

**TAMILNADU GENERATION AND DISTRIBUTION
CORPORATION LIMITED (TANGEDCO)**

**2X660 MW ENNORE SEZ
SUPERCRITICAL THERMAL POWER PROJECT**

**TECHNICAL SPECIFICATION
FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.: PE-TS-412-673-A001



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA**



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SPECIFICATION NO. PE-TS-412-673-A001

REV. NO. 00

DATE : 22/03/2017

CONTENTS

SECTION	DESCRIPTION	PAGE NO.
	PROJECT INFORMATION	1-13
SECTION – I	SPECIFIC TECHNICAL REQUIREMENTS	14
SUB SECTION – IA	SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL) ➤ ANNEXURE I: QUALITY PLAN ➤ ANNEXURE II: SUB VENDORS LIST ➤ ANNEXURE III: FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES ➤ ANNEXURE IV: DRAWING DOCUMENTS DISTRIBUTION PROCEDURE ➤ ANNEXURE V: PAINTING SPECIFICATION ➤ ANNEXURE VI: MANDATORY SPARES LIST ➤ ANNEXURE VII: DRAWING/DOCUMENTS SUBMISSION SCHEDULE ➤ ANNEXURE VIII: WATER ANALYSIS ➤ ANNEXURE IX: LIST OF TOOLS & TACKLES (AS APPLICABLE) ➤ ANNEXURE X: FORMAT FOR OPERATION AND MAINTENANCE MANUAL ➤ ANNEXURE XI: SITE STORAGE AND PRESERVATION ➤ ANNEXURE XII: GENERAL TECHNICAL REQUIREMENTS (GTR) ➤ P&ID ➤ DATA SHEET-A ➤ PLOT PLAN	15-265
SUB SECTION – IB	SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL) ➤ SPECIFIC ELECTRICAL REQUIREMENT ➤ BASIC TECHNICAL FEATURES FOR HT/ LT MOTORS ➤ ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR-(STP) ➤ STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (ELECTRIC HOIST) ➤ ELECTRICAL LOAD DATA FORMAT ➤ CABLE SCHEDULE FORMAT	266-281
SUB SECTION – IC	SPECIFIC TECHNICAL REQUIREMENTS (CONTROL & INSTRUMENTATION)	282-286
SECTION – II	GENERAL TECHNICAL REQUIREMENT	287
SUB SECTION – IIA	GENERAL TECHNICAL REQUIREMENT (MECHANICAL)	288-361
SUB SECTION – IIB	GENERAL TECHNICAL REQUIREMENT (ELECTRICAL)	362-371
SUB SECTION – IIC	GENERAL TECHNICAL REQUIREMENT (CONTROL AND INSTRUMENTATION)	372-428
SECTION - III	➤ SCHEDULE OF PRE BID CLARIFICATIONS ➤ COMPLIANCE CUM CONFIRMATION SCHEDULE ➤ SCHEDULE OF DECLARATION ➤ SCHEDULE OF DEVIATIONS ➤ SCHEDULE OF GURANTEED POWER CONSUMPTION	430 431 432 433 434



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION :

SUB-SECTION:

REV. NO. 00

DATE :

PROJECT INFORMATION

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 Supercritical Thermal Power Project at Ash Dyke of NCTPS**

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

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 VVO 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 VVO conditions, but BMCR flow shall not 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.

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

	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

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

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 & hardware 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)

- 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

- 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 | : | } Refer details in the specification elsewhere. |
| b. Forest | : | |
| c. Grass land | : | |
| d. Endangered species | : | |
| e. Others (Specify) | : | |
- 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



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION:

REV. NO. 00

DATE :

SECTION – I
SPECIFIC TECHNICAL REQUIREMENTS
SUB-SECTION IA - Specific Technical Requirements (Mech.)
SUB-SECTION IB - Specific Technical Requirements (Electrical)
SUB-SECTION IC - Specific Technical Requirements (C & I)
SUB-SECTION ID – Datasheet-A



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

SECTION – I
SUB-SECTION – IA-SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

	TITLE:		SPECIFICATION NO. PE-TS-412-673-A001	
	2X660 MW ENNORE SEZ STPP		SECTION : I	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT		SUB-SECTION: IA	
			REV. NO. 00	DATE :

1.0 GENERAL

This specification is intended to cover design (i.e. Preparation and submission of drawing/ documents including " As Built " drawings and O&M Manuals) , engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables (excluding chemicals), mandatory spares alongwith spares for erection ,start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in site transportation, assembly, minor civil works, erection & commissioning, trial run at site, preparation of drawings in 3D (if applicable) and carrying out performance guarantee /Functional / Demonstration tests at site (As applicable), training of customer/ client O&M staff (if applicable) & final handing over to end customer in flawless condition for project and package specified above complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification no. PE-TS-412-673-A001 for Sewage treatment plant package of **2X 660 MW ENNORE SEZ STPP**.

2.0 SCOPE OF SUPPLY

2.1 SCOPE OF SUPPLY FOR MECHANICAL (REFER P & ID OF SEWAGE TREATMENT PLANT)

Broad scope of supply (mechanical) for this package is detailed below and as indicated in relevant portion of this specification.

- 2.1.1 Two (2) nos.(1W+1S) submersible grinding type sewage transfer pumps for sewage sump (S1) complete with all instrumentation, valves, piping etc.
- 2.1.2 Two (2) nos.(1W+1S) submersible grinding type sewage transfer pumps for sewage sump (S2) complete with all instrumentation, valves, piping etc.
- 2.1.3 Two (2) nos.(1W+1S) submersible grinding type sewage transfer pumps for sewage sump (S3) complete with all instrumentation, valves, piping etc.
- 2.1.4 Two (2) nos.(1W+1S) submersible grinding type sewage transfer pumps for sewage sump (S4) complete with all instrumentation, valves, piping etc.
- 2.1.5 Two (2) nos.(1W+1S) submersible grinding type sewage transfer pumps for common sewage collection sump complete with all instrumentation, valves, piping etc.
- 2.1.6 All instrumentation and accessories in sewage sump S1 (RCC work in BHEL scope).
- 2.1.7 All instrumentation and accessories in sewage sump S2 (RCC work in BHEL scope).
- 2.1.8 All instrumentation and accessories in sewage sump S3 (RCC work in BHEL scope).
- 2.1.9 All instrumentation and accessories in sewage sump S4 (RCC work in BHEL scope).
- 2.1.10 All instrumentation and accessories in common sewage collection sump (RCC work in BHEL scope) located in STP area.
- 2.1.11 Two (2) nos. (1w + 1s) oil free type air blowers with electric motor drives for supplying air required for common collection sump, sludge holding tank & equalization tank. Each blower shall be complete with motor, v-belt drive with belt guard, inlet filter/silencer, flexible couplings and discharge snubber, all mounted on a single base. Relief valve(s) shall be provided as required. Acoustic hood for air blowers shall also be provided by the bidder.
- 2.1.12 One (1) no. bar screen chamber of MOC RCC (RCC work in BHEL scope) provided with bars (BAR MOC: SS-304 fitted with MS frame) inclined at 60° and spacing between bars shall be 10 mm for screening of incoming sewage.
- 2.1.13 One (1) no. oil & grease chamber of MOC RCC (RCC work in BHEL scope) provided with oil & grease



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

trap for removal of oil & grease from the incoming sewage. Mechanical items Baffle arrangement and perforated pipes etc. shall be provided by bidder.

- 2.1.14 One (1) no. above ground equalization tank of RCC construction (RCC work in BHEL scope) of minimum retention time of 8 hours located in STP area.
- 2.1.15 Two (2) nos.(1W+1S) vertical submersible grinding type FAB feed pumps for equalization tank complete with all instrumentation, valves, piping etc.
- 2.1.16 All instrumentation and accessories in equalization tank (RCC work in BHEL scope) located in STP area.
- 2.1.17 One (1) no. above ground FAB/MBBR reactor of MSRL construction (Capacity as per process requirement) located in STP area. Media for FAB/MBBR reactor shall be of MOC PVC.
- 2.1.18 Two (2) nos. (1w + 1s) oil free type air blowers with electric motor drives for supplying air required for FAB/MBBR reactor. Each blower shall be complete with motor, v-belt drive with belt guard, inlet filter/silencer, flexible couplings and discharge snubber, all mounted on a single base. Relief valve(s) shall be provided as required. Acoustic hood for air blowers shall also be provided by the bidder.
- 2.1.19 One no. above ground tube settler (secondary settler) shall be in bidder' scope. Material of construction of settler shall be MSRL and MOC of media shall be PVC.
- 2.1.20 One (1) no. above ground hypo contact cum filter feed tank of RCC construction (RCC work in BHEL scope) located in STP area.
- 2.1.21 Two (2) nos.(1W+1S) horizontal centrifugal type filter feed pumps for hypo contact cum filter feed tank complete with all instrumentation, valves, piping etc. for feeding water to Dual media filter & activated carbon filter for tertiary treatment. This pump has to be also cater the backwash requirement of Dual media filter & activated carbon filter
- 2.1.22 All instrumentation and accessories in hypo contact cum filter feed tank (RCC work in BHEL scope) located in STP area.
- 2.1.23 One (1) no. Sodium hypochlorite dosing tank (MOC: PVC) of minimum 100 ltrs. capacity for dosing chemical to hypo contact cum filter feed tank complete with instrumentation, dissolving basket and slow speed (100-200 rpm) agitator of SS-316 construction. MOC of dissolving basket will be SS-316.
- 2.1.24 One (1) no. Sodium hypochlorite dosing pump (MOC: PP) along with instrumentation and accessories as per P&ID of sewage treatment plant.
- 2.1.25 One (1) no. (1X100%) dual media filter (MOC: FRP) along with filter media, piping, valves, fittings, instrumentation and accessories associated with the same.
- 2.1.26 One (1) no. (1X100%) Activated Carbon Filter (MOC: FRP) along with media, carbon trap, piping, valves, fittings, instrumentation and accessories associated with the same.
- 2.1.27 One (1) no. above ground treated water tank of RCC construction (RCC work in BHEL scope) of minimum retention time of 8 hours located in STP area.
- 2.1.28 One (1) no. above ground treated water tank (RCC work in BHEL scope) complete with all instrumentation and accessories.
- 2.1.29 Two (2) nos.(1W+1S) horizontal centrifugal type treated water disposal pumps for treated water tank complete with all instrumentation, valves, piping etc.
- 2.1.30 One (1) no. below ground sludge sump (RCC work in BHEL scope) complete with all instrumentation and accessories.



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

- 2.1.31 Two (2) nos.(1W+1S) vertical screw type sludge transfer pumps for sludge sump complete with all instrumentation, valves, piping etc.
- 2.1.32 One (1) no. (1X100%) centrifuge of MOC MSEP/CI and wetted parts of SS-304.
- 2.1.33 One (1) no. Sodium hypochlorite dosing tank (MOC: HDPE) of 24 hrs. storage capacity for dosing chemical to centrifuge feed line complete with instrumentation, dissolving basket and slow speed (100-200 rpm) agitator of SS-316 construction. MOC of dissolving basket will be SS-316.
- 2.1.34 One (1) no. Sodium hypochlorite dosing pump (MOC: PP) along with instrumentation and accessories as per P&ID of sewage treatment plant.
- 2.1.35 1 no. sludge handling trolley for manual disposal of sludge cake.
- 2.1.36 Required Piping for transferring Centrate from centrifuge outlet to equalization tank along with necessary valve, fitting & flanges.
- 2.1.37 Required Piping for transferring waste water generated from dual media filter & activated carbon filter to equalization tank along with necessary valve, fitting & flanges.
- 2.1.38 Required Piping for transferring over flow of hypo- contact cum filter feed tank to plant drain along with necessary fitting & flanges.
- 2.1.39 Required Piping for transferring over flow of treated water tank to plant drain along with necessary fitting & flanges.
- 2.1.40 Piping required for sludge recirculation line along with valves from the outlet of sludge transfer pumps to FAB/MBBR tank along with necessary valve, fitting & flanges.
- 2.1.41 Piping required for transferring treated water through treated water disposal pumps to horticulture network (500 m) along with necessary valve, fitting & flanges.
- 2.1.42 Piping required for transferring sewage from sewage sump S1 to common sewage collection sump located in STP area (800 m) along with necessary valve, fitting & flanges.
- 2.1.43 Piping required for transferring sewage from sewage sump S2 to common sewage collection sump located in STP area (1100 m) along with necessary valve, fitting & flanges.
- 2.1.44 Piping required for transferring sewage from sewage sump S3 to common sewage collection sump located in STP area (550 m) along with necessary valve, fitting & flanges.
- 2.1.45 Piping required for transferring sewage from sewage sump S4 to common sewage collection sump located in STP area (550 m) along with necessary valve, fitting & flanges.
- 2.1.46 Sea water intake pump house is located far- off location from BTG island and treatment of the sewage generated from toilets cannot be transferred to main sewage treatment plant, hence dedicated bio-digester and Reed Bed arrangement shall be provided by bidder to cater sewage waste generated from sea water intake pump house. 1 no. bio-digester of MOC FRP (10 mm thick) of capacity 4.5 m3 shall be provided by bidder. 1no. reed bed arrangement of MOC FRP (10 mm thick) of capacity 2.25 m3 shall be provided by bidder.
- 2.1.47 Further for over flow of Reed bed arrangement shall be suitably used for horticulture. One no. hose pipe (MOC: PVC) of 10 m length shall be provided for the same.
- 2.1.48 Necessary piping, valves, fitting, instruments etc. As per P&ID for sewage treatment plant enclosed with this technical specification.
- 2.1.49 The scope of supply and erection shall include all interconnecting piping, fittings, supports, valves,



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

instruments etc.

- 2.1.50 The FAB/MBBR based sewage treatment plant operation & control shall be carried out from the stand alone DDCMIS (BHEL scope) based control system located inside STP area.
- 2.1.51 Sewage transfer pumps installed in various sewage lifting sumps (S1, S2, S3 & S4) located outside boundary of STP area shall be controlled from nearest control systems (BHEL scope).
- 2.1.52 Bidder to take care the length of piping as included elsewhere in specification of sewage treatment plant. Pipe routing shall be decided during detailed engineering, however bidder will consider 6 m static head + 10% margin during pump selection for outside STP area and treated water disposal pumps.
- 2.1.53 The pipes from the individual sewage lifting stations/ sewage sumps (S1, S2, S3 & S4 located outside STP area) to common collection sump located in STP area shall be burried. Further treated water piping from treated water disposal pumps (located in STP area) to horticulture network area shall also be burried. For burried piping wrapping, coating and protection is in bidder's scope & shall be as per IS-10221.
- 2.1.54 The pipe inside STP area shall be preferably run on pipe pedestals. All auxiliary steel structures (u-clamps, nuts, bolts, channels etc.) For fixing the pipe on the pedestal or trestles shall be in the scope of bidder. If buried piping is required, wrapping, coating and protection of all the buried pipe is also in bidder's scope & shall be as per is 10221.
- 2.1.55 All steel inserts plates with lugs, rungs, ladder, puddle pipes, bolts, edge angle in desired shape, nuts, sleeves, and all other embedding components etc. as required to grout in BHEL civil works and to support/hold the equipments being supplied under this specification shall be in bidder's scope.
- 2.1.56 Any statutory clearance required for the system from MOEF or local pollution control board in bidder's scope.
- 2.1.57 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 or carrying out performance guarantee test of bidder's supplied equipment (whichever is later) and final filling after the initial operation OR carrying out performance guarantee test at site (As applicable) of bidder's supplied equipment (whichever is later) 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. 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.
- 2.1.58 The pipe sizes indicated in the tender specification/ P & I diagram are minimum. Wherever pipe sizes are not indicated, the same shall be selected based on the specification requirement and shall be subject to BHEL / customer approval during detailing engineering. All pipes shall be carbon steel unless exclusively mentioned.
- 2.1.59 All necessary drains, vents and sampling points with valves as specified and as required are in bidder's scope.
- 2.1.60 Monitoring gadgets, instruments and equipments required for maintenance (till carrying out performance guarantee test at site (As applicable) & plant handover.
- 2.1.61 Associated piping, instrumentation and valves required for the system.
- 2.1.62 All necessary instruments and controls required for easy and safe operation of the system.
- 2.1.63 Wherever terminal points between BHEL and bidder indicated, bidder shall provide pipes with counter



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

flange.

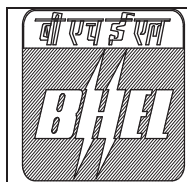
- 2.1.64 All pipes, fittings etc. Required for hand railing, platforms, and ladders shall be in the scope of bidder. All ladders shall be non-civil work. All insert plates, nuts and bolts, counter flanges wherever Applicable shall be in the scope of bidder. Supply and erection of hand railing as desired for safety purpose will be in bidder's scope.
- 2.1.65 All the sumps, tanks, reservoirs and other water retaining structures shall be provided with access ladders/rungs from operating platforms/ground level as the case may be.
- 2.1.66 Instrumentation, valves etc. Indicated in p & id of sewage treatment plant are bare minimum requirement, however bidder has to provide complete system for trouble free operation meeting technical specification requirement.
- 2.1.67 Sewage sumps S1, S2, S3, and S4 shall be located outside STP area however rest facilities indicated in P & ID of STP shall be located inside STP area provided in plot plan included in this specification.
- 2.1.68 All blank flanges/counter flanges, isolations valves, tees etc. to interconnect the pipes at all terminal points.
- 2.1.69 4 nos. Chain pulley block / electrical hoist for handling of sewage transfer pumps located outside STP area provided sewage lifting sumps (S1, S2, S3, S4). 1 no. Chain pulley block / electrical hoist for handling of common collection sump sewage transfer pump. 1 no. chain pulley block/ Electrical hoist for handling of FAB feed pumps. 1 no. chain pulley block/ Electrical hoist for handling of Vertical screw sludge transfer pumps. 1 no. chain pulley block/ Electrical hoist for handling of filter feed pump & treated water disposal pumps. 1 no. electric hoist for handling of centrifuge. Selection criterion of chain pulley block/ electric hoist shall be as per ELECTRIC HOIST AND MANUAL HOIST (CHAIN PULLEY BLOCK) specification defined elsewhere in this tender technical specification.
- 2.1.70 Media, bar screen chamber, oil & grease trap, media for FAB/ MBBR tank, media for dual media filter, media for activated carbon filter & air grid arrangement for common collection sump, equalization tank, FAB/MBBR tank & Sludge pit.
- 2.1.71 PIPING
- a) Complete piping indicated in P & ID of Sewage treatment plant is in bidder's scope of supply and erection. In addition, any additional piping required to make the system complete inside STP area shall be in bidder's scope. Pipe length inside STP area has to be considered by bidder in their scope as per approved equipment layout and piping layout during detailed engineering. The below indicated pipes shall be designed, supplied, erected, laid and tested by the bidder. Elbows, tees, flanges, counter flanges, Hangers and supports, embedment plates with lugs etc. required for the below given piping shall also be provided by the bidder.

b) Pipe distances from sumps outside STP area upto STP area are given below:

SL. NO.	FROM	TO	Distance (In meters)
1.	Sewage sump (S1)	STP area common collection sump	800
2.	Sewage sump (S2)	STP area common collection sump	1100
3.	Sewage sump (S3)	STP area common collection sump	550
4.	Sewage sump (S4)	STP area common collection sump	550

Bidder to note that no commercial settlement / adjustment shall be entertained for variation upto +/- 5% of pipe lengths tabulated above during detailed engineering.

Bidder to note that above piping distances are in bidder's scope. Distances given above are from one area to other area only, however inside piping in respective area shall be in bidder's scope which is not included in above distances. Layout and routing shall be finalized during detailed



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

engineering. However, system shall be designed to take care of any increase or decrease in length of piping.

c) Piping from treated water disposal pumps upto horticulture network 500 meters shall be in bidder's scope. Layout and routing shall be finalized during detailed engineering. However, system shall be designed to take care of any increase or decrease in length of piping.

d) In addition, any additional piping and associated accessories required to complete the system shall be in bidder's scope.

2.1.72 Mandatory spares as per attached Annexure-VI of Section IA to this technical specification.

2.1.73 Special tools and tackles as required for the system.

2.1.74 All special tools necessary for proper maintenance or adjustment of the equipment packaged in permanent box. Finish paints for touch-up painting of equipment after erection at site in sealed container.

2.1.75 Start-up and commissioning spares as required.

2.1.76 Instrument air piping (after BHEL terminal point) along with necessary valves, instrumentation, fitting & flanges to meet the system requirement shall be in bidder's scope.

2.1.77 Supply of handrail material & erection of the same shall be in bidder's scope.

3.0 ADDITIONAL REQUIREMENT

- 1) Operating platforms, ladders, supports and other structural works for each sump/tanks as well as dosing equipments etc. for sewage treatment plant to facilitate accessibility for operation and maintenance is also in bidder's scope.
- 2) All special tools necessary for proper maintenance or adjustment of the equipment packaged in permanent box. Finish paints for touch-up painting of equipment after erection at site in sealed container.
- 3) All required elbow, tee, pipe fittings etc. required for erection of the complete system including piping shall be in bidder's scope. Bidder to provide the detailed BOQ shall be derived during detail engineering. Bidder to consider 10% margin over and above the BOQ requirement of all the fittings.
- 4) All the pipes outside STP area shall be below ground(buried). For pipes running in STP area wherever pipe racks are not available, pipes shall run on pedestals or below ground. All fixing items such as U clamps, nuts, bolts etc. required to lay the pipes on pedestals shall be in bidder's scope of work. Coating, wrapping and protection required for buried pipes shall be in bidder's scope of work.
- 5) Bidder shall consider 6 m static head + 10% margin in addition to the losses in straight pipes and bend in pipes, tees, reducer, expander and valves etc. while selection of pump head during detailed engineering.
- 6) 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.
- 7) MCC, DDCMIS based control room & battery room shall be located in STP area building. All Sewage treatment facilities and chemical dosing facilities shall be located in Sewage treatment plant building. Further for all pumps located outside building shall be provided with localised canopy arrangement on pump & motor and the same shall be in bidder's scope.
- 8) 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



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

- 9) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.
- 10) Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details w.r.t. existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid 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.
- 11) Successful bidder shall furnish detailed erection manual for each of the equipment as well as complete system supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- 12) 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.
- 13) Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment / scope 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".
- 14) All necessary valves and fittings for the installations with the actuators necessary for their remote operation.
- 15) Embedment plates with lugs shall also be provided by bidder as per system requirement.
- 16) All channels & brackets, mounting plates as required for mounting of motors, pumps, stirrers, tank etc. shall be in bidder's scope.
- 17) All necessary structural steel for pipe supporting structure, platforms, walkways / pathways and access stairs, mechanical plant and equipment, mechanical services and pipe work associated with STP Plant.
- 18) All handrails shall be of 32 mm nominal bore MS pipes (medium class) as per IS: 1161 galvanized using 750 gm/sq. m of zinc. Hand railing shall be a two-rail system with the top rail 1000 mm above the walkway surface and the intermediate rail 450 mm below the top rail. Handrail post spacing shall be limited to 1500 mm as far as possible but can be proportioned to the length of the opening. In such a case spacing shall not exceed 1850 mm centre to centre of posts. Hand railing shall be shop fabricated for specific locations and field welded or bolted to the erected structural steel. Railings shall be provided with 100 mm wide and 8 mm thick MS strip at bottom as toe guard all along the length of railing in horizontal plane. For RCC stairs, hand railing with 20 mm square MS bar balustrade with suitable MS flat and Aluminium / Teakwood handrail shall be provided, unless specifically mentioned otherwise.
- 19) Instrument hook up material shall be in bidder's scope.
- 20) Permanent ladder (not rungs) for approaching the top of tanks, valves for All steel inserts with lugs, plates, bolts, nuts, sleeves, edge angles and all other embedding components etc. as required to grout in civil works and to support/hold the equipments being supplied under this specification for opening/maintenance purpose.
- 21) Wrapping, coating and protection of the entire buried pipe shall be as per IS 10221 or AWWA C 203-93.
- 22) Any item/work either supply of equipment or erection material which have not been specifically mentioned in but are necessary to complete the woks for trouble free and efficient operation of the plant shall be



TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
	SECTION : I	
	SUB-SECTION: IA	
	REV. NO. 00	DATE :

deemed to be included within the scope of this specification and shall be in bidder's scope without any commercial, technical and delivery implication to BHEL.

- 23) All other items are also included in scope of supply as specified in other part of the specification.
- 24) Bidder shall perform the guarantee parameters as per specification requirement to the satisfaction of owner. The exact modalities of verifying guarantee for the parameters indicated in the specification shall be finally as agreed with the owner during detailed engineering & mutually agreed.

4.0 ELECTRIC HOIST AND MANUAL HOIST (CHAIN PULLEY BLOCK)

Required number of electric hoist / manual hoist of adequate capacity, to meet the erection and maintenance requirements are to be provided for the various areas.

Bidder to note that chain pulley block shall be manufactured as per class-II of IS3832 & Electric hoist shall be manufactured as per class-II of IS-3938.

The stipulations of all statutory codes like Indian Electricity Act, Indian Electricity Rules, Factory Acts, Local Municipality act etc. shall however prevail over the specification requirements, in case any conflict arises between this specification and the statutory codes.

Maintenance tools and tackles shall be as per data sheet attached.

4.1 DESIGN CRITERION FOR ELECTRIC HOIST AND MANUAL HOIST (CHAIN PULLEY BLOCK)

For items weighing 300 kg and above, hoists and trolleys along with monorails shall be provided throughout the plant where crane cannot be utilized. For items weighing less than 1000 kg, manual hoists shall be provided. For items weighing 1000 kg and more, electric hoists (lift & travel) shall be provided. In case the lifting height is more than 10m, electric hoist (lift & travel) shall be provided irrespective of the weight. All hoists shall be provided with trolleys.

Capacity of cranes & hoists shall be selected considering a minimum margin of 25% over the maximum weight of the heaviest equipment / component to be handled by the Crane/Hoist.

For hand operated hoists, the hoists shall be suitable for operation from floor level. Hand chain shall be provided for long travel of trolley and the Hoisting mechanism. The operator shall be able to control the movement of the electrical/ manual hoist with the help of floor operated pendant.

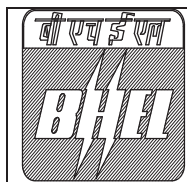
4.2 SCOPE OF SUPPLIES

Equipment and services to be furnished by the bidder for the ELECTRIC HOIST/ MANUAL HOIST with accessories as per the details given in the technical specification and data sheet A. Any equipment /accessories not specified in the specification but required to make the ELECTRIC HOIST/ MANUAL HOIST complete and efficient operation shall also be under the bidder's scope of work.

Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

4.2.1 Electric hoist shall include but not be limited to the following: -

- a. Hoisting and CT drive arrangement
- b. All electrical equipment including cables (as per electrical scope matrix) and panels.
- c. PVC insulated shrouded bus bar DSL
- d. Earthing arrangement.
- e. Initial fill of lubricant.
- f. Painting of electric hoist and accessories.
- g. Maintenance Tools & Tackles (as per attached list)
- h. Erection & Commissioning spares
- i. Isolating switch in enclosure at operating floor for disconnecting supply to DSL while maintaining the electric hoist.



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

4.2.2 Erection and Commissioning spares (ELECTRIC HOIST)

The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. The initial fill of lubricants, oil etc. shall also be supplied by the bidder.

4.2.3 Services to be provided by the bidder

Packing, forwarding and transportation to site, storage and handling at site.

4.2.4 Erection and Commissioning

4.2.5 Functional test (Overload testing, load testing at rated speed, travel and hoisting motion checks as per relevant Indian standards).

4.2.6 Obtaining clearance and acceptance certificate from the concerned competent authority after site test as applicable. Necessary fees/expenditure as required shall be borne by the bidder.

4.3 INSPECTION AND TESTING

As per enclosed reference quality plan and as per IS 3938 (latest revision). Prime inspection agency shall be Consultant/ End Customer. Equipment supplied shall be strictly in accordance with nomenclature & technical specification. Any additional testing requirement/CHP (Customer Hold Point) at any stage of inspection deemed necessary by Consultant/ End Customer during detailed engineering shall be carried out without any commercial or technical implication.

4.4 TESTING AT VENDOR'S WORKS

Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as specified in QAP and as per IS 3938 for electric hoist and IS 3832 for manual hoist.

The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

If the shop performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at bidder's cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

4.5 MAKE OF SUB - VENDOR ITEMS

Makes of bought out items will be as per list specified in the specification. No other make will be acceptable, until and unless specifically got it approved by the purchaser/ end client. (Refer annexure-II)

4.6 TESTING AT SITE

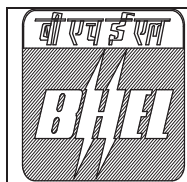
A) ELECTRIC HOIST:

As required for statutory clearance for operating at site i.e., overload test, load test and other tests as per IS 3938.

Test for Operation -After the supply has been connected, tests shall be carried out to prove the following:

- The satisfactory operation of each controller, switch, contactor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavourable conditions;
- The correctness of all circuits and interlocks and sequence of operation; and
- The satisfactory operation of all protective devices.

Overload Test -After test but before the hoist is put into service, it shall be tested with overload relays appropriately set, to lift and sustain a test load of 125 percent of the working load. During the overload



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

test, the hoist shall sustain the load under full control. The specified speeds need not be attained but the hoist shall show itself capable of dealing with the overload without difficulty.

B) MANUAL HOIST:

As required for statutory clearance for operating at site with following minimum test i.e., overload and load test.

4.7 MAINTENANCE TOOLS AND TACKLES

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual shall be supplied. Tools shall be of suitable sizes for maintenance of electric hoist of each type and capacity. Each tool and wrench shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality, specially protected against rusting.

The following shall be provided as minimum requirement:

S-No.	Description	Qty.
1	Complete set of ring spanners (Indicate the sizes offered)	1 Set
2	Complete set of screwdrivers (Indicate the sizes)	1 Set
3.	Adjustable Spanner	1 No.
4.	Insulated plier	1 No.
5.	Grease gun	1 No.
6.	Oil gun	1 No.
7.	Line tester	1 No.

Note: -The tools shall be supplied in one tool box. Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities of hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same shall be included in this list.

4.8 ELECTRICAL REQUIREMENTS

Electrical equipment shall be adequately rated to permit simultaneous operation of any combination of motions of the crane for it duty service.

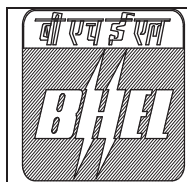
4.8.1 MOTORS

Motor ratings shall be 25% (at least) over the maximum power requirement. The hoist motors shall be rated to lift 125% of the design load at rated speed.

Motors shall suit the duty class S4, cyclic duration factor 60% and 300 starts per hour and shall be suitable for VVF operation. Motor pull out torque shall not be less than 2.75 times/ rated torque. Motor shall have class F insulation temperature rise limited to class B and enclosures shall conform to the degree of protection IP-55.

All motors shall be capable of the following:

- Operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.
- Withstand 120% of rated speed for two minutes.
- Current shall not exceed 6 times full load current for creep speed motor.
- Withstanding the stresses imposed if started at 110% rated voltage.
- Start with rated load and accelerate to full speed with 80% rated voltage at motor terminals.
- The locked rotor motor withstand time under hot condition at 110% rated voltage shall be more than motor starting time at minimum permissible voltage by at least 3 seconds for motors upto 20 seconds starting time.



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

- Maximum torque shall not be below 200% of full load torque.

Each motor more than 30 KW rating shall be provided with space heater. All electrical equipment accessories and wiring shall have tropical protection.

The VVF drive control shall be used for control of each motion. The VVF drive shall be equipped at least with 1024 pulse in card, droop control for synchronization and crane software. The rating of VVF shall be decided considering 250% of full load current of respective drive motor based on in panel rating with derated at 50 Deg C ambient temperature.

The crane(s) shall be furnished complete with all electrical equipment, accessories, like drive motors with VVF drives, conductors, insulators, protective & operating devices, cables, current collectors, all protective devices, anti-collision limit switches, mechanical overload and protection for electrical faults etc.

4.9 DSL

DSL shall meet the following requirements:

- Shrouded bus bar type.
- Minimum 20% allowance for wear and tear shall be considered during sizing.
- Voltage drop for all conductors and cables/ wires shall be limited to 3% of rated voltage between the main disconnect switch and motor terminals.

4.10 LIMIT SWITCHES

The limit switches shall be totally enclosed type IP-55. Each hoist shall be furnished with two (2) limit switches meeting the following requirements:

- A screw type limit switch with self-resetting features which will act in case of over hoisting.
- A gravity operated hand reset type limit switch as a backup protection against over hoisting. Track type limit switches shall be provided on the bridge and trolley to prevent over travelling in either direction.

Trailing cable shall be 1100 V grade, tinned copper, heat resistant, with EPR insulation and as per Class – 5 of IS-8130. Also should have inner PCP sheath and outer CSP sheath with nylon chord reinforcement & heat resistant, oil resistant and flame retardant heavy duty FRLS type.

4.11 CONTROL & INSTRUMENTATION REQUIREMENTS

Necessary start/stop and emergency controls shall be provided. Automatic reset type limit switches shall be provided to prevent over-travel for-

- Over hoisting and lowering motions of the hook.
- Long travel motion
- Cross travel motion

OPERATING SPEEDS FOR MISCELLANEOUS HOISTS

- Hoist : 3 m/min
- Trolley travel : 6 m/min
- Long travel : 10 m/min
- Creep speed : 10% of full speed (as applicable)
- Crane runway rails : Rails to suit

Notes:

- Area, type, capacity mentioned are minimum requirement and shall be finalized during detail engineering without any commercial implication.
- Travel and Lift are layout dependent and shall be finalized during detail engineering without any



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

commercial implication.

3. Additional electric/manual hoist required during detail engineering shall be provided as per design criteria given above without any commercial implication.

5.0 SCOPE OF SUPPLY (ELECTRICAL)

Complete electrical scope as per specification / details indicated in Section IB (Specific Technical Requirement Electrical) and IIB (General Technical Requirement Electrical).

6.0 SCOPE OF SUPPLY (C&I)

Complete C&I scope as per specification / details indicated in Section IC (Specific Technical Requirement C&I) and IIC (General Technical Requirement C&I).

7.0 SCOPE OF SUPPLY (CIVIL)

Total Civil is in BHEL's Scope of work, however complete grouting for equipments, fixing and any concreting inside the vessels, puddle pipe inside civil structure, nozzles, supporting plate/ structures & lining shall be in bidder's scope. Grouting material shall be in bidder's scope.

Also detailed Civil Input drawing shall be provided by bidder. Successful bidder shall furnish civil assignment drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder.

8.0 SCOPE OF SERVICES

The bidder's scope also includes following services for scope under this specification:

- (i) Erection and commissioning, unloading, storage handling and transportation at site.
- (ii) 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 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. Wrapping, coating and protection of all the buried pipe shall be as per IS 10221.
- (iii) 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.
- (iv) Erection and Commissioning of entire Sewage Treatment Plant.
- (v) Arrangement of all instruments, equipments, lab facilities, reagents, monitoring gadgets for monitoring, pre-commissioning, carrying out trial run, commissioning, PG test & till plant hand over.
- (vi) Monitoring gadgets, instruments and equipments required for maintenance (till demonstration test & Plant Hand over).
- (vii) During DCS logic preparation, logic building & Software testing of STP package, bidder shall depute his personnel at BHEL –EDN or customer office as and when required by customer / BHEL without any delay.
- (viii) Complete grouting for equipment, fixing and any concreting inside the vessels and lining.
- (ix) All personnel required during maintenance, Commissioning, trial run and PG test.
- (x) Trial run for requisite period.

	TITLE:		SPECIFICATION NO. PE-TS-412-673-A001	
	2X660 MW ENNORE SEZ STPP		SECTION : I	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT		SUB-SECTION: IA	
			REV. NO. 00	DATE :

- (xi) Performance Guarantee testing.
- (xii) Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.
- (xiii) All other facilities/ services as described in section on site services in specification and related to Sewage treatment Plant scope of work.
- (xiv) Relevant requirements as per GTR, GCC, ECC & SCC.
- (xv) 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.
- (xvi) All the Piping, Valves and Equipment's of this system shall be protected against external corrosion by providing suitable painting. The surfaces of stainless steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. Further all equipments supplied under the sewage treatment plant shall be painted as per Section IA ANNEXURE V of this Technical Specification.
- (xvii) Painting shall be as specified Section IA ANNEXURE V of this technical specification. However, any variation in the painting schedule as finally approved by BHEL / Customer shall be taken care by the bidder without any commercial and delivery implication to BHEL / Customer. Colour coding scheme shall be intimated to vendor during detail engineering.
- (xviii) Final touch up paint at site.

9.0 PAINTING

Painting shall be as specified Section IA ANNEXURE V of this technical specification. Internal painting of the equipments shall be suitable for withstanding effect of sewage. Outer painting shall be as per technical specifications. Supporting documents shall be furnished in support of suitability of the lining offered for the duty conditions by bidder during detailed engineering. However, any variation in the painting schedule as finally approved by BHEL / Customer shall be taken care by the bidder without any commercial and delivery implication to BHEL / Customer. Colour coding scheme shall be intimated to vendor during detail engineering.

10.0 TERMINAL POINTS

- (i) 25 NB Instrument air supply at 5 to 7 kg/cm² (g) – At 5 meter distance from sewage treatment plant building. However, distribution and piping inside Sewage treatment plant area will be in bidder's scope.
- (ii) Service water (50 NB) - At 5 meter distance from the Sewage treatment plant building. However, distribution and piping inside sewage treatment plant building will be in bidder's scope. Bidder to note that pressure available at terminal point for service water will be 2 kg/cm² approx. (max.); hence bidder will take care for their pump lubrication / cooling accordingly.
- (iii) All drains of STP plant shall be connected to common sewage collection sump inside STP area.
- (iv) Hard Sludge generated in sludge drying bed will be manually disposed by customer. Sludge handling trolley shall be supplied by bidder.
- (v) Piping from treated water disposal pumps to horticulture network.
- (vi) In addition to that terminal points shall be as per the P&ID for STP plant (BHEL Drg. No.:PE-DG-412-673-A001) enclosed with the technical specification.

11.0 EXCLUSIONS



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

11.1 All civil works including foundation of equipment, excavation & back filling. However complete grouting for equipment, fixing and any concreting inside vessels and lining shall be in the scope of the bidder. Civil works including operating / maintenance platforms and interconnection platforms (if any) with ladders / stairs & handrails, structural supports and hangers for pipes / ducts, all embedments and inserts with lugs including anchor fasteners, bolts etc., dressing of foundations, grouting of pockets and underpinning of base plates for equipment / structures and fixing supports, filling and finishing of openings in walls, floors, cladding, roof and trenches shall be in Bidder's scope.

11.2 Main pipe trestles

11.3 Instrument air up to terminal points.

11.4 Service water up to terminal points.

11.5 Supply of ISMB monorail.

11.6 Air conditioning, ventilation & firefighting facilities.

11.7 Other exclusions are mentioned in the electrical & C&I portion of this specification.

11.8 Chemicals.

12.0 QP AND SUB VENDOR APPROVAL

12.1 Minimum QP requirements are specified as Section IA ANNEXURE I. BHEL & customer reserves the right for inspection of imported items by BHEL/customer officials (if felt necessary). The same shall be decided during detail engineering during approval of QP's.

12.2 However, any additional comments as given by BHEL/Customer on quality plan shall be adhered by the bidder without any commercial & delivery implication to BHEL.

12.3 Requirement of detailed QP, inspection checklist, certificate of conformance etc. for each equipment and sub-vendor shall be finalized during detailed engineering stage; decision of BHEL/customer shall be binding on vendor in this regard. Any changes/additional tests insisted upon by Owner during approval of QAP's shall be accepted by bidder without any commercial and delivery implication to BHEL/Customer. Bidder shall submit the quality plans in BHEL format during detailed engineering stage. Bidder to note further that during detailed engineering all the QAP's/check lists etc. shall be submitted to Customer/BHEL for approval. All inspection & testing etc. shall be carried out accordingly.

12.4 List of make sub vendor items is enclosed as Section IA ANNEXURE-II is indicative only and is subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL. Any additional sub vendor shall be subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.

12.5 Bidder to propose sub vendor list with following back up documents within 4 weeks of placement of LOI/LOA. Thereafter no request for additional sub-vendor shall be entertained. The sub vendor list shall subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.

12.6 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.

13.0 FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES

Bidder shall meet the following outlet guaranteed parameters of sewage treatment plant as mentioned below:

OUTLET GUARANTEE PARAMETERS:

The treated sewage will conform to the following quality standards:

	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION : I	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION: IA	
		REV. NO. 00	DATE :

BOD ₅	:	< or = 10 mg/l (ppm).
COD	:	<100 mg/l (ppm).
Oil & Grease	:	-
TSS	:	< or =20 mg/l (ppm).
Coliform	:	< or =10 ³ (MPN/1000 ml)
pH	:	6.5 – 8.
Temperature	:	Ambient.

In addition to above bidder to refer Section IA ANNEXURE III for additional functional Guarantees and liquidated damages.

14.0 DESIGN/ CONSTRUCTION

In addition to the requirements of Section IIB, IIC the following shall also be complied under scope of this specification.

The P&I diagram is enclosed herein in this section for bidder's compliance.

The material of construction specified in Datasheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subject to BHEL / Customer approval during detail engineering without any commercial & delivery implication to BHEL.

15.0 SEWAGE TREATMENT PLANT OPERATION AND CONTROL

The FAB/MBBR based sewage treatment plant operation & control shall be carried out from the DDCMIS based control system (BHEL Scope).

DDCMIS based control system for FAB/MBBR based sewage treatment plant shall be located in the STP area. Sewage transfer pumps installed in various sewage lifting sumps (S1, S2, S3 & S4) other than STP area shall be controlled from nearest control system (BHEL Scope).

All pumps shall be fitted with check valves and pressure gauge on the discharge side. All pump shall be tripped automatically in case of low level in the pits/tanks and shall be start manually. Annunciations for high level in pits/tanks shall be provided.

Similarly, air blowers (located at Sewage treatment plant area) shall be suitably interlocked with DDCMIS based control system.

The control philosophy of various systems is described below. However, for all the systems, following basic process related interlocks, alarms /pre-warning signals shall be implemented in the control system as per system requirement.

- a) Among the equipments, it shall be possible to select a specific pump or tank or sump for working/standby/ maintenance etc. through control system.
- b) PERMISSIVE & INTERLOCKS:
 - (i) Starting & tripping of pumps with respect to liquid level in the respective sump/tanks or liquid pressure in the suction lines.
 - (ii) Starting & tripping of agitators with respect to liquid level in the respective tanks.
 - (iii) Starting & tripping of pumps (which are provided with forced water lubrication) with respect to lubricating water flow (through low pressure/ low flow signal as the case may be).
 - (iv) Tripping of pumps when the discharge pressure is very high to avoid operation of the pump under shutoff head.



TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
	SECTION : I	
	SUB-SECTION: IA	
	REV. NO. 00	DATE :

- (v) Stopping/ tripping of equipments due to abnormal parameters related to safety of equipments like high vibration, very high bearing lubrication water (and /or oil) temperature to the drive/pumps, very high bearing temperature of the of pump/drive etc. as applicable based on the recommendations of Equipment Supplier.
- (vi) Capacity of the metering pump shall be controllable from 10-100% continuously by adjusting the stroke length manually by a micro meter dial calibrated for 0–100% of pump capacity integral with the pump.
- (vii) Various annunciations related to low level of the chemical tanks & sumps shall be provided.
- c) ALARMS /SIGNALS
- (i) Abnormal parameters such as low & high level in tanks/sumps, high pressure at pump discharge, low header pressure, low lubrication water flow to pumps (provided with forced water lubrication system) etc.
- (ii) Failure of starting of equipments such as pumps, blowers etc. upon start command.
- (iii) Tripping of equipments due to protection logic.

In addition, the control system shall facilitate the operator to know the status of various equipments (Whether equipment is running or stopped or tripped etc., whether the equipment is selected for operation/ standby duty /maintenance mode etc. as the case may be).

Number of signals / Annunciation shall be provided in DDCMIS and the same shall be decided During Detailed Engineering stage.

16.0 DRAWING/DOCUMENTS REQUIREMENT

After award of LOI, following minimum drawing/documents shall be submitted by the bidder for BHEL/Customer approval. However, any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL.

The number of drawing/documents to be submitted by the bidder shall be as per enclosed Section IA ANNEXURE IV. The submission of soft copy or hard copy of the document whichever is later will be considered as final date of submission of the document. The bidder has to submit the revised drawing /document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

For the Drawings/Documents distribution Procedure, please refer attached Section IA Annexure-IV. Bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. The numbers of soft copies & hard copies of drawing/documents to be submitted by the bidder shall be as per enclosed Section IA Annexure-IV.

After award of LOI/LOA, drawing/documents to be submitted by the bidder for BHEL/Customer approval has been indicated in Section IA Annexure VII. However, any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL.

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 the Section IA Annexure VII of this specification. 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-

	TITLE:		SPECIFICATION NO. PE-TS-412-673-A001	
	2X660 MW ENNORE SEZ STPP		SECTION : I	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT		SUB-SECTION: IA	
			REV. NO. 00	DATE :

off meeting. Bidder to ensure following at their end

- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- 1. 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>

17.0 SPARES

The Bidder shall include in his scope of supply all the necessary Mandatory spares, start up and commissioning spares as indicated in the relevant sections of specifications. The general requirements pertaining to the supply of these spares is given below: -

17.1 RECOMMENDED SPARES:

The bidder shall also furnish list of recommended spares parts for three (3) years normal operation with unit prices. These recommended spares shall be those considered necessary by the bidder on a stand-alone basis. The BHEL reserves the right to buy any of the recommended spare parts as considered necessary by him.

The recommended spares shall be delivered at project site at least two months before the scheduled date of initial operation of first unit. However, the spares shall not be dispatched before the dispatch of the main equipment. The price of these spars will remain valid upto 6 months after placement of Notification of Award for the main equipment. However, the Bidder shall be liable to provide necessary justification for the quoted prices for these spares as desired by the BHEL/Customer.

17.2 MANDATORY SPARES:

All Mandatory spares listed in Section IA Annexure VI of this specification are in bidder's scope of supply.

All the Mandatory spares for the equipment under the contract provided by the vendor will strictly conform to the specifications and documents and will be identical to the corresponding main Equipment/components supplied under the contract.

Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.

All mandatory spares shall be delivered at site at least two months before scheduled date of initial Operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments.

Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise.

Inspection of mandatory spares shall be in line with the approved quality plans for the respective Items/equipments. The inspection categorisation of mandatory spares shall also be in line with the approved categorisation plan for the respective items/equipment.

	TITLE:		SPECIFICATION NO. PE-TS-412-673-A001	
	2X660 MW ENNORE SEZ STPP		SECTION : I	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT		SUB-SECTION: IA	
			REV. NO. 00	DATE :

17.3 START-UP & COMMISSIONING SPARES

Start-up and commissioning spares are those spares which are required during the start-up and commissioning of the equipment/system. All spares used till the plant is handed over to the BHEL/Customer shall come under this category. The Bidder shall provide for an adequate stock of such start up and commissioning spares to be brought by him to the site for the plant erection and commissioning. They must be available at site before the equipments are energized. The unused spares, if any, should be removed from there only after the issue of Taking Over certificate. All start up spares which remain unused at the time shall remain the property of the Bidder.

Notes:

- 1) The Bidder shall indicate the service expectancy period for the spares parts (mandatory) under normal operating conditions before replacement is necessary.
- 2) All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desecrator packs as necessary.
- 3) All the spares (mandatory) shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.
- 4) Each spares part shall be clearly marked or labelled on the outside of the packing with its description. When more than one spares part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.
- 5) All cases, containers are to be opened for such examination as may be considered necessary by BHEL / Customer.
- 6) The Bidder will provide the BHEL/Customer with all the addresses and particulars of his sub suppliers while placing the order on vendors for items/components/equipments covered under the contract and will further ensure with his vendors that the BHEL/Customer, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.
- 7) The Bidder shall warrant that all spares supplied will be new and in accordance with the contract Documents and will be free from defects in design, material and workmanship.
- 8) The bidder to provide datasheets/assembly drawings of the manufacturer/ any other relevant document showing Bill of Material(s), Make, Model Number, Part Number etc. through which the mandatory spares to be supplied can be uniquely identified.
- 9) The bidder shall guarantee the long term availability of spares to the BHEL/Customer for the full life of the equipment covered under the contract. The Bidder shall guarantee that before going out of production of spares parts of the equipment covered under the Contract, He shall give the BHEL/Customer at least 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to sub-vendors. Further, in case of discontinuance of manufacture of any spares by the Bidder and/or his sub-vendors, bidder will provide the BHEL/Customer, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equivalent makes required by BHEL /Customer for the purpose of procurement of such items.
- 10) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the item in the station (project), unless specified otherwise and the fraction will be rounded off to the next higher whole number.



TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
	SECTION : I	
	SUB-SECTION: IA	
	REV. NO. 00	DATE :

11) Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed and the break up for these shall be furnished.

12) In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities.

18.0 BIDDER TO FURNISH 4 SETS OF TECHNO-COMMERCIAL BID INCLUDING FOLLOWING DOCUMENTS/INFORMATION (FOR ELECTRICAL AND C&I PLEASE REFER THE RESPECTIVE SECTION OF THE SPECIFICATION).

- Deviation if any in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed)
- Compliance certificate. (Stamped & Signed)
- Schedule of Declaration. (Stamped & Signed)
- Unpriced Price Schedule duly filled as "Quoted". (Stamped & Signed).
- GUARANTEED POWER CONSUMPTION for STP package duly filled in GPC format (Stamped & Signed).

Any other documents submitted by bidder except as asked in the bid's specification shall not be evaluated & considered as null & void.

19.0 MISCELLANEOUS REQUIREMENT

- I. Bidders is advised to visit the site 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. The complete system shall be proven and necessary design documentation in support of proveness shall be submitted by the successful bidder in support of the systems, if asked by the customer without any price and delivery implication to BHEL and customer.
- III. System to be designed to meet all the statutory requirements. Preparation of all necessary drawings/data/ documents for obtaining necessary Approval of statutory authorities like CCOE, IBR, Weight & Measures Department, MOEF and any other agency/ competent authority, on behalf of the customer, related to installation of STP plant (if required) is included in bidder's scope. 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.
- IV. Any statutory requirement / clearance required for the package from government / local body shall be in bidder's scope.
- V. Vendor to attend regular engineering meeting with BHEL and customer fortnightly in BHEL or customer office as decided during detail engineering. Vendor will depute all his concerned engineering representative along with the project manager for discussion and approval. Meeting can be held at site also.
- VI. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

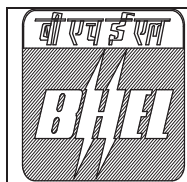
REV. NO. 00

DATE :

- VII. Latest version of all codes and standards to be followed.
- VIII. Chemical dosing system, dual media filter, activated carbon filter, filter feed pumps, treated water disposal pumps & centrifuge for sewage treatment plant shall be housed inside the sewage treatment plant building. Further DDCMIS Control panel & MCC shall also be located in STP building. STP building shall have toilet blocks for ladies and gents.
- IX. Bidder to submit BBU during detailed engineering after approval of Basic documents. BBU shall be equal to BOQ for the package and there shall be no price and delivery implication is applicable to BHEL / customer for the same. None of the items supplied for the project as non-billable. Incomplete BBU shall not be review by BHEL. Further during detail engineering breakup of supply prices of STP package in the Billing break up schedule shall be prepared as per below mentioned details:

1.0	THE BREAK UP (%) OF SUPPLY PRICES OF SEWAGE TREATMENT PLANT PACKAGE IN THE BBU SHALL BE IN LINE WITH THE BELOW PROVIDED DETAILS:	
1.1	Lump sum firm price for supply of Atmospheric tanks, pressure vessels inclusive of all taxes, duties and other levies as applicable.	5 % of Total Supply Price.
1.2	Lump sum firm price for supply of Valves inclusive of all taxes, duties and other levies as applicable.	14% of Total Supply Price.
1.3	Lump sum firm price for supply of Instruments inclusive of all taxes, duties and other levies as applicable.	15% of Total Supply Price.
1.4	Lump sum firm price for supply of Pumps inclusive of all taxes, duties and other levies as applicable.	14% of Total Supply Price.
1.5	Lump sum firm price for supply of Piping and Fittings inclusive of all taxes, duties and other levies as applicable.	33% of Total Supply Price.
1.6	Lump sum firm price for supply of agitators, strainers, blowers inclusive of all taxes, duties and other levies as applicable.	7% of Total Supply Price.
1.7	Lump sum firm price for supply of centrifuge, media for DMF & ACF, tube settler etc. inclusive of all taxes, duties and other levies as applicable.	7% of Total Supply Price.
1.8	Lump sum firm price for supply of Balance items inclusive of all taxes, duties and other levies as applicable.	5% of Total Supply Price.

- X. All interconnecting piping, valves, fittings including dosing piping, drain piping from tanks to nearby drain, flushing lines from nearest available water source, valves, fittings and accessories is also in bidder's scope.
- XI. All the vertical pumps shall be self-lubricating type.
- XII. All interconnecting piping, valves, fittings including dosing piping, drain piping from tanks to nearby drain, flushing lines from nearest available water source, valves, fittings and accessories is also in bidder's scope.
- XIII. 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 shall be taken from BHEL. 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.



