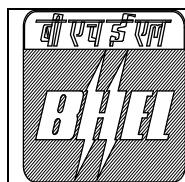
	<b>TITLE:</b>		SPECIFICATION NO. PE-TS-412-155A-A001	
	<b>2X660 MW ENNORE SEZ STPP</b>		SECTION : I	
	<b>TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT</b>		<b>SUB-SECTION: IA</b>	
			<b>REV. NO. 00</b>	<b>DATE :</b>

(iii)	<b>DIAPHRAGM VALVE</b>	<p>The Diaphragm shall conform to following requirement for DM water application:</p> <p>i) Design standard: BS: 5156 or equivalent of required rating / class. (Minimum rating of valves shall be PN 10).</p> <p>ii) Type : Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type</p> <p>iii) Material of Construction</p> <p>a) Body, Bonnet : Cast iron IS 210 Gr. FG 260 or equivalent or Cast steel ASTM A-216 Gr. WCB</p> <p>b) Body lining : Soft natural rubber(Neoprene), ebonite, Polypropylene</p> <p>c) Hand wheel : Cast Iron</p> <p>d) Compressor : Stainless Steel</p> <p>e) Stem and Bush : Stainless Steel</p> <p>For Acid and Alkali services the valve shall be CPVC PN10/Sch 40 only.</p>
<b>7.0</b>	<b>FLANGES</b>	
(i)	Feed water / Condensate	ASTM 105
(ii)	DM water	ASTM A105 rubber lined (for NB 65 mm to 150 mm) ASTM A 182 F 304 (for NB 50 mm and below)
(iii)	Instrument Air	ASTM A 105 galvanized

**TECHNICAL DATASHEET-A FOR ELECTRIC HOIST:**

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



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

**TECHNICAL SPECIFICATION FOR  
CONDENSATE POLISHING UNIT**

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

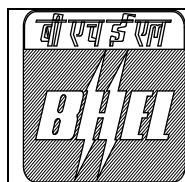
SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

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



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

**TECHNICAL SPECIFICATION FOR  
CONDENSATE POLISHING UNIT**

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

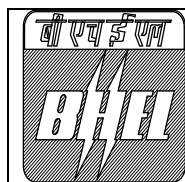
SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

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



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

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

SECTION : I

**TECHNICAL SPECIFICATION FOR  
CONDENSATE POLISHING UNIT**

**SUB-SECTION: IA**

**REV. NO. 00**

**DATE :**

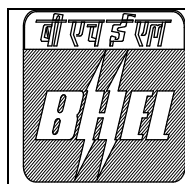
		shall be used. 4 sq.mm copper conductors shall be used for CT circuits, all other specification remaining same. In 4 sq.mm conductor impose unacceptable high burden on CTs, higher cross section of conductor shall be used.
24.0	Flexible trailing cable	1.1 KV grade Trailing cables shall have tinned copper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

#### B) MANUAL HOIST (CHAIN PULLEY BLOCK):

##### DATA SHEET-A

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





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

**TECHNICAL SPECIFICATION FOR  
CONDENSATE POLISHING UNIT**

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

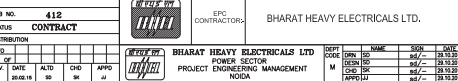
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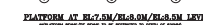
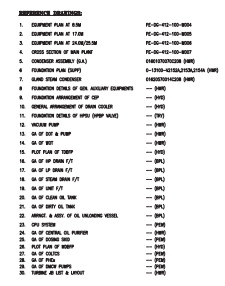
SUB-SECTION: IA

REV. NO. 00

DATE :

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

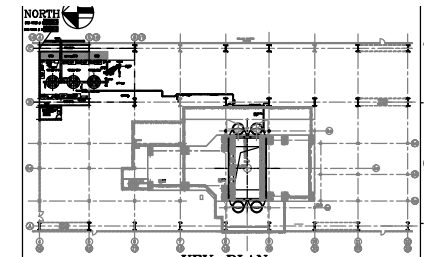
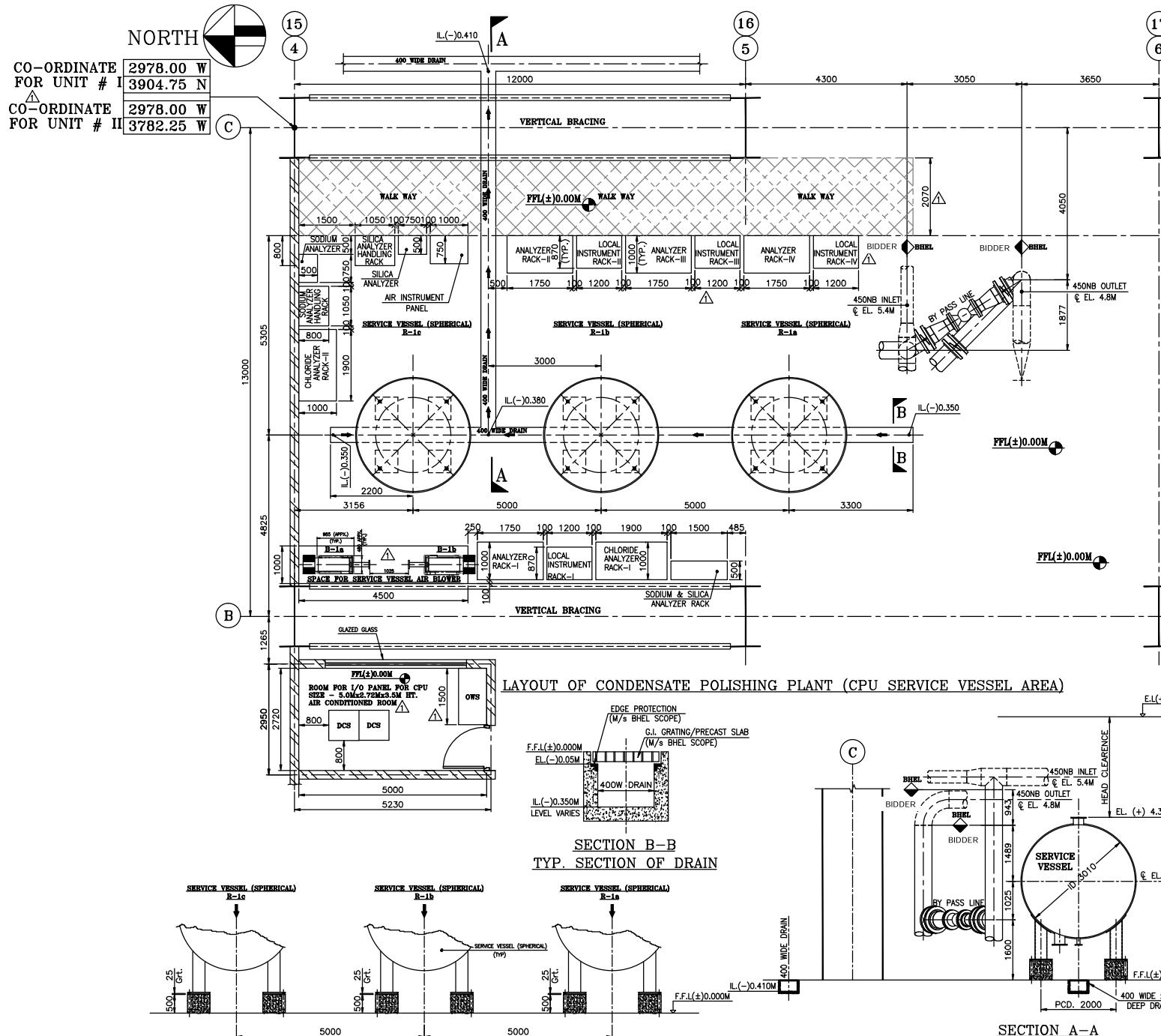




					JOB NO. <b>412</b>				
					STATUS <b>CONTRACT</b>				
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REV.	DATE	ALTO	CHD	APPO	REV.	DATE	ALTO	CHD	
02	04.06.15	SD	SK	AI	01	05.03.15	SD	SK	
01	DRAWING GENERALLY REVISED BASED ON CUSTOMER COMMENTS.				01	DRAWING GENERALLY REVISED BASED ON CUSTOMER COMMENTS.			







**EQUIPMENT LIST**

SL. NO.	TAG NO.	DESCRIPTION	QTY.	SIZE	CAPACITY
1	R-1a, R-1b & R-1c	SERVICE VESSEL (SPHERICAL) FOR UNIT # 2 (TYP.)	3	#3010	
2	B-1a & B-1b	AIR BLOWER SERVICE AREA FOR UNIT # 1 (TYP.)	2		650m <sup>3</sup> /hr.x4MWC
3	R-2a, R-2b & R-2c	SERVICE VESSEL (SPHERICAL) FOR UNIT # 2 (TYP.)	3	#3010	
4	B-2a & B-2b	AIR BLOWER SERVICE AREA FOR UNIT # 2 (TYP.)	2		650m <sup>3</sup> /hr.x4MWC

**NOTES:-**

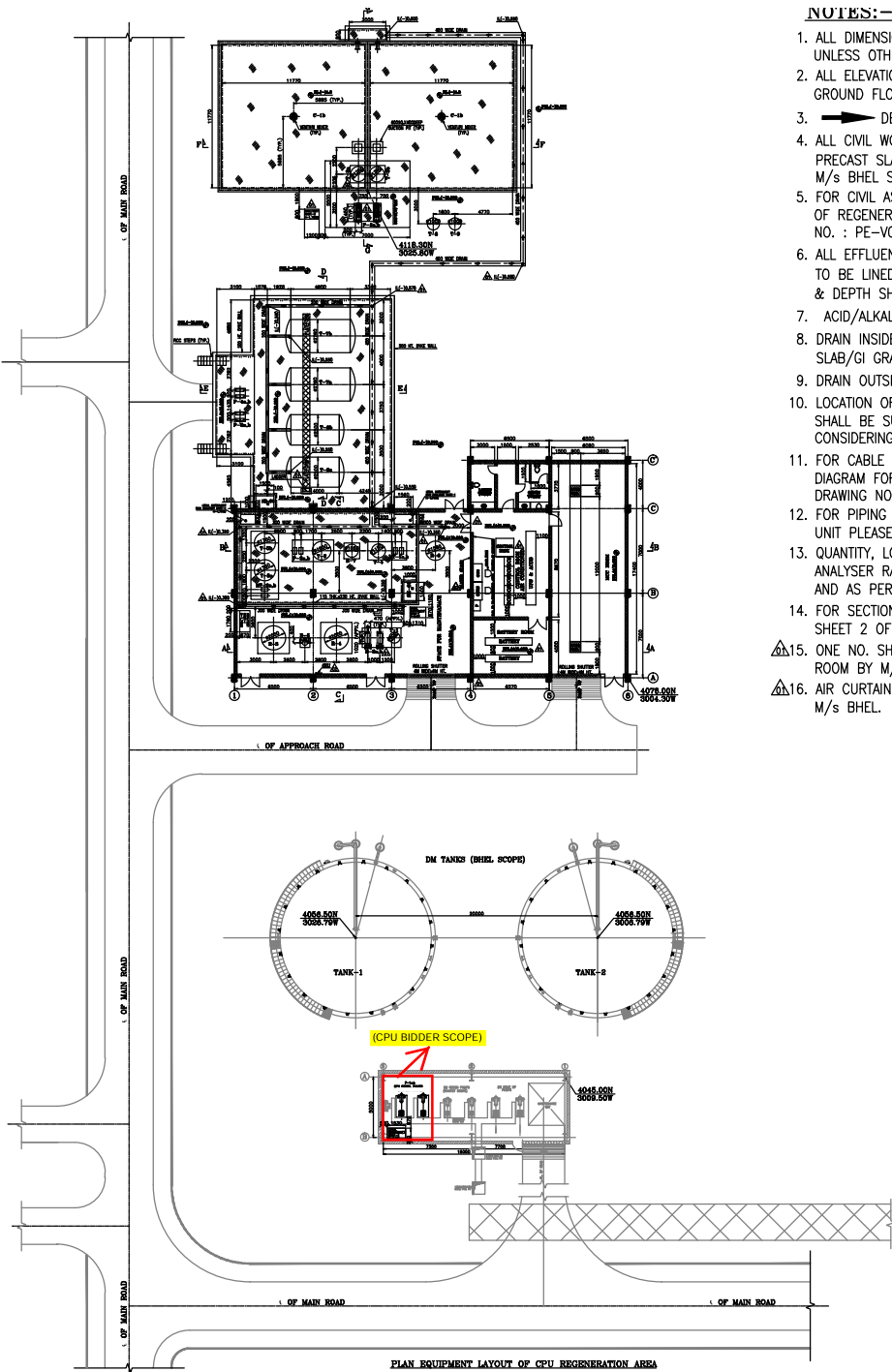
- ALL DIMENSION ARE IN MM & COORDINATES, ELEVATIONS ARE IN METER.
- ALL ELEVATIONS INDICATED ARE WITH RESPECT TO POWER HOUSE GROUND FLOOR EL.(±)0.00M, WHICH CORRESPONDS TO RL. (+) 10.0M.
- DENOTES DIRECTION OF SLOPE.
- FOR CIVIL SCOPE AND FOUNDATION DETAILS PLEASE REFER W/s BHEL DRAWING NO. : PE-V0-412-155-A029 FOR CIVIL DESIGN PURPOSE.
- FOR ARRANGEMENT OF CABLE TRAY AND TRENCH DETAILS PLEASE REFER DETAILS REFER W/s BHEL DRAWING NO. : PE-V0-412-155-A049.
- FOR PIPING LAYOUT OF SERVICE VESSEL AREA PLEASE REFER W/s BHEL DRAWING NO. : PE-V0-412-155-A037.
- CIVIL WORK IS IN W/s BHEL SCOPE.
- THIS DRAWING SHOWS THE EQUIPMENT LAYOUT OF CONDENSATE POLISHING UNIT (SERVICE VESSEL AREA) FOR UNIT # 1 (TYP.) AND EQUIPMENT LAYOUT OF CONDENSATE POLISHING UNIT (SERVICE VESSEL AREA) FOR # UNIT 2 (TYP.) SHALL BE SIMILAR.
- LOCATION, DIMENSION & QUANTITY SHOWN FOR ANALYSER RACK, LOCAL INSTRUMENT RACK AND AIR INSTRUMENT PANEL IS TENTATIVE AND SAME SHALL BE SUBJECTED TO CHANGED DURING DETAIL ENGINEERING AND AS PER AVAILABILITY OF SPACE AT SITE.
- AIR BLOWER IS SKID MOUNTED AND REST ON FLOOR, NO RCC RAISED PLATFORM & FOUNDATION IS REQUIRED.
- AS THE RIO PANEL ROOM HEIGHT IS 3.5M ONLY THERE NO FALSE CEILING CONSIDERED FOR RIO PANEL ROOM.

