvt. Ltd.,	REGULAR	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,
3	145-14000-A	TRANSMITTERS	M091	Moore Industries International Inc.	REGULAR	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com
4	145-14000-A	TRANSMITTERS	R002	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	REGULAR	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com
5	145-14000-A	TRANSMITTERS	S001	SIEMENS LIMITED	REGULAR	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshnev@siemens.com
6	145-14000-A	TRANSMITTERS	S039	SMART INSTRUMENTS LTD, BRAZIL	REGULAR	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in
7	145-14000-A	TRANSMITTERS	S106	SBEM PVT. LTD.	REGULAR	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
8	145-14000-A	TRANSMITTERS	T031	Honeywell Automation India Limited	REGULAR	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : ratesh.chaudhary@honeywell.com
9	145-14000-A	TRANSMITTERS	T111	TOSHNIWAL INDUSTRIES PVT. LTD.,	REGULAR	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
10	145-14000-A	TRANSMITTERS	V040	V. AUTOMAT & INSTRUMENTS (P) LTD.	REGULAR	Mr. R. K. BASST/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
11	145-14000-A	TRANSMITTERS	Y10	YOKOGAWA INDIA LIMITED,	REGULAR	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : udav.shankar@in.yokogawa.com

PEM APPROVED VENDOR LIST

SI No	Package Code	Package Name	Vendor Code	Vendor Name	Reg Status	Vendor Address
1	145-10000-A	TEMPERATURE GAUGE	A010	A.N. INSTRUMENTS PVT. LTD.	REGULAR	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
2	145-10000-A	TEMPERATURE GAUGE	A126	ASHCROFT INDIA PVT LTD.	REGULAR	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : ajay@aurainc.com
3	145-10000-A	TEMPERATURE GAUGE	B014	BUDENBERG GUAGE CO.LTD.	REGULAR	PO BOX-5, ALTRINCHAM CHESHIRE Phone- 0161-9285441 Pincode : WA14 4ER Email : dhbdelhi@vsnl.net
4	145-10000-A	TEMPERATURE GAUGE	F016	FORBES MARSHALL (HYD) LTD.	REGULAR	MR SAI LESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T- 4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
5	145-10000-A	TEMPERATURE GAUGE	G032	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	REGULAR	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com.
6	145-10000-A	TEMPERATURE GAUGE	G047	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	REGULAR	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincode : 403525 Email : atilworks@pvro-electric.in
7	145-10000-A	TEMPERATURE GAUGE	G071	GAUGE BOURDON INDIA PVT. LTD.	REGULAR	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : aicdelhi@general-gauges.com.
8	145-10000-A	TEMPERATURE GAUGE	H023	H.GURU INDUSTRIES	REGULAR	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mauru@vsnl.net
9	145-10000-A	TEMPERATURE GAUGE	H040	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	REGULAR	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@haurusouth.com
10	145-10000-A	TEMPERATURE GAUGE	W017	Baumer Technologies India Pvt. Ltd.	REGULAR	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com

PEM APPROVED VENDOR LIST

SI No	Package Code	Package Name	Vendor Code	Vendor Name	Reg Status	Vendor Address
1	145-13000-A	TEMP. ELEMENT	G007	GENERAL INSTRUMENT CONSORTIUM	REGULAR	Mr. Amarendra Kulkarni 511, EROS APARTMENTS, 56, NEHRU PLACE, NEW DELHI Phone- 011-26433201,5160746 Pincode : 110019 Email : amarendra@general-gauges.com
2	145-13000-A	TEMP. ELEMENT	G032	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	REGULAR	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goinstruments.com.
3	145-13000-A	TEMP. ELEMENT	I022	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	REGULAR	320, TV INDUSTIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI Phone- 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com
4	145-13000-A	TEMP. ELEMENT	P061	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	REGULAR	M. D. BICHU/R. M. BICHU G.B, HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA Phone- 9326114601 Pincode : 403507 Email : priyanka.marketing@pyro-electric.in
5	145-13000-A	TEMP. ELEMENT	T106	TECHNO INSTRUMENTS	REGULAR	Abhijit Gohel/Mr. Amit Pandya Plot No. 1145/1, Uma Convector Lane, Santej,Ta. Kalol, Gandhinagar Phone- 9909925223 Pincode : 382721 Email : amit@techno-instruments.com
6	145-13000-A	TEMP. ELEMENT	T107	Tempsens Instrument (I) Pvt Ltd	REGULAR	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com
7	145-13000-A	TEMP. ELEMENT	T108	TM TECNOMATIC SPA	REGULAR	MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzoc VIA DELLE INDUSTRIE, 36 CREMONA Phone- 39037221574 Pincode : 26100 Email : info@tmtecnomatic.com
8	145-13000-A	TEMP. ELEMENT	T111	TOSHNIWAL INDUSTRIES PVT. LTD.,	REGULAR	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
9	145-13000-A	TEMP. ELEMENT	W017	Baumer Technologies India Pvt. Ltd.	REGULAR	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com

PEM APPROVED VENDOR LIST

SI No	Package Code	Package Name	Vendor Code	Vendor Name	Reg Status	Vendor Address
1	145-25000-A	JUNCTION BOX	A101	AJMERA INDUSTRIAL & ENGINEERING WORKS	REGULAR	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, imaimera@yahoo.com
2	145-25000-A	JUNCTION BOX	K043	K.S.INSTRUMENTS PVT.LTD.	REGULAR	B-81 IND ESTATE , RAJAJINAGAR BANGALORE Phone- 23386530,9980666033 Pincode : 560044 Email : enquiryv.ksi@gmail.com
3	145-25000-A	JUNCTION BOX	S095	SUCHITRA INDUSTRIES	REGULAR	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com
4	145-25000-A	JUNCTION BOX	S114	Shrenik & Company,	REGULAR	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumin.com

