

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

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

VOLUME – II – B

**TECHNICAL SPECIFICATION
FOR
CONDENSATE POLISHING UNIT**

SPECIFICATION NO. PE-TS-412-155A-A001, R0



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



TITLE

**2X 660 MW ENNORE SEZ STPP
TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT**

SPECIFICATION NO: PE-TS-412-155A-A001

VOLUME: II B

REV 00

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SECTION - A
INTENT OF SPECIFICATIONS

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1.0 SCOPE:**1.1 CONDENSATE POLISHING UNIT**

This specification is intended to cover design, engineering, manufacture, fabrication, assembly, inspection & testing at manufacturer's works, painting, forwarding, supply and delivery at site including start up and commissioning spares, mandatory spares, properly packed for transportation, loading/unloading / handling and storage at site, in site transportation, assembly, erection and commissioning, trial run ,preparation and submission of "As Built" drawings, site testing, carrying out performance guarantee tests at site and handover of **CPU PLANT** as per details elaborated in different sections / volumes of technical specification (PE-TS-412-155A-A001) for **2X660 MW ENNORE SEZ STPP**.

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

2.0 GENERAL TECHNICAL INSTRUCTIONS

2.1 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 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.

2.2 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.

2.3 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.

2.4 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.

2.5 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under VOL-III of the specification. 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.

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- 2.6** 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.)
- 2.7** In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 2.8** 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).
- 2.9** The equipment covered under this specification shall not dispatch unless the same have been finally inspected, accepted and shipping release issue by BHEL/Customer.
- 2.10** 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.

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SECTION - B**PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA**

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 : 13°17' N to 13°18' N

Longitude : 80°18' E to 80°19' 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 VWO capacity of the steam turbine shall not be less than 105% of TMCR flow at rated parameters. Boiler maximum Continuous Rating (BMCR) will be established to match the steam flow at VWO conditions, but BMCR flow shall not 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 Abrasiveness 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.	SiO ₂	%	59.54
2.	Al ₂ O ₃	%	29.00
3.	Fe ₂ O ₃	%	6.42
4.	CaO	%	1.50
5.	Na ₂ O	%	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 & hard wares etc. The switchyard will be controlled by computerized control and data acquisition (SCADA) system.

1.14 Average Yearly Generation

The average yearly generation is calculated considering the following.

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

1.15 INFORMATION FOR ENVIRONMENTAL APPRAISAL

1.0 GENERAL INFORMATION ABOUT THE PROJECT

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

- 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 :
 - b. Forest :
 - c. Grass land :
 - d. Endangered species :
 - e. Others (Specify) :
- } Refer details in the specification elsewhere.
- 2.6.2 Give details of the following features, if they exist, within a radius of 25 km of the proposed site? :
- i. Fisheries :
 - ii. Sanctuary / natural park biosphere reserve :
 - iii. Lakes / ponds / reservoir :
 - iv. Stream / river : Buckingham canal is close to the site
 - v. Estuary / sea : Bay of Bengal is 5 km from site

- vi. Hills / mountains :
- vii. Historic / cultural / :
tourist /
archaeological scenic
sites / defence
installations

2.7 Human settlement :

2.7.1 Total number of persons :
proposed to be employed

i. During construction : 2500

450(0.75person/MW) TANGEDCO

ii. During operation : direct employees

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SECTION – C

SPECIFIC TECHNICAL REQUIREMENTS

SECTION – C1: SPECIFIC TECHNICAL REQUIREMENTS FOR MECHANICAL

SECTION – C2: SPECIFIC TECHNICAL REQUIREMENTS FOR ELECTRICAL

**SECTION – C3: SPECIFIC TECHNICAL REQUIREMENTS FOR CONTROL AND
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SECTION – C1**SPECIFIC TECHNICAL REQUIREMENTS FOR MECHANICAL****SECTION C1 – A – SCOPE OF SUPPLY & SERVICES, EXCLUSION AND TERMINAL POINTS ETC.****SECTION C1 – B – GENERAL REQUIREMENT****SECTION C1 – C – FUNCTIONAL / PERFORMANCE / DEMONSTRATION GUARANTEE****SECTION C1 – D – QUALITY ASSURANCE****SECTION C1 – E – PAINTING SPECIFICATION****SECTION C1 – F – DATASHEET A**

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SECTION C1 – A

SCOPE OF SUPPLY & SERVICES, EXCLUSION AND TERMINAL POINTS ETC.

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1.0 GENERAL

This specification is intended to cover design, engineering, manufacture, fabrication, assembly, inspection & testing at manufacturer's works, painting, forwarding, supply and delivery at site including start up and commissioning spares, mandatory spares, properly packed for transportation, loading/unloading / handling and storage at site, in site transportation, assembly, erection and commissioning, trial run, preparation and submission of "As Built" drawings, site testing, carrying out performance guarantee tests at site and handover of **CPU PLANT** as per details elaborated in different sections / volumes of technical specification (PE-TS-412-155A-A001) for **2X 660 MW ENNORE SEZ STPP**.

The Condensate polishing plant with regeneration system and associated accessories shall conform to the technical specification (PE-TS-412-155A-A001) of **2X 660 MW ENNORE SEZ STPP**.

2.0 DESIGN CONDITIONS FOR CONDENSATE POLISHING UNIT

There shall be three service vessels (3X50%) for each 660 MW unit each polishing 50% of the condensate flow corresponding to VWO (valve wide open) condition at 1% make up (Flow through each service vessel indicated in the data sheet) & all HP heaters out of service condition.

3.0 BRIEF DESCRIPTION OF THE SYSTEM

The proposed condensate plant shall treat the entire condensate of the turbine generator of each unit of power station. The proposed schematic arrangement of the condensate polishing plant and its regeneration facility shall be as per the enclosed P&I Diagram. Arrangement of piping, valves and instruments shown in the P&ID are bare minimum. The bidder shall include the complete system including regeneration facility as elaborated in this specification meeting the contractual requirements.

The condensate polisher service vessels shall be located in the TG hall of corresponding units. The resins shall be transferred to and from the common regeneration facility by sluicing through a pipeline hydraulically / hydro pneumatically.

The regeneration process offered by the bidder shall be of proven design and shall essentially be the same process by virtue of which the bidder is qualified and shall give resin-separation compatible with the desired effluent quality.

4.0 SCOPE OF SUPPLY (MECHANICAL)

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

A. SERVICE VESSEL FACILITY

- 1) There shall be three service vessels (3X50%) for each 660 MW unit each polishing 50 % of the condensate flow.
- 2) Each Condensate polisher vessels shall be complete with condensate inlet and outlet connections, connections for resin transfer to and from the vessels, bed support-cum-under drain system, inlet water distributors, air distribution arrangement for resin mixing, all fittings and appurtenances etc. as specified and as required.
- 3) One no External resin traps at the outlet of each of the polisher vessel outlet & rinse outlet, designed for in-place manual back flushing facility.
- 4) Condensate inlet and outlet headers for each installation with pipe connections to the condensate polisher vessels.
- 5) Resin transfer headers and pipe lines connecting the common external regeneration facilities to the

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condensate polisher vessels of each installation.