**C & I PANEL AND RACK LIST**

SL. NO.	DESCRIPTION	QTY.	SIZE
1	ANALYSER RACK-I ANALYSER RACK-II ANALYSER RACK-III ANALYSER RACK-IV	4	1750x1000wx1705HT.
2	LOCAL INSTRUMENT RACK-I LOCAL INSTRUMENT RACK-II LOCAL INSTRUMENT RACK-III LOCAL INSTRUMENT RACK-IV	4	1200x870wx2100HT.
3	CHLORIDE RACK-I CHLORIDE RACK-II	2	1900x1000wx2105HT.
4	SODIUM & SILICA ANALYSER RACK-I	1	1500x500wx2105HT.
5	SODIUM ANALYSER RACK	1	750Lx500wx1600HT.
6	SILICA ANALYSER RACK	1	750Lx500wx1600HT.
7	SODIUM ANALYSER RACK HANDLING RACK	1	1050Lx800wx1600HT.
8	SILICA ANALYSER RACK HANDLING RACK	1	1050Lx800wx1600HT.
9	AIR INSTRUMENT PANEL	1	1000Lx750wx1900HT.

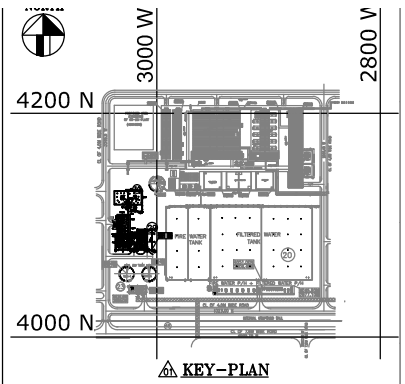
**TITLE**  
EQUIPMENT LAYOUT OF CONDENSATE POLISHING UNIT (SERVICE VESSEL AREA)





**NOTES:-**

1. ALL DIMENSIONS ARE IN MM AND LEVELS, CO-ORDINATES ARE IN METER UNLESS OTHERWISE SPECIFIED.
2. ALL ELEVATIONS INDICATED ARE WITH RESPECT TO POWER HOUSE GROUND FLOOR EL.(±)0.00M, WHICH CORRESPONDS TO RL. (+) 10.0M.
3. DENOTES DIRECTION OF SLOPE.
4. ALL CIVIL WORKS INCLUDING ACID/ALKALI PROOF LINING/TILING/PVC LINING, PRECAST SLAB, RUNGS, AIR CONDITIONING/VENTILATION SYSTEM IS IN M/s BHEL SCOPE.
5. FOR CIVIL ASSIGNMENT DRAWING OF CONDENSATE POLISHING UNIT OF REGENERATION AREA PLEASE REFER DRAWING NO. : PE-V0-412-155-A030 FOR CIVIL DESIGN.
6. ALL EFFLUENT DRAINS AND INCLUDING DRAINS LEADING TO NEU. PIT ARE TO BE LINED WITH ACID AND ALAKLI PROOF LINING AND DRAIN WIDTHS & DEPTH SHOWN ARE FINISHED DIMENSION AFTER LINING.
7. ACID/ALKALI PROOF LINING SHOWN THUS & .
8. DRAIN INSIDE THE BUILDING SHALL BE COVERED BY PRECAST SLAB/GI GRATING.
9. DRAIN OUTSIDE THE BUILDING SHALL BE COVERED BY PRECAST SLAB.
10. LOCATION OF ALL SKID BASED EQUIPMENT SHOWN ARE INDICATIVE AND SHALL BE SUITABLY ADJUSTED TO MEET THE SKID/PIPING REQUIREMENTS CONSIDERING SOME MINOR VARIATIONS.
11. FOR CABLE TRAY/TRENCH & CONDUIT ROUTING AND EARTHING LAYOUT DIAGRAM FOR CPU (REGENERATION AREA) PLEASE REFER M/s BHEL DRAWING NO.: PE-V0-412-155-A048.
12. FOR PIPING LAYOUT (REGENERATION AREA ) FOR CONDENSATE POLISHING UNIT PLEASE REFER M/s BHEL DRAWING NO.: PE-V0-412-155-A034.
13. QUANTITY, LOCATION AND DIMENSION OF LOCAL INSTRUMENT RACK AND ANALYSER RACK IS SUBJECTED TO CHANGED DURING DETAIL ENGINEERING AND AS PER SUIT AT SITE CONDITION.
14. FOR SECTION PLEASE REFER M/s BHEL DRAWING NO.: PE-V0-412-155-A033, SHEET 2 OF 2.
15. ONE NO. SHOE RACK SHALL BE PROVIDED AT MAIN ENTRANCE OF CONTROL ROOM BY M/s BHEL.
16. AIR CURTAINS AT ENTRANCE OF CONTROL ROOM SHALL BE PROVIDED BY M/s BHEL.



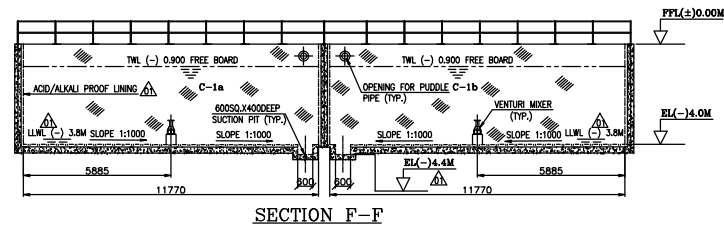
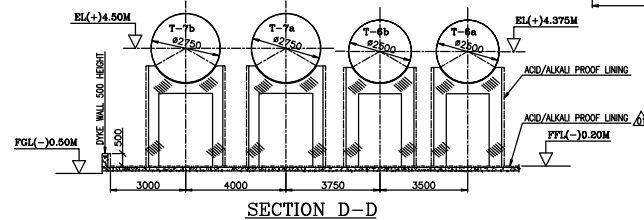
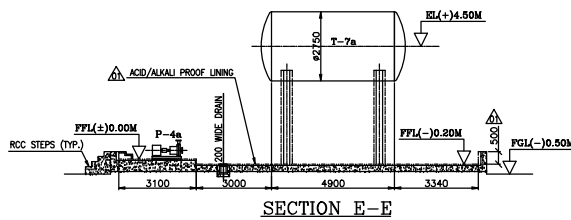
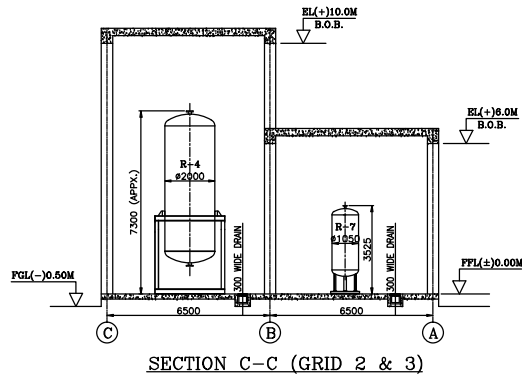
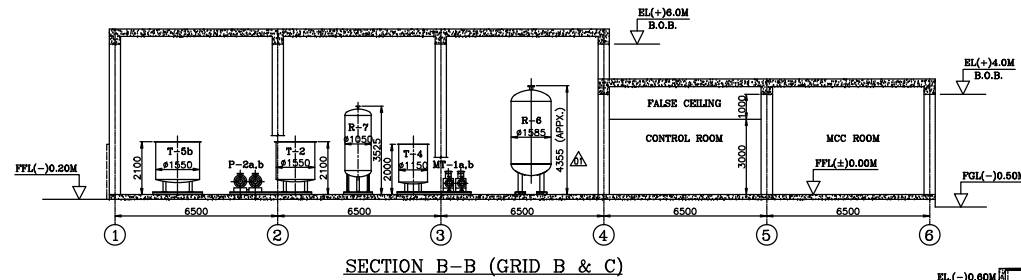
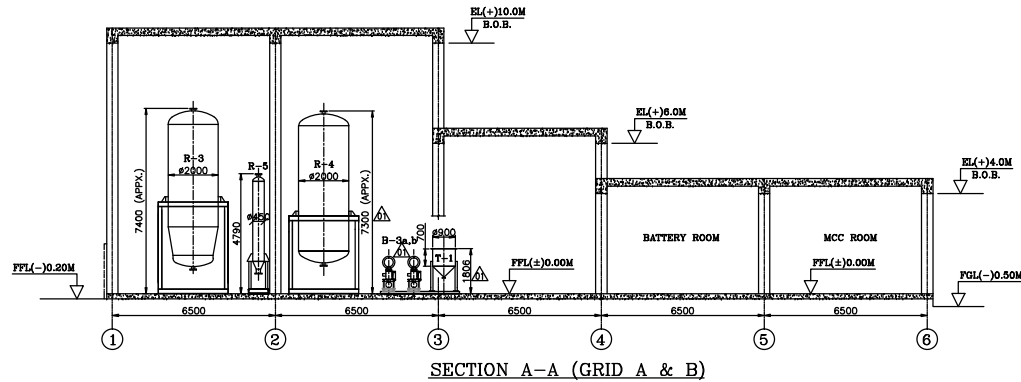
**EQUIPMENT LIST**

SL. NO.	TAG NO.	DESCRIPTION	QTY.
1	R-3	ANION REGENERATION	1
2	R-4	CATION REGENERATION	1
3	R-5	INTERFACE ISOLATION UNIT (RIU)	1
4	R-6	HOT WATER TANK	1
5	R-7	ACTIVATED CARBON FILTER	1
6	T-1	RESIN MAKE-UP HOPPER	1
7	T-2	ALKALI PREPARATION TANK	1
8	T-3a T-3b	PRIMING TANK	2
9	T-4	ALKALI DAY TANK	1
10	T-5a T-5b	ACID MEASURING TANK	2
11	T-6a T-6b	ALKALI STORAGE TANK	2
12	T-7a T-7b	ACID STORAGE TANK	2
13	T-8	ALKALI MEAS. TANK FOR N. PIT	1
14	T-9	ACID MEAS. TANK FOR N. PIT	1
15	C-1a C-1b	NEUTRALISATION PIT	1
16	MT-1a MT-1b	ALKALI DOSING PUMP	2
17	MT-2a MT-2b	ACID DOSING PUMP	2
18	P-1a P-1b	DM WATER REGENERATION CUM RESIN TRANSFER PUMPS	2
19	P-2a P-2b	ALKALI TRANSFER CUM RECIRCULATION PUMP	2
20	P-3a P-3b	ALKALI UNLOADING PUMPS	2
21	P-4a P-4b	ACID UNLOADING PUMPS	2
22	P-5a P-5b	WASTE REGULATION CUM DISPOSAL PUMPS	2
23	B-3a B-3b	AIR BLOWER REGENERATION UNIT	2
24	SH-01 SH-02	SAFETY SHOWER	2

**C & I PANEL AND RACK LIST**

SL. NO.	DESCRIPTION	QTY.	SIZE
1	ANALYZER RACK-I	1	1760Lx870Wx1705HT.
2	ANALYZER RACK-II	1	1200Lx800Wx1705HT.
3	LOCAL INSTRUMENT RACK-I	1	1310Lx870Wx2100HT.
4	LOCAL INSTRUMENT RACK-II	1	1530Lx870Wx2100HT.
5	LOCAL INSTRUMENT CUM ANALYZER RACK-I	1	1560Lx800Wx1705HT.
6	LOCAL INSTRUMENT CUM ANALYZER RACK-II	1	1560Lx800Wx1705HT.