PEM APPROVED VENDOR LIST

SI No	Package Code	Package Name	Vendor Code	Vendor Name	Reg Status	Vendor Address
1	145-36000-A	LEVEL SWITCH- CONDUTIVITY TYPE	B077	BLISS ANAND PVT. LTD.	REGULAR	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
2	145-36000-A	LEVEL SWITCH- CONDUTIVITY TYPE	F039	FLOWTECH INSTRUMENTS SERVICRS	REGULAR	Mr.Nilesh M. Shah/Mr.N.R.Rao. 900/2/B, G.I.D.C. Estate, Makarpura, VADODARA Phone- (0265) - 6508171 Pincode : 390010 Email : flowtechinstruments@yahoo.com
3	145-36000-A	LEVEL SWITCH- CONDUTIVITY TYPE	H047	HI-TECH SYSTEMS & SERVICES LTD.	REGULAR	Mr. Vikash Agrawal/Mr. Tarun Debnath 119, PARK STREET , KOLKATA Phone- 033-22290045 Pincode : 700016 Email : sandeep@hitech.in
4	145-36000-A	LEVEL SWITCH- CONDUTIVITY TYPE	L005	LEVCON INSTRUMENTS PVT. LTD.	REGULAR	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : h_iana@levcongroup.com
5	145-36000-A	LEVEL SWITCH- CONDUTIVITY TYPE	R047	RAMAN INSTRUMENTS PVT.LTD.	REGULAR	Mr. N R Shenoy/Mr G B Viji 8, First Floor.Plot : 160A Bait-Ush-Sharaf, 29th Road,Bandra(W) MUMBAI Phone- 09892331381 Pincode : 400050 Email : ramanbpl@vsnl.com
6	145-36000-A	LEVEL SWITCH- CONDUTIVITY TYPE	S008	SIGMA INSTRUMENTS CO.	REGULAR	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
7	145-36000-A	LEVEL SWITCH- CONDUTIVITY TYPE	S010	SOR INC.	REGULAR	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : ldegarmo@sorinc.com, avdhesh@sherman-india.com
8	145-36000-A	LEVEL SWITCH- CONDUTIVITY TYPE	S123	Sapcon Instrument Pvt Ltd.	REGULAR	131, PALSHIKAR COLONY Contact Person- Mr. Ashwin (9826080207) INDORE Phone- +91-731-4085751, Pincode : 452004 Email : sales@sapconinstruments.com, sapcon.vtelang@gmail.com
9	145-36000-A	LEVEL SWITCH- CONDUTIVITY TYPE	V040	V. AUTOMAT & INSTRUMENTS (P) LTD.	REGULAR	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDLAREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com

PEM approved vendor list

Sl No	Package Code	Package Name	Vendor Code	Vendor Name	Reg Status	Vendor Address
1	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A010	A.N. INSTRUMENTS PVT. LTD.	REGULAR	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
2	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A126	ASHCROFT INDIA PVT LTD.	REGULAR	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : ajay@aurainc.com
3	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	F016	FORBES MARSHALL (HYD) LTD.	REGULAR	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T- 4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
4	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	G071	GAUGE BOURDON INDIA PVT. LTD.	REGULAR	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com
5	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H023	H.GURU INDUSTRIES	REGULAR	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
6	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H040	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	REGULAR	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
7	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	W017	Baumer Technologies India Pvt. Ltd.	REGULAR	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com



TITLE
**STANDARD TECHNICAL SPECIFICATION FOR
FO SYSTEM**

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

VOLUME III

SECTION

REV 00

DATE :

**2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE
OF NCTPS, CHENNAI**

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

VOL-III

(TECHNICAL SCHEDULES)



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



TITLE
**STANDARD TECHNICAL SPECIFICATION FOR
FO SYSTEM**

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

VOLUME III

SECTION

REV 00

DATE :

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

DEVIATION SHEET (COST OF WITHDRAWAL)**PROJECT:- 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI****PACKAGE:- FUEL OIL UNLOADING AND STORAGE SYSTEM****TENDER ENQUIRY REFERENCE:-****NAME OF VENDOR:-**

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWAL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWAL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWAL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION

TECHNICAL DEVIATIONS

COMMERCIAL DEVIATIONS

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATIONS	SIGN & DATE	

NOTES:

- For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
- For directly dispatchable items, cost of withdrawl 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 withdrawl 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 withdrawl of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawl of deviation shall be taken as NIL.
- 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 withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.
- In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.
- In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

	TITLE: TECHNICAL SPECIFICATION 2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI COMPLIANCE CUM CONFIRMATION CERTIFICATE	SPEC. NO.: PE-TS-400-166-A001
		VOLUME: III
		SECTION:
		REV. NO. 0 DATE
		SHEET 1 OF 2

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions other than those mentioned under "exclusion" and those resolved as per 'Schedule of Deviations', if applicable, with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This shall be within the contracted price with no extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified/ intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre - bid discussions, otherwise BHEL/ Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.
- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment as applicable, shall be as per relevant clause of GCC /SCC /Other Commercial Terms & Conditions.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities. This clause will apply in case during site commissioning additional requirements emerges due to customer and/ or consultant's comments. No extra claims shall be put on this account.
- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.



TITLE:

**TECHNICAL SPECIFICATION
2X660MW ENNORE SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

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

VOLUME: III

SECTION:

REV. NO. 0 DATE

SHEET 2 OF 2

- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL

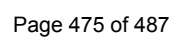
2X660MW ENNORE SEZ COAL BASED STPP AT
ASH DYKE OF NCTPS, CHENNAI

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

(DRAWINGS)