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

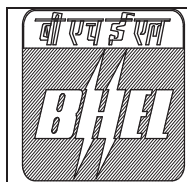
**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

- XIV. KKS numbering if required, as per BHEL/Customer requirement shall be provided by the Bidder during detailed engineering stage without any commercial/delivery implication to BHEL.
- XV. Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the works for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.
- XVI. Buried piping shall be protected as under (as per IS-10221).
Surface cleaning by wire brush, power tool cleaning etc.
Apply one coat of coal tar/primer/enamel.
Apply one layer of tape comprising of coal tar. Application of tape shall conform to AWWA C-203/IS 10221 (Appendix-B) with Minimum thickness of tape as 4MM +10%
- XVII. All drawings/documents shall be approved by BHEL/Customer during detailed engineering stage. Successful Bidder shall comply with the comment of the customer/BHEL without price & delivery implication.
- XVIII. Successful bidder shall furnish detailed erection manual for each of the equipment as well as complete system supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- XIX. 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.
- XX. Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment / scope 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 bidder, BHEL reserves the right to debit cost of such rework to bidder.
- XXI. In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.
- XXII. While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under SECTION -III of the specification. 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 to BHEL / Customer.
- XXIII. The bidder 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



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the vendor from the responsibility of providing such facilities to complete the supply and erection & commissioning of condensate polishing unit.

- XXIV. 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 judgment is not in full accordance herewith.
- XXV. 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.
- XXVI. 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 are subject to compliance to all attachments referred in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- XXVII. Deviations along with cost of withdrawal (positive or negative), 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 tender specification & there is no deviation. (Price to be given in sealed envelope only.)
- XXVIII. In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- XXIX. 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 TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO), HYDERABAD and /or DESEIN (customer's assigned consultant).
- XXX. The equipment covered under this specification shall not dispatch unless the same have been finally inspected, accepted and shipping release issue by BHEL/Customer.
- XXXI. BHEL's/Customer's representative shall be given full access to the shop in which the equipments are being manufactured or tested and all test records shall be made available to him.



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

TECHNICAL DETAILS OF SEWAGE TREATMENT PLANT



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

1.00.00 INTRODUCTION

The function of the Sewage Treatment Plant is to collect all sanitary sewage originating in the plant, perform treatment and transfer the treated water horticulture / irrigation. Sewage treatment in general carried out to reduce the solid contents of the sewage, and change the character of the sewage so that it can be reused.

Sanitary wastes are collected from the buildings that contain sanitary facilities by gravity. Sanitary lift stations shall be used to forward the waste to an onsite sewage treatment plant. Solid wastes shall be hauled offsite.

2.00.00 PROCESS DESCRIPTION (GENERAL)

The sewage treatment plant shall be designed as per guidelines of CPHEEO Manual. The anticipated no. of users shall be 2000 persons. The sewage treatment plant shall be designed to handle a flow of 75Kld considering average per capita consumption of 45lpcd with 80% of used water generated as sewage.

2.01.00 The Sewage Treatment Plant treatment scheme shall be modular type based on FAB (Fluidized Aerobic Bioreactor)/MBBR (Moving Bed Bio Reactor) technology followed by disinfection by Hypo and necessary tertiary treatment prior to reuse in horticulture purpose. Aerobic biological sludge generated shall be thickened in the tube settler and aerobically digested/dried in a sludge sump and then transferred to filter press. The dry sludge shall be disposed manually by Customer. The Process Flow Diagram / P & ID is enclosed for reference.

The sewage treatment plant shall consist of following treatment components:

- 1) **Pre-Treatment**, which consists of raw sewage collection and pumping & screening of incoming sewage & oil & grease removal from the collected sewage.

Preliminary Treatment:

- Coarse screens for screening incoming sewage
- Oil & Grease Trap
- Equalization cum holding tank

- 2) **Biological Treatment**, comprising of aeration followed by clarification and Dosing of sodium hypochlorite in the hypo contact cum filter feed tank.

Aeration System:

- Aerobic Biological treatment in the FAB/MBBR Tank with fine bubble diffused aeration.
- Transfer of treated partially treated sewage to the Clarification system.

Clarification System:

- Settling of digested sludge in the Tube Settler.
- Transfer & storage of clarified water to the Hypo Contact Cum Filter Feed Tank.
- Dosing of Sodium Hypochlorite in the Hypo Contact Cum Filter Feed Tank.
- Dosing of Sodium Hypochlorite sludge feed line to centrifuge.

- 3) **Sludge Handling System**

- Transfer of sludge to the sludge sump from FAB/MBBR tank & tube settler.
- Transfer of sludge to centrifuge through sludge transfer pumps.
- Transfer a part of sludge to FAB/MBBR tank to maintain MLSS through discharge line of sludge



TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
	SECTION : I	
	SUB-SECTION: IA	
	REV. NO. 00	DATE :

transfer pumps.

- Transfer of centrate or filtrate to the equalization tank.
- Transfer of waste water generated through DMF & ACF to the equalization tank.
- Disposal of sludge as cakes by sludge trolley.

4) Tertiary Treatment:

- Polishing of treated sewage by DMF& ACF.
- Transfer of Polished sewage water for horticulture.

Detailed description of each treatment step is given below:

The various raw sewages shall be collected by gravity at local sewage lifting stations at different areas and the same to be pumped by using 2 Nos (1W+1S) Sewage Lifting Pumps to an underground common collection sump located in sewage treatment plant area.

Collected raw sewage shall be pumped from the common collection sump using 2 Numbers (1W+1S) common collection non-clog type sump Pumps to the equalization Tank after passing through the bar screen chamber & oil grease chamber provided with oil & grease trap. In bar screen chamber (MOC: RCC) the coarse screens present in the raw incoming sewage shall be subject to screening & oil & grease chamber (MOC: RCC) shall be provided with Oil & grease trap for removal of oil & grease from the raw incoming sewage.

The Sewage Lifting Pumps shall be of submersible and heavy duty grinding type which shall cut and grind solids present in raw sewage into small fragments. The Sewage Lifting Pumps shall automatically START at high level in the Sewage Collection Pit and STOP at low level.

The common collection sump shall also be provided with a coarse air bubble diffuser and an airline tapping from the Air Blower delivery header so as to allow continuous aeration in order to protect the STP Package against unpleasant odours.

2 numbers (1W+1S) Air Blowers common for common collection sump, Equalization tank & sludge sump shall be provided to supply air through an underwater piping grid and fine air bubble membrane diffusers.

Centrate produced from centrifuge shall be transferred to Equalization tank.

2 numbers (1W+1S) vertical submersible FAB/MBBR feed pumps shall be provided in equalization tank to transfer sewage from equalization tank to FAB/MBBR reactor. 1no. FAB/MBBR reactor of MSRL construction alongwith 2 numbers (1W+1S) Air Blowers for FAB/MBBR tank to supply air through an underwater piping grid and fine air bubble membrane diffusers to FAB/MBBR reactor.

1 number tube settler of MSRL construction for Settling of digested sludge in the Tube Settler.

1 number of Hypo contact cum filter feed tank of MOC RCC shall be provided for storage of clarified water after clarification process. Further 1 no. hypo dosing system consists of 1 number Hypo dosing tank of MOC PVC along with 1 number hypo dosing pump shall be provided for dosing of sodium hypo chloride inside the hypo contact cum filter feed tank. Over flow connection from the Hypo contact cum filter feed tank shall be connected through pipe to plant drain.

Further 2 numbers (1W+1S) horizontal centrifugal type filter feed pumps shall be provided for feeding clarified water after clarification process for tertiary treatment through dual media filter & activated carbon filter.

1 number dual media filter & 1no. Activated carbon filter shall be provided for the tertiary treatment of clarified water after clarification process. Backwash & waste water generated from dual media filter & activated carbon filter shall be transferred to the equalization tank.

1 number treated water tank over ground (MOC RCC) shall be there for storage of final treated water after tertiary treatment. Further 2 numbers (1W+1S) horizontal centrifugal type treated water disposal pumps shall be provided for transferring the treated water for gardening purpose.



TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
	SECTION : I	
	SUB-SECTION: IA	
	REV. NO. 00	DATE :

1 number sludge sump of (MOC RCC underground) for storage of sludge generated from FAB/MBBR tank & tube settler shall be provided. 2 nos. (1W+1S) of vertical screw type sludge transfer pumps for feeding sludge from sludge sump to centrifuge. Further 1 number hypo dosing system consists of 1 number Hypo dosing tank alongwith 1 number hypo dosing pump shall be provided for dosing of sodium hypo chloride during feeding of sludge to centrifuge.

Sodium hypochlorite solution dosing shall be carried out into the hypo contact cum filtered feed tank & feeding line to centrifuge to control the BOD.

Further 1 number trolley mounted arrangement shall be provided for disposal of sludge cake generated from centrifuge.

The stabilized sludge shall be free of offensive odours.

Sea water intake pump house is located far- off location from BTG island and treatment of the sewage generated from toilets cannot be transferred to main sewage treatment plant, hence dedicated bio-digester and Reed Bed arrangement shall be provided to cater sewage waste generated from sea water intake pump house. Over flow of Reed bed arrangement shall be suitably used for horticulture. One no. hose pipe (MOC: PVC) of 10 m length shall be provided for the same.

2.02.00 SIZING CRITERIA FOR BIO TOILET

As per CPHEEO norms, an average flow of 45 liters per capita per day has been adopted.

Bio digester capacity are calculated as per the following table.

Sl no:	Buildings/Facilities (As per Plot Plan)	No. of people	Sewage generated in m3	Capacity of Bio digester envisaged (m3) *	Capacity of Reed bed envisaged (m3)
1.0	Sea water intake pump house	30	4.05	4.5 m3	2.25 m3

*Three days retention has been considered.

Sr. no.	System provided	BIO-DIGESTER			REED BED ARRANGEMENT		
	Building/Area Covered	Quantity	Effective capacity	MOC & Type	Quantity	Effective capacity	MOC & Type
2.0	BD-RD 1 for Sea water intake pump house	1 number	4.5 cum, (Designed for 30 people)	MOC: FRP (10 mm thick) Type: Supplier specific design	1 number	2.25 cum	MOC: FRP (10 mm thick) Type: Supplier specific design
3.0	PIPING						
3.1	Sewage pipe MOC		PVC				
3.2	Treated water pipe MOC		PVC				

3.00.00 SEWAGE GENERATION AND CHARACTERISTICS

The Sewage Treatment Plant is designed for the following sewage flow rate and characteristics are as follows:

Persons Envisaged : 2000 [45 Ltrs/Capita (lpcd) as per CPHEEO, 1993].
Flow Rate : 75 M³/day (Max). (Considering 80% of used water generated as sewage)

	TITLE:		SPECIFICATION NO. PE-TS-412-673-A001	
	2X660 MW ENNORE SEZ STPP		SECTION : I	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT		SUB-SECTION: IA	
			REV. NO. 00	DATE :

BOD ₅	:	300 mg/l (ppm).
COD	:	600 mg/l (ppm).
Oil & Grease	:	<50 mg/l (ppm).
TSS	:	300 mg/l (ppm).
Coliform	:	10 ⁶ -10 ⁷ (MPN/1000 ml)
pH	:	7 – 8.
Temperature	:	Ambient.

TREATED SEWAGE QUALITY

The treated sewage water shall be used for horticulture purpose. The treated sewage will conform to the following quality standards:

BOD ₅	:	< or = 10 mg/l (ppm).
COD	:	<100 mg/l (ppm).
Oil & Grease	:	-
TSS	:	< or =20 mg/l (ppm).
Coliform	:	< or =10 ³ (MPN/1000 ml)
pH	:	6.5 – 8.
Temperature	:	Ambient.

Notes:

- i. The treated sewage quality standards shall be achieved at average sewage flow rates as well as peak sewage flow rates.

4.00.00 SPECIFIC TECHNICAL REQUIREMENTS FOR PIPING

1. All interconnecting piping/ fittings/ valves shall be provided as required.
2. All interconnecting piping/ fittings/ valves in direct contact with sewage shall be of CI (Heavy Grade).
3. Instrument air & piping carrying air shall as per ASTM A-53 type E Gr. B galvanized /IS 1239 heavy galvanized/IS 3589 Gr 410 Galvanized to SI-4736 or equivalent.
4. Filtered Water & service water shall be 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.
5. NaOCL dosing pipes shall be of CPVC Sch 80 (ASTM).

5.00.00 CONTROL PHILOSOPHY

The FAB/MBBR based sewage treatment plant operation & control shall be carried out from the DDCMIS based control system (BHEL Scope).

DDCMIS based control system for FAB/MBBR based sewage treatment plant shall be located in the STP area. Sewage transfer pumps installed in various sewage lifting sumps (S1, S2, S3 & S4) other than STP area shall be controlled from nearest control system (BHEL scope).

All pumps shall be fitted with check valves and pressure gauge on the discharge side. All pump shall be tripped automatically in case of low level in the pits/tanks and shall be start manually. Annunciations for high level in pits/tanks shall be provided.

Similarly, air blowers (located at Sewage treatment plant area) shall be suitably interlocked with DDCMIS based control system.

Number of signals / Annunciation shall be provided in DDCMIS and the same shall be decided During Detailed Engineering stage.

Note: Bidder to note that for complete control & operation of the STP plant, bidder to also refer the respective Control & Instrumentation (Section IC& IIC) & Electrical (section IB& IIB).



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SUB-SECTION: I A

REV. NO. 00

DATE :

ANNEXURE I

QUALITY PLAN

QUALITY ASSURANCE

Test s/Check	Material Test	WPS/PQR/Welder Qualification	DPT/MPi	Assembly Fit up	Dimension	RT	Hydraulic / Water Fill	Performance Test	Test as per relevant Std/ Appd.	Data Sheets	Other Tests	Remarks
Items / Components				Y	Y			Y ¹	Y			LEGENDS: Y Applicable Y ^a One per Heat/Heat Treatment batch./Lot Y ^b On machined surfaces only. Also 100% on Butt Welds & 10% on Fillet Welds. Y ^c UT shall be done for shafts with Dia 50 mm or above & Plates of Thickness 20 mm or above. Y ^d Dynamic Balancing per ISO: 1940, Grade 6.3 minimum.
1. Horizontal Centrifugal Pumps				Y	Y							
1.1. Casing	Y ^a		Y ^b				Y					Y ¹ As per HIS, USA.
1.2. Impeller	Y ^a		Y ^b								Y ^d	Y ² 10% RT to be conducted on butt welds for Thk ≥ 10 mm.
1.3. Shaft	Y ^a		Y						Y ^c	Y ^c		Y ³ Seat Leakage Test for actuator operated valves shall be done by closing the valve with job actuator.
2. Vertical Pumps				Y	Y			Y ¹	Y			Y ⁴ Tests on Rubber Diaphragms per batch of Rubber mix such as Tensile, Elongation, Hardness, Thickness, Bleed Resistance, Flex Test for 1500 cycles etc. shall be conducted. In addition, Type Test for 50,000 cycles for each type of diaphragm shall also be conducted, if not carried out earlier.
2.1. Casing	Y ^a		Y ^b				Y					Y ⁵ Seat Leakage Test is required to be done in both directions. Disc strength test as per relevant code shall be carried out.
2.2. Impeller	Y ^a		Y ^b									Y ⁶ Blue Matching, Wear Travel for Gate Valves, reduced pressure test for check valves shall be conducted per relevant standards.
2.3. Shaft	Y ^a		Y						Y ^c			
2.4. Fabricated Parts	Y ^a	Y	Y ^b			Y ²	Y	Y ¹				
3. Dosing/ Metering Pumps	Y ^a						Y					
4. Gate/ Globe/ Check Valves	Y ^a		Y ^b	Y			Y		Y	Y ⁶		
5. Dual Plate Check Valves	Y ^a		Y ^b	Y			Y		Y	Y ¹²		
6 Diaphragm Valves	Y ^a				Y		Y ³	Y		Y ⁴		
6. Butterfly Valves (Low Pr.)				Y			Y ³	Y		Y ⁵		
7.1Body (Cast)	Y ^a		Y ^b									
7.2Disc (Cast)	Y ^a		Y ^b									
7.3 Shaft	Y ^a		Y ^b								Y ^c	
8. Plug/ Ball Valves (Low Pr.)	Y ^a		Y ^b	Y			Y		Y			
9. Blowers	Y ^a		Y ^b	Y			Y		Y	Y ^{dc}		
10. Atmospheric Storage Tanks/ Pressure Vessels	Y ^a	Y	Y ^b	Y		Y ⁸	Y		Y ^c	Y ⁷		

QUALITY ASSURANCE

Test s/Check	Material Test	WPS/PQR/Welder Qualification	DPT/MPi	Assembly Fit up	Dimension	RT	Hydraulic / Water Fill	Performance Test	Test as per relevant Std/ Appd. Data Sheets	Other Tests	Remarks
Items / Components											
11. Rubber lining	Y ^a			Y					Y	Y ⁹	Y ⁷ Heat Treatment of the Tank/Vessel shall be done per fabrication code requirement. Welded dished ends shall be stress relieved. Dished ends manufactured by cold working shall be stress relieved as per the requirement of code.
12. Reactor Clarifier	Y ^a	Y ^b	Y ^b	Y ^Y					Y	Y ¹⁰	Y ⁸ RT as per fabrication code requirements. However, dished ends welds, if manufactured by using welded plates shall be subjected to 100% RT.
13. Clariflocculator/ Plate or Tube Settler	Y ^a			Y	Y				Y		Y ⁹ Rubber Lining Mix shall be subjected to Bleed Resistance Test on mould sample. Adhesion Test, Spark Test and Hardness Test for the Rubber lined jobs shall also be conducted.
14. Hoists & Cranes	Y ^a	Y ^b	Y ^b	Y ^Y	Y ⁸	Y ⁸	Y		Y		Y ¹⁰ Gear Boxes shall be checked for smooth No Load Operation at shop to verify noise and vibration levels. Gear Ratio and Kerosene Leak Test shall also be conducted.
15. Chlorine Tonner	Y ^a	Y ^b	Y ^b	Y ^Y	Y ⁸	Y ⁸	Y				Y ¹¹ One Fan of each type & size shall be routine performance tested as per corresponding code for air flow, static pressure, total pressure, speed, efficiency, power consumption, noise & temperature rise. Also all Fans shall be subjected to run test of 4 hours during which noise, vibration, temperature rise and current drawn shall be measured.
16. Chlorine Evaporator	Y ^a	Y	Y	Y ^Y				Y			Y ¹² Blue Matching, reduced pressure test for check valves shall be conducted per relevant standards. Dry cycle test on valve spring for 100000 cycles shall be carried out as type test, if not carried out earlier, for the similar MOC, size and type of spring.
17. Chlorinator & injector	Y ^a		Y	Y	Y		Y	Y		Y ¹⁰	
18. Agitators /Flash Mixer/ Flocculator	Y ^a	Y ^b	Y ^b	Y ^Y							
19. Pipes	Y ^a			Y ^Y			Y		Y		
20. Ventilation/Exhaust Fan	Y ^a	Y ^b	Y ^b	Y ^Y				Y ¹¹	Y	Y ^{dc}	
After erection, the complete Piping system along with valves & fittings shall be hydraulically tested.											

SECTION - 5

QUALITY ASSURANCE PLAN

1.0. GENERAL REQUIREMENTS

a) Shop Tests

Shop tests shall include all tests to be carried out at Bidder's works, at works of his sub-contractor and at works where raw materials supplied from manufacture of equipment is manufactured. Testing requirement of major equipment over and above the respective code / standard requirements are given for ST & Aux. including Condenser, H P Bypass System & Vibration Isolating System.

b) Site Tests

The Bidder shall prepare and submit detailed field quality plans by setting out the quality practice and procedures to be adopted by him for assuring quality for each equipment of material at this specification from the receipt of material at site, during storage erection, precommissioning to final commissioning of the plant. These procedures shall necessarily include all checks/tests conducted at site for preservation, assembly, alignment, positioning of the equipment, foundation preparation, welding/bolting heat treatment, non-destructive examination, hydraulic test, running test, performance test etc. The Bidder shall also furnish detailed quality procedure proposed by him for storage, preservation, painting, acid cleaning, alkali boil out, steam blowing, hydraulic test air/gas tightness test etc. to the BHEL/TANGEDCO. The same shall be discussed and finalised with the BHEL/TANGEDCO and six numbers of such finalised copies shall be submitted.

2.0. STEAM TURBINE AND ASSOCIATED EQUIPMENT

2.1. High Pressure & Intermediate Enclosure

High pressure Cast Steel Enclosures (for example High pressure and Intermediate Pressure Inner and Outer Cylinders, Steam Chests and liner, Steam Inlet Pipes, nozzle boxes).

- 1) Test pieces fully representative of the material and condition of the casting shall be provided to enable the properties of material to be determined.

Creep requirements:

- a) Steels chosen for design metal temperatures less than 400°C are exempt from creep /stress rupture testing.
 - b) Steels chosen for design metal temperatures between 400°C to 540°C and having less than 3% chromium, shall require 5 years performance feedback experience in the absence of which, creep rupture test will be required to be carried out for maximum test duration of 1000 hrs/mutually agreed parameters for employer's approval.
 - c) Steels chosen for design metal temperatures above 540°C and/or having more than 3% chromium, shall require 10 years performance feedback experience OR adequate stress rupture data, in the absence of which, creep rupture test will be required to be carried out for maximum test duration of 1000 hrs/mutually agreed parameters for employer's approval.
 - d) Unspecified alloying elements shall be controlled as per the applicable standard.
- 2) Each casting shall be subjected to magnetic particle examination on the entire inner and outer surfaces after heat treatment.

- h) Shroud bands after punching and after rivet-ting shall be subjected to 100% DPT to ensure freedom from harmful surface defects.
- i) In case of cast blades, following testing shall be done:-
1. Chemical analysis/Mechanical testing per heat/heat treatment batch.
 2. Rough machined and finish machined blade shall be subjected to MPI.
 3. RT on blades.
 4. Before starting mass productions, following technological tests shall be carried out on the first lot of 10 to 15 blades :-
 - i. 100% radiography and 100% MPI on blades
 - ii. 100% hardness testing.
 - iii. Mechanical testing and metallurgical testing.
 - iv. Weld repair shall not be permitted unless prior approval of Employer is obtained.
- In case of repair is allowed, manufacturer shall submit WPS/PQR and defectogram for Employer's approval before welding. After weld repair, RT shall be carried out on repaired area.

2.5. Diaphragms

- a) Welded and fabricated Diaphragms
- 1) Concentricity checks shall be carried out on finally machined diaphragms to ensure that there are no negative overlaps between guide and moving blades.
 - 2) 10% Ultrasonic examination and 100% magnetic particle examination shall be carried out on finished, stress relieved and machined welds.
- b) Cast/Forged/Machined Diaphragms
- 1) Details of the results of the tests conducted to determine mechanical properties together with chemical analysis, metallographic/ metallurgical examination, and heat treatment procedures recommended and actually followed shall be recorded on certificates.
 - 2) Concentricity, flatness, blade drop and area checks shall be carried out on finally machined diaphragms to ensure that there are no negative overlaps between guide and moving blades and port wall. Finish shall be to employer's approval.
 - 3) A 100% ultrasonic examination shall be carried out on diaphragm materials. Blade junction areas with the side walls shall be checked by magnetic particle or dye penetrant testing.
- c) Colour matching of all the diaphragms by putting two halves together, and feeler gauge tightness check shall be carried out.

2.6. Stop, Control and bypass valves, actuators/servo-motors and steam strainers

- a) Test pieces shall be provided to enable the mechanical properties of valve bodies, bonnets, valve disc and seat, and valve spindle material to be determined.

Test Creep requirements:

- i. Steels chosen for design metal temperatures less than 400°C are exempt from creep /stress rupture testing.
 - ii. Steels chosen for design metal temperatures between 400°C to 540°C and having less than 3% chromium, shall require 5 years performance feedback experience in the absence of which, creep rupture test will be required to be carried out for maximum test duration of 1000 hrs/mutually agreed parameters for employer's approval.
 - iii. Steels chosen for design metal temperatures above 540°C and/or having more than 3% chromium, shall require 10 years performance feedback experience OR adequate stress rupture data, in the absence of which, creep rupture test will be required to be carried out for maximum test duration of 1000 hrs/mutually agreed parameters for employer's approval.
 - iv. Unspecified alloying elements shall be controlled as per the applicable standard.
- b) Dye penetrant checks shall be carried out on stellited / nitrided areas of components and stellite components in the finish ground or honed condition. Hardness checks shall be carried out to ensure required hardness.
 - c) Valve body and bonnet castings/forgings shall be subjected to 100% radiography or 100% ultrasonic examination. Body and bonnet shall also be subjected to 100% magnetic particle examination on entire surface. All pressure containing welds in body and bonnet shall be subjected to 100% RT/UT and MPI examination.
 - d) Wall thickness of the body and bonnet after finish machining shall be measured by ultrasonic method and valve seat bore shall be checked for size and concentricity.
 - e) Bar stock for valve stem shall be subjected to ultrasonic examination and finish machined stem shall be subjected to magnetic particle/Dye penetrant examination.
 - f) Each valve body and bonnet shall be hydraulically tested at minimum 1.5 times the maximum working pressure after applying temperature corrections.
 - g) All the actuating cylinders/servomotors shall be performance tested.
 - h) Performance testing shall be carried out on valve operators/ actuators to check functional requirements like trip closing and opening time, valve lift and hysteresis.
 - i) Colour matching of the valve disc and seat to ensure the required contact area is to be carried out.
- 2.7. Cast and Forged Steel Components such as LP casing, in case of cast design, inlet & extraction / exhaust connections, shaft seal covers and rings, governor shaft, bracket, threaded ring, angle ring, U-ring, servomotor parts such as body, piston, cover, yokes; turning gear casing and other items which are not specifically covered elsewhere

Results of tests conducted to determine mechanical properties, chemical analysis, metallurgical/ metallographic examination, and heat treatment procedures recommended and actually followed shall be recorded on certificates.

Each pressure containing enclosure shall be subjected to a hydraulic pressure test at 1.5 times the design pressure.

Each casting/forging shall be subjected to suitable non-destructive examination by Radiographic or ultrasonic and magnetic particle or dye penetrant examination methods to ensure freedom from harmful defects.

- b) ~~Surface defect test shall be carried out on all the springs after coiling and heat treatment.~~
- c) ~~Surface cleaning shall be checked prior to painting and check for thickness of painting shall be carried out.~~

5.0. Condenser air evacuation system for main turbine condenser and drive turbine condenser (if offered)

5.1. Pumps

- a) Vacuum pump shafts shall be subjected to ultrasonic test. After finish machining, shaft shall be subjected to magnetic particle examination/dye penetration test.
- b) Pump casings and impellers shall be subjected to magnetic particle/dye penetration test. Finished pump rotor shall be subjected to dynamic balancing.
- c) Pump casings shall be subjected to hydraulic test at 1.5 times the shut off pressure or twice the maximum operating pressure, whichever is higher.
- d) Each pump shall be tested at supplier's works at full speed and load conditions to demonstrate successful operation and performance in accordance with the design requirements.
- e) Supplier shall demonstrate by carrying out visual cavitation test that pump will be operating under all operating condition including blank off condition without cavitation.
- f) Refer relevant clauses of the specification for other items such as heat exchangers, filters, piping, valves, etc. in this system.

5.2. The complete package shall be subjected to hydraulic pressure and leakage test and shop tested to check interlocks and functional requirements. The one complete unit shall also be subjected to demonstrate successful operation and performance testing, with saturated air conditions at condenser design vacuum point as well as vacuum pump design point with total minimum three points. The test should be conducted with the respective motors to be supplied. The test shall include check for vibration and noise level.

6.0. FEED WATER HEATER, DRAIN COOLERS, GLAND STEAM CONDENSER, HEAT EXCHANGERS & PRESSURE VESSELS / STORAGE TANKS

- 6.1. All raw materials used shall have co-related mill test certificate meeting mandatory and supplementary checks of material specification.
- 6.2. Material for Tube plates shall be ultrasonically tested. Finished plates shall be subjected to suitable NDT. For clad plates, bonding shall be checked by UT. Vendor shall furnish their practice regarding manufacturing & NDT for supply of clad plates for Employer's review. Drilled Tube plates shall be checked for ovality of holes, ligaments, surface finish etc.
- 6.3. Dished ends shall be subjected to 100% MPI and RT/UT on welded joints. Knuckle portion shall be checked by MPI for surface defects and thinning shall be checked by UT.
- 6.4. Butt Welded / Full penetration joints shall be checked by suitable RT / UT. Fillet welds shall be checked by MPI / DPT.
- 6.5. Tubes shall be tested as per the relevant codes / specification / standards.
- 6.6. Before tubes expansion in the tube sheets, the mockup test for expansions shall be carried out, in case not done earlier. Torque setting of expander shall be based on mock up tests. Joints shall be checked for tube thinning.

- 6.7. Completed assemblies shall be pressure tested with working-fluid/ hydraulically/ pneumatically. The heat exchangers shall be tested on both tube side and shell side. After hydrotest, the heat exchangers shall be suitably dried and nitrogen capped. Atmospheric tanks shall be tested for leakage by water fill test for atleast 12 hrs.

7.0. PIPING, BELLOWS AND THERMAL INSULATION FOR TURBINE & AUX SYSTEMS

7.1. Piping and Fittings

- a) All raw materials used shall have co-related mill test certificate meeting mandatory and supplementary checks of material specification.
- b) All pipe lengths shall be subjected to 100% ultrasonic examination or hydraulic tests and UT/RT on longitudinal welds at the tube mill.
- c) All mother pipes used for fittings shall be subjected to a hydraulic test or an ultrasonic test at the tube mill. Raw material of all forged fittings shall be ultrasonically tested. Forged fittings shall be ultrasonically tested.
- d) Welded and cast fittings, if any, shall be subjected to suitable NDT as per applicable standards. However, as a minimum 100% RT shall be carried out on all alloy steel fittings and on carbon steel fittings for use above 71 bar design conditions.
- e) The edge preparation for shop and site welds shall be checked by MPI/LPI however edge preparation in stainless steel alloy/ steel shall be subjected to a Dye penetrant check.
- f) Thickness of pipe bends shall be checked by ultrasonic or other acceptable methods on sample basis for high pressure applications. Outer surface of bends shall be subjected to magnetic particle examination / LPI.
- g) Non-destructive examination of welds shall be carried out after post weld heat treatment, if any.
- h) Non-Destructive Examination of welds shall be carried out in accordance with the relevant design/manufacturing codes. However, as a minimum, the following requirements shall be met (except for oil piping). Further statutory requirement, wherever applicable shall also be complied with
 - 1) Temperature > 400°C and / or pressure exceeding 71 bar.
 - i. 100% RT/UT on butt welds and full penetration branch welds.
 - ii. 100% MPE.
 - 2) Temperature > 1750C up to 4000C and / or pressure exceeding 17 bar and up to 71 bar.
 - i. 100% RT / UT on butt welds and full penetration branch welds for pipe dia more than 100 NB.
 - ii. 10% RT / UT on butt welds and full penetration branch welds for pipe dia up to 100 NB.
 - iii. 100% MPE.
 - 3) Wherever SR/PWHT is envisaged, above NDTs shall be after SR/PWHT.
 - 4) For all other pipes not covered above (except oil piping), shall be subjected 100% MPE / DPT in case of underground pipes and 10% MPE/DPT in case of piping above the ground. Further, 10% of butt welds of underground piping shall be subjected to RT.

- 5) Hardness survey of welds shall be carried out on alloy steel/stainless steel piping. (100% Hardness survey of welds on P91, X20 & X22 material grade pipings).
- 6) For welds in P91, X20 & X22 materials, only induction type of heating shall be deployed for heat treatment.
- i) Oil piping shall be subjected to following NDT.
 - 1) Butt welds of Oil piping shall be subjected to 10% RT and 10% DP Test. For Jacking oil lines 100% RT & 100% DPT shall be carried out on butt welds.
 - 2) Fillet welds with load transfer shall be subjected to 100% MPE/DPT and fillet welds without load transfer shall be subjected to 10% MPE/DPT.
- j) Rubber lined pipes shall be hydraulically tested before rubber lining. All rubber lining is to be subjected to following tests as per IS-4682 part-I or acceptable equivalent:
 - 1) Adhesion test
 - 2) Check for resistance to bleeding
 - 3) Measurement of thickness
 - 4) Shore hardness test
 - 5) Visual examination and spark test at 5 kv/mm of thickness.

7.2. Metallic Expansion Bellows

- a) Hydraulic pressure test shall be carried out on each pipe and expansion bellow.
- b) Longitudinal butt weld on bellow shall be subjected to suitable NDT examination before forming, and after forming MPE / DP test shall be carried out.
- c) All welds shall be subjected to 100% magnetic particle/dye pentrant check and butt welds shall be subjected to 100% radiographic testing.
- d) All the bellows subjected to vacuum service shall be subjected to vacuum test.
- e) The bellows shall be subjected to movement test to establish suitability to perform satisfactorily in site conditions. During this test spring rate shall also be measured.
- f) Life cycle test, meridional yield rupture test and squirm test to be carried out on a prototype / expansion bellow as per Sec.D clause 3.2 of standards of Expansion joint Manufacturer Association (EJMA). In case these tests have already been accepted by employer on a prototype expansion bellow, as defined in Sec.D Clause 3.2 of Expansion Joints Manufacturers Association (EJMA) test reports may be furnished by manufacturer for consideration and approval of Employer.

7.3. Rubber Expansion Joint

- a) Rubber compound test slab after vulcanising shall be tested for tensile strength, elongation and shore hardness. Tests on rubber compound shall also include hydrostability test as per ASTM D-3137 and ozone resistance test as per ASTM D- 380.

- b) Fabric strength of synthetic fibre for reinforcement shall be checked, and test for rubber to fabric adhesion as per IS:3400/ASTM D- 413, rubber to metal adhesion as per IS 3100/ASTM D-429 shall be carried out.
- c) All expansion joints in assembled condition shall be subjected to vacuum test at 730 mm Hg under conditions to ensure its suitability to withstand deflection in each axial transverse and longitudinal direction. Duration of test shall be of minimum 10 minutes.
- d) All bare bellows shall be subjected to hydraulic pressure test in normal condition at twice the design pressure for a duration of 30 minutes.
- e) Additionally, all bare bellows shall be subjected to deflection tests under pressure, pressure being raised from zero to the design value in regular steps and deflection measured at each step.
- f) All expansion joints in assembled condition alongwith control rod assembly shall be subjected to deflection test under design pressure. The details of test procedure shall be subjected to approval by employer.
- g) Either during the hydraulic test or during the vacuum test, change in circumference at the top position of the arch shall not exceed 1.5% of measured circumference at normal position.
- h) Twenty Four (24) hours after the above tests, the permanent set (variation in dimensions with respect to its original dimension) shall be measured and recorded. The permanent set shall not be more than 0.5%.
- i) Life cycle test and burst test shall be carried out on bellows of each type, design and size. In case these test have already been accepted by employer in earlier projects for the same type / size /design, test certificate for the same may be furnished for approval of Employer.

7.4. THERMAL INSULATION

- a) For mineral wool insulation, testing shall be carried out as per IS:3144.
- b) For sprayed mineral wool, testing shall be carried out as per IS:9724.
- c) Thermal conductivity (k value) shall generally be measured in line with IS:3346.

7.5. Hangers and Supports

- a) Forged components such as clevis, turnbuckle, eye-bolts, coupling etc. will be subjected to material testing, hardness, MPE, proof load test etc.
- b) Dampers with viscous fluids will be checked for viscosity of liquid used, damping resistance of the damper, stiffness of the damper etc.
- c) Springs used for variable constant load and spring hangers shall be checked for chemical, mechanical and spring rate tests.
- d) Complete variable and constant load spring cage will be subjected to performance test and load/deflection test.
- e) Complete hanger will be subjected to performance test and load test.

8.0. VALVES

- 8.1. Inspection and testing requirements for valves other than extraction line valves and butterfly valves shall be as follows:-

- a) Pressure retaining parts of valves shall be subjected to NDT as per Table 1.
- b) Bar stock/forging above 40mm diameter for valve trim shall be subjected to UT
- c) Hardened / stellitted valve disc and seat are to be subjected to LPI and hardness check.
- d) Colour matching of valve disc/plug and seat shall be carried out to ensure contact.
- e) Hydraulic pressure test and seat leak test shall be carried out as per ANSI 16.34.
- f) Air seat leak test shall be carried out as per applicable Standards/Codes.
- g) Functional testing shall be carried out on each valve to check the following as per the approved valve data sheet:
 - 1) Smooth operation
 - 2) Valve travel, closing and opening time.
 - 3) Current drawn by actuators..
- h) Springs for safety valves shall be tested with suitable NDT and for spring rate.
- i) Safety and safety relief valves shall be tested for performance.

TABLE-1**NDT REQUIREMENTS FOR PRESSURE RETAINING COMPONENTS OF VALVES**

Valve size NB in mm	ANSI Class upto 300	ANSI Class above 300 below 600	ANSI Class above 600 below 900	ANSI Class 900 & above & below 4500
Less than 50	Visual	Visual	Visual	MPI
50 & above but below 100	Visual	Visual	MPI	MPI & RT (on 10% of valves on 100% area)
100 & above but less than 300	Visual	MPI	MPI & RT (on 10% of valves on change of section & weld ends)	MPI & RT on 100% area)
300 and above	MPI	MPI	MPI & RT (on change of sections & weld ends)	MPI, RT (on 100% area)

Note:

- i. For body and bonnet forgings UT with MPI may be adopted in place of RT. For austenitic steel MPI may be replaced by LPI.
- ii. Weld Edge Preparation shall be subjected to MPI/LPI

8.2. Extraction Line Valves

- a) Surface crack examination and hardness check shall be carried out on all hard faced/stellitted surfaces, if any.

- b) ~~As a minimum requirement of castings for all valves on cold reheat and extraction lines shall be subjected to 100% MPI on all areas and RT on Butt Weld ends and change of Section. For forgings minimum requirement shall be 100% UT and 100% MPI.~~
- c) ~~Bar stock for valves stems shall be subjected to U.T. Finish machined valve stems shall be subjected to magnetic particle examination/dye penetration test.~~
- d) ~~Wall thickness measurement by ultrasonic for critical and highly stressed zones of the casting/forging shall be carried out.~~
- e) ~~Colour matching of the valve disc and seat to ensure required contact area shall be carried out.~~
- f) ~~Hydraulic pressure tests shall be carried out on each valve to check body and bonnet strength. Seat leakage and back seat leakage test (wherever applicable) shall be carried out. Air seat leakage test shall also be carried out. Minimum test requirements of pressure shall be as per ANSI B 16.34.~~
- g) ~~Functional testing shall be carried out on each valve to check for freedom of movement, adherence to clearance, opening/ closing etc. Type tests for discharge co-efficient and pressure drop co-efficient, shall be carried out. In case the type tests have been carried out in the past and documents generated, the same shall be furnished to the Employer for approval.~~

8.3. Butterfly valves

- a) Valve discs shall be checked for surface and sub-surface defects by magnetic particle examination.
- b) Stubs and driving shafts shall be tested for internal defects by ultrasonic method.
- c) Dye penetration test shall be carried out on shafts, seat rings etc.
- d) Test samples for rubber seal shall be subjected to tensile and hardness test for vulcanising and after ageing. Hydraulic stability test and ozone crack resistance tests also be carried out.
- e) Valve shall be subjected to hydraulic pressure test for body and air seat leakage tests as per AWWA-C504
- f) Proof of design tests for valves and actuator shall be carried out as per AWWA-C504. In case the test has already been carried out on previous supplies, the contractor may submit the test certification of same for approval of employer.
- g) After complete assembly each valve with actuator will be subjected to performance test by opening and closing the valve from fully closed to fully open position and the reverse, under no flow for at least 25 cycles to check.
 - 1) Smooth uninterrupted movement of valve.
 - 2) Closing and opening time.
 - 3) Current drawn by actuator.
 - 4) Operation of tripping switch and position indicator.
- h) After assembly, one valve of each size with respective actuator shall be shop operated over the full range of movement in both the directions, with the body subjected to the full hydrostatic pressure conditions, to demonstrate that the unit is in working order without any leakage through the joints and torque switches/clutches, limit switches are operating satisfactorily. During the test, hand wheel operation, opening/closing time and current drawn shall also be

checked. The tests shall be conducted for three consecutive cycles with valveshaft both in vertical and horizontal planes.

9.0. MISC. ITEMS / EQUIPMENTS

9.1. FILTERS / STRAINERS

- a) Filters / strainers shall be tested as per the requirements of relevant codes / standards.
- b) Filters / strainers shall be performance tested for pressure drop, flow, particle size. If performance test is earlier established, then records shall be reviewed.

9.2. BLOWERS/ EXHAUSTERS

- a) Rotors shall be dynamically balanced. Leakage tests (if applicable) shall be carried out.
- b) Performance tests including noise and vibration tests shall be carried out as per relevant standards / codes.

9.3. LP CHEMICAL DOSING SYSTEM

- a) Pumps of chemical dosing system shall be performance tested as per relevant international codes.
- b) In case of diaphragm type of pumps, the life cycle test shall be done on pumps. If this test is already conducted for same model in earlier projects of TANGEDCO, then TCs for same shall be reviewed.
- c) Dosing skid shall be subjected to leakage test and functional test.

10.0. Electrical and Control & Instrumentation:

Refer Electrical and Control & Instrumentation Sections.

11.0. SITE TEST:

Quality requirements for site activities shall be as a minimum, those specified for corresponding shop activities.

11.1. Hydraulic Test of Pressure Parts :

On completion of erection of pressure parts of each steam turbine generator, the unit with its fittings and mountings in position shall be subjected to hydraulic test pressure in accordance with requirement of Indian Boiler Regulations. Water used for hydraulic test shall be made alkaline by addition of suitable chemical. After the test, all parts shall be drained and suitably preserved.

11.2. Condenser Assembly :

- a) If the condenser sections calls for site assembly, care shall be taken in assembly of sections and correctness of alignment and fit up shall be checked. Site welding shall be carried out as per the procedure approved by the employer.
- b) All weld seams shall be subjected to magnetic particle examination. At least 10% of butt welds shall be subjected to radiographic examination.
- c) All welds between condenser neck and LP turbine shall be subjected to 100% radiographic and magnetic particle examination.

- d) Condenser tubes shall be visually examined for defects, mechanical damages or any other defects prior to insertion. Both tube ends shall be thoroughly cleaned to a length of 100mm to remove oil, grease etc. and shall be checked for freedom from burrs prior to insertion.
- e) Tube expansion shall be carried out by electronic automatic torque control expanding unit, which shall be calibrated before use. Tube wall thinning and length of expansion shall be controlled and recorded.
- f) Hydrostatic testing of condenser steam space shall be carried out after connecting all the pipes with the condenser along with condenser vacuum systems by filling the steam space with water upto the tip of the last stages of blades of LP cylinder.
- g) Condenser water boxes shall be tested hydraulically at a minimum test pressure of 1.5 times the design pressure.

11.3. TURBINE ASSEMBLY

Bidder shall clearly indicate the extent of assembly to be carried out at site. Accordingly, bidder shall submit elaborate erection and assembly inspection programme of turbine for Employer's approval.

12.0. CONDENSER ON LOAD TUBE CLEANING SYSTEM/DEBRIS FILTER FOR MAIN TURBINE CONDENSER AND DRIVE TURBINE CONDENSER (IF OFFERED)

General Requirements

12.1. Ball Recirculation Pump

- a) All rotating parts shall be dynamically balanced.
- b) Pump casing shall be subjected to hydraulic test at 1.5 times the shut off head or twice the maximum working pressure whichever is higher.
- c) Complete pump assembly shall be subjected to shop performance test at supplier's works.

12.2. Ball Sorter / Fabricated Body (housing)

- a) In the case of fabricated design, all butt welds shall be subjected to 10% radiographic/ultrasonic examination. All welds shall be examined by 10% magnetic particle testing method to ensure freedom from surface and subsurface defects.
- b) Body shall be subjected to hydraulic pressure test at 1.5 times the design pressure.
- c) Performance test shall be carried out on ball sorter assembly.

12.3. Strainer

- a) Strainer mesh shall be checked for chemical composition and mesh size.
- b) Strainer body shall be subjected to hydraulic pressure test at 1.5 times the design pressure.
- c) Strainer assembly shall be checked for its function.

- 12.4. The complete system and the individual equipment shall be subjected to performance testing at Site to demonstrate successful operation and performance to meet the design conditions. The tests shall also include hydraulic test, function test, check for interlocks and sequential

operation. Site test shall also include test to establish pressure drop across the strainer section, proper functioning of DELTA-P system.

12.5. Piping and Fittings

Piping and fabricated fittings shall be subjected to following NDT.

- a) Butt welds of piping shall be subjected to 10% RT and 10% DP Test. Butt welds of Segmental flanges shall be checked by 100% RT and DPT.
- b) Fillet welds with load transfer shall be subjected to 100% MPE/DPT and fillet welds without load transfer shall be subjected to 10% MPE/DPT.

Wrought/ forged fittings shall be tested as per relevant code/ specification/ standard.

12.6. Coating / lining

12.7. Coating shall be checked for DFT and adhesion. Further, Contractor shall furnish his practice for testing of coating to ensure the uniformity and freedom from pinholes.

12.8. Rubber lined items shall be hydraulically tested before rubber lining. All rubber lining is to be subjected to following tests as per IS-4682 part-I or acceptable equivalent:

- a) Adhesion test
- b) Check for resistance to bleeding
- c) Measurement of thickness
- d) Shore hardness test
- e) Visual examination and spark test at 5 kv/mm of thickness.

12.9. VALVES

Conventional gate/ globe/ check/ ball valves shall be tested as per relevant standard.

13.0. CONDENSATE EXTRACTION PUMPS AND DRIP PUMPS (IF OFFERED)

CONDENSATE EXTRACTION PUMP

INPROCESS TEST												FINAL TESTS					
TEST	Chemical Analysis	Mechanical Prop.	Heat Treatment	Run out	U.T.	R.T	D.P.T.	M.P.I.	Balancing	Hyd. Test	Inclusion Rating	Pressure Drop Test	Performance test	NPSH Test	Vibration	Noise	Strip Down Test
ITEM DESCRIPTION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Pump Casing	Y	Y ^①	-	-	-	-	Y	-	-	Y	-						
Suction Bell	Y	Y ^①	-	-	-	-	Y	-	-		-						
Shaft	Y	Y ^①	Y	Y	Y	-	Y	Y	-		Y						
Impeller	Y	Y ^①	Y	-	-	-	Y	-	Y		-						
Rotor	-	-	-	Y	-	-	-	-	Y		-						

16.0. LOW PRESSURE PIPING

Sl.No.	Tests/Check Items / Components	Material Test	DPT/MPi	Ultrasonic Test	WPS/ WQS/PQR	Balancing	Hydraulic / Water Fill Test	Pneumatic Test	Assembly Fit up	Dimensions	Functional/operati on al Test	Performance Test	Other tests	All Tests as per Relevant Std	Adhesion / Spark	Remarks
1)	Pipes & Fittings and Metered Bends	Y ^a	Y ^b		Y		Y									
2)	Diaphragm Valves	Y ^a					Y ⁵			Y				Y ⁸		
3)	Butterfly Valves (Low Pressure)															
a)	Casted Butterfly Valves															
(i)	Body (Cast)	Y ^a	Y ^b				Y		Y	Y	Y		Y ⁷			
(ii)	Disc (Cast)	Y ^a	Y ^b													
(iii)	Shaft	Y ^a	Y	Y ^c												
b)	Fabricated Butterfly Valves															Ref. Note14
4)	Gate / Globe / Swing Check Valves	Y ^a	Y ^b	Y ^c			Y ⁵	Y	Y				Y ⁸			
5)	Dual Plate Check Valves	Y ^a	Y ^b	Y ^c			Y	Y	Y				Y ⁴			
6)	Rolled & Welded Pipes	Y ^a	Y ³		Y		Y ¹			Y						
7)	Coating & Wrapping of Pipes	Y ²											Y ²			
8)	Tanks & Vessels	Y ^a	Y ^b		Y		Y									
9)	Strainers	Y ^a	Y ^b				Y						Y ¹¹			

Sl.No.	Tests/Check	Material Test	DPT/MPi	Ultrasonic Test	WPS/ WQS/PQR	Balancing	Hydraulic / Water Fill Test	Pneumatic Test	Assembly Fit	Dimensions	Functional/operational Test	Performance Test	Other tests	All Tests as per Relevant Std	Adhesion / Spark	Remarks
10)	Rubber Expansion Joints	Y ^a					Y ¹²		Y				Y ¹³			
11)	Rubber Lining of Pipes	Y ^a	Y ^b		Y		Y			Y				Y ⁹	Y	
12)	Hangers & Supports	Y ^a						Y								
13)	Fasteners	Y ^a		Y ^b				Y								
14)	Site Welding		Y ¹		Y		Y									

Notes:

1. Weld Joints not subjected to hydraulic test shall be subjected to 100% RT.
2. Spark Test, Adhesion Test and Material Test for primer and enameled & Coal Tar Tapes as per AWWA-C-203-91
3. DPT on route run and after back gouging and on finish welds.
4. Dry Cycle Test (Spring Cycle Test) for one lakh Cycles shall be carried out as a type test..
5. Seat Leakage Test for Actuator Operated Valves, shall be done with by closing the valves with actuator.
6. Tests on rubber parts per batch of rubber mix such as hardness, adhesion, spark test, bleed test and flex test on diaphragm, type test for diaphragm for 50,000 cycles.
7. Hydraulic Test of Body, Seat and disc-strength shall be carried out in accordance with latest edition of AWWA-C-504 in presence of Employer's representatives. Actuator operated valves shall be checked for Seat Leakage by closing the valves with actuator. Seat Leakage Test shall be carried out in both directions.

8. Blue matching, wear travel for gates, valves, pneumatic seat leakage, reduced pressure test for check valves shall be done as per relevant standard. Maximum allowable vacuum loss is 0.5 mm of Hg abs. for valves to be tested for vacuum operation for internal pressure 25 mm of Hg abs. for a period of 15 minutes 9.
9. Hardness, Bleeding Test and Ozone resistance test shall be done on rubber material
10. 2% of welds shall be subjected to DPT.
11. Pressure drop across the strainer for each type and size as a special test shall be carried out
12. During hydraulic and vacuum tests at 25mm Hg abs in 3 positions, the change in the circumference of arch should not be more than 1.5%. 24 hrs after the test permanent set in dimension should not exceed 0.5%.
13. Tests on rubber for tensile, elongation, hardness, hydraulic stability check as per ASTM D 471, ozone resistance test as per ASTM D 1149 aging test and adhesion strength of rubber to fabric, rubber to metal adhesion shall be carried out.
14. For fabricated butterfly valves: UT as per ASTM A-435 on plates material for body and disc. 100% RT as per ASTM, Section-VIII, Division-I, on butt joins of body and disc and post weld heat treatment as per ASME, Section-VIII, Division- I on butt joints of body and disc of thickness above 30mm shall be carried out in addition to other tests indicated for cast butter fly valves.
 - a) One per heat/heat treatment batch/lot.
 - b) On machined surfaces only for castings and on finished butt welds.

For shaft/spindles > or = 50 m

MANUFACTURER'S NAME & ADDRESS :		MANUFACTURING QUALITY PLAN		PROJECT :	
		ITEM : Chain Pulley Block		PACKAGE : CHAIN PULLEY BLOCKS	
		QP No.: PE-TS-XXX-XXX-A001		VOL IIB, SEC C	
		REV.:0, Date:., PAGE: 1 OF 4			

Sr. No.	COMPONENT / OPERATION	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 N 10.	11.

1	RAW MATERIAL & B/OUT ITEMS:									
1.1	HOOKS	DIMENSIONS,	MA		One sample	IS: 15560	IS: 15560	MTC	✓	UT FOR SHANK DIA 50MM AND ABOVE
		CHEMICAL COMPOSITION, MECHANICAL, PHYSICAL PROPERTIES	MA	LAB ANALYSIS	PER LOT	Material specification as per approved drawings		T.C.	✓	
		IDENTIFICATION & COMPLIANCE WITH TC.	MA	VISUAL	100%	HOOK TC FROM COMPETENT AUTHORITY		IR	✓	
		INTERNAL DEFECTS	MA	UT	100%	ASTM A-388 (REFER NOTE 1)		TC	✓	
		PROOF LOAD TEST	MA	REVIEW	100%	IS 15560		TC	✓	
		NDT AFTER PROOF LOAD	MA	DPT	100%	ASTM E-165	NO RELEVANT IDENTIFICATION	TC	✓	
1.2	LOAD CHAIN	- DIMENSIONS - BREAKING STRENGTH - PROOF LOAD - HEAT TREATMENT - GRADE	MA MA MA MA MA	MEASUREMENT -TENSILE TEST -TENSILE TEST REVIEW REVIEW	100 % 1/LOT 100% 100% 1/BATCH	IS: 6216 & APPD. DRGS.	IS: 6216 & APPD. DRGS.	IR MTC MTC HT CHA RT MTC	✓ ✓ ✓ ✓ ✓ ✓ ✓	
1.3	RAW MATL. FOR GEAR/ RATCHET PAWL / RATCHET WHEEL	CHEMICAL COMPOSITION, MECHANICAL PROPERTIES	MA	LAB ANALYSIS	ONE SAMPLE PER LOT	MATERIAL SPECIFICATION AS PER	MATERIAL SPECIFICATION AS PER	MTC	✓	TC or inspection report for components

		LEGEND: ** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR				
SUB-CONTRACTOR SIGNATURE			REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

MANUFACTURER'S NAME & ADDRESS :		MANUFACTURING QUALITY PLAN		PROJECT :	
		ITEM : Chain Pulley Block		PACKAGE : CHAIN PULLEY BLOCKS	
		QP No.: PE-TS-XXX-XXX-A001		VOL IIB, SEC C	
		REV.:0, Date:., PAGE: 2 OF 4			

Sr. No.	COMPONENT / OPERATION	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 N 10.	11.

