

	TITLE: 1 X 660 MW PANKI TPS EXTENSION PROJECT		SPECIFICATION NO. PE-TS-426-155-A001	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT		SECTION : I	
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	MOC of safety relief valve	Poly propylene	SS-316
(vii)	Pressure gauge	----- One per pump with Teflon diaphragm seal -----	
(viii)	Maximum pump stroke speed per minute (SPM)	----- 100 -----	
(ix)	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, pulsation dampener etc.	
(x)	Drive motor of pump	The drive motor of each pump will be Energy Efficiency Class IE-3 as per IS : 12615	
d)	Concentration / Density Meter	Acid	Alkali
(i)	Number	One (1) at each mixing tee outlet	One (1) at each mixing tee outlet
(ii)	Type	Density indicator (Hydrometer type)	Density indicator (Hydrometer type)
(iii)	Indication	Local	Local
(iv)	Location	Diluted Acid line	Diluted Alkali line
e)	Concentration analyzer	One (1) at each mixing tee outlet	One (1) at each mixing tee outlet
f)	Flow Indicator & Flow Transmitter		
(i)	Number	One in each DM water line	One in each DM water line
(ii)	Type	Rotameter	Rotameter
(iii)	Flow Transmitter	-----One in each DM water line-----	
3.3	ACTIVATED CARBON FILTER FOR ALKALI		
(i)	Number	One (1) no.	
(ii)	Type	Vertical cylindrical with dished end bottom	
(iii)	Design Pressure minimum	Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra 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 pump suction or 10 kg/cm2 (g) whichever is maximum.	
(iv)	Capacity	10 m3/hr or design capacity of alkali transfer cum recirculation pump whichever is higher	
(v)	Design surface flow rate (max)	15 m3/m2/hr	
(vi)	Free board	Not less than 75%	
(vii)	Fill material	Activated carbon	
(viii)	Media trap (Carbon trap)	Two (2) nos. One at ACF outlet line and one at Backwash/rinse outlet of filter.	
(ix)	Bed depth	1200mm activated carbon + 300 mm Gravel support	
(x)	Pressure gauge	As per P&ID.	
(xi)	Number and Location	Two No. (One each at inlet and outlet of filter)	
(xii)	Seal	Teflon diaphragm	
(xiii)	Material of construction		
(xiv)	Shell	IS 2062 Gr A/B	
(xv)	Dish ends /Head	IS 2002 Gr.I / SA 515 Gr. 70	
(xvi)	Material of Construction for Vessel Internals	Epoxy coated carbon steel	
(xvii)	Internal painting	Primer: Two (2) coats of high built epoxy zinc phosphate DFT 50 microns Finish: Two (2) coats of high built epoxy zinc phosphate DFT 200 micron.	

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(xviii)	External painting	Primer: Two (2) coats of chlorinated rubber paint DFT 50 microns. Finish: Two (2) coats of chlorinated rubber paint DFT 100 microns.
(xix)	Design code	ASME sec VIII div 1 ed.2010 / IS 2825 as applicable
(xx)	Influent Distributor Material	SS 316
(xxi)	Manhole	Two (2) nos. minimum each of Davit type and 500 mm dia.
(xxii)	Sight Windows	One (1) no. in backwash space
(xxiii)	Hand hole	One (1) no. of 150 mm dia for removal of activated carbon
(xxiv)	Back wash flow rate	15 m ³ /m ² /hr
(xxv)	Under Drain System	Strainers on plate
(xxvi)	Accessories	Operating platforms, ladders, supports, lifting lugs (4 nos. min) etc.
3.4	ALKALI DILLUENT WATER HEATING TANK (HOT WATER TANK)	
(i)	Number	One (1)
(ii)	Type/Capacity	Vertical Cylindrical Pressure Vessels with dished end / HWT shall be sized 120% of water required for one anion regeneration vessel.
(iii)	Fluid handled	DM water
(iv)	Electric heater Qty.	2 nos. Electric heater (2X50%)
(v)	Location	Indoor
(vi)	Temperature of alkali to be heated	To obtain temp from 15 °C to 50°C at alkali mixing feed outlet within 5 hours.
(vii)	Design Pressure	Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra 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 pump suction or 10 kg/cm ² (g) whichever is maximum.
(viii)	Material of construction	
a)	Shell & dished end	SS-304 adequately insulated
(ix)	Design code	ASME sec VIII div 1 ed.2010 / IS 2825 as applicable
(x)	Temperature gauge, Temp. transmitters & Burn out protection	To be Provided by bidder (As per P&ID)
(xi)	Accessories	Manhole (size 500 mm), hand hole, vent, drain, sample connection, level transmitter, level gauge, operating platform, ladders, lifting lugs (4 Nos. minimum) etc.
3.5	CPU REGENERATION CUM RESIN TRANSFER PUMPS	
(i)	Number	Two (2x100%) nos. (1W+1S)
(ii)	Type	Horizontal centrifugal pump
(iii)	Operation	Intermittent
(iv)	Liquid to be handled	DM water
(v)	Capacity & head	As per system requirement (with 20% margin in flow & head)
(vi)	Suction condition	Flooded

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(vii)	Material of construction	
•	Casing & impeller	Stainless Steel CF 8M
•	Shaft	Stainless Steel SS 316
•	Shaft coupling	Stainless Steel SS 304
•	Shaft sleeve material	SS 316
•	Base plate	Carbon steel IS:2062
(viii)	Vibration	As per HIS
(ix)	Lubrication	Grease
(x)	Noise Level	85 DBA
(xi)	Packing seal	Mechanical type
(xii)	Pump Speed	Maximum 1500 rpm
(xiii)	Pressure gauge	One for each pump with Teflon diaphragm seal
(xiv)	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, pulsation dampener etc.
(xv)	Drive motor	The drive motor of each Pump will be Energy Efficiency Class IE-3 as per IS : 12615
(xvi)	Motor speed	Maximum 1500 rpm
3.6	AIR-BLOWERS FOR RESIN MIXING (REGENERATION AREA)	
(i)	Number	Two (2x100%) nos. (1W+1S)
(ii)	Type	Centrifugal/Twin lobe type, oil free, positive displacement
(iii)	Location	Indoor
(iv)	Duty	Intermittent
(v)	Capacity and head	As per system requirement
(vi)	Noise Level	80 dB (A) Max. at one meter distance and 1.5 m Height.
(vii)	Pressure gauge	One per blower
(viii)	Material of construction	Casing/ Housing: Cast Iron (CI) to IS210 GR. FG260 Lobe: Cast Iron (CI) to IS210GR. FG260 Shaft: Carbon steel to EN8 OR EN19 to BS970 Base Plate: MS to IS2062 Foundation/ Anchor Bolts: Hot dip Galvanized.
(ix)	Blower Speed	Maximum 1500 rpm
(x)	Drive motor	The drive motor of each air blower will be Energy Efficiency Class IE-3 as per IS : 12615
(xi)	Motor speed	Maximum 1500 rpm
(xii)	Accessories	Acoustic hood, Suction filter, Silencer, Pressure/Safety relief valve, anti-vibration pads etc.
4.0	NEUTRALISING SYSTEM	
(i)	N-PIT AND NPIT DISPOSAL SYSTEM	Effluent generated during the regeneration and resin transfer operation from CPU regeneration area shall be transferred through a drain trench to DM plant Neutralization Pit (RCC construction). There will no dedicated Neutralization pit for CPU regeneration area. One (1) no. Neutralization Pit of RCC construction with two (2) compartments with acid and alkali resistant lining/tiling along with isolation gates for

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		each compartment shall be provided in DM plant. Each section/ compartment shall have capacity to hold (waste generated from single regeneration of one stream of DM Plant + waste generated from single regeneration of one CP Service Vessel + 20% Margin).
5.0	PIPING & VALVES	
(i)	Resin Transfer piping (Full Port Ball Valves)	ASTM A 312 Gr. TP 304 Sch 40 Minimum pipe Size: NB80 Velocity : 2-3 m/s
(ii)	DM water line	ASTM A 312 Gr. TP 304 Sch 40
(iii)	Piping-Service Vessel Inlet	Piping-ASTM A 106 Gr C Ball Valves – SS-(CF8M) BFV – ASTM A 216 Gr. WCB- Body SS-(CF8M) - Disc.
(iv)	Piping-Service vessel Outlet	Piping – ASTM A 106 Gr. C BFV – SS-(CF8M) - Body & Disc both. Ball Valves – SS-(CF8M)
(v)	Service vessel bypass piping (Control valve and isolation valves)	Piping – ASTM A 106 Gr. C Butterfly type control valve & upstream & downstream Butterfly type isolation valve– ASTM A 216 Gr. WCB – Body SS-(CF8M) - Disc.
(vi)	Service vessel rinse piping	CS to ASTM A 106 Gr. C
(vii)	Acid & Alkali Regeneration piping (Diaphragm Valves)	All piping & Fittings in regeneration area shall be CPVC Sch. 80 only & valves shall be MOC CPVC minimum PN 10 rating/Sch 40 only.
(viii)	Acid / Alkali Transfer piping (Diaphragm Valves)	All piping & Fittings in regeneration area shall be CPVC Sch. 80 only & valves shall be MOC CPVC minimum PN 10 rating/Sch 40 only.
(ix)	Instrument Air piping (Full Port Ball Valves)	IS 1239 (Heavy Grade) Galvanized.
(x)	Service water	ERW Carbon Steel Pipe to ASTM 53 Gr. B / IS-1239, Part-I heavy grade for pipe size up to 150mm NB and IS-3589 for 200mm NB & above
6.0	VALVES	
(i)	ECCENTRIC PLUG VALVE / BALL VALVE (Full port)	These valves shall be used for resin transfer line. These valves shall be flanged type and of SS 316 construction.
(ii)	GLOBE VALVE	Globe valves in treated condensate service shall be of stainless steel construction, SS-316. Globe valves in crude condensate service shall be of Carbon Steel construction.

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(iii)	BUTTERFLY VALVES	Butterfly valves shall be of double flanged type of low leakage rate confirming to AWWA-C-504 class 300 (min.) or EN593/ BS:5155 PN 10 (min.) Condensate polishing plant outlet butterfly valves shall be of stainless steel construction, SS-316 (for body, disc and shaft). Condensate polishing plant inlet butterfly valves shall be of Carbon Steel construction (Body- ASTM A 216 Gr. WCB & Disc-CF8M Respectively). All the butterfly valves shall be provided with Hand wheel or lever as per the requirements. For larger sizes i.e. 150 NB and above. Valve provided with motorized or pneumatic actuator shall be provided with a hand wheel for manual operation. All the valves shall be equipped with adjustable mechanical stop-limiting devices to prevent over travel of the valve disc in the open and closed positions. The valve operators (Hand wheel or Gear reduction unit or Motor actuator etc.) shall be designed as per relevant International Standard. All the butterfly valves shall be provided with an indicator to show the position of the disc. Flanges shall conform to ANSI B 16.5 Cl.300 (min.) used for Service vessel area. Butterfly valves at the bypass line of service vessel shall be double flanged.
(iv)	DIAPHRAGM VALVE	The Diaphragm shall conform to following requirement for DM water application: i) Design standard: BS: 5156 or equivalent of required rating / class. (Minimum rating of valves shall be PN 10). ii) Type: Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type iii) Material of Construction a) Body, Bonnet: Cast iron IS 210 Gr. FG 260 or equivalent or Cast steel ASTM A-216 Gr. WCB b) Body lining: Soft natural rubber(Neoprene), ebonite, Polypropylene c) Hand wheel: Cast Iron d) Compressor: Stainless Steel e) Stem and Bush: Stainless Steel For Acid and Alkali services the valve shall be CPVC PN10/Sch 40 only.
7.0	FLANGES	
(i)	Feed water / Condensate	ASTM A105
(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
8.0	Safety Equipments	One (1) set of safety equipment comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided. One number personnel water drench shower/safety shower and eye bath in regeneration area shall be provided.

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TECHNICAL DATA SHEET-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 mentioned in specification
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
7.0	Operating speed	
7.1	Hoisting speed/ Creep speed (thru' VVVF drive)	3 MPM with creep speed 10% of main speed.
7.2	Trolley speed	10 MPM
8.0	Type of transmission	Through Electric motor and gear box.
9.0	Wire Rope	
9.1	Construction / core	6 x 36 or 6 x 37 construction, steel/ Fibre core
9.2	Code	IS:2266
9.3	Tensile designation	1770/1960 N/mm ²
9.4	Number of falls	Min. 4
9.5	Factor of safety	Not less than 5
10.0	Load Hook and block	Normalized 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	Alloy steel/carbon steel as per IS:15560
10.4	Hook suspension	Thrust bearing
10.5	Material of block suspension	Fabricated from steel plate, Material: IS: 2062
10.6	Hook can swivel freely under full load	Yes
10.7	Safety latch on hook provided	Yes
10.8	Locking device on swivelling hook	Provided
10.9	Bearing type	Antifriction Ball / Roller
10.10	Bearing life	10,000 working hours.
11.0	Gearing	
11.1	Type	Spur / Helical, hardened and tempered with machine cut teeth
11.2	Gear material	Forged steel as per IS 3938
11.3	Lubrication	Oil splash/ grease lubricated
11.4	Bearing type	Antifriction Ball / Roller
11.5	Bearing life	10,000 working hours.
12.0	Trolley drive	
12.1	Wheel	Single flange taper thread
12.2	Wheel conform to (Std. / code)	IS: 3938
12.3	Wheel material	Heat treated carbon steel/ low alloy steel, graded cast iron.
12.4	Bearing type	Antifriction Ball / Roller
12.5	Bearing life	10,000 working hours.
12.6	Trolley type	Rolled structural steel with side plates extended beyond wheel flanges to protect wheels.
12.7	Hardness	Max hardness 200 BHN
13.0	SHEAVE	

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13.1	Material	Cast steel or mild steel.	
13.2	Bearing type	Antifriction Ball / Roller.	
13.3	Bearing life	10,000 working hours.	
14.0	BRAKE (HOIST)		
14.1	Type	DC EM brakes disc type (fail to safety).	
14.2	Capacity	As per IS 3938.	
14.3	Number	One number for each motor.	
15.0	BRAKE (TROLLEY)		
15.1	Type	DC EM brakes disc type (fail to safety).	
15.2	Capacity	As per IS 3938.	
15.3	Number	One number for each motor	
16.0	ROPE DRUM		
16.1	Material	Cast iron, cast steel or mild steel.	
16.2	Flange / Flangeless	Flanged	
16.3	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 GI conductor bus bar -DSL shall be sized with a margin of 10% over load requirement.	
18.0	MOTORS		
18.1	Type	Sq. Cage induction, TEFC, S4 duty, 60% CDF.	
18.2	Number of start	300starts / hr, Motors shall be suitable for direct on-line (DOL) starting	
18.3	Voltage, Phase and Frequency	Suitable for rated frequency of 50 Hz with a voltage variation of +/-10% and frequency variation of +3 to -5% occurring separately or combined voltage and frequency variation of 10%. 3 phase, 4 wire	
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-55	
18.7	Margin	Motor nameplate rating at 50 deg C shall have Motor rating will be calculated keeping margin of at least 25% over the maximum power requirement. The hoist motors shall be rated to lift 125% of the design load at rated speed	
19.0	LIMIT SWITCHES	Hoisting	Trolley
19.1	Type	One (1) no. Snap action, self-actuating type	One (1) no. two way limit switch
20.0	Control panel	* Fabricated from CRCA sheet steel not less than 1.6 mm thick * Degree of protection shall be IP 52 * Power on indicating lamps shall be provided * Panel illumination lamps operated by door switch. * 2 nos earthing terminals on panel. * Gland plate thickness shall be minimum 3mm. * Gland plate shall be double brass compression type.	
20.1	Qunatity	1 No.	
21.0	Pendent Push buttons	Up /down / forward / Reverse push buttons. Indicative marking for easy operation shall be provided.	

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22.0	Fixed type Power cables	Copper/Aluminum material, minimum size: Min. 2.5 mm ² for Cu/ min 6 mm ² for Aluminum. Extruded PVC insulated, armoured and FRLS PVC sheathed heavy duty 1100 V
23.0	Fixed type Control cable	Copper material, min. 1.5 mm ² Control cables shall have stranded copper conductor, Extruded PVC insulated, armoured and FRLS PVC sheathed heavy duty 1100 V
24.0	Trailing cable (Power/ Control)	EPR insulated, copper conductor trailing cables, as per IS:9968.
25.0	Control Voltage	110 V
26.0	End stopper for CT	2 nos., MOC shall be as per IS 2062
27.0	Buffer for CT	2 nos. Spring/rubber type shall be provided on trolley
28.0	Bearing (Type/life)	Antifriction Ball / Roller, 10,000 working hours life

DATA SHEET-A FOR MANUAL HOIST (CHAIN PULLEY BLOCK)

1.0	Type	Chain pulley block with/without trolley
2.0	General Design	IS: 3832
3.0	Duty Class as per IS:3832	Class –II
4.0	Hoisting Mechanism	
a)	Type	Hand operated gear transmission
b)	Type of gear	Spur / Helical
c)	Load Chain	
i)	Type	Link type
ii)	Material	As per relevant standard
iii)	Conforms to (Std./Code)	IS: 6216 / IS 3077/IS 3019
d)	Hand Chain	
i)	Type	Link type
ii)	Material	Mild steel Grade 30
iii)	Conform to Std.	IS:2429 (Part II)
e)	Load Hook & Hook Block	
i)	Type of load hook	Plain shank- Trapezoidal section/ 'C' type
ii)	Load hooks conforms to	IS: 15560
iii)	Type of hook suspension	Swivelling type with safety latch
iv)	Type of make of bearing	Thrust ball bearing of hook suspension
v)	Type & Material of hook	As per IS 15560
f)	Gears/ Pinions	
i)	Type	Spur
ii)	Material	Alloy steel / carbon steel/ High graded cast iron
	Type of Bearing	Antifriction ball bearing / Roller
g)	Sprockets:	
	Type of bearings used	Antifriction ball bearing / Roller
i)	Method of lubrication	
	Bearings	Grease
	Gearing & Pinions	Grease
	Sprocket	Grease
h)	Brakes	
	Type	Screw and friction disc type
5.0	Trolley and Bridge drive	
a)	Trolley	
i)	Type	Geared (Manually operated)
ii)	Material of frame	Mild steel (IS:2062 Grade A or B)
b)	Drive Chain	

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i)	Type	Link type
ii)	Material	Steel Gr.30
iii)	Design of drive chain	IS : 2429 part 1 :1870
c)	Wheel	
i)	Number of pairs of wheel	Two in each trolley/bridge
ii)	Flange	Single flanged
iii)	Type of bearings need	Antifriction
iv)	Wheel material	As per IS 3832
d)	Gears	
i)	Type	Spur / helical
ii)	Material	Cast iron/EN8
iii)	Type of bearings used	Antifriction
e)	Method of lubrication for	
i)	Bearings	Grease
ii)	General	Grease
iii)	Sprockets	Grease
6.0	Painting	As per manufacturer's standard



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**TECHNICAL SPECIFICATION FOR CONDENSATE
POLISHING UNIT**

**SPECIFICATION NO. PE-TS-426-155-
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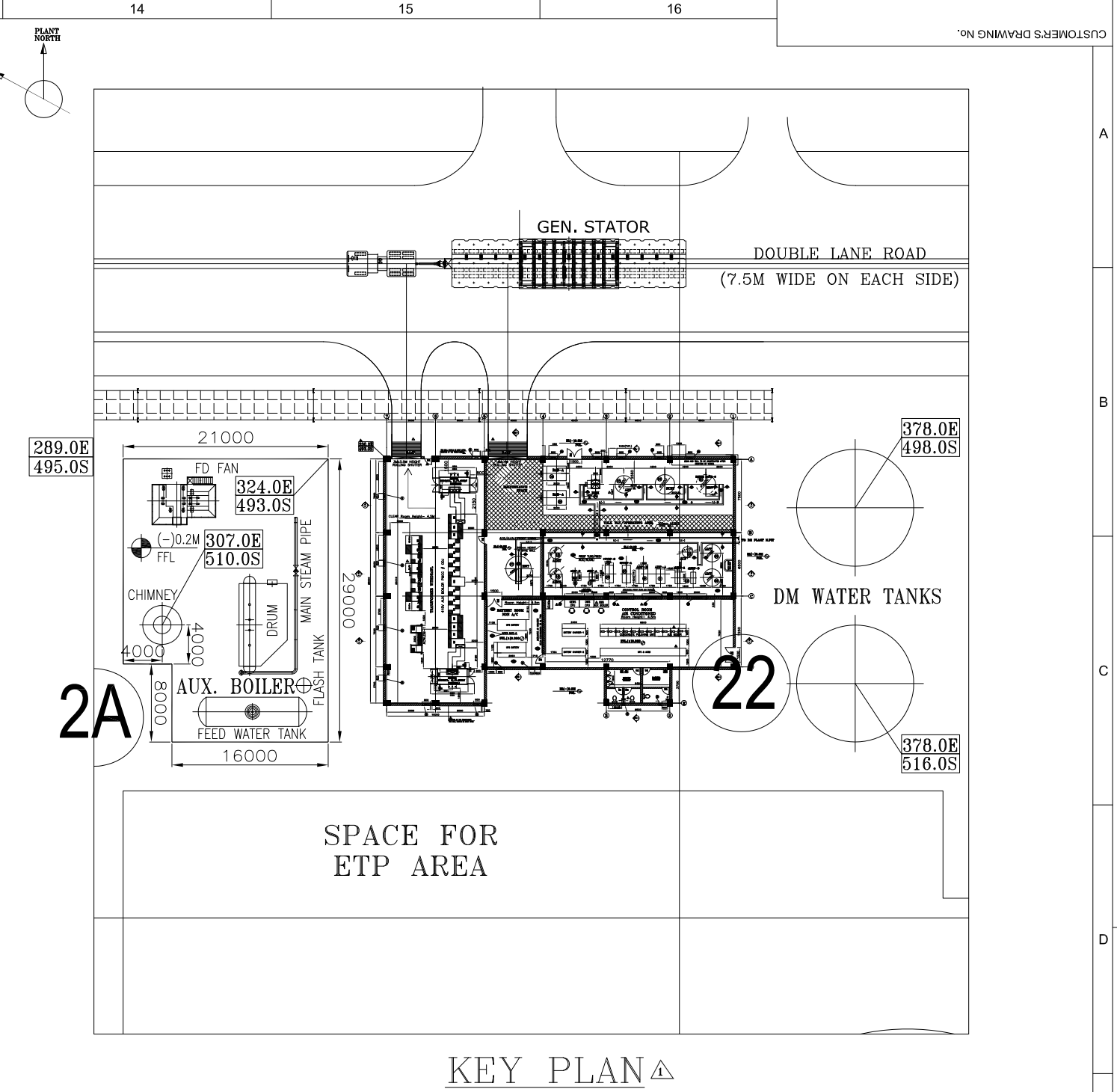
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EQUIPMENT LAYOUT OF CPU REGENERATION AREA

S.No.	PARTICULARS	SIZE OF OPENING	ELEVATION FROM FGL EL(-)0.5	QTY
01	OPENING FOR VENTILATION FAN ALONG GRID-1,2,3,4 & A ROW (01-05)	900mm(W)x900mm(H)	6100mm	5 No.
02	OPENING FOR INLET LOUVER ALONG GRID-1,2 & ROW A,B,C (06-09)	2000mm(W)x1250mm(H)	2800mm	4 No.
03	OPENING FOR VENTILATION FAN ALONG GRID 2,3 & ROW D (10)	700mm(W)x700mm(H)	4000mm	1 No.
04	OPENING FOR VENTILATION FAN ALONG GRID-7& ROW A,B,C,D,E, (11-14)	800mm(W)x800mm(H)	2800mm	4 No.
05	OPENING FOR BACKDRAFT GRAVITY DAMPER GRID-5,6,7&A,E(15-17)	800mm(W)x800mm(H)	4000mm	3 No.
06	OPENING FOR TOILET EXHAUST FAN ALONG GRID 2,3 & ROW E (18-19)	380ø	2800mm	2 No.
07	OPENING FOR INLET LOUVER ALONG GRID-4,5 & ROW D (20)	800mm(W)x800mm(H)	2800mm	1 No.



MECHANICAL EQUIPMENT LIST :-

S.No.	EQUIPMENT	APPROX. SIZE OF EQUIPMENT	QTY
01	MIXED RESIN STORAGE VESSEL	2000mmDia x 4650mmHOS	1 No.
02	SEPERATION/CATION REGENERATION VESSEL	2000mmDia x 4500mmHOS	1 No.
03	ANION REGENERATION VESSEL	1800mmDia x 4300mmHOS	1 No.
04	RESIN MAKEUP HOPPER	800mm x 800mm x 900mm(H)	1 No.
05	CPU REGENERATION PUMP	APPROX.1800mm(L)x850mm(W)	2 Nos.
06	REGENERATION AIR BLOWERS	APPROX.2000mm(L)x1500mm(W)	2 Nos.
07	HOT WATER TANK	2600mmDia x 2800mmHOS	1 No.
08	ACID MEASURING TANK FOR CATION	1800mmDia x 1600mmHOS	2 Nos.
09	ACID DOSING PUMPS	APPROX.1500mm(L)x900mm(W)	2 Nos.
10	ALKALI MEASURING TANK	1200mmDia x 1300mmHOS	2 Nos.
11	ALKALI DOSING PUMPS	APPROX.800mm(L)x600mm(W)	2 Nos.
12	ACTIVATED CARBON FILTER	APPROX.1100mmDia x 2200mmHOS	1 No.
13	ALKALI TRANSFER CUM RECIR. PUMPS	APPROX.1200mm(L)x525mm(W)	2 Nos.

