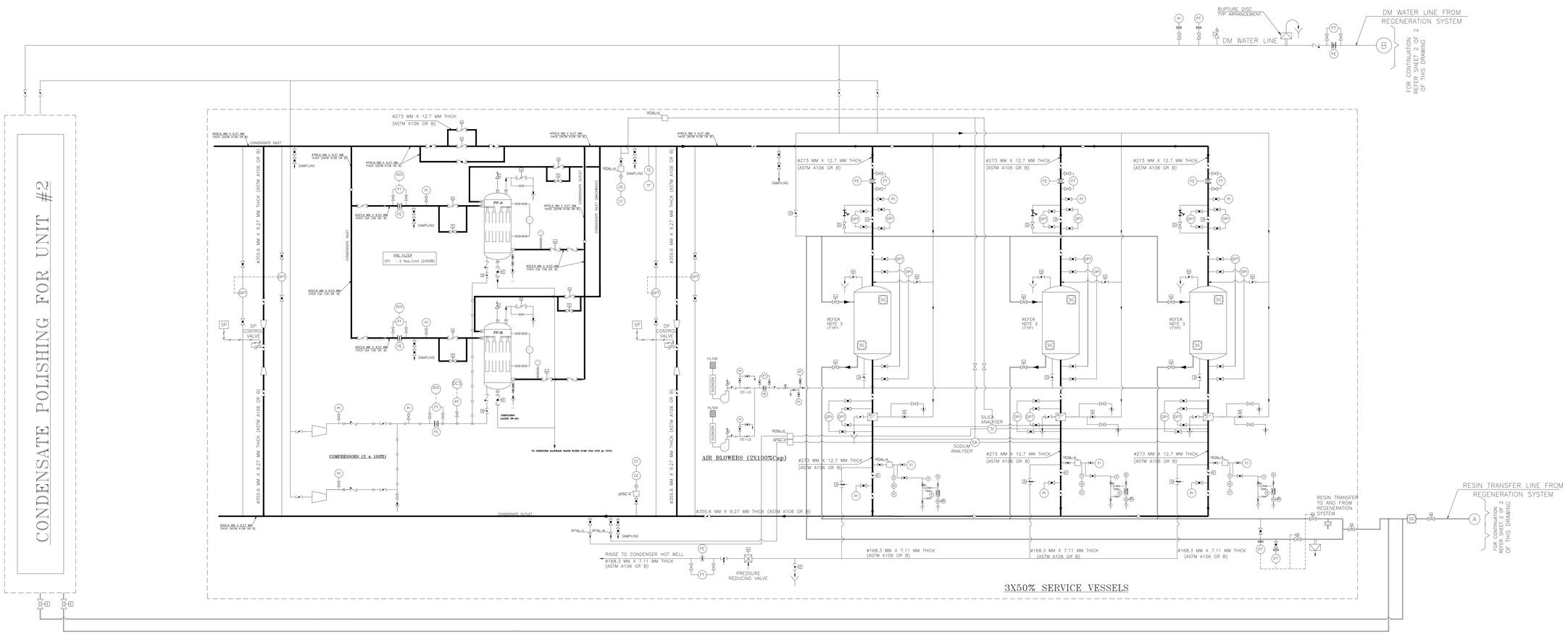
51429/2020/PS-PEM-MSX_P

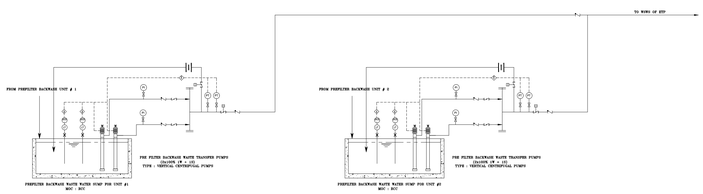
DRAWINGS

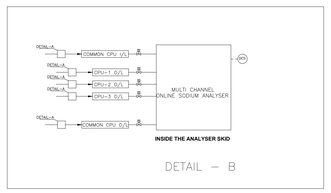
DRAWING NO. PE-DG-475-155A-A001

CUSTOMER'S DRAWING NO.

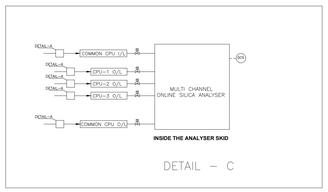


CONDENSATE POLISHING FOR UNIT #1 (TYPICAL)

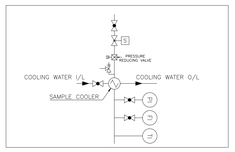




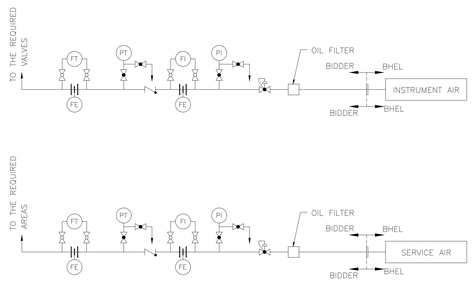
DETAIL – B



DETAIL – C



DETAIL – A



LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	PRIMING CHAMBER		BLOWER
	PUMP		ISOLATION GATE
	BALL VALVE / PLUG VALVE		DRAIN
	BUTTERFLY VALVE		OVERFLOW SEAL POT/CO_2 ABSORBER
	GLOBE VALVE		RUPTURE DISC
	DIAPHRAGM VALVE		PRESSURE REDUCING VALVE
	MOTORISED VALVE		CONDENSATE LINE
	PRESSURE RELIEF VALVE		D.M.WATER/DRAIN LINE
	NON RETURN VALVE		RINSE WATER LINE
	BUTTERFLY VALVE WITH GLAND SEALING		ACID SOLUTION LINE
	SOLENOID VALVE		ALKALI SOLUTION LINE
	RESIN TRAP		RESIN TRANSFER LINE
	SIGHT GLASS		FIELD MOUNTED INSTRUMENT
	DOUBLE ACTING PNU.CYLINDER OPERATOR		PANEL MOUNTED INSTRUMENT
	PNEUMATICALLY OPERATED VALVE		PULSATION DAMPER
	'Y' TYPE STRAINER		DIAPHRAGM SEAL
	ORIFICE PLATE	OC LS	OPEN CLOSED LIMIT SWITCH

LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
CS	CONTROL SYSTEM	FE	FLOW ELEMENT
LS	LEVEL SWITCH	CE	CONDUCTIVITY ELEMENT
LI	LEVEL INDICATOR	CT	CONDUCTIVITY TRANSMITTER(SP)
LT	LEVEL TRANSMITTER	DI	DENSITY INDICATOR
PS	PRESSURE SWITCH		ORIFICE (Pressure Breakdown)
PI	PRESSURE INDICATOR(LOCAL)		SAMPLE COOLER
PT	PRESSURE TRANSMITTER	TM	ONLINE TURBIDITY MONITOR
DPS	DIFF. PRESSURE SWITCH	SA	ONLINE SODIUM ANALYSER
DPI	DIFF. PRESSURE INDICATOR	SI	ONLINE SILICA ANALYSER
DPT	DIFF. PRESSURE TRANSMITTER	SP	SMART POSITIONER
TI	TEMPERATURE INDICATOR (LOCAL)	OC LS	OPEN CLOSE LIMIT SWITCH
TT	TEMPERATURE TRANSMITTER	FN	FLOW NOZZLE
TS	TEMPERATURE SWITCH		
TE	TEMPERATURE ELEMENT (METAL)		
FI	FLOW INDICATOR		
FT	FLOW TRANSMITTER		
FS	FLOW SWITCH		

NOTES:

1. THE P&I DIAGRAM IS TENTATIVE AND ONLY MINIMUM REQUIREMENT OF VALVES, INSTRUMENTATION ETC. HAS BEEN SHOWN. BIDDER SHOULD FURNISH COMPLETE SCHEME IN ALL RESPECTS INCLUDING ALL INSTRUMENTS, VALVES ETC. FOR SMOOTH, SAFE, EFFICIENT,TROUBLE FREE OPERATION OF PLANT FOR BHEL / CUSTOMER APPROVAL DURING DETAILED ENGINEERING.
2. INDICATES TERMINAL POINTS BETWEEN BHEL & BIDDER.
3. SERVICE VESSELS OF SPHERICAL DESIGN IS ALSO ACCEPTABLE.
4. ALL THE INSTRUMENT ISOLATION VALVES OTHER THAN FOR ACID/ALKALI APPLICATION SHALL BE GLOBE PATTERN AND DIAPHRAGM TYPE FOR ACID/ALKALI/REG WASTE APPLICATION TO BE PROVIDED AT SOURCE. NEAR THE INSTRUMENT 2-VALVE MANIFOLD FOR PRESSURE MEASURING INSTRUMENTS/3-VALVE MANIFOLD FOR DP MEASURING INSTRUMENTS/5-VALVE MANIFOLD FOR DPTS, BALL VALVE FOR FLOW INDICATORS/ANALYTICAL INSTRUMENT SHALL BE PROVIDED BY BIDDER.
5. WHERE EVER PROVIDING 2 VALVE MANIFOLD IS NOT FEASIBLE TWO NUMBERS OF GLOBE VALVES SHALL BE PROVIDED TO MEET THE FUNCTION OF 2-VALVE MANIFOLD.
6. ACID,ALKALI,DM LINE, DM WASTER LINE, REG WASTE, RESIN LINES, REGENERATION VESSEL AND MIXED RESIN STORAGE VESSELS PR. INSTRUMENTS SHALL BE PROVIDED WITH DIAPHRAGM SEAL.
7. FLOW TOTALISATION SHALL BE DONE IN SOFTWARE.
8. ALL SOLENOID OPERATED VALVES SHALL BE PROVIDED WITH SOLENOID VALVE, AIR LOCK RELAY ETC. AS REQUIRED BY PROCESS.
9. BLIND FLANGES, COUNTER FLANGES & ISOLATION VALVES SHALL BE PROVIDED BY THE BIDDER AT THE TERMINAL POINTS WHEREVER APPLICABLE.
10. ALL THE ANALYZERS SHALL BE PANEL MOUNTED.
11. ALL THE ISOLATION VALVES OF ALL THE INSTRUMENTS SHALL BE OF SS316 CONFORM TO ANSI 300# CLASS (MINIMUM).
12. REFER SHEET 2 OF 2 OF THIS DRAWING FOR ADDITIONAL NOTES.
13. FOR DESIGN PRESSURE ABOVE 40 kg/sq.cm & DESIGN TEMPERATURE LESS THAN 425 DEG C, 2 NOS. ROUTE VALVES OF 15 NB SIZE OF 800 CLASS HAVE TO BE PROVIDED BY THE BIDDER FOR PRESSURE, FLOW, LEVEL & TEMP MEASUREMENT.
14. ALL THE CONTROL LOOPS SHALL BE INDICATED IN VENDOR DOCUMENT. 15.
15. ALL THE INDIVIDUAL "Y" TYPE STRAINERS SHALL BE PROVIDED WITH DPT.
16. ALL SOLENOID VALVE SHALL BE PROVIDED BY BIDDER WITH LOCAL LED STATUS DISPLAY AND LIMIT SWITCHES SHALL BE PROVIDED BY BIDDER FOR CRITICAL APPLICATIONS TO FACILITATE REMOTE INDICATION ON OWS.
17. LOCATION OF SODIUM & SILICA ANALYZER SHALL BE INSIDE THE CONTROL ROOM. ALL REQUIRED TUBING AND RACK ALONG WITH DRAIN DISPOSAL PIPES SHALL BE IN BIDDER'S SCOPE.
18. FOR DETAIL-A & ALL ANALYSERS,ALL REQUIRED ACCESSORIES & VALVES SUCH AS ISOLATION VALVES,PRESURE REDUCING VALVE BACK PRESS REDUCING VALVE ETC SHALL BE PROVIDED FOR IMPLEMENTING SAMPLE MEASUREMENT AS PER BIDDER'S STANDARD PRACTICE.
19. PIPE LINE SIZE & THICKNESS, WHEREVER MENTIONED ARE IN MM & INDICATES MINIMUM REQUIREMENT.
20. EACH CONDENSATE POLISHING PLANT SHALL CONSIST OF THREE (3) SERVICE VESSELS (3X50% CAPACITY) FOR EACH TG UNIT.
21. BIDDER TO INDICATE RECOMMENDED ALARM LIST ALONGWITH CONTROL PHILOSOPHY AND INTERLOCK/PROTECTION WRITE UP IN LINE WITH TECHNICAL SPECIFICATION/ PROCESS ADOPTED.

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COMPUTER FILE NAME:

OWNER	THDC INDIA LIMITED (A JV OF GOVT. OF INDIA & GOVT. OF UP)
JOB NO. 475	PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT
STATUS: CONTRACT	
DISTRIBUTION	
TO	
No.OFF	
REV / DATE	
CONTRACTOR	BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT, NOIDA
DEPT	NAME / SIGN / DATE: DRN, DESN, CHD, APPD
TITLE	P & I DIAGRAM CONDENSATE POLISHING PLANT
DEPT. / SCALE / SIGN / DATE	DRAWING NO. PE-DG-475-155A-A001
	SHEET 1 OF 2 / REV 00

SIZE-A0

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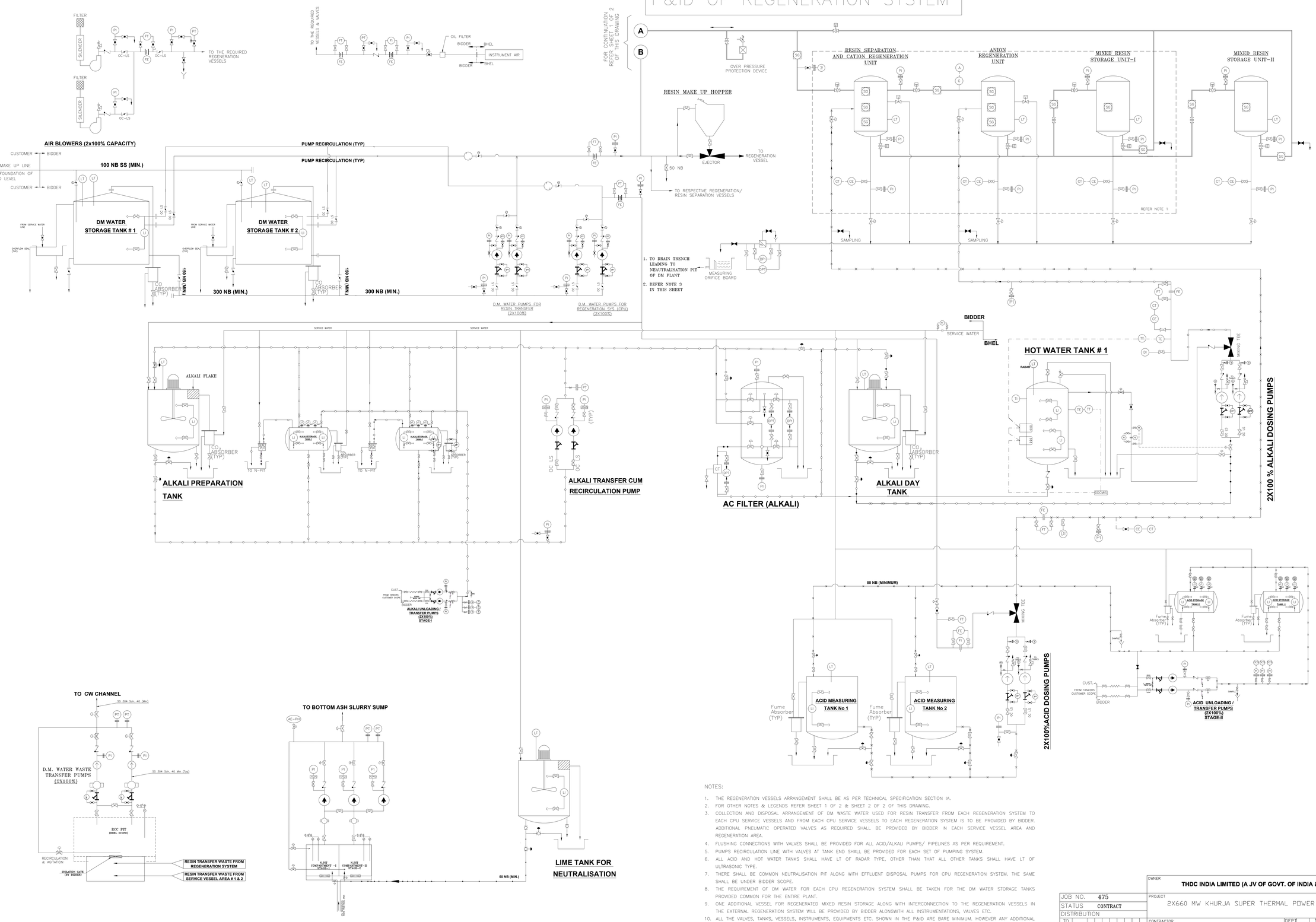
P&ID OF REGENERATION SYSTEM



NOTES:

1. THE REGENERATION VESSELS ARRANGEMENT SHALL BE AS PER TECHNICAL SPECIFICATION SECTION IA.
2. FOR OTHER NOTES & LEGENDS REFER SHEET 1 OF 2 & SHEET 2 OF 2 OF THIS DRAWING.
3. COLLECTION AND DISPOSAL ARRANGEMENT OF DM WASTE WATER USED FOR RESIN TRANSFER FROM EACH REGENERATION SYSTEM TO EACH CPU SERVICE VESSELS AND FROM EACH CPU SERVICE VESSELS TO EACH REGENERATION SYSTEM IS TO BE PROVIDED BY BIDDER. ADDITIONAL PNEUMATIC OPERATED VALVES AS REQUIRED SHALL BE PROVIDED BY BIDDER IN EACH SERVICE VESSEL AREA AND REGENERATION AREA.
4. FLUSHING CONNECTIONS WITH VALVES SHALL BE PROVIDED FOR ALL ACID/ALKALI PUMPS/ PIPELINES AS PER REQUIREMENT.
5. PUMPS RECIRCULATION LINE WITH VALVES AT TANK END SHALL BE PROVIDED FOR EACH SET OF PUMPING SYSTEM.
6. ALL ACID AND HOT WATER TANKS SHALL HAVE LT OF RADAR TYPE, OTHER THAN THAT ALL OTHER TANKS SHALL HAVE LT OF ULTRASONIC TYPE.
7. THERE SHALL BE COMMON NEUTRALISATION PIT ALONG WITH EFFLUENT DISPOSAL PUMPS FOR CPU REGENERATION SYSTEM. THE SAME SHALL BE UNDER BIDDER SCOPE.
8. THE REQUIREMENT OF DM WATER FOR EACH CPU REGENERATION SYSTEM SHALL BE TAKEN FOR THE DM WATER STORAGE TANKS PROVIDED COMMON FOR THE ENTIRE PLANT.
9. ONE ADDITIONAL VESSEL FOR REGENERATED MIXED RESIN STORAGE ALONG WITH INTERCONNECTION TO THE REGENERATION VESSELS IN THE EXTERNAL REGENERATION SYSTEM WILL BE PROVIDED BY BIDDER ALONGWITH ALL INSTRUMENTATIONS, VALVES ETC.
10. ALL THE VALVES, TANKS, VESSELS, INSTRUMENTS, EQUIPMENTS ETC. SHOWN IN THE P&ID ARE BARE MINIMUM. HOWEVER ANY ADDITIONAL VALVES, INSTRUMENTS, EQUIPMENTS ETC. AS REQUIRED BY BHEL/CUSTOMER DURING DETAILED ENGINEERING /EXECUTION/E&C STAGE SHALL BE PROVIDED BY THE BIDDER WITHOUT ANY DELIVERY AND COMMERCIAL IMPLICATION TO BHEL/CUSTOMER.
11. ONE (1) SET OF COMMON FACILITIES FOR REGENERATION OF THE ION EXCHANGE RESINS FROM THE TWO (2) NUMBERS CONDENSATE POLISHERS SIMULTANEOUSLY FOR ALL THE TURBO-GENERATOR UNITS SHALL BE PROVIDED BY BIDDER.
12. ALL THE EQUIPMENTS , VALVES, INSTRUMENTS, PIPING ETC SHOWN IN THE P & ID (SHEET 1 OF 2 & SHEET 2 OF 2) ARE IN BIDDER'S SCOPE UNLESS EXCLUSIVELY MENTIONED.

JOB NO.	475
STATUS	CONTRACT
DISTRIBUTION	
TO	
No. OF	
REV / DATE	

OWNER: THDC INDIA LIMITED (A JV OF GOVT. OF INDIA & GOVT. OF UP)

PROJECT: 2X660 MW KHURJA SUPER THERMAL POWER PROJECT

CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT, NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN			
	DESN			
	CHD			
	APPD			

TITLE: P & I DIAGRAM CONDENSATE POLISHING PLANT

DEPT. SCALE / SIGN / DATE

DRAWING NO. PE-DG-475-155A-A001

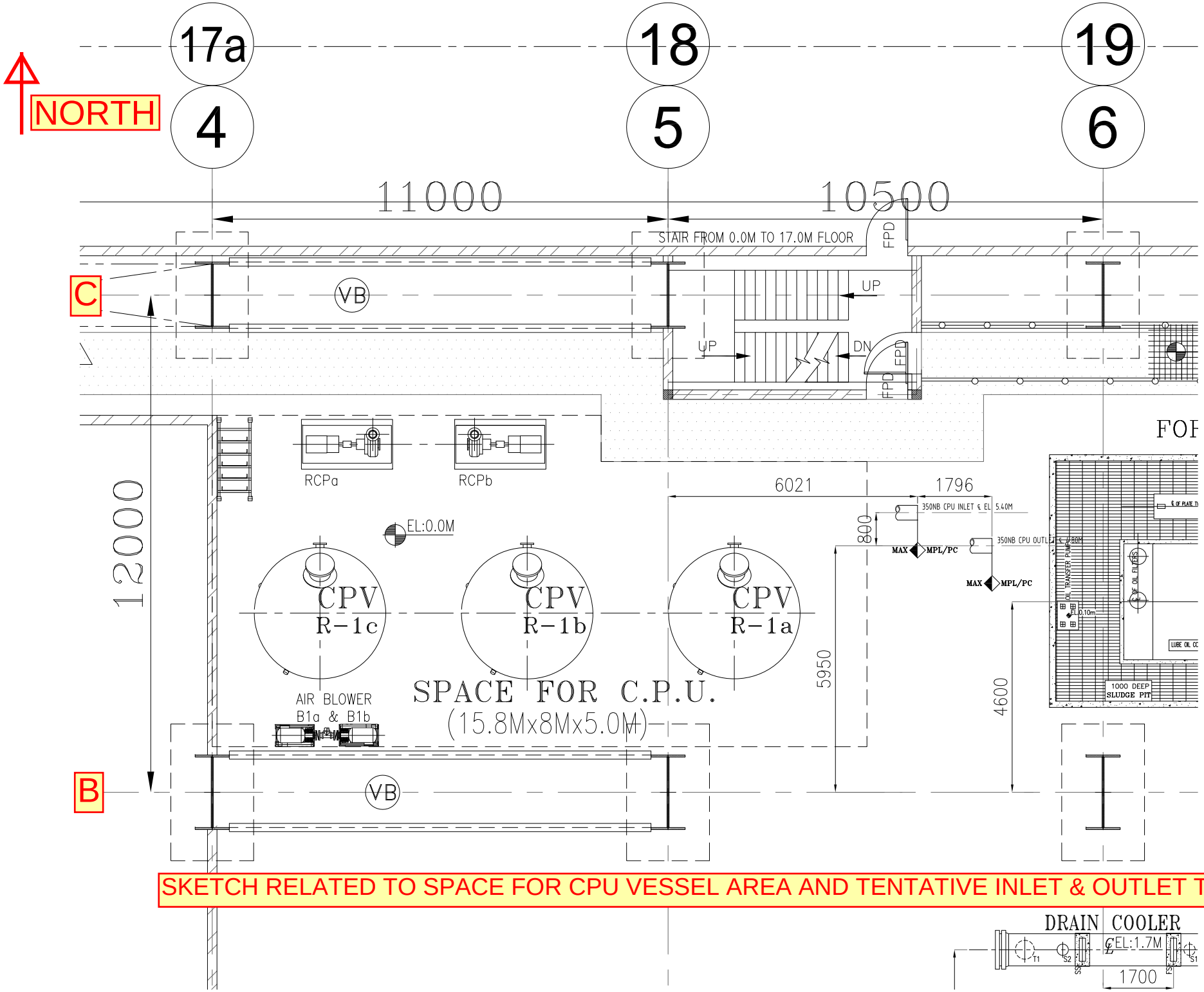
SHEET 2 OF 2 REV 00

SIZE-A0

COMPUTER FILE NAME:

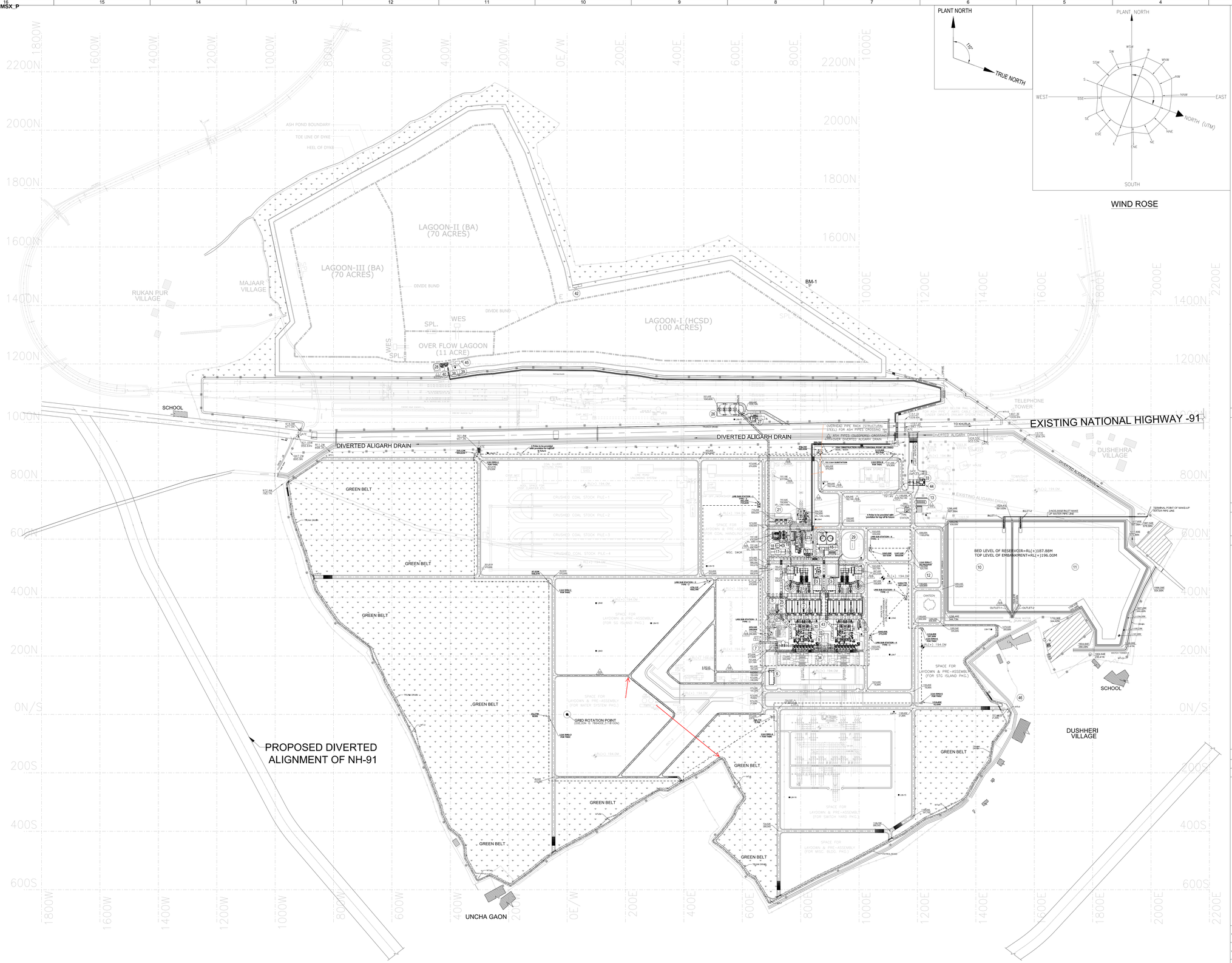
DRAWING NO. PE-DG-475-155A-A001

CUSTOMER'S DRAWING NO.



SKETCH RELATED TO SPACE FOR CPU VESSEL AREA AND TENTATIVE INLET & OUTLET TPs

51429/2020/PS-PEM-MSX_P



LIST OF BUILDING/EQUIPMENT SHOWN

NO.	DESCRIPTION OF MAJOR ITEMS
1	STEAM GENERATOR AREA
2	ELECTROSTATIC PRECIPITATOR
3	ESP / FGD CONTROL FACILITY AND CHILLER PLANT
4	CHIMNEY
5	UNIT-1 ASH EXTRACTION & BOTTOM ASH MCC ROOM
6	AIR COMPRESSOR HOUSE & MCC ROOM
7	AUXILIARY BOILER
8	NOT USED
9	BLOW DOWN PIT
10	RAW WATER RESERVOIR-1 (LIVE STORAGE)
11	RAW WATER RESERVIOR-2 (DEAD STORAGE)
12	CONSTRUCTION STORE
13	PARKING
14	FUEL OIL TANK FARM AREA INCLUDING FOAM SHED & OWS
15	FUEL OIL UNLOADING AREA AND PUMP HOUSE
16	ASH SLURRY PUMP HOUSE
17	ASH WATER PUMP HOUSE
18	SETTLING TANK
19	SURGE TANK
20	HCSD SILO
21	HCSD PUMP HOUSE
22	LIMESTONE MILL BUILDING
23	TRANSPORT AIR COMPRESSOR HOUSE
24	FLY ASH EXTRACTION TOWER
25	VACUUM PUMPS (ESP AREA) FOR AHP
26	FLY ASH SILO
27	SILO UTILITY BUILDING & ASH SILO MCC ROOM
28	ASH WATER RECIRCULATION PUMP HOUSE
29	AMMONIA STORAGE
30	FD FAN
31	ID FAN
32	PA FAN
33	GATE COMPLEX
34	MILL REJECT HANDLING SYSTEM
35	GYPSUM DEWATERING BUILDING
36	UNIT-2 ASH EXTRACTION & BOTTOM ASH MCC ROOM
37	MAIN AHP SWITCHGEAR / CONTROL ROOM CUM COMMON FGD ELECTRICAL BUILDING
38	SEEPAGE WATER PUMP HOUSE
39	DISASTER ROOM
40	AWRS CUM SEEPAGE WATER SYSTEM SWGR ROOM
41	NOT USED
42	SEEPAGE WATER PUMP HOUSE (HCSD AREA)
43	NITROGEN CYLINDER STORAGE
44	STP
45	STP (ASH POND AREA)
46	WATCH TOWER

NOTES:

01. ALL DIMENSIONS AND LEVELS ARE IN METERS.
02. ±0.00 OF MAIN PLANT AREA CORRESPONDS TO RL(+)194.500M, WHICH IS FINISHED FLOOR LEVEL (FFL) OF MAIN POWER HOUSE BUILDING.
03. FINISHED FLOOR LEVEL IN VARIOUS BUILDING IN MAIN PLANT AREA SHALL BE 0.000M.
04. BUILDING & FACILITIES INDICATED ARE PRELIMINARY AND MAY BE CHANGE IN LOCATION & SIZE OF THE FACILITIES AFTER FINALIZATION OF VENDOR.
05. SPACE FOR LAY-DOWN & PRE-ASSEMBLY ALLOCATED UNDER OWNERS SCOPE IS UNCHANGED.
06. THE COORDINATES 786400E, 3118100N IS COINCIDE WITH PLANT ORIGIN COORDINATES E 0.000, N 0.000.
07. FOR BUILDING DIMENSION AND CONFIGURATION, PLEASE REFER RESPECTIVE GA DRAWING.
08. CO-ORDINATES OF VARIOUS FACILITY MENTIONED ARE INDICATIVE AND WILL BE FINALIZED AFTER RECEIPT OF VENDOR INFORMATION AND FINALIZATION OF BUILDING / FACILITY LAYOUT.

HOLD :

01. THE LOCATION OF OWNER'S FACILTIES NEAR UNIT#1 BOILER AREA (WEST SIDE) IS UNDER DISCUSSION WITH NTPC/THDC/BHEL.

LEGENDS:

DOUBLE LANE ROAD
SINGLE LANE ROAD
PIPE RACK
PIPE CULVERT
RAW WATER PIPE CORRIDOR
GREEN BELT
CABLE RACK
UG ROAD CROSSING FOR ELECTRIC LINE
TRUNK DRAIN
RAIL LINE
BOUNDARY WALL
LAND BOUNDARY
ASH SLURRY PIPE CORRODOR
CONSTRUCTION POWER LINE
WATCH TOWER (WT)
OVERHEAD ELECTRIC LINE
CABLE TRENCH
SHALLOW TRENCH
LIGHTING MAST (LM)

SPECIAL NOTE:-

01. ALL THE FACILITIES INDICATED IN DITHER COLOR ARE UNDER THE SCOPE OF OTHERS / CUSTOMER.
03. PILING OF ANNEX BUILDING COLUMNS AND TRESTLE COLUMNS SHOULD BE DONE AT THE SAME TIME.

REFERENCE DRAWINGS:

DRAWING NO.	DRAWING TITLE
9915-999-POC-F-001 - REV-1	GENERAL LAYOUT PLAN

REV NO.	ZONE	DESCRIPTION	PPD	CHKD	APPD	DATE
03	≃	01. DRAWING HAS BEEN REVISED BASED ON NTPC COMMENTS & TCM-7. REVISED AS MARKED.	AK	HM/NBM	KSB	03-06-2020
02	≃	01. DRAWING HAS BEEN REVISED BASED ON NTPC COMMENTS & GLP MOM. REVISED AS MARKED.	PJ	HM/NBM	KSB	07-02-2020
01	≃	01. DRAWING HAS BEEN REVISED BASED ON NTPC COMMENTS AND DETAIL ENGINEERING REQUIREMENTS.	PJ	HM/NBM	KSB	06-01-2020

	NAME	SIGN	DATE
L&T-SGL PPD	PJ / AK		06-01-2020
L&T-SGL CHKD	HM		06-01-2020
L&T-SGL APPD	KSB		06-01-2020
L&T-MHPS CHKD	VVK		06-01-2020
L&T-MHPS APPD	SR		06-01-2020

TITLE: GENERAL LAYOUT PLAN

SIZE: A0 | SCALE: 1:4500 | WBS : -

UNIT DESIGNATION: 1 & 2

SHEET 01 OF 01 | REV 03

OWNER	THDC INDIA LIMITED (A JV OF GOVT. OF INDIA & GOVT. OF UP)
OWNER'S CONSULTANT	NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE)
PROJECT	KHURJA SUPER THERMAL POWER PROJECT (2 x 660 MW)
BOILER CONTRACTOR	L & T - MHPS BOILERS PVT. LTD. — JOB NO. 11015Z
BOILER CONTRACTOR CONSULTANT	L & T - SARGENT & LUNDY LTD.
L&T-MHPS DWG. NO.	11015-00-98140-3402-003 — SPEC. TITLE: SG & AUXILIARIES
NTPC DWG. NO.	9915-370-301-PVC-B-034C — SPEC. NO.: -

UNLESS OTHERWISE STATED ALL DIMENSIONS ARE IN MILLIMETRES. DO NOT SCALE. IF IN DOUBT, ASK.