TITLE  
EQUIPMENT LAYOUT OF CONDENSATE  
POLISHING UNIT (REGENERATION AREA)

**NOTES:-**

1. ALL DIMENSIONS ARE IN MM AND LEVELS, CO-ORDINATES ARE IN METER UNLESS OTHERWISE SPECIFIED.
2. ALL ELEVATIONS INDICATED ARE WITH RESPECT TO POWER HOUSE GROUND FLOOR EL.(±)0.00M, WHICH CORRESPONDS TO RL. (+) 10.0M.
3. FOR OTHER NOTES PLEASE REFER M/s BHEL DRAWING NO.: PE-V0-412-155-A033, SHEET 1 OF 2.
4. FOR PLAN PLEASE REFER M/s BHEL DRAWING NO.: PE-V0-412-155-A033, SHEET 2 OF 2.



4200 N

4000 N



3000 M

2800 M

**KEY-PLAN****EQUIPMENT LIST**

SL. NO.	TAG NO.	DESCRIPTION	QTY.
1	R-3	ANION REGENERATION	1
2	R-4	CATION REGENERATION	1
3	R-5	INTERFACE ISOLATION UNIT (IRU)	1
4	R-6	HOT WATER TANK	1
5	R-7	ACTIVATED CARBON FILTER	1
6	T-1	RESIN MAKE-UP HOPPER	1
7	T-2	ALKALI PREPARATION TANK	1
8	T-3a	PRIMING TANK	2
9	T-4	ALKALI DAY TANK	1
10	T-5a	ACID MEASURING TANK	2
11	T-6a	ALKALI STORAGE TANK	2
12	T-7a	ACID STORAGE TANK	2
13	T-8	ALKALI MEAS. TANK FOR N. PIT	1
14	T-9	ACID MEAS. TANK FOR N. PIT	1
15	C-1a	NEUTRALISATION PIT	1
16	MT-1a	ALKALI DOSING PUMP	2
17	MT-2a	ACID DOSING PUMP	2
18	P-1a	DM WATER REGENERATION CUM RESIN TRANSFER PUMPS	2
19	P-2a	ALKALI TRANSFER CUM RECIRCULATION PUMP	2
20	P-3a	ALKALI UNLOADING PUMPS	2
21	P-4a	ACID UNLOADING PUMPS	2
22	P-5a	WASTE REGULATION CUM DISPOSAL PUMPS	2
23	B-3a	AR BLOWER REGENERATION UNIT	2
24	SH-01	SAFETY SHOWER	2

TITLE  
EQUIPMENT LAYOUT OF CONDENSATE  
FOUNDER UNIT (CONDENSATION AREA)





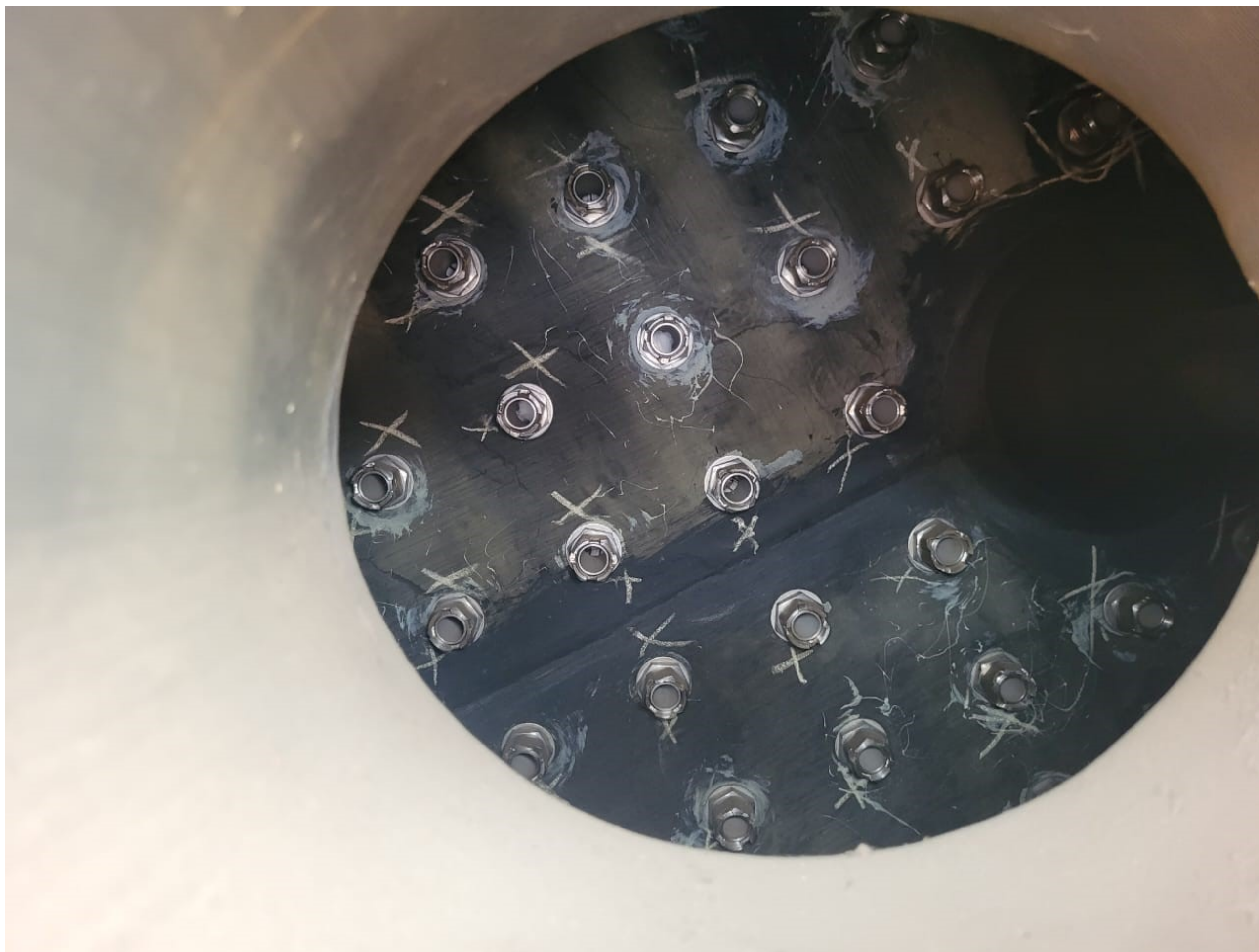


























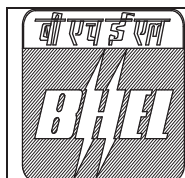












**TITLE :**  
**2X660 MW ENNORE SEZ STPP**

**SPECIFICATION NO. PE-TS-412-155A-A001**

**SECTION : I**

**TECHNICAL SPECIFICATION FOR  
CONDENSATE POLISING UNIT**


**SUB-SECTION: IB**

**REV. NO. 00**

**DATE :**

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



	<p align="center"><b>PROJECT : 2X660 MW ENNORE STPP TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT (ELECTRICAL PORTION)</b></p>	<p>SPECIFICATION NO. PE-TS-412-155A-A001 SECTION -I SUB-SECTION-I B REV 00      DATE 04:01:2017 PAGE 1 OF 1</p>
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### SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

#### 1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

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

#### 2.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 2.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:
  - a) A copy of this sheet "Electrical Equipment Specification for AC System" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
  - b) List of Erection and Commissioning spares.
  - c) List of Erection & Maintenance tools & tackles.
  - d) Electrical load requirement in the load data format.
- 2.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc., is required during tender stage. Any such submission even if made, shall not be considered as part of offer

#### 3.0 LIST OF ENCLOSURES

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

**SPECIFIC ELECTRICAL REQUIREMENT**





SL.NO.	PARAMETERS	UNIT	ENNORE
	<b>MOTOR</b>		
1	DESIGN AMBIENT TEMP	DEG. C	50
2	VOLTAGE SUPPLY AND VARIATION	VOLT	415V, $\pm 10\%$
3	FREQUENCY WITH VARIATION	Hz	50 (+) 3% to (-) 5%
4	COMBINED VOLTAGE & FREQUENCY VARIATION		10%
5	MAX ACCEPTABLE RATING OF MOTOR AT 415 V	KW	160 kW
6	SYSTEM FAULT LEVEL AND ITS DUARTION	KA	50 KA, 1 Sec
7	SUTABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION		50 KA, 0.25 sec
8	CLASS OF INSULATION & TEMP RISE LIMITED TO		Class-F and temp rise limited to Class-B
9	MIN. STARTING VOLTAGE		85%
10	MOTOR RATING FOR SINGLE PHASE SUPPLY		Upto 200W
11	MAXIMUM LOCKED ROTOR CURRENT	% OF FLC	For LT motors (except energy efficient motors) locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT energy efficient motors above 10kW with S1 duty, locked rotor current shall be as per IS: 12615-2011.
12	ACCEPTABLE NOISE LEVEL	DB	85dB at 1.0m in line with IS 12065
13	TYPE OF STARTER PROVIDED IN MCC		N.A.
14	DOP OF ENCLOSURE		Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.
15	SPACE HEATER REQUIREMENT		30KW & ABOVE
16	PAINT SHADE		Shall be confirmed during detailed engineering.
17	SPECIAL REQUIREMENT		For HT & LT Motors, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.  All motors shall be subjected to routine tests as per IS: 325 / IS: 12615.  The motors shall generally conform to IS: 325 / IEC-60034.
18	EFFICIENCY CLASS		ENERGY EFFICIENCY CLASS <b>IE-3</b> AS PER IS : 12615




# BASIC TECHNICAL FEATURES

## FOR HT/LT MOTORS

### (FOR BHEL-PEM SCOPE PACKAGES)

					PROJECT	2X660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS,CHENNAI					
REV	DATE	ALTD	CHD	APPD		OWNER	TAMIL NADU GENERATION & DISTRIBUTION CORPOARATION LIMITED				
02	13.05.15	RKG/AB	SL	RG							
REVISED AS PER TANGEDCO COMMENTS DATED 10.04.2015						OWNER'S CONSULTANT	DESEIN PRIVATE LIMITED, DESEIN HOUSE,NEW DELHI				
						EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA(U.P) INDIA				
REV	DATE	ALTD	CHD	APPD		BHARAT HEAVY ELECTRICALS LTD. POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA	DEPT CODE	DRN	NAME BKR	SIGN	DATE
01	13.03.15	BKR-SD-	SL-SD-	RG-SD-			E	DSGN	BKR	-SD-	13.01.15
REVISED AS PER TANGEDCO COMMENTS DATED 13.02.2015					TITLE	BASIC TECHNICAL FEATURES FOR HT/LT MOTORS	CHD	SL	-SD-	13.01.15	
							APPD	RG	-SD-	13.01.15	
							DRAWING NO.				
							SHEET 1 OF 7Page 228 of 437				

	<b>2 x 660 MW ENNORE SEZ STPP</b>  <b>BASIC TECHNICAL FEATURES FOR HT / LT MOTORS (FOR BHEL-PEM SCOPE PACKAGES)</b>	Doc. No.	PE-DC-412-565-E003
		Rev. No.	02
		Dated	13-05-2015
		Page	2 of 7

- 1.0 This document covers the basic technical features of high tension (HT) and low tension (LT) squirrel cage induction AC motors employed for driving auxiliaries of BHEL-PEM scope packages in **2 x 660 MW ENNORE SEZ STPP**.

## 2.0 CODES AND STANDARDS

**The motors shall generally conform to IS 325/IEC-60034. LT motors above 10 kW with continuous duty (S1) shall be energy efficient IE3 conforming to IS-12615: 2011.**

## 3.0 DESIGN REQUIREMENTS

### 3.1 General Requirements

The design ambient temperature shall be 50 deg C.

### 3.2 Supply system and rated voltage of motors

KW rating	Supply system	Rated voltage of motor
Above 1500 kW	11 KV	11 KV
Above 160 kW up to & including 1500 kW	3.3 KV	3.3 KV
From 200W up to & including 160 kW	415 V	415 V
Below 200W	240V	240V

#### 3.2.1 Supply voltage & variations shall be as follows:-

Voltage variation (AC Supply) (+/-) 10%

Frequency variation (+) 3% to (-) 5%

Combined V & F variation 10% (sum of absolute values)


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

### 3.3 Motor Rating

Motor ratings shall be adequate to meet the requirements of the drive equipment. Motors shall be continuously rated at the design ambient temperature of 50 degree C and relative humidity of 85%. Maximum continuous motor ratings shall have at least a 10% margin above the maximum load demand of the driven equipment under entire operating range including voltage & frequency variation.