- 6) Rinse water outlet headers from condensate polisher vessels of each installation up to the condenser hot well. Rinse water outlet headers from condensate-polisher vessels shall be provided with a pressure reducing valve and orifice plate, suitably designed to enable the water entry to the condenser hot well under all operating condition of condenser.
- 7) All necessary valves, and fittings for the installations with actuators necessary for their remote operation from CP System Control Panel of each 660 MW Unit. These shall include suitable foolproof arrangement to prevent accidental over pressurization of the resin transfer pipeline and regeneration facilities connected to it, which are designed for pressure much lower than that of the Condensate Polisher Mixed Beds / Condensate Polisher Service vessels.
- 8) A drain header for the condensate polisher service vessels .All necessary drains, vents and sampling points, with valves as required.
- 9) Gland sealing water piping for the Gland sealing valves in the rinse water line & other lines.
- 10) Sample cooling line piping for sample cooling for all analyzers.
- 11) Two nos. (1W + 1S) per unit oil free type air blowers with electric motor drives for each unit for supplying air required for mixing the resins in the service vessels. Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter, silencer, flexible couplings and discharge snubber, acoustic hood, relief valve etc all mounted on a single base.
- 12) Complete Instrumentation and Control for automatic operation.
- 13) Emergency bypass between the condensate influent and effluent headers. Each Condensate polisher service unit shall be provided with an automatic bypass for the condensate polisher on the condensate inlet and outlet headers of the unit with a modulating butterfly type control valve along with Butterfly isolation valves (resilient material seated, to ensure bubble-tight shut off) on the upstream and downstream sides of the control valve. Either 2X50% capacity valves or 1X100% capacity control valve shall be provided to achieve proper control under all operating conditions. Isolation valve shall be provided with geared operators for manual operation. Complete instrumentation and controls for this emergency by-pass system. Further all tubing, wiring air sets and other fittings required to complete the system shall be provided.
- 14) The plant shall include resins for each condensate polisher service vessels along with one (1) spare charge of resin in the mixed resin storage tank. Two (2) spare charge of resins per unit during commissioning and one (1) spare charge of resins as mandatory spares. Total resin charges shall be supplied for the project is twelve (12) nos. One resin charge shall be considered as resin required for one service vessel i.e. cation resin, anion resin and inert resin (if any) used for the project. Further one Year's topping requirements or 10 % of first fill quantity, whichever is more shall be supplied by bidder.
- 15) One no. Conductivity Analyzer at condensate inlet header, One no. Conductivity Analyzer at condensate outlet header, One no. Conductivity Analyzer at outlet of each Condensate polishing Mixed Beds / Condensate Polisher Service vessels.
- 16) One no. Cation Conductivity Analyzer at condensate inlet header, One no. Cation Conductivity Analyzer at condensate outlet header, One no. Cation Conductivity Analyzer at outlet of each Condensate polishing Mixed Beds / Condensate Polisher Service vessels.
- 17) One no. Conductivity Analyzer at condensate inlet header, One no. Conductivity Analyzer at condensate outlet header, One no. Conductivity Analyzer at outlet of each Condensate polishing Mixed Beds / Condensate Polisher Service vessels.
- 18) One no. pH Analyzer at condensate inlet header & One no. pH Analyzer at outlet of each Condensate polishing Mixed Beds / Condensate Polisher Service vessels.

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- 19) One no. multichannel (consist of four channel & four sensor) sodium analyzer to measure the values of common inlet and each service vessel outlet. Total number of multichannel sodium analysers for both the units shall be two.
- 20) One no. multichannel (consist of four channel & four sensor) Silica analyzer to measure the values of common inlet and each service vessel outlet. Total number of multichannel sodium analysers for both the units shall be two.
- 21) One no. multichannel (consist of four channel & four sensor) chloride analyzer to measure the values of common inlet and each service vessel outlet. Total number of multichannel sodium analysers for both the units shall be two.
- 22) Complete instrumentation and controls for this system, including the differential pressure transmitters, panel mounted indicating type controller with provision for remote manual operation, actuator for the control valve with positioner etc. All tubing, wiring, airsets, and other fittings, required to complete the system.
- 23) All the piping, valves, fitting, accessories etc. used in service vessel area shall be 300# class minimum and this area shall be considered as high pressure side.
- 24) Minimum instrumentation required as per P & ID included in this tender specification.
- 25) All butterfly valves MOC used in service vessel area in condensate inline line shall be (body :WCB Disc:CF8M/SS316) and condensate outlet line will be (Body & Disc both :CF8M/SS316)

B. REGENERATION SYSTEM

The regeneration system shall be common to polisher of both the units and shall be external. The CPU regeneration system will be located near DM plant area. Regeneration area shall be considered as low pressure area. Complete regeneration facility as mentioned below shall be in Bidder's scope:

- I. One common facility for regeneration of the resins from the condensate polishers of all the TG units shall be provided by the bidder and consisting of following:
 - 1) One no Resin Separation & Cation Regeneration Vessel.
 - 2) One no Anion resin regeneration vessel.
 - 3) One no. Mixed resin storage vessel
 - 4) All internals, fittings and appurtenances for these vessels.
 - 5) Common waste effluent header with one resin trap designed for in place manual backwashing.
 - 6) The type of vessels indicated above (s.no 1, 2 and 3) shall be as per supplier process requirement.
 - 7) Resin Make up/injection hopper complete with water ejector system for resin make up. Resin Make up/injection hopper shall be sized to handle up to minimum 150 liters of as received new resins per single injection.
 - 8) Two (2) nos. (1W+1S) oil free type air blowers with electric motor drives, for supplying all the process air required for cleaning of the resins and their regeneration processes. Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter, silencer, flexible couplings and discharge snubber, acoustic hood, relief valve etc.as required and shall be mounted on a single base.
 - 9) Two (2) nos. CPU Regeneration cum Resin Transfer Pumps each with electric drive motor drives, one normally operating and the other standby, for water supply for chemical preparation / dosing and transfer of resin from service vessel to regeneration vessels & vice-versa, backwash & rinse activities shall be provided. These CPU Regeneration cum Resin Transfer Pumps will take suction from DM water storage tanks (DM water storage tanks not in bidder's scope).

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- 10) All integral pipe works, valves, internals, fittings, hangers, supports and appurtenances etc. for these vessels.

II. BULK ACID AND ALKALI UNLOADING AND DOSING FACILITY

The Acid and alkali unloading equipment for regeneration of condensate polishing resins shall preferably be mounted on skid.

- a) One (1) no. hose Station for Transfer of Hydrochloric Acid (30-33% HCl). The hose station shall consist of one (1) no. of hose pipe. Hose size shall be of 80 mm /NB @ 20 m, provided along with coupling & diaphragm type isolation valves.
- b) One (1) no. hose station for transfer of Alkali (48% NaOH). The hose station shall consist of one (1) no. of hose pipe. Hose size shall be of 80 mm /NB @ 20 m, provided along with coupling & diaphragm type isolation valves.
- c) Two (2) nos. Bulk Acid storage tanks complete with integral pipe works, valves, level transmitter, level gauges, fume absorber cum overflow seal pot and all other accessories required. Further each of these bulk acid storage tanks have One spare nozzles of min 65NB size along with one isolation valve for chemical supply up to RO-DM plant by gravity.
- d) Two (2) nos. Bulk Alkali storage tanks complete with integral pipe works, valves, level transmitter, level gauges, CO₂ absorber, over flow seal pot and all other accessories required. Further each of these bulk alkali storage tanks have One spare nozzles of min 65NB size along with one isolation valve for chemical supply up to RO-DM plant by gravity.
- e) Two nos. (2X100%) Acid unloading pumps each complete with electrical drive motor and all other accessories as required.
- f) Two nos. (2X100%) Alkali unloading pumps each complete with electrical drive motor and all other accessories as required.

III. ALKALI PREPARATION FACILITY

In order to facilitate erection at site chemical dosing preparation equipment shall be mounted on structural steel skids and assembled (including piping) at the manufacturer's shop, to the maximum extent possible, prior to shipping. The number of mechanical connections shall be minimised by the use of pipe headers wherever possible. The bidder may also supply and install these equipment's independently instead of assembling the skids. Complete facility for preparing alkali solution from alkali lye & flakes shall be included in Bidder's scope. This will consist of the following:

- a) One number alkali solution preparation tank. The tank shall consist of slow speed agitator driven by motor, carbon dioxide absorber, overflow seal pot, dissolving basket, integral pipe works, valves and all other required accessories. The tank capacity shall be equal to 120% of regeneration requirement of one regeneration.
- b) 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 complete with integral pipe works, valves, instrumentation and all other accessories required 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 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.
- c) Two (2) nos. (1W+1S) alkali transfer cum recirculation pumps. These pumps shall be provided with a pulsation dampener at the outlet header of each pump along with necessary valves & instrumentation & accessories as required.
- d) One (1) no. Activated carbon filter for alkali complete with internals, integral pipe works, valves and all other accessories as required. Activated Carbon Filter for alkali rated flow of the filter shall not be less than the design capacity of the alkali unloading pump /alkali transfer cum recirculation pump (as applicable), and the maximum velocity through the filter for this flow shall not exceed 12 meters/hour: Depth of the filter materials shall not be less than 1 meter.