LEGEND:-

RMH	RESIN MAKEUP HOPPER
ARV	ANION REGENERATION VESSEL
SCRV	SEPERATION/ CATION / ANION REGENERATION VESSEL
MRSV	MIXED RESIN STORAGE VESSEL
RAB	REGENERATION AIR BLOWERS
HWT	HOT WATER TANK
ALMT	ALKALI MEASURING TANK
ALDP	ALKALI DOSING PUMPS
AMT	ACID MEASURING TANKS
ADP	ACID DOSING PUMPS
N-PIT	NEUTRALIZATION PIT
CPURP	CPU REGENERATION PUMPS
DMTRP	DM TRANSFER PUMPS
EL	ELEVATION
BOB	BOTTOM OF BEAM
MCC	MOTOR CONTROL CENTER
FGL	FINISHED GROUND LEVEL
FFL	FINISHED FLOOR LEVEL
TOC	TOP OF CONCRETE
D1	SINGLE DOOR
D2	DOUBLE DOOR
IL	INVERT LEVEL
ALTRP	ALKALI TRANSFER CUM RECIRCULATION PUMP
ACF	ACTIVATED CARBON FILTER

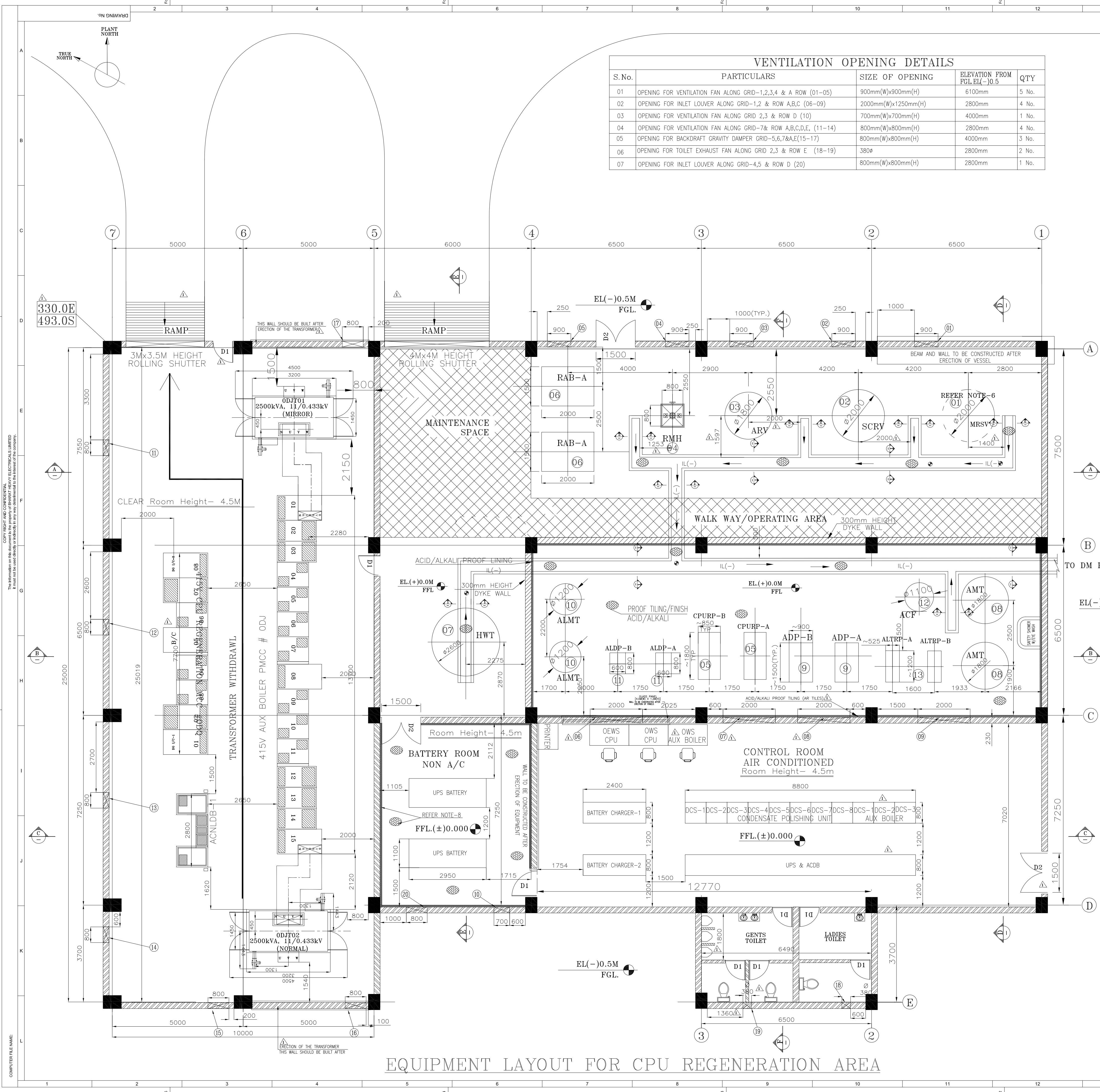
NOTES:

- ALL DIMENSIONS ARE IN MILLIMETER AND ELEVATIONS IN METRES.
- ALL DRAIN CHANNELS WILL BE PROVIDED WITH ACID/ALKALI RESISTANT TILING.
- ACID/ALKALI DYKE AREA FLOOR & WALLS TO BE PROVIDED WITH ACID/ALKALI RESISTANT TILING.
- ALL ELEVATIONS ARE MARKED W.R.T. EL(+/-) 0.00 (FINISH FLOOR LEVEL) WHICH CORRESPONDS TO RL.(+)126.5 M.
- THE INTERNAL DIMENSIONS (EQUIPMENT DETAILS) SHOWN HERE ARE INDICATIVE AND MAY UNDER GO MINOR CHANGE BASED ON THE SUPPLIER SPECIFIC REQUIREMENT DURING DETAIL ENGINEERING. HOWEVER OVERALL BUILDING DIMENSIONS WILL REMAIN UNCHANGED.
- MRSV IS APPLICABLE ONLY BASED ON SUPPLIER REGENERATION PROCESS RECOMMENDATION.
- ARV, SCRv & MRSV VESSEL NOMENCLATURE IS INDICATIVE AND MAY UNDER GO CHANGE BASED ON SUPPLIER SPECIFIC NAME.
- FLOOR AND WALL UP TO A HEIGHT OF 2.1 M OF THE BATTERY ROOM SHOULD BE LINED WITH AR TILES.

REFERENCE DRGS.

- PLEASE REFER PLOT PLAN DRG. NO. : PE-DG-426-100-M001
- OTHER REFERENCE DRAWINGS SHALL BE INDICATED BY CPU VENDOR AFTER ORDERING OF THE CPU PACKAGE.

EQUIPMENT LAYOUT FOR CPU REGENERATION AREA



CUSTOMER:

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

CONSULTANT:

DEVELOPMENT CONSULTANTS PRIVATE LIMITED

PROJECT:

1 X 660 MW PANKI THERMAL POWER STATION

JOB NO. 426

STATUS CONTRACT

DISTRIBUTION

BHARAT HEAVY ELECTRICALS LTD

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA

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REV. DATE ALTD. CHD. MGD. APD. DEPT. CODE DEPT. NAME SIGN DATE

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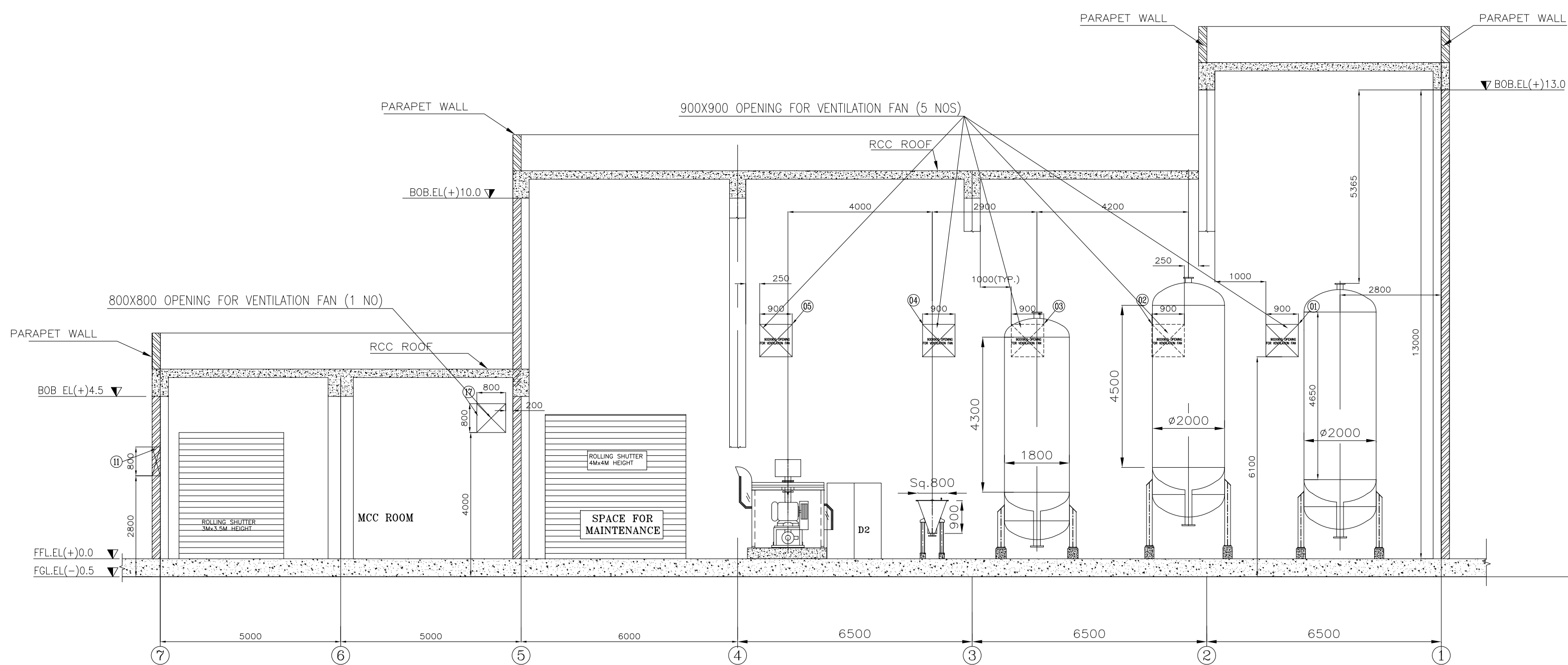
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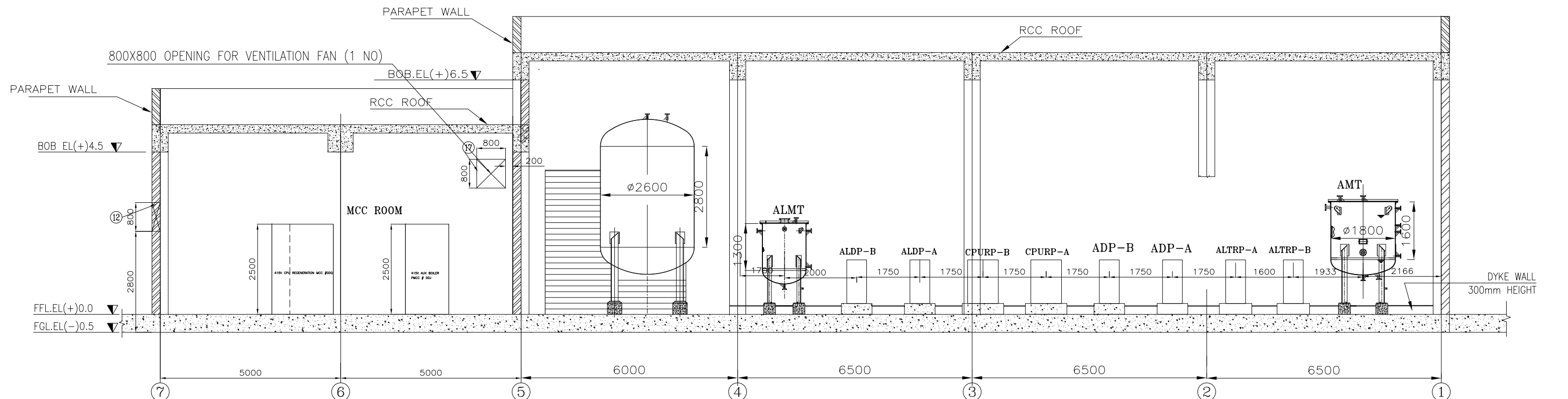
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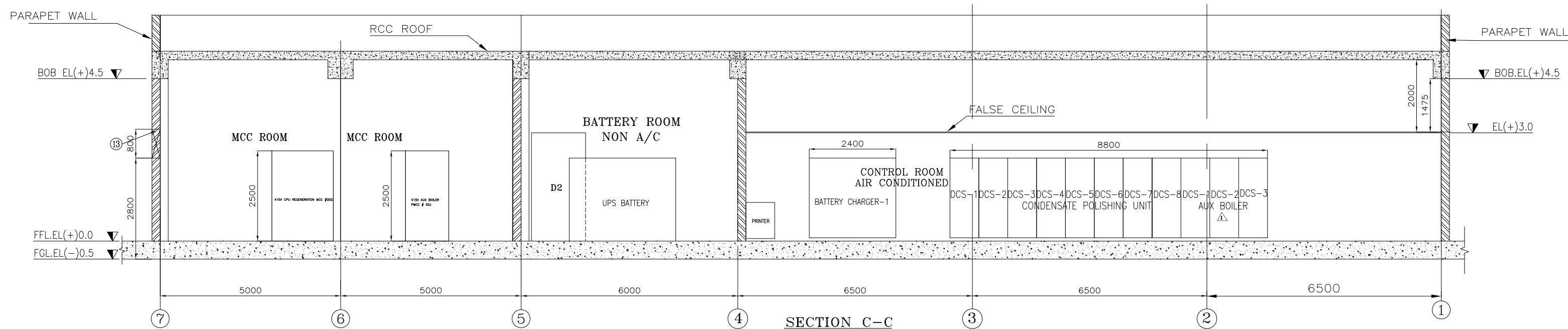
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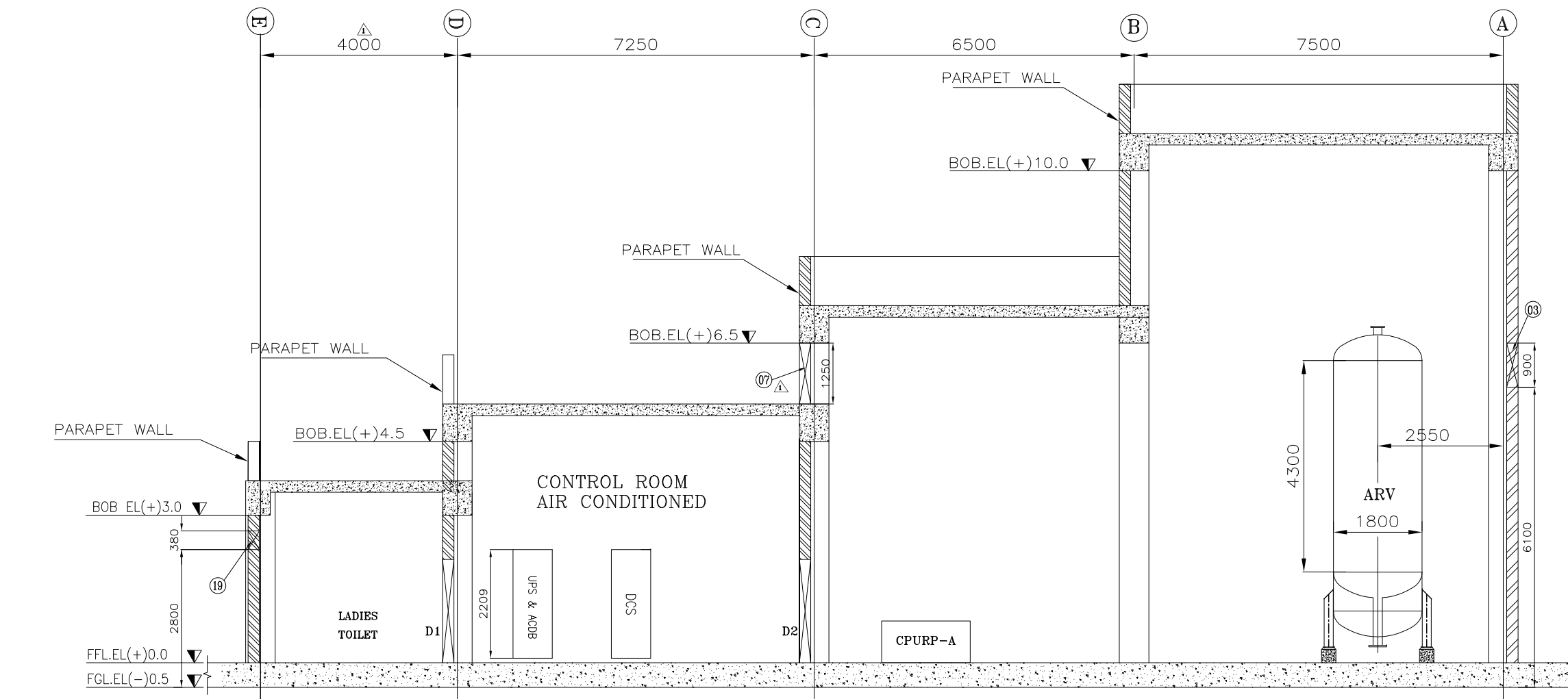
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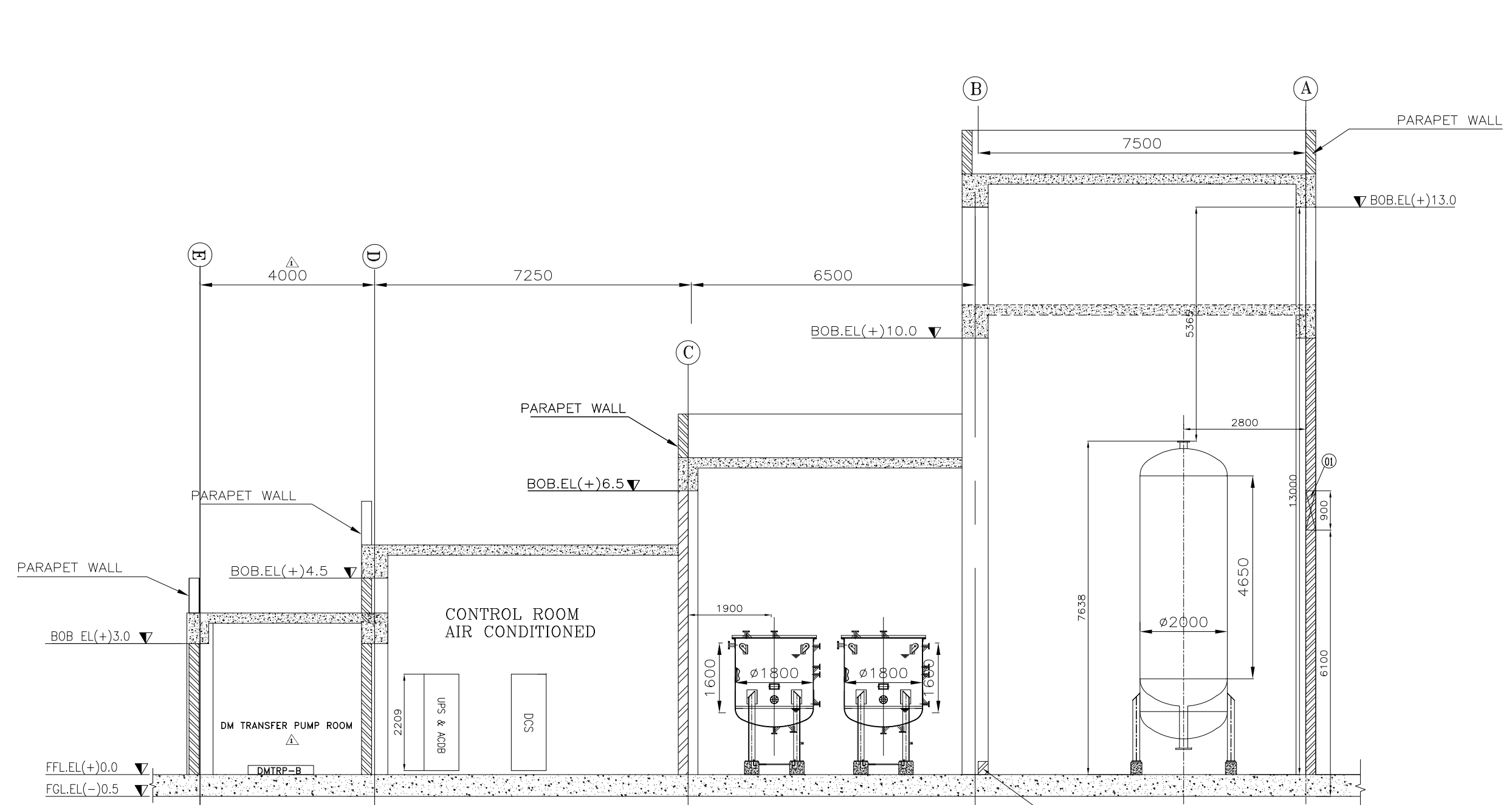
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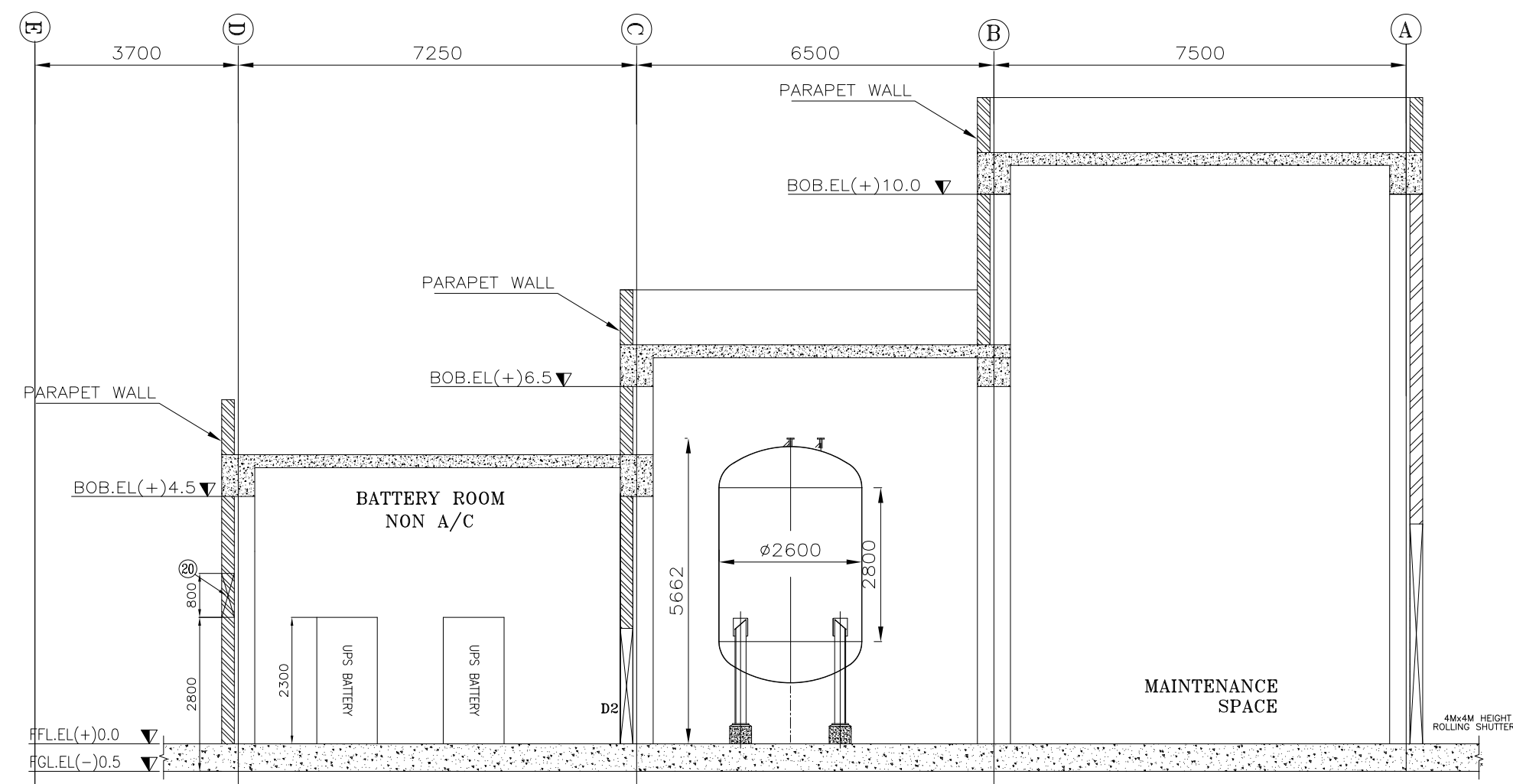
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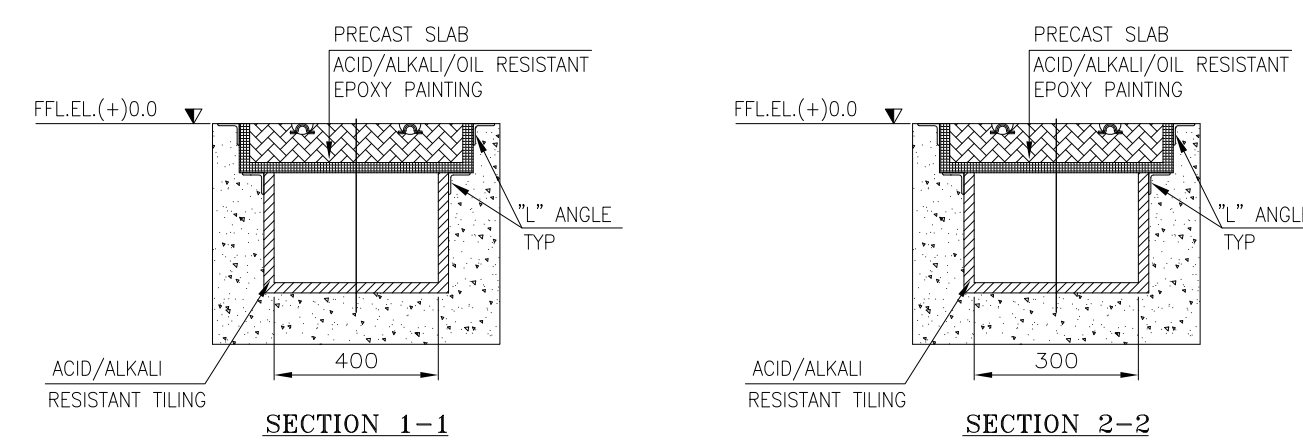
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SECTION E-E