						APPROVED DRAWING	APPROVED DRAWING			shall be given.
		INTERNAL DEFECTS	MA	UT	10%	ASTM A-388 (REFER NOTE 1)		✓	P V V	
1.4.	LOAD CHAIN WHEELS	- CHEMICAL COMPOSITION MECHANICAL PROPERTIES	MA MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	APPD. DRG.	APPD. DRG.	✓	P V V	
1.5	BEARINGS	MAKE, TYPE, CATALOGUE NO.	MA	VISUAL	RANDOM	APP DRG / MFR'S CATALOGUE	APP DRG / MFR'S CATALOGUE	✓	P V V	
1.6	HAND CHAIN WHEEL	CHEMICAL MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	AS PER DRAWING	AS PER DRAWING	✓	P V V	
1.7	HAND CHAIN	GRADE/ DIMENSION	MA	GRADE DIMENSION	100 %	AS PER DRAWING	AS PER DRAWING	✓	P V V	
1.8	TROLLEY GEARS, PINION, WHEELS, AXLE	CHEMICAL & MECHANICAL	MA	LAB ANALYSIS,	100%	APPVD DRGS	APPVD DRGS	✓	P V V	
2	IN PROCESS									
2.1	RATCHET PAWL / RATCHET WHEEL	-HARDNESS	MA	HARDNESS	100%	IS:3832 / APPD DRG.	IS:3832/ APPD. DRG.	✓	P V V	

		LEGEND: ** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR				
SUB-CONTRACTOR SIGNATURE			REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

MANUFACTURER'S NAME & ADDRESS :		MANUFACTURING QUALITY PLAN		PROJECT :	
		ITEM : Chain Pulley Block		PACKAGE : CHAIN PULLEY BLOCKS	
		QP No.: PE-TS-XXX-XXX-A001		VOL IIB, SEC C	
		REV.:0, Date:., PAGE: 3 OF 4			

Sr. No.	COMPONENT / OPERATION	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 N	11.
									10.		

		-SURFACE CRACK	MA	DPT	100 %	ASTM E165	NO DEFECT	IR	✓	P	V	V
2.2	GEARS AND PINIONS AFTER MACHINING	SURFACE HARDNESS HEAT TREATMENT, SURFACE CRACK, CASE DEPTH	MA	HARDNESS HT CHART, DPT FOR SURFACE CRACK	RANDOM ASTM E 165 FOR DPT	MFG STANDARD NO DEFECT	MFG STANDARD	IR	✓	P	V	V
3.0	FINAL INSPECTION								✓	P	V	V
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION	MA	MEASUREMENT	100 %	IS:3832 /APPD DRG	IS:3832 /APPD DRG	IR	✓	P	W	V
		PROOF LOAD TEST	CR	LOAD TEST	100%	-DO-	No cracks, flaws & other defects	IR	✓	P	W	V
		LIGHT LOAD TEST	MA	LOAD TEST	100%	IS 3832	IS 3832	IR	✓	P	W	V
		HEIGHT OF LIFT	MA	MEASUREME NT	100%	-DO-	-DO -	IR	✓	P	W	V
		SWIVELING OF HOOK	MA	VISUAL	100 %	-DO-	-DO-	IR	✓	P	W	V
		EFFORT	MA	PULL ON CHAIN	100%	-DO-	-DO-	IR	✓	P	W	V
3.2	PAINTING	-CLEANING	MA	VISUAL	AT RANDOM	APPROVED	APPROVED	IR		P	--	--
		- SHADE & DFT OF PAINT (Blue / Black)	MI	VISUAL	AT RANDOM	DRAWING/ SPECIFICATION	DRAWING/ SPECIFICATION	IR		P	W	-

		LEGEND: ** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	FOR CUSTOMER USE	
MANUFACTURER /	CONTRACTOR			
SUB-CONTRACTOR	SIGNATURE			
			REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

** M : MANUFACTURER / SUB-CONTRACTOR
 C : BHEL / NOMINATED INSPECTION AGENCY.
 N : CUSTOMER
 INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION

MANUFACTURER'S NAME & ADDRESS :		MANUFACTURING QUALITY PLAN		PROJECT :	
		ITEM : Chain Pulley Block		PACKAGE : CHAIN PULLEY BLOCKS	
		QP No.: PE-TS-XXX-XXX-A001		VOL IIB, SEC C	
		REV.:0, Date:., PAGE: 4 OF 4			

Sr. No.	COMPONENT / OPERATION	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 N 10.	11.

3.3	NAME PLATE	VERIFICATION	MA	VISUAL	100%			IR	P V --	
3.4	PACKING	-VERIFICATION	MI	VISUAL	100%	SPECS.	SPECS.	IR	P -- -	
3.5	REVIEW OF QA DOCUMENTATION	VERIFICATION	MA	VISUAL	100%	APPD. QP	APPD. QP	✓	V V V	

CR – CRITICAL, MA – MAJOR , MI – MINOR

NOTE 1: BACK WALL ECHO SHALL BE ADJUSTED TO 100% OF FULL SCREEN HEIGHT IN SOUND (DEFECT FREE) AREA. DEFECT ECHO HEIGHT MORE THAN 20% OF SCREEN HEIGHT SHALL BE TREATED AS UNACCEPTABLE. BACK WALL ECHO SHALL NOT BE LESS THAN 80% OF SCREEN HEIGHT IN ANY CASE.

NOTE 2: RECORDS IDENTIFIED WITH TICK SHALL BE ESSENTIALLY INCLUDED IN QA DOCUMENTATION.

LEGEND:		FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR	** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER		
SUB-CONTRACTOR SIGNATURE	INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		REVIEWED BY
			NAME & SIGN OF APPROVING AUTHORITY & SEAL

गोपाल गोपाल		MANUFACTURERS NAME & ADDRESS				MANUFACTURING QUALITY PLAN				PROJECT		STANDARD TECHNICAL SPECIFICATION				
		AS PER APPROVED VENDOR LIST				ITEM:				PE-TS-STD-563-A002		PACKAGE		ELECTRIC WIRE ROPE HOIST		
S.No		CHARACTERISTICS		CATEGORY	TYPE OF CHECK		EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		REMARKS			
											D*	M	C	N		
1	2	3	4	5	6	7	8	9	10	11						
1.0	RAW-MATERIALS															
1.1	a) STRUCTURAL MATERIAL b) RAW MATERIAL FOR HOIST AND GEAR BOX HOUSING, TROLLEY PLATE, ROPE DRUM IF FABRICATED	CHEM & MECH PROPS	MA	Lab analysis	1 SAMPLE PER LOT%	IS 2062 /APPD. DRG./ DATA SHEET		MTC/IR	✓	P/V	V	V		Test shall be carried out in absence of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection.		
		NDT	MA	UT	100%	ASTM A388-2004	NOTE 1	IR	✓	P	V	V		For plate thickness above 40mm		
1.1 A	SEAMLESS PIPE FOR ROPE DRUM	CHEMICAL , MECHANICAL	MA	Lab analysis	1 SAMPLE /pipe	Approved drg/ASTM A 106 Grade A or B		MTC/IR	✓	P/V	V	V		Test shall be carried out in absence of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection		
		Flattening & Acid Etching test	MA	PHYSICAL & METALLOGRAPH Y	1 SAMPLE /pipe	No cracks, pitting, rusting , damage etc		IR	✓	P	V	V				
		SURFACE DEFECTS	MA	Visual	100%											
1.2	FORGINGS FOR GEARS,PINIONS, SHAFT/AXLES, WHEELS	MECH , CHEM. PROPS	MA	Lab analysis	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET / IS:3938	LAB. REPORT	✓	P	V	V				
		NDT	CR	UT	100%	ASTM A 388	NOTE 1	MANUFACTURER'S TEST CERTIFICATE	✓	P	V	V		IF DIA or THK > 50mm		
		Hardness , surface defects after machining/grinding	MA	DPT/MPI	100%	ASTM E-165 /E-709, No linear indication		MTC	✓	P	V	V				
1.3	WIRE ROPE	Dimensional, type, construction ,	MI	measurement	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	MFRS' TEST CERT.	✓	P	V	V				
		EXAMINATION OF REPORT OF BREAKING LOAD CAPACITY	CR	Review of TC	100%	IS: 2266		MFRS' TEST CERT.	✓	P	V	V				
1.4	HOOKS	MECH. , CHEM. PROPS.	MA	Lab analysis	100%	APPROVED DRG/DATA SHEET IS:15560		MFRS' TEST CERT.	✓	P	V	V				
		U T IF SHANK DIA > 50mm	CR	NDT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	✓	P	V/W	V		SHANK PORTION ONLY		
		Dimension & PROOF LOAD TESTING	CR	Measurement , PROOF LOAD TEST	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560		QCR	✓	P	V/W	V		IF REQUIRED BY END CUSTOMER.		
		DP AFTER PROOF LOAD	CR	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	✓	P	V/W	V				
1.5	SHEAVES	MECH	MA	Tensile & hardness	1/lot	Approved drgs		MTC/IR	✓	P	V	V				

Page 66 of 434

गोपाल प्रोपर्टी 		MANUFACTURERS NAME & ADDRESS			MANUFACTURING QUALITY PLAN		PROJECT		STANDARD TECHNICAL SPECIFICATION					
		AS PER APPROVED VENDOR LIST			ITEM:		ELECTRIC QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST			
							WIRE ROPE		CONTRACT No					
									CONTRACTOR		BHEL-PEM			
									1 of 4					
S.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	M	C	N	REMARKS	
1	2	3	4	5	6	7	8	9		**	10		11	
4.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, WELD QUALITY, OVERALL DIMENSIONS.	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	✓	P	W	W	CHP	
4.2	ASSEMBLED HOIST PERFORMANCE WITH ACTUAL CONTROL PANEL, AND PENDENT PUSH BUTTON	1. LOAD TEST	CR	LOAD TEST at SWL	100%	IS:6547 / IS:3938	IS:6547 / IS:3938	MNFRS' TEST CERT.	✓	P	W	W	CHP	
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION , CURRENT MEASUREMENT LIMIT SWITCH OPERATION	CR	MEAS & VISUAL	100%	IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	✓	P	W	W	CHP	
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	✓	P	W	W	CHP	
4.3	OVER LOAD TEST	OVER LOAD TEST INCLUDING HOLDING CAPACITY OF BRAKES, LIFTING LOAD FROM MID AIR, SOUNDNESS OF WELD AFTER OVERLOAD	CR	TEST AT 125 % OF-SWL	100%	IS:3938	IS:3938	INSPN. REPORT	✓	P	W	W	CHP	
5	PAINTING													
5.1	PRIMER & FINISHING AND SHADE	Examination - Shade , DOP by paper insertion method	MI	visual	100%	DRG. & DATA SHEET & RELV. IS SPEC.	DRG. & DATA SHEET & RELV. IS SPEC.	MNFRS' TEST CERT.		P	V			
		DFT	MA	measurement	Sample					P	V			
6	PACKING	STURDINESS, PROTECTION MARKING	MA	VISUAL	100%	MFG STD	MFG STD			P				
	NOTE:													
1	When back wall echo is set to 100% in sound area then a) defect echo shall not exceed 20% b) Back echo shall be minimum 80% in any area.													
2	Less than 30 KW. Acceptance of motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows : It is hereby confirmed that the above mentioned motor/motors was/were manufactured taking care of specific requirement regarding ambient temp, voltage & frequency variation, hot start, pull out torque, starting KVA/KW, temp rise, distance between center of stud and gland plate and tested in accordance with approved drawing/data sheet.													
	LEGENDS													
	* RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY MANUFACTURER IN QA DOCUMENTATION.													
	** M: MANUFACTURER/SUBCONTRACTOR													
	C: BHEL/BHEL NOMINATED THIRD PARTY INSPECTION AGENCY													
	N: CUSTOMER/CUSTOMER'S CONSULTANT/CUSTOMER'S APPOINTED THIRD PARTY													
	P'- PERFORM", W"- WITNESS AND "V"- VERIFICATION													
	* CHP" CUSTOMER HOLD POINT													

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT TITLE		2X 660 MW ENNORE SEZ STPP		SPECIFICATION : NUMBER :PE-TS-412-673-A001					
COMPONENT/OPERATION		CHARACTERISTICS CHECK		SYSTEM CAT.		TYPE/ METHOD OF CHECK		EXTENT OF CHECK		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01		SPECIFICATION TITLE			
										ITEM AC ELECT. MOTORS BELOW 55KW (LV)		SECTION VOLUME III			
SL. NO.										REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS	
													P	W	V
1	2	3	4	5	6	7	8	9	10	11					
1.0	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	MANUF'R'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	NOTE -1 & NOTE-3				
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3			
BHEL				PARTICULARS		BIDDER/VENDOR									
				NAME											
				SIGNATURE											
				DATE											
								BIDDER'S/VENDORS COMPANY SEAL							

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT TITLE		SPECIFICATION : NUMBER : PE-TS-412-673-A001		
		SHEET 1 OF 9		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		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	VOLUME III REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL									
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	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	-
		1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-
1.3	CASTING	2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFUR'S M DRG.	ANUFUR'S DRG.	LOG BOOK	3	-
		1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-
BHEL		PARTICULARS		BIDDER/VENDOR						
		NAME								
		SIGNATURE								
		DATE								
						BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN SHEET 2 OF 9		CUSTOMER :		PROJECT		SPECIFICATION :			
				M/s TANGEDCO		TITLE		NUMBER : PE-TS-412-673-A001			
				BIDDER/ 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 AGENCY	VOLUME III REMARKS	
1	2	3	4	5	6	7	8	9	10	11	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND. 2. CHEM. & PHYSICAL PROPERTIES 3. DIMENSIONS 4. INTERNAL FLAWS	MA MA MA CR	VISUAL CHEM. & PHYSICAL TESTS MEASUREMENT UT	100% 1/HEAT NO. OR HEAT TREATMENT BATCH NO 100% -DO-	- MFG. DRG. SPEC. -DO- ASTM-A388	FREE FROM VISUAL DEFECTS RELEVANT IS MANUF'R'S DRG. MANUF'R'S SPEC. BHEL SPEC.	-DO- SUPPLIER'S TC LOG BOOK -DO-	3 3 3 3 3	- 2 2 2 2 1 2	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING 2. PHYSICAL COND. 3. DIMENSIONS (WHEREVER APPLICABLE) 4. PERFORMANCE/ CALIBRATION	MA MA MA	-DO- MEASUREMENT TEST	-DO- SAMPLE 100%	- MANUF'R'S DRG. / SPEC. -DO-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY MANUF'R'S DRG. / SPEC. -DO-	-DO- -DO- INSP. REPORT	3 3 3	2 2 2	
BHEL											
PARTICULARS				BIDDER/VENDOR							
NAME											
SIGNATURE											
DATE											
BIDDER'S/VENDORS COMPANY SEAL											

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT TITLE		SPECIFICATION : NUMBER : PE-TS-412-673-A001					
		SHEET 3 OF 9		BIDDER/ VENDOR		QUALITY PLAN		SPECIFICATION :					
				SYSTEM		NUMBER PED-506-00-Q-007, REV-03		TITLE					
				CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	SECTION		VOLUME III REMARKS
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	4	5	6	7	8	9	P	W	V		
1	2	3										10	11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC. 2. OTHER CHARACTERISTICS	MA	VISUAL	100%	-		NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2.DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA	TEST VISUAL	SAMPLE 100%	MANUF'S SPEC.		MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH 2.ELECT. PROP. & MECH. PROP	MA	MEASUREMENT ELECT. & MECH TESTS VISUAL	-DO- 100%	MANUF'S DRG. . MANUF'S SPEC./ RELEVANT IS		MANUF'S DRG.	LOG BOOK	3	-	2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
			MA	VISUAL		-		FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	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.
			MA	ELECT. & MECH. TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS		RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE										
			BIDDER'S/VENDORS COMPANY SEAL										

		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :			
				M/s TANGEDCO		TITLE		NUMBER : PE-TS-412-673-A001			
				BIDDER/ VENDOR		QUALITY PLAN		SPECIFICATION :			
SHEET 4 OF 9		SYSTEM		NUMBER PED-506-00-Q-007, REV-03		TITLE		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION		
									AGENCY	REMARKS	
									P	W	
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	-DO-	-DO-	3	-	2
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	-DO-	3	-	2
		3.SURFACE FINISH	MA	VISUAL	100%	-	-DO-	-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	-DO-	-DO-	3	-	-
		3.TEMP. WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	-DO-	-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%	-	-DO-	-DO-	3	-	-
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	-DO-	-DO-	3	-	-
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE				BIDDER'S/VENDORS COMPANY SEAL					

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT TITLE 2X 660 MW ENNORE SEZ STPP		SPECIFICATION : NUMBER : PE-TS-412-673-A001															
				BIDDER/ VENDOR		QUALITY PLAN		SPECIFICATION :															
		SHEET 5 OF 9		SYSTEM		NUMBER PED-506-00-Q-007, REV-03		TITLE															
SL. NO.		COMPONENT/OPERATION		CHARACTERISTIC CHECK		CAT.		TYPE/ METHOD OF CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD		AGENCY		SECTION		VOLUME III REMARKS	
1		2		3		4		5		6		7		8		9		10		11			
2.0		IN PROCESS				MA		VISUAL		100%		-DO-		GOOD FINISH		LOG BOOK		3/2		2		-	
2.1		STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)		1.WORKMANSHIP & CLEANNESS		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./ SAME AS RELEVANT STAND		BHEL SPEC. SPEC. 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/SVENDORS COMPANY SEAL	

		CUSTOMER :		PROJECT		SPECIFICATION :						
		M/s TANGEDCO		TITLE		NUMBER : PE-TS-412-673-A001						
		BIDDER/		QUALITY PLAN		SPECIFICATION :						
		VENDOR		NUMBER PED-506-00-Q-007, REV-03		TITLE						
SHEET 6 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III		REMARKS		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	P	W	V
1	2	3	4	5	6	7	8	9	10	11		
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC. SPEC.	MANUFR'S SPEC. /BHEL SPEC. SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.6	IMPREGNATION	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	
		1.VISCOSITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUUM	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						

		CUSTOMER :		PROJECT		SPECIFICATION :						
		M/s TANGEDCO		TITLE		NUMBER : PE-TS-412-673-A001						
		BIDDER/ VENDOR		QUALITY PLAN		SPECIFICATION :						
		SYSTEM		ITEM: AC ELECT. 2X 660 MW ENNORE SEZ STPP		TITLE						
SHEET 7 OF 9		QUALITY PLAN		NUMBER PED-506-00-Q-007, REV-03		SECTION		VOLUME III		REMARKS		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	P	W	V
1	2	3	4	5	6	7	8	9	10	11		
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
		1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	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	VERIFICATION FOR MV MOTOR ONLY	
		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		CUSTOMER :		PROJECT		SPECIFICATION :											
				M/s TANGEDCO		TITLE		NUMBER : PE-TS-412-673-A001											
				BIDDER/ VENDOR :		QUALITY PLAN		SPECIFICATION :											
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		TITLE											
SHEET 8 OF 9		CHARACTERISTIC CHECK		CAT.		TYPE/ METHOD OF CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD		SECTION AGENCY		VOLUME III REMARKS	
SL. NO.	COMPONENT/OPERATION																		
1	2	3	4	5	6	7	8	9	10			11							
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC. 2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC. 3.VIBRATION & NOISE LEVEL 4.OVERALL DIMENSIONS AND ORIENTATION 5.DEGREE OF PROTECTION 6. MEASUREMENT OF RESISTANCE OF RTD & BTD 7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER 8. NAMEPLATE DETAILS 9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED) 10. PAINT SHADE, THICKNESS & FINISH	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							
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	\$ NOTE - 2							
			MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1 ^{\$}	1	\$ NOTE - 2							
			MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-								
			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							
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	\$ NOTE - 2							
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	\$ NOTE - 2							
			MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 ^{\$}	1	\$ NOTE - 2							
			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							
			MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1 ^{\$}	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2							
BHEL				PARTICULARS		BIDDER/VENDOR													
				NAME															
				SIGNATURE															
				DATE															
				BIDDER'S/VENDORS COMPANY SEAL															

		CUSTOMER : M/s TANGEDCO		PROJECT TITLE 2X 660 MW ENNORE SEZ STPP		SPECIFICATION : NUMBER : PE-TS-412-673-A001															
QUALITY PLAN		BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE															
SHEET 9 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION AGENCY															
COMPONENT/OPERATION		CAT.		TYPE/ METHOD OF CHECK		EXTENT OF CHECK		FORMAT OF RECORD		VOLUME III REMARKS											
CHARACTERISTIC CHECK								ACCEPTANCE NORM		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																					
NAME																					
SIGNATURE																					
DATE																					
BIDDER/SVENDORS COMPANY SEAL																					

CONTROL & INSTRUMENTATION QUALITY ASSURANCE PLAN/CHECK LIST

CHAPTER-14**QUALITY ASSURANCE AND TESTING AND GUARANTEES****14.01.00 GENERAL REQUIREMENT**

- 14.01.01** All equipment furnished under this specification shall be subject to test by authorized quality assurance personnel of the Bidder, representatives of the Owner during manufacture, erection and on completion. Bidder's quality assurance personnel for these shop and site tests shall be identified in advance and shall be acceptable to the Owner. The approval of the Owner or passing of such inspection of tests will not, however, prejudice the right of the owner to reject the equipment if it does not comply with the specifications when erected or fails to give complete satisfaction in service.
- 14.01.02** The Bidder shall furnish details of shop and site tests proposed to be conducted by him at various stages to meet the specification requirements for each type of instrument/system along with his proposal. Bidder shall also furnish details of his proposed shop and site quality assurance organization for this contract
- 14.01.03** Bidder shall prepare a detailed shop and site 'Quality Assurance Programme' to meet the requirements of these specifications for Owner's approval. This document shall also contain the formats for reports and maintenance of test records specification of test equipment to be used for site tests.
- 14.01.04** All equipment and systems furnished under this specification shall be subjected to shop & site tests in accordance with the Quality Assurance Program approved by the Owner and shall be adequate to ensure full compliance with these specification, all applicable codes & standards and detailed engineering drawings and documents approved by the Owner.
- 14.01.05** The Bidder shall provide all required test equipment and simulation devices for performing all shop and site tests. All tests equipment shall be of reputed make, required accuracy class and shall be recently calibrated. The record of calibration of test equipment shall be made available to the Owner on demand.
- 14.01.06** The cost of all tests as per the requirements of this specification and approved quality assurance programme shall be included in Bidder's lump sum price for this package and no extra price shall be payable by the Owner for conducting any test as per the intent and requirements of this specification.
- 14.01.07** All approval/Inspection are to be carried out by the Owner only.



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.)



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 - 441



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.
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.
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 specifics test indicated in the specification. A list of such test are given for various equipment in table titled, TYPE TEST REQUIREMENT FOR C&I SYSTEM and under the item special requirement for solid state requirements/systems. For the balance equipments/instruments. type test may be conducted as per manufacturer standards or if required by relevant standards.

A. Out of these test listed , the bidder /subvendor/manufacturer is required



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 - 444



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 amendemends 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.



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 - 445



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



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 - 446



DESEINVolume- V: Instrumentation & Control Works
Index

12	Local gauges	Degree of protection test	IS 13947	No	No
13	Process actuated switches	Degree of protection test	IS 13947	No	No
16	LIE/LIR	Degree of protection test	IS 13947	YES	YES
18	Flow Orifice plates	calibration	ASME PTC BS 1042	YES	YES

Note:

Type test are to be conducted only for the items, which are being supplied as part of this package.



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 - 447





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

CHECK LIST FOR ANALYTICAL INSTRUMENTS

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	
	VISUAL						
	MAKE, MODEL No.						
	POWER SUPPLY						
	TYPE						
2	DIMENSIONS CHECK			P	V	V	
3	FUNCTIONAL CHECK			P	V	V	
4	LEAKAGE TEST			P	V	V	
5	HV / IR TEST			P	V	V	
6	LINEARITY			P	V	V	
7	RESPONSE TIME			P	V	V	
8	ENCLOSURE CLASS			P	V	V	
9	ACCESSORIES, AS APPLICABLE			P	V	V	
10	ACCURACY / CALIBRATION			P	V	V	
11	ALARM CONTACT TEST			P	V	V	
12	ANALOG OUTPUT CHECK			P	V	V	
13	BURN-IN TEST OF ELECTRONIC PARTS	1/LOT		P	V	V	
14	IN-BUILT INDICATOR, ZERO, SPAN, RANGE SCALE SELECTION ETC	SEE NOTE-1 BELOW		P	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.
- 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 TRANSMITTER

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

Legend :

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

Note :

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

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

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MAKE						
	MODEL No.						
2	MATERIAL (BODY. PLUNGER/TRIM)			P	W	V	
3	PORT SIZE			P	W	V	
4	CABLE CONNECTION SIZE			P	W	V	
5	ENCLOSURE CLASS			P	W	V	TYPE TEST CERTIFICATE TO BE FURNISHED BY VENDOR
6	No. OF COILS & INSULATION CLASS			P	W	V	TEST CERTIFICATE TO BE FURNISHED FOR INSULATION CLASS BY VENDOR
7	POWER SUPPLY CHECK			P	W	V	
8	IR / HV TEST			P	W	V	
9	FUNCTIONAL TEST			P	W	V	

Legend :

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

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- 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 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.

CHECK LIST FOR SIGHT FLOW INDICATOR

[illegible]

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

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



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SUB-SECTION: I A

REV. NO. 00

DATE :

1. Quality requirements specified here if contradicting as specified elsewhere in this chapter, then stringent quality requirements shall be followed by the bidder for all items without any price and delivery implications to BHEL/customer.
2. The Quality requirements mentioned here in this annexure for different mechanical, electrical & C&I items are bare minimum, if any other quality requirements required for these items as per BHEL & customer during detail engineering the same shall be accepted and provided by bidder without any price and delivery implication to BHEL & customer.



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

ANNEXURE II

LIST OF MAKES OF SUB-VENDOR ITEMS

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	PRESSURE VESSELS	GLOBAL STRUCTURES & COMPOSITE LTD	-	
		JASMINO POLYMERTECH	TALOJA	
		SYSCON ENGINEERS	AMBERNATH	
		S.V. FABRICATORS	NAVI MUMBAI	
		SPARK FABRICATORS / STEELCON	-	
		ANUP ENGINEERING	AHMEDABAD	
		MURTHAL TANKS & VESSELS	SONEPAT	
		TITAN ENGG.	DURGAPUR	
		RISHI INDUSTRIES	BAHALGARH	
		UNIVERSAL HEAT EXCHANGERS	-	
		ATS CHEM	SALEM/HOSUR	
		CHEM PROCESS SYSTEM	SANAND	
		PROGEN	CHENNAI	
		CRYSTAL ENGINEERING	HOSUR	
		ISHAN EQUIPMENTS	VADODARA	
2.	ATMOSPHERIC/ STORAGE TANKS	GLOBAL STRUCTURES & COMPOSITE LTD	-	
		JASMINO POLYMERTECH	TALOJA	
		SYSCON ENGINEERS	AMBERNATH	
		S.V. FABRICATORS	NAVI MUMBAI	
		SPARK FABRICATORS / STEELCON	-	
		ANUP ENGINEERING	AHMEDABAD	
		MURTHAL TANKS & VESSELS	SONEPAT	
		TITAN ENGG.	DURGAPUR	
		RISHI INDUSTRIES	BAHALGARH	
		UNIVERSAL HEAT EXCHANGERS	-	
		ATS CHEM	SALEM/HOSUR	
		CHEM PROCESS SYSTEM	SANAND	
		PROGEN	CHENNAI	
		CRYSTAL ENGINEERING	HOSUR	
		ISHAN EQUIPMENTS	VADODARA	
3.	RUBBER LINING (AT SHOP)	TEMSEC	KOLKATA	
		RISHI INDUSTRIES	SONEPAT	
		CORI ENGINEERS	CHENNAI	
		POLY RUBBER	MUMBAI	
		INDUSTRIAL LINING	VADODARA	
		ARUL RUBBERS	CHENNAI	



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		JASMINO POLYMERTECH	TALOJA	
		WESTERN RUBBER	NAVI MUMBAI	
		ELASTOMER LINNING	AMBERNATH	
		EMKAY RUBBER	MUMBAI	
4.	AIR BLOWERS (TWIN LOBE TYPE)	SWAN PNEUMATIC	NOIDA	
		EVEREST TRANSMISSION	NEW DELHI	
		KAY INTERNATIONAL	NEW DELHI / SONEPAT	
		EVEREST BLOWER	BAHADURGARH	
		KULKARNI POWER TOOLS	KOLHAPUR/ PUNE	
5.	METERING PUMPS	VK PUMPS	NASIK	
		MILTON ROY INDIA	CHENNAI	
		SWELLORE	AHMEDABAD	
		POSITIVE METERING PUMPS	NASIK	
		METACHEM	MUMBAI	
6.	AGITATOR	REMI PEOCESS PLANT & M/C	MUMBAI	
		FIBRE & FIBRE	MUMBAI / SILVASA	
		CEECONS	CHENNAI	
		STANDARD ENGINEERS	MUMBAI	
7.	HORIZONTAL CENTRIFUGAL PUMPS	BEST AND CROMPTON ENGG LTD.	CHENNAI	
		BHARAT PUMPS & COMPRESSORS LTD	ALLAHABAD	
		FLOWMORE LTD.	GURGAON	
		FLOWERVE INDIA CONTROLS PVT. LTD.	COIMBATORE	
		JYOTI LTD.	VADODARA	
		KIRLOSKAR BROTHERS LTD	PUNE	
		WILO MATHER & PLATT PUMPS PVT. LTD.	PUNE	
		V-FLO PUMPS & SYSTEMS CO. LTD.,	BEIJING-CHINA	
		WPIL LIMITED	KOLKATA	
8.	VERTICAL CENTRIFUGAL PUMPS	BHARAT PUMPS & COMPRESSORS LTD	ALLAHABAD	
		FLOWMORE LTD.	GURGAON	
		FLOWERVE INDIA CONTROLS PVT. LTD.	COIMBATORE	
		JYOTI LTD.	VADODARA	
		WILO MATHER & PLATT PUMPS PVT. LTD.	PUNE	
		SULZER PUMPS INDIA LTD.	THANE	
		WPIL LIMITED	KOLKATA	
9.	SCREW PUMP	UT PUMP		
		ROTO PUMPS		



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		TUSHACO		
10.	HORIZONTAL CENTRIFUGAL PUMPS (RUBBER LINED)	KISHORE PUMPS	PUNE	
		SU MOTORS	MUMBAI	
11.	NON METALLIC (PP/FRP) HORIZONTAL CENTRIFUGAL PUMPS	ENGINEERS COMBINE	THANE	
		ANTICORROSIVE	VALSAD	
		LEAK PROOF PUMPS PVT. LTD. (RAJEDIA)	-	
12.	MISC. PUMP VERTICAL TURBINE TYPE	KBL	PUNE	
		M&P	PUNE	
		WPIL	GHAZIABAD	
		KISHORE PUMPS	PUNE	
		FLOWMORE	SAHIBABAD	
13.	UNDER BED NOZZLE	JONSONS SCREEN	AUSTRALIA/ IRELAND	
14.	COATING & WRAPPING MATERIAL TAPE	IWL LTD.	CHENNAI	
		MP TAR PRODUCT	BHILAI	
		PORWAL INDUSTRIES	RAIPUR	
		RUSTECH	KOLKATA	
		STP	JAMSHEDPUR	
15.	CLARIFIER/ THICKENER MECHANISM	CLEAR WATER	DELHI	
		TRIVENI	NOIDA	
		PBJ ASSOCIATE	PUNE	
16.	CENTRIFUGE	HUMBOLT	-	
		HILLER	-	
17.	CAST IRON GATE/GLV/NRV/SRV	A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		G.M. DALUI AND SONS PVT.LTD.	HOWRAH	
		H.SARKER AND COMPANY	HOWRAH	
		LEADER VALVES LTD.	JALANDHAR	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
18.	BALL VALVE (MANUAL /PNEUMATIC/ ELECTRIC) CLASS 150	A.V. VALVES LTD	AGRA	
		AKAY INDUSTRIES PVT.LTD.	DHARWAD	
		BELGAUM AQUA VALVES PVT. LTD.	BELGAUN	
		ASIAN INDUSTRIAL VALVES & INSTRUMENTS.	CHENNAI	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		DEMBLA VALVES LTD.	THANE	
		M/S GM ENGINEERING	RAJKOT	
		HAWA VALVES (INDIA) PVT. LTD.	NAVI MUMBAI	



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		INTERVALVE (INDIA) LTD.	PUNE	
		LEADER VALVES LTD.	JALANDHAR	
		MICROFINISH VALVES PVT LTD.	HUBLI	
		NILON VALVES PRIVATE LIMITED	AHMEDABAD	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		UNIFLOW	CHENNAI	
		VALTECH INDUSTRIES	MUMBAI	
		VAAS AUTOMATION PVT. LTD.	NEW DELHI	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
19.	ELECTRIC MOTOR	CROMPTON GREAVES	AHMEDNAGAR	
		LAXMI HYDRAULICS PVT. LTD	MAHARASTRA	
		RAJINDRA ELECT INDUSTRIES	MUMBAI	
		GE-POWER	CHENNAI	
		BHARAT BIJLEE LTD.	NEW DELHI	
		SIEMENS	GURGAON	
		NGEF	NEW DELHI	
		KIRLOSKAR ELECTRIC CO LTD.	BANGALORE	
		ASEA BROWN BOVERI(ABB)	HARYANA	
		MARATHON	FARIDABAD	
20.	BUTTER-FLY VALVE	ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		INSTRUMENTATION LTD.	PALAKKAD	
		INTERVALVE (INDIA) LTD.	PUNE	
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	NAVI MUMBAI	
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	KOLKATA	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
21.	DIAPHRAGM VALVE (MANUAL / PNEUMATIC) CLASS 150	WEIR BDK	HUBLI	
		CRANE FLOW PROCESS	SATARA	
		PROCON	MUMBAI	
		MAJESTIC VALVES (LABLINE)	-	
		HAWA ENGINEERS	AHMEDABAD	



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
22.	DUAL PLATE CHECK VALVES	ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	1. DUAL PLATE CHECK VALVE CI - CLASS 150 & UP TO 600NB, 2. DUAL PLATE CHECK VALVE CCS - CLASS 150 & UP TO 500NB
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CI ,CCS & STAINLESS STEEL SPRING ASSISTED DUAL PLATE CHECK VALVES UPTO 700 NB AND 150 CLASS RATING.
23.	Y-TYPE STRAINER / STRAINER (WATER SERVICE)	OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		GRAND PRIX	NEW DELHI	
		JAYPEE	NEW DELHI	
		GREAVES COTTON	MUMBAI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI / NOIDA	
		FILTRATION ENGINEERS (I) PVT. LTD	MUMBAI	
		FLUIDNYE	-	
		SUNGOV ENGINEERING PVT. LTD.	DELHI	
		GRAND PRIX	FARIDABAD	
		JAYPEE INDUSTRIES PVT. LTD.	DELHI	
		BHATIA ENGINEERING CO.	DELHI	
24.	RUBBER FLAP TYPE CHECK VALVES	ASHVIK VALVES	-	
		FLOW WAY VALVES	-	
		BDK	-	
		MAJESTIC VALVES (LABLINE INST)	-	
		ADVANCE VALVES	-	
25.	SOLENOID VALVES	ROTEX	-	
		AVCON	-	
26.	CABLE GLAND	ALLIED TRADERS & EXPORTERS	NOIDA (U.P.)	
		ARUP ENGG & FOUNDARY WORKS	CALCUTTA	
		BALIGA LIGHTING EQPT.PVT.LTD	CHENNAI	
		COMMET BRASS PRODUCTS	MUMBAI	
		DOWELLS	MUMBAI	
		ELECTROMAC INDUSTRIES	MUMBAI	



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		INCAB	KOLKATA	
27.	CABLE LUGS	DOWELLS	MUMBAI	
		UNIVERSAL MACHINES LTD.	KOLKATA	
28.	MS PLATES	SAIL		
		ESSAR STEEL		
		TISCO		
		RINL		
		JINDAL		
		LLOYD		
		ISPAT		
		INDIAN IRON & STEEL CO. LTD		
29.	CS PIPE (ASTM A 106 GR. B)	INDIAN SEAMLESS METAL TUBES	AHMEDABAD	UPTO 150 NB
		MAHARASHTRA SEAMLESS	RAIGAD	UPTO 350 NB
30.	MS PIPES (IS: 1239 & 3589)	SAIL	ROURKELA	
		JINDAL	GHAZIBAD/HISSAR	
		SURYA ROSHNI	BAHADUR GARH	
		TATA TUBE	JAMSHEDPUR	
		PSL	CHENNAI/VIZAG/KUTCH/DAMAN	
		LALIT PROFILE	THANE	
		SAMSHI PIPES INDUSTRIES	VADODARA	
		MUKUT PIPES	RAJPURA	
		INDUS TUBES	G B NAGAR	
		MANN IND	INDORE	
		SURENDRA ENGG	RAJPURA	
		PRATIBHA PIPES & STRUCTURE PVT LTD	THANE	
		JCO GAS PIPE	CHINDWARA	
		NUKAT TANKS AND VESSELS	TARAPUR	
		DADU PIPES	SIKRANDRABAD	
		GOOD LUCK TUBES	SIKANDRABAD	
		ADVANCE STEEL TUBES	SAHIBABAD	
		BIHAR TUBES	SIKANDRABAD	
		HI TECH PIPES	SIKANDRABAD	
		RATNAMANI	KUTCH/AHMEDABAD/CHHATRAL	
		MAHARASHTRA SEAMLESS	RAIGAD	
		WELSPUN	ANJAR/BHARUCH	
31.	SS PIPES / TUBES	APEX TUBES	BEHROR (ALWAR)	
		RATNAMANI	CHATRAL	
		REMI	TARAPUR	



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		PRAKASH STEELAGE	-	
32.	SAFETY SHOWER	UNICARE	-	
		MOHAN INDUSTRIES	-	
		SUPER SAFETY SERVICES	-	
33.	FRP TANKS & FITTINGS	GLOBAL COMPOSITE	-	
		EPP	-	
		DEEPA COMPOSITE	-	
		COROSEAL INDUSTRIES	-	
		CHEMICAL PROCESS & EQUIPMENT PVT LTD	-	
		J.R FIBRE INDUSTRIES PVT LTD	-	
		POLYPLAST	-	
34.	EJECTOR	ESSEM TECHNOLOGIES	-	
		RATNA PRASAD	-	
35.	TANK (FRP)	INDUSTRIAL SERVICE	KOLKATA	
		SUNRISE	BARODA	
		GANDHI & ASSOCIATES	AHMEDABAD	
		MODERN EQUIPMENTS	CHENNAI	
		EAGLE PLAST	PUNE	
		OMEGA PLAST	MUMBAI	
36.	STROKE CONTROLLER	V K PUMPS	NASIK	
		METACHEM	MUMBAI	
		SWELORE	AHMEDABAD	
		MILTON ROY INDIA	CHENNAI	
37.	SAFETY VALVES/RELIEF VALVES	METACHEM	MUMBAI	
		KEYSTONE	BARODA	
		V K PUMPS	NASIK	
		MILTON ROY	CHENNAI	
38.	DUPLEX STRAINER	JAYPEE INDUSTRIES PVT. LTD.	NEW DELHI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI	
		OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		SUNGOV ENGINEERING PVT. LTD.	CHENNAI	
39.	STEEL GATE/GLOBE/NR VALVES	A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	(1) CARBON STEEL GATE VALVES & NON RETURN VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 300 NB (#150) (2) CARBON STEEL GLOBE VALVES: 15 NB TO 50 NB (#800)



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
				& 65 NB TO 200 NB (#150)
		FLUIDLINE VALVES COMPANY PVT.LTD.	KAUSHAMBI	
		M/S GM ENGINEERING	RAJKOT	
		INTERVALVE (INDIA) LTD.	PUNE	A) STEEL GATE VALVES: UPTO 50NB, #800 AND 65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C) SUPPLIER NOT REGISTERED FOR NR VALVES
		LEADER VALVES LTD.	JALANDHAR	
		NITON VALVE INDUSTRIES PVT LTD	MUMBAI	
		NSSL LIMITED.	NAGPUR	
		STEEL STRONG VALVES (I) PVT.LTD.,	NAVI MUMBAI	LIMITED TO RANGES & CLASSES AS AVAILABLE IN VD FILE.
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CC/CSS-GATE-BBT- UPTO600NB CL UPTO300,GATE-PSBT UPTO250NB CL 1500, GLV-BBT- UPTO300NB CL UPTO600, SCNRV- BBT-UPTO600NB CL UPTO150, SCNRV- BBT-UPTO300NB CL 300, SCNRV-PSBT- UPTO150NB CL UPTO900
		VALTECH INDUSTRIES	MUMBAI	CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE- GV/150/900, GV/300/400, GV/600/300, GV/GLV/NRV/900/250, GLV/300/300, GLV/150/350, SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.
		V.K. VALVES PVT. LTD.,	JALANDHAR	



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
40.	SLUICE GATE	H SARKAR	KOLKATA	
		JASH ENGINEERING	-	
		YASHWANT INDUSTRIES	-	
41.	3 WAY VALVE	HI TECH	AHMEDABAD	
		ADVANCE VALVES PVT.LTD	NOIDA	
		BDK	HUBLI	
		FOURESS ENGG.INDIA LTD.	MUMBAI	
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI	
		INSTRUMENTATION LTD.	PALAKAD	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		VENUS PUMP & ENGG. WORKS	KOLKATA	
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI	
		STAFFORD CONTROLS LIMITED	PUNE	
42.	PLUG VALVE(MANUAL)	MICON VALVES (INDIA) PVT.LTD	MUMBAI	
		BDK	HUBLI	
		HAWA ENGINEERS / MARCK & CARE	-	
		MICON VALVES	-	
43.	FITTINGS (CS/SS)	M.S. FITTINGS	KOLKATA	
		METAL LLOYDS	MUMBAI	
		TRUE FORGE	FARIDABAD	
		TUBE PRODUCTS	BARODA	
		NL HAZRA	KOLKATA	
		GUJRAT INFRA PIPES	BARODA	
		EDWARDS	USA	
		PIPEFIT ENGINEERS	BARODA	
		SIDDARTH & GAUTAM	FARIDABAD	
		EBY	MUMBAI	
44.	FLANGES (SS/CS)	PRADEEP METALS LTD	MUMBAI	
		TUBE PRODUCT INCOROPORATION	BARODA	
		MS FITTINGS	KOLKATA	
		HAWA ENGINEERING	-	
		ALIANCE PIPE & PLANGES	KOLKATA	
		JAI AMBE	MUMBAI	
45.	PIPE & FILLTING	GEROGE FISHCHER	DELHI	



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
	(PP,HDPE,PVC & CPVC)	ASTROL PLYTECHINC LTD	AHMEDABAD	
		JAIN IRRIGATION	-	
		ORIPLAST	-	
46.	VALVES (GATE/GLOBE/NRV/BA LL)- (PP,HDPE,PVC & CPVC)	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
		JAIN IRRIGATION	-	
		ORIPLAST	-	
47.	FILTER MEDIA	GLOBAL ABSORBENT	KOLKATA	
		BHARAT MINERALS		
48.	SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.	CHENNAI	
		BLISS ANAND PVT. LTD.	GURGAON	
		FLOWTECH INSTRUMENTS SERVICRS	VADODARA	
		INSTRUMENTATION ENGINEERS PVT LTD	TELANGANA	
		SIGMA INSTRUMENTS CO.	MUMBAI	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	
		TELACE EQUIPMENT PVT.LTD.	CHENNAI	
49.	PAINT	ASIAN PAINTS (I) LTD.		
		BERGER PAINTS INDIA LTD		
		GOODLASS NEROLAC		
		JENSON & NICHOLSON (I) LTD		
		CDC CARBOLINE (I) LTD.		
		SHALIMAR PAINTS LTD.		
		ADDISON PAINTS LTD		
		GRAND POLYCOAT		
		BOMBAY PAINTS		
		HEMPLE PAINTS (SINGAPORE)		
		JOTUN PAINTS		
50.	PNEUMATIC ACTUATOR	PROCON ENGINEERS	-	
		TYCO	-	
		CRANE PROCESS	-	
		BDK	-	
		INTERVALVE	-	
		BRAY CONTROL	-	
51.	GI CONDUITS	BIS APPROVED MAKE	-	
52.	JUNCTION BOXES (NON FLAME PROOF)	JASPER ENGNIREES PVT. LTD.	NOIDA	
		Electro Controls & Devices	GREATER NOIDA	
		M/S SHRENIK & CO.	AHMEDABAD	
		M/s PHOENIX MECANO LTD.,	PUNE	



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		ADROIT CONTROL ENGINEERS PVT.LTD.	FARIDABAD	
		M/s PHOENIX MECANO LTD.	PUNE	
		MIKA ENGINEERS	MUMBAI	
		M/s PHOENIX MECANO LTD.	PUNE	
		BAJAJ ELECTRICALS	NEW DELHI	
		AJMERA INDUSTRIES & ENGG. WORKS	NAVI MUMBAI	
		S.B. ELECTRICAL ENGINEERING CORPORATION	MUMBAI	
53.	JUNCTION BOXES (FLAME PROOF)	SUDHIR SWITCHGEAR	MUMBAI	
		EPP COMPOSITES PRIVATE LIMITED	RAJKOT-GUJARAT	
54.	FRP CABLE TRAYS & ACCESSORIES	SUMIP COMPOSITES PVT.LTD.	AHMEDABAD-GUJARAT	
		ERCON COMPOSITES	JODHPUR-RAJASTHAN	

LIST OF VENDOR & SUB-VENDOR FOR ELECTRIC HOIST AND CHAIN PULLEY BLOCK

CHAIN PULLEY BLOCK	TUOBRO FURGUSON (INDIA) PVT LTD	Approved
	TRACTEL TIRFOR INDIA PVT. LTD.	Approved
	HERCULES HOISTS LTD.	Approved

ELECTRIC HOIST	Alpha Services	Submit Credentials
	Grip Engineers Pvt. Ltd.,	Submit Credentials
	ARMSEL MHE PVT. LTD	Submit Credentials
	Mangla Hoists Pvt Ltd	Submit Credentials
	CONSOLIDATED HOISTS PVT LTD	Approved
	LIFTING EQUIPMENTS and ACCESSORIES	Submit Credentials
	REVA INDUSTRIES LTD.	Approved
	TUOBRO FURGUSON (INDIA) PVT LTD	Approved
	EDDY CRANES PVT. LTD.	Approved
	CENTURY CRANE ENGINEERS PVT. LTD.	Submit Credentials
	HERCULES HOISTS LTD.	Approved



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO ELECTRIC HOIST:

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	STEEL	SAIL		
		TISCO		
		JINDAL		
		ESSAR		
2.	HOOKS	STEEL FORGING & ENGG. CO.,	KOLKATA	
		SIMRITI FORGING		
		KARACHIWALA		UP TO 25T CAPACITY
3.	GEAR COUPLINGS	ALLIANCE		
		FLEX-TRANS (formerly known as HICLIFF)		
		SAHARA		
		NUTECH		
		OEM		
4.	WIRE ROPE	USHA MARTIN		
		FORT WILLIAMS		
		BHARAT WIRE ROPES		
5.	BEARINGS	SKF		
		FAG		
		TATA		
		NBC		
6.	MOTORS	SIEMENS		
		NGEF (up to 15kW)		
		CROMPTON		
		KIRLOSKAR		
		BHARAT BIJLI		
		MARATHON		
		ABB		
7.	BRAKES	LHP		
		ELECTROMAG		
		SPEED-O- CONTROL		
		BCH		FOR DC EM BRAKES ONLY
		KAKKU		
8.	CONTACTOR	PETHE		
		SIEMENS		
		L&T		
		SCHNEIDER (Earlier TELE MECHANIQUE)		
9.	OVER LOAD RELAYS	BCH		
		SIEMENS		
		L&T		



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		ABB		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
10.	HRC FUSES	SIEMENS		
		L&T		
		ENGLISH ELECTRIC		
		GE POWER		
		EATON (BUSSMANN)		
		ABB		
11.	ISOLATING SWITCH	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
12.	SWITCH FUSE UNITS	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
13.	TIME DELAY RELAYS	SIEMENS		
		L&T		
		ABB		
		BCH		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
14.	TRANSFORMERS	INDCOIL		
		LOGICSTAT		
		KAPPA		
		AUTOMATIC ELECTRIC		
		PRECISE ELECTRICALS		
		SILKAAN ELECTRIC MFG. CO. LTD.		
		SOUTHERN ELECTRIC		
		NEC		
15.	CABLE LUGS (HEAVY DUTY)	DOWELLS		
		UML ENGINEERS	KOLKATA	
		JAINSON		
16.	PVC POWER CABLES	APAR INDUSTRIES LTD.	MUMBAI	
		CORDS CABLE INDUSTRIES LTD.	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GOYOLENE FIBRES (INDIA) PVT.LTD	MUMBAI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		KEI INDUSTRIES LTD.	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD.	NOIDA	
		NICCO CORPORATION LTD.	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD.	NEW DELHI	
		POLYCAB WIRES PVT. LTD.	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD.	VADODARA	
		SRIRAM CABLES PVT. LTD.	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD.	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		THERMO CABLES LTD	HYDERABAD	
17.	PVC CONTROL CABLES	ADVANCE CABLE TECHNOLOGIES (P) LTD	BANGALORE	
		APAR INDUSTRIES LTD., CMI LTD	MUMBAI	
		CMI LIMITED	FARIDABAD	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DELTON CABLES LTD	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		ELKAY TELELINKS LTD	NEW DELHI	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		INCOM CABLES (P) LTD	NEW DELHI	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		NICCO CORPORATION LTD	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

Sr. No.	ITEM	SUPPLIERS	PLACE	REMARKS
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		SPM POWER & TELECOM PVT. LTD	HYDERABAD	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
		UNIVERSAL CABLES LTD	SATNA	
18.	TRAILING CABLES	NICCO	KOLKATA	
		UNIVERSAL	SATNA	
		INCAB		
		ICL	NEW DELHI	
		APAR INDUSTRIES LTD	MUMBAI	
		OMI LTD	FARIDABAD	
		KEI INDUSTRIES LTD	NEW DELHI	
		SUYOG ELECTRICALS LTD	VADODARA	
19.	XLPE POWER CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
20.	XLPE CONTROL CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CABLE CORPORATION OF INDIA LTD	MUMBAI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		UNIVERSAL CABLES LTD	SATNA	
21.	CABLE GLAND	COMMET		
		SUNIL&CO		
		ARUP ENGINEERING		
		JAINSON		
		DOWELL		
22.	PUSH BUTTONS	SIEMENS		
		L&T		
		BCH		
		SCHNEIDER		
23.	LIMIT SWITCHES	SPEED-O-CONTROL		
		ELECTROMAG		
24.	PENDENT PUSH BUTTON STATION	OEM		
25.	INDICATING LAMPS	TECKNIC		
		BCH		
		SIEMENS		



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		STANDARD		
26.	MCB	MDS		
		INDO COPP		
		STANDARD		
		SIEMENS		
		L&T		
		ABB		
		SCHNEIDER		
27.	PANELS	OEM		
		RITTAL		
		PYROTECH		
		ENAPROS		
28.	RESISTANCE BOXES	OEM		
		SAFEX FIRE SERVICES LTD		
		UNITED FIRE EQUIPMENTS PVT. LTD		
		ZENITH FIRE SERVICES (INDIA) PVT LTD		
29.	VVVF	YASKAWA		
		ABB		
		SIEMENS		
		SCHNIEDER		
		FUJI ELECTRIC		
		MITSUBISHI ELECTRIC		
30.	SHROUDED DSL	SUSHEEL		
		STROMAG		
31.	LOAD CELL	IPA		
		SARTORIUS		
32.	GEAR BOX	OEM		
		ELECON ENGINEERS		
		SHANTI GEARS		
		PBL*		* = Applicable for Geared Motors only
		NAW*		
		NORD*		
		SEW*		
		BONGFILIOLI*		

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO CHAIN PULLEY BLOCKS:

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
33.	STEEL	SAIL		
		TISCO		
		JINDAL		
		ESSAR		
34.	HOOKS	STEEL FORGING & ENGG. CO.,	KOLKATA	
		SIMRITI FORGING		
		KARACHIWALA		UP TO 25T CAPACITY
		NASHIK FORGE		