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- e) One number Carbon trap shall be provided at the outlet line of Activated carbon filter. This carbon trap shall have screen opening of 60 mesh.
- f) All interconnecting piping, valves and fittings & instrumentation as required to complete the system.

IV. ACID AND ALKALI DOSING SYSTEM

The Acid and alkali dosing equipment for regeneration of condensate polishing resins shall preferably be mounted on skid and shall be in bidder's scope. All the equipment, piping etc. shall be assembled on two structural steel skids one for acid and one alkali dosing equipment. The Acid and Alkali dosing systems shall be skid mounted and shall consist of at least following equipment's:

- a) Two (02) numbers acid measuring tanks complete with fume absorbers, overflow seal pot, integral pipe works, valves, instrumentation and all other accessories required. Each tank capacity shall be equal to 120% of regeneration requirement of one regeneration.
- b) One (1) no. Alkali measuring (day) tank including slow speed agitator driven by motor complete with carbon dioxide absorber, overflow seal pot, integral pipe works, valves, instrumentation and all other accessories required. The tank capacity shall be equal to 120% of regeneration requirement of one regeneration.
- c) Two (02) numbers (1W+1S) Positive displacement type metering pumps for acid dosing with electric motor drive, pulsation dampener & safety relief valve at the outlet header of each pump along with all other required accessories.
- d) Two (02) numbers (1W+1S) Positive displacement type metering pumps for alkali dosing with electric motor drive, pulsation dampener & safety relief valve at the outlet header of each pump along with all other required accessories.
- e) Diluent water supply separately, for acid and alkali, each provided with an automatic on-off valve, a throttling valve for setting of flow, a local flow indicator, and a mixing tee where the chemicals get injected into the water stream.
- f) All necessary suction and discharge piping for these pumps including all strainers, valves and fittings as required, upto the mixing tee with the diluent water.
- g) All the equipment, piping etc. shall be assembled on two structural steel skids one for acid and one for alkali dosing equipment. The bidder shall supply all anchor bolts, foundation plates, sleeves, nuts, inserts etc. to be embedded in concrete for these equipment skids. The length of the foundation bolts shall be liberally sized to reach below the reinforcement level. Each equipment skid shall be provided with suitable lighting lugs, eye bolts etc. to facilitate erection and maintenance.

C. NPIT AND NPIT DISPOSAL SYSTEM

- a) One (1) no. Neutralization Pit of RCC construction (civil work not in bidder's scope) with two (2) compartments with acid and alkali resistant lining/tiling along with isolation gates shall be provided in the CPU regeneration area. Each section shall have capacity to hold 150% of waste water generated from CPU in one regeneration + 120% of waste generated from RO –DM plant in one regeneration (170 m3 considering margin) . Dosing of acid and alkali shall also be provided to neutralize effluents of CPU regeneration waste before disposal.
- b) One (1) no. Acid Measuring Tank for Neutralization- pit complete with fume absorbers, overflow seal pot, integral pipe works, valves, instrumentation & all other accessories as required shall be supplied by bidder.
- c) One (1) no. Alkali Measuring Tank for neutralization-pit along with including slow speed agitator driven by motor complete with carbon dioxide absorber, overflow seal pot, integral pipe works, valves, instrumentation and all other accessories as required shall be supplied by bidder.
- d) Two (2 x 100%) capacity Waste Recirculation / Disposal pumps of horizontal centrifugal type (rubber lined) single stage with priming arrangement (two priming tanks for N-pit waste recirculation / disposal pumps) each complete with electrical drive motor. These pumps shall be of horizontal centrifugal type with priming arrangement and shall be supplied for waste recirculation and disposal to CMB of ETP.

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Each pump capacity shall be selected & designed to empty total volume of one section of the neutralization pit in 2 hours. Proven agitation system like air agitation, venturi mixing etc. shall be provided in addition to recirculation from pumps.

- e) 2 nos. sluice gate will be provided at the inlet to each compartment of neutralization pit.
- f) One no. pH Analyzer at effluent discharge header, shall be in the scope of bidder
- g) Two (2) nos. Safety Shower with necessary accessories one in acid & alkali dosing facilities and one in bulk acid & alkali storage area along with piping and isolation valve shall be in bidder's scope.
- h) All interconnecting piping, valves, instrumentation and fittings as required for the N-pit and N-pit disposal system.

D. PIPING

All the piping as listed below shall be in bidder's scope. The below indicated pipes shall be designed, supplied, erected, laid and tested by the bidder. Elbows, tees, flanges Hangers and supports, embedment plates with lugs etc. required for the below given piping shall also be provided by the bidder.

- i) Service vessel inlet header shall be SA 106 Gr-C (OD 457.2 X 12.7 mm thick)
- j) Service vessel outlet header shall be SA 106 Gr C (OD 457.2 X 12.7 mm thick)
- k) Rinse water outlet piping shall be SA 106 Gr-C (OD 168.3 x 7.11 mm). The distance between CPU service vessel to condenser hot well shall be considered as 70 meter for each unit (Total 140 m) and this piping shall be in bidder's scope.
- l) Resin transfer piping shall be minimum 80 NB and of ASTM A 312 Gr. TP 304 (SS 304) Sch 40 (minimum). One way distance for resin Transfer Piping between farthest service vessel and regeneration area shall be 550m. In addition to that complete resin transfer piping shall be in bidder's scope which shall include the piping inside regeneration area equipments also.
- m) Piping handling DM water shall be ASTM A 312 Gr. TP 304 (SS 304) Sch 40 (minimum). One way distance for DM water piping between farthest service vessel and regeneration area shall be 600 m. In addition to that complete DM Water piping shall be in bidder's scope which shall include the piping inside regeneration area equipments also.
- n) N-Pit effluent piping from N-Pit to ETP of CMB shall be minimum 150 NB CPVC Sch. 40. The distance between N-Pit and CMB (common monitoring basin) of ETP shall be 750 m and this piping shall be in bidder's scope.
- o) Piping used for handling alkali (concentrated) and alkali solution shall be CPVC Sch. 40 minimum for complete CPU regeneration area.
- p) Piping handling acid service shall be CPVC Sch. 40 for complete CPU regeneration area.
- q) Piping for air service shall be hot dip galvanized (heavy grade) steel as per IS 1239.
- r) All piping within each of the above skids/equipment shall be in bidder's scope.
- s) Similarly DM water piping from each DM water storage tanks to CPU REGENERATION CUM RESIN TRANSFER PUMPS (including re circulation lines connected to DM water storage tanks) along with their isolation valves shall be in bidder's scope.
- t) Further DM water piping from each CPU REGENERATION CUM RESIN TRANSFER PUMPS to service vessel area and regeneration area all equipments shall be in bidder's scope.
- u) Service water piping (used for cooling of condensate sample & other activities in regeneration area), piping for gland sealed valve cooling, instrument air piping and service air piping, potable water piping for eye wash 7 other applications etc. shall be in bidder's scope.