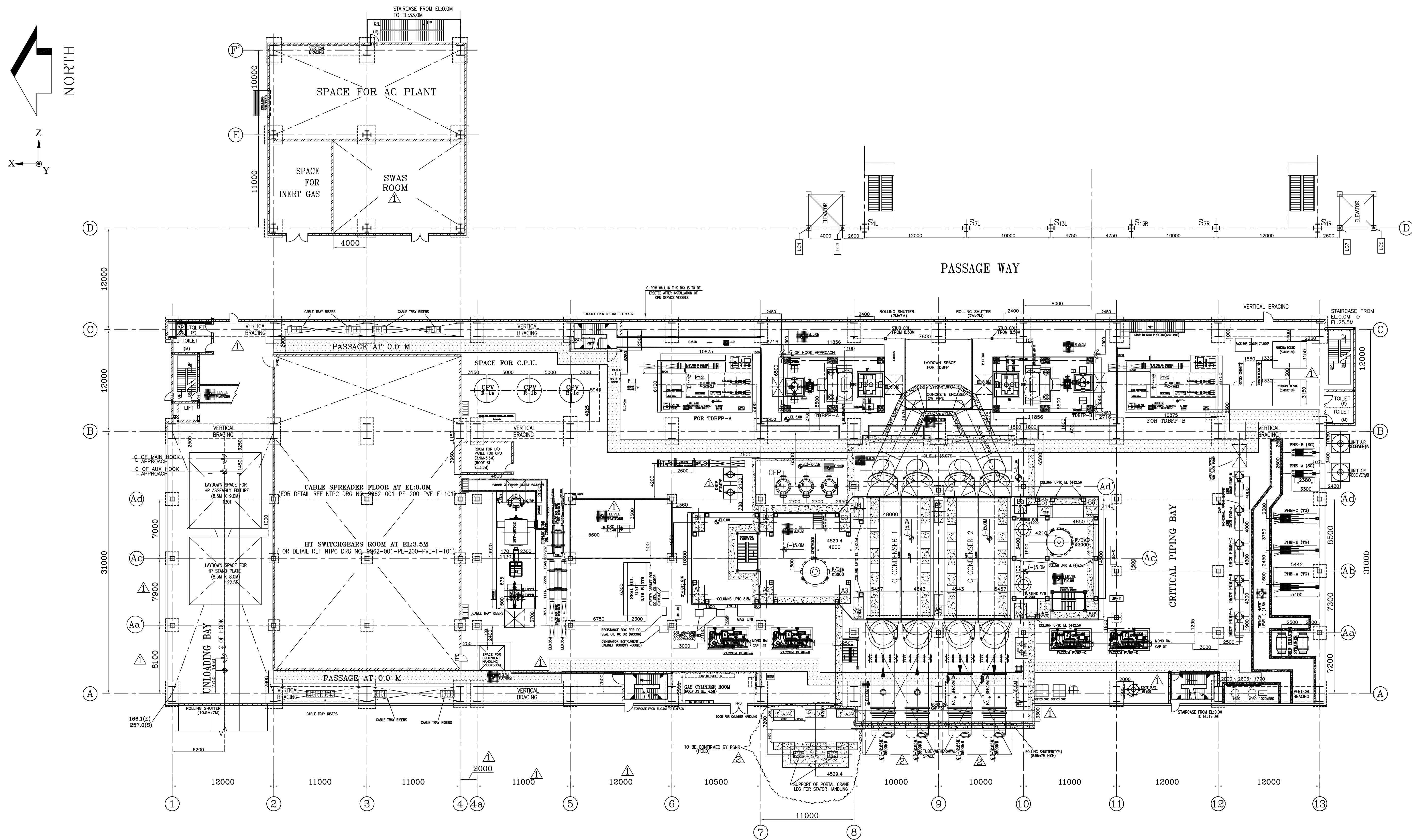
SECTION 1-1

SECTION 2-2

NOTES:

- ALL DIMENSIONS ARE IN MILLIMETER AND ELEVATIONS IN METRES.
- ALL DRAIN CHANNELS WILL BE PROVIDED WITH ACID/ALKALI RESISTANT TILING.
- ACID/ALKALI DYKE AREA FLOOR & WALLS TO BE PROVIDED WITH ACID/ALKALI RESISTANT TILING.
- ALL ELEVATIONS ARE MARKED W.R.T. EL(+/-) 0.00 (FINISH FLOOR LEVEL) WHICH CORRESPONDS TO RL(+126.5 M).
- THE INTERNAL DIMENSIONS (EQUIPMENT DETAILS) SHOWN HERE ARE INDICATIVE AND MAY UNDER GO MINOR CHANGE BASED ON THE SUPPLIER SPECIFIC REQUIREMENT DURING DETAIL ENGINEERING. HOWEVER OVERALL BUILDING DIMENSIONS WILL REMAIN UNCHANGED.
- MRSV IS APPLICABLE ONLY BASED ON SUPPLIER REGENERATION PROCESS RECOMMENDATION.
- ARV, SCR & MRSV VESSEL NOMENCLATURE IS INDICATIVE AND MAY UNDER GO CHANGE BASED ON SUPPLIER SPECIFIC NAME.

CUSTOMER:		UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED	
CONSULTANT:		DEVELOPMENT CONSULTANTS PRIVATE LIMITED	
PROJECT:		1 X 660 MW PANKI THERMAL POWER STATION	
JOB NO. 426		BHARAT HEAVY ELECTRICALS LTD	
STATUS CONTRACT		POWER SECTOR	
DISTRIBUTION		PROJECT ENGINEERING MANAGEMENT	
REV. 01 01.13.2019		The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.	
REVISED AS PER COMMENTS		TITLE: EQUIPMENT LAYOUT OF CONDENSATE POLISHING UNIT (REGENERATION AREA)	
NTPC DOCUMENT NO.:		DEPT. SCALE NTS	
		SIGN	
		DRAWING NO. PE-V0-426-155A-A003	
		SHEET 2 OF 2	
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TITLE:
**1 X 660 MW PANKI TPS EXTENSION
 PROJECT**

**SPECIFICATION NO. PE-TS-426-155-
 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)

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for **Condensate Polishing Unit Package**.
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “ both end equipment in vendor’s scope”shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of

compliance certificate/No deviation certificate.

- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor
- b) Customer (M/s DCPL) specification for Motors
- c) Customer (M/s DCPL) cabling spec (to be referred by vendor for their scope of work (as per Electrical scope between BHEL & vendor)).
- d) Quality plan for motors
- e) Datasheet (Annexure- I)
- f) Datasheet-C
- g) Electrical Load data format (Annexure –II)
- h) BHEL cable listing format (Annexure –III)

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	≤200KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection (Indoor/Outdoor)	:	IP55
5.0	Type of Cooling	:	Refer clause 1.20 of Customer Motor Specification.
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –5%)
	c) Combined voltage & freq. variation	:	10%
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	○ 90kW & Above (Breaker controlled)	:	50 kA for 1 sec
	○ Below 90kW (MCCB Contactor controlled)	:	50 KA for 01 sec.
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Refer clause 1.16 of Customer Motor Specification
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	Refer clause 1.14.5.3 & 4 of Customer Motor Specification
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable upto 0.20 kW
13.0	Tests	:	Refer clause 1.44.02 of Customer Motor Specification
14.0	Energy efficient/ Flame proof motor	:	IE-3

- Also detail Customer spec. for Motors to be referred as enclosed with the specification.

CHAPTER 17 : AC & DC MOTORS**1.00 MOTORS****1.1 SCOPE**

This specification is intended to cover design, manufacture, assembly and testing of AC Squirrel Cage Induction Motors for use in Thermal Power Plants and is supplement to the driven equipment specifications under which these motors are being procured for the project.

SITE CONDITIONS

Site conditions are covered in 'Project Data', contained in specification of the driven equipment.

1.2 Gases, Fumes & Dust Particles

1.2.01 General - Sulphur dioxide and/or trioxide fumes mildly present. Climate is tropical, conducive to fungus growth.

1.2.02 Dust Particles

1 Outdoor locations - Heavily dusty with abrasive dust and coal particles of size five (5) to hundred (100) microns present in atmosphere in large quantity.

2 Indoor Locations.

2.1 Coal conveyors - As for outdoor as per clause 1.02.02.1 above.

2.2 Other locations - Lightly dusty with abrasive dust and coal particles of size five (5) to twenty (20) microns present in atmosphere.

1.2.03 Special Fumes

1 Water treatment plant and acid cleaning room - Acid and alkali fumes present.

2 Fuel oil pumping areas & Hydrogen generation plant - Explosive fumes (flameproof motors required).

1.2.04 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

1.3 LOCATION OF MOTOR - As required

1.4 **SPECIFICATIONS & STANDARDS**.....Motors shall comply with the latest revisions of all relevant standards of BIS (IS-325, IS-900, IS-996, IS-1231, IS-1885, IS-2148, IS-2223, IS-2253, IS-2254, IS-2848, IS-3202, IS-4029, IS-4691, IS-4722, IS-4728, IS-4889, IS-6362, IS-7816, IS-8223, IS-8789, IS: 12615, IS:3177 and IEC : 60034 3Φ Induction motor) except as modified herein or in driven equipment specification.



Motors conforming to BS or IEC Publications, which ensure equivalent quality shall also be acceptable. In case of any difference between IS Specification/International Standards (IEC; NEMA etc.), this motor specification prevails.

1.5 TYPE

1.5.1 AC Motors:

- a) Squirrel cage induction motor suitable for direct-on-line starting.
- b) Continuous duty LT motors upto 160 KW Output rating (at 50 deg. C ambient temperature), shall be **Efficiency class-IE2**, conforming to IS 12615, or IEC:60034-30.
- c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.

1.5.2 DC Motors Shunt wound.

1.6 VOLTAGE (NOMINAL)

1.6.1 LV Motors

For motors upto and including 200 KW - Four hundred fifteen (415) V.

1.6.2 MV MOTORS

For motors above 200kW upto and including 1500kW, Three point three (3.3) kV.

For CHP conveyors motor above 160 kW, 3.3 kV, AC supply is to be used. However all the motors on stacker reclaimer shall be on 415 V AC only.

1.6.3 HV Motors

For motors above 1500kW - eleven(11) KV

1.6.4 All motors are to be designed for system grounding described in "System Particulars" under site information of the Driven Equipment Specification.

1.7 FREQUENCY (NOMINAL) - fifty (50) Hertz

1.8 NUMBER OF PHASES - Three (3)

1.9 SPEED - As required by the driven equipment

1.10 TYPE OF STARTING :

Direct on-line (VFD/Soft-starter/star/delta starting in special cases)

1.11 DUTY

1.11.1 Continuous motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment,



whichever is higher, considering highest system frequency and voltage variation. Crane motors shall be rated for S4 duty, 40% cyclic duration factor. If however, a higher margin is stipulated in the accompanying driven equipment specification, the higher stipulated margin shall prevail.

- 1.11.2 All HT motors shall have vibration pads for mounting vibration detectors.
- 1.11.3 All motors shall be designed to withstand hundred twenty (120) percent of rated speed without any mechanical damage for two (2) minutes.
- 1.11.4 Motors shall be designed to keep torsional and rotational natural frequencies of vibration of the motor and driven equipment atleast twenty five (25) percent above or below, preferably above the motor operating speed (to avoid resonance in vibration over the operating speed) range.
- 1.11.5 All LV motors rated 0.37kW and higher with S1 duty shall be compulsorily be of energy efficiency level IE 2 as per IS 12615:2011.

Motors rated above 37kW shall have efficiency higher than 0.92 and high power factor of atleast 0.88.

1.12 **SUPPLY VARIATIONS**

Motors shall be capable of running continuously at full load under following variations in power supply:

- 1.12.1 All equipments shall be suitable for rated frequency of 50 Hz with a variation of (+) 3% and (-)5%, voltage variation of ($\pm$) 6% for 11 kV & 3.3 kV and ($\pm$)10% for 415V and 10% (absolute sum) combined variation of voltage and frequency unless specifically brought out in the specification.

1.13 **ABNORMAL CONDITIONS CAPABILITY**

Motor shall have following capabilities as specified design ambient temperature:

- 1.13.1 The motors shall also be capable of running up again after voltage collapse to about 40% for approximate duration of 0.5 sec. Subsequent rise in voltage to 70% and further to 80% and 100%, the total duration not exceeding 20 sec.

1.13.2 Low Voltage Running :

Motor shall be capable of running satisfactorily at seventy five (75) percent nominal voltage for five (5) minutes.

1.13.3 Momentary Low Voltage Withstanding :

Motor, when running at full load, shall not stall when voltage drops down to seventy (70) percent nominal voltage for one (1) minute.

1.14 **STARTING CAPABILITY**

1.14.1 Low Voltage Starting :

Motor shall be capable of starting and accelerating to full speed at full load (including loaded equipment e.g. mills and conveyors etc) at eighty (80)

percent nominal voltage at motor terminals. Mill motors may be permitted to start with terminal voltage not below 90%.

1.14.2 Cold Motor Starting Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment eg mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.

1.14.3 Hot Motor Starting Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment e.g. mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.

1.14.4 Motor shall also be suitable for three (3) equally spread starts per hour when the motor is under normal service condition.

1.14.5 Break-away Starting Current Breakaway starting current as percent of full load current for various motor ratings shall not exceed the values given below:

1.14.5.1 Motors above 1500 KW upto 4000kW 600% without any positive tolerance except for ID Fan Motor.

1.14.5.2 Motors above 4000 KW 450%. Not subject to any positive tolerance.

1.14.5.3 For D.C. Motors the starting current shall be limited to 2 times full load current.

1.14.5.3 **Starting voltage requirement**

a) All Motors (except Mill Motors)

- 80% of rated voltage for Motors upto 4000 kW
- 75% of rated voltage for Motors above 4000 kW

b) For Mill Motors:

- 85% of rated voltage for Motors above 1000 kW
- 90% of rated voltage for Motors below 1000 kW

Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.

1.14.5.4 **Starting Time**

1.14.5.4.1 For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.

1.14.5.4.2 For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.

1.14.5.4.3 For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.



1.14.5.5 Torque Requirements:-

1.14.5.5.1 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% of motor full load torque.

1.14.5.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty Motors.

1.15 SAFE STALL TIME

1.15.1 To avoid problem in selecting standard protective relays without using speed switches, safe stall time under hot conditions (corresponding to 110% nominal voltage at motor terminals) shall be more than the accelerating time (corresponding to 80% nominal voltage at motor terminals) by the following minimum values :

1.15.1.01 Two (2) seconds, where accelerating time (at 80% nominal voltage) does not exceed 20 seconds.

1.15.1.02 Three (3) seconds, where accelerating time (at 80% nominal voltage) exceeds 20 seconds.

1.15.1.03 At no stage, speed switch shall be provided to achieve the above requirements mentioned under Clause No. 1.14.5.4

1.16 CLASS OF INSULATION

1.16.1 LV Motors Class F.

1.16.2 MV & HV Motors Class F

1.16.03 However temperature rise shall be restricted to limits corresponding to Class 'B' insulation for both HT & LT motors. The temperature under abnormal running conditions shall be limited to 5°C above class 'B' limits.

1.16.04 The value of the polarization index for motors above 200kW should not be less than 2 when determined according to IS: 7816.

1.17 **TEMPERATURE RISE UNDER NORMAL CONDITIONS**..... Temperature rise over specified design ambient temperature when motor is running with full load at nominal supply voltage & frequency shall not exceed the values given below:

S.No.	Specified Design Ambient Temperature	Thermometer Method	Resistance Method
1.17.01	50°C	60°C	70°C
1.17.02	45°C	65°C	75°C
1.17.03	40°C	70°C	80°C

1.18 BUS TRANSFER WITHSTAND CAPABILITY

Motors will be connected to an automatic bus transfer system and hence may be subjected to one hundred and fifty (150) percent of the nominal voltage during changeover of buses due to the vector difference between the residual voltage and incoming supply voltage and the duration of this condition may be one second. Motors shall be capable of withstanding the voltage and torque stresses developed under such conditions without damage. The manufacturer/vendor shall indicate the special precautions taken to meet the above requirements and confirm.

- 1.18.01 That about 5000 bus transfers, in lifetime of motor, shall not puncture its insulation.
- 1.18.02 That motor shall be capable of withstanding heavy inrush transient current caused by such bus transfers without damage.
- 1.18.03 That the motor windings shall be adequately braced to satisfactorily withstand mechanical stresses under these conditions.
- 1.18.04 The motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torques under these conditions.

1.19 TYPE OF ENCLOSURE

- 1.19.01 Outdoor Motors IP 55 (Additional canopy to be provided by EPC contractor.
- 1.19.02 Indoor Motors IP 55
- 1.19.03 IP-55 degree of protection shall be achieved without application of any compound, putty etc.
- 1.19.04 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv. as detailed below:
- a) Fuel Oil area : Group IIB
 - b) Hydrogen generation plant area : Group IIC (or Group-I, Div-II as per NEC or Class-1, Gr-B, Div-II as per NEMA/IEC60034).

1.20 METHOD OF COOLING

- 1.20.1 Method of cooling shall be IC 411 (TEFC), IC 511 (TETV) or IC 611 (CACA). However, motors rated 3000kW or above can be closed air circuit water cooled (CACW).
- 1.20.2 Large capacity motors not available with above types of cooling may be accepted with IC 81 W for IC 91 W (CACW) cooling subject to the approval of the Owner.

1.21 TYPE OF MOUNTING As required for the driven equipment.**1.21 MAXIMUM MECHANICAL VIBRATIONS**

- 1.21.01 Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits

prescribed in IS: 12075 / IEC 60034-14. Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.

1.21.02 Noise level

The noise level of motors shall not exceed 85 db (A) at 1m from operating motor measured in accordance with IS: 10265.

1.21.03 Motor body shall have two earthing points on opposite sides.

1.21.04 11 KV motors shall be offered with Separate Insulated Connector (Elastimould or Equivalent make) as per IEEE 386. The offered Elastimould terminations shall be provided with protective cover and trifurcating sleeves. Elastimould termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.

1.21.05 3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.

1.21.06 The spacing between gland plate & centre of terminal stud shall be as per Table-I.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm
UP to 3 KW	As per manufacturer's practice.
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331

Above 125 KW-upto 200 KW

203

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

1.21.07 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

1.21.08 For motors rated 1500 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.

1.21.09 The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor.

(a)	Below 110KW	:	10.0
(b)	From 110 KW & upto 200 KW	:	9.0
(c)	Above 200 KW & upto 1000KW	:	10.0
(d)	From 1001KW & upto 4000KW	:	9.0
(e)	Above 4000KW	:	6 to 6.5

1.22

WINDING & INSULATION

- (a) Type : Non-hygroscopic, oil resistant, flame resistant
- (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature.
- (c) 11kV & 3.3 kV : Thermal class 155 (F) insulation.
AC motors
The winding insulation process shall be total Vacuum Pressure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15
- (d) 240VAC, 415V : Thermal Class(B) or better
AC & 220V
DC motors

1.23

DIRECTION OF ROTATION

1.23.1

As needed by driven equipment.

1.23.2

The 3 phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor.

1.23.3

If, in the case of HT motors, fan is suitable for only one direction of rotation, the fan shall be so designed that with the slight modification work, it can be made suitable for other direction of rotation also. No extra material shall be required for doing above modification work.

1.24

BEARINGS

- 1.24.1 General Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 20,000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing.
- Bearing shall be effectively sealed against dust ingress and shall be pressure grease gun lubricated.
- If the bearings are oil lubricated, a drain plug shall be provided for draining residual oil and oil level gauge shall be provided to show precisely oil level required under standstill and running conditions.
- Unless otherwise approved, bearing lubricating system shall be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.
- For MV & HV motors, the bearings shall be insulated wherever necessary to prevent damage to motor bearings from shaft current.
- When pressure oiling is required for horizontal motors, bearings shall be sleeve type arranged for pressure oiling supplied from lubrication system of driven machine, with ring oiling for starting and emergency duty. Ring oiling system shall be adequate for starting and continuous operation of motor for at least half an hour, without pressure oiling system in operation. Oil sight flow gauges shall be provided to indicate oil flow through each bearing.
- Lubricants shall be selected for prolonged storage and normal use of motors in tropical climate and shall contain corrosion and oxidation inhibitors. Greases shall have suitable bleeding characteristics to minimize setting. The selected lubricants shall be indigenously available.
- Sleeve bearings for use with motors having flexible coupling with limited end play, shall have adequate axial end play to prevent transmission of thrust from driven equipment to motor bearings.
- Bearings shall be of reputed make subject to the approval of the Owner/Consulting Engineer.
- 1.24.2 Large motors Large motors shall preferably have spherically seated babitted, ring forced, feed lubricated, water-cooled bearings. If anti-friction bearings are provided, these shall be roller bearings rated for a minimum standard life of 30000 hours taking all bearing and driven equipment loads into account.
- 1.25 **SHAFT EXTENSION** Key slotted bare shaft extension of required length with key on driving end.
- 1.26 **DRAIN HOLES** Two (2) drain holes with plugs, one (1) on either end of motor at the bottom most point.
- 1.27 **LIFTING DEVICES** Motors shall be provided with eyebolts, lugs or other means to facilitate safe lifting.
- 1.28 **DOWEL PINS**..... It shall be possible to drill holes vertically inclined through motor feet or mounting flange for installing dowel pins after assembling motor and driven equipment, before despatch (for completed driving + driven

equipment assembly) or at site after erection (for separate supplies of above equipment).

1.29 **CENTERING SPIGOT**..... Flange mounted motor shall have centering spigot to match driven equipment socket.

1.30 **EASE OF MAINTENANCE**..... Motor shall be so constructed that it can be de-assembled and reassembled with ease.

1.31 **NAMEPLATES**..... Motor shall have nameplate(s) showing diagram of connections, all particulars as per IS: 325 and following additional information:

In addition, an arrow block shall be screwed on to the body of motor on the non-driving end to indicate direction of rotation of motor.

1.31.1 Temperature rise under normal/abnormal conditions.

1.31.2 Type of bearing and recommended lubricants.

1.32 **FINISH**..... Motor shall have glossy, light grey finish No. 631 as per IS: 5 for withstanding site conditions as per Clause 1.00 above.