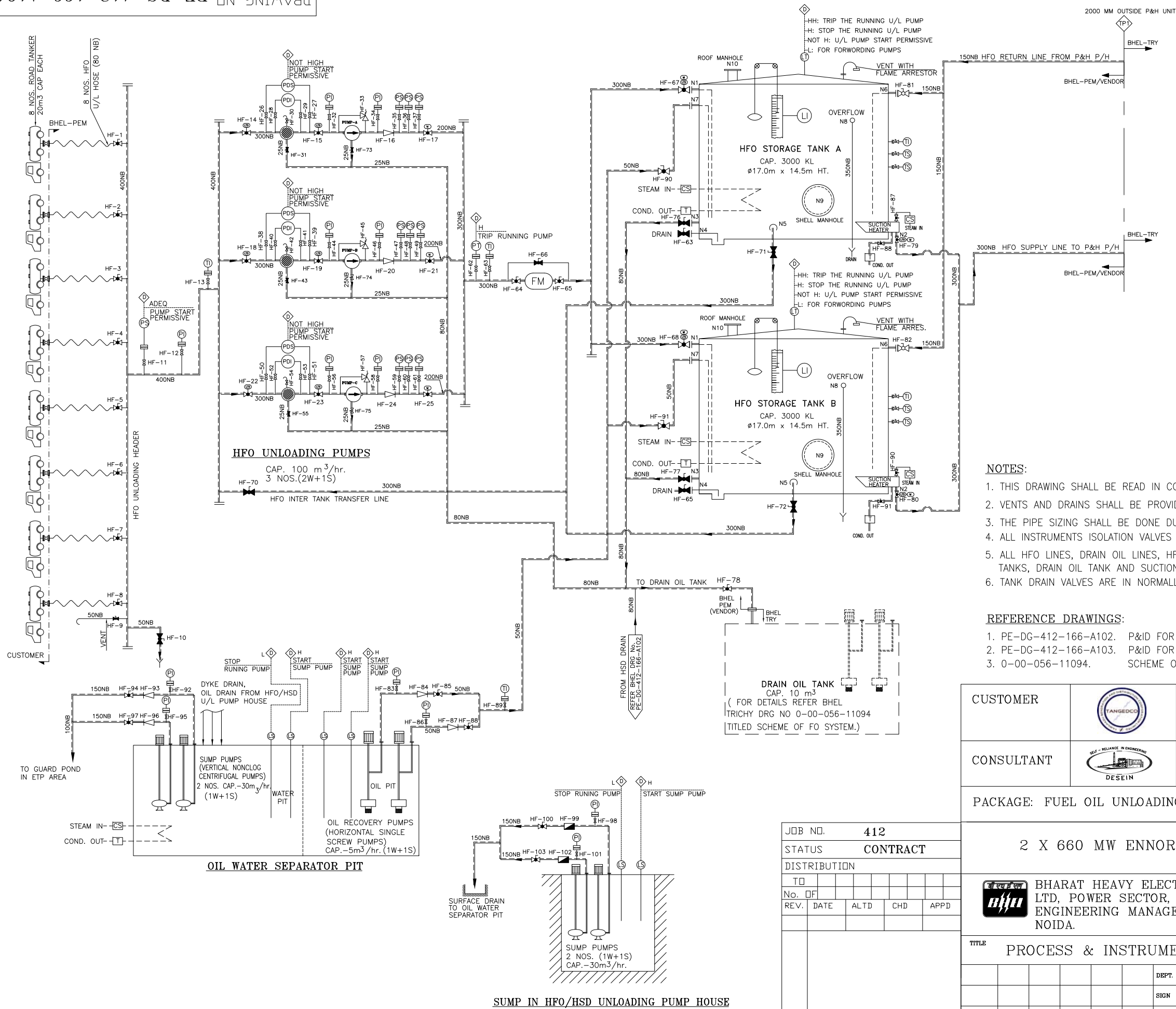
**BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA**



DRAWING NO. PE-DG-412-166-A101

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



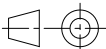
LEGEND	
SYMBOL	DESCRIPTION
	HOSE
	HFO PIPE WITH INSULATED & ELECTRIC TRACED
	COIL HEATER
	PUMP
	LOCAL DRAIN
	MOTOR
	LIMIT SWITCH
	PRESSURE INDICATOR
	PRESSURE SWITCH
	PRESSURE TRANSMITTER
	PRESSURE DIFFERENTIAL INDICATOR
	PRESSURE DIFFERENTIAL SWITCH
	LEVEL SWITCH
	LEVEL TRANSMITTER(RADAR TYPE)
	LEVEL INDICATOR
	TEMPERATURE INDICATOR
	TEMPERATURE SWITCH
	TEMPERATURE ELEMENT
	SIGNAL TO DCS
	STEAM TRAP
	SIMPLEX STRAINER
	PRESSURE SWITCH.
	STEAM CONTROL VALVE
	GLOBE VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	PLUG VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	BALL VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	GATE VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	NON RETURN VALVE
	RELIEF VALVE

NOTES:

- THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DESIGN MEMORANDUM.
- VENTS AND DRAINS SHALL BE PROVIDED AT THE HIGHEST AND LOWEST POINTS RESPECTIVELY.
- THE PIPE SIZING SHALL BE DONE DURING DETAIL ENGINEERING BASED ON PIPE SIZING CRITERIA.
- ALL INSTRUMENTS ISOLATION VALVES SHALL BE GLOBE VALVE.
- ALL HFO LINES, DRAIN OIL LINES, HFO PUMPS & STRAINER ARE ELECTRIC TRACED. HFO TANKS, DRAIN OIL TANK AND SUCTION HEATER ARE STEAM TRACED.
- TANK DRAIN VALVES ARE IN NORMALLY CLOSE CONDITION.

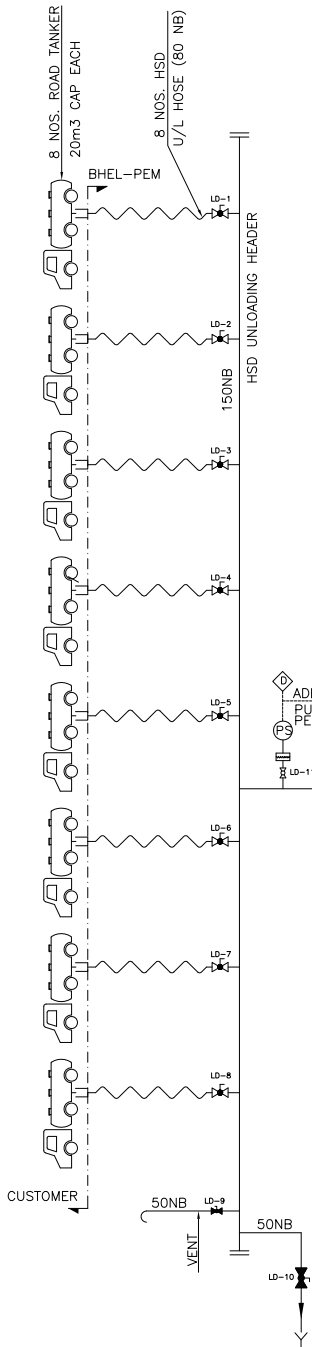
REFERENCE DRAWINGS:

- PE-DG-412-166-A102. P&ID FOR HSD SYSTEM
- PE-DG-412-166-A103. P&ID FOR STEAM AND CONDENSATE FOR HFO HEATING & TRACING.
- 0-00-056-11094. SCHEME OF FUEL OIL SYSTEM (BHEL TRICHY DRG.)