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- v) Similarly, all piping between the external regeneration facility and the skids for chemical dosing and acid/alkali preparation, and acid & alkali storage shall also be designed, supplied, erected and tested by the bidder. These shall include demineralized water piping to the chemical dosing, acid /alkali piping from external bulk storage tanks to respective preparation skids, the alkali preparation skids from the external regeneration facility, alkali solution from its preparation facility to the alkali dosing skid, dilute chemical solution piping for acid and alkali from the dosing skids to the external regeneration facility, piping to the preparation/dosing facilities, instrument air piping and power supply for immersion heaters of the diluent water tank from the regeneration facility, and all instrumentation and control wiring between these skids, etc.
- w) In addition, any additional piping and associated accessories required to complete the system shall be in bidder's scope.

NOTE: There will be no price implication to BHEL/Customer from bidder's side due to addition / deletion in piping, when the piping quantity increases $\pm 10\%$ from the specified quantity in the technical specification. 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.

E. ADDITIONAL REQUIREMENT

- 1) Operating platforms, ladders, supports and other structural works for each vessel to facilitate accessibility for operation and maintenance for all the condensate polisher mixed beds, regeneration vessels, storage tanks, alkali and acid measuring tanks & preparation tanks and other equipment's etc. is also in bidder's scope.
- 2) Initial charge of all lubricants & grease.
- 3) 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.
- 4) Start-up and commissioning spares as required.
- 5) 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.
- 6) 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.
- 7) Bidder shall consider 12 m static head + 10% margin in addition to the losses in straight and bend in pipes and valves etc. while selection of pump head during detailed engineering.
- 8) 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 PG test of bidder's supplied equipment (whichever is later) and final filling after the initial operation OR PG test 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.
- 9) 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.
- 10) MCC, PLC control room & battery room shall be located in CPU regeneration area building. All regeneration vessels and chemical dosing facilities shall be located in CPU regeneration building. Bulk chemical storage tanks, unloading and transfer pumps shall be located open to sky. Further N-pit shall be located in open area near CPU regeneration area. CPU regeneration cum resin transfer pumps shall be located near DM water Storage tanks and shall have been provided with localised KNOPY arrangement


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on pump & motor and the same shall be in bidder's scope.

- 11) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- 12) 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.
- 13) 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.
- 14) 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.
- 15) 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.
- 16) 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".
- 17) Ladder & platforms shall be provided for each tank for easy accessibility & maintenance purpose by bidder.
- 18) All necessary valves and fittings for the installations with the actuators necessary for their remote operation.
- 19) Embedment plates with lugs shall also be provided by bidder as per system requirement.
- 20) All channels & brackets, mounting plates as required for mounting of motors, pumps, stirrers, tank etc. shall be in bidder's scope.
- 21) Start-up and commissioning spares as required.
- 22) Mandatory spares as per attached Annexure to this technical specification.
- 23) 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 DM Plant.
- 24) All Motorized valves with integral starter as per requirement and as indicated in the P&ID.
- 25) 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



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handrail shall be provided, unless specifically mentioned otherwise.

- 26) Instrument hook up material shall be in bidder's scope.
- 27) 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.
- 28) Wrapping, coating and protection of the entire buried pipe shall be as per IS 10221 or AWWA C 203-93.
- 29) Any item/work either supply of equipment or erection material which have not been specifically mentioned in 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 and shall be in bidder's scope without any commercial, technical and delivery implication to BHEL.
- 30) If service air required by the bidder in the service vessel area (for hydro-pneumatic resin transfer operation etc.) then bidder to provide necessary compressors, valves, piping, fittings, flanges, instruments etc. to meet the system requirement.
- 31) All other items are also included in scope of supply as specified in other part of the specification.
- 32) Bidder to use analysis given in Section –D1 of this technical specification under SALIENT DESIGN INPUTS/ CRITERIA for NORMAL RUN & START-UP OR CONDENSER LEAK CONDITION for design of condensate polishing plant.
- 33) 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.

5.0 SCOPE OF SUPPLY (ELECTRICAL)

Complete electrical as per specification and details indicated in Section C2 (Specific Technical Requirement Electrical) and D2 (General Technical Requirement Electrical).

6.0 SCOPE OF SUPPLY (C&I)

Complete C&I as per specification and details indicated in Section C3 (Specific Technical Requirement C&I) and D3 (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.

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 and handling 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.



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- (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) Arrangement of all instruments, equipments, lab facilities, reagents, monitoring gadgets for monitoring, pre-commissioning, carrying out trial run, commissioning, PG test & plant hand over.
- (v) Monitoring gadgets, instruments and equipments required for maintenance.
- (vi) During commissioning of PLC, bidder shall arrange his concerned PLC sub-vendor personnel at site for commissioning of PLC at site, as and when required by customer / BHEL without any delay.
- (vii) Complete grouting for equipment, fixing and any concreting inside the vessels and lining.
- (viii) All personnel required during maintenance, Commissioning, trial run and PG test.
- (ix) Trial run for requisite period.
- (x) Performance guarantee testing.
- (xi) Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.
- (xii) All other facilities/ services as described in section on site services in specification and related to CPU Plant scope of work.
- (xiii) Relevant requirements as per GTR, GCC, ECC & SCC.
- (xiv) Painting shall be as specified in ANNEXURE 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 & delivery implication to BHEL & Customer.
- (xv) Final touch up paint at site.

9.0 COMMISSIONING SPARES

All the necessary commissioning spares shall be supplied as a part of base offer. Bidder will submit the list of commissioning spares for CPU plant along with the offer.

10.0 TERMINAL POINTS

10.1 CONDENSATE POLISHING PLANT - SERVICE VESSEL AREA

- (i) Service vessel inlet – (OD 457.2 X 12.7 mm thick, SA 106 Gr-C) - Single piping connection near service vessel area in BC bay for unit 1 & unit -2.
- (ii) Service vessel outlet – (OD 457.2 X 12.7 mm thick, SA 106 Gr-C) - Single piping connection near service vessel area in BC bay for unit 1 & unit -2.
- (iii) Rinse water outlet- Rinse water outlet piping (OD 168.3 x 7.11 mm, SA 106 Gr-B) from the service vessel outlet till condenser hot well for each unit is in the scope of bidder.
- (iv) The DM water used for resin transfer operations from the Regeneration building to the Condensate Polisher vessels shall be terminated by the bidder to the nearest drain trench through drain channel.
- (v) 25 NB connection of Instrument air supply at 5 to 7 kg/cm² (g) – At 5 meter distance from service vessel area.
- (vi) Gland sealing valves cooling water supply & analysers rack cooling water supply piping - Service

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water connection (25 NB) at 5 meter distance from service vessel area. Piping inside service vessel area for mentioned services will be in bidder's scope.

10.2 EXTERNAL REGENERATION AREA

- (i) DM Water Supply –The DM water piping terminal point shall be from outlet nozzles to both DM water storage tanks (DM water storage tanks not in bidder's scope) & for recirculation line terminal point shall be up to the recirculation nozzles to both DM water storage tanks. Piping from these terminal points to the pump suctions (CPU regeneration cum resin transfer pumps) shall be in the scope of bidder.
- (ii) DM Pumps Recirculation Lines – Piping from CPU regeneration cum resin transfer pumps outlet lines to DM water storage tanks recirculation nozzle shall also be in the scope of bidder.
- (iii) Alkali (48% NaOH)- A spare connection of minimum 65 NB size shall be provided along with isolation valve in both alkali storage tanks for drawing alkali for RO-DM plant .
- (iv) Acid (30-33% HCL)- A spare connection of minimum 65 NB size shall be provided along with isolation valve in both Acid storage tanks for drawing acid for RO-DM plant .
- (v) 25 NB Instrument air supply at 5 to 7 kg/cm² (g) – At 5 meter distance from the regeneration building.
- (vi) 25 NB Service air supply at 5 to 7 kg/cm² (g) - At 5 meter distance from regeneration area. If service air required is more than provided by BHEL, bidder to provide necessary compressors, valves, piping, fittings, flanges, instruments etc. to meet the system requirement.
- (vii) Drinking/potable water (25 NB) and service water (50 NB) - At 5 meter distance from the regeneration building. However distribution and piping inside regeneration area will be in bidder's scope.
- (viii) N Pit effluent piping (150 NB) from N Pit up to CMB OF ETP shall be in bidder's scope. The piping distance to be considered shall be 750 m.
- (ix) RO-DM plant regeneration waste – RO DM plant regeneration waste shall be terminated by the RO-DM plant bidder near the neutralization pit inlet channel of CPU.
- (x) In addition to that detailed terminal points shall be as per the P&ID for CPU plant (BHEL Drg. No.: PE-DG-412-155A-A001) enclosed with the technical specification.