	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION : I	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION: IA	
		REV. NO. 00	DATE :

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.
2. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.
3. 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.
4. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

CONTROL & INSTRUMENTATION SUB-VENDOR LIST

2X660 MW ENNORE SEZ SUPERCRITICAL TPS			
APPROVED VENDOR LIST [SUMMARIZED] DATED 15-DEC-2016			
Sl. No.	Package Name	Vendor Name	Approval Status for Ennore Project
CONTROL AND INSTRUMENTATION (C&I) PACKAGES			
1	ANUBAR (DELTA TUBE)	STAR-MECH CONTROLS (I) PVT.LTD.	Approved
		TM TECNOMATIC SPA	Credentials Required
		SWITZER INSTRUMENT LTD.	Approved
		RINGO VALVULAS S.L.	Credentials Required
		Severn Glocon India Pvt. Ltd.	Credentials Required
		CONTROL COMPONENT INC.	Approved
		DRESSER VALVE INDIA PVT. LTD	Credentials Required
		LESLIE CONTROLS, INC	Credentials Required
		SPX Corporation, USA	Credentials Required
		Daume Regelarmaturen GmbH,	Credentials Required
		INSTRUMENTATION LTD.	Approved
		Valitalia S.P.A. ,	Credentials Required
		WEIR VALVES & CONTROLS UK LTD.	Approved
		Koso India Private Limited,	Credentials Required
		FORBES MARSHALL ARCA PVT.LTD.	Approved
		R.K.CONTROL INSTRUMENTS PVT. LTD.	Approved
2	CONTROL VALVE	EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	Approved
		HOLTER REGELARMATUREN GmbH & Co.KG	Credentials Required
		MIL CONTROLS LTD.	Approved
		SHENJIANG VALVE CO. LTD.	Credentials Required
		Metso Singapore PTE. LTD.,	Approved
		DeZURIK - COPES VULCAN LTD., U.K.	Approved
		FISHER SANMAR LIMITED	Approved
		INTROL-ABB	Approved
		CONTINENTAL VALVES LTD	Not Approved
		FOURESS ENGG. INDIA LTD.	Credentials Required

2X660 MW ENNORE SEZ SUPERCRITICAL TPS				
APPROVED VENDOR LIST [SUMMARIZED] DATED 15-DEC-2016				
Sl. No.	Package Name	Vendor Name	Approval Status for Ennore Project	
3	FLOW ELEMENT - NOZZLE	HYDROPNEUMATICS PVT. LTD.	Approved	
		INSTRUMENTATION LTD.	Approved	
		MICRO PRECISION PRODUCTS PVT. LTD.	Approved	
		STAR-MECH CONTROLS (I) PVT.LTD.	Approved	
		SEIKO FLOW CONTROL GMBH	Approved	
		BRISTOL BABCOCK LTD. UK		Approved
4	FLOW ELEMENT - ORIFICE	BALIGA LIGHTING EQUIPMENTS PRIVATE LIMITED, CHENNAI		Approved
		ENGINEERING SPECIALITIES PRIVATE LTD		Approved
		MICRO PRECISION PRODUCTS PVT. LTD.	Approved	
		INSTRUMENTATION LTD.	Approved	
		HYDROPNEUMATICS PVT. LTD.	Approved	
		Flow Star Engineering Pvt. Ltd.,	Approved	
		STAR-MECH CONTROLS (I) PVT.LTD.	Approved	
		MINCO (INDIA) PRIVATE LIMITED	Approved	
		INSTRUMENTATION ENGINEERS PVT LTD	Approved	
		BRISTOL BABCOCK LTD. UK		Approved
5	PROGRAMMABLE LOGIC CONTROLLER	BALIGA LIGHTING EQUIPMENTS PRIVATE LIMITED, CHENNAI		Approved
		ENGINEERING SPECIALITIES PRIVATE LTD		Approved
		GE Intelligent Platforms Private Limited	Approved	
		SIEMENS LIMITED	Approved	
		ROCKWELL AUTOMATION-INDIA LTD	Approved	
		SCHNEIDER ELECTRIC INDIA PVT.LTD.	Approved	
6	ROTAMETER	Honeywell Automation India Limited	Approved	
		FLOWTECH INSTRUMENTS SERVICES	Approved	
		Flow Star Engineering Pvt. Ltd.,	Approved	
		EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	Approved	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Approved	
		INSTRUMENTATION ENGINEERS PVT LTD	Approved	
		CHEMTOOLS SAMIL (INDIA) PVT. LTD., MUMBAI		

2X660 MW ENNORE SEZ SUPERCRITICAL TPS				
APPROVED VENDOR LIST [SUMMARIZED] DATED 15-DEC-2016				
Sl. No.	Package Name	Vendor Name	Approval Status for Ennore Project	
7	ULTRASONIC FLOW TRANSMITTERS	New Package		
8	SIGHT FLOW INDICATORS	TELACE EQUIPMENT PVT.LTD.	Credentials Required	
		BLISS ANAND PVT. LTD.	Approved	
		B.K.EQUIPMENTS PVT.LTD.	Approved	
		SIGMA INSTRUMENT'S CO.	Approved	
		FLOWTECH INSTRUMENTS SERVICES	Approved	
		INSTRUMENTATION ENGINEERS PVT LTD	Approved	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Approved	

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

PEM REGISTERED VENDOR

SLN O	Package Code	Package Name	Vendor Code	Vendor Name	Vendor Address	Remarks
1	145-07000-A	ANALYTICAL INSTS.SAMPLE COOLER	J001	FORBES MARSHAL PVT. LTD.	A-33/34, MIDC ESTATE, H-BLOCK, PIMPRI, PUNE-MAHARASHTRA-INDIA Phone- 27470171,27477472 Pincode : 411018 Email : nkaushal@forbesmarshall.com	' ,
2	145-07000-A	ANALYTICAL INSTS.SAMPLE COOLER	R002	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI-MAHARASHTRA-INDIA Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com	, ,
3	145-07000-A	ANALYTICAL INSTS.SAMPLE COOLER	S001	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai- Maharashtra-INDIA Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	, ,
27	145-12000-A	FLOW ELEMENT	S044	STAR-MECH CONTROLS (I) PVT.LTD.	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE- MAHARASHTRA-INDIA Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net	, ,
28	145-12000-A	FLOW ELEMENT	I006	INSTRUMENTATION LTD.	KANJIKODE WEST, PALAKKAD, PALAKKAD-KERALA-INDIA Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	SICK PSU. BIFR CASE. , ,
29	145-12000-A	FLOW ELEMENT	M009	MICRO PRECISION PRODUCTS PVT. LTD.	K.P. CHANDHOK/ATUL CHANDHOK 4, LINK ROAD, FARIDABAD-HARYANA-INDIA Phone- 9810265688 Pincode : 121002 Email : pal@microa1.com	REGISTERED AS MSED VENDOR W.E.F.15.11.2011 FOR FY 2011-12. , ,
42	145-43000-A	FLOW ELEMENT - ORIFICE	I006	INSTRUMENTATION LTD.	KANJIKODE WEST, PALAKKAD, PALAKKAD-KERALA-INDIA Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	SICK PSU. BIFR CASE. , ,
43	145-43000-A	FLOW ELEMENT - ORIFICE	I030	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD-TELANGANA-INDIA Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com	, ,
44	145-43000-A	FLOW ELEMENT - ORIFICE	M009	MICRO PRECISION PRODUCTS PVT. LTD.	K.P. CHANDHOK/ATUL CHANDHOK 4, LINK ROAD, FARIDABAD-HARYANA-INDIA Phone- 9810265688 Pincode : 121002 Email : pal@microa1.com	REGISTERED AS MSED VENDOR W.E.F.15.11.2011 FOR FY 2011-12. , ,
45	145-43000-A	FLOW ELEMENT - ORIFICE	T211	TANSA EQUIPMENTS PVT. LTD.	Mr. Vardhan Tamhankar, Unit No35/36/41,Om Anand Industrial Est. Mohanjee Sundarjee Road,Raghunath Nagar, Thane-Maharashtra-India Phone- 022-25832323 Pincode : 400604 Email : tansaindia@gmail.com	, ,
46	145-45000-A	INSTRUMENT FITTINGS	V039	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	, Financial limit reviewed on 05.06.2014 ,
47	145-45000-A	INSTRUMENT FITTINGS	P046	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI- MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	, ,
48	145-45000-A	INSTRUMENT FITTINGS	H61	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI-Tamilnadu-INDIA Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com	' ,
49	145-45000-A	INSTRUMENT FITTINGS	P81	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai- Maharashtra-INDIA Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com	' ,

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-673-A001

50	145-45000-A	INSTRUMENT FITTINGS	P082	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai,-Maharashtra,- India, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,	, ,
51	145-45000-A	INSTRUMENT FITTINGS	C067	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan-Gujarat-INDIA Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com	, ,
52	145-45000-A	INSTRUMENT FITTINGS	A079	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	, ,
53	145-45000-A	INSTRUMENT FITTINGS	A121	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai-Maharashtra-INDIA Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com	, ,
54	145-45000-A	INSTRUMENT FITTINGS	H024	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Name changed from M/s Hyd-Air Valves Pvt. Ltd. to M/s Fluid Controls Pvt. Ltd. as per 25th MISCC-Electrical and C&I dtd. 20.02.2014 , ,
55	145-45000-A	INSTRUMENT FITTINGS	F040	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai-Maharashtra-India Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com	Registered as per 22nd Electrical and C&I MISCC Meeting dtd. 15.01.2014 ,
56	145-38000-A	INSTRUMENTS PIPE FITTINGS	H024	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	, ,
57	145-38000-A	INSTRUMENTS PIPE FITTINGS	A079	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	, ,
58	145-38000-A	INSTRUMENTS PIPE FITTINGS	P046	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	, ,
59	145-38000-A	INSTRUMENTS PIPE FITTINGS	V039	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	, ,
60	145-32000-A	INSTRUMENTS TUBE FITTINGS	V039	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	, ,
61	145-32000-A	INSTRUMENTS TUBE FITTINGS	P046	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	, ,
62	145-32000-A	INSTRUMENTS TUBE FITTINGS	A079	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	, ,

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-673-A001

63	145-32000-A	INSTRUMENTS TUBE FITTINGS	H024	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI- MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	, ,
64	145-25000-A	JUNCTION BOX	F201	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari-Gujarat-India Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com	Technical limit reviewed on 12.10.2015; , ,
65	145-25000-A	JUNCTION BOX	A101	AJMERIA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI- MAHARASHTRA-INDIA Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com	Reviewed in MISCC dt. 21.07.2015 for non-response in 4 consecutive tender enquiry; , APPROVED FOR GALVANIZED AND FRP JUNCTION BOXES; Technical limit reviewed on 30.04.2014 ,
66	145-25000-A	JUNCTION BOX	K043	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore- Karnataka-India Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net	, ,
67	145-25000-A	JUNCTION BOX	S114	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad-Gujarat-India Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com	Registered for FRP JB's AND METAL JB's , Technical limit reviewed on 30.04.2014; ,
68	145-25000-A	JUNCTION BOX	S095	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE -- Phone- Pincode : Email : suchitra.industriesblr@gmail.com	, ,
69	145-11000-A	LEVEL GAUGE	T001	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER- RAJASTHAN-INDIA Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com	, ,
70	145-11000-A	LEVEL GAUGE	S008	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI- MAHARASHTRA-INDIA Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	, ,
71	145-11000-A	LEVEL GAUGE	B077	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon-Haryana-India Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	, ,
100	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	W017	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	, NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 13.06.2012 ,
101	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	G071	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,-Maharashtra,-India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	Registered as per 26th MISCC- Electrical and C&I dtd. 06.03.2014. , ,

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-673-A001

102	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H023	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA-WEST BENGAL-INDIA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net	, Financial limit reviewed on 05.06.2014; ,
103	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H040	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE-KARNATAKA- www.hgurusouth.com Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	, ,
104	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	F016	FORBES MARSHALL (HYD) LTD.	MR. SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD-TELANGANA-INDIA Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com	, ,
105	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	B083	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata-West Bengal-India Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net	Trial to Hold as per SEARP amd-3,w.e.f. 15-09-12 , Supplier registered in trial category on 30.10.2010 and was thereafter put in susp-hold category as per SEARP Amd-03 on 15.09.2012. Further, on evaluation put in permanent category on 20.08.2014; ,
106	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A126	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,- INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Registration of "M/s Ashcroft India Pvt. Ltd." substituted to "M/s Precision Mass Products Pvt. Ltd." as per MISCC dt. 15.02.2016 based on "Termination and business transfer agreement" submitted by supplier. , ,
107	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A010	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA-WEST BENGAL-INDIA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	, ,
123	145-34000-A	ROTAMETER	E047	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	Mr V. K. Pandit/Mr Ashish Shaha 17-20, Royal chambers, Paud Road Pune-Maharashtra-India Phone- 9370469466 Pincode : 411038 Email : sales@eurekaflow.com	, ,
124	145-34000-A	ROTAMETER	F033	Flow Star Engineering Pvt. Ltd.,	MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No-7 F/2, Northern India Industrial 20/3, Mathura Road FARIDABAD-HARYANA-INDIA Phone- 9818176380 Pincode : 121005 Email : khalid@flowstar.co.in	VENDOR IS REGISTERED IN MS&D (MICRO) W.E.F.30.11.2011 FOR FY 2011-12 , ,
125	145-34000-A	ROTAMETER	I030	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD-TELANGANA-INDIA Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com	, ,
126	145-34000-A	ROTAMETER	T211	TANSA EQUIPMENTS PVT. LTD.	Mr. Vardhan Tamhankar, Unit No35/36/41,Om Anand Industrial Est. Mohanjee Sundarjee Road,Raghunath Nagar, Thane-Maharashtra-India Phone- 022-25832323 Pincode : 400604 Email : tansaindia@gmail.com	, ,
127	145-34000-A	ROTAMETER	S158	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai,-Maharashtra,-INDIA Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com	, ,
128	145-16000-A	SIGHT FLOW INDICATORS	S158	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai,-Maharashtra,-INDIA Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com	, ,

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-673-A001

129	145-16000-A	SIGHT FLOW INDICATORS	V040	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	, ,
130	145-16000-A	SIGHT FLOW INDICATORS	I030	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD-TELANGANA-INDIA Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com	, ,
131	145-16000-A	SIGHT FLOW INDICATORS	S008	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI-MAHARASHTRA-INDIA Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	Reassessed on 27.04.2016; , ,
132	145-16000-A	SIGHT FLOW INDICATORS	B077	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon-Haryana-India Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	Reassessed on 31.03.2016; , ,
133	145-16000-A	SIGHT FLOW INDICATORS	B068	B.K.EQUIPMENTS PVT.LTD.	T. BALAKRISHNAN/S.VENKATESH 217 , ARCOT ROAD PORUR , CHENNAI-TAMIL NADU-INDIA Phone- 9444057761 Pincode : 600116 Email : bkequip@gmail.com	, ,
134	145-13000-A	TEMP. ELEMENT	G032	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa,-MAHARASHTRA-INDIA Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,	GCC Rev.5 has been accepted in toto. , ,
135	145-13000-A	TEMP. ELEMENT	G071	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,-Maharashtra,-India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	, ,
136	145-13000-A	TEMP. ELEMENT	I022	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	320, TV INDUSTRIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI-MAHARASHTRA-INDIA Phone- 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com	, ,
137	145-13000-A	TEMP. ELEMENT	P061	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	M. D. BICHU/R. M. BICHU G.B, HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA-GOA-INDIA Phone- 9326114601 Pincode : 403507 Email : priyanka.marketing@pyro-electric.in	, ,
138	145-13000-A	TEMP. ELEMENT	T115	Thermal Instrument India Pvt. Ltd.	Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema,Mahim Mumbai-Maharashtra-India Phone- 09322664709 Pincode : 400016 Email : ramk@giconindia.com	Registered as per 11th MISCC-Electrical and C&I (FY 2014-15) dt. 20.09.2014. , ,
139	145-13000-A	TEMP. ELEMENT	T111	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer,- Rajasthan,-India, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	GCC Rev.5 has been accepted in toto. , ,
140	145-13000-A	TEMP. ELEMENT	T108	TM TECNOMATIC SPA	MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzocc VIA DELLE INDUSTRIE, 36 CREMONA--ITALY Phone- 39037221574 Pincode : 26100 Email : info@tmtecnomatic.com	, ,

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-673-A001

141	145-13000-A	TEMP. ELEMENT	T106	TECHNO INSTRUMENTS	Abhijit Gohel/Mr. Amit Pandya Plot No. 1145/1, Uma Conventor Lane, Santej, Ta. Kalol, Gandhinagar-Gujarat-India Phone- 9909925223 Pincode : 382721 Email : amit@techno-instruments.com	, ,
142	145-13000-A	TEMP. ELEMENT	T107	Tempsens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR-RAJASTHAN-INDIA Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com	, ,
143	145-13000-A	TEMP. ELEMENT	W017	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	, NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 13.06.2012 ,
144	145-10000-A	TEMPERATURE GAUGE	W017	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	, NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 13.06.2012 ,
145	145-10000-A	TEMPERATURE GAUGE	H023	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA-WEST BENGAL-INDIA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net	, Financial limit reviewed on 05.06.2014; ,
146	145-10000-A	TEMPERATURE GAUGE	G071	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,-Maharashtra,-India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	, ,
147	145-10000-A	TEMPERATURE GAUGE	H040	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE-KARNATAKA-www.hgurusouth.com Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	, ,
148	145-10000-A	TEMPERATURE GAUGE	G032	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa,-MAHARASHTRA-INDIA Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,	GCC Rev.5 has been accepted in toto. , ,
149	145-10000-A	TEMPERATURE GAUGE	G047	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA-GOA-INDIA Phone- Pincode : 403525 Email : gtilworks@pyro-electric.in	, ,
150	145-10000-A	TEMPERATURE GAUGE	F016	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD-TELANGANA-INDIA Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com	, ,
151	145-10000-A	TEMPERATURE GAUGE	A126	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,-INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Registration of "M/s Ashcroft India Pvt. Ltd." substituted to "M/s Precision Mass Products Pvt. Ltd." as per MISCC dt. 15.02.2016 based on "Termination and business transfer agreement" submitted by supplier. , ,

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-673-A001

152	145-10000-A	TEMPERATURE GAUGE	A010	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA-WEST BENGAL-INDIA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	, ,
158	145-14000-A	TRANSMITTERS	T031	Honeywell Automation India Limited	Mr. Ritwiji Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI-DELHI-INDIA Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com	, ,
159	145-14000-A	TRANSMITTERS	S106	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE,-MAHARASHTRA-INDIA Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in	Reviewed in MISCC dt. 21.07.2015 for non-response in 4 consecutive tender enquiry; , Technical limit reviewed on 30.04.2014 & 12.10.2015; ,
160	145-14000-A	TRANSMITTERS	T111	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer,- Rajasthan,-India, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	GCC Rev.5 has been accepted in toto. , ,
161	145-14000-A	TRANSMITTERS	V040	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014 ,
162	145-14000-A	TRANSMITTERS	Y10	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE,-KARNATAKA,-INDIA, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,	Subject to submission of renewed ISO certificate & compliance to GCC; Relevant documents (ISO 9001:2008 and GCC Rev-05) furnished on 18.06.2013. , ,
163	145-14000-A	TRANSMITTERS	S039	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI-MAHARASHTRA-INDIA Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in	Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014 ,
164	145-14000-A	TRANSMITTERS	S001	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai-Maharashtra-INDIA Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	Comm Add: Attn Mr K.K.Bedi/ Mr Sanjay Satpute, Siemens Ltd. EFIE, Plot no 6A, Sec-18, Maruti Industrial Area, Gurgaon - 122015, Ph 0124-3836250 , ,
165	145-14000-A	TRANSMITTERS	R002	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI-MAHARASHTRA-INDIA Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com	, ,
166	145-14000-A	TRANSMITTERS	P068	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune-Maharashtra-INDIA Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com	Technical limit reviewed on 12.10.2015; , Manufacturing works: J-52/7, MIDC, Bhosari, Pune ,
167	145-14000-A	TRANSMITTERS	P082	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai,-Maharashtra,-India, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,	, ,
168	145-14000-A	TRANSMITTERS	N040	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore-M.P.-India Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com	Registered in permanent category as per 11th MISCC-Electrical and C&I (FY 2014-15) dt. 20.09.2014. , Technical limit reviewed on 12.10.2015; ,

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-673-A001

169	145-14000-A	TRANSMITTERS	M091	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills-CALIFORNIA-USA Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com	INDIAN REPRESENTATIVE: CHEMTROL INDUSTRIES LTD, , ,
170	145-14000-A	TRANSMITTERS	B049	ABB LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD-HARYANA-INDIA Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com	(1) A GROUP COMPANY OF ABB, NOW. (2) NAME OF VENDOR CHANGED FROM BIRLA-KENT TAYLOR LIMITED TO ABB LIMITED W.E.F. 27.06.2011 , Technical limit reviewed and changed on 05.06.2014; Technical limit further reviewed on 12.10.2015; , ,
171	145-14000-A	TRANSMITTERS	E057	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi,-New Delhi,- India, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,	For temperature transmitter only. , ,
172	145-42000-A	ULTRASONIC FLOW METERS	F206	FLASH FORGE PVT LTD	Mr. Gautam Makker, 503, 'A'-wing, Delphi, Orchard Avenue Road, Powai Mumbai- Maharashtra-India Phone- 022-42784300 Pincode : 400076 Email : hemendrapatil@f-f.co.in	Exclusive partner for bidding of BHEL tender for M/s Endress & Hauser make Ultrasonic Flowmeters and MOU agreement valid upto 31.12.2016; , , Manufacturing works at M/s Endress & Hauser, Aurangabad, Maharashtra and M/s Endress & Hauser, Bhiwandi, Thane, Maharashtra ,
173	145-42000-A	ULTRASONIC FLOW METERS	C203	CHEMTROLS INDUSTRIES LTD	Mr. K. NANDAKUMAR AMAR HILL, SAKI VIHAR ROAD, POWAI, MUMBAI-MAHARASHTRA-INDIA Phone- 022-67151261 Pincode : 400072 Email : manikandan@chemtrols.com	Exclusive distributor for the territory of India of M/s Flexim Instruments Asia Pte Ltd., Singapore; agreement validity upto 17.08.2017. , ,
174	145-42000-A	ULTRASONIC FLOW METERS	N209	NIVUS GMBH	Mr. Marcus Fischer Im Taele 2, D - 75031 Eppingen --Germany Phone- 00491712233770 Pincode : Email : carolin.schuster@nivus.com	M/s Automation and Maintenance Systems approved as authorised distributor of M/s Nivus GmbH w.e.f. 01.11.2016 , ,
175	145-42000-A	ULTRASONIC FLOW METERS	R057	Rockwin Flowmeter India Pvt. Ltd.	B-24, Site-IV, Sahibabad Industrial Area Ghaziabad,-Uttar Pradesh,-India, Phone- 9810129687 Pincode : 201010, Email : amiya@rockwin.com	, ,

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.
2. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.
3. 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.
4. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/ CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

ANNEXURE III

FUNCTIONAL GUARANTEE AND LIQUIDATED DAMAGES

	TITLE:		SPECIFICATION NO. PE-TS-412-673-A001	
	2X660 MW ENNORE SEZ STPP		SECTION : I	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT		SUB-SECTION: IA	
			REV. NO. 00	DATE :

FUNCTIONAL GUARANTEES REQUIREMENTS

GENERAL

The term "Performance Guarantees" wherever appears in the technical specification shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly, the term "Performance Tests" wherever appears in the technical specification shall have the same meaning and shall be synonymous to "Guarantee Test(s)".

PERFORMANCE GUARANTEES / PERFORMANCE TESTS

GENERAL REQUIREMENTS

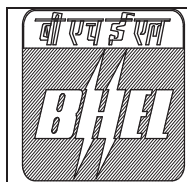
- i) The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in the specifications.
- ii) The guaranteed performance parameters furnished by the Bidder in his offer, shall be without any tolerance values whatsoever. All margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.
- iii) The Bidder shall conduct performance test and demonstrate all the guarantees covered herein under Category I, II & III. The various tests which are to be carried out during performance guarantee tests are listed in this Subsection. The guarantee tests shall be conducted by the Bidder at site in presence of owner.
- iv) All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the contract price.
- v) The performance tests shall be performed using only the normal number of Owner supplied operating staff. Contractor, vendor or other subcontractor personnel shall be used only for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.
- vi) It shall be responsibility of the Contractor to make the plant ready for the performance guarantee tests.

vii) **Test Instrumentation, Flow Measurement and their Calibration**

All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the bidder shall get these instruments calibrated in an independent test Institute approved by the Owner. All test instrumentation required for performance tests shall be supplied by the bidder and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subject to the approval of the Owner. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.

Tools and tackles, thermowells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the bidder free of cost.

- viii) The P&G test procedures shall be submitted for equipments/ system & subsystem under Bidder's scope for all Guarantees under category I, II & III as mentioned below, as per latest International codes / standard including correction curves, meeting the specification requirements along with sample



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees.

ix) The contractor shall submit for Owner's approval the detailed Performance Test procedure containing the following:

- (a) Object of the test
- (b) Various guaranteed parameters & tests as per contract.
- (c) Method of conductance of test and test code.
- (d) Duration of test, frequency of readings & number of test runs.
- (e) Method of calculation.
- (f) Correction calculations & curves.
- (g) Instrument list consisting of range, accuracy, least count, and location of instruments.
- (h) Scheme showing measuring points.
- (i) Sample calculation
- (j) Acceptance criteria.
- (k) Any other information required for conducting the test.

The Performance test shall be carried out as per the agreed procedure.

x) Test Reports

After the conductance of Performance test, the bidder shall submit the test evaluation report of Performance test results to Owner promptly but not later than one month from the date of conductance of Performance test. Preliminary test reports shall be submitted to the Owner after completing each test run. Six (6) hard copies and two (2) soft copies on CD-ROM of each test report of final conducted test on each equipment/plant/system shall be submitted to Owner for approval.

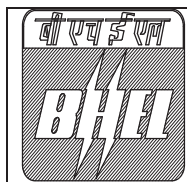
xi) The performance guarantee test will be carried out within three months after the successful completion of Initial Operation of facilities or as per the time frame specified for a particular equipment/ plant/ system in the Technical specifications. Delay in conductance of the test beyond this period will not be normally permitted by the OWNER. In the event of OWNER agreeing to conductance of such tests after three months, for reasons not attributable to the OWNER, as assessed by the Owner, no factor for ageing shall be considered for computing performance of the equipment.

xii) Performance Guarantee Tests on the equipments/systems not covered in this Sub-section shall be carried out as per the procedure/test codes specified in respective detailed section.

xiii) If, the Functional Guarantees are not met, either in whole or in part, the Owner may, at its sole discretion, provide the Contractor notice, setting forth particulars of such defects or failure. The Contractor shall, forthwith upon receipt of such notice, at its cost and expense, make such changes, modifications and/or additions to the Plant and Equipment or any component thereof, as may be necessary to meet the Functional Guarantees. The Bidder shall notify the Owner upon completion of the necessary replacement, changes, modifications and/or additions, shall request the Owner to facilitate the repetition of the Guarantee Tests until the Functional Guarantees have been met. If, the Functional Guarantees are not attained either in the whole or in part, even after the expiry of any additional time granted by the Owner (after carrying out necessary changes, modifications, and/or additions), the Owner may, at its sole discretion, exercise anyone of the following options:

(i) For Category-I Guarantees- Performance Guarantees under Penalty.

Reject the equipment / system / plant and recover from the Contractor the payments already made, if the level of tested Functional Guarantees is beyond the acceptable shortfall limits
(or)



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

Accept the equipment / system / plant with penalty, if the level of tested Functional Guarantees is within the acceptable shortfall limits. The penalty for shortfall in performance shall be levied separately for each unit. The penalty values and acceptable shortfall limits are applicable for per unit basis except for total auxiliary power consumption (as total auxiliary power consumption shall be guaranteed for the two units). The penalty shall be pro-rated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category-I' Guarantees.

(ii) For Category-II Guarantees – Performance Guarantee under Rejection

Reject the equipment / system/ plant and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category-II' Guarantees. Conformance to the performance requirements under Category-II is mandatory.

(iii) For Category-III Guarantees - Performance Guarantee under Compulsory Correction

Reject the equipment /system / plant and recover from the Contractor 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 the Owner. Such damages shall, however be limited to the cost of replacement of the equipment(s) / system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance. These parameters/capacities shall be termed as Category-III Guarantees

1.00 GUARANTEES UNDER CATEGORY I

Guaranteed auxiliary power consumption for sewage treatment plant

Bidder to quote guaranteed auxiliary power requirement for sewage treatment plant considering all working drives as listed below. The total power consumption should be well within the values as mentioned below. Bidder to include guaranteed power consumption in their offer as per format attached in technical specification (Section –III, GPC format). Auxiliary power consumption shall be used for technical loading as per mentioned criteria during bid evaluation stage.

Liquidated damages shall be applicable during demonstration / PG test at site as per rate given in below on difference between actual power consumption of drives listed and guaranteed auxiliary power consumption.

Bidder to note that guaranteed auxiliary power consumption value for station (in KW) for Sewage treatment plant shall be well within the values given below:

Complete Sewage Treatment Plant – 24.75 KW (Considering duty factor of 0.5)

Working Drives to be considered for sewage treatment plant for guaranteed auxiliary power consumption:

- 1)Sewage transfer pump motor for sewage sump (S1) – 1 working
- 2)Sewage transfer pump motor for sewage sump (S2) – 1 working
- 3)Sewage transfer pump motor for sewage sump (S3) – 1 working



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

- 4)Sewage transfer pump motor for sewage sump (S4) – 1 working
- 5)Sewage transfer pump motor for common sewage collection sump– 1 working
- 6)FAB /MBBR feed pump motor– 1 working
- 7)Air blower motor for FAB/MBBR tank– 1 working
- 8)Common air blower motor for EQ. tank/Sludge Sump/ Common collection sump– 1 working
- 9)NaOCL dosing pump motor for hypo contact cum filter feed tank– 1 working
- 10)Agitator motor for NaOCL dosing tank for hypo contact cum filter feed tank– 1 working
- 11)Filter feed pump motor– 1 working
- 12)Treated water disposal pump motor– 1 working
- 13)Sludge transfer pump motor– 1 working
- 14)NaOCL dosing pump motor for sludge feed line to centrifuge – 1 working
- 15)Agitator motor for NaOCL dosing tank for sludge feed line to centrifuge – 1 working
- 16)Centrifuge motor – 1 working
- 17)Any other drive which is not listed above but required for completeness of the Sewage treatment plant package.

Note: 1) All power shall be measured at motor input terminal.

LOADING CRITERIA FOR AUXILIARY POWER CONSUMPTION DURING BID EVALUATION STAGE

For bid evaluation purpose on account of guaranteed auxiliary power consumption, the same shall be loaded at the rate of **Rs. 3,56,607/- per KW** (Rupees Three lacs fifty six thousand six hundred & seven per Kilowatt) for the differential power consumption for above package.

LIQUIDATED DAMAGES CRITERIA FOR AUXILIARY POWER CONSUMPTION DURING DEMONSTRATION / PG TEST

If the actual power consumption exceeds the guaranteed power consumption, liquidated damages shall be payable by the bidder at the rate of **Rs.3,56,607/- per KW** (Rupees Three lacs fifty six thousand six hundred & seven per Kilowatt) excess power consumption, over the base guaranteed power consumption figure indicated by bidder in his bid.

If the contractor is not able to demonstrate the guarantees, CLIENT/ BHEL will have the right to Reject the equipment / system / plant and recover the payments already made or accept the equipment / system after levying liquidated damages.

2.00 GUARANTEE UNDER CATEGORY –II

NIL

3.00 GUARANTEE UNDER CATEGORY –III

The parameters/capabilities to be demonstrated for various systems/equipment shall include but not be limited to the following:

- a.** Noise level of all pumps and blowers at the rated duty point shall be demonstrated at site.

NOISE



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
 TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
 A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in the technical specifications.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779.

Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation.

A minimum of 6 points around each equipment shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and the size of the equipment. The measurement shall be done with slow response on the A - weighting scale. The average of A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
 TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
 A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

ANNEXURE IV

DRAWING DOCUMENTS DISTRIBUTION PROCEDURE

ANNEXURE-IV

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

indigenous supplies. The cost towards this inspection shall be borne by the Contractor.

- b) In the case of imported supplies: - For imported materials or non- indigenous supplies, the inspection shall be carried out by a foreign agency of repute to be appointed by the contractor as approved by the Owner. The cost of such inspection shall be borne by the Contractor.

18.0 OPERATION AND MAINTENANCE MANUALS:

- 18.1 For all the equipments supplied by the Contractor, he shall submit to the Owner ten sets of the O&M manuals. The manual shall contain the operational features of the equipment, DOs & DON'Ts, trouble shooting, maintenance schedules for preventive maintenance, detail dimensional drawings, cross sectional drawings, method of assembly etc. to make the Owner's staff acquainted with the equipment as well as to enable them to operate and maintain the same in prescribed manner. Manuals shall contain all information for ordering of the spares, like part name, part no., Drawing/material Specifications, address of the supplier with phone no. & fax no. etc. Contractor shall ensure that these O&M manuals are made available to the Owner well before starting of initial trials of equipment.

18.2 ERECTION MANUALS:

- 18.2.1 In order to enable the engineers of the Owner to supervise the works properly, Contractor shall furnish five copies of erection manuals depicting therein the erection procedure, special precautions to be taken, various clearance to be maintained, erection checks and tests to be carried out before the equipment is put to initial trials.

19.0 SUBMISSION AND APPROVAL OF DRAWINGS:

- 19.1 The contractor shall submit the drawings in sequential order to match with completion of milestone activity. The contractor shall submit all the G.A. drawings, mechanical, electrical and

civil drawings, data sheets etc. for approval of the Owner along with the design calculations and general write up wherever involved. The drawings for all the systems shall be properly coordinated. While scrutinizing the drawings, the Owner shall indicate the corrections to be made in these drawings and documents, which the contractor shall incorporate or justify its correctness. The Contractor then shall submit the revised drawings for approval of the Owner. On approval of the same, Contractor shall furnish six copies and soft copy on CD of these approved drawings to the Owner as per the distribution to be intimated. Any delay in approval of drawings by Owner, due to submission of incorrect data, non-submission of data, non-updating the drawings in line with the corrections indicated shall be to the Contractor's account. During the currency of the contract, if any approved drawings are required to be modified, such details of the modifications required to be carried out shall be separately maintained. On completion of all the works, the Contractor shall incorporate all the changes necessitated in the drawings and submit 6(six) sets of all the "As built" drawing for the records of the Owner. As the drawings shall be approved based on the basic information furnished by the Contractor, approval by the Owner shall not absolve the Contractor of his responsibilities towards correctness of design & performance of the equipment.

20.0 TEST REPORTS:

- 20.1 On completion of tests of equipment at manufacturer's works, the Contractor shall furnish 4 copies of test certificates to the Owner for approval and subsequent despatch clearance. The test report shall invariably indicate identification data, including model no., sl. no. etc. of the equipment, method of application and duration of test along with test results. Only on approval of these test results by the Owner or Owner's representative, dispatch clearance will be issued for dispatch of material to site.



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

Note:

- Quantity of prints may change during detailed engineering stage based on BHEL / Customer requirement. However the same will be adhered by the bidder without any delivery/commercial implication to BHEL.
- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.
- Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and approval.
- The date of submission of drawing documents shall be considered as the date of submission of hard and soft copies whichever is later.
- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying to the requirement shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required.
- Bidder has to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.
- Bidder to submit instrument schedule, cable schedule and valve schedule in MS- Excel format during detailed engineering.
- Bidder to also furnish the auto cad copy / MS-word (as applicable) of the following documents after award of contract. However any other auto cad copy/MS-Excel/MS-word of any other document as per the insistence of BHEL / customer will also be submitted by the bidder without any delivery/commercial implication to BHEL.
 - P&IDs.
 - Equipment lay out.
 - Equipment Cable tray layout.
 - Civil scope drawings.
 - Piping lay out drawing.



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

ANNEXURE V

PAINTING SPECIFICATION

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. Austenitic 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	:	Deutsches Institut für 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 substrate 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 e.g. Trichloroethylene 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 spray. 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 reapplied 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 pull 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 55928 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

Removal 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 200⁰C, upto 400⁰C, 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 < 400⁰C

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

Removal 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 to 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 500µm

Touch up after erection as required.

6.6 Painting of Pipes

6.6.1 Buried Piping

Internal surfaces

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

The total dry film thickness of 150 microns.

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

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 seawater 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

Repairing 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)	631/7078 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.



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
 TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
 A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

ANNEXURE VI

MANDATORY SPARE LIST



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

MANDATORY SPARES LIST FOR SEWAGE TREATMENT PLANT

Sl. No.	Name of Items	Unit	QUANTITY
1.0	CIRL DIAPHRAGM VALVE		
a)	Complete valve	Nos.	Two (2) Nos. each of different size of valve in the system
b)	Diaphragm	Nos.	Five (5) Nos. each of different sizes valves
c)	Valve spindle	Nos.	Two (2) Nos. each of different sizes valves
2.0	OTHER TYPE VALVE (EXCEPT CONTROL VALVE)		
a)	Complete valve	No.	One (1) No. each of different size of valve in the system
b)	Sampling & needle valve	Nos.	Four (4) Nos. each type & size
c)	Pressure Gauge	Nos.	Two (2) Nos. for each Range/Type
3.0	LEVEL GAUGE		
a)	Glass Tube	Nos.	Five (5) Nos. for each size
b)	Off-set valve	Nos.	Two (2) Nos. for each size
4.0	MAINTENANCE SPARES		
a)	Pressure Gauge	Nos.	Two (2) Nos. for each Range / Type
b)	Flow Indicator (Bypass / on line type)	Nos.	Two (2) Nos. for each size
c)	Float	No.	One (1) No. for each size
d)	Meter tube	No.	One (1) No. for each size
e)	Gaskets	Nos.	Three (3) Nos.
5.0	PH INSTRUMENT		
a)	Complete meter with cell & accessories	No.	One (1) No. for each size
b)	Neon lamp	Nos.	Eight (8) Nos. for each size.
c)	Power supply card	No.	One (1) No. for each size
d)	Amplifier PCB	No.	One (1) No. for each size
e)	Controller PCB	No.	One (1) No. for each size
f)	Transformer	No.	One (1) No. for each size
g)	Relay	No.	One (1) No. for each size
h)	Meter movement	No.	One (1) No. for each size
i)	Electrodes Assembly	No.	One (1) No. for each size
6.0	MOTORS – BEARINGS	Set	One (1) Set each for drive end and Non-drive end.
7.0	415 V MOTORS		
a)	Terminal plates	Nos.	10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW
b)	Heaters	Set	2 sets
c)	Greasing arrangements	Set	4 sets each type of motor
d)	Motor of each type and rating	No.	10% of the installed quantity or minimum 1 number whichever be higher
e)	Bearings (DE and NDE) for each type and rating of motor	Set	4 sets
8.0	MEASURING INSTRUMENTS		
8.01	Indicators, Recorders, Electrical Metering and Skid Mounted Instruments:		



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

(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 (As applicable)	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
8.02	Temperature Elements and Thermo wells		
(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)	Thermo wells	Nos.	10% for each type of temperature sensors or a minimum of one for each type, whichever is more
8.03	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.
9.0	Erection hardware		
9.01	Instrument valves	Nos.	Ten (10) percent of each type & Size installed
9.02	Condensate pots of each type & Size installed	Nos.	Ten (10) percent of total number of Installed or four numbers whichever is higher.
9.03	Manifold	Nos.	Ten (10) percent of each type & Size installed
9.04	Fittings	Nos.	Ten (10) percent of each type & Size installed
10.0	Mandatory spares not covered above		
10.1	Bidder to supply 10% or 1 no. (Whichever is more) of each type of sensor/instrument, instrumentation /mechanical fittings etc. for the system.		

MANDATORY SPARES: List of Mandatory Spares for Electric hoists are as follows & no Mandatory Spares are applicable for Chain Pulley Blocks.

Electric Hoists		
SL NO	ITEM DESCRIPTION	QTY
1	Brake linings	2 set of each type
2	Rope guide & rope tightener	1 no. of each type
3	Limit switch	2 set of each type & size
4	Gear box / gear set	2set of each type
5	Drum Bearing	1set of each type & rating



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

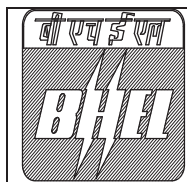
DATE :

NOTES:

- i) Unless stated otherwise, a "set" or "Lot" means items required for complete replacement in one equipment of each type / size/ range.
- ii) Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.
- iii) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the population of the item required for one unit of 660 MW in the station (project), unless specified otherwise.
- iv) All the Mandatory spares for the equipment under the contract provided by the vendor will strictly conform to the specifications and documents and will be identical to the corresponding main Equipment/components supplied under the contract.
- v) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments.
- vi) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise.
- vii) Inspection of mandatory spares shall be in line with the approved quality plans for the respective Items/equipments. The inspection categorisation of mandatory spares shall also be in line with the approved categorisation plan for the respective items/equipment.
- viii) These spares shall be considered as per the applicable items in main supply of respective packages.
- ix) In case, mandatory spares are not applicable as per equipment / item selected, bidder has to provide equivalent mandatory spare as per for selected equipment / item in line with list of mandatory spares.
- x) In case mandatory spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities in line with list of mandatory spares.

THE VENDOR WARRANTS:

1. That all spares supplied will be new and in accordance with the contract document and will be free from defects in design, material and workmanship and shall further guarantee as under:
2. In case of any failure in the original component/equipments due to faulty designs, materials and workmanship, the corresponding spare parts if any, supplied will be replaced without any extra cost to the BHEL and customer unless a joint examination and analysis by BHEL and/or customer of such spare parts prove that the defect found in the original part that failed can safely be assured not to be present in spare parts.
3. The long term availability of spares to the BHEL and the customer for the full life of the equipment covered under the contract and that before going out of production of spare parts of the equipment covered under the contract, vendor and his sub-vendors shall give the BHEL and



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

the customer at least 24 (Twenty-Four) months advance notice so that the latter may order his bulk requirements of spares, if he so desires. The same provision will also be applicable to the sub-vendors. Further, in case of discontinuance of manufacture of any spares by the vendors or his sub-vendors the vendors and his sub-vendors, will provide the BHEL and the customer, 2 (two) years in advance, with full manufacturing drawings, material specifications and technical information required by the BHEL and the customer for the purpose of manufacture of such items and also the right to manufacture such spares for their own requirements.

4. Further in case of discontinuance of supply of spares by the vendors or his sub-vendors, the vendor will provide the BHEL and the customer with full information for replacement of such spares with other equivalent makes, if so required by the BHEL and the customer.
5. Notwithstanding the above, the vendor shall be responsible for supply of spares for the lifetime of the package at reasonable prices. The prices of all future requirements of spares shall be derived from the corresponding ex-works price at which the orders for such spares have been placed by the BHEL and the customer as a part of the mandatory or long term or any other kind of spares. The base indices for calculating ex-works price shall be commissioning of last equipment under main contract.
6. The vendor will indicate the delivery period of the spares, which the BHEL and the customer may procure in accordance with this clause.
7. In case of emergency requirements of spares, the vendor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.
8. In case the vendor fails to supply the mandatory or long term or any other kind of spares on the terms stipulated above, the BHEL and the customer shall be entitled to purchase the same from the alternate sources at the risk and the cost of the vendor and recover from the vendor, the excess amount paid by the BHEL and the customer over the rates as per the contract. In the event of such risk purchase by the BHEL or the customer, the purchases will be as per the works and procurement policy of the BHEL and the customer prevalent at the time of such purchases and BHEL & the customer at his option may include a representative from the vendor in finalizing the purchases.
9. It is expressly understood that the final settlement between the parties in terms of relevant clauses of the tender document shall not relieve the vendor of any of his obligations under the provision of long term availability of spares and such provisions shall continue to be enforced till the expiry of 30 (thirty) years period reckoned from the scheduled date of completion of trial operation of the last equipment unless otherwise discharged expressly in writing by the BHEL or the customer.

**TITLE:****2X660 MW ENNORE SEZ STPP**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT****SUB-SECTION:IA**

REV. NO. 00

DATE :

ANNEXURE VII**DRAWING / DOCUMENTS SUBMISSION SCHEDULE**

	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION : I	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION:IA	
		REV. NO. 00	DATE :

After award of LOI/LOA, following minimum drawing/documents shall be submitted by the bidder for BHEL/Customer approval. However any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL.

For the Drawings/Documents Submission Procedure, please refer following Annexure-A. Bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. The number of drawing/documents to be submitted by the bidder shall be as per enclosed Annexure-V.

Every revised submission incorporating comments shall be resubmitted within 7 days.

BHEL shall provide observation / approval within 15 days from the date of document submission by bidder.

Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. Engineering meeting shall be held fortnightly, for which the bidder shall depute his concerned engineers along with project manager to PEM office or at customer office without fail.

Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account.

Sl. No.	DOCUMENT / DRAWING NO.	DRAWING / DOCUMENT TITLE	SCHEDULE OF SUBMISSION FROM LOI	SIZE
BASIC ENGINEERING DRAWING/ DOCUMENT				
1	PE-V0-411-673-A001	P&I Diagram for Sewage Treatment Plant	4	A1
2	PE-V0-411-673-A007	Design Calculation of Sewage Sump Pits (As applicable)	14	A4
3	PE-V0-411-673-A002	Layout of Sewage Treatment Plant	4	A1
4	PE-V0-411-673-A020	Operation & Control Philosophy SEWAGE TREATMENT PLANT	6	A4
5	PE-V0-411-673-A008	PROCESS DESIGN AND SIZING CALCULATION INCLUDING PRESSURE DROP CALCULATIONS (STP)	4	A4
6	PE-V0-411-673-A025	Sub Vendor List & inspection criteria for SEWAGE TREATMENT PLANT	4	A4
MANUFACTURING DRAWING/DOCUMENTS				
7	PE-V0-411-673-A016	Data Sheet of Agitator FOR SEWAGE TREATMENT PLANT	10	A4
8	PE-V0-411-673-A005	MECH. GA DRAWINGS OF ALL SEWAGE SUMPS AND TANKS FOR SEWAGE TREATMENT PLANT	10	A1
9	PE-V0-411-673-A040	QAP for Control Cable & screened control cables	10	A4
10	PE-V0-411-673-A039	Data sheet Control Cable & screened control cables	10	A4



TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
	SECTION : I	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	
	REV. NO. 00	DATE :

11	PE-V0-411-673-A015	TECHNICAL DATA SHEET FOR METERING PUMPS FOR SEWAGE TREATMENT PLANT	10	A4
12	PE-V0-411-673-A034	MECH. GA OF LAMELLA TUBE SETTLER CLARIFIER FOR SEWAGE TREATMENT PLANT	10	A1
13	PE-V0-411-673-A013	TECHNICAL DATA SHEET- INSTRUMENTS SEWAGE TREATMENT PLANT	10	A4
14	PE-V0-411-673-A010	DATA SHEET OF VALVES SEWAGE TREATMENT PLANT	10	A4
15	PE-V0-411-673-A027	QAP FOR METERING PUMPS WITH MOTOR FOR SEWAGE TREATMENT PLANT	10	A4
16	PE-V0-411-673-A036	TECHNICAL DATA SHEET OF MOTOR for SEWAGE TREATMENT PLANT	10	A4
17	PE-V0-411-673-A026	QAP FOR SUBMERSIBLE WITH MOTOR SEWAGE TREATMENT PLANT	10	A4
18	PE-V0-411-673-A011	TECHNICAL DATA SHEET OF SUBMERSIBLE PUMPS SEWAGE TREATMENT PLANT	10	A4
19	PE-V0-411-673-A035	QAP FOR VALVES SEWAGE TREATMENT PLANT	10	A4
20	PE-V0-411-673-A012	TECHNICAL DATA SHEET OF SCREW AND HORIZONTAL CENTRIFUGAL PUMPS FOR SEWAGE TREATMENT PLANT	10	A4
21	PE-V0-411-673-A028	QAP FOR BLOWERS WITH MOTOR FOR SEWAGE TREATMENT PLANT	10	A4
22	PE-V0-411-673-A033	QAP FOR LAMELLA CLARIFIER TUBE SETTLER FOR SEWAGE TREATMENT PLANT	10	A4
23	PE-V0-411-673-A014	TECHNICAL DATA SHEET OF BLOWERS SEWAGE TREATMENT PLANT	10	A4
24	PE-V0-411-673-A041	GA DRAWING FOR ELECTRIC HOIST, DSL ARRANGEMENT AND PAINTING DETAILS	12	A3
25	PE-V0-411-673-A042	SCHEMATIC CIRCUIT DIAGRAM FOR ELECTRIC HOIST	12	A4
26	PE-V0-411-673-A043	MECHANISM SIZING CALCULATION FOR ELECTRIC HOIST	12	A4
27	PE-V0-411-673-A044	MANUFACTURING QUALITY PLAN FOR ELECTRIC HOIST	12	A4
28	PE-V0-411-673-A045	MANUFACTURING QUALITY PLAN FOR CHAIN PULLY BLOCK	12	A4
29	PE-V0-411-673-A046	GA DRAWING FOR CHAIN PULLEY BLOCK WITH DETAIL BOM WITH PAINTING DETAILS	12	A3

DETAIL ENGINEERING DOCUMENT				
30	PE-V0-411-673-A037	CABLE TRAY/ TRENCH & CONDUIT ROUTING DIAGRAM OF STP	12	A1
31	PE-V0-411-673-A004	YARD PIPING LAYOUT OF STP	16	A1
32	PE-V0-411-673-A003	PIPING LAYOUT OF STP (INSIDE AREA)	10	A1
33	PE-V0-411-673-A017	Instrument Schedule SEWAGE TREATMENT PLANT	12	A4
34	PE-V0-411-673-A021	Valve Schedule SEWAGE TREATMENT PLANT	12	A4
35	PE-V0-411-673-A019	ELECTRICAL LOAD DATA SEWAGE TREATMENT PLANT	8	A4
36	PE-V0-411-673-A022	O & M Manual FOR SEWAGE TREATMENT PLANT	24	A4
37	PE-V0-411-673-A018	Cable Schedule FOR SEWAGE TREATMENT PLANT	16	A4

	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION : I	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION:IA	
		REV. NO. 00	DATE :

38	PE-V0-411-673-A023	Painting Schedule FOR SEWAGE TREATMENT PLANT	10	A4
39	PE-V0-411-673-A032	ENGINEERING BOQ FOR SEWAGE TREATMENT PLANT	20	A4
40	PE-V0-411-673-A030	ERECTION PROCEDURE SEWAGE TREATMENT PLANT	16	A4
41	PE-V0-411-673-A047	ERECTION PROCEDURE FOR ELECTRIC HOIST	16	A4
42	PE-V0-411-673-A048	O & M Manual FOR ELECTRIC HOIST AND CHAIN PULLEY BLOCK	24	A4
43	PE-V0-411-673-A031	PG TEST FOR SEWAGE TREATMENT PLANT	20	A4
44	PE-V0-411-673-A038	DCS ENGINEERING DOCUMENTS FOR STP	12	A4

Bidder to refer list of documents required in sub -section IC & II C of this specification also.

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.: -
 - a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
 - c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
 - d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
 - e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 etc.
 - f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.
 - g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION : I	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION:IA	
		REV. NO. 00	DATE :

- h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing no.
 - i) 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.
 - j) Bidder to follow the following the drawing submission schedule:
 - k) 1st submission of drawings from date of LOI as per the submission schedule.
 - l) Every revised submission incorporating comments – within 7 days.
 - m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.
5. 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 the Annexure III of this specification. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end:
- Internet explorer version – Minimum Internet Explorer 7
 - Internet speed – 2 mbps (Minimum preferred)
 - Pop ups from our external DMS IP (124.124.36.198) should not be blocked
 - Vendor's Internal proxy setting should not block DMS application's link (<http://124.124.36.198/wrenchwebaccess/login.aspx>)”
 - DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
 - For quick access bidder may refer the link <http://bhelpem.com/DMSManuals/DMSManuals.html>



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
 TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
 A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

ANNEXURE VIII

WATER ANALYSIS (NOT APPLICABLE)



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
 TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
 A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

ANNEXURE IX

LIST OF TOOLS & TACKLES (AS APPLICABLE)



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

Bidder to consider necessary tools and tackles for mechanical, electrical (Refer Sub section –I B & II B) and control & instrument (Refer Sub section –I C & II C) as per their system requirement. In addition, bidder to adhere relevant clauses of tender specification also.



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
 TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
 A001**

SECTION : I

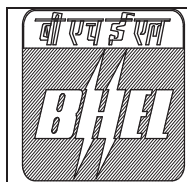
SUB-SECTION:IA

REV. NO. 00

DATE :

ANNEXURE X

FORMAT FOR OPERATION AND MAINTENANCE MANUAL



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

Bidder to submit operation and Maintenance manual with minimum information as listed in below check list during contract stage.