### 3.4 Starting Requirements

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

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

Minimum Starting Voltage requirement for all motors (except mill motors):

1. 85 % of rated voltage for motors up to 1000 kW
2. 80 % of rated voltage for above 1000 kW and up to 4000 kW
3. 75 % of rated voltage for above 4000 kW

- 3.4.3 The locked rotor current of the HV (11 kV) motors (except MDBFP motors) shall not exceed 650% of full load current inclusive of tolerance as per IS: 325 and for MV (3.3 kV) motors locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT motors (except energy efficient motors) locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT energy efficient motors above 10kW with S1 duty, locked rotor current shall be as per IS: 12615-2011.

- 3.4.4 The following frequency of starts shall apply to HV (11 kV), MV (3.3 kV) & LT motors

- i) Two nos. consecutive cold starts in quick succession with third start after 5 minutes in cold condition.
- ii) Two nos. consecutive hot starts in the interval of 15 minutes in hot condition.

- 3.4.5 Locked motor withstand time of motors under hot condition at highest voltage limit shall be as follows:

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


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

### 3.5 Running Requirements

- 3.5.1 Motors shall run satisfactorily at a supply voltage of 80% of rated voltage for 5 minutes with full load without injurious heating to the motor.
- 3.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

### 3.6 Stress during bus Transfer:



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- 3.6.1 Motors shall withstand the voltage and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.
- 3.6.2 Motor windings shall be adequately braced to satisfactorily withstand the mech. Stresses during above condition.
- 3.6.3 Motors shall be capable of withstanding heavy in-rush transient current caused by bus transfer without damage.
- 3.6.4 Motor and driven eqpt. Shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

### 3.7 Noise level

The maximum noise level for motors shall be in line with IS 12065.

### 3.8 Vibration

The maximum vibration for motors shall be in line with IS: 12075.

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

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## 4.0 CONSTRUCTIONAL FEATURES

### 4.1 Degree of Protection

- 4.1.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Canopy shall be provided for outdoor motors. CW motors (in case of screen prot. Drip proof) shall conform to degree of protection IP: 23 as per IS: 4691. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.

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


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

### 4.2 Enclosure and Cooling

- 4.2.1 Motors shall generally have totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) enclosures or Closed Air circuit Air (CACA), the method of cooling conforming to IC-0141 or IC-0151 or IC-0161 of IS: 6362 up to 3000 kW motor. CW Motors may be screen protected drip proof (SPDP).

- 4.2.2 Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.



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4.2.3 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

#### 4.3 Class of Insulation

HV/MV/LT motors shall have class F insulation. The temperature rise of all motors shall be limited to the limits applicable to Class 'B' insulation. In case of continuous operation at extreme voltage limits, 10deg C rise above the temperature limits specified in IS: 325 shall be permissible.

#### 4.4 Bearings

4.4.1 Horizontally mounted motors shall have grease lubricated ball/roller or sleeve bearings. For HV/MV motors, the bearings shall be regreasable type and for LV motors, these bearings can be either sealed life lubricated type or regreasable type as per manufacturer's standard.

4.4.2 The vertical motors shall have a combined thrust and guide bearing on top and guide bearing at bottom. If the ball or roller bearings can take vertical thrust, thrust and guide bearing need not be provided.

4.4.3 After taking all motor driven equipment loads and thrust (if any) into account, the bearings shall be suitable for min. 20,000 working hours. Re-greasable bearings shall be provided with grease nipples and relief holes for on-line re-greasing and shall be suitable for 8000 working hours without changing of the grease.

4.4.4 The bearings of solidly coupled motors shall be of the same type as those of the driven equipment.

4.4.5 For motors below 15 kW shall be provided with sealed ZZ bearing.

4.4.6 Motors rated above 1000kW shall be provided with insulated end shield on non-driving end to prevent flow of shaft current.

#### 4.5 Terminals and Terminal Boxes

4.5.1 Motors of rating 90 kW and up to 160kW will be controlled by air circuit breaker with numerical protection. For all motors of rating up to 90kW shall be provided with MCCBs. The terminal box of motors for HV (11 kV), MV (3.3 kV) & LT motors shall be designed for the maximum fault current for a duration of at least 0.25 secs. **11kV & 3.3kV motors terminals shall be able to withstand 44kA for 0.25 seconds.**


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4.5.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.5.3 For HV/MV motors, the main terminal box shall be of phase-segregated type with clamping arrangement for the terminals.

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

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

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- 4.5.6 Motor terminals and terminal leads shall be fully insulated with no bar live parts.
- 4.5.7 Separate terminal boxes shall be provided for space heaters and temp. Indicators. If this is not possible in case of LT motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material for single core cables) with double compression tinned brass glands shall be provided in terminal boxes.
- 4.5.8 Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 180 and 90 degree for HT and LT motors respectively.
- 4.5.9 Cable glands and cable lugs as per selected cable sizes shall be provided in line with cable erection philosophy. For single core cable termination, gland plates shall be of non-magnetic material.
- 4.6 Grounding

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

#### 4.7 General

- 4.7.1 Motors provided for similar drives shall be interchangeable.
- 4.7.2 An arrow block shall be screwed on the body of the motors on the non-driving end to indicate the direction of rotation of the motors.
- 4.7.3 Motors for Fuel oil unloading and drain oil pumps located in hazardous areas shall be with flame-proof enclosures in accordance with IS 2148 / IEC 60079.

a) Fuel oil area: Group - IIB.

b) Hydrogen generation plant area: Group - IIC

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

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#### 5.0 ACCESSORIES

##### 5.1 SPACE HEATERS


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

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

##### 5.2 RESISTANCE TEMPERATURE DETECTORS (RTDs)

- 5.2.1 HV/MV motors stator windings shall be provided with 12 nos. Simplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of winding temperature. The leads from RTDs of each motor shall be brought out to a separate terminal Box.



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

### 5.3 DIAL TYPE TEMP. INDICATORS

5.3.1 For HV/MV motors, each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. The indicators shall have 2 nos. NO contacts rated for 5A, 240 V AC and 0.5 A, 220 V DC for alarm/trip purpose.

### 5.4 Vibration monitoring pads

5.4.1 Provision shall be made in all HV/MV motors for mounting vibration detectors.

### 6.0 NAME PLATE

Motors shall have stainless steel name plate with all particulars as per IS: 325. In addition bearing identification number and type of lubricant is to be indicated.

### 7.0 PAINTING

Motor including fan shall be painted with corrosion proof paints of colour shade Siemens grey (RAL 7032).

### 8.0 TESTING

#### 8.1 Type Tests

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


#### 8.2 Routine Tests

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

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONT ROL CODE	REMA RKS	LOAD No.	VERIFICATI ON FROM MOTOR DATASHEE T (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	Nos						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
<b>SERVICE VESSEL AREA (UNIT -I)</b>																				
AIR BLOWER FOR SERVICE VESSEL (B1a, B1b)	18.5 KW	9.98 KW	S	1	1	D	U	-	I	-	SERVICE VESSEL									
REDUNANDT 230VAC UPS SUPPLY FOR ANALYSER	8 A		S	1	-	E	S	-	C	-	SERVICE VESSEL									
<b>SERVICE VESSEL AREA ( UNIT –II)</b>																				
AIR BLOWER FOR SERVICE VESSEL (B2a, B2b)	18.5 KW	9.98 KW	S	1	1	D	U	-	I	-	SERVICE VESSEL									
REDUNANDT 230VAC UPS SUPPLY FOR ANALYSER	8 A		S	1	-	E	S	-	C	-	SERVICE VESSEL									
<b>REGENERATION AREA</b>																				
AIR BLOWER FOR REGEN. AREA (B3a, B3b)	11 KW	6.42 KW	S	1	1	D	U	-	I	-	REGEN. AREA									
ACID DOSING PUMPS (MT-2a, MT-2b)	2.2 KW	1.4 KW	S	1	1	D	U	-	I	-	REGEN. AREA									
ELECTRIC HEATER FOR HOT WATER TANK (HE01, HE02)	30 KW	30 KW	S	2	-	D	D	-	I	-	REGEN. AREA									
ALKALI METERING PUMPS (MT-1a, MT-1b)	1.1 KW	0.65 KW	S	1	1	D	U	-	I	-	REGEN. AREA									
AGITATOR FOR ALKALI MEASURING TANK (AG-1)	0.37 KW	0.3 KW	S	1	-	D	U	-	I	-	REGEN. AREA									
AGITATOR FOR ALKALI PREP. TANK (AG-2)	0.37 KW	0.3 KW	S	1	-	D	U	-	I	-	REGEN. AREA									
AGITATOR FOR ALKALI MEASURING TANK FOR N. PIT (AG-3)	0.37 KW	0.3 KW	S	1	-	D	U	-	I	-	REGEN. AREA									
<b>Electrical Load Data of CPU Drive (Bidder to adhere the same)</b>																				
<b>NOTES:</b> 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER 2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V : ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)																				
<b>LOAD DATA (ELECTRICAL)</b>	<b>JOB NO.</b>		<b>412</b>		<b>ORIGINATING AGENCY</b>				<b>PEM (ELECTRICAL)</b>											
	<b>PROJECT TITLE</b>		<b>2X660 MW ENNORE SEZ STPP</b>		<b>NAME</b>				<b>DATA FILLED UP ON</b>											
	<b>SYSTEM</b>		<b>CONDENSATE POLISHING UNIT</b>		<b>SIGN.</b>				<b>DATA ENTERED ON</b>											
	<b>DEPTT. / SECTION</b>		<b>MAX</b>		<b>SHEET 1 OF 2</b>		<b>REV. 00</b>		<b>DE'S SIGN. &amp; DATE</b>											



LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONT ROL CODE	REMA RKS	LOAD No.	VERIFICATI ON FROM MOTOR DATASHEE T (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	Nos						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
ALK. TRANS. CUM RECIRCULATION PUMPS(P- 2a, P-2b)	2.2 KW	1.16 KW	S	1	1	D	U	-	I	-	REGEN. AREA									
ACID UNLOADING PUMPS(P4a, P4b)	3.7 KW	2.24 KW	S	1	1	D	U	-	I	-	REGEN. AREA									
ALKALI UNLOADING PUMPS(P3a, P3b)	5.5 KW	2.92 KW	S	1	1	D	U	-	I	-	REGEN. AREA									
DM. WATER REGEN. AND RESIN TRANSFER PUMPS (P- 1a, P-1b)	22 KW	15.13 KW	S	1	1	D	U	-	I	-	REGEN. AREA									
NEUTRALIZED EFFLUENT PUMPS(P5a, P5b)	15 KW	9.55 KW	S	1	1	D	U	-	I	-	REGEN. AREA									
REDUNDANT 230VAC UPS SUPPLY FOR ANALYSER	6 A		S	1	-	E	S	-	C	-	REGEN. AREA									

		<b>BHARAT HEAVY ELECTRICALS LTD</b> PROJECT ENGINEERING MANAGEMENT (MECHANICAL AUXILIARY)
This approval status shall be interpreted as laid down in the contract and it shall not relieve the contractor from the contractual obligation.		
APPROVAL CATEGORY AWARDED = IV		
CAT I - Approved CAT II - Approved With Comments as Noted CAT III- Not Approved CAT IV- Reference Drawing		
Name M.K .Gupta	Signature:	
<small>Digitally signed by mureesh kumar gupta DN: cn=mureesh kumar gupta, o=PEM, ou=PEM, email=mureesh.kumar.gupta@bhel.co.in, c=IN Date: 2018.08.04 09:45:23 +05'30'</small>		

### Electrical Load Data of CPU Drive (Bidder to adhere the same)

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER

2. ABBREVIATIONS : \* VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: \*\* FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTOR CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.	412	ORIGINATING AGENCY		PEM (ELECTRICAL)	
	PROJECT TITLE	2X660 MW ENNORE SEZ STPP	NAME		DATA FILLED UP ON	
	SYSTEM	CONDENSATE POLISHING UNIT	SIGN.		DATA ENTERED ON	
	DEPTT. / SECTION	MAX	SHEET 2 OF 2	REV. 00	DE'S SIGN. & DATE	

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

PACKAGE : CPU

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

PROJECT: 2X660 MW ENNORE STPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling ( max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system  100/ 50 mm FRP cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL  Vendor	BHEL  Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. FRP cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) &	BHEL	BHEL	Refer note no. 4 for electronic earthing



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

PACKAGE : CPU

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

PROJECT: 2X660 MW ENNORE STPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
	lightning protection			
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR( FOR EPC PROJECTS)

PACKAGE : CPU

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

PROJECT: 2X660 MW ENNORE STPP

3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.