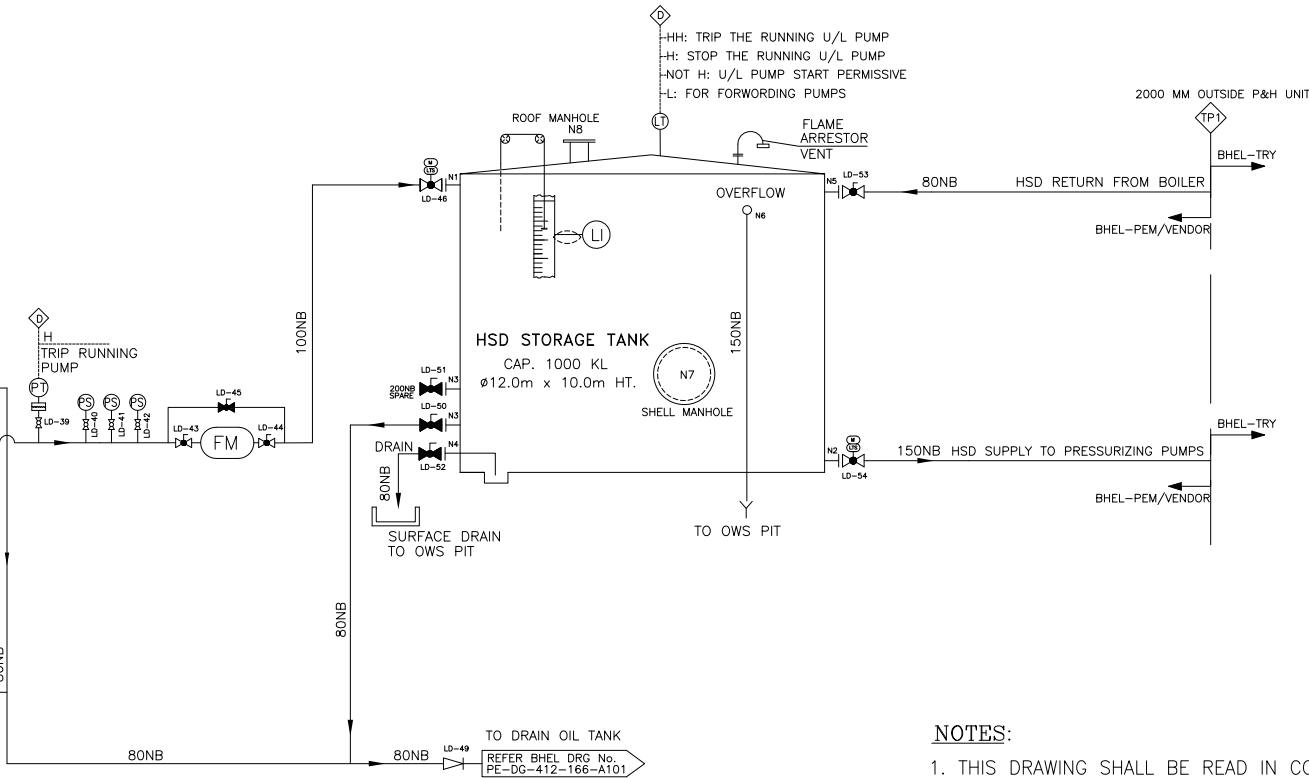
CUSTOMER		TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TENGEDCO)							
CONSULTANT		M/s DESEIN PVT LTD. DESEIN HOUSE, GK – II, NEW DELHI							
PACKAGE: FUEL OIL UNLOADING AND STORAGE SYSTEM.									
2 X 660 MW ENNORE SEZ COAL BASED STPP									
	BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT, NOIDA.		DEPT CODE M		NAME	SIGN	DATE		
				DRN	SC	Sd/-	21.01.2015		
				DESN	KY	Sd/-	21.01.2015		
				CHD	HK	Sd/-	21.01.2015		
				APPD	PK	Sd/-	21.01.2015		
TITLE PROCESS & INSTRUMENTAION DIAGRAM FOR HFO SYSTEM									
						DEPT.	SCALE		DRAWING No.
						SIGN			PE-DG-412-166-A101
						DATE			SHEET 01 OF 01

COPY RIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED
it must not be used directly or indirectly in any way detrimental to the interest of the company.

DRAWING NO. PE-DG-412-166-A102



HSD UNLOADING PUMPS
CAP. 50 m³/hr.
2 NOS.(1W+1S)



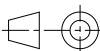
NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DESIGN MEMORANDUM.
2. VENTS AND DRAINS SHALL BE PROVIDED AT THE HIGHEST AND LOWEST POINTS RESPECTIVELY.
3. THE PIPE SIZING SHALL BE DONE DURING DETAIL ENGINEERING.
4. ALL INSTRUMENTS ISOLATION VALVES SHALL BE GLOBE VALVE.
5. TANK DRAIN VALVES ARE IN NORMALLY CLOSE CONDITION.

REFERENCE DRAWINGS:

1. PE-DG-412-166-A101. P&ID FOR HFO SYSTEM
2. PE-DG-412-166-A103. P&ID FOR STEAM AND CONDENSATE FOR HFO HEATING & TRACING.