CHECK LIST FOR OPERATION & MAINTENANCE MANUAL

Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

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



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

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



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SPECIFICATION NO. PE-TS-412-673-
A001

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

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



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

ANNEXURE XI

SITE STORAGE AND PRESERVATION



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
 TREATMENT PLANT**

SPECIFICATION NO. PE-TS-412-673-
 A001

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

CONTENT

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



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SUB-SECTION:IA

REV. NO. 00

DATE :

1. SCOPE OF THE DOCUMENT

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

2. PURPOSE OF STORAGE & PRESERVATION

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

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

a) GENERAL STORAGE REQUIREMENTS

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



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SUB-SECTION:IA

REV. NO. 00

DATE :

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

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

b) GENERAL PRESERVATION REQUIREMENTS

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



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SUB-SECTION:IA

REV. NO. 00

DATE :

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.

11. Following preservatives/preservation methods can be used depending upon type of equipment

- a. Rust preventive fluid (RPF)
- b. Rust protective paints
- c. Tarpaulin covers, in case of outdoor storage
- d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

- Ingress of moisture and corrosion damages.
- Damage to protective coating.
- Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.

- In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
- Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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



ii Semi-closed storage. (S)

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





TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :



iii Open storage (O)

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

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

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





TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SUB-SECTION:IA

REV. NO. 00

DATE :

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

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



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SUB-SECTION:IA

REV. NO. 00

DATE :

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



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SUB-SECTION:IA

REV. NO. 00

DATE :

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



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SUB-SECTION:IA

REV. NO. 00

DATE :

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



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SUB-SECTION:IA

REV. NO. 00

DATE :

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



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

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



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
 TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
 A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

5. CONCLUSION

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

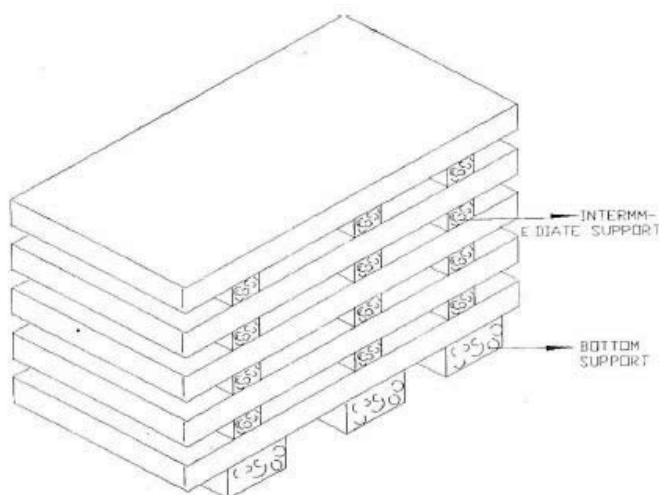


Figure – 1 – PLATE STACKING ARRANGEMENT

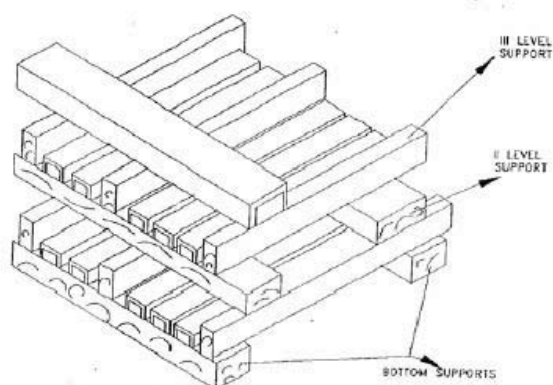


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
 TREATMENT PLANT**

**SPECIFICATION NO. PE-TS-412-673-
 A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

ANNEXURE XII

GENERAL TECHNICAL REQUIREMENTS (GTR)

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)

- (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.

- 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

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 at least 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

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.

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

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.

- 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 NO_x.
- 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.

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 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. Performance calculation Duct design. Pressure part	Failure analysis	Future plan for technology induction R&D work inprogress	

PRODUCT	AREAS OF TRAINING REQUIREMENT				
	Product Design	Plant Visit	Visit Manufacturer's Work To	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 Em- ployer's engineers with the help of trainer.				

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

PRODUCT	AREAS OF TRAINING REQUIREMENT				Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Product Design	Plant Visit				
	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	Familiarization of power plants of various makes of feed pumps	Manufacturing process of various components of BFP			
	Criteria for selection of boiler	Data collection of BFP	Assembly of BFP			

PRODUCT	AREAS OF TRAINING REQUIREMENT			Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Product Design	Plant Visit			
	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				Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Product Design	Plant Visit				
	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	Collection of data for analysis of availability of Condenser	Testing capability at works			
	Condenser support selection & design	O&M history/problems related to condenser	Product development in process			
	Sizing of condenser w.r.t. super critical units		Future plan for technology induction			
	Latest technological trends in condenser arrangement and design		R&D work in progress			
	Condenser vacuum system design					

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

AREAS OF TRAINING REQUIREMENT					
PRODUCT	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 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				Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Product Design	Plant Visit				
DDCMIS - Control System Hardware	Basic design features for system & its modules	Operation feedback			Manufacturing processes special attention to handling of the modules Maintenance facilities	
	System capabilities & system design techniques					
	Communication with MMI & other system					
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	Operational feedback	Manufacturing procedure & precautions for handling the system System testing facilities		
	Flame scanner location				
MANDAYS	16	6	6	12	
DDCMIS - EHTC, Turbine stress control system, Turbine protection system & ATRS	Basic design concept & features	Operational feedback	Manufacturing procedure & precautions for handling the system System testing facilities		
	Logics of turbine stress control system Implementation of failsafe philosophy in turbine protection system				
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						Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Product Design	Plant Visit						
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	(a) Manufacturing process for		
	- Insulation system	- Familiarisation with different sub-systems	- 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	- Manufacturing process & facilities for testing various equipment of excitation system		
	Excitor	- Familiarisation with various equipment functioning at reference plants			
	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 Work	Manufacturer's	Operation & Maintenance Of Plant
Boiler Feed pump H.T. Motor	Design Criteria for the	Operational feed back	Manufacturing process & test facilities		
	Stator core & wdg				
	Rotor core & wdg				
	Insulation system				
	Cooling arrangement				
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	Familiarization with feed back (in super critical plant) on failure analysis and vibration analysis of piping.	Cold Setting of spring hanger	
	Optimization study for sizing including pressure drop calculation and selection of single or double lead together with Owner's engineers	Study of Feed back regarding hanger setting strategies and practice	Cyclic tests carried on spring hangers.	
	Design and stress analysis of lines with Expansion Joints together with Owner's engineers		Cyclic tests carried on expansion joints	
	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.		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 treat ment 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	

	Project Stage Package Supplier Bidder No.	: : : : :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL	DOC.NO.: REV. NO.: DATE : PAGE : OF							
S. N.	Item	QP/ Cat.	Insp.	QP No.	QP 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.											

[illegible]

ANNEXURE-V

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

MFGR.'s LOGO		MANUFACTURER'S NAME AND ADDRESS		MANUFACTURING QUALITY PLAN						PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER:	
				ITEM :							
				SUB-SYSTEM:		QP NO.: REV.NO.: DATE: PAGE: OF....					
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTITY OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		REMARKS
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									
MANUFACTURER/ SUB-SUPPLIER		MAIN- SUPPLIER						DOC. NO.: REV..... CAT.....			
		FOR THE									

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

MFGR.'s LOGO		SUPPLIER'S NAME AND ADDRESS		FIELD QUALITY PLAN				PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER:	
				ITEM :		QP NO.: REV.NO.:			
				SUB-SYSTEM :		DATE: PAGE: OF			
SL NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS# OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	REMARKS
1. 2.		3.	4.	5.	6.	7.	8.	9.	10.
		LEGEND: * RECORDS, INDENTIFIED 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)	OWNE R USE	REVIEWED BY	APPROVE D BY	APPROV AL SEAL



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SUB-SECTION:

REV. NO. 00

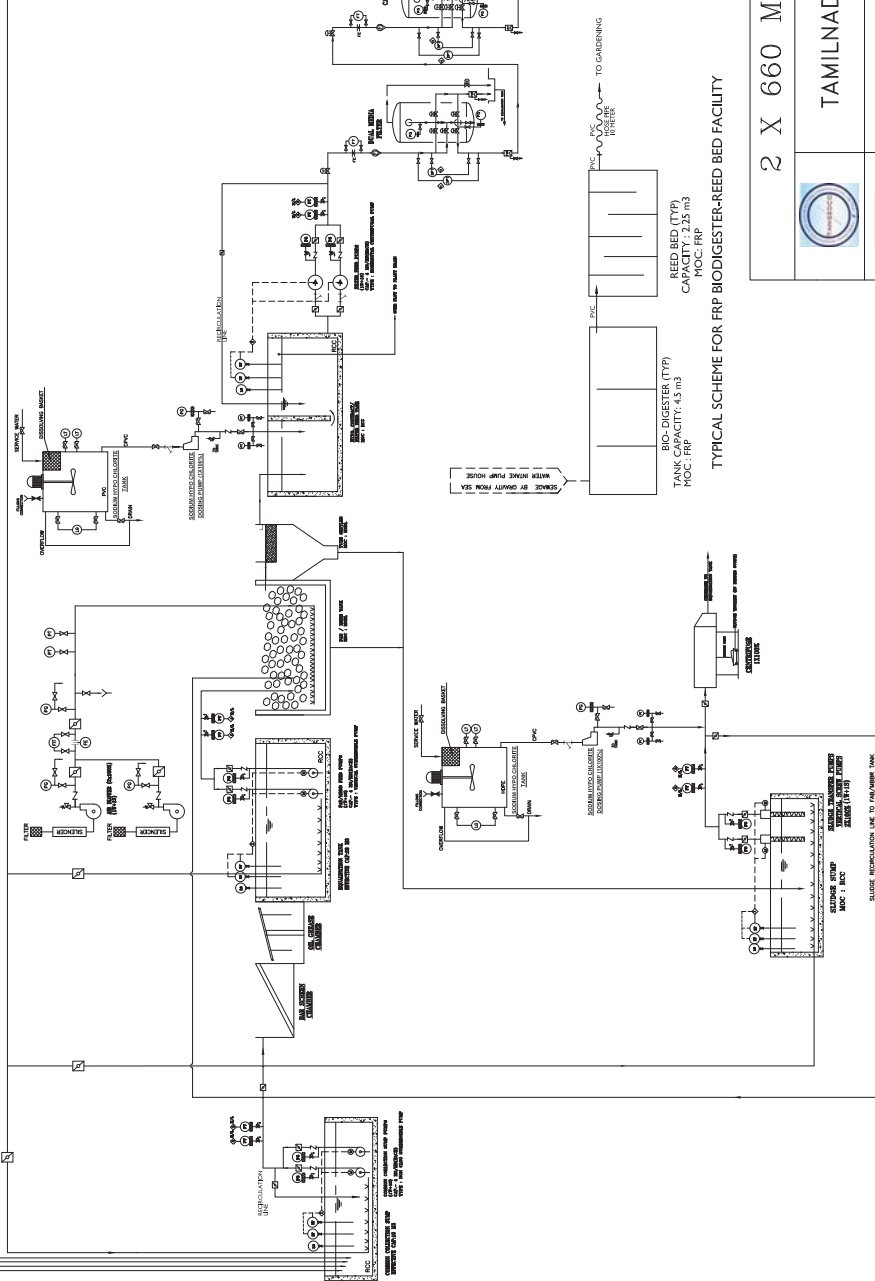
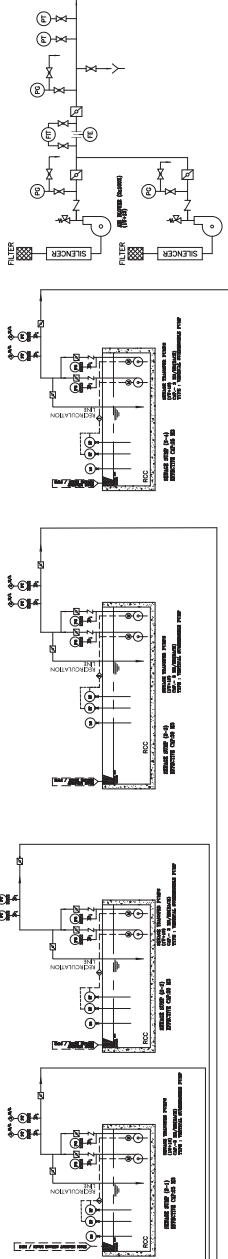
DATE :

P & ID

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

DRAWING NO.



TYPICAL SCHEME FOR FRP BIODIGESTER-REED BED FACILITY

LEGEND	
	GATE VALVE
	NON RETURN VALVE
	METERING/ DOSING PUMP
	STRAINER
	PRESSURE RELIEF VALVE
	DIAPHRAGM VALVE
	DIAPHRAGM SEAL
	VERTICAL SCREW PUMP
	BUTTERFLY VALVE
	3 WAY GAUGE COCK
	BALL VALVE
	HORIZONTAL CENTRIFUGAL PUMP
	AIR BLOWER
	FILTER MEDIA TRAP
	CARBON TRAP
INSTRUMENT LEGEND-	
	FIELD
	LEVEL
	INSTRUMENT
	PRESSURE
	GAUGE
	INTERLOCK
	LEVEL TRANSMITTER
	ALARM
	MOTOR
	FLOW INDICATOR CUM TRANSMITTER
	PRESSURE TRANSMITTER
	TURBIDITY METER
	FLOW ELEMENT
	TEMPERATURE INDICATOR
	pH ANALYSER
	FLOW INDICATOR

- NOTES :
1. THE P&I DIAGRAM IS INDICATIVE AND ONLY MINIMUM REQUIREMENT OF VALVES, INSTRUMENTATION ETC. HAS BEEN SHOWN. BIDDER SHOULD FURNISH COMPLETE P&I DIAGRAM WITH ALL NECESSARY VALVES, INSTRUMENTS AND PIPING TO BE PROVIDED AT SOURCE. MARK THE INSTRUMENTS 2-WAY MANIFOLD FOR PRESSURE, 3-WAY MANIFOLD FOR FLOW, 4-WAY MANIFOLD FOR FLOW AND PRESSURE. PROVIDE 2-WAY MANIFOLD FOR FLOW INDICATOR/ANALYTICAL INSTRUMENTS.
 2. INDICATED TERMINAL POINTS BETWEEN BHEL/CUSTOMER & BIDDER. BHEL SIDE - SCOPE OF BIDDER. CUSTOMER SIDE - SCOPE OF BIDDER.
 3. ALL THE INSTRUMENT ISOLATION VALVES OTHER THAN FOR CHEMICAL APPLICATION TO BE PROVIDED AT SOURCE. MARK THE INSTRUMENTS 2-WAY MANIFOLD FOR PRESSURE, 3-WAY MANIFOLD FOR FLOW, 4-WAY MANIFOLD FOR FLOW AND PRESSURE. PROVIDE 2-WAY MANIFOLD FOR FLOW INDICATOR/ANALYTICAL INSTRUMENTS.
 4. WHERE EVER PROVIDING 2-WAY MANIFOLD IS NOT FEASIBLE, TWO HANDBERS OF GLOBE VALVES SHALL BE PROVIDED TO MEET THE FUNCTION OF 2-WAY MANIFOLD. PROVIDE 2-WAY MANIFOLD FOR FLOW INDICATOR/ANALYTICAL INSTRUMENTS.
 5. ALL THE INSTRUMENT PART (EXCEPT AIR SERVICE) SHALL BE PROVIDED WITH DIAPHRAGM SEAL.
 6. FLOW TOLERANCE SHALL BE DONE IN SOFTWARE.
 7. ALL ISOLATED OPERATED VALVES SHALL BE PROVIDED WITH BHEL/TYPE VALVE.
 8. ALL THE INSTRUMENTS SHALL BE PROVIDED WITH BHEL/TYPE VALVE.
 9. ALL THE TRANSMITTERS PROCESS ACTIVATED SWITCHES ARE TO BE CONNECTED TO DCS.
 10. ALL THE ANALYSERS SHALL BE ANALYSED.
 11. ALL THE ISOLATION VALVES OF ALL THE INSTRUMENTS SHALL BE OF SS316 CONFORM TO ANSI 150# CLASS.
 12. DOUBLE ROOT VALVE WILL BE PROVIDED BY BIDDER WHEN LINE PRESSURE IS MORE THAN 40 BAR.
 13. LEVEL TRANSMITTERS FOR CHEMICAL TANKS SHALL BE ULTRASONIC TYPE.
 14. INSTRUMENTS SHALL BE PROVIDED WITH BHEL/TYPE VALVE.
 15. PHOSPHORY AND INTERLOCK/PROTECTION MODEL OF P&I REQUIREMENT SHALL BE PROVIDED BY BIDDER.
 16. ALL THE WIRING SHALL BE PROVIDED FOR EACH INSTRUMENT/ANALYTICAL DURING SIGNAL ENGINEERING.
 17. FLUSHING CONNECTIONS WITH VALVES SHALL BE PROVIDED FOR ALL PUMPS/PIPE LINE.

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.

REV.	DATE	APPD	CHD	ALTD	STATUS	JOB NO. 412
					DISTRIBUTION	
					CONTRACT	

2 X 660 MW ENNORE SEZ SUPER CRITICAL TPP		TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD.	
CONSULTANT: DESEIN PVT LTD, NEW DELHI.		BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NDIDA	
TITLE SEWAGE TREATMENT PLANT		DEPT CODE DRN DK DESN MKG CHD JP APPD PK	
DRAWING NO. PE-DG-412-673-A001		NAME SIGN	
SHEET 01 OF 01		DATE 10.3.2017	
REV 0		10.3.2017	
SIZE-A3		10.3.2017	

**TITLE:****2X660 MW ENNORE SEZ STPP**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT****SUB-SECTION: IA****REV. NO. 00****DATE :****DATASHEET – A FOR STP**

Sl. No.	DESCRIPTION	
1.0	Capacity of STP	75 m3/day
2.0	Common Collection Sump	
i)	Numbers Required	One (1) no.
ii)	Capacity	10 m3
iii)	MOC	RCC
iv)	Type of Aeration	Coarse Bubble Diffused Aeration Type
v)	Type of Diffusers	Coarse bubble diffusers with retrievable arrangement
vi)	No. of Diffusers	As per system requirement
vii)	No. of chain pulley block/electric hoist and capacity	One no., chain pulley block or electrical hoist as per specification requirement, capacity as per specification requirement.
viii)	Handrail	To be provided by bidder
3.0	Common Collection Sump Pumps	
i)	Numbers Required	2 nos. (1W+1S)
ii)	Type	Non-clog sump pumps ,Submersible grinder type
iii)	Flow	4.0 m3/hr
iv)	Head	As per process requirement
v)	Particle Size	Up to 20 mm
vi)	MOC	Casing – Cast Iron to IS 210 FG 260 Impeller- SS304
vii)	Drive Motor	Induction motor, 415V, 3 Φ, 50 Hz, TEFC, Energy Efficiency Class IE-3 as per IS : 12615
4.0	Screen Chamber	
i)	Numbers required	1 no.
ii)	Bar screen chamber MOC	RCC
iii)	Bar screen chamber capacity	As per process requirement
iv)	Type	Perforated sheet
v)	Cleaning	Manual
vi)	Angle of inclination	60°
vii)	Bar MOC	SS-304 fitted with MS frame
viii)	Velocity	<1.0 m/sec
ix)	Spacing of bar`	10 mm
5.0	Oil & Grease chamber	
i)	Numbers required	1 no.
ii)	Oil & grease chamber MOC	RCC
iii)	Oil & grease chamber capacity	As per process requirement

**TITLE:****2X660 MW ENNORE SEZ STPP**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT****SUB-SECTION: IA****REV. NO. 00****DATE :**

6.0	Oil & Grease Trap	
i)	Numbers Required	One (1) no.
ii)	Flow	3.5 m ³ /hr
iii)	MOC	RCC with baffle arrangements
iv)	Perforated pipe MOC	PVC/CS
7.0	Equalization Tank	
i)	Numbers Required	1 no.
ii)	Flow	3.5 m ³ /hr.
iii)	Detention Time	8 hours
iv)	MOC of Tank	RCC
v)	Depth	2.5 m
vi)	Type of Aeration	Coarse Bubble Diffused Aeration Type
vii)	Type of Diffusers	Coarse bubble diffusers with retrievable arrangement
viii)	No. of Diffusers	As per system requirement
ix)	No. of chain pulley block/electric hoist and capacity	One no., chain pulley block or electrical hoist as per specification requirement, capacity as per specification requirement.
x)	Handrail	To be provided by bidder
8.0	Common Air Blowers for Equalization Tank /Sludge Sump /Common Collection Sump	
i)	Numbers Required	2 nos. (1W+1S)
ii)	Type of Blower	Twin lobe type
iii)	Flow	To cater Air requirement for Equalization tank & Sludge Sump & Common Collection Sump
iv)	Head	As per process requirement
v)	MOC	CI to IS 210 Gr. FG 260
vi)	Accessories	NRV, Pressure Gauge, Safety valves
vii)	Drive Motor	Induction motor, 415V, 3 Φ, 50 Hz, TEFC, Energy Efficiency Class IE-3 as per IS : 12615
viii)	Common Base plate/ mounting plate	MS as per IS 2062
9.0	FAB/MBBR Feed Pumps	
i)	Numbers Required	2 nos. (1W+1S)
ii)	Type	Vertical Submersible Grinder type Pumps
iii)	Flow	4.0 m ³ /hr
iv)	Head	As per process requirement
v)	MOC	Casing – Cast Iron to IS 210 FG 260 Impeller & shaft - SS304
vi)	Particle Size	Up to 10 mm
vii)	Drive Motor	Induction motor, 415V, 3 Φ, 50 Hz, TEFC, Energy Efficiency Class IE-3 as per IS : 12615
10.0	FAB/MBBR Reactor	

**TITLE:****2X660 MW ENNORE SEZ STPP**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT****SUB-SECTION: IA****REV. NO. 00****DATE :**

i)	Numbers Required	One(1) no.
ii)	Flow	3.5 m ³ /hr.
iii)	Food to Microorganism(F/M) Ratio	0.1-0.15 Kg BOD/ Kg MLSS/ day
iv)	MLSS (Mixed Liquor Suspended Solids)	3000-6000 mg/l
v)	MOC of Tank	MSRL
vi)	Depth	Minimum 4-5 m
vii)	Type of Aeration	Coarse Bubble Diffused Aeration Type
viii)	Type of Diffusers	Coarse bubble diffusers with retrievable arrangement
ix)	No. of Diffusers	As per system requirement
x)	Fab Media	PVC
xi)	Media Qty	As per system requirement
xii)	Free Board	500 mm
xiii)	Volume (in m ³)	As per process requirement
11.0	Air Blowers for FAB/MBBR Tank	
i)	Numbers Required	2 nos. (1W+1S)
ii)	Type of Blower	Twin lobe type
iii)	Flow	To cater Air requirement of FAB tank
iv)	Head	As per process requirement
v)	MOC	CI to IS 210 Gr. FG 260
vi)	Accessories	NRV, Pressure Gauge, Safety valves
vii)	Drive Motor	Induction motor, 415V, 3 Φ, 50 Hz, TEFC, Energy Efficiency Class IE-3 as per IS : 12615
viii)	Common Base plate/ mounting plate	MS as per IS 2062
12.0	Tube settler (Secondary Settler)	
i)	Numbers Required	One (1) no.
ii)	Flow	3.5 m ³ / hr.
iii)	Surface flow rate	2 m ³ / m ² /hr.
iv)	MOC of settler	MSRL
iv)	Quantity of tube settler media	As per process requirement
v)	MOC of media	PVC
vi)	Free board	500 mm
13.0	Hypo Contact Cum Filter Feed Tank	
i)	Numbers Required	One (1) no.
ii)	Capacity	As per Process requirement
iii)	MOC	RCC
iv)	Handrail	To be provided by bidder
14.0	Hypo Dosing System	
14.1	Hypo Dosing Tank	
i)	Numbers Required	One (1) no.
ii)	Capacity	100 liters OR 24 hour storage requirement @2 ppm dosing rate whichever is higher
iii)	MOC	PVC
14.2	Hypo Dosing Pump	
i)	Quantity	One (1) no.
ii)	Capacity	0-6 LPH or 2 ppm continuous dosing rate requirement whichever is higher
iii)	Type	Metering Pump
iv)	MOC	PP

**TITLE:****2X660 MW ENNORE SEZ STPP**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT****SUB-SECTION: IA****REV. NO. 00****DATE :**

v)	Drive Motor	Induction motor, 415V, 3 Φ , 50 Hz, TEFC, Energy Efficiency Class IE-3 as per IS : 12615
15.0	Filter Feed Pumps	
i)	Quantity	Two (2X100%) nos. (1W+1S)
ii)	Type & Operation	Horizontal Centrifugal, Continuous
iii)	Suction condition	Flooded.
iv)	Capacity	4.0 m ³ /hr.
v)	Head	As per process requirement
vi)	Material of Construction	
	• Casing	Cast Iron IS:210 Gr FG 260
	• Impeller	Stainless steel CF 8M
	• Shaft & Shaft sleeve material	Stainless steel SS Gr. 304 & SS316
	• Packing seal	Mechanical type
	• Drive motor	Induction motor, 415V, 3 Φ , 50 Hz, TEFC, Energy Efficiency Class IE-3 as per IS : 12615
	• Common base plate	Carbon steel IS:2062
vii)	Noise level	85 DBA
viii)	Vibration	As per HIS
ix)	RPM	1500 approx.
x)	Drive motor	Induction Motor 415V, 3 Phase, 50 Hz, TEFC, Energy Efficiency Class IE-3 as per IS : 12615
xi)	Interconnecting Piping Material	Carbon Steel with Rubber lining.
16.0	Dual Media Filter	
i)	Quantity	1 no.
ii)	Capacity	3.5 m ³ /hr.
iii)	Surface flow rate	10 m ³ /hr./m ²
iv)	Size	As per process requirement
v)	Design pressure	6 Kg/ cm ² (g)
vi)	MOC	FRP
vii)	Media	Graded quartz sand free from carbonates and other foreign material and anthracite.
viii)	Rising Space(Free board)	100 %
17.0	Activated Carbon Filter	
i)	Quantity	1 no.
ii)	Capacity	3.5 m ³ /hr.
iii)	Surface flow rate	12 m ³ /hr./m ²
iv)	Size	As per process requirement
v)	Design pressure	6 Kg/ cm ² (g)
vi)	MOC (Shell & Dish)	FRP
vii)	Media	Activated Carbon
viii)	Supporting Media	Graded Gravel
ix)	Minimum Bed depth	1200 mm
x)	Rising Space(Free board)	100 %

**TITLE:****2X660 MW ENNORE SEZ STPP**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT****SUB-SECTION: IA****REV. NO. 00****DATE :**

18.0	Treated Water Tank	
i)	Number required	1 no.
ii)	Capacity (Effective)	28 m3
iii)	Flow	3.5 m3/hr.
iv)	Detention Time	8 Hrs.
v)	MOC of tank	RCC
vi)	Depth	2.5 m- 4 m
vii)	Handrail	To be provided by bidder
19.0	Treated Water Disposal Pumps	
i)	Quantity	Two (2X100%) nos. (1W+1S)
ii)	Type & Operation	Horizontal Centrifugal, Continuous
iii)	Suction condition	Flooded.
iv)	Capacity	4.0 m3/hr.
v)	Head	As per process requirement
vi)	Material of Construction	
	• Casing	Cast Iron IS:210 Gr FG 260
	• Impeller	Stainless steel CF 8M
	• Shaft & Shaft sleeve material	Stainless steel SS Gr. 304 & SS316
	• Packing seal	Mechanical type
	• Drive motor	Induction Motor 415V, 3 Phase, 50 Hz, TEFC, Energy Efficiency Class IE-3 as per IS : 12615
	• Common base plate	Carbon steel IS:2062
vii)	Noise level	85 DBA
viii)	Vibration	As per HIS
ix)	RPM	1500 Approx.
x)	Drive motor	Induction Motor 415V, 3 Phase, 50 Hz, TEFC, Energy Efficiency Class IE-3 as per IS : 12615
xi)	Interconnecting Piping Material	Carbon Steel with Rubber lining.
20.0	Sludge Sump (waste Pit)	
i)	Number required	1 no.
ii)	MOC & type	RCC, Under Ground, Outdoor Location
iii)	Capacity (Effective)	As per Process requirement
iv)	Instrumentation	As per P&ID
v)	Inside Protection	5 mm thick coal tar epoxy screened lining
vi)	No. of chain pulley block/electric hoist and capacity	One no., chain pulley block or electrical hoist as per specification requirement, capacity as per specification requirement.
vii)	Handrail	To be provided by bidder
21.0	Sludge transfer Pumps	
i)	Quantity	Two (2X100%) nos. (1W+1S)
ii)	Type	Vertical Screw Pumps
iii)	Location	Outdoor
iv)	Service	Intermittent



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

v)	Suction condition	Flooded.
vi)	Rated Flow	As per process requirement or 2 m ³ /hr whichever is higher.
vii)	Head	As per process requirement
viii)	Type of fluid handled	Sludge from system
ix)	Material of Construction	
	• Casing	2% Ni-CI to IS:210 Gr FG 260
	• Rotor	SS-316
	• Stator	Nitrile/EPDM
	• Shaft	SS-316
	• Drive motor	Induction Motor 415V, 3 Phase, 50 Hz, TEFC, Energy Efficiency Class IE-3 as per IS : 12615
x)	Noise level	85 DBA
xi)	Vibration	As per HIS
xii)	RPM	1500 Approx.
xiii)	Drive motor	Induction Motor 415V, 3 Phase, 50 Hz, TEFC, Energy Efficiency Class IE-3 as per IS : 12615
22.0	Centrifuge	
i)	Quantity	One (1) number (1X100%)
ii)	Type	Decanter
iii)	Inlet concentration	2%
iv)	Outlet concentration	20% (min.)
v)	Capacity	As per process requirements
vi)	Liquid handled	Secondary sludge
vii)	Material of construction	Wetted parts: SS304 Other parts : MSEP/CI
viii)	Motor	IP-55 with outdoor installation, 3 phase, 415 V, TEFC type squirrel cage induction motor, Rating as per requirement, Energy Efficiency Class IE-3 as per IS : 12615
ix)	Base Frame	MS Fabricated (
x)	Accessories	Suitable piping, valves, pressure gauge at delivery pulley, V-belt drive, foundation bolts etc.
xi)	No. of electric hoist and capacity	One no., Capacity as per specification requirement.
23.0	Hypo Dosing System for centrifuge	
23.1	Hypo Dosing Tank	
i)	Numbers Required	One (1) no.
ii)	Capacity	24 hour storage requirement @2 ppm dosing rate (minimum) or as per process requirement whichever is higher
iii)	MOC	HDPE
23.2	Hypo Dosing Pump	
i)	Quantity	One (1) no.
ii)	Capacity	2 ppm continuous dosing rate requirement
iii)	Type	Metering Pump
iv)	MOC	PP
v)	Drive Motor	Induction motor, 415V, 3 Φ , 50 Hz, TEFC, Energy Efficiency Class IE-3 as per IS : 12615

**TITLE:****2X660 MW ENNORE SEZ STPP**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT****SUB-SECTION: IA****REV. NO. 00****DATE :**

24.0	Sewage Sumps (Outside STP Area)	
i)	Sewage sump S1, S2, S3, S4	Capacity as per P&ID
ii)	MOC	RCC
iii)	Type	Covered at top, below ground
iv)	Accessories	Coarse bar screen (MOC : MSEP) at each sump location
v)	Handrail	To be provided by bidder
vi)	No. of chain pulley block/electric hoist and capacity	One no. at each sump location , chain pulley block or electrical hoist as per specification requirement, capacity as per specification requirement.
25.0	Sewage Transfer Pumps(Outside STP Area)	
i)	Type	Vertical submersible grinder type,
ii)	Quantity per sump	2 X 100 %
iii)	Capacity	As per P & ID of Sewage Treatment plant
iv)	MOC casing	Cast Iron to IS 210 FG 260
v)	MOC impeller	Stainless Steel AISI 304
vi)	MOC shaft	SS 410
vii)	Drive Motor	Induction motor, 415V, 3 Φ , 50 Hz, TEFC, Energy Efficiency Class IE-3 as per IS : 12615

Further bidder to provide 1 no. Common chain pulley block (portable type) for handling of filter feed pump & treated water disposal pumps alongwith motor as per specification requirement, capacity shall be selected based on heaviest pump with motor weight from the above listed two drives & as per specification requirement.

For piping and valves specification bidder to refer specification of LP PIPING, VALVES & SPECIALITIES Included under section II-A mechanical of this technical specification.

PUMPS AND PIPE SELECTION CRITERIA

Pump and Pipeline carrying water and chemicals etc. shall generally be sized on the following velocities. However wherever minimum pipe sizes are defined in the drawing/datasheets, the selected size shall not be less than the specified size.

	VELOCITY IN m/sec.		
	BELOW 50 MM.	50-150 MM	200 MM AND ABOVE
Pump Suction for water	-----	1.2-1.5	1.2-1.8
Pump discharge for water	1.2-1.8	1.8-2.4	2.1-2.5
Header for water	-----	1.5-2.4	2.1-2.4
Pump Suction for chemical solution	1.0-1.2	1.1-1.3	-----
Pump discharge for chemical solution	1.2-1.4	1.3-1.5	-----
Gravity flows	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.		

Note 1- All piping system shall be capable of withstanding the maximum pressure in the corresponding line.

**TITLE:****2X660 MW ENNORE SEZ STPP**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT****SUB-SECTION: IA****REV. NO. 00****DATE :**

Note 2- TDH of all pumps shall be decided by the supplier assuming the following 'C' values in Hazen & Williams equation for calculation of friction loss.

- a) Carbon steel pipes – 100
- b) CI Pipes /Ductile Iron pipes –100
- c) Rubber lined steel pipe – 120
- d) PVC/HDPE pipes – 140
- e) Stainless steel pipes -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.

TECHNICAL DATASHEET-A FOR ELECTRIC HOIST:

Sl.no	DESCRIPTION	TECHNICAL PARTICULARS
1.0	Type	Steel wire electric hoist with electrically operated trolley
2.0	Scope (Qty., Capacity, Lift, Travel Length)	As per specification and layout requirement
3.0	Type of service	Indoor
4.0	Overload test	125% of SWL
5.0	Design Ambient temperature	50° C
6.0	General Design	As per IS: 3938 / 1983 or latest, Class-II duty
6.1	Design standards	IS: 3938, IS: 2266, IS: 4029, IS: 900, IS: 4237, IS: 694, IS: 3043, IS: 1822, IS: 2147, IS: 1554, IS: 325, IS: 15660, IS 9968 Part I etc as per latest revision
6.2	Duty class	Class II duty
7.0	Operating speed	
7.1	Hoisting speed	3 MPM
7.2	Trolley speed	6 MPM
8.0	Type of transmission	Through Electric motor and gear box.
9.0	Wire Rope	
9.1	Construction / core	6 x36 construction, steel core/Fibre core



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

9.2	Code	IS:2266
9.3	Number of falls	Min. 4
9.4	Factor of safety	Not less than 5
10.0	Load Hook and block	NORMALISED HOOK ONLY
10.1	Type of load hook	Plain shank trapezoidal section with safety latch.
10.2	Load hook Code	IS: 15560
10.3	Load hook Material	As per IS:15560
10.4	Hook suspension	Thrust bearing
10.5	Material of block suspension	Fabricated from steel plate, Material: IS: 2062
11.0	Gearing	
11.1	Type	Spur / Helical
11.2	Gear/ pinion material	as per IS 3938
11.3	Lubrication	Oil splash/ grease lubricated
11.4	Bearing type	Antifriction Ball / Roller
12.0	Trolley drive	
12.1	Wheel	Single flange taper thread
12.2	Wheel conform to (Std. / code)	IS: 3938
12.3	Wheel material	C55Mn75/ En-8/ En-9. (Max hardness 200 BHN)
12.4	Bearing type	Antifriction Ball / Roller
12.5	Trolley type	Rolled structural steel with side plates extended beyond wheel flanges to protect wheels.
12.6	Hardness	Max hardness 200 BHN
13.0	SHEAVE	
13.1	Material	Fabricated from steel plate. IS: 2062 Gr. A or Gr. B / as per IS: 3938
13.2	Bearing type	Antifriction Ball / Roller.
14.0	BRAKE (HOIST and TROLLEY)	
14.1	Type	DCEM brakes disc type (fail to safety).
14.2	Capacity	As per IS 3938.
14.3	Number	One number for each motor.
15.0	ROPE DRUM	
15.1	Material	Cast iron, cast steel or mild steel.



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

15.2	Flange / Flangeless	Flanged
15.3	Type of groove	As per manufacturers standard to suit the layout requirement.(Shall be decided during detail engineering)
17.0	TYPE OF DSL	
17.1	CT travel	PVC Shrouded bus bar conductor type DSL
18.0	MOTORS	
18.1	Type	Sq. Cage induction, TEFC, S4 duty, 40% CDF.
18.2	Number of start	300 starts / hr
18.3	Voltage , Phase and Frequency	415V $\pm 10\%$, 3 phase, 4 wire, 50 Hz
18.4	Class of insulation	Class "F" and temperature rise limited to class B.
18.5	Type of enclosure	TEFC
18.6	Degree of protection provided for enclosure	IP-54/55 (indoor/outdoor)
18.7	Margin	10% over maximum continuous load demand
19.0	LIMIT SWITCHES	Hoisting
19.1	Type	Snap action, self actuating type
20.0	Control panel	* Fabricated from Cold rolled sheet steel not less than 2.5mm for front & rear & 2mm for side, top & bottom portion with gland plate of 3mm thick. * Degree of protection shall be IP 54. * Power on indicating lamps shall be provided * Panel illumination lamps operated by door switch. * 2 nos earthing terminals on panel. * 20 % spares terminals (clip on type) shall be provided. * Power and control terminals (clip on type) shall be on separate channels. * Gland plate shall be double brass compression type.
20.1	Qty	1 No.
21.0	Pendent Push buttons	Up /down / forward / Reverse push buttons. Indicative marking for easy operation shall be provided.
22.0	Power cables	1.1 KV grade XLPE power cables shall have compacted aluminium conductor for cables including 10 sq. mm and above and copper conductor for cables below 10 sq.mm, XLPE insulated, PVC inner-sheathed (as applicable), armoured, FRLS PVC outer-sheathed conforming to IS: 7098. (Part-I).
23.0	Control cable	Control cable shall be multi core, minimum 2.5 sq.mm cross section, stranded copper conductor, PVC insulated, inner PVC sheathed / galvanized steel wire armored and outer sheath made of FRLS PVC compound. In situation where accuracy of measurement or voltage drop in control circuit, warrant, higher cross sections as required



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SUB-SECTION: IA

REV. NO. 00

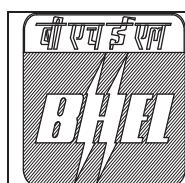
DATE :

		shall be used. 4 sq.mm copper conductors shall be used for CT circuits, all other specification remaining same. In 4 sq.mm conductor impose unacceptable high burden on CTs, higher cross section of conductor shall be used.
24.0	Flexible trailing cable	1.1 KV grade Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90°C continuous conductor temperature and 250 deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968
25.0	Control Voltage	110 V

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

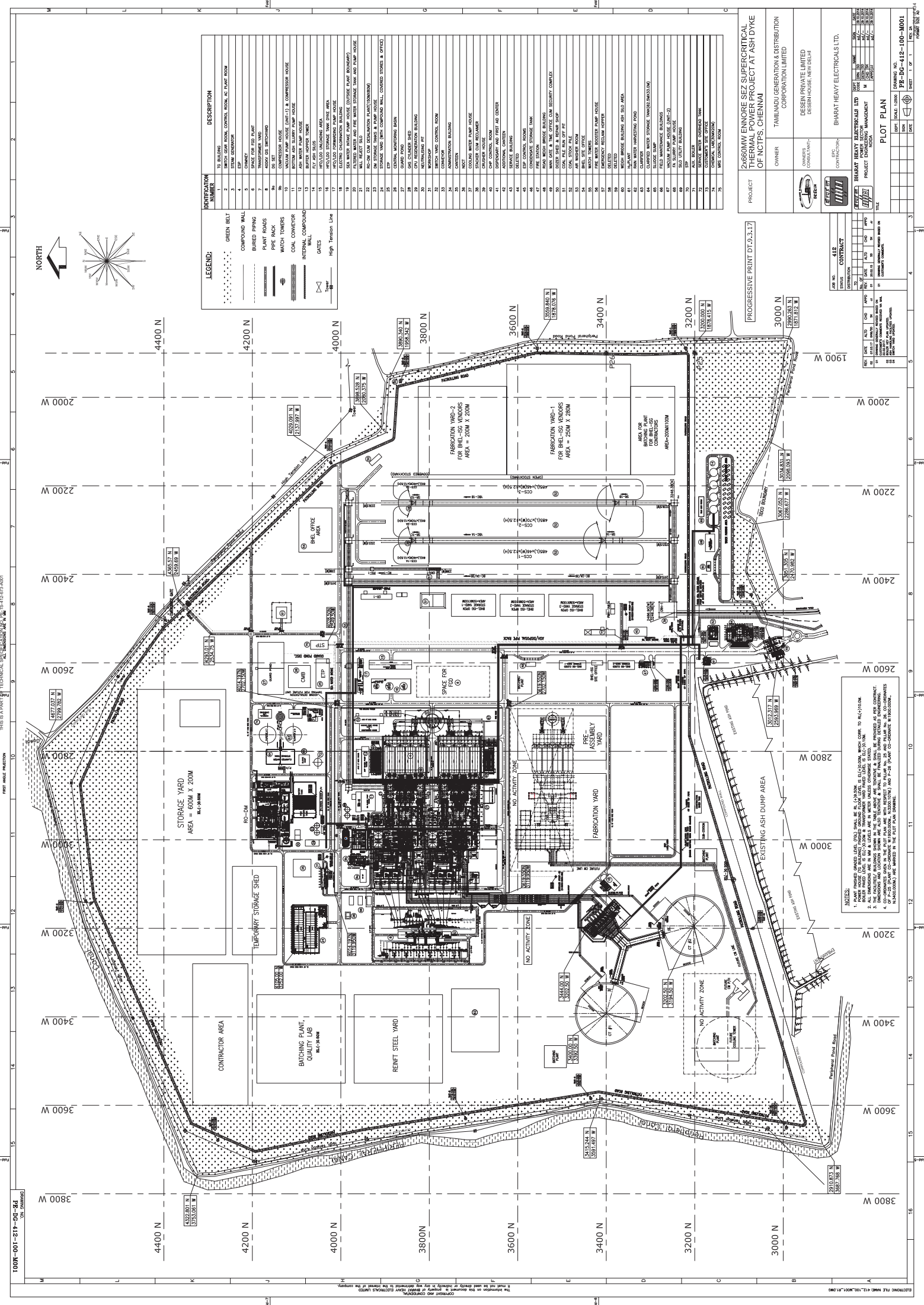
DATA SHEET-A

- 1.00.00 Type : Hand operated chain pulley block
- 2.00.00 Area : As per scope sheet attached
- 3.00.00 Design : IS: 3832, IS: 2429, IS 15560, IS 210, IS 4367, IS 6216, IS: 4460. (All standards shall be of latest revision)
- 4.00.00 Duty Class as per IS:3832 : Class –II
- 5.00.00 Hoisting Mechanism
- a) Type : Hand operated gear transmission
- b) Type of gear : Spur / Helical
- c) Load Chain :
i) Type : Link type
ii) Material : Alloy steel grade 80 as per IS: 6216
iii) Conforms to (Std./Code) : IS: 6216
- d) Hand Chain :
i) Type : Link type
ii) Material : Mild steel (grade 30) as per IS 2429 Part I
- e) Load Hook & Hook Block :
i) Type of load hook : Plain shank- Trapezoidal section
ii) Load hooks conform to : IS: 15560
/ Material
iii) Type of hook suspension : Swivelling
iv) Type of make of bearing : Thrust ball bearing
of hook suspension



TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
	SECTION : I	
	SUB-SECTION: IA	
	REV. NO. 00	DATE :

- f) Gears/pinion :
- i) Type : Spur
- ii) Material : Alloy steel / carbon steel (Material confirming to IS 3832)
- iii) Type of bearing used : Antifriction ball bearing / Roller
- g) Sprockets
- i) Type of bearings used : Antifriction ball bearing / Roller
- h) Method of lubrications Used
- i) Bearings : Grease
- ii) Gearing & Pinions : Grease
- iii) Sprockets : Grease
- i) Brakes
- i) Type : Ratchet and pawl arrangement along with screw and friction disc type
- 6.00.0 Trolley & Bridge Drive
- a) Trolley
- i) Type : Geared (Manually operated)
- ii) Material of frame : Rolled structural steel (IS:2062 Grade A or B)
- b) Drive Chain
- i) Type : Link type
- ii) Material : Steel Gr.30
- c) Trolley Wheel
- i) Number of pairs of wheel : Two/four
- in each trolley/bridge
- ii) Flange : Single flanged
- iii) Wheel material : Heat Treated Carbon steel/low alloy steel/graded cast iron (Material confirming to IS 3832)
- iv) Type of bearings need : Antifriction
- d) Gears
- i) Type : Spur / helical
- ii) Material : Alloy/ Carbon steel (Material confirming to IS 3832)
- iii) Type of bearings used : Antifriction
- e) Method of lubrication for
- i) Bearings : Grease
- ii) Sprockets : Grease
- f) Load chain wheel
- i) Material : SG iron/ Steel casting/IS 3832
- g) Hand chain wheel
- i) Material : SG iron/ Steel casting/Grey iron Casting./IS 3832



IDENTIFICATION NUMBER	DESCRIPTION
1	STEEL ROOF
2	STEEL ROOF
3	STEEL ROOF
4	STEEL ROOF
5	STEEL ROOF
6	STEEL ROOF
7	STEEL ROOF
8	STEEL ROOF
9	STEEL ROOF
10	STEEL ROOF
11	STEEL ROOF
12	STEEL ROOF
13	STEEL ROOF
14	STEEL ROOF
15	STEEL ROOF
16	STEEL ROOF
17	STEEL ROOF
18	STEEL ROOF
19	STEEL ROOF
20	STEEL ROOF
21	STEEL ROOF
22	STEEL ROOF
23	STEEL ROOF
24	STEEL ROOF
25	STEEL ROOF
26	STEEL ROOF
27	STEEL ROOF
28	STEEL ROOF
29	STEEL ROOF
30	STEEL ROOF
31	STEEL ROOF
32	STEEL ROOF
33	STEEL ROOF
34	STEEL ROOF
35	STEEL ROOF
36	STEEL ROOF
37	STEEL ROOF
38	STEEL ROOF
39	STEEL ROOF
40	STEEL ROOF
41	STEEL ROOF
42	STEEL ROOF
43	STEEL ROOF
44	STEEL ROOF
45	STEEL ROOF
46	STEEL ROOF
47	STEEL ROOF
48	STEEL ROOF
49	STEEL ROOF
50	STEEL ROOF
51	STEEL ROOF
52	STEEL ROOF
53	STEEL ROOF
54	STEEL ROOF
55	STEEL ROOF
56	STEEL ROOF
57	STEEL ROOF
58	STEEL ROOF
59	STEEL ROOF
60	STEEL ROOF
61	STEEL ROOF
62	STEEL ROOF
63	STEEL ROOF
64	STEEL ROOF
65	STEEL ROOF
66	STEEL ROOF
67	STEEL ROOF
68	STEEL ROOF
69	STEEL ROOF
70	STEEL ROOF
71	STEEL ROOF
72	STEEL ROOF
73	STEEL ROOF
74	STEEL ROOF
75	STEEL ROOF

PROJECT

2460MW ENHANCED SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI

OWNER

TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED

DESIGNER

DEEPA ENGINEERING PRIVATE LIMITED

CONTRACTOR

BARATH HEAVY ELECTRICALS LTD.

CLIENT

BARATH HEAVY ELECTRICALS LTD.

PROJECT LOCATION

CHENNAI, INDIA

SCALE

1:1000

DATE

10/01/2024

BY

DESIGNER

CHECKED BY

DESIGNER

APPROVED BY

DESIGNER

REVISIONS

1. 10/01/2024

PROJECT PLAN

PJ-412-100-M01

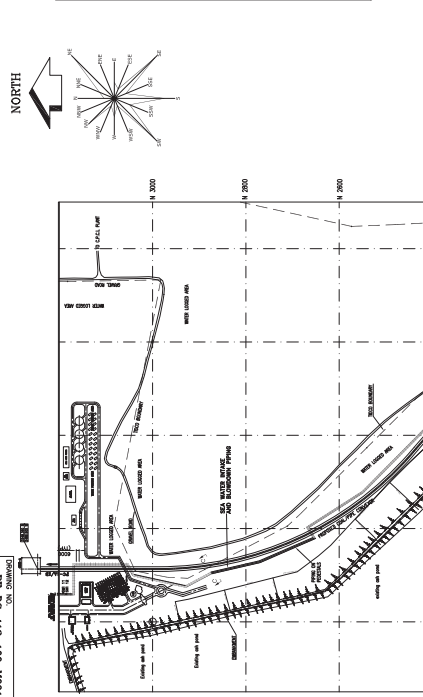
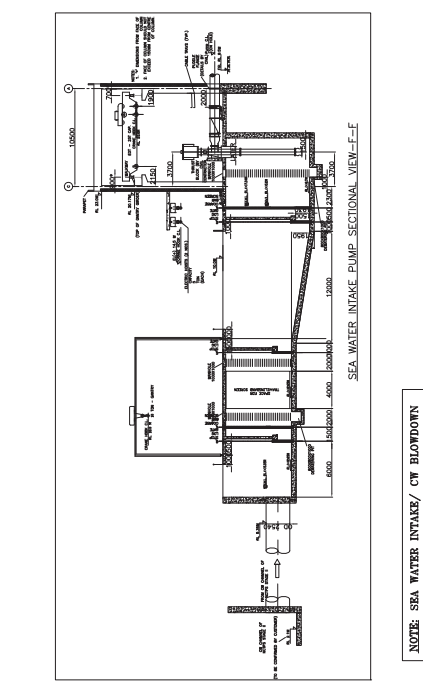
SHEET 1 OF 1

REV. 2

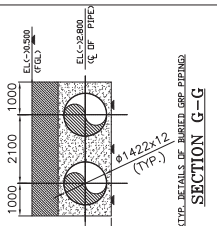
THIS IS A PART OF TECHNICAL SPECIFICATION AND IS NOT TO BE USED IN ISOLATION. THE INFORMATION IN THIS DRAWING IS THE PROPERTY OF THE DESIGNER AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, WITHOUT PERMISSION IN WRITING FROM THE DESIGNER.

NOTES:

1. PLANT FINISHED GRADE LEVEL (FGL) SHALL BE AS PER THE FGL DATA PROVIDED BY THE CLIENT.
2. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
3. ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE SPECIFIED.
4. DIMENSIONS AND LOCATION SHOWN ARE ALSO SUBJECT TO CHANGE AND SHALL BE FINISHED AS PER THE CONTRACT.
5. ALL DIMENSIONS AND LOCATION SHOWN ARE ALSO SUBJECT TO CHANGE AND SHALL BE FINISHED AS PER THE CONTRACT.
6. ALL DIMENSIONS AND LOCATION SHOWN ARE ALSO SUBJECT TO CHANGE AND SHALL BE FINISHED AS PER THE CONTRACT.