REV: 00 DATE:

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

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

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





[illegible]



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

**SPECIFICATION NO. PE-TS-412-155A-A001**

**SECTION : I**

**TECHNICAL SPECIFICATION FOR CONDENSATE  
POLISHING UNIT**

**SUB-SECTION: IC**

**REV. NO. 00**

**DATE :**

**SECTION – I**  
**SPECIFIC TECHNICAL REQUIREMENTS**  
**SUB-SECTION IC - Specific Technical Requirements (C&I)**



	<b>2X660 MW ENNORE STPP</b>	
	<b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)</b>	
<ol style="list-style-type: none"> <li>1. The control of CPU shall be DDCMIS based which shall be in BHEL's scope. DDCMIS panels, OWS, Local control panel, GIU, UPS, Printers shall be provided by BHEL.</li> <li>2. The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire CPU. The requirements given are to be read in conjunction with detailed technical specification enclosed in the specification. Further in case of any discrepancy in the requirement noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per BHEL's interpretation shall be complied by the bidder during contract stage without any commercial implication to BHEL.</li> <li>3. The instrumentation to be provided for CPU shall be as per the technical specification document / drawings wherever provided for the respective systems as a minimum requirement for bidding purpose. However for completeness of the system and its associated equipment, Bidder shall also provide all the necessary instruments to the process requirement even if not indicated in the given technical Specification document /drawings. During detail engineering if any additional instruments are required for safe &amp; reliable operation of plant, bidder shall supply the same without any technical, commercial and delivery implication to BHEL.</li> <li>4. The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable.</li> <li>5. All the instruments/equipment/electrical items shall be provided &amp; designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply.</li> <li>6. All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified and an anticorrosive paint shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange shall also be included wherever required with the field instruments.</li> </ol>		

	<b>2X660 MW ENNORE STPP</b>	
	<b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)</b>	
<p>7. The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg / Cm<sup>2</sup>.</p> <p>8. All the instruments/drives shall be terminated on JB's in field. JB's shall be in Bidder's scope. Bidder to consider minimum 10 nos. of JB's.</p> <p>9. All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. The same shall be in Bidder's scope. All transmitters shall be HART compatible.</p> <p>10. All the instruments indicated in P&amp;ID are minimum requirement and it is mandatory to use sensors/signals/measurements with 2 out of 3 logic for critical control &amp; protection (Analog &amp; Binary). Application/service and sensors with 1 out of 2 logic for all other control &amp; interlock (Analog &amp; Binary) application/service. Dual sensors shall be provided for instruments required for auto starting of LT driven pumps or LT driven pump tripping due to very low level of water/discharge pressure very low. Dual measurement shall be employed for the measurements used for analog control functions.</p> <p>11. All the instruments/ sensors/transmitters/switches meant for redundant applications shall have completely separate and independent impulse pipes/ root valves etc. No redundant instrument shall share a single process tapping. There will be separate and independent tapping for every individual instrument.</p> <p>12. RTD's shall be of duplex type. Temperature transmitters are envisaged for RTD for monitoring services/application only.</p> <p>13. Instrument installation shall be as per the attached Instrument Installation Drawing.</p> <p>14. All motorised valves of 200NB or more than 200NB size shall be provided with integral motorized bypass valves on all process lines.</p> <p>15. All motorised actuator shall be provided with conventional actuators with integral starter for ON/OFF valves. Non-contact type electronic 2- wire</p>		



	<b>2X660 MW ENNORE STPP</b>	
	<b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)</b>	
<p>position transmitters shall be provided for all inching type motorised valves. The detailed specification is attached elsewhere in the specification.</p> <p>16. Valve end position (Open &amp; Close) shall be monitored for the manual critical valves, wherever provided.</p> <p>17. Bidder to comply with codes and standards as mentioned in the specification.</p> <p>18. Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system.</p> <p>19. All approval/Inspection are to be carried out by Owner or owner appointed agency only.</p> <p>20. Bidder shall provide erection hardware as per installation drawings.</p> <p>21. Bidder to provide mandatory spares as per mandatory spares list attached elsewhere in the specification.</p> <p>22. Bidder to perform tests of C&amp;I items/instruments/systems as per Quality plans/type test attached in the specification.</p> <p>23. Power Supply Requirement: Power supply for instruments, analysers etc. shall be provided at a single point which shall be decided during detail engineering. Further any electrical distribution shall be in bidder's scope. Any other voltage requirement for instruments, analysers etc. to be arranged/derived by bidder by providing suitable control transformer.</p> <p>24. All cables terminated in the terminal block, power distribution scheme instruments shall be ferruled. Ferruling shall be double cross ferruling (i.e.) so source and destination addresses shall be marked on both sides of the tube ferruling.</p> <p>25. Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable &amp; Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification.</p> <p>26. Each pneumatic device requiring air supply and intended for field mounting shall include a filter regulator air set with gauge, to owner's approval.</p> <p>27. Bidder's presence is required for 3 Man days (Excluding travel time) at EDN Bangalore during FAT of DDCMIS for certifying correctness &amp; completeness of implementation of Control logic. Intimation to attained FAT shall be informed</p>		

	<b>2X660 MW ENNORE STPP</b>	
	<b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)</b>	
<p>in 2 days advance. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.</p> <p>28. Contractor's C&amp;I representative shall be present at BHEL-PEM for 3 man-days, for preparation of Control scheme of CPU. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.</p> <p>29. Bidder's presence is required for 15 Man days (in three visit) at site during commissioning of DDCMIS for assistance related to process correctness. Three visit with total 15 Man days (Excluding travel time) in which one visit shall be of 5 Man days each. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.</p> <p>30. Bidder to ensure participation of their senior personnel and experts in discussions with Owners and other equipment bidders during various stages of contract implementation as required by the Owner.</p>		



## CUSTOMER SPECIFICATION REQUIREMENT

Open and Close limit switch feed backs of valves are to be connected to DCS for remote viewing and for interlocks and protection.

Remote and local indications of various parameters to the process requirement shall be provided. ( The same can be decided during detailed engineering)

The instruments shall be offered as per the process requirement for complete auto operation.

Necessary instruments pressure gauges, Temperature gauges, DP instruments, Pressure transmitters, Radar Level transmitters, Differential pressure transmitters, Temperature Elements Various analysers, Magnetic type level indicators, shall be provided. The junction boxes and instruments / electronics housing used shall be Non – corrosive material.

Flow transmitters for each stream of CPU are to be provided for monitoring the performance and accountability

The bidder shall furnish required list and type of instruments during detail



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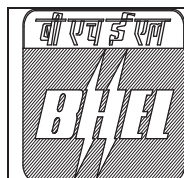
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engineering subject to the approval of owner.

Pneumatic actuators with all accessories shall be controlled using solenoid valves, which shall be energized from OWS / Control Panel. The opening and closing of these valves is based on system requirement, which is programmed in the Control system. Feed backs to the control system regarding the valve open / close position are set through the limit switches.

- 1.A panel mounted cation conductivity indicator shall be interlocked to prevent advancing of the automatic sequence until the rinse down is complete.
- 2.A differential pressure switch installed between the influent and effluent headers shall on a high signal cause an annunciator alarm.
- 3.Panel mounted cation conductivity indicators shall be provided to monitor the polishing system influent and effluent streams as well as the discharge of each service vessel.
- 4.On Plant DDCMIS failure, it shall be possible to operate the valves by means of manual operation of solenoid valves also.



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## **SECTION – II**

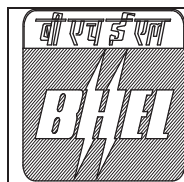
### **GENERAL TECHNICAL REQUIREMENTS**

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

**SUB-SECTION IIB - GENERAL TECHNICAL REQUIREMENTS (ELECTRICAL)**

**SUB-SECTION IIC - GENERAL TECHNICAL REQUIREMENTS (C & I)**





**TITLE :**  
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**TECHNICAL SPECIFICATION FOR CONDENSATE  
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 A001**

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**SUB-SECTION : IIA**


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## **SECTION – II**

### **GENERAL TECHNICAL REQUIREMENTS**

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

	<b>TITLE:</b> <b>2X 660 MW ENNORE SEZ STPP</b>	SPECIFICATION NO. PE-TS-412-155A-A001
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## TECHNICAL SPECIFICATION FOR PRESSURE & STORAGE VESSEL

	TITLE: <b>2X 660 MW ENNORE SEZ STPP</b>	SPECIFICATION NO. PE-TS-412-155A-A001
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	<b>TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT</b>	SUB-SECTION - II A
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## 1.00.00 GENERAL

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

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

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

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


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

## 2.00.00 GENERAL DESIGN FEATURES


### 2.01.00 Design

2.01.01 Design of all pressure vessels shall conform to ASME Section VIII or acceptable equivalent international standard. Design pressure shall be the maximum expected pressure to which the vessels may be subjected to plus 10% additional margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pumps suction if any. Design pressure of condensate service vessels is indicated elsewhere in this specification. For all other pressure vessels, design pressure shall be at least 10 Kg/cm<sup>2</sup> (g).



	TITLE: <b>2X 660 MW ENNORE SEZ STPP</b>	SPECIFICATION NO. PE-TS-412-155A-A001
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- 2.01.02 Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and other chemicals shall conform to IS: 803.
- 2.01.03 Design of all horizontal cylindrical atmospheric storage tank containing water, acid, alkali and other chemicals shall conform to BS: 2594.
- 2.01.04 Design temperature of all pressure vessels and storage tanks shall be 10 deg. C higher than the maximum temperature that any part of the vessel/tank is likely to attain during operation.
- 2.01.05 In case, tank is subjected to vacuum; the same shall be taken care in designing the tank.
- 2.01.06 The design of Demineralised water storage tanks (Vertical type) shall conform to IS: 803. Supporting frame where required shall be in accordance with IS: 800. The tank shall be "Non-pressure" fixed roof type with atmospheric vents.
- 2.02.00 All vessels / tanks without inside rubber lining shall have a corrosion allowance of minimum 2 mm and mill allowance (minimum 0.3 mm) for shell and dished ends. Thinning allowance of 2 mm (minimum) shall be considered for dished end. Vessel / tanks ends shall be of dished design and constructed by forging, pressing or spinning process. Conical or flat ends shall not be accepted. All dished ends shall be stress relieved.
- 2.03.00 All the atmospheric tanks shall have sufficient free board above the "Level High"/"Normal Level" as the case may be. The overflow level shall be kept at least 20 cm or 10% of vessel height above the "Level High"/"Normal Level" for all the tanks except for the DM tanks for which a minimum height of 300 mm shall be provided over the "High Level". Further, a minimum 300 mm free board shall be provided above the top of overflow level to the top of the tank. Wall thickness of atmospheric tanks shall not be less than 6 mm.
- 2.04.00 Vessels coming under preview of IBR shall be designed accordingly.
- 2.05.00 Interior surfaces of all tanks shall be clear of stiffeners and other structural supports. Tanks shall be reinforced and stiffened externally as required.
- 2.06.00 All welds on inner tank surface shall be free of voids, gaps craters, pits, high spots, sharp edges, abrupt ridges and valleys or undercut edges. High spots, irregularities and sharp edges shall be removed by grinding. Inside weld seams shall be ground flush and smooth applicable for corrosion resistant coating or lining.
- 2.07.00 All internal baffles, wear plates, pipes etc. shall be continuously welded on both sides at all contact points with full fillet welds which shall be free of voids, gaps, craters, high spots, sharp edges, and undercutting. Sharp edges shall be ground to a 3 mm minimum radius.
- 2.08.00 Weld splatter shall be removed.
- 2.09.00 All welding shall be performed by ASME qualified welders under Section-IX of ASME Boiler and Pressure Vessel code and welding electrodes shall be as per relevant Codes/Standards viz. AISC Section 1.17 etc.
- 2.10.00 The plates for cylindrical tanks shall be accurately formed in bending rolls to the diameters called for, and the completed shells be concentric and plump. Plates shall be cold-rolled by plate bending machine in a number of passes to true curvature and joined by welding.
- 2.11.00 Vessels seam shall be so positioned that they do not pass through vessel connections.

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### 3.00.00 MATERIAL OF CONSTRUCTION

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

### 4.00.00 APPURTENANCES

#### 4.01.00 Manholes

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

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

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

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

#### 4.01.05 Sight Glasses

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

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

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

#### 4.02.00 Lifting Lungs

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


#### 4.03.00 Vessels Supports

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

#### 4.04.00 Vessel Internals

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

Specification requirements for vessel internals are as follows:

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#### 4.05.00 **Inlet water and Regenerant Distributors**

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

#### 4.06.00 **Underdrains**

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

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

#### 4.08.00 **Internal Fasteners**

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

#### 4.09.00 **Piping Connections**

All lined vessel connections and connections in unlined vessels 25 NB and larger shall be to ANSI 300 lb class. Flat face flanges shall be used throughout. Nozzle material shall be ASTM-A106. Grade B. schedule 80 pipe. All flanged connections shall be supplied complete with matching counter flanges, nuts, bolts and full-face gaskets.