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DATA SHEET-A

	TITLE: TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT 2X660 MW KHURJA STPP	BHEL DOCUMENTS NO.: PE-TS-475-155-A001	
		VOLUME IIB	
		SECTION – IA	
		REV. NO. 00	DATE:

1.0	**DESCRIPTION OF TURBO GENERATOR UNIT (TG) FOR WHICH CONDENSATE POLISHING IS TO BE PROVIDED :**	
(i)	No. of units	Two (2)
(ii)	Capacity of unit	660 MW
(iii)	Total flow in all the service vessels (per unit)	1346 Tones per hour
2.0	**CONDENSATE POLISHER SERVICE VESSELS PER UNIT :**	
(i)	Number of condensate polisher service vessel	Three numbers (3X50%)
(ii)	Type of condensate polisher service vessel	Cylindrical / Spherical
(iii)	Capacity of each condensate polisher service vessel	50% of condensate flow
(iv)	Flow through each condensate polisher service vessel	673 Tones per hour
(v)	Operating pressure of each condensate polisher service vessel	30.0 kg./sq.cm (g)
(vi)	Design pressure of each condensate polisher service vessel	45.2 kg./sq.cm (g)
(vii)	Operating temperature of service vessel and their internals/ appurtenances including resin	46.9 degree Celsius.
(viii)	Design temperature of service vessel and their internals/ appurtenances including resin	60 degree Celsius.
(ix)	Pressure drop	• 3.5 kg/sq cm (max, including CPU service vessels, pre filters, valves and fittings & resin traps connected with the unit) for clogged condition. • 2.1 kg/sq cm (max, including CPU service vessels, pre filters, valves and fittings & resin traps connected with the unit) for clean condition.
(x)	Design code of each condensate polisher service vessel	ASME sec VIII div 1 ed. 2010 or acceptable equivalent international standard.
(xi)	Material of construction of each condensate polisher service vessel	• Carbon steel plates to SA - 515/ 516 Gr. 70 with rubber lining inside. The lining shall be of rubber having a hardness of 65 plus/minus 5 shore-A meeting the requirements of IS: 4682, Part-I (4.5 mm thick Rubber lining in three layers). • Inlet water distributor: - Hub and internals diffuser splash plate or header and perforated laterals. Material of construction shall be SS-316 • Under drains: - Same as above with screened laterals with internal perforated pipes and rubber lined flat bottom.
(xii)	Resin traps at the outlet of each condensate polisher service vessel	Rubber lined steel construction and internals (cord & screen) shall be of JOHNSON SCREENS IRELAND or equivalent (SS-316) construction
2.1	**AIR-BLOWERS FOR RESIN MIXING (SERVICE VESSELS AREA) PER 660 MW TG UNIT**	
(i)	Number of air blowers per 660 MW TG Unit	Two (2x100%)
(ii)	Type of each air blowers	Centrifugal/Twin lobe type, oil free, positive displacement

(iii)	Duty	Intermittent
(iv)	Capacity & Head	As required
(v)	Pressure gauge	One per blower
(vi)	Location of each air blowers	Indoor
(vii)	Material of Construction	Casing, cover and stator – Cast Iron GR FG 260 to IS 210 Lobe/ Impeller – Cast Iron GR FG 260 to IS 210 Shaft – Carbon steel BS:970 En-8/ANSI-I045
(viii)	Accessories	Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter/silencer, flexible couplings and discharge snubber, all mounted on a single base. Relief valve(s) shall also be provided by the bidder.
2.2	**PRE FILTER**	
(i)	Number	Two (2X50%) for each 660 MW TG unit Total (4X50%) for station
(ii)	Type	Back washable (Horizontal / Vertical)
(iii)	Design code of each pre filter	ASME sec VIII div 1 (latest)
(iv)	Flow through each pre filter	673 Tones per hour
(v)	Operating pressure of each Pre Filter	30.0 kg./sq.cm (a)
(vi)	Design pressure of each Pre Filter	45.2 kg./sq.cm (g)
(vii)	Operating temperature of Pre Filter and their internals/ appurtenances	46.9 degree Celsius.
(viii)	Design temperature of Pre Filter and their internals/ appurtenances	60 degree Celsius.
(ix)	Pre –Filter Housing	2 nos. for each TG-unit
(x)	Pre- Filter media (Cartridge)	20 micron/ Proven Design Mesh Size (PP material/ Proven Design).
(xi)	Automatic Bypass provision & valve arrangement	Inlet, outlet and common bypass motorized/pneumatic valves with necessary interlocks with CPU
(xii)	Absolute recovery	99.98%
(xiii)	Material of construction (shell & dished ends) of each pre filter	Carbon steel plates to SA - 515 / 516 Gr. 70 with rubber lining inside. The lining shall be of rubber having a hardness of 65 plus/minus 5 shore-A meeting the requirements of IS: 4682, Part-I.
2.3	**COMPRESSOR FOR BACKWASHING (PRE-FILTER) PER 660 MW TG UNIT**	
(i)	Number of compressor per 660 MW TG Unit	Two (2x100%)
(ii)	Type	Oil Free Screw compressors (Air cooled/ water cooled)
(iii)	Duty	Intermittent

(iv)	Capacity & Head	As required
(v)	Design Temp/ RH	45deg Celsius/ 75 RH
(vi)	Design & Testing Code	ISO 1217
(vii)	Pressure gauge	One per compressor
(viii)	Location of each compressor	Indoor
(ix)	Material of Construction	As per manufacturers standard suitable for CPU application
2.4	**BACKWASH WATER COLLECTION TANK (BHEL SCOPE)**	
(i)	Number	One (1) for each 660 MW TG unit
(ii)	Type	RCC Pit With Solvent Free Epoxy Coating.
(iii)	Capacity	Holding capacity shall be 1.5 times the capacity of condensate water required for backwashing of pre filter
2.5	**PRE FILTER BACKWASH WASTE WATER TRANSFER PUMPS**	
(i)	Number	Two (1 working+1 standby) for each 660 MW TG unit
(ii)	Type	Vertical Centrifugal
(iii)	Pump Speed	Maximum 1500 rpm
(iv)	Capacity & head	Designed for evacuating water from the backwash waste water tank before next filling and head as required.
(v)	Material of construction	
•	casing, impeller	SS316L
•	Shaft	SS 316L
•	shaft sleeve material	SS 410
(vi)	Recirculation line with pneumatic actuated regulating type diaphragm valve	Required
3.0	**EXTERNAL REGENERATION FACILITIES (One (1) set of external regeneration system common for all the condensate polishing plants shall be provided by the bidder.)**	

3.1	**CHEMICAL HANDLING, PREPARATION & DOSING SYSTEM**			
a)	**Chemical Tanks**	**Alkali Preparation Tank**	**Alkali Day Tank**	**Acid Measuring Tank**
(i)	Number required	One (1) Number	One (1) Number	Two (2) Number
(ii)	Type	-- Vertical Cylindrical with dish end at bottom and cover at top; Atmospheric --		
(iii)	Useful capacity (Each)	Minimum 10 Cu.m	Each tank shall be adequate to hold chemical for 125% of one regeneration	

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(iv)	Material	---------- M.S. with 4.5 mm thick rubber lining inside----------	
(v)	Accessories Required	Vent, Overflow, drain connection, manhole (only for alkali preparation tank), motor driven stirrer (only for alkali preparation tank & alkali day tanks), dissolving basket in SS 316 construction (only for alkali preparation & alkali day tanks), fume absorber/ CO_2 absorber, operating platform, ladders, lifting lugs (4 nos minimum) etc. as required by manufacturer's standard	
(vi)	Stirrer per tank	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 RPM Max. Material of Construction of each stirrer and agitator = Stainless Steel – 316.	Not Applicable.
(vii)	Dissolving basket	One number per tank. Material of Construction of each dissolving basket – SS316.	Not Applicable.
b)	**Dosing Pumps**	**Acid**	**Alkali**
(i)	Number	Two (1Working +1Standby) (2X100%)	Two (1Working +1Standby) (2X100%)
(ii)	Type	---------- Simplex positive displacement type; hydraulically operated diaphragm type ----------	
(iii)	Whether suction strainer required	---------- Yes ----------	
(iv)	Material of Construction of strainer	Haste alloy –B	SS316
(v)	Accessories		
1)	Pressure Dampener	----------Two (2)----------	
2)	External safety relief valve (in addition to inbuilt safety valve)	Two (Hastelloy-B)	Two (SS:316)
3)	Maximum pump stroke speed per minute	----------100 per minute----------	
(vi)	**Material of construction**		
1)	Liquid End (Pump Head, Valves, Valve housing, valve spring etc.).	PVC	AISI:316
2)	Diaphragm	PT.F.E.	P.T.F.E.
3)	Packing	P.T.F.E.	P.T.F.E.
4)	Shaft	---------- Hardened steel EN 8 (BS:970)----------	
5)	Worm & Worm Wheel (If Applicable)	----------Manganese Bronze----------	