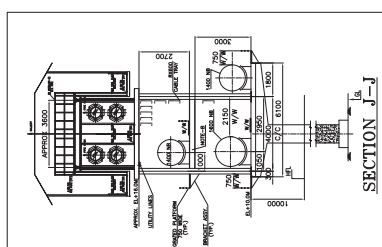
NOTES:



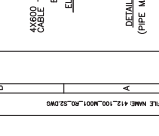
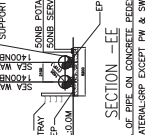
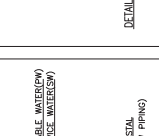
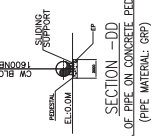
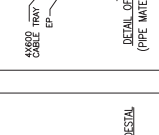
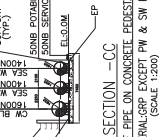
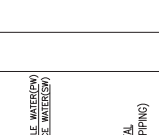
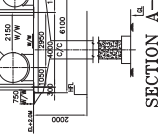
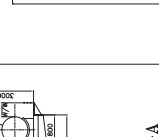
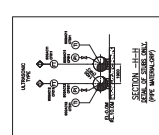
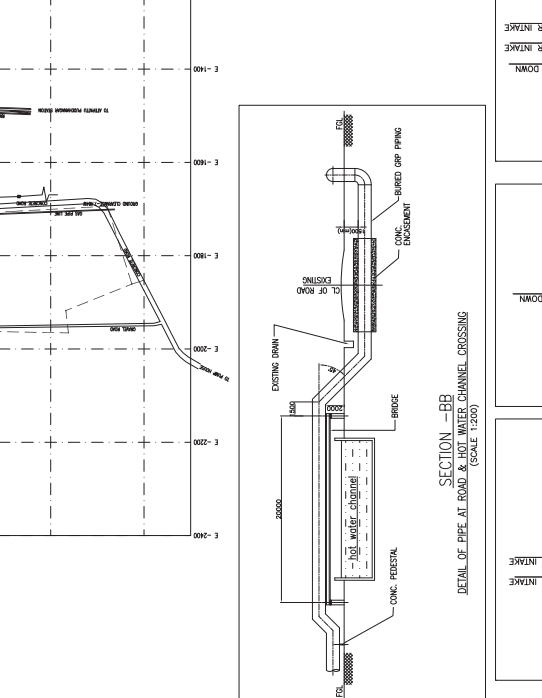
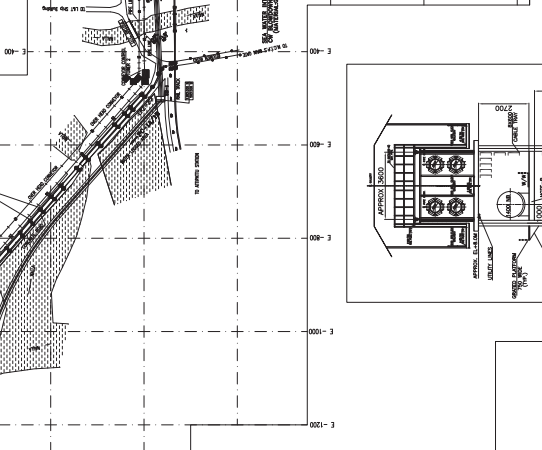
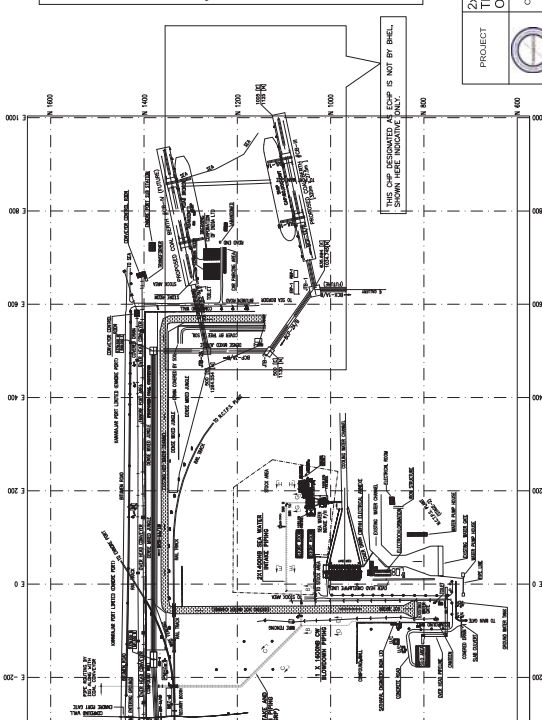
STYP. DETAILS OF BURIED GRP PIPING



10



— [a] —



PROJECT		OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED												
		OWNER'S CONSULTING ENG.	DESEN PRIVATE LIMITED DESEN HOUSE, NEW DELHI												
		EPIC CONTRACTORS	SHARAT HEAVY ELECTRICALS LTD.												
		SHARAT HEAVY ELECTRICALS LTD PROJECT MANAGER PROJECT ENGINEERING MANAGER	<table><tr><td>DATE</td><td>NO.</td><td>DATE</td><td>NO.</td><td>DATE</td><td>NO.</td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr></table>	DATE	NO.	DATE	NO.	DATE	NO.						
DATE	NO.	DATE	NO.	DATE	NO.										
 DRAWING NO. PR-324-412-100-M048															
 SHEET 1 OF 1															

[illegible][illegible]

Technical drawing of a mechanical assembly, likely a pump or motor component. The drawing includes a side view (top) and a cross-sectional view (bottom). The side view shows a cylindrical body with a flange, a central shaft, and a mounting bracket. Dimensions are given in millimeters (mm). The cross-sectional view shows the internal components, including a central shaft, a rotor, and a stator. Dimensions are also given in millimeters (mm). The drawing is labeled 'A-A' and '16'.

SECTION - D-D
DETAIL OF PIPE ON CONCRETE
(PIPE MATERIAL GRP)

1000MM
CW BLOW DOWN
1000MM
CONCRETE SUPPORT
E.L.O.M.

SCALE 1:200

**TITLE:****2X660 MW ENNORE SEZ STPP**

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT****SUB-SECTION: IB**

REV. NO. 00

DATE :

SECTION – I
SPECIFIC TECHNICAL REQUIREMENTS
SUB-SECTION IB - Specific Technical Requirements (Electrical)



TECHNICAL SPECIFICATION FOR
2X660 MW ENNORE SEZ STPP
SEWAGE TREATMENT PLANT
(ELECTRICAL PORTION)

SPECIFICATION NO. PE-TS-412-673-A001
SECTION: I
SUB -SECTION- IB
REV 00 DATE 03.04.2015
PAGE 1 OF 1

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

- 1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure-I to Section – C [Scope of Work (Electrical)].
- 1.2 Make of various equipment/ items in the scope of bidder shall be to approval of owner during detailed engineering stage without any commercial implications.
- 1.3 Bidder shall furnish all AC as well as DC loads required for the system at different voltage levels (eg. 415V AC, 240 V AC, 220 V DC etc.) of all types, such as motor feeders, supply feeders in PEM format along with the offer.
- 1.4 All electrical equipment shall be suitable for the power supplies, fault levels and climatic conditions indicated in project information enclosed with the specification.
- 1.5 All drawings, data sheets, Quality Plan, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage as per formats enclosed. The same shall be subject to approval without any commercial implications.
- 1.6 Technical requirements shall be as per specifications listed in Clause 3.1, 3.2, 3.3, 3.4 & 3.5. In case of any discrepancy between Customer specification and BHEL standard specification, Customer specification shall prevail.

2.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 2.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:
 - a) A copy of this sheet "Electrical Equipment Specification for AC System" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
 - b) List of Erection and Commissioning spares.
 - c) List of Erection & Maintenance tools & tackles.
 - d) Electrical load requirement in the load data format.
- 2.2 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

3.0 LIST OF ENCLOSURES

- 3.1 Electrical scope between BHEL & vendor (Annexure-I).
- 3.2 Technical specification – Customer specification - Motors
- 3.3 BHEL standard specification for LT motors: PE-SS-999-506-E101
- 3.4 Datasheets – A and C
- 3.5 Quality Plan for motors.
- 3.6 Load data format (Annexure-II).
- 3.7 Basic Technical Features for Motors (PE-DC-412-565-E003)

SPECIFIC ELECTRICAL REQUIREMENT

SL.NO.	PARAMETERS	UNIT	ENNORE
	MOTOR		
1	DESIGN AMBIENT TEMP	DEG. C	50
2	VOLTAGE SUPPLY AND VARIATION	VOLT	415V, $\pm 10\%$
3	FREQUENCY WITH VARIATION	Hz	50 (+) 3% to (-) 5%
4	COMBINED VOLTAGE & FREQUENCY VARIATION		10%
5	MAX ACCEPTABLE RATING OF MOTOR AT 415 V	KW	160 kW
6	SYSTEM FAULT LEVEL AND ITS DUARTION	KA	50 KA, 1 Sec
7	SUTABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION		50 KA, 0.25 sec
8	CLASS OF INSULATION & TEMP RISE LIMITED TO		Class-F and temp rise limited to Class-B
9	MIN. STARTING VOLTAGE		85%
10	MOTOR RATING FOR SINGLE PHASE SUPPLY		Upto 200W
11	MAXIMUM LOCKED ROTOR CURRENT	% OF FLC	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.
12	ACCEPTABLE NOISE LEVEL	DB	85dB at 1.0m in line with IS 12065
13	TYPE OF STARTER PROVIDED IN MCC		N.A.
14	DOP OF ENCLOSURE		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. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.
15	SPACE HEATER REQUIREMENT		30KW & ABOVE
16	PAINT SHADE		Shall be confirmed during detailed engineering.
17	SPECIAL REQUIREMENT		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. All motors shall be subjected to routine tests as per IS: 325 / IS: 12615. The motors shall generally conform to IS: 325 / IEC-60034.
18	EFFICIENCY CLASS		ENERGY EFFICIENCY CLASS IE-3 AS PER IS : 12615:2011

BASIC TECHNICAL FEATURES

FOR HT/LT MOTORS

(FOR BHEL-PEM SCOPE PACKAGES)

					PROJECT	2X660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS,CHENNAI						
REV	DATE	ALTD	CHD	APPD		OWNER	TAMIL NADU GENERATION & DISTRIBUTION CORPORATION LIMITED					
02	13.05.15	RKG/AB	SL	RG								
REVISED AS PER TANGEDCO COMMENTS DATED 10.04.2015						OWNER'S CONSULTANT	DESEIN PRIVATE LIMITED, DESEIN HOUSE,NEW DELHI					
REV	DATE	ALTD	CHD	APPD		EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA(U.P) INDIA					
01	13.03.15	BKR-SD-	SL-SD-	RG-SD-								
REVISED AS PER TANGEDCO COMMENTS DATED 13.02.2015						BHARAT HEAVY ELECTRICALS LTD. POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA		DEPT CODE	DRN	NAME BKR	SIGN	DATE
						TITLE	BASIC TECHNICAL FEATURES FOR HT/LT MOTORS	E	DSGN	BKR	-SD-	13.01.15
									CHD	SL	-SD-	13.01.15
									APPD	RG	-SD-	13.01.15
								DRAWING NO.		PE-DC-412-665-003		
								SHEET 1 OF 7		REV. 02		

	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.	02
		Dated	13-05-2015
		Page	2 of 7

- 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 IE3 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.	02
		Dated	13-05-2015
		Page	3 of 7

- 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 to HV (11 kV), MV (3.3 kV) & LT motors

- 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.

3.6 Stress during bus Transfer:

	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.	02
		Dated	13-05-2015
		Page	4 of 7

- 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.

3.9 Crane duty motors will be of squirrel cage induction motor and shall suit the duty class S4, cyclic duration factor 40% and 300 starts. Crane duty motors shall be provided with VVFD for speed control.

1

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. Canopy shall be provided for outdoor motors. 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).

- 4.2.2 Motors shall not be provided with any electric or pneumatic operated external fan for cooling the 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.	02
		Dated	13-05-2015
		Page	5 of 7

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

HV/MV/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 below 15 kW shall be provided with sealed ZZ bearing.

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 for HV (11 kV), MV (3.3 kV) & LT motors shall be designed for the maximum fault current for a duration of at least 0.25 secs. **11kV & 3.3kV motors terminals shall be able to withstand 44kA for 0.25 seconds.**

1

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.

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.

	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.	02
		Dated	13-05-2015
		Page	6 of 7

- 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 of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material for single core cables) 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

- 4.8 Neutral terminal box of motors rated 1000kW and above shall provision of mounting Neutral CTs of PS class identical to the CTs to be provided at switchgear end. Further the neutral terminals of HV motors rated below 1000kW shall be accessible.

1

5.0 ACCESSORIES

5.1 SPACE HEATERS

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

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

5.2 RESISTANCE TEMPERATURE DETECTORS (RTDs)

- 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.

	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.	02
		Dated	13-05-2015
		Page	7 of 7

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.

REV-0, DATE: 16.02.2017

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: SEWAGE TREATMENT PLANT

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2 X 660MW ENNORE STPP

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 FRP 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 FRP 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) &	BHEL	BHEL	Refer note no. 4 for electronic earthing

REV-0, DATE: 16.02.2017

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: SEWAGE TREATMENT PLANT

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2 X 660MW ENNORE STPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
	lightning protection			
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	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
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.

REV-0, DATE: 16.02.2017

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: SEWAGE TREATMENT PLANT

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2 X 660MW ENNORE STPP

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.

REV: 00 DATE:

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: ELECTRIC HOIST FOR STP PLANT**PROJECT :2X660 MW ENnore STPP****SCOPE OF VENDOR: SUPPLY , ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT**

<u>S. NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	Isolating Switch	Vendor	Vendor	BHEL will provide one number 415 V(3ph, 4W) supply feeder only up to isolating switches for cranes. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	Vendor	Cable from supply feeder to isolating switch shall be in BHEL scope.
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	Vendor	
4	Equipment Earthing	Vendor	Vendor	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
5	Motors	Vendor	Vendor	
6	Cable glands and lugs for equipment supplied by vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.
7	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
8	Equipment layout drawings	Vendor	-	
9	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-IIS-412-8/3-A001				VOLTAGE CODE**	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONT ROL CODE	REMA LOAD RKS No.	VERIFICATI ON FROM MOTOR DATASHEE T (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY	SIZE CODE	Nos														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
ANNEXURE-II																					
NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER 2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V : ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)																					
LOAD DATA (ELECTRICAL)	JOB NO.	412		ORIGINATING AGENCY		PEM (ELECTRICAL)															
	PROJECT TITLE	2X660 MW ENNORE SEZ STPP		NAME		DATA FILLED UP ON															
	SYSTEM	SEWAGE TREATMENT PLANT		SIGN.		DATA ENTERED ON															
	DEPTT. / SECTION	MAX		SHEET 1 OF 1		REV. 00		DE'S SIGN. & DATE													
Page 280 of 430																					

	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION : I	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION: IC	
		REV. NO. 00	DATE :

SECTION – I
SPECIFIC TECHNICAL REQUIREMENTS
SUB-SECTION IC - SPECIFIC TECHNICAL REQUIREMENTS (C&I)

	2X660 MW ENNORE STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
Specific Technical Requirements (C&I) 1. The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire STP. 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 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 BHEL's interpretation shall be complied by the bidder during contract stage without any commercial implication to BHEL. 2. The instrumentation to be provided for STP shall be as per the technical specification document / drawings wherever provided for the respective systems as a minimum requirement for bidding purpose. However for completeness of the system and its associated equipment, Bidder shall also provide all the necessary instruments to the process requirement even if it is not specifically indicated in the given technical Specification document /drawings During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any technical, commercial and delivery implication to BHEL. 3. The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. 4. All the instruments/equipment/electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply. 5. Instruments shall be suitable for sea or saline water application. MOC of impulse tubing & impulse pipe shall be CPVC (3/8") Sch 80 or better, Industrial grade up to manifold. MOC of impulse tubing, fittings (from manifold to instrument) and manifold shall be super duplex SS. 6. 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 proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg / Cm². 7. All the instruments/drives shall be terminated on JB's in field. JB's shall be in Bidder's scope. Bidder to consider minimum 5 nos. of JB's.		

	2X660 MW ENNORE STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
8. All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. The same shall be in Bidder's scope. All transmitters shall be HART compatible. 9. All the instruments indicated in PID are minimum requirement and it is mandatory to use sensors/signals/measurements with 1 out of 2 logics for all control & interlock (Analog & Binary) application/service as explained below: 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 measurement shall be employed for the measurements used for analog control functions. 10. All the instruments/ sensors/transmitters/switches meant for redundant applications shall have completely separate and independent impulse pipes/ root valves etc. No redundant instrument shall share a single process tapping. There will be separate and independent tapping for every individual instrument. 11. All level transmitters shall be of ultrasonic type. 12. Doppler effect type flow meters shall be used for sludge applications. 13. RTD's shall be of duplex type. Temperature transmitters are envisaged for RTD for monitoring services/application only. 14. DP instruments with min. Capillary length of 15m to be supplied in case of installation in pit. 15. Instrument installation shall be as per the attached "Standard Hook-up diagram of instrument." 16. All motorised valves of 200NB or more than 200NB size shall be provided with integral motorized bypass valves on all process lines. 17. All motorised actuator shall be provided with conventional actuators with integral starter for ON/OFF valves. Non-contact type electronic 2- wire position transmitters shall be provided for all inching type motorised valves. The detailed specification is attached elsewhere in the specification. 18. Valve end position (Open & Close) shall be monitored for the manual critical valves, wherever provided.		

	2X660 MW ENNORE STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
19. Bidder to comply with codes and standards as mentioned in the specification. 20. Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system. 21. All approval/Inspection are to be carried out by Owner or owner appointed agency only. 22. Bidder shall provide erection hardware as per installation drawings. 23. Bidder to provide mandatory spares as per mandatory spares list attached elsewhere in the specification. 24. Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. 25. Power Supply Requirement: Power supply for instruments, analysers etc. shall be provided at a single point which shall be decided during detail engineering. Further any electrical distribution shall be in bidder's scope. Any other voltage requirement for instruments, analysers etc. to be arranged/derived by bidder by providing suitable control transformer. 26. All cables terminated in the terminal block, power distribution scheme instruments shall be ferruled. Ferruling shall be double cross ferruling (i.e.) source and destination addresses shall be marked on both sides of the tube ferruling. 27. Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. 28. Number of pairs to be selected for Instrumentation cable (Size: 0.5 mm²): a) F-Type: 2P/4P/8P/12P/24P b) G-Type: 4P/8P/12P 29. Number of cores to be selected for Control cable (Size: 2.5 mm²): a) 3 Core b) 5 Core c) 12 Core 30. Each pneumatic device requiring air supply and intended for field mounting shall include a filter regulator air set with gauge, to owner's approval.		

	2X660 MW ENNORE STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
31. Bidder to delegate /depute their persons/experts (5 working days) as per owner/consultants' requirement without any additional cost at site during commissioning. 32. Bidder to ensure participation of their senior personnel and experts in discussions with Owners and other equipment bidders during various stages of contract implementation as required by the Owner.		

	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION : II	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT		
		REV. NO. 00	DATE :

SECTION – II

GENERAL TECHNICAL REQUIREMENTS

- SUB-SECTION IIA - GENERAL TECHNICAL REQUIREMENTS (MECH.)
- SUB-SECTION IIB - GENERAL TECHNICAL REQUIREMENTS (ELECTRICAL)
- SUB-SECTION IIC - GENERAL TECHNICAL REQUIREMENTS (C & I)



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : II

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SUB-SECTION : IIA

REV. NO. 00

DATE :

SECTION – II

GENERAL TECHNICAL REQUIREMENTS

SUB-SECTION IIA - GENERAL TECHNICAL REQUIREMENTS (MECH.)

CHAPTER 31

31.0 SEWAGE TREATMENT PLANT

- 31.1 The sanitary waste streams from the different buildings of the plant shall be collected by gravity into the respective manholes. The sewage shall flow from the manholes to the nearest collection chambers by gravity. The collected sewage in the collection chambers shall flow through sewer lines and flow to the common collection sump. From the common collection sump the sewage shall be pumped to the equalization Tank located in the STP Area.
- 31.2 The sewage treatment plant shall be designed as per guidelines of CPHEEO Manual. The anticipated no. of users shall be 2000 persons. The sewage treatment plant shall be designed to handle a flow of 75Kld considering average per capita consumption of 45lpcd with 80% of used water generated as sewage. The Sewage Treatment Plant shall be modular type based on FAB/MBBR technology followed by disinfection by Hypo and necessary tertiary treatment prior to reuse in horticulture purpose.
- 31.3 The finally treated sewage shall meet the norms of environment protection rules 1986 and its amendments and the rules of State Pollution Control Board. The Flow Diagram of Sewage Collection & Conveyance with treatment facility have been outlined in Drg No.111-12- 3512(Rev.0)

The major areas as sources of sanitary waste water shall be:

- STG Building
- Service Building
- Transformer Yard
- Switch Yard
- Compressed Air Building/ DG Room
- ESP Control Room
- Ash Water & Slurry Pumphouse & Ash Water Recovery & Compressor Area
- CW & ACW Pump House
- Canteen
- Workshop Building
- Fire Station Building
- RO-II,DM plant, CPU Regeneration & N.Pit
- Fuel Oil Pump House & Tank Area
- Crusher House
- CHP Control Room
- Raw Water Pump House
- Ware House
- Security & Time Office
- Sea Water Intake System and Water Treatment Plant (RO Stage – I) located in NCTPS Stage II.
- Ash Water Pumphouse.
- Ash slurry pumphouse

S NO.	Source of Waste water	No. of persons	Qty of waste Generated (m3/day) Tentative	Disposal to
A.	FROM PLANT BUILDINGS			
1	STG Building	300	5.4	Main Sewer line
2	Service Building	100	3.5	Main Sewer line
3	Transformer Yard	40		
4	DG Room Building	20		
5	Switch yard	30		
6	CW & ACW Pump House	50	10	Main Sewer line
7	Canteen	300		
8	Workshop Building	200		
9	Fire Station Building	50	1.6	Main Sewer line
10	DM plant , CPU Regn & N.pit Area	40		
11	ESP Control Room	40	3.0	Main Sewer line
12	Ash Water & Slurry Pump House	80		
13	Clarifier Ash water Recovery	20		
14	Ash Compressor House	20		
15	Pre Treatment Plant	120	2.2	
16	F.O. Pump House & Tank Area & Unloading Area	80	1.5	
17.	CHP control Room	150	1.0	
18.	Raw Water pump House	30	0.5	
19.	Administrative Building	100	7.8	
20.	Ware House	200		
21.	Security& Time office	30		
	Total No. of users	2000		

The above list is not exhaustive and bidder shall provide STP for all applicable areas like facilities located in NCTPS Stage II etc.

At the locations where the quantum of sewage generated is minimal it shall be collected in the respective manholes and finally flow to the septic tanks by gravity wherein the partial treatment shall be provided, and partially treated sewage shall

be treated with online hypo dosing prior to being reused in the nearby areas for horticulture.

All the sewer lines shall be designed such that the self cleaning velocity is maintained and the materials to be used for sewer lines shall be RCC NP3 pipe. The manholes shall be located at intersections along the sewer line at every change in direction and the maximum spacing of 30 meters in straight stretches to facilitate the maintenance of sewer lines. Sewer lines shall be designed considering peak factor as per guidelines of CPHEEO manual and shall run at 0.5 full at ultimate peak flow.

31.4 The Sewage treatment plants shall consist of following treatment components:

- ❖ Preliminary Treatment:
 - Coarse Screens for screening incoming sewage
 - Oil & Grease Trap
 - Equalization cum holding tank
- ❖ Aeration System:
 - Aerobic Biological treatment in the FAB Tank with fine bubble diffused aeration
 - Transfer of treated partially treated sewage to the Clarification system.
- ❖ Clarification System:
 - Settling of digested sludge in the Tube Settler
 - Transfer & storage of clarified water to the Hypo Contact Cum Filter Feed Tank
 - Dosing of Sodium Hypochlorite in the Hypo contact Cum Filter Feed Tank
- ❖ Sludge Handling Sytem:
 - Transfer of sludge to the sludge sump from the aeration tank & clarifier
 - Transfer of sludge to filter press/centrifuge
 - Transfer of centrate or filtrate to the equalization tank.
 - Disposal of sludge as cakes by sludge trolley.
- ❖ Tertiary Treatment:
 - Polishing of treated sewage by DMF& ACF.
 - Transfer of Polished sewage water for horticulture.

INLET/OUTLET PARAMETERS FOR STP

SNo.	Parameters	Unit	Inlet Paramet ers	Guaranteed Parameters
1.	Ph		7.0 - 8.0	6.5 - 8.0
2.	BOD	ppm	300	<20
3.	COD	ppm	600	<100
4.	Oil & Grease	ppm	<50	-

5.	Coliform	MPN/1000ml	10^6 - 10^7	$\leq 10^3$
6.	Suspended Solids	ppm	300	≤ 20

DATA SHEETS FOR SEWAGE TREATMENT PLANT

S. No.	Description	Units	Parameter
1.0	Common Collection Sump		
i)	Numbers Required	Nos.	One
ii)	Capacity	M3	10
iii)	MOC:		RCC
1.01	Common Collection Sump Pumps		
i)	Numbers Required	Nos.	2 (1W+1S)
ii)	Type		Non clog sump Pumps
ii)	Flow	M3/hr	4.0
iii)	Head	MWC	As per process requirements
iv)	Particle Size		Upto 20 mm
v)	MOC		CI-Casing, Impeller-SS-304
1.02.	Screen Chamber		
i)	Numbers Required	Nos.	1(1w+0s)
ii)	Type		Perforated Sheet
ii)	Cleaning		Manual
iii)	Angle of inclination		60°
iv)	Bar MOC		SS-304 fitted with MS frame
v)	Velocity	m/s	<1.0
vi)	Spacing of Bar	mm	10
1.03	Oil & Grease Trap		
i)	Numbers Required	Nos.	One
ii)	Flow	M3/hr	3.5
iii)	MOC:		RCC with baffle arrangements
1.04	Equalization Tank		
i)	Numbers Required	Nos.	1
ii)	Flow	M3/hr	3.5
iii)	Detention Time	Hrs	8
iv)	MOC of Tank		RCC
v)	Depth	M	2.5-4.0
vi)	Type of Aeration		Coarse Bubble Diffused Aeration Type
vii)	Type of Diffusers		Coarse bubble diffusers with retrievable arrangement
viii)	No. of Diffusers		As per requirement
1.05	Air Blowers for Equalization Tank/ Sludge Sump		
i)	Numbers Required	Nos.	2 (1W+1S)
ii)	Type of Blower		Twin lobe
iii)	Flow	M3/hr	To cater Air requirement for Equalization tank & Sludge Sump.
iv)	Head	Mtrs	As per process requirements
iv)	MOC		CI

S. No.	Description	Units	Parameter
v)	Accessories		NRV, Pressure Guage, Safety valves
1.06	FAB Feed Pumps		
i)	Numbers Required	Nos.	2 (!W+1S)
ii)	Type		Vertical Submersible Pumps
ii)	Flow	M3/hr	4.0
iii)	Head	MWC	As per process requirements
iv)	MOC		CI Body, SS 304 Impeller & Shaft
v)	Particle Size		Upto 10 mm
1.07	FAB Reactor		
i)	Numbers Required	Nos.	1
ii)	Flow	M3/hr	3.5
iii)	F/M Ratio	Kg BOD/ kg/ MLSS	0.1-0.15
iv)	MLSS	mg/l	3000-6000
iv)	MOC of Tank		MSRL
v)	Depth	M	Min 4-5 Mtrs
vi)	Type of Aeration		Fine Bubble diffused Aeration Type
vii)	Type of Diffusers		Silicon based fine bubble diffusers retrievable arrangement
viii)	No. of Diffusers		As per requirement
ix)	Fab Media		PVC
x)	Media Qty		As per requirement
xi)	Free Board	mm	500
xii)	Volume	M3	As per Process Requirements
1.08	Air Blowers for FAB Tank		
i)	Numbers Required	Nos.	2
ii)	Type of Blower		Twin lobe
iii)	Flow	M3/hr	To cater Air requirement for Aeration Tank.
iv)	Head	Mtrs	As per Process Requirements
v)	MOC		CI
vi)	Accessories		NRV, Pressure Guage, Safety valves
1.09	Secondary Settler		
i)	Numbers Required	Nos.	1
ii)	Flow	M3/hr	3.5
iii)	Surface Flow Rate	M3/m2/hr	2
iii)	MOC of Settler		MSRL
iv)	Qty of Tube settler Media	M3	As per Process Requirements
v)	MOC of Media		PVC
vi)	Free Board	mm	500
1.10	Hypo Contact Cum Filter Feed Tank		

S. No.	Description	Units	Parameter
i)	Numbers Required	Nos.	1
ii)	MOC		PVC
iii)	Make		Sintex
1.11	Hypo Dosing System		
1.11.1	Hypo Dosing Tank		
i)	Quantity		01 Nos.
ii)	Capacity		100 ltrs
iii)	MOC		PVC
iv)	Make		Std.
1.11.2	Hypo Dosing Pumps		
i)	Quantity		01 Nos.
ii)	Capacity		0 -6 lph
iii)	Type		Metering
iv)	Make		Std.
1.12	Filter Feed Pumps	Nos.	Two (2) (1W+1S) 100%
i)	Type & Operation		Horizontal, Centrifugal, Continuous
ii)	Suction condition		Flooded.
iii)	Capacity & Head	M3/hr, MWC	4.0, as per process requirement
iv)	Material of Construction		
	• Casing		Cast Iron IS:210 Gr FG 260
	• Impeller		Stainless steel CF 8M
	• Shaft & Shaft sleeve material		Stainless steel SS Gr. 304 & SS316
	• Packing seal		Mechanical type
	• Drive motor		Induction motor, 415V, 3 Φ , 50 Hz, TEFC.
	• Common base plate		Carbon steel IS:2062
v)	Noise level		85 DBA
vi)	Vibration		As per HIS
vii)	RPM		1500
viii)	Drive motor		Induction Motor 415V, 3 Phase, 50 Hz, TEFC
ix).	Interconnecting Piping Material		Carbon Steel with Rubber lining.
1.13	Dual Media Filter		
i)	Quantity	Nos.	1
ii)	Capacity	M3/hr	3.5
iii)	Surface Flow Rate	M3/hr/m ²	10
iv)	Size		As per Process Requirements
v)	Design Pressure	Kg/cm ²	6
vi)	MOC		FRP
vii)	Media		Graded quartz sand free from carbonates and other foreign material and anthracite.
viii)	Rising Space		100%
ix)	Make		Standard

S. No.	Description	Units	Parameter
1.14	Activated Carbon Filter		
i)	Quantity	Nos.	1
ii)	Capacity	M3/hr	3.5
iii)	Surface Flow Rate	M3/hr/m2	12
iv)	Size		As per Process Requirements
v)	Design Pressure	Kg/cm2	6
vi)	Media		Activated Carbon
vii)	Supporting Media		Graded Gravel
viii)	Minimum Bed Depth	mm	1200
ix)	Rising Space		100%
x)	Shell & Dish Material		FRP
1.15	Treated Water Tank		
i)	Numbers Required	Nos.	1
ii)	Flow	M3	3.5
iii)	Detention Time	Hrs	8
iv)	MOC of Tank		RCC
v)	Depth	M	2.5-4.0
1.16	Treated Water Pumps	Nos.	Two (2) (1W+1S) 100%
i)	Type & Operation		Horizontal, Centrifugal, Continuous
ii)	Suction condition		Flooded.
iii)	Capacity & Head	M3/hr,M	4.0 , as per process requirements
iv)	Material of Construction		
iv)	Casing		Cast Iron IS:210 Gr FG 260
v)	Impeller		Stainless steel CF 8M
vi)	Shaft & Shaft sleeve material		Stainless steel SS Gr. 304 & SS316
vii)	Packing seal		Mechanical type
viii)	Drive motor		Induction motor, 415V, 3 Φ , 50 Hz, TEFC.
ix)	Common base plate		Carbon steel IS:2062
x)	Noise level		85 DBA
xi)	Vibration		As per HIS
xii)	RPM		1480
xiii)	Drive motor		Induction Motor 415V, 3 Phase, 50 Hz, TEFC
xiv)	Interconnecting Piping Material		Carbon Steel with Rubber lining.
1.17	Sludge Sump (Waste Pit)		
i)	Number	No.	One (1)
ii)	MOC & Type		RCC, Under ground, Outdoor location
iii)	Capacity	Cu.m	As per Process Requirements
iv)	Instruments		Level switch with indication on panel
v)	Inside Protection		5 mm thick coal tar epoxy screened lining

S. No.	Description	Units	Parameter
1.18	Sludge Transfer Pumps	Nos.	Two (2) (1W+1S) 100%
i)	Numbers Required	Nos.	2
ii)	Type		Vertical Screw Pumps
iii)	Location		Outdoor
iv)	Type of Fluid		Sludge From clarifier
v)	Rated Flow	M3/hr	As per process requirements (approx 2)
vi)	Head		As per process requirements
vii)	Service		Intermittent
viii)	Pump Speed	RPM	1500
ix)	Material of Construction		
	• Casing		2% Ni.- CI to IS 210 FG 260
	• Rotor		SS-316
	• Stator		Nitrile/EPDM
	• Shaft		SS-316
1.19	Centrifuge	Nos.	One(1)
i)	Type		Decanter
ii)	Inlet Concentration		2%
iii)	Outlet Concentration		20%(Min.)
iv)	Capacity		As per Process Requirements
v)	Liquid Handled		Secondary Sludge
vi)	Material of Construction		Wetted Parts-SS-304 Other parts – MSEP/CI
vii)	Motor		IP55 with outdoor installation, 3 phase, 415V, TEFC Type Squirrel cage induction Motor, Rating as per requirement.
viii)	Base Frame		MS Fabricated
ix)	Acessories		Suitable piping, valves pressure guage at delivery Pulley, V Belt Drive , foundation Bolts etc.

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.

	TITLE:	SPECIFICATION NO. PE-TS-412-673-A001
	2X 660 MW ENNORE SEZ STPP	SECTION - II
		SUB-SECTION - II A
		REV.NO. 0 DATE :
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	

TECHNICAL SPECIFICATION FOR PRESSURE & STORAGE VESSEL

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION - II A
		REV.NO. 0 DATE :

1.00.00 GENERAL

The following principal pressure and atmospheric vessels for the system has been covered in this part of specification.

1. Condensate Polisher Service vessels.
2. Condensate Polisher Resin Separation and Cation Regeneration vessel.
3. Condensate Polisher anion regeneration vessel.
4. Condensate Polisher mixed resin storage Vessel.
5. Alkali diluent Heating cum Storage Vessel.(hot water tank)
6. Activated carbon filter
7. Alkali Preparation Tank
8. Alkali Day Tank
9. Resin Injection Hopper
10. Acid Measuring Tank.
11. Acid Storage Tank
12. DM storage tank.
13. Alkali storage tank

1.01.00 Of these, the items specified from Sr. no. 1 to 6 shall be designed as pressure vessels and the rest shall be atmospheric vessels.

1.01.01 All other vessels, not specifically listed here, but required for the Bidder's system shall also meet the general requirements of this specification.

1.01.02 Process requirements of these vessels shall be governed by the requirements of the Condensate Polishing System, which will determine their design conditions. Following sections only indicate some of the minimum requirements which must be met, and the actual design of these vessels shall be better than these, if that is required from process considerations.

2.00.00 GENERAL DESIGN FEATURES

2.01.00 Design

2.01.01 Design of all pressure vessels shall conform to ASME Section VIII or acceptable equivalent international standard. Design pressure shall be the maximum expected pressure to which the vessels may be subjected to plus 10% additional margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pumps suction if any. Design pressure of condensate service vessels is indicated elsewhere in this specification. For all other pressure vessels, design pressure shall be at least 10 Kg/cm² (g).

	TITLE:	SPECIFICATION NO. PE-TS-412-673-A001
	2X 660 MW ENNORE SEZ STPP	SECTION - II
		SUB-SECTION - II A
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	REV.NO. 0 DATE :

- 2.01.02 Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and other chemicals shall conform to IS: 803.
- 2.01.03 Design of all horizontal cylindrical atmospheric storage tank containing water, acid, alkali and other chemicals shall conform to BS: 2594.
- 2.01.04 Design temperature of all pressure vessels and storage tanks shall be 10 deg. C higher than the maximum temperature that any part of the vessel/tank is likely to attain during operation.
- 2.01.05 In case, tank is subjected to vacuum; the same shall be taken care in designing the tank.
- 2.01.06 The design of Demineralised water storage tanks (Vertical type) shall conform to IS: 803. Supporting frame where required shall be in accordance with IS: 800. The tank shall be "Non-pressure" fixed roof type with atmospheric vents.
- 2.02.00 All vessels / tanks without inside rubber lining shall have a corrosion allowance of minimum 2 mm and mill allowance (minimum 0.3 mm) for shell and dished ends. Thinning allowance of 2 mm (minimum) shall be considered for dished end. Vessel / tanks ends shall be of dished design and constructed by forging, pressing or spinning process. Conical or flat ends shall not be accepted. All dished ends shall be stress relieved.
- 2.03.00 All the atmospheric tanks shall have sufficient free board above the "Level High"/"Normal Level" as the case may be. The overflow level shall be kept at least 20 cm or 10% of vessel height above the "Level High"/"Normal Level" for all the tanks except for the DM tanks for which a minimum height of 300 mm shall be provided over the "High Level". Further, a minimum 300 mm free board shall be provided above the top of overflow level to the top of the tank. Wall thickness of atmospheric tanks shall not be less than 6 mm.
- 2.04.00 Vessels coming under preview of IBR shall be designed accordingly.
- 2.05.00 Interior surfaces of all tanks shall be clear of stiffeners and other structural supports. Tanks shall be reinforced and stiffened externally as required.
- 2.06.00 All welds on inner tank surface shall be free of voids, gaps craters, pits, high spots, sharp edges, abrupt ridges and valleys or undercut edges. High spots, irregularities and sharp edges shall be removed by grinding. Inside weld seams shall be ground flush and smooth applicable for corrosion resistant coating or lining.
- 2.07.00 All internal baffles, wear plates, pipes etc. shall be continuously welded on both sides at all contact points with full fillet welds which shall be free of voids, gaps, craters, high spots, sharp edges, and undercutting. Sharp edges shall be ground to a 3 mm minimum radius.
- 2.08.00 Weld splatter shall be removed.
- 2.09.00 All welding shall be performed by ASME qualified welders under Section-IX of ASME Boiler and Pressure Vessel code and welding electrodes shall be as per relevant Codes/Standards viz. AISC Section 1.17 etc.
- 2.10.00 The plates for cylindrical tanks shall be accurately formed in bending rolls to the diameters called for, and the completed shells be concentric and plump. Plates shall be cold-rolled by plate bending machine in a number of passes to true curvature and joined by welding.
- 2.11.00 Vessels seam shall be so positioned that they do not pass through vessel connections.

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION - II A
		REV.NO. 0 DATE :

3.00.00 MATERIAL OF CONSTRUCTION

3.01.00 All pressure vessels shall be fabricated from carbon steel plates as specified in datasheet A of this specification and lined internally. All atmospheric tanks shall be fabricated of material as specified in datasheet A and lined internally.

4.00.00 APPURTENANCES

4.01.00 Manholes

4.01.01 All the pressure vessels and horizontal type storage tanks shall be provided with manhole of 500 mm diameter minimum size, preferably at the top head, complete with cover plate, lifting handle, davit cap, nuts, bolts, gaskets etc. to ensure leak tightness at the test pressure.

4.01.02 The vertical type storage tanks shall be provided with a manhole of 500 mm dia on the top cover, if the diameter of the tank is 1200 mm or more. For the DM water storage tanks, manholes shall be provided as per IS:803.

4.01.03 All the vessels and tanks shall be normally provided with a six inch gasketed handhole located near the bottom of the straight side.

4.01.04 The required lining/coating for the inside surface of the manhole/handhole, nozzle and cover plate of the manhole/handhole shall be same as that of the respective vessel/tank.

4.01.05 Sight Glasses

All the vessels mentioned shall be provided with pad type sight glasses on their vertical sides. Locations of these sight glasses shall be as follows:

4.01.06 One with the centre line at the normal level of the bed top, and one near the bottom of the straight side, for each of these vessels.

4.01.07 In addition, item no. 1.00.00 shall be provided with sight glasses, with their center lines at each of the normal separated resin interfaces.

4.02.00 Lifting Lugs

All vessels of diameter 1200mm or greater shall be provided with a minimum of 4 lifting lugs. Smaller vessels shall be provided with at least 2 lifting lugs.

4.03.00 Vessels Supports

Adequate supporting arrangements like straps, saddles, skirt rings, or legs of steel shall be provided to transfer all loads to the respective skid structures.

4.04.00 Vessel Internals

The internals for pressure Vessels shall be designed for a low pressure drop to promote uniform distribution and flow through the vessels and to withstand the full design pressure of the vessel in both directions.

Specification requirements for vessel internals are as follows:

	TITLE:	SPECIFICATION NO. PE-TS-412-673-A001
	2X 660 MW ENNORE SEZ STPP	SECTION - II
		SUB-SECTION - II A
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	REV.NO. 0 DATE :

4.05.00 **Inlet water and Regenerant Distributors**

Hub and laterals with diffuser splash plates or header and perforated laterals. Material of construction shall be type 316 stainless steel, except for acid service which shall be of Hastelloy B.

4.06.00 **Underdrains**

Same as above with screened laterals with internal perforated pipes, and rubber-lined false bottom. For resin separation/regeneration/mixed resin vessels, it may have fully screened bottom (NEVA – clog type with para Septanurse screen, fully supported by subway grid, or equal).

4.07.00 For lined vessels, they shall also be lined in the same manner as the internal surfaces of these vessels. For the caustic diluent heating/storage tank, they shall be of type 304 stainless steel construction.

4.08.00 **Internal Fasteners**

All internal fasteners shall be of type 316 stainless steel and heavy duty locknuts shall be used throughout.

4.09.00 **Piping Connections**

All lined vessel connections and connections in unlined vessels 25 NB and larger shall be to ANSI 300 lb class. Flat face flanges shall be used throughout. Nozzle material shall be ASTM-A-106. Grade B. schedule 80 pipe. All flanged connections shall be supplied complete with matching counter flanges, nuts, bolts and full-face gaskets.

4.10.00 All vessel connections in unlined tanks smaller than 25 NB shall be screwed to ANSI 2.1 for schedule 80 pipe.

4.11.00 **Resin Traps**

Outlets of each of the condensate polisher service vessel and the waste effluent header of the common external regeneration facility, shall be provided with a resin trap. These resin traps shall be a minimum, conform to the following:

4.11.01 The resin trap shells shall be of steel construction and lined internally with saran or Polypropylene. The internals for all traps shall be johnson well screen type, of 316 stainless steel in both directions, resin traps located in processes effluent lines shall have a screen opening that does not exceed 120 percent of the associated process vessel under drain screen opening. Resin traps located in waste effluent headers shall have a screen opening of approximately 60 mesh.

4.11.02 Each resin trap shall be fully piped and valved for inplace manual back flushing.

5.00.00 **SPECIFIC DETAILS**

5.01.00 **Alkali Diluent Heating – Storage Tank (Hot water tank)**

One (1) no. hot water tank for heating of alkali diluent water with (2X50%) electric heating coil, adequately insulated of stainless steel construction shall be provided. The capacity of tank shall be minimum 20% higher than the maximum water demand. This tank shall be provided with burn out protection, pressure relief valve, level switches, temperature

	TITLE:	SPECIFICATION NO. PE-TS-412-673-A001
	2X 660 MW ENNORE SEZ STPP	SECTION - II
		SUB-SECTION - II A
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	REV.NO. 0 DATE :

indicator etc. The heaters shall be sized for heating the water from a temperature of 15 to 50 deg. C in 5 hours at the outlet of ejector.

All tank internals, including the inlet water tail pipe, shall be fabricated of type 304 stainless steel.

5.02.00 **Atmospheric Tanks**

Wall thickness of these tanks shall not be less than 6mm.

5.03.00 **Resin Injection Hopper**

The supplier shall provide a hopper type tank for resin make-up, using water slurry, to the condensate polishing systems. This make-up system will constitute a portion of the condensate polishing external regeneration system. The resin hopper shall have a conical bottom and a flat top. The top shall have a piano type hinged port, having a lifting handle, of sufficient size for easy resin loading. The resin shall discharge through a bottom connection to a water ejector for transport. Water shall be added to the hopper to assist in the resin transfer. The ejector discharge shall be to the resin separation-cation regeneration vessel. Demineralized water shall be used throughout for the resin transfer. Piping of the resin make-up system shall be the responsibility of the Bidder as a part of the external resin regeneration system.

a) **Capacity**

The resin make-up hopper tank shall be sized to handle up to 150 liters of as received new resin per single injection.

b) **Material**

The resin make-up hopper tank shall be fabricated of mild carbon steel having a minimum thickness of 6mm and lined.

5.04.00 **Chemical preparation and day tanks**

These shall be vertical cylindrical tanks. They shall be of carbon steel fabrication, lined and provided with full height level gauges right up to the overflow levels.

The alkali preparation tank shall be provided with a dissolving basket of type 316 stainless steel constructions, and a motorized slow speed stirrer mounted eccentrically to the tank by a bracket fixed to the side wall. The stirrer shall have impellers of type 316 stainless steel.

The alkali day tank shall be provided with an airtight cover complete with a breather arrangement, to prevent absorption of carbon dioxide from the atmosphere by the alkali solution contained in it. The overflow connection shall also be provided with a suitable seal for this purpose.

The tanks for ammonia solution (if applicable) shall also be provided with similar arrangements to prevent escape of ammonia vapour to outside.

5.05.00 **LINING**

All internal lining of vessels provided under this specification shall be of natural rubber, meeting the following minimum requirements.

5.05.01 **Hardness**

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION - II A
		REV.NO. 0 DATE :

Lining used may be soft rubber having a shore durometer reading of 65 on the A scale, or semi-hard rubber having a durometer reading of 65 on the A scale. Variations in hardness of the rubber lining between the different areas of a specific tank shall be within +/-5 durometer reading.

5.05.02 **Chemical Resistance**

The lining material shall be suitable for prolonged service in the chemical environment described below:

- Hydrochloric acid, 2 to 8% concentration, at temperature from 10 deg C to 50 deg C.
- Sodium hydroxide, 1 to 4% concentration, at temperature from 30 deg C to 50 deg C.
- 100 to 500 mg /l of sulphuric and hydrochloric acid combined. Ratio of concentration of these two acid 1 : 5 to 5 : 1 and temperatures from 10 deg C to 40 deg C.
- 1 to 10mg/l of sodium hydroxide at temperature from 10 deg C to 40 deg C.

The linings will be subjected to the condition (a) or (b) for intermittent periods of approximately one hour out of eight hours, and to conditions (c) or (d) remainder of the time.

5.05.03 **Thickness**

The lining shall be applied in three layers, resulting in a total thickness of not less than 4.5 mm anywhere on the internal surfaces of the vessels. The lining shall extend over the full face of all flanged connections and shall have a minimum thickness of 3 mm in all such external areas.

5.05.04 **Surface Preparation**

Prior to rubber lining all surfaces must be prepared in the following manner.

- Degrease surface prior to blasting.
- The surface is to be blasted with steel grit or sharp silica sand to a white and bright metal surface.
- All traces of grit and dust should be removed with a vacuum cleaner or by brushing. Care must be taken to avoid contaminating the surface.
- Immediately after blasting and removal of grit, the first coat of primer or cement shall be applied and allowed to dry.

5.05.05 **Protection**

After the lining is completed the vessels shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation erection, etc. They shall not also be stored in direct sunlight. No further welding or burning shall be carried out on the vessel, after application of the lining.

	TITLE:	SPECIFICATION NO. PE-TS-412-673-A001
	2X 660 MW ENNORE SEZ STPP	SECTION - II
		SUB-SECTION - II A
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	REV.NO. 0 DATE :

All lining projecting outside of the vessel, shall be protected adequately from mechanical damages during shipment, handling, storage etc.

Suitable warning, indicating the special care that must be taken with respect to these lined vessels, shall be stenciled on their outside surfaces with the letter at least 12mm high.

Example:

“Warning – Tank is lined”

“Do not weld or Burn”

“Do not Store in Direct Sunlight” etc.

6.00.00

CODES AND STANDARDS

The design, manufacture, shop testing, site fabrication and erection, testing and commissioning of the pressure and storage vessels shall conform to the latest revisions of the following standards, in addition to other standards mentioned elsewhere in the tender document subject to any modification and requirement, as specified here in after.

a)	IS: 803	-	Code of practice for design, fabrication and erection of Vertical Mild Steel cylindrical welded oil storage tanks.
b)	IS: 816	-	Code of practice for use of metal arc welding for general construction in mild steel.
c)	IS: 817	-	Code of practice for training and testing of metal arc welders.
d)	IS: 822	-	Code of procedure for inspection of welds.
e)	IS:1363	-	Black hexagonal bolts, nuts and locknuts (dia 6 to 39 mm) and black hexagon screws (dia to 24 mm).
f)	IS:1367	-	Technical supply conditions for threaded fasteners.
g)	IS:2062	-	Specification for weld able structural steel.
h)	IS:2002	-	Steel plates for pressure vessels for intermediate and High temperature service including boilers.
i)	IS:2825	-	Code of unfired pressure vessels.
j)	IS:3133	-	Manhole and inspection opening for chemical equipment.
k)	IS:4049	-	Specification for formed ends for tanks and pressure vessels.
l)	IS:4682	-	Code of practice for lining of vessels and equipment for chemical processes Rubber Lining.
m)	BS:2594	-	Specification for carbon steel welded horizontal cylindrical storage tanks.

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION - II A
		REV.NO. 0 DATE :

n) ASME - Boiler and pressure vessel Section VIII code.

o) ASTM - American Society for Testing and Materials.

7.00.00 FABRICATION

7.01.00 The vessel ends for storage tanks of vertical type shall have flat bottom. However, the ends of horizontal storage tanks, and all the pressure vessels shall be dished design of Tori-spherical type designed.

7.02.00 The plates to be used for fabrication shall preferably have a minimum width of 1500 mm.

7.03.00 All the joints (circumferential / longitudinal) shall be continuous butt welded, inside and outside. Connection shall be flush with inner surface of tanks and welded continuously on both sides of shell. Sharp inside edges shall be rounded to a minimum 3 mm radius.

7.04.00 Welding sequence shall be adopted in such a way so as to minimize the distortion due to welding shrinkage. Contractor shall indicate in his drawing the sequence of welding proposed by him which should meet prior approval of the engineers. Welding shall not be carried out when the surface of the parts to be welded are wet from any cause and during periods of rain and high winds unless the welder and work are properly shielded.

7.05.00 All pressure vessels and storage tanks except Demineralised water (D.M.) shall be fabricated complete and tested at manufacturer's works to ensure better workmanship.

7.06.00 Tank Connections

7.06.01 Bidder shall furnish all pipe material required for tank connection for the process requirement. In addition to these, additional connections, if required by the Owner for the inter-connection of their piping, instrumentation etc. shall also be provided. Such additional requirement will be intimated to the successful Bidder later and Contractor shall provide these fittings to match with the Owner's items. Adequate pipe support attachments in the external surface of the tank/vessel shall be provided for Owners pipes for all the vessels/tanks. All lined vessels connections shall be conforms to ANSI 300 lb class. Nozzle material shall be ASTM-106 Grade B, Schedule 80.

7.06.02 All flanged connections should be supplied complete with matching counter flanges, nuts bolts and gasket materials. The flange design, (thickness and drilling etc.) shall match with the interconnected piping flanges.

7.06.03 Bolts and nuts to be used externally to the vessels shall be of hexagonal head conforming to IS:1367. However, internal fasteners if any, shall be of IS:316 /SS-304 or Hastalloy-B as per the duty conditions.

7.06.04 Gaskets shall be of full face type.

7.06.05 Sight glasses shall be provided for the tanks/vessels as specified in the standard specification. The material for sight glass shall be high quality transparent PLEXIGLASS of sufficient thickness to withstand the test pressure. The sight glass shall be provided with suitable gaskets and bolts to ensure leak tightness at the test pressure.

7.07.00 Vessels Supporting Lifting Lugs

7.07.01 Adequate supporting arrangements like straps, saddles, skirt boards, pillars etc. shall be provided to transfer all loads to civil foundation. All foundation bolts, inserts etc. shall also be provided.

	TITLE:	SPECIFICATION NO. PE-TS-412-673-A001
	2X 660 MW ENNORE SEZ STPP	SECTION - II
		SUB-SECTION - II A
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	REV.NO. 0 DATE :

- 7.07.02 All vessels of internal, diameter of 1200 mm or greater shall be provided with minimum four (4) lifting lugs for safe and effective handling during erection. Smaller vessels shall be provided with at least two (2) lifting lugs.
- 7.07.03 Material of construction for these vessel supports, saddles, lugs shall conform to IS:2062 of tested quality.
- 7.08.00 **Special Accessories Storage Tanks**
- 7.08.01 Vessel internals wherever required shall be provided as detailed out elsewhere in the specification.
- 7.08.02 All the pressure vessels and tanks shall be provided with drain connections along with drain valves of suitable size. Further all the atmospheric storage tanks shall be provided with over flow connection designed for the filling rate of the respective tank.
- 7.08.03 All the pressure and tanks shall be provided with the vent connections. The design shall be as to offer adequate area for venting. Venting area shall be such that over pressure/vacuum is not created in the tank during maximum filling/drain-off rate. The maximum draw off rate for the DM storage tanks shall be intimated later to the successful bidder.
- 7.08.04 Various instrumentation and the fittings required for the same shall be supplied as elaborated in data sheets.
- 7.08.05 Water seal shall be provided for the overflow line of DM and degassed water storage tanks. The vent and overflow lines of alkali preparation /measuring / day tanks and vent line of DM storage tanks shall be provided with Carbon dioxide absorber of proven design to prevent contamination from atmospheric air. Carbon dioxide absorber shall preferably be located at ground level. The vent and overflow lines of Acid measuring tanks shall be provided with fume absorber using suitable packing material, such as pall rings/raschig rings.
- 7.08.06 Conservation vent valves shall be provided in the vent line of DM storage tanks so that, at a vacuum to the extent of 65 mm water column, the valve shall open to relieve the vacuum. Body and trim of the valve shall be Die Cast Aluminum.

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 shal 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 1½ times the nominal pipe diameter. 90 deg. Bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.
- 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	BS 1452 Gr. 14/IS-210 Gr FG 260
	Hinge pin for non-return valves	AISI 316
	Stem for gate globe valves	13% chromium steel or Equivalent
	Back Seat	13% chromium steel / 13% Chrome overlay
	Companion Flanges	IS 2062
	External hardware	SS 316
	Internal hardware	SS 316
(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.

CHAPTER 10

10.0 MISCELLANEOUS PUMPSETS

10.1 GENERAL INFORMATION

10.1.1 Sump pumps specified hereinafter shall be used to dewater various sump pits in various plant areas like BTG area, Plant Water System, Ash Handling plant etc. where gravity draining is not be envisaged and to ensure general housekeeping

10.1.2 Pumps under this specification have been divided into following three (3) groups according to different duty envisaged and location of sumps/pits.