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

#### 4.11.00 **Resin Traps**

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

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


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

### 5.00.00 **SPECIFIC DETAILS**

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

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



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

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

#### 5.02.00 **Atmospheric Tanks**

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

#### 5.03.00 **Resin Injection Hopper**

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

##### a) **Capacity**

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

##### b) **Material**

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

#### 5.04.00 **Chemical preparation and day tanks**

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

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


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

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

#### 5.05.00 **LINING**

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

##### 5.05.01 **Hardness**

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

#### 5.05.02 **Chemical Resistance**

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

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

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

#### 5.05.03 **Thickness**

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


#### 5.05.04 **Surface Preparation**

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

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

#### 5.05.05 **Protection**

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

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

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

Example:

“Warning – Tank is lined”

“Do not weld or Burn”

“Do not Store in Direct Sunlight” etc.


## 6.00.00

### CODES AND STANDARDS

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

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



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

o) ASTM - American Society for Testing and Materials.

#### **7.00.00 FABRICATION**

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

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

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

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

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

#### **7.06.00 Tank Connections**

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

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


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

7.06.04 Gaskets shall be of full face type.

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

#### **7.07.00 Vessels Supporting Lifting Lugs**

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

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

## CHAPTER 13

### 13.0 LP PIPING, VALVES & SPECIALITIES

#### 13.1 Equipment sizing Criteria

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

##### a) Water Application

		Water Velocity in m/sec		
	Pipe Size	Below 50 mm	50-150 mm	200 mm & above
a)	Pump suction	-----	1.2-1.5	1.2-1.8
b)	Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5
c)	Header	----	1.5-2.4	2.1-2.4

The pipes in CW, ACW & DMCW system shall be designed to maintain a maximum velocity of 2 m/s inside the pipelines at pump discharge.

Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.

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

i)	Carbon steel pipe	100
ii)	CI Pipe/Ductile Iron	100
iii)	Rubber lined steel pipe	120
iv)	Stainless steel pipe	100

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

##### b) Compressed Air Application



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

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

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

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

- 13.1.14 Recirculation pipes alongwith valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30% design

flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.

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

## **13.2.00 TECHNICAL SPECIFICATION**

### **13.1.00 GENERAL**

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

### **13.2.00 Pipes and fittings**

13.2.1 All low pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness as adhered to. The bidder shall furnish the pipe sizing / thickness calculation as per the criteria mentioned above under LP piping equipment sizing criteria of this Technical Specification.

13.2.2 Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.

13.2.3 Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the contractor and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localized bending stresses.

13.2.4 Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M).

13.2.5 Wherever Bidder's piping coming under this specification, terminates at an equipments or terminal point not included in this specification, the reaction and the thermal movement imposed by bidder's piping on equipment terminal point shall be within limits to be approved by the Employer.

13.2.6 The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/expansion joint etc. shall be provided as may be necessary depending on layout.

13.2.7 Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.

- 13.2.8 For rubber lined ERW pipes, beads shall be removed.
- 13.2.9 Inspection holes shall be provided at suitable locations for pipes 800 NB and above as required for periodic observations and inspection purposes.
- 13.2.10 At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.
- 13.2.11 For large size pipes/duct, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1:8. Requirement shall be decided as per relevant code.

Transient analysis / surge analysis wherever specified and required shall be conducted in order to determine the location, number and size of the Air-Release valve on certain long distance/high volume piping systems such as CW/ ACW/ Raw Water etc.

### **13.3.00 Material**

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

1.	Circulating Water (CW) – CW Pumphouse to Condenser & Condenser to Cooling Tower	RCC DUCT WITH INSIDE PROTECTIVE COATING AS INDICATED IN VOLUME VI
2.	Circulating Water (CW) – Pump Discharge, condenser risers including header near condenser and cooling tower riser.	IS 3589 FABRICATED FROM IS 2062 PLATES –INTERNALLY LINED WITH CORROCOAT OR POLYUREA COATING OF 1500 MICRONS DFT /GRP/ FRP
3.	ACW	UPTO 150 NB - ASTM A 312 TP 316 L (ERW)/ DUPLEX SS 200 NB & ABOVE - ERW IS 1978 (OR) API5L (OR) IS 3589 FABRICATED FROM IS 2062- Internally lined with Corrocoat or polyureA Coating inside of 1500 microns DFT
4.	RO Stage I reject, RO Stage II	UPTO 150 NB - ASTM A 312 TP 316



	Reject, Guard pond inlet & discharge, Piping from Reject sump,. Ash water piping using sea water and all other sea water applications.	L (ERW)/ DUPLEX SS 200 NB & ABOVE - ERW IS 1978 (OR) API5L (OR) IS 3589 FABRICATED FROM IS 2062-Internally lined with Corrocoat or polyureA Coating inside of 1500 microns DFT/ GRP/ FRP
5.	Sea Water Intake Pipe, CT Make up, Make up upto clarifier & CT Blowdown Pipe	GRP
6.	RO Stage I Permeate, Filtered Water, service water, AHP Seal Water, HVAC Make up, Air Pre-Heater Wash water, Passivated DM Water and clarifier sludge.	IS-2062 Gr. B/ASTM-A-36/ASTM A-53 type 'E' Gr. B/IS-3589 Gr. 410/IS-1239 Heavy. 150 NB & above pipes shall be spiral welded.
7.	RO Stage II Permeate, Dematerialized water, (condenser Make up water, Boiler fill and Deaerator Fill water) & DMCW overhead tank make-up water	Stainless steel to ASTM A-312, Gr. 304 welded for sizes above 50mm NB  Stainless steel to ASTM A312, Gr. 304 sch. 40 Seamless for sizes 50 mm and below
8.	Drinking water	ASTM A-53 type E Gr. B galvanized /IS 1239 heavy galvanized/IS 3589 Gr 410 Galvanized to SI-4736 or equivalent.
9.	Instrument air & plant air.	ASTM A-53 type E Gr. B galvanized /IS 1239 heavy galvanized/IS 3589 Gr 410 Galvanized to SI-4736 or equivalent.
10.	Fuel Oil piping	API5L
11.	HOSES FOR HFO TANKER HEATING (STEAM/ CONDENSATE)	CARBON STEEL – ELECTRO ZINC PLATED
12.	FUEL OIL UNLOADING LINES	IS1239 / IS1978 / API5L Gr.B (ERW) / IS3589 FABRICATED FROM IS 2062 PLATES
13.	FUEL OIL PUMP DISCHARGE LINES	ASTM A 106 GR B
14.	UF Feed/ Chemical Backwash (Upto 150 NB) (Pipes & Fittings)	CPVC ON 10 Sch 40
15.	UF Feed/ Chemical Backwash (> 150 NB)	GRP
16.	Sodium Hypochlorite (pipes & Fittings)	CPVC Sch 80 ASTM
17.	RO High pressuer Discharge (Pipes & Fittings)	Dupless SS
18.	Cleaning Solution Line (Pipes & Fittings)	CPVC ON 10 Sch 40

## 13.3.7

In water lines, pipes upto 150 mm NB shall conform to ANSI B36.10/ASTM-A-53, Type-E Gr. B/IS:1239 Gr. Heavy and minimum selected thickness shall not be

less than IS: 1239 Grade heavy except for dematerialized water and condensate spill lines.

- 13.3.9 Pipes of above 150 mm NB shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589 Gr. 410. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr. B/ASTM-A-36. However, larger pipes, i.e. 1000 mm NB and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr. B and shall meet the requirements of AWWA-M-11(for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/ surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be).
- 13.3.10 In dematerialized water service, the pipes upto 50 NB shall be of stainless steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipes shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65 mm NB upto and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness.
- 13.3.11 Bidder/Contractor shall note that pipes offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.
- 13.3.12 Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410/IS: 1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanized to IS 4736 or any equivalent internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B/IS: 3589, Gr. 410/IS: 1239 Gr. Heavy. The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanized).
- 13.3.13 Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses.
- 13.3.14 Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.
- 13.3.15 If carbon steel plates of thickness more than 12 mm are used for manufacture of pipes, fittings and other appurtenances, then the same shall be control-cooled or normalized as the case may be following the guidelines of the governing code.

#### **13.4.0 Piping Wall Thickness**

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

NB mm (inch)	15 (1/2)	30 (3/4)	25 (1)	32 (1¼)	40 (1.5)	50 (2)	65 (2.5)	80 (3)	100 (4)	125 (5)
Min. thickness, mm	3.2	3.2	3.6	3.6	3.6	3.6	3.6	4.0	4.5	5.4
NB mm (inch)	150 (6)	200 (8)	250 (10)	300 (12)	350 (14)	400 (16)	450 (18)	500 (20)	600 (24)	
Min. thickness, mm	5.4	6.35	6.35	6.35	7.1	7.1	7.1	8.0	8.0	

> NB 600 mm to NB 900 mm	-	8.0 mm
> NB 900 mm to NB 1200 mm	-	10.0 mm
> NB 1200 mm to 1400 mm	-	12.0 mm
> NB 1400 mm to 1600 mm	-	14.0 mm
> NB 1600 mm to NB 2200 mm	-	16.0 mm
> NB 2200 mm	-	18.0 mm

### 13.5.00 Piping Layout

- 13.5.1 Piping shall be grouped together where practicable and routed to present a neat appearance.
- 13.5.2 Piping routing shall be such as to provide sufficient clearance for removal and maintenance of equipment, easy access to valves, instruments and other accessories. The piping shall not encroach on the withdrawal space of various equipments.
- 13.5.3 Over head piping shall have a normal minimum vertical clearance of 2.5 meters above walkways and working areas and 8 m above roadways/railways. When several pipelines are laid parallel, flanged joints must be staggered. Welded and flanged joints should as far as possible be located at one third span from supports. If the support is situated right under the welded joints this joint must be reinforced with a strap. Flanged and welded joints must be avoided in the middle of the span. Valves should be located in such a manner so as to ensure their convenient operation from the floor or the nearest platform.
- 13.5.4 Pipelines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run-pipe and submit to Employer for approval.
- 13.5.5 All piping shall be routed so as to avoid interference with other pipes and their hangers and supports, electrical cable trays, ventilation ducting, structural members, equipment etc.
- 13.5.6 Adequate clearance shall be ensured with respect to the above to accommodate insulation and pipe movements, if any.
- 13.5.7 Piping shall generally be routed above ground but where specifically indicated / approved by the project Manager the pipes may be arranged in trenches or buried. Pipes at working temperature above the ambient shall however not be buried.

- 13.5.8 Sufficient up stream and down stream lengths shall be provided for flow measuring devices, control valves and other specialties.
- 13.5.9 All local instruments shall be located on pipelines as to render them observable from the nearest available platforms.
- 13.5.10 Openings provided in the wall for pipelines must be closed with bricks and mortar with 10-12 mm clearance between brick work and pipe after taking care of insulation and thermal movement, if any. The clear space must be filled with felt or asbestos or approved filling compound.

#### **13.6.00 Slope/Drains and Vents**

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

#### **13.7.0 Pipe Joints**

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

##### **13.7.1 Screwed**

- (a) Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT/IS:554 unless specified otherwise.
- (b) Galvanized pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanized pipes shall not be joined by welding. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanized, or in case match pipes an fittings are already galvanized before the above mentioned fabrication then



suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & out side) after welding with zinc rich electrode, alongwith the nascent threaded metal portion at both free ends given the same application of Zinc Silicate paste. Alternatively flanged jointing may be employed for pipe sizes 100 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydro test.

- (c) Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately.
- (d) For pipe sizes from 350 mm NB to 550 mm NB (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanized. Any site welding done on galvanized pipes shall be done with zinc-rich special electrodes and the welded surfaces whether inside or outside shall be coated with zinc-silicate pasts. Seal welding of flanges with zinc-rich electrode will be permitted only when any flange is leak-prone during hydro testing.
- (e) For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection (with zinc-rich special electrodes) followed by application of zinc silicate coating at welded surfaces both inside and outside the pipe, except for the last blank/blind flange, or, equipment connection where application of zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.