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6)	Connecting Rod	----------Manganese Bronze----------
7)	Cross head Guide	---------- Bronze----------
(vii)	Capacity & Head	----------As per system requirement ----------
3.2 Activated Carbon Filter for Alkali		
(i)	Number	One (1) number
(ii)	Type	Vertical cylindrical with dished end bottom
(iii)	Material of construction	Carbon steel plates to SA - 515 / 516 Gr. 70 with rubber lining inside. The lining shall be of rubber having a hardness of 65 plus/minus 5 shore-A meeting the requirements of IS: 4682, Part-I. Influent Distributor Material- SS 316
(iv)	Design code	ASME sec VIII div 1 ed. 2010 or acceptable equivalent international standard.
(v)	Size	10 M3/hr minimum (not less than the design capacity of alkali transfer cum recirculation pump)
(vi)	Bed depth of filter material	1 Meter (minimum)
(vii)	Flow velocity	12 m/hr (max).
(viii)	Seal	Teflon diaphragm
(ix)	Manhole	Two (2) nos. minimum each of Davit type and 600 mm dia.
(x)	Sight Windows	One (1) no. in backwash space
(xi)	Hand hole	One (1) no. of 150 mm dia for removal of activated carbon
(xii)	Accessories	Manhole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs (4 Nos minimum) etc.
3.3 Alkali diluent water heating tank (Hot water tank)		
(i)	Number	One (1) number
(ii)	Type/Capacity (Each)	Vertical Cylindrical with dished end with Electric heater (2X50%) / 120% of max water required for regeneration or 10 Cu. M whichever is higher.
(iii)	Design code	ASME sec VIII div 1 ed. 2010 or acceptable equivalent international standard.
(iv)	Temperature of alkali to be heated	To obtain temp. from 15 deg C to 50 deg C at alkali mixing feed out let within 5 hours.
(v)	Temp. Transmitter	To be provided by the bidder.
(vi)	Burn out protection	To be provided by the bidder.

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(vii)	Material of construction of tank:	Carbon steel plates to SA - 515 / 516 Gr. 70 with rubber lining inside. The lining shall be of rubber having a hardness of 65 plus/minus 5 shore-A meeting the requirements of IS: 4682, Part-I.
(viii)	Density meter	1 No. at each mixing tee outlet
(ix)	Accessories	Manhole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs (4 Nos minimum), Pressure Relief Valve, Temperature Indicator & Switches etc.

3.4 DM water pumps

S. No.	Description / Data	DM Water (for Resin Transfer) Pumps	DM Water (for Regeneration) Pumps
(i)	Numbers. required	Two (1 working+1 standby) (2x100%)	Two (1 working+1 standby) (2x100%)
(ii)	Type	----------Horizontal, Centrifugal ----------	
(iii)	Pump Speed	----------Maximum 1500 rpm----------	
(iv)	Capacity & head of each pump	As required	As required
(v)	Liquid to be handled	DM Water	DM Water
(vi)	Type of Shaft sealing	Mechanical Seal	Mechanical Seal
(vii)	**Material of construction**		
a)	Casing	----------ASTM A 351 CF 8M----------	
b)	Impeller	----------ASTM A 351 CF 8M----------	
c)	Shaft	---------- SS 316----------	
d)	Shaft Sleeves	----------SS 410----------	
e)	Wear Rings & Mechanical Seal	----------As Per manufacturer's Standard----------	
(viii)	'Y' type strainer	----------One number per pump (Material shall be SS316)-------	
(ix)	Recirculation line with motor actuated regulating type butterfly valve	----------Required ----------	
(x)	Accessories	Coupling Guards, drain plug, Vent valve, Suction hoses, isolation valves, etc. as required as per manufacturer's standard	

3.5 Air-blowers for Resin Mixing (Regeneration area)

(i)	Number	Two (1 working+1 standby)
(ii)	Type	Centrifugal/Twin lobe type
(iii)	Duty	Intermittent
(iv)	Capacity & Head	As required
(v)	Pressure gauge	One per blower

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(vi)	Location	Outdoor
(vii)	Material of Construction	Casing, cover and stator – Cast Iron GR FG 260 to IS 210 Lobe/ Impeller – Cast Iron GR FG 260 to IS 210 Shaft – Carbon steel BS:970 En-8/ANSI-I045
(viii)	Accessories	Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter/silencer, flexible couplings and discharge snubber, all mounted on a single base. Relief valve(s) shall also be provided by the bidder.
3.6	**DM Waste Water Collection Tank (BHEL SCOPE)**	
(i)	Number	One (1) Number
(ii)	Type	RCC Pit With Solvent Free Epoxy Coating.
(iii)	Capacity	Holding capacity shall be 1.5 times the capacity of DM water required for transferring resins from regeneration system or 50 cum whichever is higher.
3.7	**DM Waste Water Transfer pumps**	
(i)	Number	Two (1 working+1 standby) (2x100%)
(ii)	Type	Horizontal centrifugal single stage with priming system
(iii)	Pump Speed	Maximum 1500 rpm
(iv)	Capacity & head	Suitable to pump the total volume (Minimum 50 Cu.m/hr). Head to suit the requirement
(v)	Type of Shaft sealing	Mechanical Seal
(vi)	Material of construction	
•	casing, impeller	SS 316
•	Shaft	SS 316
•	shaft sleeve material	SS 316
(vii)	'Y' type strainer	One number per pump (Material shall be SS316)
(viii)	Recirculation line with pneumatic actuated regulating type diaphragm valve	Required
(ix)	Number of priming chambers	Two (2)
3.8	**Lime Tank for N Pit**	
(i)	Number	One (1)
(ii)	Material of construction	SS 316
(iii)	Type	Vertical Cylindrical Atmospheric with dished bottom and cover at top
(iv)	Useful capacity	Adequate to hold quantity of alkali required for neutralization of excess acid in waste effluent generated due to single regeneration of a condensate polisher mixed bed with 25% overall margin or 2 cum

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		whichever is higher.	
(v)	Accessories Required	Vent, Overflow, drain connection, motor driven stirrer, dissolving basket (SS316), CO2 absorber, operating platform, ladders, manhole, lifting lugs (4 nos minimum) etc.	
(vi)	Stirrer per tank	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 RPM Max. Material of Construction of each stirrer and agitator = Stainless Steel – 316.	
(vii)	Dissolving basket	One number. Material of construction : AISI-316	
3.9	**Alkali Transfer Cum Recirculation Pumps**		
(i)	Chemical to be used	Sodium Hydroxide (5-50% Conc)	
(ii)	Type	Horizontal Centrifugal	
(iii)	Numbers required	Two (1 working+1 standby)	
(iv)	Duty	Intermittent	
(v)	Capacity/ Head of Pump	As required,10 Cum/hr (min.)/ As required (10 MWC (min.)	
(vi)	Maximum Pump Speed	1500 rpm	
(vii)	Materials of construction	Stainless Steel-316	
(viii)	Pressure gauge	One per pump with teflon diaphragm seal	
(ix)	Pressure Dampener	One per pump	
(x)	Reinforced Rubber hoses	Minimum two (2) nos. of size 80 mm NB of min. 10 m. with isolation valves	
(xi)	'Y' type strainer	One number per pump (Material shall be SS316)	
(xii)	Accessories required for each pump	Coupling guard, drain plug, vent valve, Suction hoses, isolation valves, Y- type strainers, pressure gauges, pulsation dampener etc. as required as per manufacturer's standard	
3.10	**Acid & Alkali Unloading Pumps**		
S. No.	**Description / Data**	**Acid Unloading Pumps**	**Alkali Unloading Pumps**
(i)	Chemical to be used	30-33% HCl	5 to 50% NaOH
(ii)	Type	Horizontal, Centrifugal	Horizontal, Centrifugal
(iii)	Numbers required	Two (1W+1S) (2x100%)	Two (1W+1S) (2x100%)
(iv)	Duty	Intermittent	Intermittent
(v)	Capacity/ Head of Pump	As required	As required
(vi)	Maximum Pump Speed	Maximum 1500 rpm	Maximum 1500 rpm