All sharp edges and scales shall be removed from the surface, which shall then be thoroughly degreased, de-rusted and given two (2) coats of primer and two (2) coats of finish paint. It is preferred that a phosphate coat is given to motor prior to application of primer coat. Motors for water treatment plant shall have Zinc Chromate base with acid resistant Epilex 4 paint.

1.33 **TERMINAL BOXES**

1.33.1 GeneralMotors shall be provided with separate terminal boxes for main, space heaters, embedded temperature detectors, bearing temperature indicators and moisture detectors terminals. When it is not possible to provide LT motors with separate terminal box for space heater terminals, space heater terminals shall be adequately segregated from the main terminals in the single box. Terminal boxes shall be weatherproof and water-tight conforming to minimum IP-55 degree of protection with removable front cover for making connections. IP-55 degree of protection shall be achieved without application of compound. Space between and around terminals shall be adequate for easily connecting aluminium conductor cables. Terminal box arrangement shall be to the approval of the Owner /Consulting Engineer. All terminal boxes shall be suitable for proper termination of the type and tentative size of cables specified in Clause 1.34 below, however, exact size of cables shall be furnished by Owner during engineering stage.

The terminal boxes shall be complete with cable glands and termination accessories as required. Suitable non-magnetic material construction shall be adopted for terminal boxes where single core cables are to be terminated. All HT motors shall be provided with phase segregated terminal box.

Terminal bushings and clamps shall be non-absorbent, non- inflammable, insulated material for connecting with cable.

1.33.2 **Main Terminal Box**



1.33.2.1 LV Motors Main terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.

1.33.2.2 MV & HV Motors Motor shall be provided with two (2) terminal boxes for stator terminals. One (1) terminal box shall be for phase terminals while other one for forming star connection. These should be interchangeable to facilitate cable routing.

Neutral terminal box for HT motors rated above 1500 KW shall be suitable for mounting of three (3) Nos. wound/bar primary/ring type cast resin insulated current transformers for differential protection. These transformers shall be supplied and mounted in the motor terminal box. In addition to above, 3 Nos. of identical current transformers shall be supplied loose for mounting in the switchgear. Stator phase terminal box may either be phase segregated or standard terminal box suitable for both top and bottom entry of cables (i.e. they should be capable of being turned through 180 Degrees). The terminal box shall be designed for termination of XLPE cables using heat shrinkable or push on type terminating Kit. Terminal leading shall be stud type or leading wire type.

1.33.2.3 Cable End Boxes.....Terminal Boxes shall be provided with cable end boxes having cable lugs and cable glands for cables of sizes as specified in Clause 1.34 below.

Cable box shall be suitable for glanding the cables; and shall have adequate space between cable glands terminating studs to allow suitable bends of cable inside the cable box for all 3 phases of relevant cable sizes specified.

1.33.2.4 The terminal boxes shall be capable of withstanding at the terminals the system fault level (as indicated below) without rupture for a duration of atleast 0.25 seconds.

Min. fault level for MV Motors - 40 KA

Min. fault level for LV & HV Motors - 50 KA

1.33.2.5 **PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:**

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

1.33.2.6 Terminal Accessories.....Each terminal end shall be furnished with bimetallic washers, spring washers, nuts and crimp type aluminium (preferably tinned) lugs suitable for cables of sizes as specified in Clause 1.34 below.

1.34 **TYPE AND SIZE OF CABLES**

1.34.1 **Space Heaters**



- 1.34.1.1 For LV Motors: Two point five (2.5) mm², two (2) core copper conductor PVC insulated, armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable to IS: 1554 (Part-I).
- 1.34.1.2 For MV & HV Motors: Six (6) mm² two core aluminium conductor PVC insulated armoured and FRLS PVC sheathed heavy duty 650/1100V grade cable to IS: 1554 (Part-I).
- 1.34.2 For Embedded Temperature Detectors two sets of six (6) Twisted triad 0.5 mm² ATC copper conductor armoured, shielded cable, 650/1100 V Grade IS: 1554 (Part-I). For bearing temperature, RTDS, two (2) sets of four (4) twisted triad 0.5 mm², ATC copper conductor armoured shielded 650/1100 V Grade, IS: 1554 (Part-I).
- 1.34.3 Bearing Temperature Indicators - For each indicator, 0.5 mm² six (6) tarnished triad ATC copper conductor, PVC insulated, shielded armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable as per IS: 1554 Part-I. Two (2) cables one (1) for each bearing temperature indicator.
- 1.34.4 For Moisture Detectors.....As for space heaters as per Clause 33.01.01 above.

1.34.5 For Main Terminals

LT Motors

1. Three (3) core cablesStranded aluminium conductor, XLPE insulated, colour coded, laid up, PVC sheathed, GI wire / strip armoured, FRLS PVC jacketed overall, 650 / 1100V grade, heavy-duty cables as per IS: 1554 (Part-I).
2. Single core cablesStranded aluminium conductor, XLPE insulated, hard drawn aluminium wire/ strip armoured FRLS PVC jacketed overall, 650 / 1100V grade, heavy duty cable as per IS: 1554 (Part-I).

HT Motors

1. Three (3) core cables stranded aluminium conductor, XLPE insulated, screened colour coded, laid up, PVC sheathed, GI wire/strip armoured FRLS PVC jacketed overall, 6.6 KV / 11 KV grade, heavy duty cables as per requirement for unearthed system as per IS: 7098 (Part-II).

The size and no. of cable to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box, cable gland and lugs suitable for the same.

Cable size may be increased in some cases because of large number of cables in under-ground ducts or because of voltage drop consideration. The supplier shall supply with terminal box and cable accessories suitable for higher size of cable at no extra cost.

1.35 EARTHING

- 1.35.01 General..... Two (2) grounding terminals one (1) on either side at the bottom suitable for connecting mild steel/GI flat/GI wire grounding conductor, size of grounding conductor shall be decided during detailed engineering.



- 1.35.02 LV Motors.....At each earthing point, two (2) drilled and tapped holes with hexagonal head bolts, plain washers, spring washers and tinned lugs (for motors upto 5.5 KW) for size of conductor specified shall be provided.
- 1.35.03 MV & HV Motors.....Non-corrodible metallic grounding pad shall be welded or brazed at each earthing point. The size of grounding pad shall be 75x65x25 mm. Grounding pad shall have 40 mm apart two (2) drilled and tapped holes with hexagonal head bolts, plain washers and spring washers for size of conductor specified. In addition, one suitable earthing terminal shall be provided inside the stator phase terminal box for earthing metallic shield of XLPE cables.
- 1.36 **EMBEDDED TEMPERATURE DETECTORS**.....HT motor shall be provided with six (6) Nos. duplex resistance temperature detectors (RTDs) embedded in stator winding at locations where high temperatures are expected. In addition one (1) duplex type RTD shall be provided in each bearing. The RTDs shall be 3 wire duplex platinum resistance type having a value of 100 ohms at 0 Deg.C
- 1.37 **BEARINGS TEMPERATURE INDICATORS**..... HT motors shall be provided with dial type two (2) bearing temperature indicators and will have two (2) sets of contacts, each set having 2 NO + 2 NC contacts rated for 5A at 240V AC and 0.5A at 220V DC. One set will be set to operate at lower value to give alarm and other set at a higher value to trip the motor.
- 1.38 **SPACE HEATERS**.....Valve / Damper actuator motors; and Motors above 30 KW shall be provided with one (1) or two (2) space heaters suitable for 240V, 50 Hertz single phase AC supply and of adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation or deterioration of insulation during shut down. Heaters shall be mounted inside the motor in accessible locations so that their removal and replacement is simple. Motors upto 30 kW shall have stator windings suitable for connections to 24V, 50 Hz AC supply for space heating.
- Motors upto 30 kW shall have stator windings suitable for connection to 24V, 50 Hz ac supply for space heating
- The terminals of space heaters shall be brought out to a separate totally enclosed dust proof and weatherproof terminal box.
- 1.39 **HOT AIR TEMPERATURE DETECTOR**
- If the motor is of CACA or CACW enclosure, a thermometer with alarm contracts in hot air circuit shall be provided.
- 1.40 **WATER FLOW INDICATOR**
- If the motor is of CACW enclosure a provision shall be made for visual indication of water flow and flow switch shall also be provided with alarm contacts. Thermometers shall be provided in water inlet and outlet circuits.
- 1.41 **MOISTURE DETECTORS**.....Motors with type of cooling 1C 81W or 1C 91 W shall be provided with moisture detectors for raising alarm in the event of water tube failure.

- 1.42 **BED PLATE**.....Whenever motor is supplied with driven equipment the Supplier shall ensure that bed plate suits both motor and driven equipment and is adequately braced to keep vibration and misalignment within allowable limits to the approval of driven equipment and motor manufacturers.
- 1.43 **OTHER ACCESSORIES**..... Motor shall be supplied with all accessories and parts other than those, specified above which are necessary and/or useful for efficient operation.
- 1.44 **TYPE TEST**
- 1.44.01 **HT MOTORS**
- a) The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract.
 - b) The type tests shall be carried out in presence of the Purchaser's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the Purchaser's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
 - c) In case the contractor has conducted such specified type test(s) within last five years as on the date of bid opening, he may submit during detailed engineering the type test reports to the Purchaser's for waiver of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Purchaser's reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.
 - d) Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Purchaser's either at third party lab or in presence of client representative and submit the reports for approval.
 - e) **LIST OF TYPE TESTS TO BE CONDUCTED**



The following type tests shall be conducted on each type and rating of HT motor

- i) No load saturation and loss curves upto approximately 115% of rated voltage
- ii) Measurement of noise at no load.
- iii) Momentary excess torque test (subject to test bed constraint).
- iv) Full load test(subject to test bed constraint)
- v) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

f) LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED

The following type test reports shall be submitted for each type and rating of HT motor

- i) Degree of protection test for the enclosure followed by IR, HV and no load run test.
- ii) Terminal box-fault level withstand test for each type of terminal box of HT motors only.
- iii) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15
- iv) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

1.44.02**LT Motors**

- a) LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Purchaser's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
- b) However if the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Purchaser's shall conduct all such tests under this contract at no additional cost to the Purchaser either at third party lab or in presence of client representative and submit the reports for approval.

1.44.03**LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

1 x 660 MW – Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only

- i) Measurement of resistance of windings of stator and wound rotor.
- ii) No load test at rated voltage to determine input current power and speed.
- iii) Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
- iv) Full load test to determine efficiency power factor and slip .
- v) Temperature rise test.
- vi) Momentary excess torque test.
- vii) High voltage test.
- viii) Test for vibration severity of motor.
- ix) Test for noise levels of motor(Shall be limited as per clause no 1.21.01 of this section)
- x) Test for degree of protection and
- xi) Over speed test.
- xii) Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

1.44.04 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

1.45 INFORMATION WITH PROPOSAL

1.45.1 AC Motor Data Sheet.

1.45.2 Dimension Drawing/Foundation load details of motor and driven equipment.
1.45.03 Manufacturer's catalogue showing constructional details.

1.46.00 **INFORMATION ON AWARD OF CONTRACT**.....Within six (6) weeks from the date of award of the Contract, following shall be furnished:

1.46.01 Motor Data Sheet.

1.46.02 Certified binding dimension drawing of motor complete with all accessories and fittings specifically showing terminal boxes, terminal spacing and sizes, earthing connections and sizes thereof, mounting details, lifting lugs, final foundation loads and dimensions with tolerances of centering spigot (where needed), shaft extension and key.

1.46.03 Following characteristics curves:

1.46.03.01 Torque-speed curves for motor at eighty (80), hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment.

1.46.03.02 Current-speed curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage

1.46.03.03 Current-time curves at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.

1.46.03.04 Thermal withstand curves for hot and cold at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.



- 1.46.03.05 Efficiency, power factor, current and speed versus power output curves.
- 1.46.03.06 Speed-time curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage.
- 1.46.03.07 Negative phase sequence current withstand characteristics.

1.47 COMMISSIONING CHECK LIST (HT MOTORS)

A PRELIMINARY CHECKS

Check the following:

1. Check the name plate details according to specification. Discrepancies, if any, to be satisfactorily resolved.
2. Check tightness of all bolts, clamps and connecting terminals.
3. Check body earthing
4. Check whether bearing lubrication is adequate
5. Check clearance inside terminal box
6. Checking stator (motor air gap) Check – Grease lubrication (for ball or roller bearing) is adequate if the motor was in storage for very long period replace the grease, by fresh grease after flushing the bearing clean. Excess grease in the bearing (housing ... is overheat of bearings) Check the free rotation of the rotor in decoupled condition. Check the air gap between stator and rotor at four positions 90o apart at driving and non-driving end. Compare the recorded values with factory results. For slip ring motors : with starting resistances.
 - a) Check the variation of resistance
 - b) Check brush lifting and slip ring short.

B COMMISSIONING CHECKS

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Measure resistance of motor winding (in case of large motors)
4. Control and interlocks should be checked
5. Motor protection relay to be calibrated
6. Phase sequence and direction of rotation
7. Other than DOL scheme to be checked example trafo starts
9. Measure starting current starting timer and no load current
10. On load operations starting and running currents (observed vibrations, temperatures of bearings and body)
11. On load operation, starting and running currents (observed vibrations, temperatures of bearings and body)
12. In case of forced water cooling of start or check winding temperatures as ready by built in RTDs.
13. Water level (start up cooling) low to be checked for limit switch operation.

1.48 COMMISSIONING CHECK LIST (LT MOTORS)**A PRELIMINARY CHECKS**

Check the following:

1. Check the name plate details according to specification. Discrepancies, if any, to be satisfactorily resolved.
2. Check tightness of all bolts, clamps and connecting terminals.
3. Check body earthing
4. Check whether bearing lubrication is adequate
5. Check clearance inside terminal box

B COMMISSIONING CHECKS

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Over load and short circuit relay tests and settings
4. Control and interlocks should be checked
5. Phase sequence and direction of rotation
6. Operation of timer in case of star delta starting
7. Measure starting current starting timer and no load current
8. On load operations starting and running currents

1.49 DC MOTOR SPECIFICATION

DC Motor will be of continuous duty type totally enclosed fan cooled (TEFC) having IP-54 degree of protection suitable for 220 V DC supply. DC motor will be shunt wound type having high torque characteristic suitable for Bi-directional rotation at rated speed and output. The general constructional features and details of DC motor will be in line with details/ particulars stipulated in the specification for AC squirrel cage induction motors.

Contractor will furnish the data in respect of DC motors.

DATASHEET

Auxiliary power supply		
1.1	HV supply	
	11kV, 3 Φ , 3W, 50 Hz non effectively earthed	Motors rated above 1500 kW
	Fault level	50 kA for 1 second
1.2	MV supply	
	3.3kV, 3 Φ , 3W, 50 Hz non effectively earthed	Motors above 200kW upto and including 1500kW
	Fault level	40 kA for 1 second
1.3	LV supply	
	415V, 3 Φ , 3W, 50 Hz effectively earthed	Motors below and including 200kW
	Fault level	50kA for 1 second
	110V, 1 Φ , 2W, 50 Hz effectively earthed	Lighting, space heating, AC control and protective devices
1.4	DC supply	
	220V, 2W, unearthed	DC alarm, control and protective devices.
	Fault level	25 kA for 1 second
2	Range of variation	As indicated in the specification
2.1	AC supply	
	voltage	-----
	Frequency	-----
	Combined voltage & frequency	-----
2.2	DC supply	198 to 240 V
Note: During starting of largest motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.		

CHAPTER 18 : ACTUATORS**1.00.00 ELECTRICAL ACTUATORS WITH INTEGRAL STARTERS****1.01.00 SCOPE**

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

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

1.02.00 CODES STANDARDS

All the equipment specified herein shall comply with the requirements of the latest issue of the relevant National & International standards.

The design and materials used for the components shall also comply with the relevant National & International standards.

As a minimum requirement, the following standards shall be complied with :

Electric motor operated actuators: IS 9334

Degrees of protection provided by enclosures at low: IS 2147

voltage switch gear and control gear

Flame Proof enclosure at electrical apparatus: IS 2148

Specification for three phase induction motors: IS 325

AC contactor for voltages not exceeding 1000 V: IS 2959

Degree of protection provided by enclosures for : IS 4691

Rotating electrical machinery

Specification for rotating electrical machines: IS 4722

For other code refer Section D28.

1.03.00 SERVICE CONDITIONS

The actuator shall be integral type and suitable for operation in a hot, humid and tropical atmosphere, highly polluted at places with coal dust & fly ash and shall be suitable for an ambient temperature ranging from (-) 20 deg C to (+) 70 deg C.

Actuators for explosion-hazardous applications shall in addition be certified Flameproof for Zones 1 and 2 (Divisions 1 and 2 Group gases).

2.00.00 RATING

(a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire 50HZ +/-5%.

(b) Sizing:-

For Open/Close at rated speed against designed differential pressure at 90% of rated voltage.

For isolating service:- three successive open-close operations or 15 mins, whichever is higher. For regulating service 150 starts per hour or required cycles, whichever is higher.

2.01.00 PERFORMANCES

2.01.01 The actuator shall meet the following performance requirements:

2.01.02 Open and close the valve completely and make leak-tight valve closure, without jamming.

2.01.03 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).

Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

The entire mechanism shall withstand any shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

2.02.00 SPECIFIC REQUIREMENT**2.02.01 CONSTRUCTION**

a) The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator and transmitter, . in built thermostat for overload protection, space heater and internal wiring. Actuator shall be integral type. Integral starters shall have facility to hook-up with plant DCS for positioning of limit and torque switches.

b) The actuator enclosure shall be totally enclosed, dust tight, weather proof (NEMA-6/IP-68) suitable for outdoor use without necessity of any canopy.

c) All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

d) The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

e) A lockable local/remote selector switch shall also be provided for selecting mode of operation.

f) Gear Train :

Metal (Fibre gears are not acceptable) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energised.

g) Manual Wheel:

Shall disengage automatically during motor operation.

2.02.02

MOTOR

The squirrel cage induction motor shall be designed for full voltage direct-on-line start, with starting current limited to 6 times full-load current. The motor shall be capable of starting at 85% of rated voltage and running at 80% of rated voltage at rated torque and also at 85% of rated voltage at 33% excess rated torque for a period of 5 minutes each. The motors shall otherwise generally conform with technical specification for motors mentioned elsewhere in this specification.

The actuators shall be sized so as to open or close valves/ dampers at rated speed enclosure shall not be more than 70 degree 'C' over ambient temp. of 70 deg.C as these are subjected to higher ambient conditions due to their vicinity to operate fluid on continuous load operation. The actuators shall be suitable for a relative humidity of 95%. Class of insulation shall be class-F and type of enclosure shall be IP-68.

The actuators shall be designed to be self locking upon loss of power. Motor shall be designed to close in 30 secs from full open position and shall have adequate capacity to open and close under full unbalanced design pressure.

The actuators shall be flange mounted to valve bonnets or with gearing and disengaging hand wheel for dampers.

2.02.03

LIMIT SWITCHES

Each motor actuator shall have Six (6) rotary drum position limit switches with two for open each with 2 NO + 2NC contacts and two for close each with 2 NO + 2 NC contacts positions, each with adjustable setting between fully open and fully closed positions. Each rotary drum limit switch shall have two (2) limit switches for intermediate open position each with 2 NO + 2 NC contacts. The limit switches shall have capacity of 5A at 240V AC or 0.5A at 220V DC.

Each motor actuator shall also have two (2) torque limit switches with four (4) normally opened and four (4) normally closed contacts each.

The torque switches shall have a minimum accuracy of 3% of set value. The torque switches shall be provided with calibrated knobs for setting desired torque and separate knobs shall be provided for open and close torque switches. The torque and position limit switches shall be housed in a separate enclosure with protection class as that of actuator.

The motor operators/actuators shall conform to AWWA specification and shall be capable of meeting 150 percent of unseating torque at specified voltage.

The motor actuators shall have 2 nos. potentiometric type transmitters of 100 ohm rating.

Torque switches shall function to stop the motor on closing. Upon actuation by the torque clutch it is restricted its attempt to open or close, thereby causing an overloading torque. Torque switches shall be non-self resetting type only (i.e.) once a particular direction torque switch operates, it will get resetted only when the equipment is operated in other direction.

All six (6) limit switches shall be changeover type and adjustable besides having the snap facility. All limit switches, contacts shall be wired up independently upto the terminal block.

2.02.04. **POSITION INDICATOR/TRANSMITTER**

- a) Motor actuators shall be provided with clearly visible local position indicators mounted on the operator assembly itself. Suitable transducers shall be provided for remote indication of the position.
- b) To be provided for 0 to 100% travel.
- c) As required. Suitable for stabilized 4-20 mA signal, 2 wire inductive type, 24 volts DC operated.

2.02.05. **HAND WHEEL**

Hand wheel shall enable manual operation in case of power failure but it shall get automatically disengaged when once the motor starts functioning. The effort required to operate manually shall not exceed 18 Kg.

2.02.06 **SPACE HEATER**

Provision of space heater, if necessary, shall also be made with servomotor limit switch compartments. The space heaters shall be suitable for operation at 240V AC and its rating shall be indicated by the tenderer. Space heater circuit shall be complete with thermostat.

2.02.07 **TERMINAL BOX**

- a) The terminals, terminal boards, terminal boxes, winding coils and associated equipments shall be suitable for connection to supply system having short circuit capacity specified in data sheet and clearance time determined by associated fuses. The terminal boxes shall be totally enclosed.
- b) 650V grade for power cables.

2.02.08 **WIRING**

All wiring connections for various limit and torque switches, space heaters, position transmitters shall be brought out on separate terminal boards mounted on the valve, having liberal space for wiring and making connections to Purchaser's external circuits. Plug in type terminals shall be used suitable for analog/digital application. There shall be atleast 5 terminal spare to terminate spare cores of cable. Size of each control terminal shall be such that two (2) nos. lugged 2.5 sq.mm cable can be terminated on

each side. Power terminals shall be suitable for termination of 6 sq.mm lugged wire or as required depending on the motor capacity.

Motor terminal box and actuator terminal box shall be provided with cable glands to suit cable type and size.

Adequate earthing terminals preferably not less than 8 SWG GI wire shall be provided for suitable earthing system. Two earthing terminals shall be provided per motor, one No. on either side of the motor. The actuator shall include a diagnostic module, which will store and enable down load historical down load operation and torque data to permit analysis of actuator and valve in service performance. Data down load shall be carried out without removing any covers and all shall be available locally to the actuator or remotely via telecommunication data transfer. Diagnostic and configuration software shall be made for user PC system.

2.02.09 INTERFACES:

Open/Close command termination logic with position & torque Limit Switches, positioner circuit shall be suitably built in the PCB inside the actuator.

- (a) For Binary Drive (both ON-OFF and INCHING type) :- Open/Close command & status thereof and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided.

Interface with the control system shall be through hardware signal only. Inter posing relays provided (with coil burden 2.5 VA) in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system.

- (b) For Modulating Drive:- the command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided
- (c) Open/close command termination logic shall be suitably built inside actuator.

2.02.10 DRAWING AND DATA AND MANUALS

Data sheet for each of the actuator shall be furnished alongwith internal wiring diagram, suggested control schematic and limit switch contact development and manufacturer's catalogues.

2.02.11 NAME PLATE

Name plate shall be provided on the actuators with at least following data
(a) Tag no. (b) Torque Rating (c) Full travel time.

2.02.12 PAINTING

The actuator shall be painted with epoxy based paint (the colour shall be indicated by the supplier). Paint shade shall be RAL 7032.

2.02.13 PACKING

The actuators shall be properly packed for transport by rail/ road/sea as applicable.

2.02.14 OVERLOAD PROTECTION

The actuator motor shall be provided with integral starter along with thermistor for overload protection.

2.02.15 TESTS

The actuator and all components thereof shall be subject to routine factory tests as per relevant IS Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

Following routine test shall be conducted as per IEC/IC standard. (a) Meggar Test, (b) Continuity test, (c) Operational test. Test certificates duly signed by inspecting agency shall be furnished.

The actuator shall be type tested as per IEC/National Standard, by international/national recognised test house. The test certificates issued by this house shall be furnished.

2.02.16 TEST WITNESS

Tests shall be performed in the presence of Owner/Purchaser's representative so desired by the Owner/ Purchaser. The contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

REV-0, DATE: 21.02.2019.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)**PACKAGES: CPU****SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT****PROJECT:**

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. OR (DE to select the choice applicable for their project) 415 V AC, 3 phase, 3 wire supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.

REV-0, DATE: 21.02.2019.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)**PACKAGES: CPU****SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT****PROJECT:**

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
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.

REV-0, DATE: 21.02.2019.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)**PACKAGES: CPU****SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT****PROJECT:****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.
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

PROJECT 1X660 MW UPRVUNL PANKI TPS EXTN

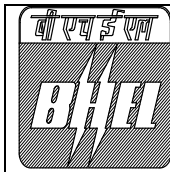
SCOPE OF VENDOR: SUPPLY , ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

<u>S. NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	Isolating Switch	Vendor	Vendor	BHEL will provide one number 415 V(3ph, 3W) 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]

ANNEXURE III

[illegible]



TITLE:
**1 X 660 MW PANKI TPS EXTENSION
PROJECT**

**SPECIFICATION NO. PE-TS-426-155-
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)

FORM NO. PEM-6686-0



Technical specification for
CONTROL & INSTRUMENTATION

1X660 MW TPS PANKI EXTN.