11.0 PG TEST

Functional Guarantees and liquidated damages shall be as per Section C1C of this specification. Bidder shall perform the guarantee parameters as per the 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. The Bidder shall arrange all the Monitoring gadgets / instruments / equipment required for performing guarantee parameters (returnable after PG test).

12.0 EXCLUSIONS

12.1 All civil works including foundation of equipment. However complete grouting for equipment, fixing and any concreting inside vessels and lining shall be in the scope of the bidder. But civil works including operating / maintenance platforms and interconnection platforms (if any) with ladders / stairs & handrails, structural supports and hangers for pipes / cables / ducts, crane rails, all embedment and inserts with lugs including anchor fasteners, bolts etc., dressing of foundations,

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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 vendor's scope.

12.2 Main pipe trestles interconnecting CPU regeneration building and Service vessel Pipe trestle. However, auxiliary structure, hanger/support components for all the piping (CPU regeneration area, in acid/alkali handling area, interconnecting acid/alkali storage area, CPU service vessels, DM water piping, resin transfer piping, instrument air piping, service air piping and effluent disposal piping etc.) are in bidder's scope.

12.3 Instrument air & service air up to terminal points.

12.4 All chemicals except reagents, monitoring gadgets required for pre-commissioning, commissioning, trial run and PG test.

12.5 Air conditioning, ventilation & firefighting facilities.

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

12.7 Drinking water and service water & DM water up to terminal points.

13.0 QP AND SUB VENDOR APPROVAL

13.1 Minimum QP requirements are specified as C1 D. However any additional comments as given by BHEL/Customer shall be adhered by the bidder without any commercial & delivery implication to BHEL.

13.2 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.

13.3 The sub vendor list (as per Annexure-I) enclosed elsewhere in this specification is indicative only and is subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.

13.4 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 be subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.

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

13.6 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.

13.7 PLC should be procured/ sourced from original manufacturers only; PLC from system house shall not be acceptable.

14.0 DESIGN/ CONSTRUCTION

In addition to the requirements of Section C & D the following shall also be complied under scope of this specification.

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The P&I diagram is enclosed herein in this section for bidders compliance.

The material of construction specified in data sheet-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 DRAWING/DOCUMENTS REQUIREMENT

After award of LOI, following minimum drawing/documents shall be submitted by the bidder for BHEL and 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 Annexure elsewhere specified in this specification. 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 Annexure-V. 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 Annexure-V.

After award of LOI/LOA, drawing/documents to be submitted by the bidder for BHEL/Customer approval has been indicated in Annexure VI. 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 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 confirm drawings submission schedule as follows:

- Drawing/documents submission schedule: First submission of basic drawings/ documents – (Process Design & Sizing Calculation, Resin Data Sheet & curves and P&ID shall be within 4 weeks from the date of LOI and Operation & Control Philosophy along with Control System Configuration Diagram, and Equipment Layout within 6 weeks from the date of LOI.)
- Every revised submission incorporating comments – within 7 working days.
- Bidder further confirmed 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 fort nightly, for which the bidder shall depute his concerned engineer along with project manager to BHEL PEM office or at customer office. The meeting can also be held at site.
- Bidder to also provide the auto-cad copy of the all drawings (i.e. P& ID, Equipment Layout, Civil assignment drawing, cable tray/trench layout drawings, piping layout drawings) & Excel files of documents (i.e. Process design & sizing calculation, pressure drop calculation, valve schedule, instrument schedule etc.) for checking of the document during detail engineering stage.

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Bidder to ensure following requirements at their end for engineering drawing/ document submissions:

- 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>

16.0 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:-

16.1 MANDATORY SPARES

- i) 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.
- ii) The list of mandatory spares which is to be considered by bidder in their scope are indicated in respective Annexure-II mentioned elsewhere in this specification.
- iii) Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.
- iv) 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.
- v) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise.
- vi) 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.

16.2 RECOMMENDED SPARES

Bidder shall also provide a list of recommended spares for 3 years of normal operation of the Condensate polishing plant.

16.3 START-UP & COMMISSIONING SPARES

- i) 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.

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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 inter changeable 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 or other packages 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.
- 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.



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- 13) Identification: Each spare shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents 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 purpose of identification.

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

17.0 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 and any other agency/ competent authority ,on behalf of the customer, related to installation of CPU 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. 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.
- V. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- VI. Latest version of all codes and standards to be followed.
- VII. CPU regeneration facilities (except bulk acid & alkali storage and Neutralisation pit which area kept in open) shall be housed in RCC Building. Control room, battery room & MCC room for CPU plant shall be housed shall be located in RCC building. RCC building shall have toilet blocks for ladies and gents.
- VIII. 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.
- IX. Any statutory requirement / clearance required for the package from government / local body shall be in bidder's scope.



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- 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. 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.
- XIII. 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.
- XIV. 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.
- XV. Buried piping shall be protected as under (as per IS-10221).
Surface cleaning by wire brush, power tool cleaning etc.
Apply one coat of coaltar/primer/enamel.
Apply one layer of tape comprising of coaltar. Application of tape shall conform to AWWA C-203/IS 10221 (appendix-B) with Minimum thickness of tape as 4MM +10%
- XVI. 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.
- XVII. 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.
- XVIII. 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.
- XIX. 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.
- XX. 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.
- XXI. 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.

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18.0 PAINTING

Painting shall be C1 E of technical specification. Internal painting of the equipments shall be suitable for withstanding effect of effluent. 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.

19.0 HOIST AND TROLLEYS WITH MONORAILS

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.

19.1 CAPACITY OF CRANES & HOISTS

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.

19.2 ELECTRICAL REQUIREMENTS

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

- 19.2.1 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.
- 19.2.2 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.
- 19.2.3 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.
 - Maximum torque shall not be below 200% of full load torque.
- 19.2.4 Each motor more than 30 KW rating shall be provided with space heater. All electrical equipment accessories and wiring shall have tropical protection.
- 19.2.5 The VVF drive control shall be used for control of each motion. The VVF drive shall be equipped at least with 1024 pulse in/crd, 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.



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19.3 DSL

19.3.1 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.

19.4 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.

19.5 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.

19.6 CONTROL & INSTRUMENTATION REQUIREMENTS

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

- a) Over hoisting and lowering motions of the hook.
- b) Long travel motion
- c) Cross travel motion

19.7 OPERATING SPEEDS FOR MISCELLANEOUS HOISTS

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

Notes:

1. Area, type, capacity mentioned are minimum requirement and shall be finalized during detail engineering without any commercial implication.
2. Travel and Lift are layout dependent and shall be finalized during detail engineering without any commercial implication.
3. Additional electric/manual hoist required during detail engineering shall be provided as per design criteria given above without any commercial implication.

20.0 MINIMUM IMPORTED ITEMS

- i) Resins.

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SECTION C1 – B
GENERAL REQUIREMENT

CHAPTER – 3

GENERAL TECHNICAL REQUIREMENTS

1.00.00 INTRODUCTION

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

2.00.00 BRAND NAME

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

3.00.00 BASE OFFER & ALTERNATE PROPOSALS

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

4.00.00 COMPLETENESS OF FACILITIES

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

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

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

5.00.00 CODES & STANDARDS

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

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

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

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

- (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 atleast two coats of primer.