(vii)	Materials of construction	Polypropylene or equiv. for HCl	Stainless Steel-316
(viii)	Pressure gauge	One per pump with teflon diaphragm seal	One per pump with teflon diaphragm seal
(ix)	Pressure Dampener	One per pump	One per pump
(x)	Reinforced Rubber hoses	Minimum two (2) nos. of size 80 mm NB of min. 10 m. with isolation valves	Minimum two (2) nos. of size 80 mm NB of min. 10 m. with isolation valves
(xi)	'Y' type strainer	One number per pump	One number per pump
(xii)	Accessories required for each pump	Coupling guard, drain plug, vent valve, Suction hoses, isolation valves, Y- type strainers, pressure gauges, pulsation dampener etc. as required as per manufacturer's standard	
4.0	**Piping**		
(i)	Resin Transfer piping material	Stainless steel type 304 Sch.40 (min.)	
(ii)	Service vessel Inlet piping material	ASTM A-106 Gr. B	
(iii)	Service vessel Outlet piping material	ASTM A-106 Gr. B	
(iv)	Pre filter Inlet piping material	ASTM A-106 Gr. B	
(v)	Pre filter Outlet piping material	ASTM A-106 Gr. B	
(vi)	Service vessel rinse piping material	ASTM A-106 Gr. B	
(vii)	Piping handling Acid Service	carbon steel Polypropylene lined/ CPVC as per ASTM F441 (Sch.80)	
(viii)	Piping material for Alkali	SS 316 Sch-10 (min.)	
(ix)	Piping material handling DM Water and Pre Filter backwash waste	Stainless steel SS 304 Schedule 40 (minimum)	
(x)	Piping material for DM waste water	Stainless steel type 304 Sch.40 (Min)	
(xi)	Instrument Air & service air piping material	hot dip galvanized (heavy grade) steel	
6.0	**SAFETY EQUIPMENT**	Ten (10) sets of safety equipment [(Personal Protection Equipment (PPE)] comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided by bidder. Two (2) Nos. Personnel water drench shower/safety shower and eye bath shall also be provided by the bidder.	

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SPECIFIC TECHNICAL REQUIREMENTS FOR ELECTRICAL

	TITLE:	SPECIFICATION NO.
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	VOLUME NO. : **II-B**
		SECTION: **C**
		REV NO. : **00** DATE: 15.06.20
	2X660 MW KHURJA STPP-TG	SHEET: 1 OF 1

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I	CABLE SCHEDULE FORMAT (ANNEXURE-III)	1
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II	MOTOR DATASHEET-C	2
II	GENERAL TECHNICAL REQUIREMENT FOR LV MOTORS	4
II	REFERENCE QUALITY PLAN	3
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The requirements mentioned in Section-I shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-II.

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

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

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.**
e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer /BHEL approval without any commercial and delivery implications to BHEL
g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
h) Motor shall meet minimum requirement of motor specification.
i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
j) Cable BOQ worked out based on routing of cable listing provided by the vendor for "both end equipment in vendor's scope" shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

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

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

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

4.0 LIST OF ENCLOSURES

a) Electrical scope between BHEL & vendor (Annexure –I)
b) Electrical Load data format (Annexure –II)
c) BHEL cable listing format (Annexure –III)
d) Technical specification for motors.
e) Datasheets & quality plan for motors.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

ANNEXURE-I

SECTION-I

PACKAGES : CONDENSATE POLISHING UNIT
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: 2X660 MW KHURJA STPP-TG

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

PACKAGES : CONDENSATE POLISHING UNIT
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: 2X660 MW KHURJA STPP-TG

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

NOTES:

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

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONT ROL CODE	REMA RKS	LOAD No.	VERIFICATI ON FROM MOTOR DATASHEE T (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

ANNEXURE-II

SECTION-I

NOTES:
1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.	475	ORIGINATING AGENCY		PEM (ELECTRICAL)	
	PROJECT TITLE	2X660 MW KHURJA STPP-TG	NAME		DATA FILLED UP ON	
	SYSTEM	CONDENSATE POLISHING UNIT	SIGN.		DATA ENTERED ON	
	DEPTT. / SECTION	MAUX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

CABLE SCHEDULE FORMAT

ANNEXURE III

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
   a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
   b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
   c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
   d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
   e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
   f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
   g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
|	|	|	|
Cable Voltage Code (see B below)	No. of cores (e.g. 01,03,3H, 07)	Cable code (See C below)	Cable size (e.g. 035,185,2.5, 0.5)

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V

(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

CLAUSE NO.	TECHNICAL REQUIREMENTS

MOTORS

1.00.00 GENERAL REQUIREMENTS

1.01.00 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.

1.02.00 All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.

1.03.00 Contractor shall provide fully compatible electrical system, equipment, accessories and services.

1.04.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

1.05.00 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.

1.06.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances for contractors equipment and systems shall be under the contractor scope.

1.07.00 Degree of Protection

Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-

i)	Indoor motors	-	IP 54
ii)	Outdoor motors	-	IP 55
iii)	Cable box-indoor area	-	IP 54
iv)	Cable box-Outdoor area	-	IP 55

2.00.00 CODES AND STANDARDS

1)	Three phase induction motors	:	IS/IEC:60034
2)	Single phase AC motors	:	IS/IEC:60034
3)	Crane duty motors	:	IS:3177, IS/IEC:60034
4)	DC motors/generators	:	IS/IEC:60034
5)	Energy Efficient motors	:	IS 12615, IEC: 60034-30

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.00.00	**TYPE**
3.01.00	**AC Motors:** a) Squirrel cage induction motor suitable for direct-on-line starting. b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30. HT motors shall have minimum design efficiency of 95 % Tolerance on efficiency value applicable as per IEC 60034. c) Crane duty motors shall be squirrel cage Induction motor as per the requirement. d) Motor operating through variable frequency drives shall be suitable for inverter duty with VPI insulation. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable. e) Motors operating through variable frequency drives shall also meet the requirements mentioned in subsection for VFD.
3.02.00	DC Motors Shunt wound
4.00.00	**RATING** (a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor. (b) Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.
5.00.00	**TEMPERATURE RISE** **Air cooled motors** 70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation. **Water cooled** 80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation. 41 deg.C over inlet cooling water maximum temperature of 39 deg.C for thermal class 90 (Y) wet wound Boiler circulation pump motor.
6.00.00	**OPERATIONAL REQUIREMENTS**

CLAUSE NO.	TECHNICAL REQUIREMENTS
6.01.00	**Starting Time**
6.01.01	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.
6.01.02	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.
6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
6.02.00	**Torque Requirements**
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.
6.03.00	**Starting voltage requirement** (a) Up to 85% of rated voltage for ratings below 110 KW (b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW (c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW (d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW (e) Up to 75 % of rated voltage for ratings above 4000KW Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.
7.00.00	**DESIGN AND CONSTRUCTIONAL FEATURES**
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.
7.02.00	All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). The method of movement

CLAUSE NO.	TECHNICAL REQUIREMENTS
	of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below (a) Fuel oil area : Group – IIB (b) Hydrogen generation : Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA / IEC60034)
7.03.00	Winding and Insulation (a) Type : Non-hygroscopic, oil resistant, flame resistant (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature. (c) 11kV & 3.3 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be Global Vacuum Pressure Impregnated i.e. resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15. However winding insulation for wet wound Boiler circulation pump motor shall be thermal class 90 (Y) or better. (d) 240VAC, 415V AC & 220V DC motors : Thermal Class (B) or better
7.04.00	Motors rated above 1000KW shall have insulated bearings/housing to prevent flow of shaft currents.
7.05.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
7.06.00	Noise level for all the motors shall be limited to 85dB (A) except for BFP motor for which the maximum limit shall be 90 dB(A). Vibration shall be limited within the limits prescribed in IS/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.
7.07.00	In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer and 2 numbers duplex platinum resistance type temperature detectors.

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7.08.00	Motor body shall have two earthing points on opposite sides.
7.09.00	11 KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.
7.10.00	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.
7.11.00	The spacing between gland plate & center of bottom terminal stud shall be as per Table-I.
7.12.00	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.
7.13.00	The motors shall be suitable for bus transfer schemes provided on the 11kV, 3.3 kV /415V systems without any injurious effect on its life.
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
7.15.00	The size and number of cables (for HT and LT motors) to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box suitable for the same.
8.00.00	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) From 50KW & upto 110KW : 11.0 (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
9.00.00	CW motor shall be designed with minimum power factor of 0.8 at design duty point.
10.00.00	**TYPE TEST**
10.01.00	**HT MOTORS**
10.01.01	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

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	tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.
10.01.02	The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer'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.
10.01.03	In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the employer for waival 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 employer 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.
10.01.04	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 ten 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 ten 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 employer either at third party lab or in presence of client/ employer's representative and submit the reports for approval.
10.01.05	**LIST OF TYPE TESTS TO BE CONDUCTED** **The following type tests shall be conducted on each type and rating of HT motor** (a) No load saturation and loss curves upto approximately 115% of rated voltage. (b) Measurement of noise at no load. (c) Momentary excess torque test (subject to test bed constraint). (d) Full load test (subject to test bed constraint) (e) 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

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	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.
10.01.06	**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** (a) Degree of protection test for the enclosure followed by IR, HV and no load run test. (b) Terminal box-fault level withstand test for each type of terminal box of HT motors only. (c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15 (d) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15
10.02.00	**LT Motors**
10.02.01	LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for employer's approval the reports of all the type tests as listed in this specification and carried out within last *ten* 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.
10.02.02	However if the contractor is not able to submit report of the type test(s) conducted within last ten 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 employer either at third party lab or in presence of client/ employer's representative and submit the reports for approval.
10.02.03	**LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED** **The following type test reports shall be submitted for each type and rating of LT motor of above 100 KW only** 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed 3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) 4. Full load test to determine efficiency power factor and slip. 5. Temperature rise test. 6. Momentary excess torque test.