10.1.2.1 Group - A

The Group - A pumps shall be electric motor driven permanently installed vertical wet pit bottom suction volute type and shall handle drainage water, containing solid particles with sludges, polluted liquid, oils etc. from the area where they are installed. These pumps shall run intermittently by the use of high and low level switches in the sump. Particle size in the water shall not normally exceed 15 mm.

Group-A pumps shall also be provided to all indoor sumps of the plant and outdoor sumps of capacity 5 cu.m and above and underground cable vaults (if any) under the scope of this specification.

10.1.2.2 Group - B

These pumps shall be horizontal centrifugal electric motor/diesel engine driven portable type. Each pump set along with control panel etc. shall be mounted on a trolley for ease of transportation. These pumps shall be suitable for dewatering of pipelines of large diameter, if required and alike jobs and handling of liquids containing hard solid particles, sludge, polluted liquid, significant amount of fuel oil/HSD etc. and particle size shall not normally exceed 20 mm. These types of pumps shall be used in different plant areas.

10.1.2.3 Group - C

The Group - C pumps shall be vertical submersible portable type pump motor sets with suitable arrangement for carrying to any place and for lowering to and raising from various water reservoirs and pits. The pump motor set shall be suitable for handling water containing mud/sludge, solid particles, cotton waste, silica, ash particles, coal particles, polluted liquid etc. The particle size in water shall not exceed 20 mm. These pumps shall be utilised to dewater various deep sumps/pits (e.g. C.W pump house) in case of any eventuality.

10.2 CODES AND STANDARDS

10.2.1 The design, manufacture and performance of the sump pumps and drives specified, hereinafter, shall comply with the requirements of all applicable codes, the latest applicable Indian/British/American/DIN Standards, in particular the following:

10.2.2 IS-1710 : Vertical Turbine Pumps for clear cold and fresh water.

- 10.2.3 IS-5120 : Technical Requirements – Roto-dynamic special purpose pumps.
- 10.2.4 IS-5600 : Sewage and drainage pumps.
- 10.2.5 Hydraulic Institute Standards of USA.
- 10.2.6 The materials of the various components shall conform to the applicable IS/BS/ASTM/DIN Standards.
- 10.3 GENERAL PERFORMANCE REQUIREMENT
- 10.3.1 The pumps shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the "Range of Operation" as stipulated by the manufacturer.
- 10.3.2 Pumps shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum head being at shut off.
- 10.3.3 Permanently installed vertical pumps shall be suitable for parallel operation. The head vs capacity, the bhp. vs capacity characteristics etc. shall match to ensure equal load sharing and trouble free operation throughout the range. Drive Motor shall not be overloaded when pump discharge is more than rated condition.
- 10.3.5 The static head requirement of portable submersible type sump pump may have a considerably wide range of variation depending upon the depth of pit being dewatered. While the pump shall have adequate capacity at the maximum head, the motor shall be sufficiently rated to cater for any overloading during the pump operation at its minimum possible head, i.e., maximum discharge.
- 10.3.6 Pump motor set shall run smooth without undue noise and vibration. Acceptable peak to peak vibration limits shall generally be guided by Hydraulic Institute Standards (latest edition).
- 10.4 SCOPE OF WORK
- 10.4.1 Pumps under groups A, B and C as listed in the Annexure- I along with drive units, couplings and other accessories mentioned below, as also those needed to make the pump-motor sets complete in all respect, for proper operation and maintenance. All motors in outdoor duty shall be provided with IP-55 enclosure and canopy. In addition to the accessories listed in Annexure-I, each pump set shall also include the following:
- 10.4.2 For the vertical Group - A sump pump motor sets
- Two (2) nos. redundant ultrasonic type level transmitter (2 Nos.) with limiter technique shall be provided for alarming, auto start & auto stop. along with necessary junction box, local control panel, control cables etc. to achieve automatic starting/stopping of the sump pumps, and also ON/OFF indication for sump pump shall be monitored at DDC system. The entire assembly being mounted on the same base frame as mentioned above (item "b"). The control panel shall also be equipped with start/stop push button for starting/stopping individual sump pumps manually. Local control panel and cable shall be as per requirements described else where in the specification.

10.4.3

For each of the trolley mounted horizontal Group-B sump pump motor sets/pump-Diesel Engine sets

- a) One (1) no. 7.5 meters long hose for the pump suction and one (1) no.30 meters long hose for the pump discharge, either ends of each hose being provided with female hose coupling.
- b) One (1) no. 500 mm long straight pipe piece, with both ends flanged, one end matching with the pump suction nozzle.
- c) Two (2) nos. male type hose couplings, one of which is suitable for coupling with the above mentioned 500 mm pipe piece on one side and the 7.5 meters long suction hose on the other side, whereas the other is suitable for coupling with the pump discharge nozzle on one side and the 30 metres long hose on the other side. The pump suction pipe-piece and discharge nozzle shall be of flanged type. As such each coupling end that is to match with the pipe/pump nozzle shall also be flanged and shall be equipped with necessary bolts, nuts & gaskets.
- d) A foot valve (of Bidder's recommended size) with suction strainer, necessary coupling and matching piece/reducer (if necessary) to couple with the 7.5 meter long suction hose end.
- e) A starter panel complete with incoming switch/contacter, fuse, overload relays, start-stop push button, O/L reset push button, cable gland, wiring terminals, red and green indication lamps (LED type), necessary control cables etc., and also 50 metres length of flexible power cable with power plug at one end and arrangement to connect the other end with the starter panel.
- f) The pump motor set with a baseframe along with the starter panel, power cable, suction & discharge hoses etc., as mentioned above, shall be mounted on a suitable trolley with swivelling front wheel and having adequate fixing arrangement for all equipment, for operation without any undue vibration and with facility for being handled by a single operator.

10.4.5

For each of the portable submersible Group-C sump pump motor sets.

- a) Two (2) nos. 30 metres long discharge hose, having female hose coupling at both ends.
- b) One (1) no. 500 mm long pipe piece with both ends flanged, one end connected by necessary bolts, nuts & gaskets with the flanged discharge nozzle of the sump pump.
- c) One (1) no. male type hose coupling, one end of which is suitable to couple with the discharge hose and the other end is flanged, matching with the above mentioned 500 mm long pipe end and connected therewith by necessary bolts, nuts & gaskets.
- d) Suitable attachment for temporary seat of the pump motor set on the floor at sump bottom.

- e) One (1) no. 25 metres long submersible type power cable having a power plug at one end and a hermetically sealed (waterproof) cable gland for connection with the pump drive- motor at the other end.
- f) Suitable lugs and other attachments on the pump motor assembly frame, for hoisting and lowering of the pump motor set from and to the sump.
- g) One starter panel, having a plug socket as receptacle of the above mentioned power plug (item "e"), a 25 metre long incoming power cable with switch/contacter and fuse, start- stop push buttons, red and green LED type indication lamps, over load relays, O/L reset push button, cable gland etc., and also a suitable arrangement for temporarily mounting the starter panel, near the sump, where the portable sump pump-motor set is to work. The incoming 25 metre long power cable shall also be provided with a suitable power plug at one end.

10.4.6 Lubrication of one (1) initial fill and one additional fill after commissioning.

10.4.7 Rust inhibitor paint at Manufacturer's works.

10.5 DESIGN AND CONSTRUCTION

10.5.1 The design, construction testing and other details of the sump pumps and related accessories shall be in line with the stipulations and data in this chapter.

10.5.2 Each sump pump shall be equipped and coupled with a drive motor, with rating so selected as to have at least 15% margin over the maximum power required by the pump, throughout its range of operation. All other requirements of the drive motors shall be as stipulated in the Electrical Specification Vol IV.

The discharge rate of sump pump is uncontrolled. As such pump should be capable to operate even under a condition of as low as 25% of specified total head. Motors of group-B pumps should be designed to cater such eventuality.

10.5.3 All electrical items shall conform to the stipulations of Electrical Specification Vol IV as applicable.

10.5.4 All piping shall be as per IS-1239 of medium or heavy grade (as suited for the maximum operating pressure) and shall be either galvanised or painted with approved rust inhibiting paint. Pipe size shall be as per Appendix-II. Any matching piece/reducer required to match the pipe with pump nozzle, hose, etc. shall be provided.

10.5.5 All valves shall be steel body type as per applicable IS/BS/ANSI standard, with pressure class compatible with the maximum working pressure.

10.5.6 All hoses shall be of steel wire reinforced type. Pump suction hose shall be suitable for working under vacuum. Pump discharge hose shall be suitable to withstand the maximum pressure that it may be subjected to in all working conditions, including hydrostatic testing of the sump pump discharge line.

10.5.7 Pump suction strainer shall have openings large enough just to permit the entry of solids having maximum size as stipulated under clause no. 1.02.00.

10.6 Pumps

10.6.1 Pumps under Group-A shall be wet pit type, vertical shaft, centrifugal, vertical submerged suction, non-clog volute type complete with enclosed shaft, discharge pipe, head assembly thrust bearing and drive assembly, cover plates etc.

10.6.2 Pumps under Group-B shall be of horizontal shaft, single stage, end suction, radially split casing, centrifugal, non-clog design complete with common base plate, drive assembly etc. These pumps shall be trolley mounted portable type.

10.6.3 Pumps under Group-C shall be submersible pump-motor type, single stage and non-clog design and shall be portable type.

10.7 Casing

- a) Casing shall be so designed to allow free passage of specified maximum size of solid.
- b) Casing shall be designed to withstand the maximum shut-off pressure developed by the pump.
- c) The casings shall be cast, free from blowholes, sand holes, other detrimental defects. The casing shall be complete with suction and discharge connections.
- d) For pumps under Group-A adequate seal arrangement shall be made to keep leakage of liquid from casing to column assembly to minimum and adequate drain shall be provided in column assembly to permit escape of the leakage flow. The casing shall also include the bearing housing of the bottom pump shaft bearing.
- e) Casing of pumps under Group-B shall be provided with vent connections and drain connections with valves. These pumps shall be manually primed.

10.8 Impeller

- a) The impeller shall be open/semi-open non clog type, cast in one piece and specially designed to pass large solids or unscreened liquids. The clearance between stationary and moving parts should be such as to allow sustained performance without exclusive maintenance.
- b) Impellers of pumps under Group-A shall have provision for adjustment from an accessible location and for pumps under Group-C shall be capable of passing fibrous material like cotton waste, jutes, etc.

10.9 Pump Shaft

- a) Shaft size selected shall be such that critical speed is at least 20% away from the operating speed and the runaway speed.
- b) The shaft shall be ground and polished to final dimension and of ample size to withstand all stresses resulting from rotor weight, hydraulic loads and across the line starting. Shaft shall be provided with renewable sleeves particularly under stuffing boxes and other locations as recommended by pump manufacturers.

- c) The coupling between shafts shall be so designed that they become tight during pump operation.

10.10 Column Pipe (for pumps under Group-A)

The discharge pipe shaft assembly shall be flanged or screwed as per manufacturer's standard and standard length of each piece of column pipe shall be in conformity to the shaft piece lengths from consideration of easy handling.

10.11 Bearings

- a) Adequate nos. of properly designed bearings shall be furnished. Bearings for pumps shall be antifriction type and lubricated by grease. Line shaft bearings of vertical pumps shall also be grease lubricated. All necessary grease gun, grease cup and tubing shall be included.
- b) Thrust bearing of adequate design shall be furnished for taking the entire pump thrust arising from all probable conditions of continuous operation through out its "range of operation" and also the shut-off condition. The life of thrust bearing shall be 20,000 working hour minimum for the load corresponding to the duty point. The bearings shall be lubricated by grease from a location conveniently accessible. Design shall be such that the lubricant cannot contaminate the handling liquid.

10.12 Wearing Ring/Liner Plate

Renewable wearing rings/liner plates shall be provided either on impeller or on the casing or on both impeller and casing.

10.13 Stuffing Box

Stuffing Box of pumps under Group-A shall be of mechanical packing type. For pumps under Group-B and Group-C mechanical seal of reliable design shall be provided.

10.14 Coupling

Pump and motor shall be connected with a suitable flexible coupling. Coupling shall be provided with coupling guard.

10.15 Mounting Plate for Group-A Pumps and Base Plate for pumps under Group-B.

Each pump under Group-A shall be provided with a suitable mounting plate. The mounting plate shall be adequately sized to accommodate the level switches, discharge pipe, grease cups etc. if any. Pumps and motor under Group-B shall be mounted in one base plate. Base plate shall be of rigid construction properly ribbed as needed. Suitable drain with valve and drain funnel shall be furnished by the Bidder.

The necessary supporting plate, mounting frame, base plate etc. as required shall be supplied under this specification, along with anchor bolts, foundation bolts, pipe, sleeves etc. Lifting lug, eyebolts, etc. as required for the proper handling of each pump set shall be furnished.

10.16 Suction Bell

The pumps under Group-A, C shall be complete with adequately dimensioned suction bell to guide and streamline intake fluid.

10.17 Material of Construction

For material of construction of various parts of data specification sheet shall be referred to.

10.18 **INSPECTION AND TESTING**

10.18.1 All pumps shall be tested at the shop for capacity, head, efficiency and brake horse power. These tests are to be done according to the requirements of "Hydraulic Institute Standard".

10.18.2 The pump integral accessories like thrust bearing, pump motor coupling etc. shall be subject to tests as per manufacturer's standard.

10.18.3 Test on motors, control panels, starter panels, cables shall be conducted as per the requirement of Vol.IV of this specification and as per Quality Assurance Plan to be approved by Owner during detail engineering.

10.18.4 After delivery/erection at site, pumps shall be operated to prove satisfactory and trouble free performance.

10.19 **DRAWINGS, DATA, INFORMATION REQUIRED**

10.19.1 Location and dimension of all sumps which requires assisted evacuation, present in the areas covered under the scope of this specification.

10.19.2 List of location of Group-A .

10.19.3 Characteristic curves of pumps showing effective head, pump input power, efficiency, submergence and NPSH, against capacity ranging from shut-off condition to 125% or rated capacity for Group A, B pumps and to 150% of rated capacity for Group C pumps.

10.19.4 Speed vs. torque curve of the pump corresponding to recommended mode of pump starting, super-imposed on speed vs. torque of the motor, corresponding to 80% and 100% rated voltage.

10.19.5 Diagram showing the type of lubrication system etc.

DATA SPECIFICATION SHEET

S. No.	Description	Group A	Group B	Group C
1	Pumps			
1.1	Rated Capacity	Capacity of each pump should be so selected to empty sump pit in 10 to 15 minutes	Twenty (20)	Fifty (50)
1.2	Total Dynamic Head at rated Capacity (MLC)	To be calculated with 10% margin on frictional drop	15	20
1.3	Minimum suction lift	-	6	-
1.4	Nos. required	These pumps shall be provided in all indoor sumps and outdoor sumps of 5 cum & above and underground cable vaults and CW pumphouse. Pumps shall be of 2 x 100% capacity for each sump.	Four (4) (2 electric motor driven and 2 diesel engine)	Four (4)
1.5	Duty	Intermittent		
1.6	Pump design standard	IS 5120/ IS 1710/ HIS		
1.7	Parallel operation	Yes	No	Yes
1.8	Material of Construction			
a)	Base Plate/ Cover Plate	MS – IS 2062	MS – IS 2062	MS – IS 2062
b)	Column Pipe	MS – IS 2062	MS – IS 2062	MS – IS 2062
c)	Casing	2% NiCi	2% NiCi	2% NiCi
d)	Impeller	2% NiCi	2% NiCi	2% NiCi
e)	Pump/ Impeller Shaft	SS 410	SS 410	SS 410
f)	Shaft Sleeve	SS 410	SS 410	SS 410
g)	Shaft Coupling	SS 410	SS 410	SS 410
h)	Shaft Bearing	BUSH GM as per IS 306	BUSH GM as per IS 306	BUSH GM as per IS 306
i)	Gland	CI IS 210 FG 260	CI IS 210 FG 260	CI IS 210 FG 260
j)	Fasteners	SS 304	SS 304	SS 304

Note : In all areas where Group A pumps are installed and will handle Sea Water like CWPH Pit the material of construction of all components of the pumps shall be Duplex Stainless steel.

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
		SUB-SECTION - II A
		REV.NO. 0 DATE:
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	

TECHNICAL SPECIFICATION FOR HORIZONTAL CENTRIFUGAL PUMPS

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION - II	
		SUB-SECTION - II A	
		REV.NO.	0
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT		

1.00.0 SCOPE

- 1.01.0 This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps.

2.00.00 CODES AND STANDARDS

- 2.01.0 The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.

2.02.0 List of Applicable Standards.

1	IS : 1520	Horizontal Centrifugal Pumps for clear cold fresh water.
2	IS : 5120	Technical requirements of roto dynamic special purpose pumps.
3	API : 610	Centrifugal pumps for general refinery service.
4	IS : 5639	Pumps Handling Chemicals & corrosion liquids.
5	IS : 5659	Pumps for process water.
6	HIS	Hydraulic Institute Standards, USA
7	ASTM-1-165-65	Standards Methods for Liquid Penetration Inspection.

- 2.03.03 In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.

3.00.00 DESIGN REQUIREMENTS

- 3.01.00 The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve over the operating range of 40% to 120% of the duty point. The maximum efficiency of pump shall be preferably be within +/- 10% of the rated design flow as indicated in the data sheets.
- 3.02.00 The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of 15% more than the design head.

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
		SUB-SECTION - II A
		REV.NO. 0 DATE:
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	

3.03.00 Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

3.04.00 Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:

SPEED	Antifriction Bearing	Sleeve Bearing
1500 rpm and below	75.0 micron	75.0 micron

3.05.00 The noise level shall not exceed 85 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment.

3.06.00 The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.

3.07.00 The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).

3.08.00 Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.

3.09.00 The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.

4.00.0 DESIGN CONSTRUCTION

4.01.00 Design and construction of various components of the pumps shall conform to the following general specifications. for material of construction of the components, data sheets shall be referred to.

4.02.0 Pump Casing

4.02.01 Pump casing shall have axially or radially split type construction. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.

4.02.02 Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
		SUB-SECTION - II A
		REV.NO. 0 DATE:
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	

4.03.00 Impeller

4.03.01 Impeller shall be closed, semi-closed or open type, and it shall be designed in conformance with the detailed analysis of the liquid being handled.

4.03.01 The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.

4.04.00 Impeller/Casing Wearing Rings

4.04.01 Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.

4.05.00 Shaft

4.05.01 The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.

4.05.02 The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.

4.06.00 Shaft Sleeves

4.06.01 Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland.

4.06.02 Shaft sleeve shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

4.07.00 Bearings

4.07.01 Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished

4.07.02 The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.

4.07.03 Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
		SUB-SECTION - II A
		REV.NO. 0 DATE:
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	

4.07.04 Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.

4.08.00 Stuffing Boxes

4.08.01 Stuffing box design should permit replacement of packing without removing any part other than the gland.

4.08.02 Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.

4.09.00 Mechanical Seals

4.09.01 Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.

4.09.02 The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.

4.10.00 Pump Shaft Motor Shaft Coupling

4.10.01 The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

4.11.00 Base Plate

4.11.01 A common base plate mounting both for the pump and motor shall be provided. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.

4.12.00 Assembly and Dismantling

4.12.01 Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
		SUB-SECTION - II A
		REV.NO. 0 DATE:
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	

4.13.00 Drive Motor (Prime Mover)

- 4.13.01 The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps are specified, the actual motor rating is to be selected by the tenderer considering overloading of the pumps in the event of tripping of operating pumps.

5.00.00 TESTING FOR HORIZONTAL CENTRIFUGAL PUMPS

The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of this specification and in compliance with the requirement of applicable Codes and Standards. The particulars of the proposed tests shall be submitted to the Owner for approval before conducting the tests.

5.01.00 Hydrostatic Tests

All pressure parts shall be hydraulically tested at 200% of pump rated head or at 150% shut off head whichever is higher. The test pressure shall be maintained for 1/2 hr. and no leakage shall be permitted. While arriving at the above pressure, the maximum suction head specified in Data Sheet shall be taken into account.

5.02.00 Performance Tests

- 5.02.01 All the pumps shall be tested in the Manufacture's Works at rated speed for capacity, efficiency and brake horse power. Pumps shall be given running test over the entire operating range covering from the shut off head to the maximum flow. The duration of test shall be minimum one (1) hour. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standards or as applicable equivalent
- 5.02.02 The test shall be preferably conducted with the actual motor being furnished.
- 5.02.03 Only those pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and excessive vibration is observed during the performance test. Otherwise strip down examination is limited to bearing inspection only.
- 5.02.04 The pump accessories e.g. the thrust bearing, couplings etc. shall be subjected to tests as per manufacturer's standards.

5.03.00 Mechanical Balancing

All rotating components of the pumps shall be statically balanced. In addition to static balancing, rotating components of the pumps shall be balanced dynamically at or near the operating speed. Tenderer shall furnish acceptance norm for this test.

5.04.00 Visual Inspection

Pumps shall be offered for visual inspection by the bidder before shipment. The components of the pumps shall not be painted before inspection.

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
		SUB-SECTION - II A
		REV.NO. 0 DATE:
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	

5.05.00 NPSH Test

NPSH test shall be conducted with water as medium if required. NPSH shall not be mandatory in case type test certificates are furnished for the similar rating of pumps.

5.06.00 Noise and Vibration Measurement

Noise and vibration shall be measured during the performance testing at shop as well as during the site test.

5.06.01 The noise level shall not exceed 85 dBA. Noise level measurement will be made as per applicable internationally acceptable standard. The measurement shall be carried out with calibrated integrating sound level meter meeting the requirement of IEC:651 or BS:5969 or IS:9779. Sound pressure level will be measured all round the pump and motor set at a distance of one meter from the nearest surface of the machine and at a height of 1.5 m from the floor level. A minimum of six (6) points should be covered for measurement. The measurement shall be done with a slow response on the A-weighted scale. The average of the A-Weighted sound pressure measurements expressed in decibels to a reference 0.0002 microbars shall not exceed the specified value.

The tests shall be carried out on the machine operating at rated speed and as near as possible to the rated power. Corrections for background noise and correction on account of test environment will be considered in line with applicable standard. For this purpose all the additional data required should necessarily be collected during the test.

5.06.2 Vibration check will also be done as per HIS. Vibration would be checked at thrust bearing locations on horizontal, radial and vertical direction. The acceptance limits would be as per HIS. The instrument used would be IRD 308 or equivalent with velocity pick-up. Vibration limits to be specified as per the speed of the pump.

5.07.00 Material Test Certificate

5.07.01 Material of the various pump components shall be tested in accordance with the relevant standards. Test certificates for these shall be furnished for the Owner's approval.

5.07.02 Where stage inspection is desired by BHEL/customer all material test certificates shall be correlated and verified with the actual material used for construction before starting fabrication by BHEL/customer's inspector who will stamp the material. In case mill test certificate for the material are not available, the supplier shall carry out physical and chemical tests at his own cost from a testing agency, approved by BHEL/Customer, as per the requirement of specified material standard. The sample for physical and chemical testing shall be drawn up in presence of BHEL/Customer's inspector who shall also witness the testing.

5.08.00 Non Destructive Testing

- (a) UT shall be carried out on shafts of diameter more than 50 mm.
- (b) DP tests shall be carried out on shaft and impeller.

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
		SUB-SECTION - II A
		REV.NO. 0 DATE:
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	

- (c) No weld repair shall be allowed on cast iron.

5.09.00 Field Testing

- 5.09.01 After installation, the pumps offered shall be operated to prove satisfactory performance as individual equipment as well as a system run. If the performance at site is found not to the requirements then the equipment shall be rectified or replaced by the Vendor, at no extra cost to the Owner. The procedure of the above testing will be mutually agreed between the Owner and the contractor. Noise and vibration tests shall also be repeated at site.
- 5.09.02 Based on observation of the trial operation, if modifications and repairs are necessary, the same shall be carried out by the contractor to the full satisfaction of the engineer and then the performance and guarantee tests to be repeated at site as per relevant clauses of the specification.

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
		SUB-SECTION - II A
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	REV.NO. 0 DATE:

TECHNICAL SPECIFICATION FOR METERING PUMPS

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION - II	
		SUB-SECTION - II A	
		REV.NO. 0	DATE:
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT		

1.00.0 GENERAL

- 1.01.01 Specification cover the design, material, construction features, manufacture, inspection, testing the performance at the vendor's/sub-vendor's works, delivery to site, erection, commissioning and testing of metering pumps.

2.00.0 GENERAL DESIGN FEATURES

- 2.00.01 Pumps shall be simplex positive displacement hydraulically operated diaphragm design, driven by squirrel cage induction motor through suitable speed reduction unit. Maximum pump stroke speed shall not exceed 100 per minute.
- 2.00.02 The stroke shall be continuously adjustable to give a capacity variation 0-100% range while the pump is running or stopped. Adjustment of capacity shall be done by manual control facility (micrometric adjusting type) to be provided locally for each of the pump.
- 2.00.03 The stroke shall be continuously adjustable to give a capacity variation 0-100% range while the pump is running or stopped. Adjustment of capacity shall be done by manual control facility (micrometric adjusting type) to be provided locally for each of the pump.
- 2.00.04 Capacity variation may be effected by changing eccentricity of the driving crank or by suitable hydraulic circuit. Pump accuracy shall be industry standard $\pm 1\%$ of capacity setting.
- 2.00.05 Pumps shall be provided with an integral relief valve, spring operated to release pressure when delivery line blockage occurs.
- 2.00.06 Crankcase shall be constructed of high quality cast iron, which will also house the gearbox and guides of cross head.
- 2.00.07 Guided, controlled travel, double-ball check valves or equivalent, shall be provided both on the suction and discharge side.
- 2.00.08 Material of construction of the various parts shall be as per the details furnished elsewhere in the specification. However all parts coming in contact with acid shall be of Haste alloy 'B' and for alkali it should be of SS-316 only.
- 2.00.09 Suitable gland seal shall be provided to prevent leakage.
- 2.00.10 Electric drive motor particulars should follow enclosed electrical chapters.

3.00.00 TESTING**3.01.00 Testing and Inspection at Manufacturer's Works**

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION - II	
		SUB-SECTION - II A	
		REV.NO. 0	DATE:
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT		

- 3.01.01 The manufacturer shall conduct all tests required to ensure that the equipment furnished conforms to the requirements of this Specification and is in compliance with requirements of the applicable codes. The particulars of the proposed tests and the procedures for the tests shall be submitted to Owner for approval before conducting the tests.
- 3.01.02 The Owner's representatives shall be given full access to all tests for which the Manufacturer shall inform the Owner allowing adequate time so that if the Owner so desires, his representatives can witness the test.
- 3.01.03 All materials and castings used for the equipment shall be of tested quality. The test certificates shall be made available to Owner.
- 3.01.04 The pump casing shall be hydraulically tested at 200% pump operating pressure or 150% of design pressure whichever is higher. The test pressure shall be maintained at least for ½ an hour.
- 3.01.05 The rotating parts of pump drive shall be subjected to static balancing.
- 3.01.06 All pumps shall be tested at the shop for capacity, volumetric accuracy, repetitive accuracy, power and volumetric efficiency. The tests are to be done according to the requirements of the "Hydraulic Institute" of U.S.A. and Indian Standards as applicable.
- 3.01.07 The pump accessories e.g. gear box, speed reduction unit etc. will be subjected to tests as per manufacturer's standards. The test results shall be furnished to the Owner.
- 3.01.08 The combined variation of the pump and motor should be restricted within limits specified by Hydraulic Institute Standard, USA when the pump operated singly or in parallel.
- 3.01.09 All pumps shall be subject to strip down examination visually to check for mechanical damages after performance testing at shop.
- 3.01.10 Diaphragm of the metering pump shall be type tested as per applicable code/standard.
- 3.01.11 Performance test shall be carried out for the setting of pressure relief valve.
- 3.01.12 Test reports and certificates of all the above-mentioned tests to ensure satisfactory operation of the system shall be submitted to the Owner for approval before dispatch.

3.02.00 Test at Site

After erection at site pumps as detailed under different groups shall be operated to prove satisfactory performance as individual equipment as well as a system. If the performance at site is found to be not to the requirements, then the equipment shall be rectified or replaced by the Vendor at no extra cost to the Owner.

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION - II A
		REV.NO. 0 DATE:

**TECHNICAL SPECIFICATION
FOR
VERTICAL CENTRIFUGAL PUMPS**

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION - II A
		REV.NO. 0 DATE:

1.00.00 GENERAL INFORMATION

1.01.00 The general guidelines as illustrated in the subsequent clauses of this section shall be applicable for vertical pumps to be procured under the scope of this package.

2.00.00 CODES AND STANDARDS

2.01.00 In addition to the requirements spelt out elsewhere in the specification, the equipment to be provided under this section shall specifically conform to the following codes, standards, specifications and regulations, as applicable, including all the latest amendments subsequent to the year of publication as mentioned below.

2.01.01 IS 1710/1989: Vertical Turbine Pumps for Clear, Cold and Fresh Water.

2.01.02 IS 5120/1977: Technical requirements - Rotodynamic special purpose pumps.

2.01.03 IS 5639/1970: Pumps for handling chemical and corrosive liquids.

2.01.04 IS 5659/1970: Pumps for process water.

2.01.05 IS 6536/1972: Pumps handling volatile liquids.

2.01.06 IS 9137/1978: Code for acceptance for centrifugal, mixed flow and axial
Flow pumps - Class 'C'

2.01.07 BS 5316 Acceptance tests for Centrifugal, mixed flow Part-I/1976
And axial flow pumps - Class 'C' Tests (ISO 2548/1973)

2.01.08 BS 5316: Acceptance tests for Centrifugal, mixed flow Part-II/1977
And axial flow pumps - Class 'B' Tests (ISO 3555/1977)

2.01.09 ANSI B 73.2M Vertical inline centrifugal pumps for chemical process 1984

2.01.10 API 610/1989: Centrifugal pumps general refinery services.

2.01.11 Hydraulic Institute Standards of USA (1983).

2.01.12 PTC 8.2/1965: Power Test Codes - Centrifugal pumps.

3.00.00 Accessories:

All the pumps under this specification shall be complete with following standard/special accessories.

3.01.00 Standard accessories:

- a) Pump motor coupling along with coupling guard
- b) Common base plates for pump and motor.

	TITLE:	SPECIFICATION NO. PE-TS-412-673-A001
	2X 660 MW ENNORE SEZ STPP	SECTION - II
		SUB-SECTION - II A
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	REV.NO. 0 DATE:

- c) Lubrication system along with all internal piping, valves, fittings, specialties etc. as required.
- d) Counter flanges for suction/ discharge nozzles along with fixing nuts, bolts and gaskets.
- e) Anchor bolts, nuts, seating steel works, etc. as necessary for mounting the pump-motor unit on Civil foundations.
- f) Suitable vent (with valves)/ lifting/ handling attachments for the pump/ motor/ Accessories.
- g) Suitable drain connections with isolating valves as applicable.
- h) Set of "Special" Tools & Tackles for Pumps and motors, if any.
- i) Erection and commissioning spares, "on as required" basis.
- j) Bidder shall provide various drawings, data, calculations, test reports/ certificates, Operation and maintenance manuals, As-built drawings, etc. as specified and as necessary.

3.02.00 Services included in Bidder's Scope:

3.02.01 The pumps shall be guaranteed to meet the performance requirements as specified vide datasheet – A and also for trouble free operation after commissioning.

4.00.00 TECHNICAL REQUIREMENTS:

4.01.00 The pumps shall be Electric motor driven.

4.02.00 The Pumps shall conform to HIS

4.03.00 Vertical type pumps with 1500rpm.

4.04.00 Minimum efficiency of vertical pump will be 40%.

4.05.00 No negative tolerance shall be permitted in rated capacity & TDH.

4.06.00 No negative tolerance shall be permitted in efficiency at rated capacity.

4.07.00 The shut off head of pumps shall be at least 115% of pump rated TDH.

4.08.00 The pumps shall be capable of developing the required total head at rated capacity for Continuous operation. The pumps shall operate satisfactorily at any point on the Q-H Characteristic curve over a range of 0% to 130% capacity and shall be suitable for Continuous operation between 30% to 130% capacity.

4.09.00 Selection of the pumps shall be such that the design point shall be met even with negative manufacturing tolerance.

4.10.00 The total head capacity curve shall be continuously rising towards the shut off, the pumps shall preferably be non-overloading type and stable.

4.11.00 The pumps shall be capable of running over the entire range of NPSH conditions required without any noise, vibration or cavitations.

4.12.00 The pumps shall be of stiff shaft design. The minimum internal clearances should be sufficiently more than the max. Static deflection of the shaft. Shaft size selected must take into consideration the critical speed as specified in API-610.

4.13.00 Pumps and motors shall run smooth without undue noise and vibration. The vibration shall be within 75 microns for pump - motor set. The noise level shall be limited to 85 dB at distance of 1.0M.

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION - II A
		REV.NO. 0 DATE:

4.14.00 High reliability of the pumps is an essential requirement and therefore it gets weight age over its efficiency. It is therefore essential that the bidder choose a standard proven model from the range of pumps manufactured.

4.15.00 If water handled by pump is dirty/ not suitable for lubrication/ cooling, the bidder shall provide requisite strainer/ filters, tanks, motorized valves, etc. after the tap off for the required service, the arrangement provided shall be subject to Purchaser's approval.

5.00.00 OTHER REQUIREMENTS:

5.01.00 The materials of construction for various components specified are the minimum Requirements indicated in datasheet – A section C and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty.

6.00.00 PAINTING FOR PUMPS:

- a) The surface of SS, Gun metal, brass, bronze and non metallic component shall not be applied with any painting.
- b) The Steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shop blasting etc. as per the agreed procedure.

For all the steel surfaces inside the (indoor installation) building, a coat of red oxide primes of min. thickness of 50 microns followed up with under coat of Synthetic Enamel paint of min. thickness of 50 microns shall be applied. the top coat shall consist of two coats each of min. thickness of 50 microns of synthetic enamel paint and thus total thickness shall be min. 200 microns.

7.00.00 PERFORMANCE REQUIREMENTS

7.01.00 Pump (s) shall preferably be designed to have the best efficiency at the specified duty point. Further, the pumps (s) shall be suitable for continuous operation at any point within its 'range of operation'.

7.02.00 Under all circumstances, the 'range of operation' of the pump (s) shall exclude any Unstable operating zone of the head-capacity curve.

8.00.00 DESIGN AND CONSTRUCTION

Pumps shall be of vertical shaft, complete with bowl, column pipe, discharge head and base plate with all accessories. General design and constructional features of the pumps shall be as follows:

8.01.00 BOWL ASSEMBLY

8.01.01 This will be either a single, mixed flow or axial flow type with discharge co-axial with shaft. Type of impeller shall be chosen on the basis of the pump specific speed and the characteristics of handling fluid.

8.02.00 IMPELLER SHAFT, LINE SHAFT AND HEAD SHAFT

8.02.01 Shaft size shall be selected on the basis of maximum torque to be applied on the pump shaft. Critical speed of the shaft shall be sufficiently away from the pump operating speed and in no case shall lie between 90% and 110% of the rated speed.

	TITLE: 2X 660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION - II
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION - II A
		REV.NO. 0 DATE:

8.02.02 Impeller shaft shall be guided by bearings provided in each bowl or above and below the impeller shaft assembly. The butting faces of the shaft shall be machined square to the assembly and the shaft shall chamfer at the edges.

8.02.03 Line shaft may be single or multiple pieces as required. In case of multiple pieces, line shaft shall be coupled as per the standard practice of the manufacture. For screwed coupling, directions shall permit tightening of the joint during pump operation.

8.02.04 Replaceable shaft sleeves shall be furnished at applicable location, particularly under stuffing box and at other locations, as considered necessary.

8.03.00 BEARINGS

8.03.01 SHAFT BEARINGS

Adequate number of properly designed bearings shall be provided for smooth and trouble free operation of the pump. Number of bearings shall consider the number of shaft pieces used and the critical speed of the shaft. Bearings shall be either lubricated by external clear water/oil/grease or self-lubricated. In case of external water/oil lubrication, complete lubrication arrangement shall be furnished with the pump.

8.03.02 THRUST BEARING

Thrust bearing of adequate size and capacity shall be provided to take the vertical thrust of the impeller arising out of the pump operation and dead weight of the rotating Components. Life of the thrust bearing shall be guided by the design standard of the pump. Thrust bearing shall be capable of running continuously at maximum load. Thrust bearing shall be either grease or oil lubricated. Lubrication arrangement shall be such that the lubricant does not contaminate the handling fluid. The arrangement shall also be adequate to protect the bearing, while the pump coast down to stop in case of power failure of the station. Pre-lubrication of the thrust bearing, if recommended by the pump manufacturer, shall be taken care of in designing the lubrication system. Cooling of the thrust bearing, if necessary, shall be done by the handling fluid/external Water, depending on the fluid handled. Location of the thrust bearing may be at the pump body or at the driver, or at both depending on the requirement.

	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION : II	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION : IIB	
		REV. NO. 00	DATE :

SECTION – II

GENERAL TECHNICAL REQUIREMENTS

SUB-SECTION IIB - GENERAL TECHNICAL REQUIREMENTS (ELECTRICAL)

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : II-B
		REV NO. : 00 DATE : 29/08/2005 SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 1 OF 4

1.0 INTENT OF SPECIFICATION

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

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

2.0 CODES AND STANDARDS

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

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

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

3.0 DESIGN REQUIREMENTS

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

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

3.3 Starting Requirements

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

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

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 2 OF 4

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

3.3.3 The following frequency of starts shall apply

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

3.4 Running Requirements

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

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

3.5 Stress During bus Transfer

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

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

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

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

4.0 CONSTRUCTIONAL FEATURES

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

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

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

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

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 3 OF 4
4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors. 4.5. Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point. 4.6. In case Class ‘F’ insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class ‘B’ insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C. 4.7 Terminals and Terminal Boxes 4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A. Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet “A”. 4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end. 4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively. 4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation. 4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A. 4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691. 4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes. 4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors. 4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type. 4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal. 4.9 General		

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 4 OF 4
4.9.1 Motors provided for similar drives shall be interchangeable. 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors. 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above. 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956. 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz. 4.9.6 Name plate with all particulars as per IS: 325 shall be provided 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions. 5.0 INSPECTION AND TESTING 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied. 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser. 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan. 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A. 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT a) OGA drawing showing the position of terminal boxes, earthing connections etc. b) Arrangement drawing of terminal boxes. c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet). i) Current vs. time at rated voltage and minimum starting voltage. ii) Speed vs. time at rated voltage and minimum starting voltage. iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling. iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.		

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO. PE-TS-412-673-A001
		SECTION :II
		SUB-SECTION: IIB
		REV NO. 00 DATE 04/01/2017
		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. PE-TS-412-673-A001
		SECTION :II
		SUB-SECTION: IIB
		REV NO. 00 DATE 04/01/2017
		SHEET 2 OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SPECIFICATION NO. PE-TS-412-673-
A001

SECTION : II

SUB-SECTION : IIB

REV. NO. 00

DATE :

Explanatory notes for filling up cable list for routing through Win Path, 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 Win Path 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)
B = 6.6KV (Power cables)
C = 3.3KV (Power cables)

	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION : II	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	SUB-SECTION : IIB	
		REV. NO. 00	DATE :

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

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

(C) CABLE CODES

1.1 PVC Copper

A = Armoured FRLS

B = Armoured Non-FRLS

C = unarmoured FRLS

D = Unarmoured Non-FRLS

2.1 PVC Aluminium

E = Armoured FRLS

F = Armoured Non-FRLS

G = unarmoured FRLS

H = Unarmoured Non-FRLS

3.1 XLPE Copper

J = Armoured FRLS

K = Armoured Non-FRLS

L = unarmoured FRLS

M = Unarmoured Non-FRLS

4.1 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



TITLE:
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-673-A001

SECTION : II

**TECHNICAL SPECIFICATION FOR SEWAGE
TREATMENT PLANT**

SUB-SECTION : IIC

REV. NO. 00

DATE :

SECTION – II

GENERAL TECHNICAL REQUIREMENTS

SUB-SECTION IIC - GENERAL TECHNICAL REQUIREMENTS (C&I)



INDEX

S. No.	DESCRIPTION
1.	NOT APPLICABLE
2.	INDEX SHEET
3.	CONTROL PHILOSOPHY FOR STP
4.	NOT APPLICABLE
5.	LIST OF DOCUMENTS/DELIVERABLES
6.	ACTUATORS
7.	FIELD & MEASURING INSTRUMENTS
8.	APPLICABLE CODES AND STANDARDS
9.	NOT APPLICABLE
10.	INSTRUMENT INTALLATION DIAGRAM
11.	NOT APPLICABLE
12.	NOT APPLICABLE

CONTROL PHILOSOPHY FOR STP

CONTROL PHILOSOPHY FOR STP

1. The overall operation & control of STP shall be through standalone control system of DDCMIS (BHEL's scope) family, located in STP Control Room. Separate DDCMIS panels, Back-up control desk, UPS, OWS, OEWS, and Printers inside the control room shall be provided by BHEL.
2. Sewage transfer pumps installed in various sewage lifting sumps (S1, S2, S3 & S4) other than STP area will be operated by level controls (low/ high) at the sump & pump discharge pressure (low/ high). The same shall be controlled from nearest control system (BHEL's scope).
3. For auto operation, one pump shall be kept in Auto running and the other pump shall be kept in Auto standby. The pump selected in Auto running shall start at high level and trip at low level.
4. All controls, fault indications/ alarms, interlocks, logics shall be implemented in DDCMIS (BHEL's scope).
5. Complete Instrumentation for control, monitoring and operation of entire STP shall be in bidder's scope. In addition to this, all drives, JB's, erection hardware, instrument enclosures/rack shall also be in Bidder's scope.

LIST OF DOCUMENTS/DELIVERABLES

LIST OF VENDOR DELIVERABLES FOR C&I FOR STP (2 X 660 MW ENNORE SEZ STPP)			
DOCUMENT NUMBER	PE-GL-412-603-I001	SHEET	1 of 1
SI.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-412-603-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
2	PE-V0-412-603-I902	CONTROL SCHEME/LOGIC DIAGRAM(TO BE IMPLEMENTED IN DCS)	A
3	PE-V0-412-603-I903	HMI PICTURES/PLANT SCHEMATICS	I
4	PE-V0-412-603-I904	INSTRUMENT SCHEDULE with set points	A
5	PE-V0-412-603-I905	GROUPING AND TERMINATION	A
6	PE-V0-412-603-I906	I/O LIST (ANALOG & BINARY)	A
7	PE-V0-412-603-I907	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
8	PE-V0-412-603-I908	DATASHEETS FOR INSTRUMENTS, JB's,Analysers etc.along with catalogue	A
9	PE-V0-412-603-I909	INSTRUMENT HOOK-UP DRAWING	A
10	PE-V0-412-603-I910	QUALITY PLANS/CHECK LISTS (For all applicable instruments)	A
11	PE-V0-412-603-I911	CABLE SCHEDULE & INTERCONNECTION	I
12	PE-V0-412-603-I912	ANNUNCIATION & SOE LIST	A
NOTES: ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER 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.			

ACTUATORS

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-DG-412-145-I902	
			VOLUME II B	
			SECTION D	
			REV. NO. 01	DATE: 14.02.17
			SHEET 1	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL *	* PROJECT	2x 660 MW ENNORE SUPERCRITICAL TPP		
	OFFER REFERENCE			
	* TAG NO. SERVICE			
	* DUTY	☐ ON / OFF	☐ INCHING	
	* LINE SIZE (inlet/outlet): MATERIAL			
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY		
	* OPENING / CLOSING TIME			
	* WORKING PRESSURE			
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%		
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY		
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:68		
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL		
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.		
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.		
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.		
HANDWHEEL	* REQUIRED	☒ YES ☐ NO		
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED		
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.			
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY		
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY		
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- INCLUSIVE OF I.S. TOLERANCE		
	ACTUATOR APPLICABLE WIRING DIAGRAM	☐ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram		
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐		
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☒ EPOXY ☐		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY		
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V		

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-DG-412-145-I902	
			VOLUME II B	
			SECTION D	
			REV. NO. 01	DATE: 14.02.17
			SHEET 2	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	@ ENCLOSURE CLASS OF MOTOR	☒ IP 68 ☐ FLAME PROOF		
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B		
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☐ -----		
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED		
INTEGRAL STARTER	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED		
	TYPE OF SWITCHING DEVICE	☒ CONTACTORS ☐ THYRISTORS		
	TYPE	☒ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)		
	STEP DOWN CONT. TRANSFORMER	☒ REQUIRED		
	OPEN / CLOSE PB	☒ REQUIRED ☐ NOT REQUIRED		
	STOP PB	☒ REQUIRED ☐ NOT REQUIRED		
	INDICATING LAMPS	☒ REQUIRED ☐ NOT REQUIRED		
	LOCAL REMOTE S/S	☒ REQUIRED ☐ NOT REQUIRED		
	STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED		
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (MOTOR THERMOSTAT TRIP, O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, PHASE LOSS, S/S IN LOCAL or OFF MODE, STOP PB OPTD, TORQUE OPEN/CLOSE CUTOFF)		
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER		
	QUANTITY	☒ 2 NOs. ☐ 3 NOs.		
	DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC		
	DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX		
	LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms		
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN / CLOSE	☒ 1 No. ☐ 2Nos. / ☒ 1 No. ☐ 2Nos		
	CONTACT TYPE	2 NO + 2 NC		
	RATING	5A 240V AC AND 0.5A 220V DC		
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE		
	ACCURACY	+3% OF SET VALUE		
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN : INT : CLOSE	☐ 1 No ☒ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☒ 2Nos.
	CONTACT TYPE	2 NO + 2 NC		
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC		

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-DG-412-145-1902	
			VOLUME II B	
			SECTION D	
			REV. NO. 01	DATE: 14.02.17
			SHEET 3	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	☒ REQUIRED ☐ NOT REQUIRED		
	MFR & MODEL NO.	BIDDER TO SPECIFY		
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☒ ELECTRONIC (2 WIRE) CONTACTLESS		
	SUPPLY	☒ 24V DC ☐		
	OUTPUT	☒ 4-20mA		
SPACE HEATER	ACCURACY	$\pm 1\%$ FS		
	@SPACE HEATER	REQUIRED		
	@ POWER SUPPLY (NON INTEGRAL)	230V AC, 1 PH., 50 Hz		
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY		
TERMINAL BOX	@ RATING			
	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED		
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☒ IP 68 @ ☐		
	@ EARTHING TERMINAL	REQUIRED		
CABLE GLANDS	PLUG & SOCKET (9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ☒ NOT REQUIRED ☐ 2 NOS. ☐		
	@ POWER CABLE GLAND	SIZE: suitable for 3Cx2.5sq mm Cu		
	@ SPACE HEATER CABLE GLAND	SIZE:-		
	OTHER CONTROL CABLE GLANDS	QUANTITY & SIZE: Cable gland suitable for 8Px0.5 sq mm & 2P x 0.5 sq mm cable.		
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY		_____ Kg.
NOTES: 1. SCOPE: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY. 2. CODES & STANDARDS: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722 3. ACTUATOR SHALL HAVE HARDWIRED CONTACTS FOR FOLLOWING SIGNALS (a) ACTUATOR IN LOCAL MODE (b) ACTUATOR IN REMOTE MODE 4. BIDDER TO ENSURE AVAILABILITY OF SPARE 1NO + 1NC LIMIT SWITCH & TORQUE SWITCH. 5. SS TAG NAME PLATE SHALL BE PROVIDED. 6. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C. 7. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, NI PLATED BRASS MATERIAL SHALL BE PROVIDED. 8. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE. 9. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. 10. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING. 11. LOCAL DIGITAL POSITION INDICATOR SHALL BE PROVIDED FOR INCHING DUTY DRIVES. 12. COMMANDS SHALL BE LATCHED AT INTEGRAL STARTER END. 13. SWITCHES SHALL BE TERMINATED IN JB MOUNTED ON ACTUATOR. \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE. ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS				
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
	SEEMA KHATRI	SURESH CHAND SHARMA	SURESH CHAND SHARMA	NAME
				SIGNATURE
	05.10.2016	05.10.2016	05.10.2016	DATE

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

FIELD & MEASURING INSTRUMENTS

CHAPTER-3**FIELD AND MEASURING INSTRUMENTS****3.00.00 FIELD & MEASURING INSTRUMENTS (PRIMARY & SECONDARY INSTRUMENTS)****3.01.00 GENERAL REQUIREMENTS**

- 3.01.01** Instruments, control devices and other equipment accessories covered under this specification shall be furnished in accordance with I&C specification sheets and drawings enclosed herewith and the requirements of all applicable clauses of this specification.
- 3.01.03** The instrumentation/control equipment and accessories shall be from the latest proven design for which the performance and high availability have been demonstrated by a considerable record of successful operation in power station service for similar applications. The bidder shall furnish sufficient evidence to fully satisfy the Owner in this regard.
- 3.01.04** For plug in type instruments, The plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections.
Signal/Electrical connection shall be screwed connection with double compression type Nickel-plated brass cable glands for Explosion proof area, Flame proof area and high vibration prone area.
- 3.01.05** Every instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuse of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
- 3.01.06** All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC article 500, class 1, Division 1 area & flame proof) and an anti corrosive paint shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange shall also be included wherever required with the field instruments.
- 3.02.00** Following minimum requirement of field instruments shall be fulfilled by Bidder (In addition, Redundancy criteria for field instruments shall be as specified else where in specification): -



DESEIN

Vol-V : Instrumentation & Control Works

- iii. Level Transmitters (Type as per Owner approval) for open sump/tank/bunker/vessel/heaters.
- iv. Stand pipes on both side of tank for all level instruments (LT, LS & LG).
- v. Flow elements with flow transmitter & Flow meter for flow measurement of process medium as decided by owner
- vi. Pressure gauges and temp. Gauges at inlet and outlet of each heat exchanger and cooler.
- vii. DPG, DPT & DPS across the filters/strainers.
- viii. Tapping points/test points shall be provided.
- x. All Thermocouples & RTDs shall be Duplex.
- xi. All Field Instruments used in acid or alkaline atmosphere shall be with standard Anti corrosion coating i.e. the combination of Polyurethane and epoxy resin baked coating (ANSI/ISA-71.04).
- xii. All primary instruments installed at "Minus level or Floor" shall be with protection class of IP 68.
- xiii. Transmitters (all type) for monitoring & controls purpose.



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 - 39



DESEIN**Vol-V : Instrumentation & Control Works**

- xvii All field mounted push button, selector switch etc. shall be as per IEC or NEMA 4X protection.
- xviii All limit switch shall be conform to IEC-60947-5-1.
- xxi. Temp. Transmitters are envisaged with RTD & Thermocouples for monitoring services/application only. However any RTD & Thermocouples are used for control, interlock & protection application, same shall be directly wired to DDCMIS/DCS/PLC using instrumentation & Extension cables respectively.
- xxii. As for the water flow/ steam flow measurements, **necessary flow elements/ transmitters are chosen in the process line and supplied such that their algebraic summation shall be mass balanced for calculating the system efficiency.**
- xxiii. Contacts less, electronic 2-wire position transmitters shall be provided for all inching type motorised valve
- xxiv. ~~For CW sump level, Raw water reservoir level, Turbine oil tank, coal bunkers, Ash Silo, LDO/HFO tank, DM water tanks, CS tank, Acid and alkali applications, only~~ non contact type level transmitters like Acoustic, Ultrasonic, Radar based shall be provided by bidders as approved by owner.
- xxvii. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

FIELD INSTRUMENTS SHALL BE SUPPLIED & OFFERED AS PER DATA SHEETS SPECIFIED BELOW:



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 - 40



DESEIN**Vol-V : Instrumentation & Control Works****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.

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 m 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 BOP 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



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 - 41



DESEIN**Vol-V : Instrumentation & Control Works**

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 non integral and standalone type. Snubbers/Pulsation dampners 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.

3.03.02 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

- Enclosure : Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.

- Protective Diaphragm : Teflon



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 - 42



DESEIN**Vol-V : Instrumentation & Control Works**

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 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 dampners/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
-Above 1.0Kg/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



DESEIN**Vol-V : Instrumentation & Control Works**

		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 Pulsation dampener/snubber (S316)	:	Pump and compressor discharge lines
- 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 corrosive liquid lines diaphragm type sensors required. Armored capillary of 10 M for Corrosive liquid service.



DESEIN**Vol-V : Instrumentation & Control Works**

: Contact type pressure gauges are not acceptable for interlock & protection.

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

The Temperature transmitter shall accept Universal dual inputs of all types of thermocouples & RTD, 0-5V input signals etc.



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 - 45



DESEIN**Vol-V : Instrumentation & Control Works**

Temp. Transmitter shall be extremely stable against Ambient temp variation, The accuracy figure shall be inclusive of effect due to ambient temperature variation.

3.03.05 RESISTANCE TEMPERATURE SENSORS WITH THERMOWELLS

Applicable Standard	:	ASME PTC 19.3 - Latest Revision DIN EN 60751:1996, BS EN/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.