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

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

9.00.00 QUALITY ASSURANCE PROGRAMME

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

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

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

9.02.00 General Requirements - Quality Assurance

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

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

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

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

9.02.12 Unless otherwise proven and specifically agreed with the Owner, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

9.02.13 No welding shall be carried out on cast iron components for repair.

9.02.14 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

9.02.15 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

All plates of thickness above 40mm & all bar stock/Forging above 40mm dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.

9.02.16 The Bidder shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors bought out items (BOI). All the sub-Bidder proposed by the Bidder for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Bidder and finalised with the Owner, shall be subject to Owner's approval. The Bidder's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Owner for approval within the period agreed at the time of pre-awards discussion and identified in review category prior to any procurement. Monthly progress reports on sub-Bidder detail submission / approval shall be furnished. Such vendor approval shall not relieve the Bidder from any obligation, duty or responsibility under the contract.

9.02.17 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Owner, the Bidder's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-Bidder shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Owner and such approved Quality Plans shall form a part of the purchase order/contract between the Bidder and sub-Bidder. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications,

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

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

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

Elevated Temperature Test Cycle

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

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

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

Burn in Test Cycle

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

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

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

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

9.03.00 QA Documentation Package

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

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

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

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

9.03.02 Typical contents of QA Documentation is as below:-

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

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

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

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

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

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

9.03.05 Transmission Of QA Documentation

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

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

9.04.00 Project Manager's Supervision

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

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

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

9.05.00 Inspection, Testing And Inspection Certificates

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

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

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

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

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

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

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

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

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

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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	

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

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

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

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

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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 &			

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

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

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

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

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

ANNEXURE-III

		Project :		LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL						DOC. NO.:	
		Stage :								REV. NO.:	
		Package :		SUB-SYSTEM:						DATE :	
		Supplier :								PAGE : OF	
Bidder No. :											
S. N.	Item	QP/ Cat.	Insp.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status/ category	Sub-supplier Details submission schedule	Remarks
LEGENDS 1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY the Owner) A – For these items proposed vendor is acceptable to the Owner. To be indicated with letter “A” in the list alongwith the condition of approval, if any. DR – For these items “Detailed required” for the Owner review. To be identified with letter “DR” in the list. NOTED – For these items vendors are approved by Main Supplier and accepted by the Owner without specific vendor approval from the Owner. To be identified with “NOTED.” 2. QP/INSPN CATEGORY: CAT-I : For these items the Quality Plans are approved by the Owner and the final acceptance will be on physical inspection witness by the Owner. CAT-II : For these items the Quality Plans approved by the Owner. However no physical inspection shall be done by the Owner. The final acceptance by the Owner shall be on the basis review of documents as per approved QP. CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by the Owner shall be on the basis certificate of conformance by the main supplier. UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.											

ANNEXURE-V

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

ANNEXURE-VI

MFGR.'s LOGO	MANUFACTURER'S AND ADDRESS	MANUFACTURING QUALITY PLAN						PROJECT :				
		ITEM :		QP NO.: REV.NO.: DATE: PAGE: OF....				PACKAGE :				
		SUB-SYSTEM:						CONTRACT NO. :				
								MAIN-SUPPLIER:				
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTIC S	CLA SS	TYPE OF CHEC K	QUANT UM OF CHECK	REFERENC E DOCUMENT	ACCEPTAN CE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.	D *	**	10.	11.
				LEGEND: * RECORDS, IDENTIFIED WITH "TICK" ($\sqrt{\quad}$) 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 AND AS APPROPRIATE, CHP: THE OWNER SHALL IDENTIFIED IN COLUMN "N"	V: OWNER USE	REVIEWED BY	APPROVED BY	APPROVAL SEAL
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ANNEXURE-VII

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	QUANT UM OF CHECK	REFEREN CE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		REMAR KS	
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.	
			LEGEND: * RECORDS , IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS #: A = CRITICAL, B=MAJOR, C=MINOR;					DOC. NO.: REV.....			
MANUFACTURER/ SUB-SUPPLIER		MAIN- SUPPLIER					FOR THE				

SIGNATURE	'A' SHALL BE WITNESSED BY THE OWNER FQA, 'B' SHALL BE WITNESSED BY OWNER'S ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY ERECTION SUPPLIER (A & B CHECK SHALL BE OWNER CHP STAGE)	OWNE R USE	REVIEWED BY	APPROVE D BY	APPROV AL SEAL
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**TITLE**

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SECTION – C1-C

FUNCTIONAL / PERFORMANCE / DEMONSTRATION GUARANTEE

**TITLE****2X 660 MW ENNORE SEZ STPP
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FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND GUARANTEE TESTS

(The term "Performance Guarantees" wherever appears in this Section shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever appears in this Section shall have the same meaning and shall be synonymous to "Guarantee Test(s)". The term "TMCR" (Turbine maximum continuous rating) appearing in the Technical Specification shall mean 660 MW electrical power output at generator terminals (power at generator terminals as per clause indicated in this section) under 0% cycle make-up and 76 mm Hg (abs) condenser pressure unless used in conjunction with a different cycle make-up and/or a different condenser pressure.

1.00 PERFORMANCE GUARANTEES**General Requirements**

- 1.01 The Bidder shall guarantee that the equipment offered shall meet the rating and performance requirements stipulated for various equipment covered in this specifications.
- 1.02 The guaranteed performance parameters furnished by the bidder in his offer, shall be without any tolerance values and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.
- 1.03 The bidder shall demonstrate all the guarantees covered herein during performance guarantee/acceptance test. The various tests which are to be carried out during performance guarantee/acceptance tests are listed in the specification. The guarantee tests shall be conducted by the bidder at site in presence of BHEL / CUSTOMER on each unit individually.
- 1.04 All costs associated with the tests shall be included in the bid price.
- 1.05 In case during performance guarantee tests, it is found that the equipment/system has failed to meet the guarantees, the bidder shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the BHEL / CUSTOMER and re-conduct the performance guarantee test(s) with BHEL / CUSTOMER's consent. However if the specified performance guarantee(s) are still not met but are achieved within the Acceptable shortfall limit specified in the specification, BHEL / CUSTOMER will accept the equipment/system/plant after levying liquidated damages as mention in the specification. If, however, the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the BHEL / CUSTOMER, after the tests have been completed, the BHEL / CUSTOMER will have the right to either of the following:

a) For Category-I Guarantees

Reject the equipment/system/plant and recover from the bidder the payments already made.

OR

Accept the equipment/system/plant after levying liquidated damages as specified hereunder. The liquidated damages, for shortfall in performance shall be levied separately for each unit. The rates indicated are on station basis and per vessel basis respectively. The liquidated damages shall be pro-rated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category-I' Guarantees.

b) For Category-II Guarantees

Reject the equipment/system/plant and recover from the bidder 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.



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c) For Category-III Guarantees

Reject the equipment/system/plant and recover from the bidder 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 BHEL/CUSTOMER. Such damages shall, however be limited to the cost of replacement of the equipments/systems replacement of which shall remove the deficiency so as to achieve the guarantee performance. These parameters / capacities shall be termed as Category-III, guarantees.