### **13.7.2 Welded**

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

### **13.7.3 Flanged**

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

### **13.8.00 Bends/elbows/mitre bends/Tees/Reducers & other fittings**

- 13.8.1 Unless otherwise specified elbows shall be of long radius type.
- 13.8.2 For pipe sizes up to 65 Nb, long radius forged elbows or seamless pipe bends shall be used. Pipe bends, if used, shall be cold bent to a radius measured to the centre line of pipe of 3 to 5 times the pipe diameter.
- 13.8.3 For steel pipes 80 Nb and above, seamless long radius forged elbows shall be used. For pipe size 250 Nb and above mitre bends may be used for all pipes except rubber lined pipes. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. Bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.
- 13.8.4 Mitre bends are not acceptable in case of rubber lined mild steel pipes.
- 13.8.5 For pipe fittings such as reducers and tees, the material shall be to ASTM-A-234 gr. WPB up to 300 NB. For pipe reducers and tees above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fittings shall conform to the dimensional standard of ANSI B-16.9.
- However, for pipes up to 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.
- For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.
- 13.8.6 Stainless steel fittings shall conform to either ASTM-A-182, Gr. 304 (316 for Sea water application, if any) or ASTM-A-403, Gr. WP 304 (316 for Sea Water application, if any) Class-S, for sizes up to and including 50 mm NB, i.e. the fitting shall be of seamless construction.
- However, for stainless steel fittings above 50mm NB, the same shall conform to ASTM-A-403, Gr. WP 304 (316 for Sea water application, if any), Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.
- 13.8.7 In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.
- 13.9.00 Flanges**
- 13.9.1 Flanges shall be slip on type. Welding of flanges in tension is not permitted.
- 13.9.2 All flanges and flanged drilling shall be to ANSI B 16.5/BS EN-1092 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 (316 for Sea water application, if any) or equivalent. For all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water (Sea water) etc flanges & bolts & nuts shall be SS 316 L construction.
- 13.10.00 Specific technical requirement of laying buried pipe with anti corrosive treatment**

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

#### **13.10.1 Trenching**

- (a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822.
- (b) Free access shall be provided for the welding of the circumferential joints by increasing the width and depth of the trench at these points. There should be no obstruction to the welder from any side so that good welded joint is obtained.
- (c) The free working space shall conform to IS: 5822. The trench shall be excavated so as to provide minimum cover of 1000 mm between the top of the pipe and finished grade.
- (d) Prior to lowering and laying pipe in any trench, the bidder shall backfill and compact the bottom of the trench or excavation in accordance with IS: 5822 to provide an acceptable bed for placing the pipe.
- (e) Coating and Wrapping shall be done as under.

#### **13.10.2 Preparation and cleaning of piping**

- (a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Kerosene will not be permitted for cleaning. This cleaning operation shall be immediately followed by priming with the mechanical priming machine.
- (b) Certain inaccessible portions of the pipeline (which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager.
- (c) The cleaning and priming operation shall be carried out at site. The entire pipe length shall be cleaned but the ends of the pipes shall be left without coating for a distance of 230 mm for joints, which shall be coating manually at site after laying, welding and testing the pipe.

#### **13.10.4 Trench bed preparation and back filling**

Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS: 5822.

#### **13.10.5 Laying of galvanized steel (GI) pipes**

All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before

jointing Threaded portion on either side of the socket joints shall be applied with Zinc silicate paste.

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

### **13.11.00 Cleaning and Flushing**

13.11.1 All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.

13.11.2 Before erection all pipe work, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done in such a manner that the coating on MS pipe is not affected.

13.11.3 After erection, all water lines shall be 1.2-1.5 times the operating velocities in the pipelines.

13.11.4 All compressed air pipe work shall be cleaned by blowing compressed air.

### **13.12.00 Painting of Pipes**

#### **13.12.1 Buried Piping**

##### **Internal surfaces**

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

The total dry film thickness of 150 microns.

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

##### **External surfaces**

- (i) Surface cleaning by Sand Blasting.
- (ii) Coal tar primer compatible with coal tar enamel grade. The number of coats shall be two with a DFT of 35 microns each.
- (iii) Coal tar enamel shall be applied. A single spiral inner wrap of glass fibre tissues shall be applied overlapping at least 25 mm ensuring impregnation of glass fibre tissues in the first coat. The second coat of enamel and second outer wrap of glass fibre felt, Type – I to IS: 7193-1974 will be applied in the same way confirming to Table – 10 of IS – 10221 – 1982.



The total thickness of the coating will not be less than 4.0 mm

- (iv) Alternatively Wrapping with coal tar based anticorrosion tape conforming to IS 15337: 2003 is also acceptable in lieu of s.no. (iii) above. Wrapping thickness shall be 4.0 mm.

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

### **13.12.2 Overground Piping**

#### **Internal surfaces**

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

The total dry film thickness of 150 microns.

#### **External surfaces**

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

### **13.12.3 Other requirements**

- (a) Paint manufacturers instructions shall be followed in method of application, handling, drying time etc.
- (b) The color of the finish paint shall be as per approved color-coding.
- (c) If finish paint was applied in shop, one coat of finish paint shall be applied at site.
- (d) The dry film thickness of paint shall not be less than 0.15 mm.

### **13.12.4 Color code for identification**

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

### **13.13.00 Specification for hangers and supports**

13.13.1 All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.

13.13.2 While designing supports for rubber lined pipes special consideration should be given. Any kind of welding on these pipes is not allowed after rubber lining.

- 13.13.3 Hanger for piping 65 mm Nb and larger and all spring support assemblies regardless of size shall be completely engineered in conformance with the provisions of power piping code ANSI B 31.1.
- 13.13.4 Hangers, saddles, supports etc. shall be fabricated from plates/pipes sections conforming to ASTM A 53/IS: 2062/IS:226/ or equivalent. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. The structural steel work shall be as per IS: 800/BS:4360. Insulation protection saddles shall be used at support point of all insulated piping.
- 13.13.5 The support shall be so interspaced as to minimize sagging of the pipes and to keep them within permissible limits where pipes are full with the conveying media.
- 13.13.6 The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.
- 13.13.7 All pipe supports shall be designed to provide an absolute minimum head room of 2.5 m from floor in passages/walkways.
- 13.13.8 At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.
- 13.13.9 All components of hangers/support shall be provided with two coats of primer (red oxide paint) at shop before dispatch to site. After erection they shall be given finish coat of Long Oil Synthetic enamel to IS: 2932 of total DFT 100 to 140 microns. CLH & VLH will be primed with Epoxy Zinc rich primer of 50 micron followed by finish painting of Aliphatic Acrylic Polyurethane or equivalent of DFT 65 microns.
- 13.14.00 Design/Construction/Material Particulars of Gate/Globe/Check Valves/Globe Stop Valve/Butterfly Valve**
- 13.14.1 GENERAL**
- (a) All valves shall be suitable for the service conditions i.e. flow, temperature and pressure, at which they are required to operate.
  - (b) The valves as well as all accessories shall be designed for easy disassembly and maintenance.
  - (c) Valves to be installed outside shall be required to have the stem properly protected against atmospheric corrosion.
  - (d) All rising stem valves shall be provided with back seat to permit repacking (of glands) with valves in operation. All valves shall preferably be of outside screw and yoke type.
  - (e) All valves shall be closed by rotating the hand wheel in the clockwise direction when looking at the face of the hand wheel. In case where the hand wheel is not directly attached to the valve spindle suitable gearing shall be introduced.
  - (f) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined.
  - (g) Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a

minimum of maintenance is required. For valves of size 350 mm and above either bevel or spur gearing shall be provided to facilitate manual operation.

- (h) The valves coming in vacuum lines shall be of extended gland type and / or water sealed.
- (i) The actuator-operated valves shall be designed on the basis of the following:
  - (1) The internal parts shall be suitable to support the pressure caused by the actuators.
  - (2) The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc.
  - (3) All actuator-operated valves shall be provided with hand operated gearing mechanism also.
  - (4) All actuators operated valves shall open/close fully within time required by the process.
- (j) Valves coming under the purview of IBR shall meet IBR requirements.
- (k) Gate/slucice valves shall be used for isolation of flow. Gate valves shall be provided with the following accessories in addition to other standard items:
  - (1) Hand wheel
  - (2) Position indicator (for above 50 mm NB valve size)
  - (3) Draining arrangement wherever required.
- (l) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction.
- (m) Check valves shall be used for non-return service. They shall be swing check type or double door (Dual plate) check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate check valves are preferable for its spring controlled opening/closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600 mm NB.
- (n) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing.
- (o) All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form an integral part of the valve. Stop-gap arrangement in this respect is not acceptable.
- (p) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.

- (q) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer.
- (r) All valves except those with rising stems shall be provided with continuous mechanical position indicator; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.
- (s) For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS-1538 for fitting shall be applicable.

### 13.14.2 VALVE BODY MATERIAL

Valve body material for various services shall be as follows:

Valve body material for water application like DM Cooling Water (Passivated DM Water) (DMCW), RO Stage I Permeate, AHP Seal Water, APH/ ESP Wash, Service Water, Potable Water, HVAC Make UP shall be cast iron for sizes 65 NB and above; gun-metal/ Forged Carbon Steel for sizes 50 NB and below.

Valve body material for sea water application like Circulating Water. Auxiliary Cooling water, Blowdown, CT make up, sea water Intake, Guard pond inlet & Discharge, Ash Water using sea water, RO Stage II reject, RO Stage I reject, Reject Sump discharge and all other sea water applications shall be SS 316 L for all sizes.

For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.

DM water: SS body and disc alongwith SS internals.

Condensate: Cast Carbon Steel/Forged Carbon Steel.

- 13.14.2.1 The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.

#### Standards and Codes

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



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

#### **13.14.2.2 End Connections**

The end connections, shall comply with the following:

Socket welding (SW) – ANSI B 16.11

Butt Welding (BW) – ANSI B 16.25

Threaded (SC) – ANSI B 2.1

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

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

**13.15.00 Check Valves**

13.15.1 Check valves shall comply with the following characteristics:

- (a) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal);
- (b) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position.
- (c) In the case of swing check valves, the body seat shall be inclined at such an angle from the vertical as will facilitate closing and prevent chatter.

13.15.2 Drilling on flanges of flanged valves must correspond to the drilling on flanges of the piping system on which the valves are to be installed.

13.15.3 All flanged valves intended for installation in steel piping systems shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class.

13.15.4 Counter flanges to be installed on air pipes shall be screwed-on type irrespective of size.

**13.16.00 Globe Valves**

13.16.1 The globe valves shall have the following characteristics;

Straight conveyed flow

Right angle

Preferably, the valves shall be of the vertical stem type.

13.16.2 Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle.

13.16.3 The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened.

13.16.4 For the regulating valves, valves with regulating plug & parabolic outline disc type is preferred.

13.16.5 All motorized globe valves with regulating plug for which indication of percentage (%) opening are required in the control room shall be provided with necessary position transmitter.

**13.17.00 Gate valves**

All gate valves shall be of the full-way type, and when in the full open position the bore of the valve shall not be constricted by any part of the gate.

Gate valves shall be of the solid/elastic or articulated wedge disc and rising stem type.

### **13.18.00 Air Release Valve**

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

### **13.19.00 Butterfly Valves**

#### **13.19.1 Design/Construction**

- (a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or any other approved equivalent standard latest edition. Fabricated steel (IS: 2062 GR. B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm nb diameter. In such a case, however, the bidder will have to necessarily submit thickness calculations, in order to establish the integrity of the fabricated valve body under the system operating pressure condition.
  - (1) The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However for sizes 600 NB and below the valves of Wafer construction are also acceptable.
  - (2) The seals, both on the body (sleeve) and on the disc shall be of the material specified. Necessary shaft seal shall be provided and adequately designed to ensure no leakage across the seal. This seal shall be designed so that they will allow replacement without removal of the valve shaft. The sealing ring on the disk shall be continuous type and easily replaceable.
  - (3) For all types of valves, the design with shaft eccentric to the disc is preferred. The shaft shall be solid type and shall pivot on bushings. Bushings/sleeve type bearings shall be contained in the hub of valve body. The bearing shall be self-lubricated type with low coefficient of friction and should not have any harmful effect on water and on valve components.
  - (4) The design of the shaft shall be such that it will safely sustain maximum differential pressure across the closed valve. The shaft

and any key (taper pin etc.) for transmitting the torque between shaft and disc shall be capable of withstanding the maximum torque required to operate the valve. However, the shaft diameter shall not be less than the minimum shaft diameter specified in relevant code. Necessary Torque Calculation and the torque class selected on the basis of the same shall be furnished to the Employer for information.

- (5) The disc shall rotate from the full open to the tight shut position. The disc shall be contoured to ensure the least possible resistance to flow and shall be suitable for throttling operation. While the disc is in the throttled position, valve shall not create any noise or vibration.

- (6) The operating mechanism shall be mounted directly on or supported from the valve body.

- (7) All valves shall be complete with:

Position indicator (located in a visible place)

Arrow indicating the flow direction;

Adjustable mechanical stop limiting devices to prevent over

Travel of valve disc in open/close position.

All valves shall be "tight shut off"

- (8) Hand operated valves shall have the following

Local hand controls

The hand controls shall close the valve with clockwise rotation.

The hand controls shall be dimensioned to guarantee an easy maneuver under most severe conditions.

The hand controls shall be provided with locking systems suitable to avoid the disc assuming a non-desirable position during the operation.