SPEC NO.:

VOLUME

SECTION -D

REV. NO. 00

DATE :

SHEET OF

SECTION-C

SPECIFIC TECHNICAL REQUIREMENT



**C&I SPECIFICATION FOR
CONDENSATE POLISHING UNIT**

SECTION: C
SUB SECTION: C&I

**C&I SPECIFIC TECHNICAL REQUIREMENT
FOR DCS BASED
CONDENSATE POLISHING UNIT**

|



C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT

SECTION: C
SUB SECTION: C&I

Specific Technical Requirements (C&I):

1. Condensate Polishing Unit (CPU) shall be operated from DCS (BHEL's scope).
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 within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial implication.
3. The make/model of various instruments/items/systems shall be as per NTPC approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
4. All instruments and control elements shall be terminated on JB/LCP in field and both instrument and JB/LCP are in bidder scope. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable.
5. For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.
6. Bidder to provide mandatory spares as per mandatory spares list.
7. Electrical Actuators with integral starter shall be provided for all on/off and inching type valves along with necessary interface units for linking to corresponding Control System as applicable, typical Hook-up diagram of drives is included for reference.
8. The specifications for instruments mentioned in the specification are minimum requirements. The detail specifications shall be finalized during detail engineering.
9. The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of only deviation, a No deviation certificate is to be furnished.
10. The quantity of instruments for the system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.
11. Bidder to terminate all instrumentation and control elements in junction boxes. Bidder to provide input/output list, drives list, junction box schedule and termination details, recommended control logics / write-up etc. the list of documents to be submitted after award of contract is to be referred by bidder.
12. All the transmitters supplied by Bidder shall be rack mounted. The transmitter racks shall be in Bidder's scope of supply. All transmitters shall be HART compatible.



C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT

SECTION: C
SUB SECTION: C&I

13. Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication. The make/model of various instruments/items/systems shall be as per customer/BHEL approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
14. Instrument installation and accessories required for the same shall be in Bidder's scope and shall be submitted after award of contract. However, any instrument/ analyser installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering.
15. All Temperature sensors shall be Duplex type and temperature transmitter shall be provided for all temperature measurement applications.
16. Bidder to provide temperature transmitter, JB/Rack & other erection hardware.
17. Bidder to furnish electrical load/UPS load data during detailed engineering.
18. UPS Power supply shall be provided by BHEL at a single point, further distribution to various instruments/equipment of the system shall be in bidder scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Bidder to submit the power requirement along with the bid.
19. Bidder's presence is required for 3 Man days (Excluding travel time) at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic. Intimation to attained FAT shall be informed in 2 days advance. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.
20. Contractor's C&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.
21. 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.
22. Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection (DCS end terminal details shall be provided to vendor during detail engineering to incorporate in cable interconnection), JB grouping, Annunciation list, SOE list, List of Instruments/devices for HART in BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.



C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT

SECTION: C
SUB SECTION: C&I

23. Interface of MCC, HT SWGR, Solenoid valves, field instruments, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.
24. Local control panel if any required for operation shall be in bidder scope.
25. The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback. Solenoid Valve shall be rated for 24V Dc only.
26. All field instruments enclosure shall be IP65 local panel/cabinet enclosure shall be IP 55, unless otherwise specified.
27. Diaphragm seal shall be provided with Instruments having contact with corrosive media.
28. Redundancy of sensors shall be provided by bidder
 - (i) Triple redundancy for all analog and binary inputs required for protection of system/drives.
 - (ii) For all other control functions dual redundancy of the sensors shall be provided by the bidder.
29. Double root valve shall be provided for all pressure tapings where the pressure exceeds 40kg/cm².
30. Use of process actuated shall be avoided unless unavoidable.
31. Number of pairs to be selected for Screen /Control cable
 - a) F-Type: 2P/4P/8P/12P (Size: 0.5sqmm²)
 - b) G-Type: 2P/4P/8P/12P (Size: 0.5sqmm²)
 - c) Core Cable: 3CX2.5sqmm²/ 5CX2.5sqmm²/ 12CX1.5sqmm²
32. Sodium Analyser and Silica Analyser, if applicable, shall be of Multi stream with sequencer /stream selector (min. 4 streams)
33. Instrument installation shall be as per the attached "Standard Hook-up diagram of instrument."
34. In addition to requirements specified here, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification.
35. In case of any conflict and repetition of clauses in the specification, BHEL discretion will prevail.
36. Measuring instruments (primary & secondary), SWAS equipment/analysers offered for this package shall have at least one year's satisfactory operation in one power station having unit rating of 200 MW or above. Provenness certificate shall be provided as per the attached format (Annexure - 4).
37. All the outdoor field instruments such as analysers/transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack so that the equipments are protected against rain/ sunlight etc.

ANNEXURE - 1

(g) Redundancy requirements

i Triple Redundancy

Triple Sensing device shall be provided for following applications:-

- a. **For** Binary and analog inputs required for protection of boiler, turbine and major auxiliaries of main plant whose non-availability may result in 50% loss of unit availability and loss of generation.
- b. Binary and analog inputs, which are, required for protection of more than one equipment as well as protection signals for important auxiliaries and HT Drives of main plant (fed by a supply feeder of ratings 3.3 kV onwards)/MDBP/TDBFP etc.,
- c. Separate triple sensors for Instruments required for auto starting of HT driven pumps or HT driven pump tripping due to very low level of water & discharge pressure very low.
- d. For binary and analog inputs which are also required for protection in addition to CLCS. The same shall include but not limited to the critical measurement used for following CLCS :-
Furnace draft, main steam and reheat steam temperatures, feed-water flow, throttle pressure, turbine first stage pressure, separator level, LPH and HPH level, deaerator level, hotwell level, CEP minimum recirculation, BFP minimum recirculation etc.
- e. For lube oil protection of all the HT drives, 2 out of 3 logics and necessary pressure transmitters for lube oil pressure shall be provided by bidder accordingly. However for bearing / winding temperature of HT motor, refer Electrical subsections, Vol. IV.
- f. Left and right side shall be treated as individual path / individual parameter, and each side/path shall have own triple redundancy accordingly.

ii Dual Redundancy

Dual Sensing device shall be provided for following applications:

- a. For binary and analog inputs required for all other closed loop control system (CLCS), protection and interlock conditions purpose of other equipments.
- b. 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.
- c. Dual redundant position transmitters shall be provided for Steam Admission Valves i.e. (Emergency Stop & Control Valves, Reheat Stop Valves & Control valves), Extraction steam QCNRV, CRH NRV.
- d. For instruments required for Heat rate measurements & PADO calculations.

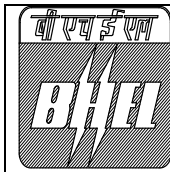
- iii. For binary and analog inputs used for alarm and monitoring only, single sensor criteria shall be applicable.



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TITLE:
**1 X 660 MW PANKI TPS EXTENSION
 PROJECT**

**SPECIFICATION NO. PE-TS-426-155-
 A001**

SECTION : II

**TECHNICAL SPECIFICATION FOR CONDENSATE
 POLISHING UNIT**

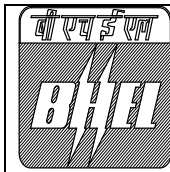
REV. NO. 00

DATE :

SECTION – II

GENERAL TECHNICAL REQUIREMENTS

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



TITLE:
**1 X 660 MW PANKI TPS EXTENSION
PROJECT**

**SPECIFICATION NO. PE-TS-426-155-
A001**

SECTION : II

**TECHNICAL SPECIFICATION FOR CONDENSATE
POLISHING UNIT**

SUB-SECTION : IIA

REV. NO. 00

DATE :

SECTION – II

GENERAL TECHNICAL REQUIREMENTS

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

CHAPTER 9: CONDENSATE POLISHING SYSTEM**9.0 CONDENSATE POLISHING SYSTEM****9.1 Design Criteria**

9.1.1 The system shall be designed for 100% condensate polishing for 660 MW Unit corresponding to the maximum mass flow rate established with VWO condition of turbine with suitable bypass arrangement plus maximum heat cycle make-up, with due consideration of redundancy as described elsewhere in this specification.

There will be three vessels (two in operation and one as standby), each polishing vessel of capacity 50% of Condensate flow corresponding to maximum :

9.1.2 Operating pressure shall be normal operating pressure of condensate extraction pump.

9.1.3 (i) Under the above operating and design flow through the polisher, each service vessel shall be designed to operate continuously for at least 10 days in Hydrogen Cycle.

(ii) During start up or condenser tube leakage, service cycle shall be of minimum 50hours.

9.1.4 The total pressure drop across condenser polisher units under dirty conditions shall be restricted to 3.5 bar (g).

9.1.5 For vessels of spherical shape, where the bed cross sections vary, the diameter of the vessel shall be selected considering velocity of condensate through it, not exceeding 1.75 meter/min.

9.1.6 The effective depth of the mixed resin bed in the condensate service vessels shall not be less than 1100 mm.

9.1.7 The inlet and outlet quality for design of CPU exchanger shall be as under:

DESIGN ANALYSIS OF CRUDE CONDENSATE

Contaminants	Unit	Normal Condition	Start Up Condition
Ammonia	ppb	250	1500
Copper	ppb	5	5
Total Ferrous Iron	ppb	50	1000
pH value (polisher runs at 25°C with H / OH mode)	ppb	8.5-9.0	9.0-9.6
Chloride (as Cl)	ppb	20	100
Sodium (as Na)	ppb	10	20
Silica (as SiO ₂)	ppb	30	500



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Contaminants	Unit	Normal Condition	Start Up Condition
Crud (mostly black oxide of iron)	ppb	50	1000

NOTE:

Under condenser tube leak condition, the CP System shall be designed for ingress of 2000 ppb TDS in addition to the influent contaminants under Normal Condition as stated above. The cation and anion load distribution for 2000 ppb TDS shall be based on cooling water composition.

DESIGN ANALYSIS OF TREATED CONDENSATE

Contaminants	Unit	Normal Condition	Start Up Condition	Tube Leakage Condition
Total Dissolved Solids (ammonia excluded)	ppb	Less than 25	Less than 50	
Ammonia	ppb	Below detectable limit	Below detectable limit	
Silica (as SiO ₂)	ppb	Less than 5	Less than 20	Less than 20
Total Ferric Iron	ppb	Less than 2	Less than 10	
Total Copper	ppb	Less than 1	Less than 1	
pH value (runs in H/OH mode)	ppb	6.5 - 7.5	6.5 - 7.5	
Electric Conductivity after hydrogen column (25°C)	μS/cm	Less than 0.1	Less than 0.2	
Chloride (as Cl)	ppb	Less than 2	Less than 10	
Sodium (as Na)	ppb	Less than 2	Less than 5	Less than 20
Crud (mostly black oxide of iron)	ppb	Less than 5	Less than 100	

- 9.1.8 The condensate polisher service vessel shall be located in the TG Building of unit. The resin shall be transferred to and from the regeneration facility by sluicing through a pipeline.
- 9.1.9 The regeneration process shall be of proven design and shall give resin-separation compatible with the desired effluent quality.
- 9.1.10 External Regeneration Facility shall be located in DM Plant area as shown in layout of DM Plant/CPU regeneration area.



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9.2 Condensate Polishing Units

- (i) Condensate Polisher Spherical service vessels as specified in technical data sheet complete with condensate inlet and outlet connections, connections for resin transfer to and from the vessels, bed support-cum-under drain system, inlet water distributors, air distribution arrangement for resin mixing all fittings and appurtenances etc. as specified and as required.
- (ii) External resin traps at condensate & rinse outlet of each of the polisher vessels, designed for in-place manual back flushing.
- (iii) Condensate inlet and outlet headers with pipe connections to the condensate polisher vessels.
- (iv) Resin transfer headers and pipe lines connecting the external regeneration facilities to the condensate polisher vessels of each installation. The resin transfer pipe lines shall be of SS-304 and sized for a flow velocity of between 2 and 3 m/s.
- (v) Rinse water outlet headers from condensate-polisher vessels shall be provided with a pressure reducing valve and orifice plate, suitably designed to enable the water entry to the condenser hot well under all operating condition of condenser.
- (vi) All necessary valves, and fittings for the installations with actuators necessary for their remote operation. These shall include suitable fullproof arrangement to prevent accidental over pressurization of the resin transfer pipeline and regeneration facilities connected to it, which are designed for pressure much lower than that of the polisher service vessels.
- (vii) A common drain header for the condensate polisher service vessels .All necessary drains, vents and sampling points, with valves as required.
- (viii) Gland sealing water piping for the valves in the rinse water line.
- (ix) All pressure vessels shall be designed and constructed in strict accordance with the ASME code Section VIII/IS 2825 or acceptable equivalent international standard.
- (x) All pressure vessels shall be fabricated from carbon steel plates as per SA-515/516 Gr. 60/ 70 and lined internally.
- (xi) Lining used shall be natural rubber having a shore durometer reading of 65 ± 5 Shore 'A' as per IS 4682 Part I.
- (xii) 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.



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(xiii) Vessel internal shall meet the following requirements:

Inlet water and under drains distributor

Hub and internals diffuser splash plate or header and perforated laterals. Material of construction shall be SS-316.

Same as above with screened laterals with internal perforated pipes and rubber lined flat bottom.

All internal fasteners shall be of SS-316 and heavy duty locknuts shall be used throughout.

(xiv) **Analytical Instruments (Normal)**

The polisher units shall be provided at common inlet and each outlet unit with a minimum of following analytical on line analysers.

- pH Analyser
- Conductivity Analyser
- Cation Conductivity Analyser
- Sodium Analyser
- Silica Analyser
- Chloride Analyser

(xv) Two (2) (1W + 1S) oil free type air blowers with electric motor drive for supplying air required for mixing the resins in service vessels.

(xvi) Adequate resins for each condensate polisher service vessels along with one (1) spare charge of resin in the mixed resin storage tank. One (1) spare charge of resins during commissioning and one (1) spare charge of resins as mandatory spares. Total charges six (6)

9.3 Emergency Bypass System

- 9.3.1 Each Condensate polisher service unit shall be provided with an automatic bypass for the condensate polisher on the condensate inlet and outlet headers of the unit with a globe type control valve and globe type isolation valves (resilient material seated, to ensure bubble-tight shut off) on the upstream and down stream sides of the control valve.
- 9.3.2 In the event of excessive pressure differential between the condensate inlet and outlet headers, this control valve will open automatically to bypass requisite quantity of condensate to prevent this pressure differential from exceeding a preset limit when two vessels/one vessel/no vessel is in operation.
- 9.3.3 Not Used
- 9.3.4 Complete instrumentation and controls for this system, including the differential pressure transmitters, panel mounted indicating type controller with provision for remote manual operation, and actuator for the control



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valve with position indicator shall be furnished. All tubing, wiring air sets and other fittings required to complete the system shall be installed.

- 9.3.5 The isolation valve shall be provided with geared operator for manual operation and shall be located at a height which can be easily operatable.
- 9.3.6 The entire system shall be designed for an internal pressure of at least the design pressure of service vessels and for a maximum condensate flow of not less than total design flow of all the working service vessels.
- 9.3.7 The control system shall be so designed that the control valve is able to bypass 50% of rated flow when any of the service vessel is out of service and 100% of flow when both the service vessels are out of service.

9.4 Exchange Resins

- 9.4.1 Cation-Anion resin ratio shall be 2 parts Cation to 1.0 part anion by volume. In case the process require any non ionic resin the same shall represent at least 10 percent of the bed volume, but not less than 15 cm of the bed depth in the resin separation/Cation regeneration tank of the external regeneration facility.
- 9.4.2 The resins shall be of reputed manufacturer with adequate past record of successful service for not less than 3 years in similar application. Some of these possible resin makes are as follows:

- (i) Duolite.
- (ii) Rohm and Hass
- (iii) Dowex
- (iv) Purolite.

The CPU Grade resin shall be of uniform particle size quality with uniformity co-efficient of 1.2 and suitable for short term excursion of temperature upto 60 °C.

9.5 External Regeneration Facility

- 9.5.1 The regeneration of the ion-exchange resins from the condensate polishers of the turbo-generator unit shall consists of following :
- Resin Separation & Cation Regeneration Vessel
 - Anion resin Regeneration Vessel
 - Mixed resin storage vessel

However, any other proven alternative scheme of external regeneration as per the standard practice of Supplier of CP System may also be adopted subject to suitability of the same in all respects for satisfactory operation and performance of Condensate Polisher Mixed Beds.



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9.5.2 Vessel Freeboard Requirements

The pressure vessels in the external regeneration facility shall be provided with adequate freeboards over the top of the settled resins, to minimize resin loss during their use. Minimum permissible freeboards are as follows:

- Resin Separation & Cation Regeneration Vessel
 - Not less than 100%
- Anion resin Regeneration Vessel
 - Not less than 100%
- Mixed resin storage vessel
 - Not less than 100%
- Activated carbon filter - Not less than 75%

Suitable mill tolerances shall be considered for determining the thickness of the shells and dished ends. A minimum thinning allowance of 2 mm shall be considered for the dished ends.

- One (1) no. Resin Injection Hopper, complete with water ejector system for resin make-up. The tank shall be sized to handle up to 150 liters of as received new resins.
- All internals, fittings and appurtenances for these vessels.
- All necessary piping, valves and fittings for this installation with the actuators necessary for their remote automatic operation. These shall include all drains, vents and sampling points with valves as specified and as required.
- Common waste effluent header with one resin trap designed for in-place manual backwashing.
- Two (2) (1W + 1S) nos. CPU regeneration pumps with electric motor drives, one normally operating & other stand-by for water supply for chemical preparation / dosing & transfer of resin from service vessel to regenerating vessels & vice-versa shall be provided.
- Two (2) (1W + 1S) oil free type air blowers with electric drive motors, for supplying all the process air required for cleaning of resins and their regeneration processes. Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter / silencer, flexible coupling and discharge snubber, all mounted on a single base, along with Relief valves, Acoustic hood etc. as required.

9.5.1 Chemical Regeneration System

All equipment for dosing of acid and alkali solutions shall be rated to provide a maximum dosing rate at least 20% in excess of that required from process calculation. The Acid and alkali dosing equipment for regeneration of



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condensate polishing resins shall preferably be mounted on skid, which shall consist of at least the following:

- (i) Acid and alkali shall be dosed by means of metering pumps depending upon regeneration technique used for CPU. There would be separate metering pumps for acid & alkali. There shall be 2 x 100% metering pumps for each application.
- (ii) For heating of alkali diluent water a hot water tank with electric heater 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 indicator etc. The temperature switches provided on the tank shall control the heater. The heaters shall be sized for heating the water from a temperature of 15 to 50 deg. C at the outlet of ejector.
- (iii) Two (2) nos. acid measuring tanks each of adequate capacity to hold 120% acid required for one regeneration.
- (iv) Two (2) nos. alkali measuring tanks each of adequate capacity to hold 120% alkali required for one regeneration.
- (v) All interconnecting piping, valves and fittings as required for the system.

9.5.2 Bulk acid and alkali storage tanks

DM Plant Bulk acid / alkali storage tanks shall be used.

9.5.3 DM Water for regeneration

DM water required shall be drawn from DM Water Storage Tanks.

9.5.4 Effluent Disposal System

DM Plant neutralizing pit shall be used.

Note: All Piping, Valves & Fittings handling acid and alkali shall be of CPVC SCH 80 Only.

Bidder shall provide all the consumable including chemicals till the Trial Run Operation of the plant and additional chemicals of one (1) month requirement.



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9.5.5 Operation**9.5.5.1 Control & Operation of Plant**

The regeneration system will be external. Under normal conditions, it will hold a complete charge of freshly regenerated and mixed resin, ready for use, in its storage tank. For regeneration, resin from the exhausted exchanger vessel will be transferred hydro pneumatic/hydraulically to this facility. The empty exchanger vessel will then be filled up with the already regenerated resin, which was stored in the regeneration facility. This exchange vessel shall come into service soon after requisite condition is satisfied or as and when desired by the operator. In the meantime, the exhausted resin charge will be cleaned, separated, regenerated, mixed and rinsed before being stored for the next use.

The common influent headers of each polisher service unit will be connected to an automatic bypass line to be provided. This bypass line shall include a differential pressure device, which on a high signal will cause an automatic valve to open, bypassing the service vessels.

- (i) It shall be possible to operate the regeneration plant in auto/semi-auto/manual mode. In 'Auto' mode, once the sequence has been initiated, it shall proceed from step to step automatically. In 'Semi-auto' mode each step shall be performed only after initiation by the operator. In Manual mode, complete operation shall be by the operator by operation from the control panel. On DDCMIS failure, it shall be possible to operate the valves by means of manual operation of solenoid valves also.
- (ii) The condensate-polishing unit shall be controlled from Plant Water System DDCMIS. This system shall be suitably interlocked with the regeneration system.
- (iii) Each of the solenoid valves in CPU plant shall be provided with 'close-Auto-open control switches. In 'Auto' position of the control switch the solenoid valve shall receive close/open command from the Automatic sequence logic.
- (iv) It shall be possible to select each of the CPU vessels for any of the following operations.
 - (a) Service
 - (b) Resin Transfer from CPU vessel to Regeneration plant.
 - (c) Resin Transfer from Regeneration Plant to CPU vessel.
 - (d) Isolation from service.
 - (e) Rinse Recycle.

9.5.5.2 Condensate Polisher Control System

- (i) The requirements of Control System are to be read in conjunction with detailed Technical specification & data sheets enclosed in the C&I specification Vol. V chapter-14.



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- (ii) For CPU control Philosophy, the bidder shall refer C&I specification Vol. V.
- (iii) Plant schematic for monitoring & operation shall be available on OWS, bidder to further submit list of important signal along with applicable schematic for monitoring in DDCMIS.
- (iv) All instruments required for package shall be supplied, mounted on the gauge board racks, along with accessories like impulse pipe, fittings & valve manifolds etc.
- (v) Time synchronization of control system with master clock system is to be carried out. Necessary hardware/software for same to be provided.
- (vi) All bidirectional drives are with integral starter.
- (vii) 2 x 100% parallel redundant UPS, 1 x 100% Bypass stabilizer & 1 set of battery bank for minimum 60 minute back up at 100% load shall be provided..
- (viii) Smart positioners shall be provided for pneumatically controlled valves.
- (ix) For detailing of control systems & field and measuring instruments, bidder shall refer C&I specification Vol. V chapter-4, 14 & 2 respectively.