2.00 GUARANTEES UNDER CATEGORY I

NIL

3.00 GUARANTEE UNDER CATEGORY –II

NIL

4.00 GUARANTEE UNDER CATEGORY –III

CONDENSATE POLISHING PLANT

5.00 Following shall be guaranteed by the Bidder in the relevant Guarantee Schedule of the Bid Document and falls under “GUARANTEE UNDER CATEGORY –III”:

a. NORMAL OPERATING CONDITION:

- i. Design Flow of each Service Vessel of Condensate Polishing Plant to be guaranteed.
- ii. Guaranteed service length (Period between two successive regenerations) of each service vessel shall be 30 days (720 hours).
- iii. Bidder shall guarantee the number of hours of operation of each service vessel in hydrogen cycle mode.
- iv. Quantity of Chemicals (30% HCl & 48% NaOH) per regeneration of each service vessel shall be guaranteed. Bidder to refer Technical Specification regarding minimum regeneration level to be employed while furnishing the guaranteed chemical consumption figures.
- v. Effluent Quality of Condensate:
 - With specified Design Flow, influent quality, each CPU Vessel regenerated with Guaranteed quantity of Chemical (Acid & Alkali) shall be guaranteed to maintain the effluent quality as specified in technical specification throughout the cycle (i.e. period between two successive regenerations) of 30 days (720 hours). No shortfall in guaranteed effluent quality will be accepted by the BHEL / customer during the service cycle.
 - Throughout the Service Cycle each Service vessel regenerated with guaranteed chemicals (Acid & Alkali), shall treat the condensate with influent crud level of 50 ppb at its design Flow and crud level of condensate at vessel outlet shall be guaranteed to be 5 ppb.

b. UNIT START UP CONDITION OR CONDENSER LEAK CONDITION

With Design Flow, influent quality, each Service vessel regenerated with guaranteed chemicals (Acid & Alkali) shall be guaranteed to maintain the effluent quality as specified in technical specification throughout useful service run of not less than 50 hours (i.e. period



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between two successive regenerations). No shortfall in guaranteed effluent quality will be accepted by the BHEL / customer during the service cycle. Throughout the Service Cycle of each CPU service vessel, total crud content in the effluent shall not exceed 150 ppb considering an influent average crud level of 500 ppb in the condensate.

- c. Pressure drop across the polisher service vessel (as defined elsewhere) in clean and dirty condition of resin at rated design flow i.e.
 - i) At the design flow rate, the pressure drop between inlet and outlet flanges of the polisher Condensate Polisher Mixed Beds with clean resin bed shall not exceed 2.0 bar (g).
 - ii) Maximum pressure drop under dirty conditions shall be restricted to about 3.5 bar (g) including the pressure drop across effluent resin traps.
- d. Vibration & parallel operation of all the pumps and blowers at the rated duty point shall be demonstrated at site.
- e. Noise level of all pumps and blowers at the rated duty point shall be demonstrated at site.
 - i) Noise: All the CPU plant pumps and blowers 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.

6.00 PERFORMANCE GUARANTEE / ACCEPTANCE TEST

6.1. General Requirements

- a) It is the responsibility of the Bidder to perform the Performance Guarantee/Acceptance test as specified in this Section. The performance tests will be performed using only the normal number of BHEL /Customer supplied operating staff for monitoring of PG test. Bidder personnel shall be used for instructional purposes or data collection and conducting the PG test at site. At all times during the Performance Tests the effluents quality from the Plant shall not exceed the Guaranteed Effluent Limits.
- b) The Bidder shall make their system ready for the performance guarantee tests.
- c) 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 TANGEDCO/BHEL. 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 costs associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the bid price. All calibration procedures and standards shall be subjected to the approval of the TANGEDCO/BHEL. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes. Tools and tackles, thermo wells (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.

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- d)** The Bidder shall submit for TANGEDCO/BHEL approval the detailed Performance Test procedure containing the following:

- (i) Object of the test.
- (ii) Various guaranteed parameters & tests as per contract.
- (iii) Method of conductance of test and test code.
- (iv) Duration of test, frequency of readings & number of test runs.
- (v) Method of calculation.
- (vi) Correction curves.
- (vii) Instrument list consisting of range, accuracy, least count, and location of instruments.
- (viii) Scheme showing measurement points.
- (ix) Sample calculation.
- (x) Acceptance criteria.
- (xi) Any other information required for conducting the test.

The Performance / Acceptance test shall be carried out as per the agreed procedure. After the conductance of Performance test, the Bidder shall submit the test evaluation report of Performance test results to TANGEDCO/BHEL promptly but not later than one month from the date of conductance of Performance test. However, preliminary test reports shall be submitted to the TANGEDCO/BHEL after completing each test run.

e) Test Interruptions:

In the event of a test interruption resulting from an Event of Force Majeure the interrupted Performance Test must be started again and test data that were collected during the interrupted test must be ignored.

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**SECTION C1 – D
QUALITY ASSURANCE**

**TITLE**

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QUALITY PLAN FOR MECHANICAL ITEMS



TITLE

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CONDENSATE POLISHING PLANT

Tests/Check Items / Components	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic / Water Fill	Pneumatic Test	Functional/operational Test	Bleeding resistance tests	Adhesion/ Spark Test	Performance Test	Other Test	All Test as per relevant Std/ Appd Data Sheets	Dynamic Balancing	Remarks
CPU Service Vessel	Y ^a	Y	Y	Y	Y	Y	Y ³						Y ¹			
Acid Alkali/Chemical Storage Tanks/ Vessels (LP)	Y ^a	Y	Y	Y	Y	Y ⁴	Y									
Resins/Activated Carbon & Internals of CPU	Y ^a				Y									Y		
Rubber Lining of Vessels/ Tanks/ Pipes etc	Y ^a				Y					Y ²	Y			Y		
Dosing Pumps/Metering Pumps	Y ^a						Y					Y ⁵		Y		
Diaphragm Valves	Y ^a				Y		Y ⁶	Y ⁶						Y ⁷		
Butterfly Valves (Low Pressure)					Y		Y ⁶		Y				Y ⁸			
1. Body (Cast)	Y ^a		Y ^b													
2. Disc (Cast)	Y ^a		Y ^b													
3. Shaft	Y ^a		Y										Y ^c			
High Pressure Ball Valves & Butterfly Valves	Y ^a						Y							Y		
Horizontal Centrifugal Pumps				Y	Y							Y ⁵		Y		
1. Casing	Y ^a		Y ^b				Y									
2. Impeller	Y ^a		Y ^b												Y	
3. Shaft	Y ^a		Y										Y ^c		Y	
Rotary Blowers				Y	Y							Y		Y		
1. Casing	Y ^a		Y ^b				Y									
2. Rotor	Y ^a		Y										Y		Y	



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Notes:

1. Heat Treatment shall be done as per ASME code.
2. Bleeding Resistance tests shall be done by keeping the sample in 33% HCl, 48% NaOH and DM Water for 72 Hrs.
3. Hydro Test shall be conducted, before Rubber lining.
4. As per code requirements.
5. As per HIS, USA.
6. Hydro test of body before Rubber lining. Seat Leakage test for Actuator operated valves shall be done by closing the Valves with Job Actuator.
7. Tests on Rubber parts such as Diaphragms shall be done per batch of Rubber mix, such as Tensile, Hardness, Adhesion, Spark Test, Bleed Resistance test and Flex test. Life Cycle test for Diaphragms for 50000 cycles etc shall also be done.
8. Hydro Test of Body, Seat & Disc Strength shall be carried out in accordance with latest edition of AWWA C-504 Standard. Proof of Design Test in accordance with latest edition of AWWA C-504 Standard shall also be carried out, if not carried out earlier. Seat Leakage test for Actuator operated valves shall be done by closing the Valves with Job Actuator. Seat leakage test shall be carried out in both directions.
 - a) One per Heat/Heat Treatment batch/Lot
 - b) On machined surfaces only.
 - c) UT shall be done for shafts with Dia 50 mm or above.
9. For all other Misc. items, refer Table on LP piping.
10. Inspection / test / check requirements for pressure vessels other than service vessel are same as for inspection / test / check requirements for service vessel as indicate in table given above.
11. For piping, vales, fillings in service vessel area quality requirements please also refer power cycle piping quality plan.
12. 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.