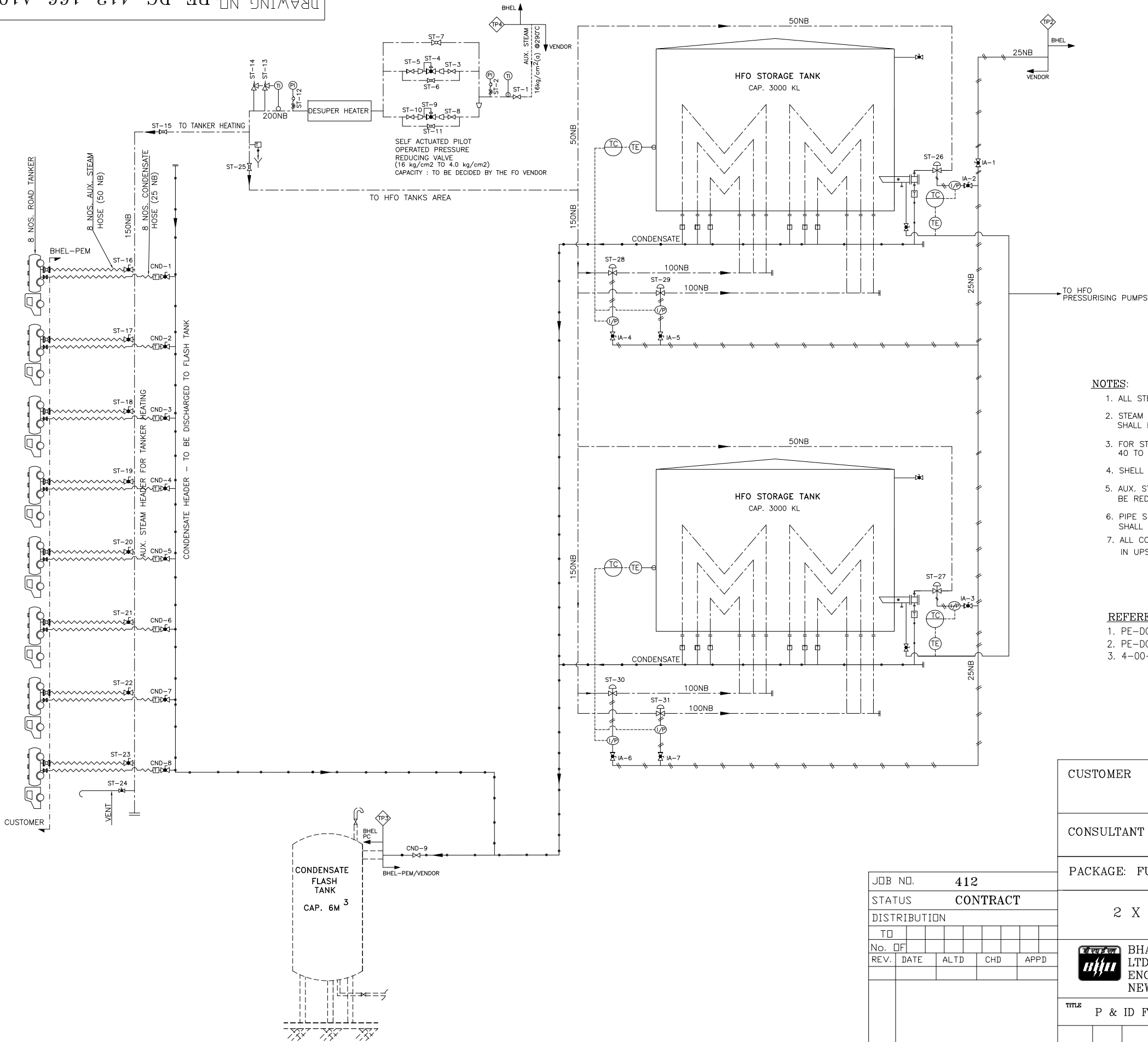
LEGEND	
SYMBOL	DESCRIPTION
	HOSE
	HSD PIPE
	PUMP
	PROGRAMMABLE LOGIC CONTROLLER
	DISTRIBUTED CONTROL SYSTEM
	LOCAL DRAIN
	MOTOR
	LIMIT SWITCH
	PRESSURE INDICATOR
	PRESSURE SWITCH
	PRESSURE TRANSMITTER
	PRESSURE DIFFERENTIAL INDICATOR
	PRESSURE DIFFERENTIAL SWITCH
	LEVEL SWITCH
	LEVEL TRANSMITTER(RADAR TYPE)
	LEVEL INDICATOR
	TEMPERATURE INDICATOR
	TEMPERATURE SWITCH
	TEMPERATURE ELEMENT
	SIGNAL TO DCS
	STEAM TRAP
	SIMPLEX STRAINER
	PRESSURE SWITCH.
	STEAM CONTROL VALVE
	GLOBE VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	PLUG VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	BALL VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	GATE VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	NON RETURN VALVE
	RELIEF VALVE

CUSTOMER		TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TENGEDCO)							
CONSULTANT		M/s DESEIN PVT LTD. DESEIN HOUSE, GK – II, NEW DELHI							
PACKAGE: FUEL OIL UNLOADING AND STORAGE SYSTEM									
2 X 660 MW ENNORE SEZ COAL BASED STPP									
	BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT, NOIDA.		DEPT CODE M		NAME	SIGN	DATE		
				DRN	SC	Sd/-	21.01.2015		
				DESN	KY	Sd/-	21.01.2015		
				CHD	HK	Sd/-	21.01.2015		
				APPD	PK	Sd/-	21.01.2015		
TITLE PROCESS & INSTRUMENTATION DIAGRAM FOR HSD SYSTEM									
						DEPT.	SCALE	DRAWING No.	
						SIGN		PE-DG-412-166-A102	
						DATE		SHEET 01 OF 01	REV 00

DRAWING NO. PE-DG-412-166-A103

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



LEGEND	
SYMBOL	DESCRIPTION
	TEMPERATURE CONTROLLER
	TEMPERATURE ELEMENT
	STEAM TRAP
	PLUG / BALL VALVE
	GATE VALVE
	PNEUMATICALLY OPERATED CONTROL VALVE
	HOSE
	COIL HEATER
	LOCAL DRAIN
	ELECTRICAL SIGNAL
	CONDENSATE LINE
	INSTRUMENT AIR LINE
	AUX. STEAM LINE
	I/P CONVERTER