DATASHEET - CONDENSATE POLISHING UNIT

1.0	DESCRIPTION OF TURBO GENERATOR UNIT (TG) FOR WHICH CONDENSATE POLISHING IS TO BE PROVIDED :	
(i)	No. of units	One (1)
(ii)	Capacity of each unit	660 MW
2.0	CONDENSATE POLISHER SERVICE VESSELS PER UNIT :	
(i)	No. of condensate polisher service vessel	Three (3 x 50% Full flow condensate polishing)
(ii)	Capacity of each condensate polisher service vessel	50 % of total condensate flow per unit
(iii)	Flow through each condensate polisher service vessel per unit	Bidder need to specify
(iv)	Operating pressure of each condensate polisher service vessel	Bidder need to specify
(v)	Design pressure of each condensate polisher service vessel	Bidder need to specify
(vi)	Design code of each condensate polisher service vessel	ASME Sec VIII Div. I Ed 2010
(vii)	Design Temp.	60 ° C
(viii)	Type of vessels	Vertical (spherical)
(ix)	Emergency by-pass system	To be provided



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(x)	Material of construction of service vessel	Carbon steel plates to SA 516 Gr. 70 with minimum 4.5 mm thick rubber lining inside in three layers	
(xi)	Resin traps at the outlet of each condensate polisher service vessel & rinse outlet	SS with SS 316 Internals	
2.1	AIR-BLOWERS FOR RESIN MIXING (SERVICE VESSELS AREA)		
(i)	Number	Two (2 x 100%)	
(ii)	Type	Centrifugal/Twin lobe type oil free, positive displacement	
(iii)	Duty	Intermittent	
(iv)	Capacity and head / Noise Level	As required/80dB(A) Max. at one meter	
(v)	Pressure gauge	One per blower	
(vi)	Location	Indoor	
(vii)	Material of construction	Cast Iron	
(viii)	Dive motor	The drive motor of each air blower will be energy Efficient-1 as per IS : 12615	
3.0	EXTERNAL REGENERATION FACILITIES		
3.1	REGENERATION VESSELS		
(i)	Resin Separation & Cation Regeneration Vessel	One (1)	
(ii)	Anion Regeneration Unit	One (1)	
(iii)	Mixed Resin Storage Unit	One (1)	
(iv)	Type	Vertical (Cylindrical)	
(v)	Material of construction (shell & dished ends)	SA 516 Gr. 70 / SA 282 Gr. C with minimum 4.5 mm thick rubber lining inside in three layers.	
(vi)	Design code	ASME sec. VIII div 1 ed. 2010 / IS 2825 as applicable	
(vii)	Minimum Design Pressure for Pressure Vessels	10 Kg/cm2 (g) minimum	
(viii)	Resin traps at the common outlet header of regeneration vessels	SS with SS 316 Internals	
(ix)	Accessories	Operating platforms, ladders, supports, lifting lugs (4 nos. minimum) and other structural works for each regeneration vessel to facilitate accessibility for operation and other equipments etc.	
3.2	CHEMICAL HANDLNG, PREPARATION & DOSING SYSTEM		
a)	CHEMICAL TANKS	ALKALI MEASURING TANK	ACID MEASURING TANK
(i)	Number	Two (2)	Two (2)
(ii)	Type	----- Vertical Cylindrical Atmospheric with dished bottom and cover at top -----	
(iii)	Useful capacity	Adequate to hold quantity of alkali required (40% NaOH) for single regeneration	Adequate to hold quantity of acid required (30% HCL) for single regeneration of a condensate polisher mixed bed with 20%



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		of a condensate polisher mixed bed with 20% overall margin.	overall margin.
(iv)	Material (Shell, Dished end & top cover)	----- IS 2062 Gr. A/B -----	
(v)	External protection	----- Inside line with Natural rubber (minimum 4.5 mm thick in three layers) -----	
(vi)	Vent, Overflow, drain connection	----- Required -----	
(vii)	Level indicator	----- Gauge glass with overlap -----	
(viii)	Level transmitter per tank	One (1)	One (1)
(ix)	Accessories	Fume absorbers, carbon dioxide absorber, manhole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs (4 Nos. minimum) etc.	
b)	DOSING PUMPS	ACID DOSING	ALKALI DOSING
(i)	Number	Two (2x100%)	Two (2x100%)
(ii)	Type	----- Simplex positive displacement hydraulically operated diaphragm type -----	
(iii)	Accessories		
a)	Pressure Dampener	One per pump	One per pump
b)	External safety relief valve (in addition to inbuilt safety valve)	Two	Two
c)	MOC of safety relief valve	Poly propylene	SS-316
(iv)	Pressure gauge	----- One per pump with Teflon diaphragm seal -----	
(v)	Maximum pump stroke speed per minute	----- 100 -----	
(vi)	Material of construction		
a)	Liquid End (Pump Head, Valves, Valve housing, valve spring etc.)	Polypropylene	SS 316
b)	Diaphragm	-----P.T.F.E.-----	
c)	Packing	-----P.T.F.E.-----	
d)	Shaft	----- Hardened steel EN 8 (BS : 970) -----	
e)	Worm & worm wheel(if applicable)	----- Manganese Bronze -----	
f)	Connecting rod	----- Manganese Bronze -----	
g)	Cross head guide	----- Bronze -----	
(vii)	Capacity & head	Capable of meeting regeneration one cation /Anion unit (with 20% margin); head as required (with 20% margin).	
(viii)	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, pulsation dampener etc.	
(ix)	Drive motor of pump	The drive motor of each pump will be Energy Efficient-1 as per IS : 12615	



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(iv)	Piping-Service vessel Outlet	Piping – ASTM A 106 Gr.C BFV – SS CF8M Ball Valves – SS CF8M
(v)	Service vessel bypass piping Butterfly Valves of flangeless water type)	Piping – ASTM A 106 Gr. C BFV – A 216 WCB
(vi)	Service vessel rinse piping	CS to ASTM A 106 Gr.C
(vii)	Acid & Alkali Regeneration piping & Valves	All piping, Valves & Fittings shall be CPVC Sch. 40 only
(viii)	Acid / Alkali Transfer piping & Diaphragm Valves	
(ix)	Instrument Air piping & Full Port Ball Valves	IS 1239 Galvanized
(x)	BUTTERFLY VALVES	Butterfly valves shall be of double flanged of low leakage rate confirming to AWWA-C-504 class 300 (min.) or BS:5155 PN 10 (min.) Butterfly valves in treated condensate service shall be of stainless steel construction, SS-316 (for body, disc and shaft). Butterfly valves in crude condensate service shall be of Carbon Steel construction. All the butterfly valves shall be provided with Hand wheel or lever as per the requirements. For larger sizes i.e. 150 NB and above. Valve provided with motorized or pneumatic actuator shall be provided with a hand wheel for manual operation. All the valves shall be equipped with adjustable mechanical stop-limiting devices to prevent over travel of the valve disc in the open and closed positions. The valve operators (Handwheel or Gear reduction unit or Motor actuator etc.) shall be designed as per relevant International Standard. All the butterfly valves shall be provided by the bidder with an indicator to show the position of the disc. Flanges shall conform to ANSI B 16.5 CL.300 (min.) Butterfly valves at the bypass line of service vessel shall be double flanged.
(xi)	DIAPHRAGM VALVE	The Diaphragm shall conform to following requirement for DM water application



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		i) Design standard : BS : 5156 or equivalent of required rating / class. (minimum rating of valves shall be PN 10). ii) Type : Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type iii) Material of Construction a) Body, Bonnet : Cast iron IS 210 Gr. FG 260 or equivalent or Cast steel ASTM A-216 Gr. WCB b) Body lining : Soft natural rubber, ebonite, Polypropelene c) Handwheel : Cast Iron d) Compressor : Stainless Steel e) Stem and Bush : Stainless Steel For Acid and Alkali services the valve shall be CPVC PN10/Sch 40 only.
	GLOBE VALVE	Globe valves in treated condensate service shall be of stainless steel construction, SS-316. Globe valves in crude condensate service shall be of Carbon Steel construction.
(xii)	ECCENTRIC PLUG VALVE / BALL VALVE	These valves shall be used for resin transfer line. These valves shall be flanged type and of SS 316 construction.
5.0	Flanges	
(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



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S. No.	Description	Units	Parameter					
vii)	Vent, overflow, Drain, fume absorber and sample connection		All pipe, flange & valves MOC CPVC. Piping upto inlet of each exchanger. Except Bulk Tank isolation valve					
ix)	Manhole, staircase, platform		-----Required-----					
5.3	Fume Absorbers							
i)	Numbers Required		One per tank					
ii)	Material of construction		CPVC					
5.4	Measuring Tanks		Acid			Alkali		
			Cation Unit	MB	NP	Anion Unit	MB	NP
i)	Numbers required		2	2	1	2	2	1
ii)	Type		-----Vertical-----					
iii)	Useful capacity of each tank		125% of chemical requirement for one regeneration.					
iv)	Material of Construction.		Carbon Steel with 4.5 mm thick rubber lining inside in 3 layers					
v)	External protection		Chlorinated rubber paint DFT 300 microns with two coats of primer.					
vi)	Vent, overflow, Drain connection		Required, all pipe, flange & valves MOC-CPVC					
vii)	Agitator		---			One (1) per tank SS slow speed agitator with reduction gear & motor. ASME SA 479 Gr. 316 One (1) per tank having MOC ASME SA 479 Gr. 316		
viii)	MOC for Shaft & Impeller							
ix)	Dissolving baskets No. & MOC							
5.5	Preparation Tanks/Vessels		AC Filter	Hot Water tank	Brine Preparation Tank			
i)	Type		Vertical Cylinder Pressure Vessels with Dished Ends					
ii)	Numbers Required	Nos.	One(1)	One(1)	One(1)			
iii)	Liquid To be Handled		NaOH	Hot Water	Brine			
iv)	Type Of Heater		Not applicable	Electric (2x50%)	Not applicable			
v)	Location		Outdoor					
vi)	Effective Capacity		10 m^3/hr	Suitable Volume to meet the requirement for regeneration of one (1) bed	Suitable Volume to meet system requirements for one brine rejuvenation cycle.			



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S. No.	Description	Units	Parameter		
				volume of SBA at 40°C + regeneration of one (1) anion regeneration vessel + 20% margin.	
vii)	Design Surface Flow Rate	m3/m2/hr	15	Not Applicable	Not Applicable
viii)					
ix)	Filter Media		Activated Carbon	Not Applicable	Not Applicable
x)	Minimum Bed depth	mm	1000	Not Applicable	Not Applicable
xi)	Underdrain System		Strainer on plate	Not Applicable	Not Applicable
xii)	Shell material		MS	SS with Insulation	MS
xiii)	Shell Lining		Epoxy	-----	Rubber lining
xiv)	External Painting		Chlorinated Rubber paint	-----	Chlorinated Rubber paint
xv)	Accessories		Manhole, Handholes, vent & Drain Connection with required Valves	Manhol, Handholes	Vent Overflow& Drain connection with required Valves
5.6	Concentration Meter		Acid		Alkali
i)	Number		-----One (1) per ejector-----		
ii)	Type		Density indicator (Hydrometer type)		
iii)	Indication		-----Local-----		
iv)	Location		-----Diluted Acid/Alkali line-----		
6.0	Neutralising System				
6.1	Neutralisation Pit		One (1) (twin compartment)		
i)	MOC & Protection		RCC & Acid / Alkali proof PPG lining		
ii)	Effective capacity of each compartment	M3	To hold waste generated from single regeneration of one stream of DM Plant + waste generated from single		



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S. No.	Description	Units	Parameter		
			regeneration of one CP Service Vessel + 20% Margin.		
iii)	Isolation gate valves		To be provided		
6.2	Neutralised Waste Disposal Pumps		Two (2) (1w+1s) in each compartment.		
i)	Capacity and Head	M3/hr, MWC	To empty pit in four (4) Hours Transfer water to CMB		
ii)	Type		Vertical , Centrifugal		
iii)	Lubrication		Grease		
iv)	Noise Level		85 DBA		
v)	Material of Construction				
	- Column Pipe		Stainless Steel CF 8M		
	- Base Plate		Carbon Steel IS:2062		
	- Impeller		Stainless Steel CF 8M		
	- Shaft		Stainless Steel SS 304		
	- Shaft coupling		Stainless Steel SS 304		
	- Shaft sleeve		SS 316		
vii)	Drive motor		Induction motor 415V, 3 phase 50Hz, TEFC		
6.3	Blowers		MB/N-PIT	DMF	
i)	Quantity	Nos.	Two (1W + 1S)	Two (1W + 1S)	
ii)	Type		Twin lobe	Twin lobe	
iii)	Location		Indoor inside DM Plant Building	Indoor inside DM Plant Building	
iv)	Duty		Continuous	Continuous	
v)	Capacity		As per process requirements	As per process requirements	
vi)	Drive motor		Induction Motor 415 V; 3 Ph, 50 Hz	Induction Motor 415 V; 3 Ph, 50 Hz	
6.4	D.M. Water Storage Tanks				
	i. Quantity	No.	Two (2)		
	ii. Capacity (effective)	Cu.m	1000		
	iii. M.O.C.		M.S.E.P.		
	iv. Accessories		The tanks shall be provided with 3 layers of floating polypropylene balls to avoid contact with CO ₂ atmospheric oxygen along with breather and water seal		
Note: For Design Details please refer Volume III , Chapter 35 (V3B. Ch. 35).					
7.0	DM Water Pumps		DM Regeneration	DM Water Transfer	CPU Regeneration
i)	Number		Two (2) (1W+1S)	Two (2) (1W+1S)	Two (2) (1W+1S)
ii)	Type		Horizontal Centrifugal	For Design Details please	Horizontal Centrifugal



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S. No.	Description	Units	Parameter
iii)	Operation		Intermittent
iv)	Suction condition		Flooded
v)	Capacity & head m ³ /hr MWC		As per process requirement
vi)	Material of Construction		
	- Casing		Stainless Steel CF 8M -
	- Base plate		Carbon steel IS:2062
	- Impeller		Stainless Steel CF 8M--
	- Shaft		Stainless steel SS 316-
	- Shaft coupling		Stainless Steel SS 304-
	- Shaft sleeve		-SS 316
vii)	Vibration		As per HIS
viii)	Lubrication		Grease-
ix)	Noise Level		85 DBA
x)	RPM		15000 (asynchronous)
xi)	Drive motor		Induction Motor 415 V, 3 Phase, 50 Hz, TEFC
8.0 Condensate Storage Tanks			
i.	Quantity	No.	One (1)
ii.	Capacity (effective)	Cu.m.	500
iii.	M.O.C.		M.S.E.P.
iv.	Accessories		The tanks shall be provided with 3 layers of floating polypropylene balls to avoid contact with CO ₂ atmospheric oxygen along with breather and water seal
Note: For Design Details please refer Volume III , Chapter 35 (V3B. Ch. 35).			
9.0 Air Receiver Vessel			
i)	Quantity	No.	One (1)
ii)	Capacity	Cu.m.	5
iii)	Design code		IS 2825
iv)	MOC		IS 2062
v)	Design Pressure	Kg/hr	10



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AMENDMENT WTP & WWTP

Sl. No.	Volume / Chapter	Page No.	Clause No.	Bid Specification	AMENDMENT
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19.	Volume-III/ Chapter-9	1 of 14	9.1.5	For vessels of spherical shape, where the bed cross sections vary, the diameter of the vessel shall be selected considering velocity of condensate through it, not exceeding 1.75 meter/min.	For vessels of spherical shape, where the bed cross sections vary, the diameter of the vessel shall be selected considering velocity of condensate through it, not exceeding 2.0 meter/min.
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1 x 660 MW - Panki Thermal Power Station**AMENDMENT WTP & WWTP**

Sl. No.	Volume / Chapter	Page No.	Clause No.	Bid Specification	AMENDMENT
20.	Volume-III/ Chapter-9	1& 2 of 14		DESIGN ANALYSIS OF CRUDE CONDENSATE: Silica (as SiO ₂) DESIGN ANALYSIS OF TREATED CONDENSATE: Silica (as SiO ₂)	DESIGN ANALYSIS OF CRUDE CONDENSATE: Reactive Silica (as SiO ₂) DESIGN ANALYSIS OF TREATED CONDENSATE: Reactive Silica (as SiO ₂)
21.	Volume-III/ Chapter-9	2 of 14		DESIGN ANALYSIS OF TREATED CONDENSATE: Total Ferric Iron	DESIGN ANALYSIS OF TREATED CONDENSATE: Total ferrous iron
22.	Volume-III/ Chapter-9	2 of 14	9.3.1	Each Condensate polisher service unit shall be provided with an automatic bypass for the condensate polisher on the condensate inlet and outlet headers of the unit with a globe type control valve and globe type isolation valves (resilient material seated, to ensure bubble-tight shut off) on the upstream and down stream sides of the control valve.	Each Condensate polisher service unit shall be provided with an automatic bypass for the condensate polisher on the condensate inlet and outlet headers of the unit with a double flanged butterfly type control valve and double flanged butterfly type isolation valves on the upstream and downstream sides of the control valve.
24.	Volume-III/ Chapter-9	1 & 2 of 14	9.1.7	Design analysis of crude condensate & treated condensate : Copper inlet & outlet values:	The figures with reference to the Copper may be ignored in case the complete metallurgy is ferrous.
25.	Volume-III/ Chapter-9	4 of 14	9.2 (XIV)	Analytical Instruments (Normal) : The polisher units shall be provided at common inlet and each outlet unit with a minimum of following analytical on line analysers. - pH Analyser - Conductivity Analyser - Cation Conductivity Analyser - Sodium Analyser - Silica Analyser - Chloride Analyser	Analytical Instruments (Normal) : The polisher units shall be provided at common inlet and each outlet unit with a minimum of following analytical on line analysers. - pH Analyser - Conductivity Analyser - Cation Conductivity Analyser The polisher units shall be provided at common inlet and each outlet unit with multi stream (Four channel) sodium analyzer, Silica Analyser & Chloride Analyser. - Sodium Analyser - Silica Analyser

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Sl. No.	Volume / Chapter	Page No.	Clause No.	Bid Specification	AMENDMENT
					- Chloride Analyser
28.	Mechanical/Tender Drawings/Condensate Polishing Unit/Volume-VII		14A14-DWG-M-017 (SH. 1 OF 2)-R-0		Note: Analytical Instruments (Normal) shall be provided as follows: The polisher units shall be provided at common inlet and each outlet unit with a minimum of following analytical on line analysers. - pH Analyser - Conductivity Analyser - Cation Conductivity Analyser The polisher units shall be provided at common inlet and each outlet unit with multi stream (Four channel) sodium analyzer, Silica Analyser & Chloride Analyser. - Sodium Analyser - Silica Analyser - Chloride Analyser
29.	Volume-III/ Chapter-2, Section-1	4 of 8	4.0	Condensate Polishing Plant including filters, mixed bed unit, regeneration unit, piping, valves and instrumentation shall be included in the Bidder's scope. The CPU shall be provided with associated chemical feed system for preparing, measuring and dosing the required chemicals.	Condensate Polishing Plant including mixed bed unit, regeneration unit, piping, valves and instrumentation shall be included in the Bidder's scope. The CPU shall be provided with associated chemical feed system for preparing, measuring and dosing the required chemicals.

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AMENDMENT WTP & WWTP

Sl. No.	Volume / Chapter	Page No.	Clause No.	Bid Specification	AMENDMENT
30.	Volume-III/ Chapter-2, Section-2	37 of 63	4.0	The condensate polishing units shall be of deep mixed bed type. Condensate Polishing Plant including filters, mixed bed unit, regeneration unit, piping, valves, instrumentation as described in elsewhere in the specification shall be included in the Bidder's scope.	The condensate polishing units shall be of deep mixed bed type. Condensate Polishing Plant including mixed bed unit, regeneration unit, piping, valves, instrumentation as described in elsewhere in the specification shall be included in the Bidder's scope.

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CHAPTER 35: GENERAL REQUIREMENT FOR MISCELLANEOUS TANKS**35.1 General**

- 35.1.1 This section covers the design, supply of steel pipes and plates, structural steel and all accessories as required, paints and protective paintings as specified and as required, fabrication, erection, painting, testing of Fabricated & Miscellaneous Tanks with accessories as specified and associated civil works.

35.2 Codes & Standards

The design, manufacture and testing of tanks shall comply with the requirements of one or more of the following standards as applicable.

- 35.2.1 IS-805: Code of practice for use of steel in gravity water tank.
- 35.2.2 IS-816: Code of practice for use of metal arc welding for general construction in mild steel.
- 35.2.3 IS-9595: Metal arc welding of carbon and carbon manganese steels – Recommendations.
- 35.2.4 BS EN 12285-1&2: Workshop fabricated horizontal cylindrical steel tank.
- 35.2.5 IS-10987: Horizontal Cylindrical storage tank for Petroleum products.
- 35.2.6 IS-803: Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tanks.
- 35.2.7 IS-804: Code of practice for material, design, fabrication and erection of rectangular pressed steel tanks.
- 35.2.8 API-650: Welded Steel Tanks for Oil Storage

35.3 Miscellaneous Steel Tanks : General Requirements

- 35.3.1 The connections, accessories and fittings to be supplied with each tank shall be as specified and as required. The piping material required inside or outside up to the flanged terminal shall be supplied by the Contractor.

Tank connections shall be provided with suitable counterflanges with necessary bolts, nuts & gaskets by the Contractor.

- 35.3.2 The tank, where applicable, shall be complete with supporting structure, legs or pedestals, base plate, anchor bolts, nuts & sleeves etc. as required.
- 35.3.3 The special fittings, e.g. conservation vent valves, level indicators etc. shall also be supplied by the Contractor.
- 35.3.4 Preparation of detailed design, fabrication drawings, bill of materials, tag and piece numbers, welding procedure, etc.

Stiffeners where not specified and other structural framing for supporting tank shell shall be designed by the Contractor including supply of materials for the same.



- 35.3.5 This specification covers supply of steel plates, structural steel, pipes etc. as required.
- 35.3.6 The scope of work under this specification includes excavation and backfilling work required for installation of pipes running underground.
- 35.3.7 All pipe supports, thrust blocks, etc. as required will be properly designed and constructed by the Contractor in accordance with approved drawings. Necessary steel work at supports shall also be supplied, fabricated and erected by the Contractor.
- 35.3.8 The final fixing grout over the concrete support or through the opening left in the concrete work shall also be done by the Contractor.
- 35.3.9 The designer and manufacturer of storage tanks shall comply with and obtain approval of all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. The tanks shall conform to IS 803 / IS 804 / IS 805 / IS 2825 / API 650 / IS 4049 / IS 4682 (part-I) and IS 4864 to 4870 / ASME B& PV code Sec.-VIII as the case may be

35.4 DESIGN AND CONSTRUCTION

- (a) Design of all vertical atmospheric storage tanks containing water, acid, alkali and other chemical shall conform to IS: 803 & API 650.
- (b) Design of all horizontal atmospheric storage tanks containing water, acid, alkali and other chemicals shall generally conform to IS:2825 as regards to fabrication and general construction taking care of combined bending, shear & hoop stresses developed due to supporting arrangement.
- (c) Design temperature of vessels shall be 10 deg. C higher than the maximum temperature that any part of the vessel is likely to attain during the course of operation.
- (d) Tank shall be made from mild steel plates to BS 4350/IS-2062 Gr. B (or equivalent).
- (e) The joint efficiency factors to be adopted for design calculations shall be in accordance with the specified design code.
- (f) Tank shall be provided with suitable supporting joints. All vessels shall be provided with lifting lugs, eye bolts etc. for effective handling during erection.
- (g) The material for flanges shall be of ASTM A 105/IS-2062 Gr. B.
- (h) For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature.
- (i) Vessel seams shall be so positioned that they do not pass through vessel connections. For cylindrical vessel consisting of more than two sections longitudinal seams shall be offset.



- (j) Tanks shall be provided with float operated level indicators/level gauges/level transmitters and level switches, as required, with complete assembly. Suitable flanged pads for level switches mounting shall also be provided. The level indicator can be top or side mounted as the case may be.
- (k) In addition to inlet and outlet nozzles, the tanks shall be provided with vents, overflow, drain nozzles complete for various connections on tanks. Overflow lines from storage tanks is to be routed to the nearest surface drains. For tanks containing DM water, alkaline water or power cycle water the vent to atmosphere shall be through carbon-di-oxide absorber vessel suitably mounted on the tank. CO₂ absorber vessel shall be provided with the initial fill of chemicals. Similarly for equipment cooling water overhead tank, the overflow & drain from tank shall be combined together and shall be led to nearest drain (at zero level) via. a seal-trough so as not to come directly in contact with atmosphere.
- (l) Tanks shall have suitable stairs/ladders walking arrangement on inside and outside of the tanks, manholes/inspection covers as required and also platform suitably located.
- (m) Tank supporting arrangement as approved by Employer shall be provided with all plates/angles/joints/flats and supporting attachment including lugs, saddles, legs etc.
- (n) Piercing nozzles/pipes from tank body/dish ends shall be adequately compensated as per relevant code.
- (o) Tank fabrication drg. and design calculations shall be approved by the Project Manager.

35.5 Technical Requirements

- 35.5.1 Tanks shall be suitably constructed for safe, proper and continuous storage of liquid described. The design code, material standard, minimum plate thickness, size and other details shall be as per the specified Codes and Standards as applicable.
- 35.5.2 For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature.
- 35.5.3 Vessel seams shall be so positioned that they do not pass through vessel connections. For cylindrical vessels consisting of more than two sections, longitudinal seams shall be offset.
- 35.5.4 Where possible, the inside seam weld shall be ground smooth, suitable for application of corrosion resistant primer.
- 35.5.5 Due consideration for wind load and/or earthquake effect shall be given by the Contractor in the design of tanks. Data for wind load and earthquake shall be taken as indicated in the Project Information of this specification. Maximum allowable stresses for design loadings combined with wind or earthquake shall not exceed 133% of stress permitted for the design loading condition but in no case shall exceed 80% of specified minimum yield strength of the material.



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- 35.5.6 Except where otherwise indicated in the Purchaser's drawings/ specifications, if the stiffening of the shell and/or roof is necessary the same shall be stiffened from outside.
- 35.5.7 Reinforcement pads in tank connections shall be provided as per applicable code & the reinforced connection shall be completely preassembled into a shell plate. The completed assembly including the connection shall be thermally stress-relieved as per API Standard 620 if specified.
- 35.5.8 All welding shall be done as per IS-816, IS-817 and IS-9595, latest revision as applicable. All welds are to be continuous welds. Bidder shall clearly state in his offer the make and type of welding rods proposed by him for fabrication. Inspection of welding shall be carried out in accordance to IS-822 and IS-9595. Welding sequence shall be adopted in such a way so as to minimise 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 Purchaser/Consultant.

35.6 Tank Connections

- (a) Bidder shall furnish all piping material required for the tank connections.
- (b) Unless otherwise specified, for all flanged connections Bidder shall furnish suitable counterflanges and the necessary nuts, bolts, gaskets etc.
- (c) Flange faces of all nozzles shall be machined and square with the vessel centrelines.
- (d) Unless otherwise stated, bolts and nuts shall be of hexagonal head conforming to IS-1357, latest revision.
- (e) The material and thickness of gaskets shall be suitable for the specified service. On completion of hydraulic test, Contractor shall replace the gaskets used during testing at his own cost.
- (f) All tanks shall be provided with connections for drains, vents and overflow.