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 - 46



DESEIN**Vol-V : Instrumentation & Control Works**

Bidder shall provide calculation for thermowell as per ASME – PTC-19.3 2010.

- 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.

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



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 - 47



DESEIN**Vol-V : Instrumentation & Control Works**

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 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



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 - 51



DESEIN**Vol-V : Instrumentation & Control Works**

		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)



DESEIN**Vol-V : Instrumentation & Control Works****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

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	:	$\pm 0.25\%$ of span or better
Resolution	:	$\pm 0.1\%$ of span
Temperature Compensation:	:	To be provided with Transducer.



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 - 53



DESEIN**Vol-V : Instrumentation & Control Works**

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,



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 - 54



DESEIN**Vol-V : Instrumentation & Control Works**

		Condenser Hotwell, LP heaters, CBD 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 & $\pm$ 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:		



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 - 55



DESEIN**Vol-V : Instrumentation & Control Works**

~~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



DESEIN**Vol-V : Instrumentation & Control Works**

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	:	$\pm 0.1\%$ 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



DESEIN

Vol-V : Instrumentation & Control Works

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.



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 - 64



DESEIN**Vol-V : Instrumentation & Control Works**

- 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



DESEIN**Vol-V : Instrumentation & Control Works**

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



DESEIN**Vol-V : Instrumentation & Control Works**

Power Supply	:	240V AC, 50 Hz. From UPS
Accuracy	:	+/-1% of full scale span.
Stability	:	±1% of full scale per month non-cumulative
Repeatability	:	+/-1% of span
Protection class	:	IP - 65
Process connection	:	¼ inch NPT (F) / SCRD for on line type. ¾ inch NPT (M) SCRD for pipe mounted
Electrical connection	:	½ inch NPT (F) SCRD
Accessories	:	Automatic temp. Compensation in the range of 0-100 Deg.C

5.12.00**Technical Specification of pH Cell and Transmitters**

- a) Applicable Standard pH electrodes shall conform to IS: 6804-1972 except as modified in this specification
- b) Type:
- i) Cell Measuring and Reference Electrode Combination with Flow through type (SS316/Polypropylene flow chambers) for power plant's steam & water application. Sensor shall not be affected by flow variation. Sensor shall be designed for power plant applications.
- ii) Monitors Electronic (microprocessor based) indicating type with adjustable range facility.
- c) Material:
- i) Measuring & reference Toughened sensitive
- ii) Electrode pH glass
- iii) Monitor body Carbon steel/Aluminum/Polycarbonate
- d) Monitor output
- i) 4-20 mAmp D.C. with HART protocol spare out put
- ii) 4-20mA DC with HART protocol for DDCMIS
Output load : 500Ω
- e) Power supply 240V AC, 50 Hz from UPS
- f) Accuracy/repeatability + 0.03 pH/+0.02PH
- g) Resolution + 0.01 pH or 1 mV. 1C
- h) Stability 0.02 pH per week
- i) Annunciation contacts from monitors:



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 - 238



DESEIN**Vol-V : Instrumentation & Control Works**

i)	Number	2 SPDT 'Hi' and 'Lo'
ii)	Type	Snap action micro switch
iii)	Rating	5 amp, 240V AC, 0.2 Amp, 220V DC
j)	Connection:	
i)	Process	One-quarter (1/4)inch NPT(F) SCRD ON-LINE
ii)	Electrical	Half (1/2) inch NPT(F) SCRD
k)	Mounting:	
i)	Cell	Pipe Mounted
ii)	Monitors	Flush panel mounting
l)	Accessories	i) Automatic temperature compensation with fast response integral temperature sensors in the range 0-100°C ii) Co-axial cable as required iii) Sample coolers iv) low and pressure regulators v) Standard pH solutions vi) SS316 impulse tubing and fittings vii) Isolation & drain valves as required viii) Electrode holders ix) Other accessories as required x) Sample rate set valves xi) Alarm settings and indications on monitor. xii) RFI/EMI shielded, weather and corrosion proof casing

5.13.00 Technical Specification of Dissolved Oxygen Analyser

a)	Applicable Standards	ASTM PTC 19.11-1970 except as modified in this specification
b)	Type	Microprocessor based Electro-chemical
c)	Material	Die-cast aluminum/SS/Polycarbonate
d)	Output	i) 4-20 mAmp DC spare output ii) 4-20 m Amp, DC Isolated output for DCS.
e)	Supply	240V AC, 50 Hz from UPS
f)	Accuracy	± 5 % of reading
g)	Response:	
i)	Sensitivity	$\pm$ Two (2) per cent overall
ii)	Time (sensor)	Less than 30 seconds for 90% step change.
h)	Connection:	



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 - 239



DESEIN**Vol-V : Instrumentation & Control Works**

- Type Snap action micro switch
 - Rating 5A, 240V AC, 0.2A, 220V DC
 - Mounting Flush
- viii) Terminal points All components piped & wired to terminal points
- ix) Accessories
- i) Flow regulator
 - ii) Flow gauges
 - iii) Sample rate set valves
 - iv) Other accessories as required to make the system complete

5.20.00 Technical Specification of Residual Chlorine Analyser**SENSOR**

Method	:	Amperometric
Electrodes	:	Gold Cathode/Silver Anode
Cell Material	:	PVC
Electrolyte	:	Potassium Bromide

TRANSMITTER

Type	:	Microprocessor Based with self diagnostic features
Transmitter Output	:	4 – 20 mA
Enclosure Protection	:	IP65
Enclosure Material	:	Polyester coated Al.
Electrical Connection	:	½" NPT (F)
Mounting	:	FIELD
Display Type	:	LCD
Display Details	:	4 digit backlit LCD matrix
Diagnostics	:	Required
Meter Range	:	0-1 mg/l
Resolution	:	0.01 ppm
Area Classification	:	SAFE
Electromagnetic Compatibility	:	BUILT – IN
Temp. Compensator	:	AUTO – BUILT – IN
Temp. Compensating element	:	PT100

5.21.00 Technical Specification of Turbidity Analyser**SENSOR**

Reference type	:	On Line
Operating principle	:	Alternating Light Source
Cleaning	:	Self Cleaning
Electrode holder – type	:	Flow Through
Body Material	:	CPVC
Process Connection	:	½" NPT (F)



DESEIN**Vol-V : Instrumentation & Control Works**

Pre Amplifier : Built-In

TRANSMITTER

Type : Microprocessor Based
 Transmitter Output : 4-20 mA DC
 Enclosure Protection : IP65
 Enclosure material : polycarbonate
 Electrical connection : ½" NPT (F)
 Local Indicator : Provided (LCD Display)
 Accuracy : 0.2 NTU or $\pm 2\%$ of reading
 Repeatability : $\pm 0.1\%$ of span
 Temp. compensator : built-in
 Cable between transmitter & sensor : To be provided

5.22.00 All analysers shall be supplied with chemicals/regents required for 12 months operation. Bidder shall also provide start up kits, buffer solution for pH and conductivity analyzer. The analyser supplier shall submit the preparation procedure / formula of the reagent to be used in analyser solution.

5.23.00 Technical Specification of Flue Gas Analyzers

The following analyzers are envisaged:-

- i) Flue Gas Oxygen & CO analyzer for control and monitoring.
- ii) Opacity analyzer for ESP (At each Path). "refer the clause 16.1.3 for technical Specification."
- iii) Each analyser shall be independent and shall not share power supply modules, processor etc. with other analyser.

5.24.00 General Specification of Flue Gas Oxygen Analyser

- a) Type Direct mounted Zirconia probe
(In situ) Zirconia probe analyzer should have facility of "in situ" calibration as well as easy replacement of Zirconia cell. Zirconia cell protection shall be by providing ceramic filter at the end of probe.
- b) Probe 316SS (1800 mm long)
- c) Output
 - i) 4-20 mA DC HART for spare output
 - ii) 4-20 m Amp, DC HART, Separate outputs for DDCMIS.
- d) Supply 240V AC, 50 Hz from Plant UPS
- e) Accuracy ± 1 per cent of span (or) better inclusive of linearity, repeatability.
- f) Repeatability $\pm 0.5\%$ of full scale
- g) Ranges As per Cl. No. 5.27.00.
- h) System response 90% of full scale Less than 3 seconds with test gases, with actual process 20 seconds.
- i) Connection:



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 - 245



DESEIN**Vol-V : Instrumentation & Control Works**

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 convertors 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.



DESEIN**Vol-V : Instrumentation & Control Works**

- (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 SS. 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 varister, 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.



DESEIN**Vol-V : Instrumentation & Control Works**

- 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 V0 inflammability class in accordance with UL94", IEC60664/IEC60664A/DIN VDE 0110. Facility to stimulate IPR manually shall be provided. The VA burden of relays shall be suitable to match the capacity of output modules. Interposing relay & sockets for mounting the interposing relay shall be of same make only.

3.03.44**RECORDERS (CHARTLESS)**

Type	:	Micro-processor based, Digital
- No. of Channels	:	TFT display type Forty Eight (48) point).



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 - 73



CHAPTER-12**FLOW ELEMENTS**

12.00.00 This specification covers the design, material, construction features, manufacture, inspection and testing at the VENDOR'S/SUB-VENDOR'S WORKS and delivery to site of Flow Elements.

The equipment furnished to this specification shall conform exactly to the requirements herein, unless modified by the respective Data Sheet of the equipment.

12.01.00 The design, material, construction features, manufacture, inspection and testing of flow elements shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

12.02.00 Technical Requirement

316SS long radius, weld in flow nozzles with D and D/2 pressure tapings; 316SS flow orifice plate assembly with flange tap connections; β ratio of 0.4 to 0.7. Element material of SS 316. The material of Flow nozzle shall be A182F91, where pipe material is A335P91. The material of all type of accessories will be SS316. End connections for flow elements will be butt welded except orifice plate on condensate return line to CST, which will be flanged. The accuracy of the flow element shall be $\pm 0.5\%$ or better.

Standards

The flow elements (Orifice plates) shall be designed in accordance with ASME PTC – 19.5 (Pt – II), ISA RP3.2, 1960 or BS 1042/ISO 5167.

The flow elements (Flow Nozzles) shall be designed in accordance with ASME PTC – 19.5 (Pt – II), or BS 1042/ISO 5167.

Construction and installation of flow nozzles and orifices shall conform to the requirements of ASME Performance Test Code PTC-19.5 as mentioned above and discharge coefficients shall be predicted in accordance with data published in ASME Research Report on Fluid Meters.

Flow nozzles shall be provided for critical measurements where weld-in construction is required. Flow nozzles shall be made with quater, triple or dual sets of pressure taps installed in the pipe wall where required considering spare one set of pressure tap. Installation of flow nozzles and pressure taps shall be made in the pipe fabricator's shop.

Anubars shall be used where pressure loss is critical and/or conditions permit their reliable installation.

Concentric orifice plates shall only be provided for other flow measurements where flanged construction and higher pressure losses are acceptable. Orifice plates shall be



made of stainless steel. Orifice flanges shall be of the raised face weld neck type with dual sets of taps. Thickness of Orifice plate shall be 3 mm for pipe diameter up to 300 mm and 6 mm for pipe diameter above 300 mm.

Coriolis principle based mass flow meters shall be used for flow (mass & volume) measurement of liquid fuel.

Aerofoil/ Venturi tubes shall be provided for Air flow measurement.

Flow element shall be accompanied by IBR certification. Hydraulic test pressure shall be considered 1.5 times of design pressure at normal temperature.

SS nameplate to flow elements shall include Tag no/ KKS No./Sl. No./ Body Material/Beta ratio/line size & thickness/ direction of flow.

BIDDER to ensure that maximum pressure drop/loss shall be limited to 30% of Differential Pressure for flow Nozzle & 60% of DP for Orifice plate.

12.03.00 **ANNUBAR/Averaging Pitot tube**

Type/Construction : Averaging Pitot tube with direct mounting type on pipe

Materials :

Body	:	SS316
Nipple	:	SS316
Gaskets	:	Teflon
Bolts & nuts	:	SS316
Flange	:	SS316
Process Connection	:	1 1/2" Flanged
Instrument connection	:	1/2" NPT (F) through needle valve
Differential range	:	(To suit the accurate flow)
Accessories	:	Bolts, Nuts, Cover plates, Adapter and Gaskets SS tag plate as required
Tests	:	Tested at two hundred (200) percent of the Maximum process Pressure

12.04.00 **Aerofoil**

Materials	:	As per IS 2062 in line with Duct material
Accuracy	:	+/- 1to2%
Repeatbility	:	+/- 0.1% to 0.2%
Type of tappings	:	Total 4 pairs of tapings (3 pairs of tapings with stubs & 1 spare pair plugged)
Tap size	:	1/2" SW
End connection	:	Flanged with mating flange
Beta ratio	:	0.4 to 0.7
Accessories	:	SS tag plate, nuts, bolts, packing & hardware, etc.
Standards	:	ASME PTC – 19.5 (Pt - II), or BS 1042/ISO 5167



~~Pressure Loss : $\leq 20\%$ of DP~~

12.05.00 PERFORMANCE

The Bidder shall submit type test certificate from a recognized test house certifying evaluation of construction standard, accuracy of calibration.

12.06.00 TESTS AND INSPECTION

All equipment components shall be individually tested to ensure correct functioning. Following tests shall also be conducted:

- a) Calibration test
- b) Dimensional check
- c) Material test

Wet calibration shall be carried out as on each size and design of flow element as per ASME PTC or BS 1042/ISO 5167. The other tests shall conform to ASME-PTC 19.5. The Bidder shall submit the reports for all the tests carried out for Owner's review and records. The functional test shall also be witnessed by owner as per approved QAP.



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 - 379



DESEIN**Vol-V : Instrumentation & Control Works**

- iv. **Back up panel system** shall be designed for handling ~~the situation in clause 2.12.00 for failure of HMI.~~
- v. **For electrical layout, complete backup panel with mosaic** shall have to be provided for complete on/off operations with necessary meters, DDU's, synchroscope etc. as specified elsewhere in specification.
- iv. Control panel cum desk with HW annunciation windows, ILPBs, Ammeters, PBs, voltmeters, indicators, mimic, recorders etc. shall be provided as per Annexure A – Control System Philosophy for BOP packages. Profile/Overall GA of backup control panel cum desk for BOP packages shall be same as indicated in drawing no. 114-05-0105 attached with NIT.

2.06.00 PROTECTION, CLASS OF CABINETS / PANELS, ENCL.OSURES ETC.

- a) All panels, desks cabinets, consoles & enclosures furnished at least comply with the requirements of protection classes as indicated below.
 - 1. In-door Air-conditioned (A.C.) areas - IP32/42 (min.)
 - 2. In-door Non A.C. areas:
 - (a) Ventilated enclosures - IP42
 - (b) Non Ventilated. IP 54
 - 3. Out-door IP55 / IP65
(As per the requirement)
- b) Distribution boxes, junction boxes, cold junction compensation boxes, terminal boxes and all other field mounted equipment to be furnished as per this specification shall have weather protection conforming to IP 65.
- c) The design of panels, cabinets, enclosures and packaging density of components mounted therein shall be such that the temperature rise does not exceed 10 deg. C above the ambient under the worst conditions.
- d) The panels housing electronic hardware shall be provided with flame and smoke detectors by bidder.
- e) Enclosures for peripheral equipments like printers, etc. shall take care of noise and shall ensure minimum possible noise disturb to the working personnel.

2.06.01 Guards, barriers and access doors, covers of plates shall be marked to indicate the hazard, which may occur upon removal of such devices. Danger or caution signs shall be used to warn of specific hazards such as voltage or current. The marking shall be permanently affixed to the equipment.

2.07.00 ~~System Documentation~~

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 - 31



APPLICABLE CODES AND STANDARDS

1.08.00 CODES AND STANDARDS

1.08.01 All equipments, system and service covered under this specification shall comply with the requirements of the latest statutes regulations and safety codes as applicable in the locality where the equipments/systems will be installed. The Bidder shall fully acquaint himself with these requirements and shall ensure compliance with them.

The equipments, systems and services furnished as per this specification shall conform to the codes and standards mentioned in Cl. no. 1.08.02 of this Section. However in the event of any conflict between the requirements of two standards or between the requirements of any standard and this specification, the more stringent requirements shall apply unless confirmed otherwise by the Owner in writing. The decision of the Owner shall be final and binding in all such cases.

The Bidder's scope of supply shall include some items such as thermowells, and other in-line devices for main steam, hot reheat, cold reheat, feed water system falling under the purview of Indian Boiler Regulation (IBR) Act. It shall be the responsibility of the Bidder to obtain the necessary approval of the concerned Inspecting Authority/Chief Inspector of Boilers for the design and design calculations and manufacturing and erection procedures as called for under the IBR act for all items requiring such certifications.

The requirements of statutory authorities (e.g. MOEF, Inspectors of factories, IBR, TAC, BEE, CPCB/TNPCB etc) with regards to various plants areas like Main plant, Fuel oil plant/system, Chlorination Plant, Fire Fighting system, Emission Measurement, Ambient Air Monitoring system etc. shall be complied, even if not actually spelt out.

1.08.02 Reference Codes and Standards

The design, manufacture, inspection, testing, site calibration and installation of all equipment and systems covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable ANSI,



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 - 14



DESEIN**Vol-V : Instrumentation & Control Works**

ASME, IEEE, NEC, NEMA, ISA, DIN, VDE, NFPA, IEC, EIA, TIA and Indian Standards and their equivalents. Bidder to note that in no case, OEM/manufacturers own standards shall be accepted.

1.08.02.01 Temperature Measurement

1. Performance Test Code for temperature measurement ASME PTC 19.3 (1974 – R 1998)
2. Temperature measurement - Thermocouples ANSI-MC 96.1 – 1982, IEC 584
3. Temperature measurement by electrical resistance thermometers - IS-2806.
4. Thermometer-element-platinum resistance-IS-2848, IEC 751/DIN 43760
5. RTD Design Code – DIN EN 60751:1996, BS EN 60751 : 2008
6. Thermowell Design Code – ASME PTC 19.3 TW – 2010

1.08.02.02 Pressure Measurement

1. Performance Test Code for pressure measurement - ASME PTC 19.2 (2010)
2. Bourdon tube pressure and vacuum gauges - IS 3624, IS 3602, ASME B 40.1

1.08.02.03 Electronic measuring Instruments & Control hardware

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973), IS 9319
2. Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 - 1974.
3. Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1:ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975): ISA-S26 (1968).
5. Surge withstand capability (SWC) tests - ANSI C 37.90A (1974) IEEE Std. 472 (1974). IEC – 255.4.
6. Printed circuit boards - IPC TM-650, IEC 326 C
7. General requirements and tests for printed wiring boards - IS 7405 (Part-I) - 1973
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles ANSI C73-1973.
11. Direct acting Electrical Indicating Instruments: IS-1248-1968.

1.08.02.04 Instrument Switches and Contacts

1. Contact rating - AC services NEMA ICS Part-2 125, A600
2. Contact rating - DC services NEMA ICS Part-2-125, N600.



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 - 15



DESEIN**Vol-V : Instrumentation & Control Works****1.08.02.09 Enclosures**

1. Types of enclosures - NEMA Std. ICS-6-110.15 through 110.22 (Type 4 to 13).
2. Racks, panels, and associated equipment - EIA: RS-310-B (ANSI C83.9 - 1972)
3. Protection Class for Enclosure, Cabinets, Control Panels and Desks - IS-13947-1962.

1.08.02.15 Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A106.
2. Material for socket weld fittings - ASTM - A105.
3. Dimensions of fittings - ANSI B16.11
4. Code for pressure piping, welding, hydrostatic testing - ANSI B31.1.

1.08.02.18 Flow measurement

1. ASME Performance Test Code PTC-19.5 (2004), ISA RP3.2
2. BS 1042
3. ISO 5167

1.08.02.11 Sampling System

1. Stainless steel material of tubing and valves for sampling system - ASTM A269-82 Gr TP316.
2. Submerged helical coil heat exchangers for sample coolers ASTM D 11-98.
3. Water and Steam in power cycle - ASME PTC 19.11(2008).
4. Standard methods of sampling system - ASTM D 1066-69.

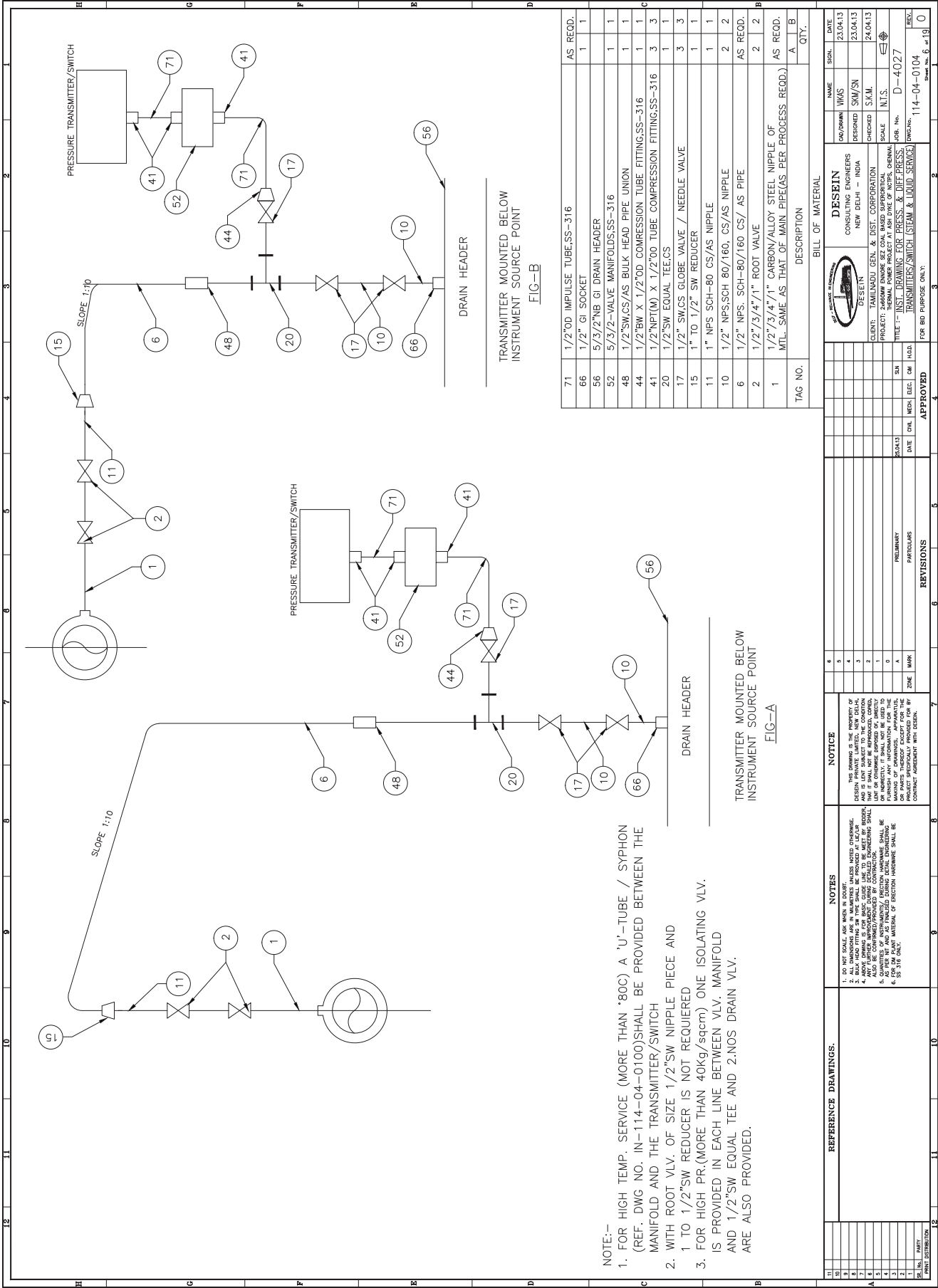
1.08.02.14 Process Connection and Piping:

1. Codes for pressure piping power piping ANSI B31.1
2. Seamless carbon steel pipe ASTM A-106.
3. Forged and Rolled Alloy steel pipe flanges, forged fittings, valves and parts - ASTM A-182.
4. Material for socket welded fittings - ASTM A-105.
5. Seamless ferrite alloy steel pipe - ASTM A-335.
6. Pipe fittings of wrought carbon steel and alloy steel - ASTM A-234.
7. Composition bronze or metal castings - ASTM B-62.
8. Seamless copper tube, bright annealed ASTM B-168.
9. Seamless copper tube - ASTM B-75.
10. Dimensions of fittings - ANSI B-16.11
11. Valves flanged and butt welding ends - ANSI B16.34.
12. Nomenclature for Instrument tube fittings ISA-RP-42.1 - 1982.



INSTRUMENT INSTALLATION DIAGRAM

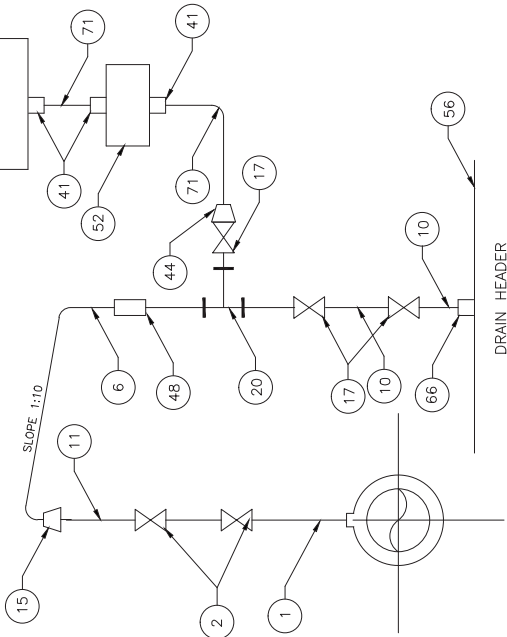
[illegible]



NOTE:-

1. FOR HIGH TEMP. SERVICE (MORE THAN *80C) A 'U'-TUBE / SYPHON (REF. DWG NO. IN-114-04-0100) SHALL BE PROVIDED BETWEEN THE MANIFOLD AND THE TRANSMITTER/SWITCH
2. WITH ROOT VLV. OF SIZE 1/2"SW NIPPLE PIECE AND 1 TO 1/2"SW REDUCER IS NOT REQUIRED
3. FOR HIGH PR.(MORE THAN 40Kg/sqcm) ONE ISOLATING VLV. IS PROVIDED IN EACH LINE BETWEEN VLV. MANIFOLD AND 1/2"SW EQUAL TEE AND 2.NOS DRAIN VLV. ARE ALSO PROVIDED.

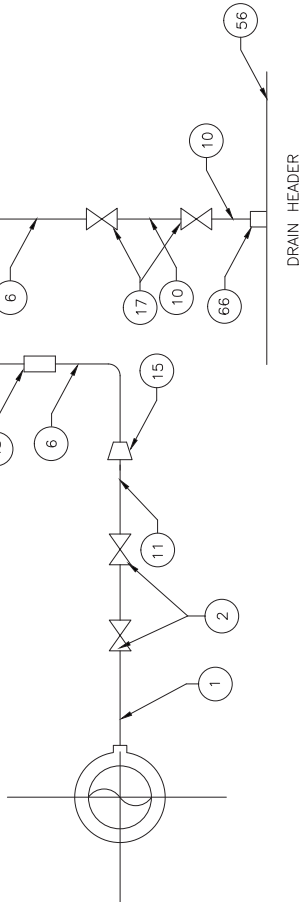
PRESSURE TRANSMITTER/SWITCH



TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
FIG—C

TAG NO.	DESCRIPTION	C	D	QTY.
71	1/2"OD IMPULSE TUBE,SS-316			AS REQD.
66	1/2" GI SOCKET			1
56	2"NB GI DRAIN HEADER			1
52	5/3/2-VALVE MANIFOLDS,SS-316			1
48	1/2"SW,CS/AS BULK HEAD PIPE UNION			1
44	1/2"BN X 1/2"OD COMPRESSION TUBE FITTING,SS-316			1
41	1/2"NPT(M) X 1/2"OD TUBE COMPRESSION FITTING,SS-316			3
20	1/2"SW EQUAL TEECS			1
17	1/2" SW,CS GLOBE VALVE / NEEDLE VALVE			3
15	1" TO 1/2" SW REDUCER			1
11	1" NPS SCH-80 CS/AS NIPPLE			1
10	1/2" NPS,SGH 80/160, CS/AS NIPPLE			2
6	1/2" NPS SCH-80/160 CS/ AS PIPE			AS REQD.
2	1/2"/3/4"/1" ROOT VALVE			2
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)			AS REQD.

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
FIG—D



REFERENCE DRAWINGS.

1. IS NOT SCALE (SEE DRAWING)
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
3. BULK HEAD FITTING IN TYPE SHALL BE PROVIDED AT LEAST 100mm FROM THE MANIFOLD.
4. ANY CHANGES TO THE DRAWING SHALL BE APPROVED BY THE DESIGNER.
5. QUANTITIES OF INSTRUMENTS/ FITTINGS/HARDWARE SHALL BE AS SHOWN IN THE BILL OF MATERIAL.
6. FOR ALL PLANT MATERIAL OF DESIGN HARDWARE SHALL BE AS PER SPECIFICATION PROVIDED FOR THE PROJECT.

NOTICE

THIS DRAWING IS THE PROPERTY OF DESBIN CONSULTING ENGINEERS AND IS LOANED TO THE CLIENT FOR THE PROJECT ONLY. IT SHALL NOT BE REPRODUCED, COPIED, OR IN ANY MANNER, WITHOUT THE WRITTEN PERMISSION OF DESBIN CONSULTING ENGINEERS. ANY UNAUTHORIZED USE OR REPRODUCTION OF THIS DRAWING SHALL BE AT THE USER'S RISK AND WITHOUT LIABILITY TO DESBIN CONSULTING ENGINEERS.

REVISIONS

NO.	DATE	BY	REVISION
1	25.04.13	DESIGN	PRELIMINARY
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

APPROVED

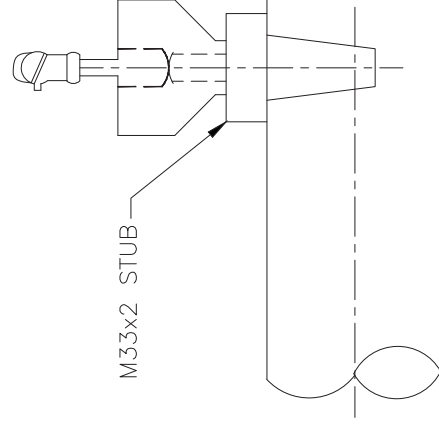
DATE	CIVIL	MCH	ELEC	CM	HAZ
25.04.13					

BILL OF MATERIAL

TAG NO.	DESCRIPTION	C	D	QTY.
71	1/2"OD IMPULSE TUBE,SS-316			AS REQD.
66	1/2" GI SOCKET			1
56	2"NB GI DRAIN HEADER			1
52	5/3/2-VALVE MANIFOLDS,SS-316			1
48	1/2"SW,CS/AS BULK HEAD PIPE UNION			1
44	1/2"BN X 1/2"OD COMPRESSION TUBE FITTING,SS-316			1
41	1/2"NPT(M) X 1/2"OD TUBE COMPRESSION FITTING,SS-316			3
20	1/2"SW EQUAL TEECS			1
17	1/2" SW,CS GLOBE VALVE / NEEDLE VALVE			3
15	1" TO 1/2" SW REDUCER			1
11	1" NPS SCH-80 CS/AS NIPPLE			1
10	1/2" NPS,SGH 80/160, CS/AS NIPPLE			2
6	1/2" NPS SCH-80/160 CS/ AS PIPE			AS REQD.
2	1/2"/3/4"/1" ROOT VALVE			2
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)			AS REQD.

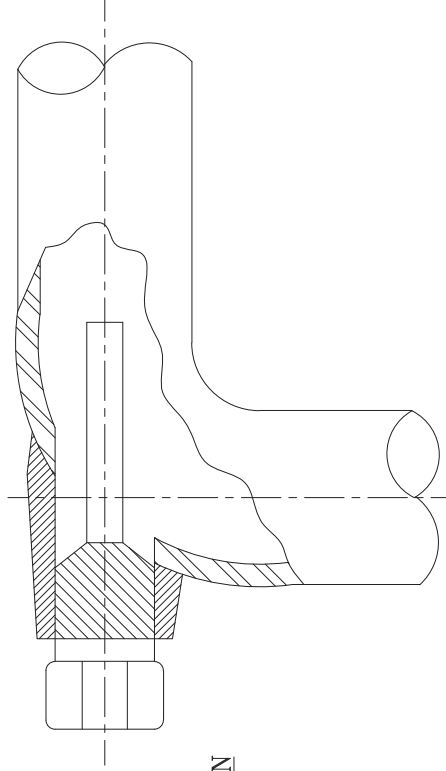
DESIGN

NAME	DATE
DESIGN	23.04.13
CHECKED	24.04.13
SCALE	N.T.S.
JOB NO.	D-4027
PW No.	114-04-0104



1. MATERIAL OF THE BOSS SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED.
2. LENGTH OF THE STUB (L) SHALL BE 63/45 mm DEPENDING UPON PIPE SIZE, AS PER CORPORATE STD. AS 7326102/ FOR PIPE OD 88.9mm TO 159mm STUB HEIGHT SHALL BE=65mm & FOR PIPE OD >219.1mm STUB HEIGHT SHALL BE= 65mm.
3. STRAIGHT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 168.3mm & ABOVE. THE STUB HEIGHT FOR PIPE OD, 168.3mm TO <219.1mm SHALL BE 65mm.
4. SLANT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 88.9mm TO 159mm.
5. FOR MAIN PIPE OD'S 88.9mm & BELOW SUITABLE EXPANDER SHALL BE USED.

(FOR MAIN PIPE OD 168.3mm & ABOVE)



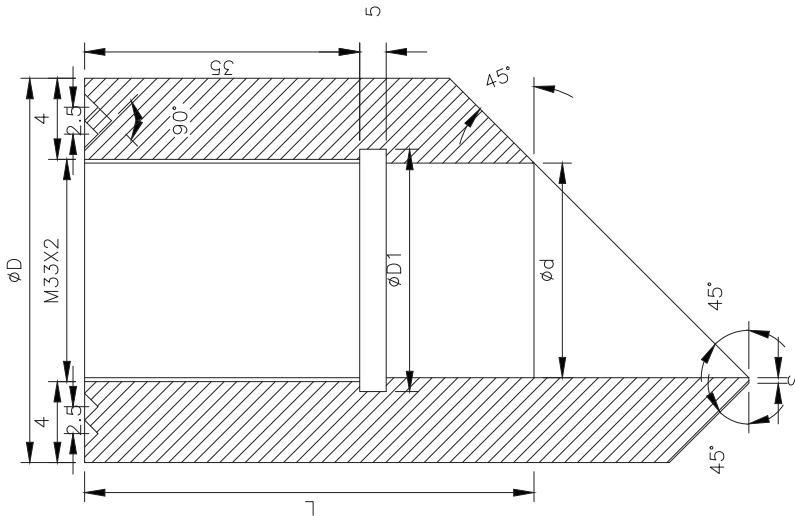
(FOR MAIN PIPE OD 88.9mm & BELOW)

FOR PIPE OD BELOW 219.1mm	29	55	33.5	1.5	65
FOR PIPE OD 219.1mm & ABOVE	29	55	33.5	1.5	45
MAIN PIPE SIZES	d	D	D1	S	L

[illegible]

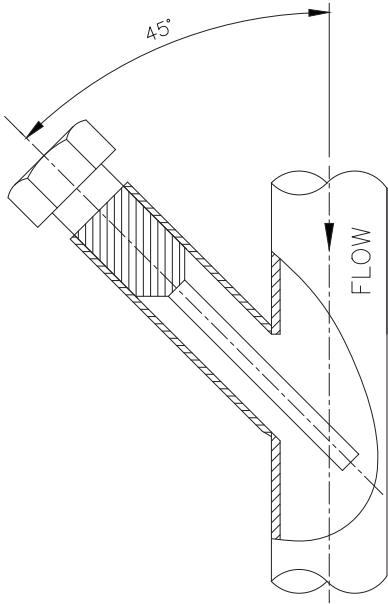
NOTE :-

1. MATERIAL OF THE BOSS SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED.
2. LENGTH OF THE STUB (L) SHALL BE 65/45 mm DEPENDING UPON PIPE SIZE, AS PER CORPORATE STD. AA 7326102.(FOR PIPE OD 88.9mm TO 159mm STUB HEIGHT SHALL BE=65mm & FOR PIPE OD >219.1mm STUB HEIGHT SHALL BE=45mm)
3. STRAIGHT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 168.3mm & ABOVE. THE STUB HEIGHT FOR PIPE OD, 168.3mm TO <219.1mm SHALL BE 65mm.
4. SLANT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 88.9mm TO 159mm.
5. FOR MAIN PIPE OD'S 88.9mm & BELOW SUITABLE EXPANDER SHALL BE USED.



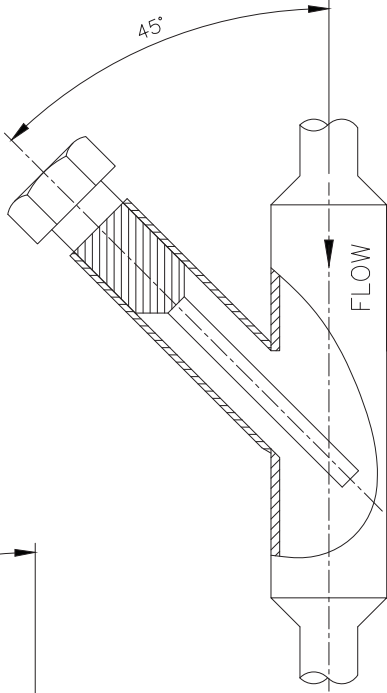
TEMPERATURE STUB FOR SLANT IMMERSION

FOR PIPE OD BELOW 219.1mm	29	55	33.5	1.5	65
FOR PIPE OD 219.1mm & ABOVE	29	55	33.5	1.5	45
MAIN PIPE SIZES	d	D	D1	S	L



INSTALLATION TYPE-3

(FOR MAIN PIPE OD 88.9mm TO 159mm)



INSTALLATION TYPE-4

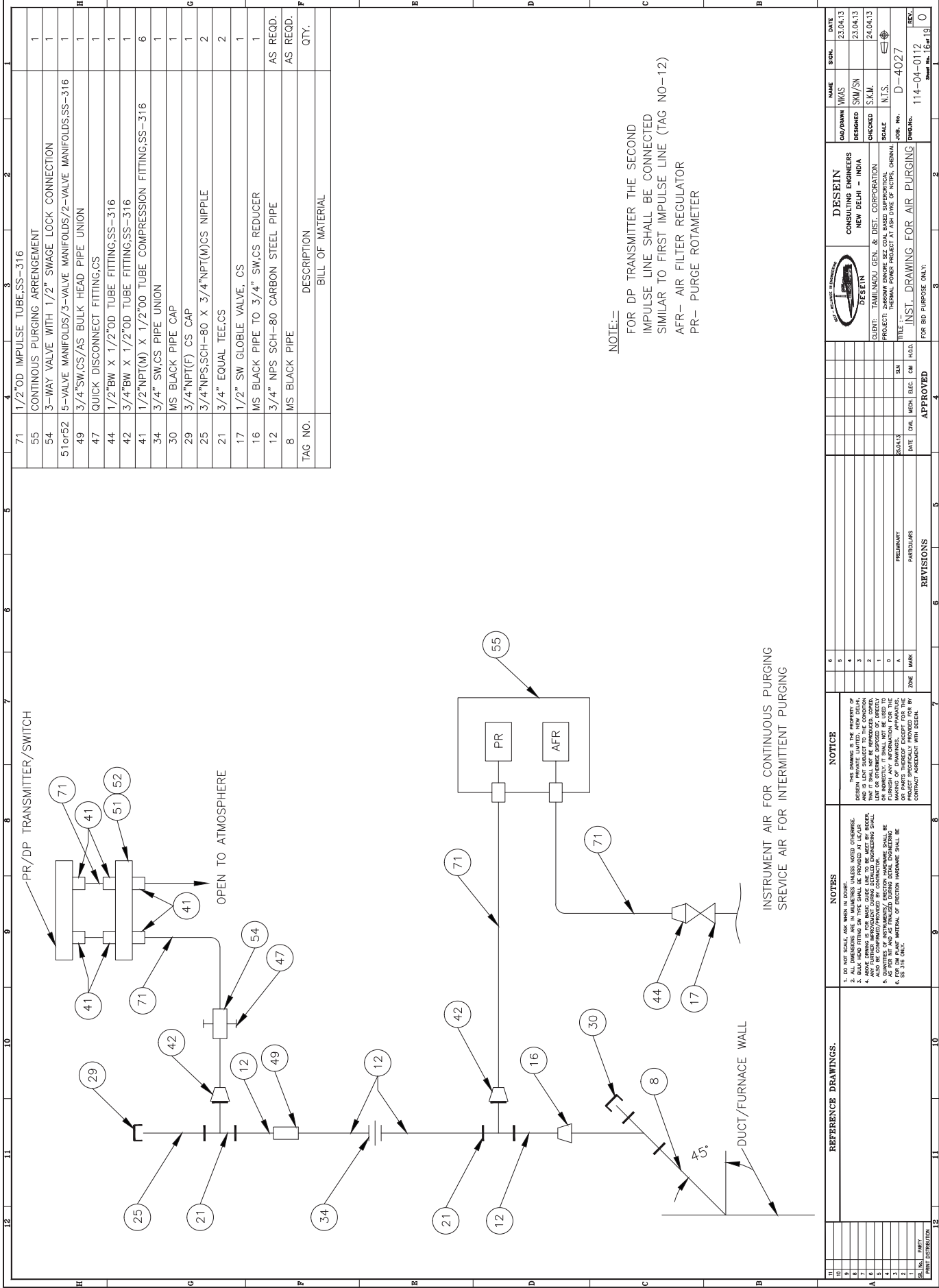
(FOR MAIN PIPE OD 88.9mm & BELOW)

11	10	9	8	7	6	5	4	3	2	1
12	11	10	9	8	7	6	5	4	3	2
13	12	11	10	9	8	7	6	5	4	3
14	13	12	11	10	9	8	7	6	5	4
15	14	13	12	11	10	9	8	7	6	5
16	15	14	13	12	11	10	9	8	7	6
17	16	15	14	13	12	11	10	9	8	7
18	17	16	15	14	13	12	11	10	9	8
19	18	17	16	15	14	13	12	11	10	9
20	19	18	17	16	15	14	13	12	11	10
21	20	19	18	17	16	15	14	13	12	11
22	21	20	19	18	17	16	15	14	13	12
23	22	21	20	19	18	17	16	15	14	13
24	23	22	21	20	19	18	17	16	15	14
25	24	23	22	21	20	19	18	17	16	15
26	25	24	23	22	21	20	19	18	17	16
27	26	25	24	23	22	21	20	19	18	17
28	27	26	25	24	23	22	21	20	19	18
29	28	27	26	25	24	23	22	21	20	19
30	29	28	27	26	25	24	23	22	21	20
31	30	29	28	27	26	25	24	23	22	21
32	31	30	29	28	27	26	25	24	23	22
33	32	31	30	29	28	27	26	25	24	23
34	33	32	31	30	29	28	27	26	25	24
35	34	33	32	31	30	29	28	27	26	25
36	35	34	33	32	31	30	29	28	27	26
37	36	35	34	33	32	31	30	29	28	27
38	37	36	35	34	33	32	31	30	29	28
39	38	37	36	35	34	33	32	31	30	29
40	39	38	37	36	35	34	33	32	31	30
41	40	39	38	37	36	35	34	33	32	31
42	41	40	39	38	37	36	35	34	33	32
43	42	41	40	39	38	37	36	35	34	33
44	43	42	41	40	39	38	37	36	35	34
45	44	43	42	41	40	39	38	37	36	35
46	45	44	43	42	41	40	39	38	37	36
47	46	45	44	43	42	41	40	39	38	37
48	47	46	45	44	43	42	41	40	39	38
49	48	47	46	45	44	43	42	41	40	39
50	49	48	47	46	45	44	43	42	41	40
51	50	49	48	47	46	45	44	43	42	41
52	51	50	49	48	47	46	45	44	43	42
53	52	51	50	49	48	47	46	45	44	43
54	53	52	51	50	49	48	47	46	45	44
55	54	53	52	51	50	49	48	47	46	45
56	55	54	53	52	51	50	49	48	47	46
57	56	55	54	53	52	51	50	49	48	47
58	57	56	55	54	53	52	51	50	49	48
59	58	57	56	55	54	53	52	51	50	49
60	59	58	57	56	55	54	53	52	51	50
61	60	59	58	57	56	55	54	53	52	51
62	61	60	59	58	57	56	55	54	53	52
63	62	61	60	59	58	57	56	55	54	53
64	63	62	61	60	59	58	57	56	55	54
65	64	63	62	61	60	59	58	57	56	55
66	65	64	63	62	61	60	59	58	57	56
67	66	65	64	63	62	61	60	59	58	57
68	67	66	65	64	63	62	61	60	59	58
69	68	67	66	65	64	63	62	61	60	59
70	69	68	67	66	65	64	63	62	61	60
71	70	69	68	67	66	65	64	63	62	61
72	71	70	69	68	67	66	65	64	63	62
73	72	71	70	69	68	67	66	65	64	63
74	73	72	71	70	69	68	67	66	65	64
75	74	73	72	71	70	69	68	67	66	65
76	75	74	73	72	71	70	69	68	67	66
77	76	75	74	73	72	71	70	69	68	67
78	77	76	75	74	73	72	71	70	69	68
79	78	77	76	75	74	73	72	71	70	69
80	79	78	77	76	75	74	73	72	71	70
81	80	79	78	77	76	75	74	73	72	71
82	81	80	79	78	77	76	75	74	73	72
83	82	81	80	79	78	77	76	75	74	73
84	83	82	81	80	79	78	77	76	75	74
85	84	83	82	81	80	79	78	77	76	75
86	85	84	83	82	81	80	79	78	77	76
87	86	85	84	83	82	81	80	79	78	77
88	87	86	85	84	83	82	81	80	79	78
89	88	87	86	85	84	83	82	81	80	79
90	89	88	87	86	85	84	83	82	81	80
91	90	89	88	87	86	85	84	83	82	81
92	91	90	89	88	87	86	85	84	83	82
93	92	91	90	89	88	87	86	85	84	83
94	93	92	91	90	89	88	87	86	85	84
95	94	93	92	91	90	89	88	87	86	85
96	95	94	93	92	91	90	89	88	87	86
97	96	95	94	93	92	91	90	89	88	87
98	97	96	95	94	93	92	91	90	89	88
99	98	97	96	95	94	93	92	91	90	89
100	99	98	97	96	95	94	93	92	91	90
101	100	99	98	97	96	95	94	93	92	91
102	101	100	99	98	97	96	95	94	93	92
103	102	101	100	99	98	97	96	95	94	93
104	103	102	101	100	99	98	97	96	95	94
105	104	103	102	101	100	99	98	97	96	95
106	105	104	103	102	101	100	99	98	97	96
107	106	105	104	103	102	101	100	99	98	97
108	107	106	105	104	103	102	101	100	99	98
109	108	107	106	105	104	103	102	101	100	99
110	109	108	107	106	105	104	103	102	101	100
111	110	109	108	107	106	105	104	103	102	101
112	111	110	109	108	107	106	105	104	103	102
113	112	111	110	109	108	107	106	105	104	103
114	113	112	111	110	109	108	107	106	105	104
115	114	113	112	111	110	109	108	107	106	105
116	115	114	113	112	111	110	109	108	107	106
117	116	115	114	113	112	111	110	109	108	107
118	117	116	115	114	113	112	111	110	109	108
119	118	117	116	115	114	113	112	111	110	109
120	119	118	117	116	115	114	113	112	111	110
121	120	119	118	117	116	115	114	113	112	111
122	121	120	119	118	117	116	115	114	113	112
123	122	121	120	119	118	117	116	115	114	113
124	123	122	121	120	119	118	117	116	115	114
125	124	123	122	121	120	119	118	117	116	115
126	125	124	123	122	121	120	119	118	117	116
127	126	125	124	123	122	121	120	119	118	117
128	127	126	125	124	123	122	121	120	119	118
129	128	127	126	125	124	123	122	121	120	119
130	129	128	127	126	125	124	123	122	121	120
131	130	129	128	127	126	125	124	123	122	121
132	131	130	129	128	127	126	125	124	123	122
133	132	131	130	129	128	127	126	125	124	123
134	133	132	131	130	129	128	127	126	125	124
135	134	133	132	131	130	129	128	127	126	125
136	135	134	133	132	131	130	129	128	127	126
137	136	135	134	133	132	131	130	129	128	127
138	137	136	135	134	133	132	131	130	129	128
139	138	137	136	135	134	133	132	131	130	129
140	139	138	137	136	135	134	133	132	131	130
141	140	139	138	137	136	135	134	133	132	131
142	141	140	139	138	137	136	135	134	133	132
143	142	141	140	139	138	137	136	135	134	133
144	143	142	141	140	139	138	137			

Page 424 of 434







NOTE:--
FOR DP TRANSMITTER THE SECOND
IMPULSE LINE SHALL BE CONNECTED
SIMILAR TO FIRST IMPULSE LINE (TAG NO-12)
AFR- AIR FILTER REGULATOR
PR- PURGE ROTAMETER

REFERENCE DRAWINGS.										NOTES										NOTICE										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA										DESEIN CONSULTING ENGINEERS NEW DELHI -									



	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION : III	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT		
		REV. NO. 00	DATE :

SECTION III

	TITLE:	SPECIFICATION NO. PE-TS-412-673-A001	
	2X660 MW ENNORE SEZ STPP	SECTION : III	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT	REV. NO. 00	DATE :

SCHEDULE OF PRE-BID CLARIFICATION

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

Note: Bidder to furnish all the pre bid in the above indicated pre bid clarification format only. General Pre bid clarification will not be considered.

	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-673-A001	
		SECTION : III	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT		
		REV. NO. 00	DATE :

COMPLIANCE CUM CONFIRMATION SCHEDULE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing 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/ deviations with regard to same.
- b.) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/Customer approval in the event of order & 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. The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.
- c.) All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.
- d.) There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.
- e.) The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.
- f.) The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).
- g.) All sub vendors shall be subject to BHEL/CUSTOMER approval.
- h.) Any special tools & tackles, if required, shall be in bidder's scope.
- i.) Demonstration parameters shall stand valid till the satisfactory completion of demonstration test and its acceptance by BHEL/Customer.

	TITLE: 2X660 MW ENNORE SEZ STPP		SPECIFICATION NO. PE-TS-412-673-A001	
			SECTION : III	
	TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT			
			REV. NO. 00	DATE :

DECLARATIONS

I certify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated and there is no deviation to the specification.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Bidders Company Name

Authorized representative's
Signature

Name

Bidder's Name

The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated

THIS IS A PART OF TENDER TECHNICAL SPECIFICATION PE-TS-412-673-A001**SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL****PROJECT:- 2X 660 MW ENnore SEZ STPP****SEWAGE TREATMENT PLANT****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 withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
- For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
- All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
- Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
- Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
- Bidder shall furnish price copy of above format along with price bid.
- The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
- Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
- For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
- Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
- All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
- Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
- In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
- In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

2x660MW ENNORE SEZ STPP - SEWAGE TREATMENT PLANT						
SECTION -III						
GUARANTEED POWER CONSUMPTION FORMAT						
Sl.No.	Description / Item	Working	Standby	Power Consumption (KW) (For Complete sewage treatment plant)	Duty Factor	Total Power Consumption (KW)
1	2	3	4	5	6	7 = 5 x 6
1	Complete Sewage treatment plant (Considering all working drives as per technical specification)				0.50	
Notes		Total KW				
Power consumption (KW) of all working motors applicable for STP package shall be measured at motor input terminals when operating at the rated capacity and pressure and performed on test rig at the vendor's works and actual motor shall be used for this purpose.						
1						
2	The base auxiliary power is 24.75 KW. Quoted power by bidder at column no. (7) shall be evaluated with respect to base auxiliary power. For bid evaluation purpose, excess power quoted by bidder over base auxiliary power, shall be loaded with Rs. 356607 per KW.					
3	Power quoted by bidder shall be termed as 'Guaranteed Power consumption' (GPC) and bidder shall be liable to demonstrate compliance to GPC value during PG test/ Demonstration test at site. If the actual power consumption exceeds the guaranteed power consumption, liquidated damages shall be payable by the Bidder at the rate of Rs. 356607 per KW excess power consumption, over the guaranteed power consumption indicated by bidder in his bid. Such liquidated damages may be recovered from Bidder by the BHEL by deduction from the contract price or by enforcing the contract performance guarantee or in any other manner deemed fit by the BHEL. For this purpose, the drives of standby equipment shall not be considered.					
REMARKS: METHOD OF CALCULATION OF GPC (GUARANTEED POWER CONSUMPTION) FOR STP PACKAGE						
1) Bidder shall calculate power consumption of Sewage Treatment Plant by adding power required (at motor input terminal) for all working drives of Sewage Treatment plant and same shall be multiplied by duty factor `given at column number 6 of GPC format.Output shall be quoted at column number 7 which will be treated as final GPC for STP package.						