NOTES:

- ALL STEAM/CONDENSATE LINES SHALL BE INSULATED.
- STEAM TRAPS FOR SUCTION HEATER & FLOOR COIL HEATER OF STORAGE TANKS SHALL BE OF IB TYPE. ALL OTHER STEAM TRAPS SHALL BE OF TD TYPE.
- FOR STEAM LINES & TRACER LINES, TRAPS SHALL BE PROVIDED AT EVERY 40 TO 45 MTR.
- SHELL SURFACE OF F.O. STORAGE TANKS SHALL BE INSULATED.
- AUX. STEAM WILL BE SUPPLIED TO AT 16KG/SQ. CM (a) & 290 °C. FURTHER IT SHALL BE REDUCED TO 4KG/SQ. CM (a) OR AS PER SYSTEM REQUIREMENT.
- PIPE SIZES FOR ALL STEAM LINES, TRACER LINES, CONTROL STATIONS, CONDENSATE LINES ETC. SHALL BE PROVIDED AS PER APPROVED CALCULATION.
- ALL CONTROL VALVES SHALL BE PROVIDED WITH ISOLATION VALVES AND WITH A DRAIN VALVE IN UPSTREAM AND DOWNSTREAM.

REFERENCE DRAWINGS:

- PE-DG-412-166-A101. P&ID FOR HFO SYSTEM
- PE-DG-412-166-A102. P&ID FOR HSD SYSTEM
- 4-00-301-40586 SCHEME OF CONDENSATE FLASH TANK.(BHEL PC)

CUSTOMER		TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)							
CONSULTANT		M/s DESEIN PVT LTD. DESEIN HOUSE, GK – II, NEW DELHI							
PACKAGE: FUEL OIL UNLOADING AND STORAGE SYSTEM.									
2 X 660 MW ENNORE SEZ COAL BASED STPP									
 BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT, NEW DELHI		DEPT CODE M	NAME		SIGN	DATE			
			DRN	SC	Sd/-	21.01.2015			
			DES	KY	Sd/-	21.01.2015			
			CHD	HK	Sd/-	21.01.2015			
			APPD	PK	Sd/-	21.01.2015			
TITLE P & ID FOR STEAM AND CONDENSATE FOR HFO HEATING & TRACING									
						DEPT.		DRAWING No. PE-DG-412-166-A103	
						SIGN			
						DATE			
SHEET 01 OF 01								REV 00	

2X660MW ENNORE SEZ COAL BASED STPP
AT ASH DYKE OF NCTPS, CHENNAI

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

(UNPRICED PRICE SCHEDULE)



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

SCHEDULE-1								
2 X 660 MW ENNORE SEZ COAL BASED STPS, FUEL OIL UNLOADING & STORAGE SYSTEM.								
SUGGESTIVE PRICE FORMAT (MAIN PRICE)								
S.No	Details of Works or Equipment/System	Total ex-works Price	ED	CST /VAT	FREIGHT	E&C Charges	Service tax/ Any other taxes /duties	TOTAL (For site price)
1	2	3	4	5	6	7	8	9 = 3 + 4 + 5 + 6 + 7 + 8
1.0	Lumpsum prices							
1.1.0	Lumpsum firm price for SUPPLY comprising design, engineering, manufacturing, inspection and testing at vendor's / sub-vendor's works, painting, forwarding, proper packing, shipment and delivery at project site, including freight in line with drawings / documents / test procedures to be approved by Customer / consultant, inclusive of all prevailing taxes, duties and other levies for Fuel Oil Unloading & Storage System with all accessories including electricals, control & instrumentation items, start up & commissioning spares, mandatory spares as required for the total scope defined as per technical specification PE-TS-412-166-A001 .					NA		
1.2.0	Lumpsum firm price for Erection & commissioning comprising unloading, storage, handling and transportation at site, erection and commissioning, minor civil work as required, trial run at site, functional/demonstartion Test at site and handing over to the customer in line with drawings / documents / test procedures to be approved by Customer / consultant, inclusive of all prevailing taxes, duties and other levies for Fuel Oil Unloading & Storage System as required for the total scope defined as per technical specification PE-TS-412-166-A001 .	NA						
1.3.0	Total (1.1.0 +1.2.0)							
	Notes:							
a)	Bidder to note that total (for site price) indicated above at 1.3.0 shall be considered for evaluation and hence should be complete in all respect for the full scope defined under tehcnical specification.							
b)	Any item not included in the price quoted above and shown separately will not be taken cognizance of and the offer shall be liable for rejection.							
c)	Total (FOR site supply price) indicated at S.N.1.1.0 above should match with the total of item wise break-up of S.N.1.4 of SCHEDULE-2 .							
d)	Bidder shall furnish the price of all items as indicated in the price SCHEDULE 1,2 & 3 . Bidder's offer shall liable to be rejected in case bidder does not furnish the same. For SCHEDULE-2 , pls refer next page.							
e)	Bidders are requested to obtain clarifications in case of any doubt before filling the price schedule in the prebid clarification stage. It is requested not to make any assumption.							