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, HP 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, nut, 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 > 400⁰C 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 under ground 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 penetrant 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 stem shall be subjected to UT. Finish machined valve stem 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 disc 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 test shall be conducted for three consecutive cycles with valve shaft 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 / strainer 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 dents, 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 ^b			Y				Y ^b		
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 ^b	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 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
10)	Rubber Expansion Joints	Y ^a					Y ¹²		Y				Y ¹³			
11)	Rubber Lining of Pipes	Y ^a	Y ^b		Y		Y			Y				Y ^a	Y	
12)	Hangers & Supports	Y ^a						Y								
13)	Fastners	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.

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

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 joints 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

17.0 POWER CYCLE PIPING

17.1 H.P. PIPING FOR TURBINE AND AUX.

1. Piping & Fittings

- a) All raw materials used shall have co-related mill test certificate meeting mandatory and supplementary checks of material specification.
- b) Raw material of all forged/formed fittings shall be ultrasonically tested. All mother pipes used for fitting shall either be ultrasonically tested or hydraulic tested. Forged fittings shall be ultrasonically tested and formed fittings shall be MPI tested.
- c) All pipe lengths shall be subjected to 100 % ultrasonic examination or hydraulic tests and UT/RT on longitudinal welds at the tube mill.
- d) Welded and cast fittings if any shall be subjected to suitable NDT as per applicable standards. However, 100 % RT shall be carried out on alloy steel fittings and on carbon steel fittings for use above 71 bar design conditions.
- e) The edge preparation for shop and site welds in stainless steel /alloy steel shall be subjected to a dye penetrate check
- f) Thickness of pipe bend 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) For welds in P91, X20 & X22 materials, induction type of heating shall be deployed for heat treatment, or heat treatment can be carried out in furnace.
- i) 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. Further statutory requirement, wherever applicable shall also be complied with.
 - a) Temperature > 400 Deg, C and / or pressure exceeding 71 bar
 - i. 100% RT/UT on butt welds and full penetration branch welds.
 - ii. 100% MPE.
 - b) Temperature > 175 Deg, C upto 400 Deg. C and/or pressure exceeding 17 bar and upto 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 for pipe dia upto 100NB.
 - iii. 100% MPE.
 - c) 100% UT & 100% MPI on all butt welds of P 91 and X22 UT shall be carried out by digital recorded type.

Wherever SR/PWHT is envisaged, above NDTs shall be after SR/PWHT.
- j) For all other pipes not covered above, 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.

- k) 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 piping) and 3% hardness survey on welds of other alloy steel.

2. Hangers & Supports

- a) All raw materials used shall have co-related mill test certificate meeting mandatory checks of material specification.
- b) Completed springs shall be tested for Scragging Test & Load vs Deflection Test and for dia. > 25mm MPI shall be carried out.
- c) Butt Welds shall be tested for UT and fillet welds shall be tested for MPI.
- d) Turn buckle/ pipe clamps/ Hangers of thickness > 25mm shall be checked by MPI/DPT on bent portion.
- e) Assembled Hangers shall be checked for Variation in deflection and Travel vs Load test.

3. Thermal Insulation & Lagging, Cladding

a) Light resign bound mineral wool:

LRB mattresses of Rockwool/Glasswool from approved manufacturing sources confirming to 8183, tested as per relevant clauses of IS 3144. Wire mesh of diameter 0.71mm (min.) shall only be used.

b) Lagging & Cladding

Aluminium sheeting confirming to ASTM B-203-1060 temper H14 from reputed manufacturer.

4. Valves

- a) Pressure retaining parts of valves shall be subjected to (min.) NDT as per Table 2.
- b) Hardened / stellitted valve disc and seat are to be subjected to LPI and hardness check.
- c) Color matching of valve disc/plug and seat shall be carried out to ensure min. 80% contact and no through passage.
- d) Hydraulic pressure test and seat leak test shall be carried out as per ANSI 16.34/ IBR.
- e) Air seat leak test shall be carried out as per applicable Standards/Codes.
- f) Functional testing shall be carried out on each valve to check the following as per the approved valve data sheet
 - i. Smooth operation
 - ii. Valve travel, closing and opening time.
 - iii. Current drawn by actuators.
- g) Springs for safety valves shall be tested with suitable NDT and for spring rate.
- h) Safety and safety relief valves shall be tested for performance.

TABLE-2

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:

For body and bonnet forgings UT with MPI may be adopted in place of RT.

For austenitic steel MPI may be replaced by LPI.

	MANUFACTURER'S NAME & ADDRESS :	<u>MANUFACTURING QUALITY PLAN</u> ITEM : Chain Pulley Block QP No.: PE-TS-XXX-XXX-A001 REV.: 0, Date.: , PAGE: 1 OF 4	PROJECT : PACKAGE : CHAIN PULLEY BLOCKS VOL IIB, SEC C
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Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
									M C N	
									10.	
1.	2.	3.	4.	5.	6.	7.	8.	9.		11.

1	RAW MATERIAL & B/OUT ITEMS:												
1.1	HOOKS	DIMENSIONS,	MA		One sample	IS: 15560	IS: 15560	MTC	✓	P	V	V	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.	✓	P	V	V	
		IDENTIFICATION & COMPLIANCE WITH TC.	MA	VISUAL	100%	HOOK TC FROM COMPETENT AUTHORITY		IR	✓	P	V	V	
		INTERNAL DEFECTS	MA	UT	100%	ASTM A-388 (REFER NOTE 1)		TC	✓	P	V	V	
		PROOF LOAD TEST	MA	REVIEW	100%	IS 15560		TC	✓	P	V	V	
		NDT AFTER PROOF LOAD	MA	DPT	100%	ASTM E-165	NO RELEVANT IDENTIFICATION	TC	✓	P	V	V	
1.2	LOAD CHAIN	- DIMENSIONS	MA	MEASUREMENT	100 %	IS: 6216 & APPD. DRGS.	IS: 6216 & APPD. DRGS.	IR	✓	P	V	V	
		- BREAKING STRENGTH	MA	-TENSILE TEST	1/LOT			MTC	✓	P	V	V	
		- PROOF LOAD	MA	-TENSILE TEST	100%			HT	✓	P	V	V	
		-HEAT TREATMENT	MA	REVIEW	100%			CHA	✓	P	V	V	
		-GRADE	MA	REVIEW	1/BATCH			RT	✓	P	V	V	
								MTC	✓	P	V	V	
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	✓	P	V	V	TC or inspection report for components

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

	MANUFACTURER'S NAME & ADDRESS :	<u>MANUFACTURING QUALITY PLAN</u> ITEM : Chain Pulley Block QP No.: PE-TS-XXX-XXX-A001 REV.: 0, Date.: , PAGE: 2 OF 4	PROJECT : PACKAGE : CHAIN PULLEY BLOCKS VOL IIB, SEC C
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Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
									M C N	
									10.	
1.	2.	3.	4.	5.	6.	7.	8.	9.		11.

						APPROVED DRAWING	APPROVED DRAWING			shall be given.
		INTERNAL DEFECTS	MA	UT	10%	ASTM A-388 (REFER NOTE 1)	IR	✓	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.	MTC ✓	P V V	
1.5	BEARINGS	MAKE, TYPE, CATALOGUE NO.	MA	VISUAL	RANDOM	APP DRG / MFR'S CATALOGUE	APP DRG / MFR'S CATALOGUE	IR ✓	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	MTC ✓	P V V	
1.7	HAND CHAIN	GRADE/ DIMENSION	MA	GRADE DIMENSION	100 %	AS PER DRAWING	AS PER DRAWING	MTC ✓	P V V	
1.8	TROLLEY GEARS, PINION, WHEELS, AXLE	CHEMICAL & MECHANICAL	MA	LAB ANALYSIS,	100%	APPVD DRGS	APPVD DRGS	IR/T C ✓	P V V	
2	IN PROCESS									
2.1	RATCHET PAWL / RATCHET WHEEL	-HARDNESS	MA	HARDNESS	100%	IS:3832 / APPD DRG.	IS:3832/ APPD. DRG.	IR ✓	P V V	

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