35.7 Accessories

The tanks shall be provided with following minimum accessories as indicated in the Specification. All the accessories shall conform to relevant Indian Standards.

- a) **Level transmitter**
SMART (HART) type D.P. level transmitters shall be provided for continuous level measurement as well as for alarm/Interlock (wherever applicable).
- b) **Level gauge**
Reflex type Gauge Glass shall be provided at each tank.
- c) Where the tank height exceeds 2 M, vertical ladder is to be provided with cage.



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- d) Top Manhole shall be provided in all tanks. Manhole size shall be 600 mm NB (minimum).
- 35.8 When installation of tank is specified the recommendation regarding installation in BS EN 12285-1 & 2 shall be followed in general. In addition to those recommendations, the following shall also be taken care of.
- 35.9 The finished tank grade for cylindrical tank shall be crowned from the outer periphery to the centre with a slope. The sloping factor shall be taken as 1:35 unless otherwise specified.
- 35.10 Welding shall be done in accordance with IS-816, IS-817, IS-822 & IS-9595.
- 35.11 Welding sequence shall be adopted in such a way so as to minimise the distortion due to welding shrinkage. Contractor shall indicate in his drawing the sequence of welding proposed by him which should meet prior approval of the Engineer.
- 35.12 **Corrosion Protection**
- (a) A corrosion allowance, applicable to surface in contact with corrosive media, when required, shall be taken into consideration.
- (b) Manholes shall be provided for easy access into the vessels. The size shall be minimum 500 mm and will be with cover plate, nuts bolts, etc. to ensure leak tightness at the test pressure.
- (c) Each tank shall be provided with drilled cleats welded to the tank for electrical grounding. Material of cleats shall be same as that of the shell.
- (d) Epoxy-coating shall be provided on the inside of vessel in three coats (minimum) resulting in total thickness of not less than 150 micron in which ever case required, such as equipment cooling water overhead tank, sodium hydroxide tank, condensate storage tank, condensate surge tank etc.
- 35.13 **Cleaning & Painting**
- (a) Inside surface of all tanks shall be protected by anti-corrosive paints as required.
- (b) For tanks/vessel requiring epoxy painting, all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.
- (c) Outside surfaces of all vessels shall be provided with two coats of primer with three (3) coats of epoxy resin based paint of approved color.

	TITLE: 1 X 660 MW PANKI TPS EXTENSION PROJECT	SPECIFICATION NO. PE-TS-426-155-A001
		SECTION - II
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	SUB-SECTION - II A
		REV.NO. 0 DATE:

**TECHNICAL SPECIFICATION FOR
PRESSURE & STORAGE VESSEL**

	TITLE:	SPECIFICATION NO. PE-TS-426-155-A001
	1 X 660 MW PANKI TPS EXTENSION PROJECT	SECTION - II
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	SUB-SECTION - II A
		REV.NO. 0 DATE:

1.00.00 GENERAL

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

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

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

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

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

2.00.00 GENERAL DESIGN FEATURES

2.01.00 Design

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

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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 30 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 Lugs

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

4.03.00 Vessels Supports

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

4.04.00 Vessel Internals

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

Specification requirements for vessel internals are as follows:

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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-A-106. Grade B. schedule 80 pipe. All flanged connections shall be supplied complete with matching counter flanges, nuts, bolts and full-face gaskets.

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

4.11.00 Resin Traps

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

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

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

5.00.00 SPECIFIC DETAILS

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

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

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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 or 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 SS: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.

34.0 GENERAL REQUIREMENTS HORIZONTAL AND VERTICAL WATER SERVICE PUMPS**34.1 SCOPE**

General requirements in respect of design, material, constructional features, manufacture, inspection, testing the performance at the Vendor's/ Sub-Vendor's works and delivery to site erection, field testing and commissioning of Horizontal Centrifugal Pumps.

34.2 CODES AND STANDARDS

Design, material, construction manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment supplied shall comply with the latest applicable Indian standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.

34.2.1 List of Applicable Standards

- i) IS : 1520 - Horizontal Centrifugal Pumps for clear cold fresh water.
- ii) IS : 5120 - Technical requirements of roto-dynamic special purpose pumps
- iii) API - 610 - Centrifugal pumps for general refinery service.
- iv) IS : 5639 - Pumps Handling Chemicals & corrosion liquids.
- v) IS : 5659 - Pumps for process water
- vi) HIS - Hydraulic Institute Standards; USA
- vii) ASTM-I-165-65 - Standards Methods for Liquid Penetration Inspection.
- ix) IS-1710/1989 - Vertical Turbine Pumps for Clear, Cold and Fresh Water.

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

34.3 DESIGN REQUIREMENTS

The maximum efficiency of pumps shall be preferably within + 10% of the rated design flow indicated in data sheets.

Total head capacity curve shall be continuously rising from the operating point towards shut - off without any zone of instability and with a minimum shut off head of 15% more than design head.

Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation.

DCPL

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Mechanical Works**Ch 34 : General Requirments
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Speed	Antifriction bearing	Sleeve bearing
1500 rpm and below	75.0 micron	75.0 micron
3000 rpm	50.0 micron	65.0 micron

The noise level shall not exceed 85 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1M from the equipment surface.

The pumps shall be capable of starting with discharge valve fully open and close condition.

34.4 DESIGN CONSTRUCTION**34.4.1 Horizontal Pumps**

Pump casing shall have radially/axially split type construction. The casing shall be designed to withstand the maximum shut - off pressure developed by the pump at the pumping temperature.

Pump casing shall be provided with a vent connection and piping with fittings & valves Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pr. Gauge as standard feature.

Impeller

Impeller shall be closed or semi-closed as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled. The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying pinning or lock rings.

Impeller/ Casing Wearing Rings

Replaceable type wearing rings shall be provided at suitable locations pumps. Suitable method of locking the wearing ring shall be used.

Shaft

The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.

Shaft Sleeves

Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening shaft and shaft sleeve assembly should ensure concentric rotation.

Bearings

Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble - free operation shall be furnished.

The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Anti-friction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hours of continuous operation at maximum axial and a radial loads and rated speed.



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Proper lubricating arrangement for the bearings shall be provided such that lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearing assembly.

Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearing housing.

Stuffing Boxes

Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standard. If external gland sealing is required, it shall be done from the pump connection.

Mechanical Seals:

Wherever specified in pump data sheet, mechanical seals shall be provided. The sealing face should be highly lapped surfaces of material known for their low frictional co-efficient & resistance to corrosion against the liquid being pumped.

Pump and Motor Shaft Coupling

The Pump and motor shaft shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor.

Base Plate

A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be of fabricated steel and of rigid construction, suitable ribbed and reinforced.

Assembly and Dismantling

Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

34.4.2 For Vertical Pumps

Pumps shall be of vertical shaft, complete with bowl, column pipe, discharge head and base plate with all accessories, as applicable. General design and constructional features of the pumps shall be as follows:

Bowl Assembly

This will be either a single or multi-stage centrifugal, mixed flow or axial flow type with discharge co-axial with shaft. Type of impeller shall be chosen on the basis of the pump specific speed and the characteristics of the handling fluid.

Pump(s) shall have provision for adjustment of impellers in vertical direction from an accessible location, preferably at the housing (where separate thrust bearing for the pump is provided). The adjustment mechanism must take into consideration the extension of the line shaft due to hydraulic down thrust, weight of the shaft and impeller.

Discharge Head

Pump(s) shall be either above floor or below floor discharge type, as specified in the specification, attached to this section.

In case, expansion joint is to be used at the pump discharge, pump base plate shall either be adequately designed to take the unbalanced forces and moments from the use of such expansion joint or a separate thrust block at the pump discharge head shall be provided to transmit these forces to the external supporting structure. Calculation of thrust load shall be done considering the highest pressure seen by the pump and internal diameter of the arch of the expansion bellow.

Column pipe

Column pipe shall be flanged and of bolted connection. Column pipes shall be designed for full internal vacuum.

In case the specification asks for the pump with below floor discharge, and the water level is at or above the discharge valve level, the column pipe piece located at the intermediate floor level shall be provided with suitable floor sealing device.

In case of multi-piece column pipe and shaft assembly, the design shall permit raising/lowering of the pump assembly piece by piece without any difficulty. Any fixtures, clamps, etc. necessary for such purpose shall be supplied by the Contractor under this section. The Contractor shall also submit a write-up describing clearly the procedure of handling the pump.

Impeller shaft, line shaft and head shaft

Shaft size shall be selected on the basis of maximum torque to be applied on the pump shaft.

Critical speed of the shaft shall be sufficiently away from the pump operating speed and in no case shall lie between 90% and 110% of the rated speed.

Impeller shaft shall be guided by bearings provided in each bowl or above and below the impeller shaft assembly. The butting faces of the shaft shall be machined square to the assembly and the shaft shall be chamfered at the edges.

Line shaft may be of single or multiple pieces as required. In case of multiple pieces, line shaft shall be coupled as per the standard practice of the manufacturer.

For screwed coupling, screw directions shall permit tightening of the joint during pump operation.

Replaceable shaft sleeves shall be furnished at applicable locations, particularly under stuffing box and at other locations, as considered necessary.

Shaft enclosing tube

Shaft enclosing tube shall be required, unless self lubricated (and cooled) type of shaft bearings is asked for. Length of the shaft enclosing tube shall be in conformity with the shaft piece lengths.

Seal rings

Replaceable seal/wear rings both on impeller and on casing shall be provided in case it is asked for.

Bearings**Shaft bearings**

Adequate number of properly designed bearings shall be provided for smooth and trouble-free operation of the pump. Number of bearings shall consider the number of shaft pieces used and the critical speed of the shaft. Bearings shall be either lubricated by external clear water/oil/grease or self lubricated as specified in the Specification.

In case of external water/oil lubrication, complete lubrication arrangement shall be furnished with the pump. If the specification calls for prelubrication of the shaft bearings, prelubrication tank and other accessories shall be within the scope of supply of the Bidder/Contractor.

Thrust Bearing

Thrust bearing of adequate size and capacity shall be provided to take the vertical thrust of the impeller arising out of the pump operation and dead weight of the rotating components. Life of the thrust bearing shall be guided by the design standard of the pump. Thrust bearing shall be capable of running continuously at maximum load.

Thrust bearings shall be either grease or oil lubricated. Lubrication arrangement shall be such that the lubricant does not contaminate the handling fluid. The arrangement shall also be adequate to protect the bearing, while the pump coast down to stop in case of power failure of the station. Pre-lubrication of the thrust bearing, if recommended by the pump manufacturer, shall be taken care of in designing the lubrication system.

Cooling of the thrust bearing, if necessary, shall be done by the handling fluid / external water, depending on the fluid handled.

Location of the thrust bearing may be at the pump body or at the driver, or at both depending on the requirement of specification or as per the recommendation of the pump manufacturer (and approved by Purchaser).

Reverse Rotation

If the specification calls for, the pump impeller and other rotating components shall be designed for reverse rotation, when subject to reverse flow at rated pump discharge head.

34.5 Drive Motor (Prime Mover)

The KW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps is specified, the actual motor rating is to be selected considering overloading of the pump in the event of tripping of operating pumps. Continuous motor rating (at 50 deg. Cent, ambient) for pump shall be at least 15% above the maximum load demand of the driven equipment in the complete range.

Annexure - A
SUBMERSIBLE PUMPS**SCOPE**

This specification covers general requirements in respect of design, material, manufacture, construction, testing & inspection at Vendor's / sub-vendor's delivery to site, of submersible pumps.

CODES AND STANDARD

The design manufacture and performance of submersible pumps shall be comply with all currently applicable statues, regulation, and safely codes in the locality where the Equipment will be installed. The Equipment shall also conform to the latest applicable Indian standards listed below/equivalent standards.

List of Applicable Indian Standards

- IS: 8034 - Submersible pumps for clear cold fresh water
IS: 5120 - Technical requirement of Rotodynamic Special Purpose pumps.

In case of any contradiction with aforesaid standards and the technical specification requirements, the stipulation of the technical specification shall prevail.

DESIGN AND PERFORMANCE REQUIREMENTS

- The pump shall be of single stage mono - block type with non-clog design.
- Components of Identical pumps shall be interchangeable.
- Pumps shall have continuously rising head characteristics.

MOTOR RATING

Continuous motor rating (at 50 deg. C ambient) for pumps shall be at least fifteen percent (15%) above the maximum load demand of the driven equipment in the complete operating range to take care of the system frequency variations.

FEATURES OF CONSTRUCTION

- Pumps shall be of Submersible, wet pit type.
- Pumps shall be able to pass through solids upto 20 mm and capable of handling waste water which may contain, sludge, plastic solids etc.
- Coupling device shall ensure leak proof joint between the pump and discharge elbow. This shall also enable pump to be removed from the sumps without the necessity of dismantling any nuts, bolts etc.
- Pumps shall be portable type and capable of using in any sump as and when required. Pump shall be provided with required stool, flexible, hose chain connection etc. for easy installation, removal and maintenance. Adequate length of chain required for lowering the pump into the sump and flexible type discharge pipe shall be provided.
- Impeller

The Impeller shall be as indicated in Data Sheets in this Sub-section. Enclosed impellers shall be equipped with seal rings on their hubs. In case of open impeller, the pump shall be design to take care of the additional thrust produced.

32.0 MISCELLANEOUS PUMPSETS**32.1 GENERAL INFORMATION**

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

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

32.1.2.1 Group - A

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

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

32.1.2.2 Group - B

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

32.1.2.3 Group - C

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

32.2 CODES AND STANDARDS

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

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



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- 32.2.3 IS-5120 : Technical Requirements – Roto-dynamic special purpose pumps.
- 32.2.4 IS-5600 : Sewage and drainage pumps.
- 32.2.5 Hydraulic Institute Standards of USA.
- 32.2.6 The materials of the various components shall conform to the applicable IS/BS/ASTM/DIN Standards.

32.3 GENERAL PERFORMANCE REQUIREMENT

- 32.3.1 The pumps shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the "Range of Operation" as stipulated by the manufacturer.
- 32.3.2 Pumps shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum head being at shut off.
- 32.3.3 Permanently installed vertical pumps shall be suitable for parallel operation. The head vs capacity, the bhp. vs capacity characteristics etc. shall match to ensure equal load sharing and trouble free operation throughout the range. Drive Motor shall not be overloaded when pump discharge is more than rated condition.
- 32.3.5 The static head requirement of portable submersible type sump pump may have a considerably wide range of variation depending upon the depth of pit being dewatered. While the pump shall have adequate capacity at the maximum head, the motor shall be sufficiently rated to cater for any overloading during the pump operation at its minimum possible head, i.e., maximum discharge.
- 32.3.6 Pump motor set shall run smooth without undue noise and vibration. Acceptable peak to peak vibration limits shall generally be guided by Hydraulic Institute Standards (latest edition).

32.4 SCOPE OF WORK

- 32.4.1 Pumps under groups A, B and C as listed in the Annexure- I along with drive units, couplings and other accessories mentioned below, as also those needed to make the pump-motor sets complete in all respect, for proper operation and maintenance. All motors in outdoor duty shall be provided with IP-55 enclosure and canopy. In addition to the accessories listed in Annexure-I, each pump set shall also include the following:

32.4.2 For the vertical Group - A sump pump motor sets

Three (3) nos. capacitance level switches per sump; one for low level, the second for high level and the third for very high level, along with necessary junction box, local control panel, control cables etc. to achieve automatic starting/stopping of the sump pumps, and also ON/OFF indication for sump pump shall be monitored at DDC system. The entire assembly being mounted on the same base frame as mentioned above (item "b"). The control panel shall also be equipped with start/stop push button for starting/stopping



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individual sump pumps manually. Local control panel and cable shall be as per requirements described else where in the specification.

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

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

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

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

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

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

32.4.7 Rust inhibitor paint at Manufacturer's works.

32.5 DESIGN AND CONSTRUCTION

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

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

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

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

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

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

32.5.6 All hoses shall be of steel wire reinforced type. Pump suction hose shall be suitable for working under vacuum. Pump discharge hose shall be suitable to withstand the maximum pressure that it may be subjected to in all

working conditions, including hydrostatic testing of the sump pump discharge line.

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

32.6 Pumps

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

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

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

32.7 Casing

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

32.8 Impeller

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

32.9 Pump Shaft

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

32.10 Column Pipe (for pumps under Group-A)

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

32.11 Bearings

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

32.12 Wearing Ring/Liner Plate

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

32.13 Stuffing Box

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

32.14 Coupling

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

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

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

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

32.16 Suction Bell

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

32.17 Material of Construction

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

32.18 INSPECTION AND TESTING

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

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

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

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

32.19 DRAWINGS, DATA, INFORMATION REQUIRED

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

32.19.2 List of location of Group-A .

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

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- 32.19.4 Speed vs. torque curve of the pump corresponding to recommended mode of pump starting, super-imposed on speed vs. torque of the motor, corresponding to 80% and 100% rated voltage.
- 32.19.5 Diagram showing the type of lubrication system etc.



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DATA SHEET – MISCELLANEOUS PUMPSETS

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



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	TITLE: 1 X 660 MW PANKI TPS EXTENSION PROJECT	SPECIFICATION NO. PE-TS-426-155-A001
		SECTION - II
		SUB-SECTION - II A
		REV.NO. 0 DATE:
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	

**TECHNICAL SPECIFICATION FOR
HORIZONTAL CENTRIFUGAL PUMPS**

	TITLE:	SPECIFICATION NO. PE-TS-426-155-A001
	1 X 660 MW PANKI TPS EXTENSION PROJECT	SECTION - II
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	SUB-SECTION - II A
		REV.NO. 0 DATE:

1.00.0 SCOPE

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

2.00.00 CODES AND STANDARDS

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

2.02.0 List of Applicable Standards.

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

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

3.00.00 DESIGN REQUIREMENTS

- 3.01.00 The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve over the operating range of 40% to 120% of the duty point. The maximum efficiency of pump shall be preferably be within +/- 10% of the rated design flow as indicated in the data sheets.
- 3.02.00 The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of 15% more than the design head.

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3.03.00 Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

3.04.00 Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:

SPEED	Antifriction Bearing	Sleeve Bearing
1500 rpm and below	75.0 micron	75.0 micron

3.05.00 The noise level shall not exceed 85 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment.

3.06.00 The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.

3.07.00 The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).

3.08.00 Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.

3.09.00 The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.

4.00.0 DESIGN CONSTRUCTION

4.01.00 Design and construction of various components of the pumps shall conform to the following general specifications. for material of construction of the components, data sheets shall be referred to.

4.02.0 Pump Casing

4.02.01 Pump casing shall have axially or radially split type construction. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.

4.02.02 Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.

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4.03.00 Impeller

- 4.03.01 Impeller shall be closed, semi-closed or open type, and it shall be designed in conformance with the detailed analysis of the liquid being handled.
- 4.03.01 The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.

4.04.00 Impeller/Casing Wearing Rings

- 4.04.01 Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.

4.05.00 Shaft

- 4.05.01 The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.
- 4.05.02 The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.

4.06.00 Shaft Sleeves

- 4.06.01 Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland.
- 4.06.02 Shaft sleeve shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

4.07.00 Bearings

- 4.07.01 Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished
- 4.07.02 The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.
- 4.07.03 Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.

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4.07.04 Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.

4.08.00 Stuffing Boxes

4.08.01 Stuffing box design should permit replacement of packing without removing any part other than the gland.

4.08.02 Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.

4.09.00 Mechanical Seals

4.09.01 Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.

4.09.02 The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.

4.10.00 Pump Shaft Motor Shaft Coupling

4.10.01 The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

4.11.00 Base Plate

4.11.01 A common base plate mounting both for the pump and motor shall be provided. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.

4.12.00 Assembly and Dismantling

4.12.01 Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

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4.13.00 Drive Motor (Prime Mover)

- 4.13.01 The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps are specified, the actual motor rating is to be selected by the tenderer considering overloading of the pumps in the event of tripping of operating pumps.

5.00.00 TESTING FOR HORIZONTAL CENTRIFUGAL PUMPS

The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of this specification and in compliance with the requirement of applicable Codes and Standards. The particulars of the proposed tests shall be submitted to the Owner for approval before conducting the tests.

5.01.00 Hydrostatic Tests

All pressure parts shall be hydraulically tested at 200% of pump rated head or at 150% shut off head whichever is higher. The test pressure shall be maintained for 1/2 hr. and no leakage shall be permitted. While arriving at the above pressure, the maximum suction head specified in Data Sheet shall be taken into account.

5.02.00 Performance Tests

- 5.02.01 All the pumps shall be tested in the Manufacture's Works at rated speed for capacity, efficiency and brake horse power. Pumps shall be given running test over the entire operating range covering from the shut off head to the maximum flow. The duration of test shall be minimum one (1) hour. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standards or as applicable equivalent
- 5.02.02 The test shall be preferably conducted with the actual motor being furnished.
- 5.02.03 Only those pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and excessive vibration is observed during the performance test. Otherwise strip down examination is limited to bearing inspection only.
- 5.02.04 The pump accessories e.g. the thrust bearing, couplings etc. shall be subjected to tests as per manufacturer's standards.

5.03.00 Mechanical Balancing

All rotating components of the pumps shall be statically balanced. In addition to static balancing, rotating components of the pumps shall be balanced dynamically at or near the operating speed. Tenderer shall furnish acceptance norm for this test.

5.04.00 Visual Inspection

Pumps shall be offered for visual inspection by the bidder before shipment. The components of the pumps shall not be painted before inspection.

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5.05.00 NPSH Test

NPSH test shall be conducted with water as medium if required. NPSH shall not be mandatory in case type test certificates are furnished for the similar rating of pumps.

5.06.00 Noise and Vibration Measurement

Noise and vibration shall be measured during the performance testing at shop as well as during the site test.

- 5.06.01 The noise level shall not exceed 85 dBA. Noise level measurement will be made as per applicable internationally acceptable standard. The measurement shall be carried out with calibrated integrating sound level meter meeting the requirement of IEC:651 or BS:5969 or IS:9779. Sound pressure level will be measured all round the pump and motor set at a distance of one meter from the nearest surface of the machine and at a height of 1.5 m from the floor level. A minimum of six (6) points should be covered for measurement. The measurement shall be done with a slow response on the A-weighted scale. The average of the A-Weighted sound pressure measurements expressed in decibels to a reference 0.0002 microbars shall not exceed the specified value.

The tests shall be carried out on the machine operating at rated speed and as near as possible to the rated power. Corrections for background noise and correction on account of test environment will be considered in line with applicable standard. For this purpose all the additional data required should necessarily be collected during the test.

- 5.06.2 Vibration check will also be done as per HIS. Vibration would be checked at thrust bearing locations on horizontal, radial and vertical direction. The acceptance limits would be as per HIS. The instrument used would be IRD 308 or equivalent with velocity pick-up. Vibration limits to be specified as per the speed of the pump.

5.07.00 Material Test Certificate

- 5.07.01 Material of the various pump components shall be tested in accordance with the relevant standards. Test certificates for these shall be furnished for the Owner's approval.
- 5.07.02 Where stage inspection is desired by BHEL/customer all material test certificates shall be correlated and verified with the actual material used for construction before starting fabrication by BHEL/customer's inspector who will stamp the material. In case mill test certificate for the material are not available, the supplier shall carry out physical and chemical tests at his own cost from a testing agency, approved by BHEL/Customer, as per the requirement of specified material standard. The sample for physical and chemical testing shall be drawn up in presence of BHEL/Customer's inspector who shall also witness the testing.

5.08.00 Non Destructive Testing

- (a) UT shall be carried out on shafts of diameter more than 50 mm.
- (b) DP tests shall be carried out on shaft and impeller.

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- (c) No weld repair shall be allowed on cast iron.

5.09.00 Field Testing

- 5.09.01 After installation, the pumps offered shall be operated to prove satisfactory performance as individual equipment as well as a system run. If the performance at site is found not to the requirements then the equipment shall be rectified or replaced by the Vendor, at no extra cost to the Owner. The procedure of the above testing will be mutually agreed between the Owner and the contractor. Noise and vibration tests shall also be repeated at site.
- 5.09.02 Based on observation of the trial operation, if modifications and repairs are necessary, the same shall be carried out by the contractor to the full satisfaction of the engineer and then the performance and guarantee tests to be repeated at site as per relevant clauses of the specification.

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**TECHNICAL SPECIFICATION
FOR
VERTICAL CENTRIFUGAL PUMPS**

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1.00.00 GENERAL INFORMATION

1.01.00 The general guidelines as illustrated in the subsequent clauses of this section shall be applicable for vertical pumps to be procured under the scope of this package.

2.00.00 CODES AND STANDARDS

2.01.00 In addition to the requirements spelt out elsewhere in the specification, the equipment to be provided under this section shall specifically conform to the following codes, standards, specifications and regulations, as applicable, including all the latest amendments subsequent to the year of publication as mentioned below.