SCHEDULE-2							
2 X 660 MW ENNORE SEZ COAL BASED STPS, FUEL OIL UNLOADING & STORAGE SYSTEM.							
SUGGESTIVE PRICE FORMAT (SUPPLY BREA-UP)							
S.No	Details of Works or Equipment/System	Total ex-works Price	ED	CST /VAT	FREIGHT	TOTAL (For site price)	Items price %age w.r.t total supply price
1	2	3	4	5	6	7 = 3 + 4 + 5 + 6	8
1.4	<u>Break - up of Total (for site supply price) given at S.N 1.1.0 of SCHEDULE-1</u>						
1.4.1	Lump sum price for steel plates for HFO Tanks, HSD tanks.						23 - 27
1.4.2	Lump sum price for structural steels including flanges, hand rails, gratings etc for FOHS.						2 - 4
1.4.3	Lump sum price for HFO & HSD flexible metallic/ neoprene unloading hoses with all accessories						less than 1
1.4.4	Lump sum price for Steam & condensate hoses with all						1 - 2
1.4.5	Lump sum price for HFO & HSD Pipe & Fittings (excluding insulation & cladding)						16 - 20
1.4.6	Lump sum price for Steam & Condensate Pipe & Fittings (excluding inulation & cladding)						5 - 7
1.4.7	Lump sum price for Air, oily water & others types of pipes & fittings Fittings						less than 1
1.4.8	Lump sum price for Valves (Ball / Plug / Gate / check / Globe / others) in HFO & HSD line						10 - 13
1.4.9	Lump sum price for Valves (Gate / check / Globe / others) in steam & condensate line						1 - 3
1.4.10	Lump sum price for Valves in Water and air line						0.5 - 1
1.4.11	Lump sum price for Steam Trap						3 - 5
1.4.12	Lump sum price for HFO unloading Pumps with motor (3 nos, cap. 100 cum/hr)						6 - 8

1.4.13	Lump sum price for HFO unloading Pumps Strainers						1 - 1.5
1.4.14	Lump sum price for HSD unloading Pumps with motor (2 nos, cap. 50 cum/hr)						0.5 - 1
1.4.15	Lump sum price for HSD unloading Pumps Strainers						0.5 - 1
1.4.16	Lump sum price for Suction Heater in HFO tanks						1 - 3
1.4.17	Lump sum price for Pressure Reducing Station complete in all						3 - 5
1.4.18	Lump sum price for Drain Oil pump motor set (2 nos) in all						0.5 - 1
1.4.19	Lump sum price for Sump pump motor set (2 nos) in pump house and water pit of OWS (2 nos) in all respect						0.5 - 1
1.4.20	Lump sum price for recovery Oil pump motor set (2 nos) in oil pit of OWS , complete in all respect						0.5 - 1
1.4.21	Lump sum price for Control valves in steam line (for floor coil heater in HFO tanks)						0.5 - 1
1.4.22	Lump sum price for Control valve in steam line (for suction heater in HFO tanks)						0.5 - 1
1.4.23	Lump sum price for Control valve in steam line (for drain oil						0.5 - 1
1.4.24	Lump sum price for Instruments (Gauges, Transmitters,						1 - 3
1.4.25	Lump sum price for Insulation & Cladding						0.5 - 1
1.4.26	Lump sum price for Equipment and accessories of OWS including pipings, bends, heating arrangement, skimmer pipe, butterfly valve, rung ladder etc.						less than 1
1.4.27	Lump sum price for any other items not included above, but required to complete Fuel oil unloading & storage package as per system requirement.						less than 1
1.4.28	Total price for special tools & tackles for maintenance, if any						less than 1
1.4.29	Total price for startup and commissioning spares						less than 1
	Total percentage range						78-113
1.4.31	Total of 1.4 (sum of 1.4.1 to 1.4.36)						

Notes:

- a) Total (for site supply price) of mandatory spares indicated at **S.N.1.4.36 above** shall match with the total of item wise break-up of **S.N.1.5 of SCHEDULE-3**.
- c) Items price %age w.r.t total FOR SITE supply price is indicated under last column of **each row from 1.4.1 to 1.4.36**. Bidder to strictly fill the prices of each item under column no.8 as per indicated percentage only.

SCHEDULE-3									
2 X 660 MW ENNORE SEZ COAL BASED STPS, FUEL OIL UNLOADING & STORAGE SYSTEM.									
SUGGESTIVE PRICE FORMAT (MANDATORY SPARES)									
S.No	Details of Works or Equipment/System	Unit Ex-works price	Unit	Qty (Nos)	Total ex-works Price	ED	CST /VAT	FREIGHT	TOTAL (For site price)
1	2	3	4	5	6	7	8	9	10=6+7+8+9
1.5	<u>Break - up of Total (for site supply price) given at S.N 1.4.36 of SCHEDULE-2</u>								
1.5.1	HFO/HSD UNLOADING PUMPS								
1.5.1.1	COUPLING PADS / BUSHES AND COUPLING BOLTS		set*	ONE SET /PUMP					
1.5.1.2	BEARINGS		set*	TWO SETS /PUMP					
1.5.1.3	MECHANICAL SEALS		set*	TWO SETS/PUMP					
1.5.1.4	COUPLINGS		set	ONE SET/PUMP					
1.5.1.5	COUPLING PADS		set	TWO SETS/PUMP					
1.5.1.6	SET OF SEALS, O-RINGS & GASKETS		set	2 SETS/PUMP					
1.5.1.7	BEARINGS FOR PUMP		set	2 SETS/PUMP					
1.5.1.8	SET OF ALL TYPES OF BUSHES SLEEVES		set	2 SETS/PUMP					
1.5.1.9	CATRIDGE		nos	1 NO EACH TYPE					
1.5.2	DRAIN OIL PUMP/ RECOVERY OIL TRANSFER PUMP/ WASTE WATER PUMP/ SUMP PUMP(FOR EACH TYPE)								
1.5.2.1	BEARING OR BEARING METALS AND WEARING PARTS FOR EACH ROTATING UNIT.		sets	1 COMPLETE SET					
1.5.2.2	CONNECTING COUPLING FOR EACH ROTATING UNITS (COUPLING ASSEMBLY)		nos	1 SET					
1.5.2.3	PACKING AND GASKETS OF TOTAL INSTALLED		%	100%					
1.5.2.4	INNER WEAR AND TEAR PARTS FOR EACH SIZE AND TYPE OF PUMP		sets	1 SET					
1.5.3	HOSES								
1.5.3.1	UNLOADING HOSES (HFO & HSD)		%	20% OF TOTAL QUANTITY					
1.5.3.2	STEAM AND CONDENSATE HOSES		%	20% OF TOTAL QUANTITY					
1.6	415 V Motors								
1.6.1	Terminal plates			10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW					
1.6.2	Heaters			2 sets					