Hand wheel shall be made of malleable iron with arms and rims of adequate strength. The hand wheel of diameters 300 mm or less shall be provided with handles for ease of operation. The pulling force required on the hand wheel rim shall not exceed 25 Kgf when operating the valve under full flow and operating pressure.

Valves-350 Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same.

Valves-350 Nb and above shall also be provided with gear operator arrangement suitable for manual operation. Manual operation of valve shall be through worm and gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque. It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering.



Adjustable stops shall be provided to prevent over travel in either direction.

Limit and torque switches (if applicable) shall be enclosed in water tight enclosures alongwith suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.

#### 13.19.2 Material of Construction (Butterfly Valves)

Materials and other design details shall be as indicated below:

##### (a) Cast Iron Butterfly valves

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

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

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

##### (c) Stainless Steel Butterfly Valves

Body & Disc	ASTM A 351, Gr. CF8M/ASTM-A-182-Gr. 304
-------------	---

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

## (d) Carbon Steel Butterfly Valves

Body & Disc	ASTM A 216, Gr. WCB
Shaft	ASTM A 182, Gr. 304/ASTM-A-479 Gr. 304/Equivalent
Disc & Seat Rings	EPT/BUNA-N/Neoprene
Companion Flanges	IS 2062
External hardware	SS 316
Internal hardware	SS 316

## 13.19.3 Proof of Design Test (Type Test) for Butterfly Valves

Proof of Design (POD) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual POD test shall be conducted by the bidder in the presence of Employer's representative.

All valves that are designed and manufactured as per AWWA-C-504 shall be governed by the relevant clauses of POD test in AWWA-C-504. For Butterfly valves designed and manufactured to EN-593 or equivalent, the POD test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of POD test of AWWA-C-504.

**13.20.00 MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)**

(a) The materials shall generally comply with the following:

<b>(1) Cast Steel Valves</b>	
Body & bonnet	ASTM A 216 Gr. WCB/ ASTM A 105
Disc for non-return Valves	ASTM A 216 Gr. WCB/ ASTM A 105
Trim.	ASTM A 182 Gr. F6 or Equivalent
Companion Flanges	IS 2062
External hardware	SS 316

	Internal hardware	SS 316
<b>(2)</b>	<b>Stainless Steel Valves</b>	
	Body & Bonnet	ASTM A 351 Gr. CF 8M/ ASTM A 182 Gr. 304
	Disc	-do-
	Trim.	ASTM 182 Gr. F. 316 /ASTM-A-479 Gr. 316 or Integral with body
	Companion Flanges	SS 304
	External hardware	SS 316
	Internal hardware	SS 316
<b>(3)</b>	<b>Cast Iron Valves</b>	
	Body & bonnet 260	BS 1452 Gr. 14/IS-210 Gr. FG
	Seating surfaces and rings	13% chromium steel/13% Chrome overlay
	Disc for non-return valves	BS 1452 Gr. 14/IS-210 Gr FG 260
	Hinge pin for non-return valves	AISI 316
	Stem for gate globe valves	13% chromium steel or Equivalent
	Back Seat	13% chromium steel / 13% Chrome overlay
	Companion Flanges	IS 2062
	External hardware	SS 316
	Internal hardware	SS 316
<b>(4)</b>	<b>Gun Metal Valves</b>	
	Body and bonnet	IS 318 Gr. 2/Equivalent Standard
	Trim	-do-
	Companion Flanges	IS 2062
	External hardware	SS 316
	Internal hardware	SS 316
<b>(5)</b>	<b>Duplex Stainless Steel</b> (All Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc)	

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

- (b) Cast iron body valves shall have high alloy steel stem and seat.
- (c) Material for counter flanges shall be the same as for the piping except for sea water application.

#### **13.21.00 Float Operated Valves**

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

#### **(b) DESIGN AND CONSTRUCTION FEATURES**

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

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

#### **13.22.00 PAINTING OF VALVES:**

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



damaged, the same shall be made good by the contractor by repainting with compatible painting primer and enamel to the satisfaction of the project manager.

### **13.23.00 RUBBER EXPANSION JOINTS**

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

13.23.13 Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.

13.23.14 Bidder to note that any metallic part which comes in contact with DM / Corrosive water shall be of stainless steel material.

**13.23.15** For all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc the bolts & nuts, stretcher plates and companion flanges shall be SS 316 L.

## **13.24.00 STRAINERS**

### **13.24.1 Simplex type**

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

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

### **13.24.2 Duplex type**

(a) The strainers shall be basket type and of duplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe. The mesh of strainer element shall be commensurate with the actual service required. Pressure drop across the strainer in new condition shall not exceed 4.0 MWC at full flow.

(b) Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows.

- |      |   |
|------|---|
| Body | IS: 318, Gr. 2<br>Up to 50 mm Nb, and IS:210,<br>Gr. FG 260 of ASTM-A-515 Gr. 75/IS-2062<br>Gr. B and internally epoxy-painted above 50 NB. |
|------|---|

SS 316 L (all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc)

Strainer element      Stainless steel (AISI 316)/ SS 316 L (all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc)

End connection      Screwed up to 50 mm NB, and Flanged above 50 NB. Gasket shall be of full face type

- (c) The strainer will have a permanent stainless steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data.
- (d) The size of the strainer and the flow direction will be indicated on the strainer body casting.
- (e) Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100% clogged condition exerting shut-off pressure on the element.

#### 13.24.3

Three shop coats of paint preceded by two coats of primer shall be applied to all exposed surfaces as required to prevent corrosion. All parts shall be adequately protected for rust prevention. The use of grease or oil other than light grade mineral oils for corrosion protection is prohibited.

## CHAPTER – 33

### POWER CYCLE PIPING, VALVES, FITTINGS & THERMAL INSULATION

#### 33.0 POWER CYCLE PIPING, VALVES, FITTINGS & THERMAL INSULATION

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

#### 33.1 PERFORMANCE REQUIREMENT

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

#### 33.2 Line Sizing

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

##### Steam

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

##### Water

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

##### Oil

(i)	HFO, HSD	:	2 m/s
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WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following “C” value.

i)	Carbon steel pipe	100
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ii)	CI Pipe/Ductile Iron	100
iii)	Rubber lined steel pipe	120
iv)	Stainless steel pipe	100

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

### 33.3

#### **CODES & STANDARDS**

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

ASME-B31.1 : Code for Power Piping

ASME-B16.5 : Pipe Flanges & Flanged Fittings

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

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

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

ANSI B-16.25: Butt Welding Ends.

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

ASME-B36.19 : Stainless Steel Pipe

IBR : Indian Boiler Regulations (Latest Revision)

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

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

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

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

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

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

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

ASTM A403 : Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.

API-594 : Check valves: Flanged, Lug, Wafer and Butt-welding.

API-598 : Valve Inspection and Testing

API-600 : Bolted bonnet steel gate valves for Petroleum and natural gas industries.

API-602 : Compact Steel Gate Valve – Flanged, Threaded, Welding and Extended Body Valves.

BS- 1873 : Steel Globe and globe stop and check valves ( flanged and butt-welding ends) for Petroleum, Petrochemical and allied industries.

BS- 1868 : Steel check valves (flanged and butt-welding ends) for Petroleum, Petrochemical and allied industries.

IS 12709 : GRP pipes, joints and fittings for use for potable water supply

IS 14402 : GRP pipes, joints, and fittings for use for sewerage, industrial waste and water.

ANSI/AWWA C950-07: AWWA Standard for Fiber Glass pipes.

AWWA M45 : AWWA manual of water Supply & Fiberglass Pipes Design.

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

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

### 33.4 **Scope of Supply**

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

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

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

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

Line drains from Main Steam, Hot Reheat, Cold Reheat, L.P. bypass & high pressure (above 40 kg/cm<sup>2</sup>) extraction lines shall be provided with double isolation valves in series for each branch - each located at the two extreme ties of the line drain route. The valve near the condenser

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

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

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

Following general requirements shall however be considered:

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

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

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

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

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

33.5 **SCOPE OF SERVICES**



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

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

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

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

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

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

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

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

### 33.6 **POWER CYCLE PIPING**

#### 33.6.1 **EQUIPMENT SIZING CRITERIA**

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

##### 33.6.1.1 **PIPE SIZING**

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

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

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

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

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

### 33.6.2 MATERIAL SELECTION

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

### 33.6.3 PIPE WALL THICKNESS

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

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

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

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



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

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

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

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

#### 33.6.4

#### **LAYOUT**

- (a) All high points in piping system shall be provided with vents. All low points shall be provided with drains. Provision of drains on steam piping shall be as per ASME code TDP-1. Drain lines shall be adequately sized so as to clear condensate in the line and prevent water hammer and damage to turbine due to water induction. All piping shall be sloped towards the system low point such that slope is maintained in both hot and cold condition.
- (b) All drain and vent lines in piping system with design pressure 40 Kg/cm<sup>2</sup> (g) and above or with vacuum service shall be double valved.
- (c) The piping routing shall be such that clear headroom of not less than 2.5 meters above the walkaways /working area is available. The contractor shall ensure correct orientation of and easy access to valves and instruments etc. and sufficient clearance for removal and maintenance of the same. The piping shall not encroach on withdrawal space of various equipment and walking space.
- (d) Wherever there is possibility of ingress of rain water through floor /ceiling opening at points where any pipe passes through floor /ceiling suitable weather protection hood shall be provided.

#### 33.6.5

#### **STRESS ANALYSIS**

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

## 33.6.6

**HANGERS AND SUPPORTS**

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

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

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

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

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

## 33.6.7

**THERMAL INSULATION**

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

Design ambient temperature

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

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

33.6.8

**FLASH TANKS**

- (a) The flash tanks shall be adequately sized to take care of the total drains in the complete power cycle piping system. There shall be sufficient margin to accommodate the possible variation in drains quantities as well as flash steam. Flash tanks shall be designed as per the requirement of ASME boiler and Pressure vessels (B&PV) codes, & ANSI standard. The contractor shall selection for employer's review.
- (b) However the minimum design pressure and temperature for the flash tanks shall be 3.5 Kg/cm<sup>2</sup> (g) and 210°C respectively. Flash tanks shall also be designed for full vacuum condition.
- (c) Corrosion allowance of 3.0 mm shall be added to the design thickness of the shell and head of the vessels. The minimum thickness of the vessels including corrosion allowance shall not be less than 8 mm.
- (d) The flash tanks and manifolds shall be designed to take care of the impact forces due to incoming drains.
- (e) In case the spray is in manifold, the material for the flash tank manifold shall conform to ASTM A335 Gr. P22 or better and its thickness shall not be less than SCH 100 of ANSI B36.10 irrespective of temperature of the fluid handled
- (f) The temperature in the flash tanks shall be maintained by using condensate /feed water spray, as the case may be and in whichever case applicable. The spray shall be automatically controlled. However for flash tanks open to atmosphere continuous spray through an orifice shall also be acceptable.

33.6.9

**SPECIFIC REQUIREMENTS – PIPES & FITTING**

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

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

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

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

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

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

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

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

#### 33.6.10

#### **SPECIFIC REQUIREMENTS – VALVES & SPECIALTIES**

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

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

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

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

Check valves shall have full floating and accurately guided discs.

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

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

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

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

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

#### 33.6.11

#### **INTEGRAL BYPASS VALVES**



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

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

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

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

### 33.6.12 **SPECIFIC REQUIREMENTS: FABRICATION**

- 33.6.12.1 Piping system fabrication shall be in accordance with the requirement of ANSI B 31.1 however for system under purview of IBR, the requirements of IBR, shall also be complied with. All dissimilar material piping connection shall be subjected to the acceptance and approval of the employer. Complete document shall be submitted by the contractor in addition to the fulfillment of IBR requirement.
- 33.6.12.2 Where welded pipes and fittings are used the longitudinal weld seams of adjoining sections shall be staggered by 90 deg.
- 33.6.12.3 Access holes for radiography at shop for piping requiring 100 % radiography shall be provided only if the area to be radio graphed is not accessible from pipe ends. Access holes for field radiography shall be provided.
- 33.6.12.4 Except where otherwise specified, all piping shall have butt-welded connections with a minimum of flanged joints, if necessary. All high pressure steam valves and accessories shall have welded connections. Where flanges are adjacent to welded fittings, weld neck flanges shall be used.
- 33.6.12.5 Branches shall, in general, be formed by welding. Standard fittings may be used in positions and for sizes where approval has been given in detail drawings. Pipe bends and tees shall be truly cylindrical and of uniform section. All welded branches shall be reinforced where needed as per the applicable codes/regulations.
- 33.6.12.6 Unless otherwise specified, for all welded lines with pressure above 7 kg/ cm<sup>2</sup>(g) and/or temperature above 2000C, branch connections for branch sizes upto 25% of welded mains shall be made with special forged steel welded fittings.

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

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

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

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

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

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

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

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

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

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

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

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