2.01.01	IS 1710/1989:	Vertical Turbine Pumps for Clear, Cold and Fresh Water.
2.01.02	IS 5120/1977:	Technical requirements -Rotodynamic special purpose pumps.
2.01.03	IS 5639/1970:	Pumps for handling chemical and corrosive liquids.
2.01.04	IS 5659/1970:	Pumps for process water.
2.01.05	IS 6536/1972:	Pumps handling volatile liquids.
2.01.06	IS 9137/1978:	Code for acceptance for centrifugal, mixed flow and axial
2.01.07	BS 5316	Acceptance tests for Centrifugal, mixed flow Part-I/1976 And axial flow pumps - Class 'C' Tests (ISO 2548/1973)
2.01.08	BS 5316:	Acceptance tests for Centrifugal, mixed flow Part-II/1977 And axial flow pumps - Class 'B' Tests (ISO 3555/1977)
2.01.09	ANSI B 73.2M 1984	Vertical inline centrifugal pumps for chemical process
2.01.10	API 610/1989:	Centrifugal pumps general refinery services.
2.01.11	Hydraulic Institute Standards of USA (1983).	
2.01.12	PTC 8.2/1965:	Power Test Codes - Centrifugal pumps.

3.00.00 Accessories:

All the pumps under this specification shall be complete with following standard/special accessories.

3.01.00 Standard accessories:

- a) Pump motor coupling along with coupling guard
- b) Common base plates for pump and motor.

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- c) Lubrication system along with all internal piping, valves, fittings, specialties etc. as required.
- d) Counter flanges for suction/ discharge nozzles along with fixing nuts, bolts and gaskets.
- e) Anchor bolts, nuts, seating steel works, etc. as necessary for mounting the pump-motor unit on Civil foundations.
- f) Suitable vent (with valves)/ lifting/ handling attachments for the pump/ motor/ Accessories.
- g) Suitable drain connections with isolating valves as applicable.
- h) Set of "Special" Tools & Tackles for Pumps and motors, if any.
- i) Erection and commissioning spares, "on as required" basis.
- j) Bidder shall provide various drawings, data, calculations, test reports/ certificates, Operation and maintenance manuals, As-built drawings, etc. as specified and as necessary.

3.02.00 Services included in Bidder's Scope:

3.02.01 The pumps shall be guaranteed to meet the performance requirements as specified vide datasheet – A and also for trouble free operation after commissioning.

4.00.00 TECHNICAL REQUIREMENTS:

4.01.00 The pumps shall be Electric motor driven.

4.02.00 The Pumps shall conform to HIS

4.03.00 Vertical type pumps with 1500rpm.

4.04.00 Minimum efficiency of vertical pump will be 40%.

4.05.00 No negative tolerance shall be permitted in rated capacity & TDH.

4.06.00 No negative tolerance shall be permitted in efficiency at rated capacity.

4.07.00 The shut off head of pumps shall be at least 115% of pump rated TDH.

4.08.00 The pumps shall be capable of developing the required total head at rated capacity for Continuous operation. The pumps shall operate satisfactorily at any point on the Q-H Characteristic curve over a range of 0% to 130% capacity and shall be suitable for Continuous operation between 30% to 130% capacity.

4.09.00 Selection of the pumps shall be such that the design point shall be met even with negative manufacturing tolerance.

4.10.00 The total head capacity curve shall be continuously rising towards the shut off, the pumps shall preferably be non-overloading type and stable.

4.11.00 The pumps shall be capable of running over the entire range of NPSH conditions required without any noise, vibration or cavitations.

4.12.00 The pumps shall be of stiff shaft design. The minimum internal clearances should be sufficiently more than the max. Static deflection of the shaft. Shaft size selected must take into consideration the critical speed as specified in API-610.

4.13.00 Pumps and motors shall run smooth without undue noise and vibration. The vibration shall be within 75 microns for pump - motor set. The noise level shall be limited to 85 dB at distance of 1.0M.

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4.14.00 High reliability of the pumps is an essential requirement and therefore it gets weight age over its efficiency. It is therefore essential that the bidder choose a standard proven model from the range of pumps manufactured.

4.15.00 If water handled by pump is dirty/ not suitable for lubrication/ cooling, the bidder shall provide requisite strainer/ filters, tanks, motorized valves, etc. after the tap off for the required service, the arrangement provided shall be subject to Purchaser's approval.

5.00.00 OTHER REQUIREMENTS:

5.01.00 The materials of construction for various components specified are the minimum Requirements indicated in datasheet – A section C and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty.

6.00.00 PAINTING FOR PUMPS:

- a) The surface of SS, Gun metal, brass, bronze and non metallic component shall not be applied with any painting.
- b) The Steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shop blasting etc. as per the agreed procedure.

For all the steel surfaces inside the (indoor installation) building, a coat of red oxide primes of min. thickness of 50 microns followed up with under coat of Synthetic Enamel paint of min. thickness of 50 microns shall be applied. the top coat shall consist of two coats each of min. thickness of 50 microns of synthetic enamel paint and thus total thickness shall be min. 200 microns.

7.00.00 PERFORMANCE REQUIREMENTS

7.01.00 Pump (s) shall preferably be designed to have the best efficiency at the specified duty point. Further, the pumps (s) shall be suitable for continuous operation at any point within its 'range of operation'.

7.02.00 Under all circumstances, the 'range of operation' of the pump (s) shall exclude any Unstable operating zone of the head-capacity curve.

8.00.00 DESIGN AND CONSTRUCTION

Pumps shall be of vertical shaft, complete with bowl, column pipe, discharge head and base plate with all accessories. General design and constructional features of the pumps shall be as follows:

8.01.00 BOWL ASSEMBLY

8.01.01 This will be either a single, mixed flow or axial flow type with discharge co-axial with shaft. Type of impeller shall be chosen on the basis of the pump specific speed and the characteristics of handling fluid.

8.02.00 IMPELLER SHAFT, LINE SHAFT AND HEAD SHAFT

8.02.01 Shaft size shall be selected on the basis of maximum torque to be applied on the pump shaft. Critical speed of the shaft shall be sufficiently away from the pump operating speed and in no case shall lie between 90% and 110% of the rated speed.

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8.02.02 Impeller shaft shall be guided by bearings provided in each bowl or above and below the impeller shaft assembly. The butting faces of the shaft shall be machined square to the assembly and the shaft shall chamfer at the edges.

8.02.03 Line shaft may be single or multiple pieces as required. In case of multiple pieces, line shaft shall be coupled as per the standard practice of the manufacture. For screwed coupling, directions shall permit tightening of the joint during pump operation.

8.02.04 Replaceable shaft sleeves shall be furnished at applicable location, particularly under stuffing box and at other locations, as considered necessary.

8.03.00 BEARINGS

8.03.01 SHAFT BEARINGS

Adequate number of properly designed bearings shall be provided for smooth and trouble free operation of the pump. Number of bearings shall consider the number of shaft pieces used and the critical speed of the shaft. Bearings shall be either lubricated by external clear water/oil/grease or self-lubricated. In case of external water/oil lubrication, complete lubrication arrangement shall be furnished with the pump.

8.03.02 THRUST BEARING

Thrust bearing of adequate size and capacity shall be provided to take the vertical thrust of the impeller arising out of the pump operation and dead weight of the rotating Components. Life of the thrust bearing shall be guided by the design standard of the pump. Thrust bearing shall be capable of running continuously at maximum load. Thrust bearing shall be either grease or oil lubricated. Lubrication arrangement shall be such that the lubricant does not contaminate the handling fluid. The arrangement shall also be adequate to protect the bearing, while the pump coast down to stop in case of power failure of the station. Pre-lubrication of the thrust bearing, if recommended by the pump manufacturer, shall be taken care of in designing the lubrication system. Cooling of the thrust bearing, if necessary, shall be done by the handling fluid/external Water, depending on the fluid handled. Location of the thrust bearing may be at the pump body or at the driver, or at both depending on the requirement.

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**TECHNICAL SPECIFICATION FOR
METERING PUMPS**

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1.00.0 GENERAL

- 1.01.01 Specification cover the design, material, construction features, manufacture, inspection, testing the performance at the vendor's/sub-vendor's works, delivery to site, erection, commissioning and testing of metering pumps.

2.00.0 GENERAL DESIGN FEATURES

- 2.00.01 Pumps shall be simplex positive displacement hydraulically operated diaphragm design, driven by squirrel cage induction motor through suitable speed reduction unit. Maximum pump stroke speed shall not exceed 100 per minute.
- 2.00.02 The stroke shall be continuously adjustable to give a capacity variation 0-100% range while the pump is running or stopped. Adjustment of capacity shall be done by manual control facility (micrometric adjusting type) to be provided locally for each of the pump.
- 2.00.03 The stroke shall be continuously adjustable to give a capacity variation 0-100% range while the pump is running or stopped. Adjustment of capacity shall be done by manual control facility (micrometric adjusting type) to be provided locally for each of the pump.
- 2.00.04 Capacity variation may be effected by changing eccentricity of the driving crank or by suitable hydraulic circuit. Pump accuracy shall be industry standard $\pm 1\%$ of capacity setting.
- 2.00.05 Pumps shall be provided with an integral relief valve, spring operated to release pressure when delivery line blockage occurs.
- 2.00.06 Crankcase shall be constructed of high quality cast iron, which will also house the gearbox and guides of cross head.
- 2.00.07 Guided, controlled travel, double-ball check valves or equivalent, shall be provided both on the suction and discharge side.
- 2.00.08 Material of construction of the various parts shall be as per the details furnished elsewhere in the specification. However all parts coming in contact with acid shall be of Haste alloy 'B' and for alkali it should be of SS-316 only.
- 2.00.09 Suitable gland seal shall be provided to prevent leakage.
- 2.00.10 Electric drive motor particulars should follow enclosed electrical chapters.

3.00.00 TESTING

3.01.00 Testing and Inspection at Manufacturer's Works

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- 3.01.01 The manufacturer shall conduct all tests required to ensure that the equipment furnished conforms to the requirements of this Specification and is in compliance with requirements of the applicable codes. The particulars of the proposed tests and the procedures for the tests shall be submitted to Owner for approval before conducting the tests.
- 3.01.02 The Owner's representatives shall be given full access to all tests for which the Manufacturer shall inform the Owner allowing adequate time so that if the Owner so desires, his representatives can witness the test.
- 3.01.03 All materials and castings used for the equipment shall be of tested quality. The test certificates shall be made available to Owner.
- 3.01.04 The pump casing shall be hydraulically tested at 200% pump operating pressure or 150% of design pressure whichever is higher. The test pressure shall be maintained at least for ½ an hour.
- 3.01.05 The rotating parts of pump drive shall be subjected to static balancing.
- 3.01.06 All pumps shall be tested at the shop for capacity, volumetric accuracy, repetitive accuracy, power and volumetric efficiency. The tests are to be done according to the requirements of the "Hydraulic Institute" of U.S.A. and Indian Standards as applicable.
- 3.01.07 The pump accessories e.g. gear box, speed reduction unit etc. will be subjected to tests as per manufacturer's standards. The test results shall be furnished to the Owner.
- 3.01.08 The combined variation of the pump and motor should be restricted within limits specified by Hydraulic Institute Standard, USA when the pump operated singly or in parallel.
- 3.01.09 All pumps shall be subject to strip down examination visually to check for mechanical damages after performance testing at shop.
- 3.01.10 Diaphragm of the metering pump shall be type tested as per applicable code/standard.
- 3.01.11 Performance test shall be carried out for the setting of pressure relief valve.
- 3.01.12 Test reports and certificates of all the above-mentioned tests to ensure satisfactory operation of the system shall be submitted to the Owner for approval before dispatch.

3.02.00 Test at Site

After erection at site pumps as detailed under different groups shall be operated to prove satisfactory performance as individual equipment as well as a system. If the performance at site is found to be not to the requirements, then the equipment shall be rectified or replaced by the Vendor at no extra cost to the Owner.

Chapter 27: LP PIPING, VALVES & SPECIALITIES**27.0 LP PIPING, VALVES & SPECIALITIES****27.1 Equipment sizing Criteria**

- 27.1.1 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.
- 27.1.2 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.
- 27.1.3 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)

- 27.1.4 The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.
- 27.1.5 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.
- 27.1.6 Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered.
- 27.1.7 Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.
- 27.1.8 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.
- 27.1.9 Material of construction for pipes carrying various fluids shall be as specified elsewhere.
- 27.1.10 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.
- 27.1.11 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.
- 27.1.12 Threaded joints shall be provided with Teflon sealant tapes.
- 27.1.13 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 may be butterfly valves.

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27.1.14 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.

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

27.2.00 TECHNICAL SPECIFICATION**27.1.00 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.

27.2.00 Pipes and fittings

27.2.1 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 shall be 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.

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

27.2.3 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.

27.2.4 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).

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



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- 27.2.6 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.
- 27.2.7 For rubber lined ERW pipes, beads shall be removed.
- 27.2.8 Inspection holes shall be provided at suitable locations for pipes 800 NB and above as required for periodic observations and inspection purposes.
- 27.2.9 At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.
- 27.2.10 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.

27.3.00 Material

- 27.3.1 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.
- 27.3.2 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.
- 27.3.3 All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockiest are not acceptable.
- 27.3.4 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.
- 27.3.5 Material of construction for pipes carrying various fluids shall be as follows:

1	Intake Water, Raw water, Ash water, Circulating Water (CW), Aux. Cooling water (ACW), clarified Water, CW blow down, *Effluent disposal, service water, AHP Seal Water, 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. Buried CW pipes shall be encased in 500 mm thk RCC. At road crossings live loads should be considered and this encasing thickness shall vary accordingly. 150 NB & above pipes shall be spiral welded.
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2	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
3.	*Drinking (potable) water	ASTM A-53 type E Gr. B galvanized /IS 1239 heavy galvanized/IS 3589 Gr 410 Galvanized to IS-4736 or equivalent.
4.	Instrument air & plant air.	ASTM A-53 type E Gr. B galvanized /IS 1239 heavy galvanized/IS 3589 Gr 410 Galvanized to IS-4736 or equivalent.
5.	Fuel Oil piping	API5L

NOTE: Bidder to note that for Effluent disposal system and potable water system for colony (* marked) Ductile Iron (DI) pipes conforming to IS 8329 and for fittings IS 9523 can be offered as an alternate to the mild steel/ galvanized mild steel pipes as specified above for standalone or outside plant boundary stretches. Various design aspects of DI piping has been discussed later in Annexure-I.

- 27.3.6 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 demineralised water, drinking water and condensate spill lines.
- 27.3.7 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).
- 27.3.8 In demineralised 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.
- 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.
- 27.3.9 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



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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).

- 27.3.10 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.
- 27.3.11 Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.
- 27.3.12 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.
- 27.3.13 Buried CW Pipes/ headers shall be minimum 12 mm thick, encased in 500 mm thk RCC. However this thickness shall be reviewed for live loads at road crossings according to AWWA M11 and increased adequately, if required.

27.4.0 Piping Wall Thickness

- 27.4.1 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 1.6 mm shall be considered while selecting the thickness.
- 27.4.2 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

NOTE: For buried CW pipe with 500 mm thick RCC encasing (as detailed in cl. no. 27.3.5), the minimum acceptable thickness shall be as indicated below.

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> NB 600 mm to NB 900 mm	-	8.0 mm
> NB 900 mm to NB 1200 mm	-	10.0 mm
> NB 1200 mm	-	12.0 mm

27.5.00 Piping Layout

- 27.5.1 Piping shall be grouped together where practicable and routed to present a neat appearance.
- 27.5.2 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.
- 27.5.3 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.
- 27.5.4 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.
- 27.5.5 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.
- 27.5.6 Adequate clearance shall be ensured with respect to the above to accommodate insulation and pipe movements, if any.
- 27.5.7 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.
- 27.5.8 Sufficient up stream and down stream lengths shall be provided for flow measuring devices, control valves and other specialties.
- 27.5.9 All local instruments shall be located on pipelines as to render them observable from the nearest available platforms.
- 27.5.10 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.



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27.6.00 Slope / Drains and Vents

- 27.6.1 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.
- 27.6.2 Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.

27.7.0 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.

27.7.1 Screwed Joints

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

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

27.7.2 Welded Joints

- (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.

27.7.3 Flanged Joints

- (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.

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

- 27.8.1 Unless otherwise specified elbows shall be of long radius type.



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- 27.8.2 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.
- 27.8.3 For steel pipes 80 Nb and above, seamless long radius forged elbows shall be used. For pipe size 250 Nb and above mitre bends may be used for all pipes except rubber lined pipes. The bend radius shall be $1\frac{1}{2}$ times the nominal pipe diameter. 90 deg. Bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces $22\frac{1}{2}$ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.
- 27.8.4 Mitre bends are not acceptable in case of rubber lined mild steel pipes.
- 27.8.5 For pipe fittings such as reducers and tees, the material shall be to ASTM-A-234 gr. WPB up to 300 NB. For pipe reducers and tees above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fittings shall conform to the dimensional standard of ANSI B-16.9.
- However, for pipes upto 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.
- For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.
- 27.8.6 Stainless steel fittings shall conform to either ASTM-A-182, Gr. 304 (316 for Sea water application, if any) or ASTM-A-403, Gr. WP 304 (316 for Sea Water application, if any) Class-S, for sizes upto and including 50 mm NB, i.e. the fitting shall be of seamless construction.
- However, for stainless steel fittings above 50mm NB, the same shall conform to ASTM-A-403, Gr. WP 304 (316 for Sea water application, if any), Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.
- 27.8.7 In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.

27.9.00 Flanges

- 27.9.1 Flanges shall be slip on type. Welding of flanges in tension is not permitted.
- 27.9.2 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.



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27.10.00 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.

27.10.1 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 or any international standard.
- (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.

27.10.2 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) On the internal surface for pipes 1000 NB and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.
- (d) 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.

27.10.3 Coating and wrapping / Anti corrosive Protection Coal tar tape

- a. Buried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are:

- (1) Coating primer (coal tar primer)
- (2) Coating enamel (coal tar enamel)
- (3) Wrapping materials.

All primer/coating/wrapping materials and methods of application shall conform to IS: 10221 except asphalt/bitumen material. Materials (primer/coating/wrapping) as per AWWA-C-203 are also acceptable.

Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fiber, tissue inner wrap followed by glass fiber or coal tar impregnated Kraft outer wrap or finish coat.

Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of Coats and wraps shall be decided based on soil corrosivity/resistivity as indicated in IS-10221. Soil data-for this purpose shall be made available.

Total thickness of completed coating and wrapping shall not be less than 4.0 mm.

- b. Alternatively, the anti-corrosive protection for buried pipes can consist of anti-corrosive protection Coal-tar tapes. Material and application of tapes shall conform to IS 15337 or equivalent. These-tapes shall be applied hot over the cold coal tar primer in steps of 2 mm thickness so as to cover the spiral edges of the first tape by the application of second tape. The total thickness of the finished protective coating shall be 4.0 mm min.

27.10.4 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.

27.10.5 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.

27.11.00 Cleaning and Flushing

- 27.11.1 All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.
- 27.11.2 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.
- 27.11.3 After erection, all water lines shall be hydro tested at 1.5 times the design pressure.
- 27.11.4 All compressed air pipe work shall be cleaned by blowing compressed air.

27.12.00 Painting of Pipes**27.12.1 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.

NOTE : CW piping shall be encased in 500 mm thk RCC.

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

27.12.2 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 140 microns (min).

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.

The total dry film thickness of 140 microns (min).

27.12.3 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.

27.12.4 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.

27.13.00 Specification for hangers and supports

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

27.13.2 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.

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- 27.13.3 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.
- 27.13.4 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.
- 27.13.5 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.
- 27.13.6 The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.
- 27.13.7 All pipe supports shall be designed to provide an absolute minimum head room of 2.5 m from floor in passages/walkways.
- 27.13.8 At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.
- 27.13.9 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.
- 27.14.00 Design /Construction /Material Particulars of Gate /Globe /Check Valves /Globe Stop Valve /Butterfly Valve**
- 27.14.1 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) General requirement of valves are as indicated below:
- (1) The valves as well as all accessories shall be designed for easy disassembly and maintenance.
 - (2) Valves to be installed outside shall be required to have the stem properly protected against atmospheric corrosion.
 - (3) 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.
 - (4) 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.



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- (5) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined.
 - (6) 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.
 - (7) The valves coming in vacuum lines shall be of extended gland type and / or water sealed.
- (c) 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.
- (d) Valves coming under the purview of IBR shall meet IBR requirements.
- (e) 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.
- (f) 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.
- (g) 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.
- (h) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing.

- (i) 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.
- (j) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.
- (k) 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.
- (l) 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.
- (m) 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.

27.14.2 VALVE BODY MATERIAL

Valve body material for various services shall be as follows:

Valve body material for water application like circulating water, Secondary circuit auxiliary cooling water of ECW system, Raw water, Ash water make-up, service water, clarified water, DM cooling water (pH corrected) & drinking water shall be cast iron for sizes 65 NB and above; gun-metal for sizes 50 NB and below.

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.

- 27.14.2.1 The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes and 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



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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

27.14.2.2 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)

- 27.14.2.3 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).
- 27.14.2.4 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.

- 27.14.2.5 All gun metal body valves shall have screwed ends.
- 27.14.2.6 All flanged end valves/specialties shall be furnished alongwith matching counter flanges, fasteners, gaskets etc. as required to complete the joints
- 27.15.00 Check Valves**
- 27.15.1 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.
- 27.15.2 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.
- 27.15.3 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.
- 27.15.4 Counter flanges to be installed on air pipes shall be screwed-on type irrespective of size.
- 27.16.00 Globe Valves**
- 27.16.1 The globe valves shall have the following characteristics;
- Straight conveyed flow
- Right angle
- Preferably, the valves shall be of the vertical stem type.
- 27.16.2 Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle.
- 27.16.3 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.
- 27.16.4 For the regulating valves, valves with regulating plug & parabolic outline disc type is preferred.

27.16.5 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.

27.17.00 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.

27.18.00 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.

125# ASA cast iron body, double ball construction air release valve with flanged ends to ASA B 16.10; and bolted cover to release the air. Construction materials shall be as below:

Body, cover	:	Cast iron to IS:210 Gr.FG 260
Bolts	:	Light weight leather/wooden balls
Seats	:	Bronze to ASTM-B-62
Cover packing	:	Braided asbestos
Float	:	Wood/rubber

27.19.00 Butterfly Valves**27.19.1 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.

27.19.2 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
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Shaft	BS 970 431 S: 291/EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.
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Seat ring	18-8 Stainless steel
Seal	Nitrile Rubber

(b) Stainless Steel Butterfly Valves

Body & Disc	ASTM A 351, Gr. CF8M/ASTM-A-182-Gr. 304
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Shaft	ASTM A 182, Gr. 316/ASTM-A-479 Gr. 316/Equivalent
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Disc & Seat Rings	EPT/BUNA-N/Neoprene
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(c) 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
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27.19.3 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.

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

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

(1) Cast Steel Valves

Body & bonnet	ASTM A 216 Gr. WCB/ ASTM A 105
Disc for non-return Valves	ASTM A 216 Gr. WCB/ ASTM A 105
Trim.	ASTM A 182 Gr. F6 or Equivalent

(2) Stainless Steel Valves

Body & Bonnet	ASTM A 351 Gr. CF 8M/
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ASTM A 182 Gr. 304

Disc -do-

Trim. ASTM 182 Gr. F. 316
/ASTM-A-479 Gr. 316 or Integral
with body**(3) Cast Iron Valves**

Body & bonnet BS 1452 Gr. 14/IS-210 Gr. FG 260

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**(4) Gun Metal Valves**

Body and bonnet IS 318 Gr. 2/Equivalent Standard

Trim -do-

- (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.

27.21.00 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.
- (g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec.
- (h) The valves shall have flanged connections.



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27.22.00 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.

27.23.00 RUBBER EXPANSION JOINTS

- 27.23.1 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.
- 27.23.2 The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.
- 27.23.3 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.
- 27.23.4 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.
- 27.23.5 Reinforcement, consisting of solid metal rings embedded in carcass shall be provided.
- 27.23.6 Expansion joints shall be complete with stretcher bolt assembly. The expansion joints shall be suitable to absorb piping movements and accommodate mismatch between pipelines.
- 27.23.7 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.
- 27.23.8 The expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.
- 27.23.9 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.

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- 27.23.10 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.
- 27.23.11 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.
- 27.23.12 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.
- 27.23.13 Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.
- 27.23.14 Bidder to note that any metallic part which comes in contact with DM / Corrosive water shall be of stainless steel material.

27.24.00 STRAINERS

27.24.1 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) |
| (b) | Strainer Element | Stainless steel (AISI 316) |
| (c) | End connection | Screwed upto 50 mm Nb, and flanged above 50 mm Nb |

27.24.2 Duplex type

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

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

Strainer element Stainless steel (AISI 316)

End connection Screwed up to 50 mm Nb, and
Flanged above 50 mm 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.

27.24.3 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



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