1.6.3	Greasing arrangements			4 sets each type of motor					
1.6.4	Motor of each type and rating			10% of the installed quantity or minimum 1 number whichever be higher					
1.6.5	Bearings (DE and NDE) for each type and rating of motor			4 sets					
1.7	BATTERY								
1.7.1	Battery cell			10					
1.7.2	MT cell container of each type			10					
1.7.3	Level indicator			6					
1.7.4	Vent plugs			12					
1.7.5	Inter-cell connector			10					
1.7.6	Set of nuts, bolts and washer			12					
1.8	BATTERY CHARGERS								
	The list of mandatory spare parts for the battery charger covered under this package are as follows: The bidder is required to indicate the item wise price of listed mandatory spares in respective schedule. These quoted price shall be considered for bid evaluation.								
1.9	For Float cum boost Charger of Unit Batteries.								
1.9.1	Electronic Cards (with all components mounted)			1 set of each type and rating.					
1.9.2	Fuses			4 nos of each type and rating					
1.9.3	SCR			6 nos of each type and rating					
1.9.4	Blocking Diode			6 sets of each type and rating					
1.9.5	Potentiometer			3 sets of each type and rating.					
1.10	For Float cum boost Charger of Switchyard Batteries.								
1.10.1	Electronic Cards (with all components mounted)			1 set of each type and rating.					
1.10.2	Fuses			4 nos of each type and rating					
1.10.3	SCR			6 nos of each type and rating					
1.10.4	Blocking Diode			6 sets of each type and rating					
1.10.5	Potentiometer			3 sets of each type and rating.					

1.10.6	Each type of lamps, PBs, ILPBs, fuse, MCB, MCCB used in the equipment/system.		Nos.	20 % of Installed of each type.					
1.11	Measuring Instruments								
1.11.1	Indicators, Recorders, Electrical Metering and Skid Mounted Instruments								
1.11.1.1	Indicators, recorders and meters offered from each model for the project. These instruments shall be supplied with three sets of blank scales.		Nos.	10 % of Installed of each type/Model or a minimum of one number for each model and type, whichever is more					
1.11.1.2	For skid mounted instruments		Nos.	10% of total number of instruments for each Type and model or a minimum of one number for each model and type, whichever is more					
1.11.2	Temperature Elements and Thermowells								
1.11.2.1	Thermocouple/RTD elements		Nos.	10% spare 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.					
1.11.2.2	Thermowells		Nos.	10% for each type of temperature sensors or a minimum of one for each type, whichever is more					
1.11.2.3	Hooters, Buzzers, Cooling fans of each type.		Nos.	Ten (10) percent or 2 no. (Whichever is more)					
1.11.2.4	Interface cables		Set	2 sets of each type/model					
1.11.2.5	Power supply modules (AC to DC convertors)		Nos.	10% or Five no. (Whichever is more) of each type/model					
1.11.3	Relay based Control Panels								
1.11.3.1	LEDs for indicating lights		Nos.	10% of qty installed.					

1.11.3.2	Control circuit fuses/MCB/MCCB/ Semiconductor Fuses		Nos.	300% of installed of each type, current rating.					
1.11.3.3	Relays modules & contactors.		Nos.	20% spare of qty Installed of each type & rating.					
1.11.4	Alarm Annunciation System								
1.11.4.1	logic modules, group card modules, power supply modules, Hooters and any other electronic module.		Nos.	20% spares of each type installed					
1.11.4.2	un-engraved window boxes complete with LED etc.		Nos.	5% spares of each size installed					
1.11.4.3	LEDs for annunciation facia windows and LEDs box assemblies offered for the project		Nos.	20% of qty installed					
1.11.4.4	Annunciator hooter		Nos.	One (1) No. of each type					
1.11.5	Erection hardware								
1.11.5.1	Instrument valves		Nos.	Ten (10) percent of each type & Size installed					
1.11.5.2	Condensate pots of each type & Size installed		Nos.	Ten (10) percent of total number of Installed or four numbers whichever is higher					
1.11.5.3	Manifold		Nos.	Ten (10) percent of each type & Size installed					
1.11.5.4	Fittings		Nos.	Ten (10) percent of each type & Size installed					
1.11.5.5	Electronic cards		Nos.	One no. of each type					
1.11.6	Mandatory Spares for Control valves, Power Cylinder, Control Dampers, Actuators and Accessories								
1.11.6.1	Following spares shall be furnished for control valves, Power Cylinder, Control Dampers as applicable.								
1.11.6.1.1	control valve stem packing for each control valve		Set	One set of spare for each control valve.					
1.11.6.1.2	Moulded rubber diaphragms for each control valve		Nos.	2 Nos for each control valve.					
1.11.6.1.3	O-rings and rubber gaskets for each control valve		Set	One sets for each control valve.					
1.11.6.1.4	lubricants for gaskets for each control valve		Lot	100 percent qty. for one year consumption.					
1.11.6.1.5	limit switches for each control valve		Set	2 sets for each control valve.					

1.11.6.1.6	valve positioner for each control valve		Set	1 sets for each control valve.					
1.11.6.1.6	Position transmitter (4-20mA)		Lot	20 percent for total qty. of control valves.					
1.11.6.1.7	valve trims (such as plug, stem, seat ring /cage, guide bushing, stem lock pin, packing retaining ring, etc) for each control valve.		Set	One set for each control valve.					
1.11.6.1.8	completes actuator		Lot	1 No. of each type or minimum 10 percent for each type and size whichever is more.					
1.11.6.1.9	Solenoid valves		Lot	20 percent of Solenoid valves or min 2 no. of each type for total qty. of control valves.					
1.11.6.1.10	I to P converters, Pressure regulators.		Lot	20 percent of total I to P convertors, Pressure regulators.					
1.12.1	sensor/instrument, instrumentation/mechanical fittings etc for any other electronic system, feeder control cabinets, hydrastep (EWLI), Vibration Monitoring System, CCTV, C&I Lab Instruments, On line Carbon in Ash analyser 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.		Lot	10 percent of total or 1 no. (whichever is higher) for each type.					
NOTE:- ~~C&I Mandatory spares are indicated in above list.~~ These spares shall be considered as per the applicable items in main supply of respective packages.									