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7. High voltage test.

8. Test for vibration severity of motor.

9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section)

10. Test for degree of protection and

11. Over speed test.

12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

10.03.00 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.

10.04.00 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW	**Minimum distance between centre of bottom terminal 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	385/203 (For Single core cables only)

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

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

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बी एच ई एल BHEL	**LV MOTORS** **DATA SHEET-A** **2X660 MW KHURJA STPP-TG**	SPECIFICATION NO. VOLUME II B SECTION REV NO. 00 DATE 15.06.20 SHEET 1 OF 1

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	Upto 200KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	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% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	*110 kW and above (Breaker Controlled)	:	50 KA for 0.25 sec.
	* Below 110 kW (Contactor Controlled)	:	50 KA protected by HRC fuse
	f) LV System grounding	:	Solidly
5.0	Class of insulation	:	Class 'F', with temp rise limited to class B.
6.0	Minimum voltage for starting (As percentage of rated voltage)	:	85% for motor ratings below 110kW 80% for motor ratings from 110kW to 200kW.
7.0	Power cables data	:	Shall be given during Detailed engg.
8.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
9.0	Space heater supply **(30KW & ABOVE)**	:	240 V, 1Φ , 50 Hz
10.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw
11.0	Locked rotor current a) Limit as percentage of FLC	:	As per IS 12615
12.0	Makes	:	BHEL/ Customer approval (Package owner to take care)
13.0	Paint shade	:	Blue (RAL 5012)
15.0	Additional tests	:	As per QP
14.0	Degree Of protection for motor/ terminal box	:	Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-

i) Indoor motors - IP 54
ii) Outdoor motors - IP 55
iii) Cable box-indoor area - IP 54
iv) Cable Box-Outdoor area - IP 55

* LT motors of continuous duty shall be energy efficient IE3 class conforming to IS-12615

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

- **Also detailed Customer spec. for Motors is to be referred as enclosed with technical spec.**

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SPECIFIC TECHNICAL REQUIREMENTS FOR C&I

INDEX

S. No.	DESCRIPTION
1	TITLE SHEET
2	INDEX SHEET
3	C&I SPECIFIC TECHNICAL REQUIREMENTS
4	LIST OF DOCUMENTS/DELIVERABLES
5	GENERAL TECHNICAL SPECIFICATION
6	MEASURING INSTRUMENTS
7	INSTRUMENT STUB DETAILS
8	MOTORISED VALVE ACTUATOR SPECIFICATION
9	PROCESS CONNECTION, PIPING
10	DRIVE AND INSTRUMENT INTERFACE DIAGRAM
11	INSTRUMENT CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY
12	QUALITY ASSURANCE
13	TYPE TEST REQUIREMENT
14	MANDATORY SPARE LIST
15	KKS TAGGING PHILOSOPHY
16	SUB VENDOR LIST

C&I SPECIFIC TECHNICAL REQUIREMENT FOR DCS BASED CPU SYSTEM

Specific Technical Requirements (C&I):

1.0 Condensate Polishing Unit System shall be operated from DDCMIS (BHEL's scope)

2.0 Interface of MCC, field Equipment, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.

3.0 Bidder to supply all the instruments required for the package along with necessary fittings, accessories and valve manifold etc. for control monitoring and operation of CPU system. All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments.

4.0 All the Electronic Transmitter for Pressure, Temperature, Differential Pressure and DP based Flow /Level measurements shall be genuine, verifiable PROFIBUS PA protocol compatible instruments. The transmitters shall be connected to DDCMIS through PROFIBUS PA protocol complying to IEC 61158 directly from transmitter. This is subject to customer approval and BHEL decision shall be final.

5.0 The PROFIBUS protocol design shall be further validated by BHEL and approved by NTPC during detailed engineering and any variation/ changes required based on DDCMIS system requirements and actual field installation, operational philosophy etc. shall be considered by bidder without any implications.

6.0 All transmitters (except PROFIBUS PA compatible transmitters) shall be smart type and shall have 4-20mA DC signal with superimposed digital communication (HART).

7.0 All the transmitters supplied by Bidder shall be rack/enclosure mounted. The transmitter racks/enclosures shall be in Bidder's scope of supply.

8.0 All Temperature sensors shall be Duplex type and temperature transmitter shall be provided for all temperature measurement applications. Bidder to provide temperature transmitter along with compensating cable, JB/Rack & other erection hardware.

9.0 Use of process actuated switch shall be avoided unless unavoidable.

10.0 All transmitters shall be suitably grouped together and mounted inside (i) Local Instruments Enclosures (LIEs) in case of open areas of the plant and (ii) In Local Instrument Racks (LIRs) in case of covered areas.

11.0 All field instruments enclosure shall be IP65, local panel/cabinet enclosure shall be IP 55, unless otherwise specified.

12.0 All instruments (except PROFIBUS PA compatible transmitters) 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.

13.0 Electrical Actuators (as applicable) shall be Non-Intrusive type electric actuators envisaged with integral starter. The interface of these actuators with DCS shall be of two types viz. with Hardwired interface and with PROFIBUS DP interface. All actuator settings including torque, limit switches shall be possible without opening the actuator cover and LCD indication shall be available integral to actuator body. Open/Close command termination logic suitably built inside the actuator Details shall be referring the specification.

14.0 All ON, OFF, INCHING Type electric actuators shall be PROFIBUS DP compatible. However, the exact protocol shall be based on finalized protocol of DCS. If PROFIBUS DP protocol is envisaged, then actuator shall have two (redundant) PROFIBUS DP ports for connecting the redundant PROFIBUS DP cables. That is if one PROFIBUS DP cable is cut or not working/not available, then complete actuator functionality shall be available through the second redundant cable without any manual intervention.

15.0 Drive control philosophy/signal exchange list attached elsewhere in the specification are Tentative. Shall be finalized during detailed engineering.

16.0 Complete C&I system for CPU System is in bidder's scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder without any commercial implication.

17.0 The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire CPU System. 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.

18.0 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.

19.0 Bidder to furnish electrical load/UPS load data during detailed engineering

20.0 415V AC/ 230V 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, changeover circuit 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.

21.0 Power supply derived for contact interrogation, interposing relay and solenoid shall generally be ungrounded 24 V D.C. only.

22.0 The specifications for instruments mentioned in the specification are minimum requirements. The detail specifications shall be finalized during detail engineering. 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.

23.0 The make of the items shall be from sub-vendor list. However, the make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict or repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

24.0 The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards.

25.0 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

26.0 The scope of cable shall be referred in Electrical scope split sheet in Electrical portion of the specification.

27.0 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 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

28.0 Instrument installation and accessories required for the same shall be in Bidder's scope and shall be subject to customer/BHEL's approval during detailed engineering.

29.0 Bidder to provide erection hardware including junction boxes, canopies, structural steel as required.

30.0 Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

31.0 Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.

32.0 To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.

33.0 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 bidders.

34.0 The design of the control systems and related equipment shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved and shall not cause a hazardous

condition. However, it shall also be ensured that occurrence of false trips is avoided/ minimized.

35.0 All panels, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable).

36.0 The requirements given are to be read in conjunction with detailed Technical specification enclosed.

37.0 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.

38.0 All the instruments/equipments/electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply

39.0 All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange (SS316 material), nuts & bolts etc. shall also be included, wherever required with the field instruments.

40.0 For instruments which are not located inside covered building, suitable canopy/ protective arrangement shall be provided which shall be approved during detail engineering.

41.0 All the wetted parts of the instruments including the accessories like root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments as well as valves shall be of SS-316 material, suitable pressure class and same shall be in bidder’s scope.

42.0 All instruments should be supplied with valid calibration and test certificates provided by OEM.

43.0 The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback.

44.0 Instrument installation shall be as per the attached "Standard Hook-up diagram of instrument."

45.0 At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc.

46.0 The contacts of equipment mounted instruments; sensors, switches etc. For external connection including spare contacts shall be wired out to suitably located junction boxes by bidder.

47.0 Double root valve shall be provided for all pressure tapings where the design pressure exceeds 40kg/cm2.

48.0 All the instruments PG/DPG/DPT/PT etc. (as applicable) having contact with corrosive media shall be provided with chemical/diaphragm seal.

49.0 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.

50.0 Bidder's presence is required for minimum 09 Man days (in three visits, excluding travel time) at site in which each visit shall be of minimum 03 Man days during commissioning of DCS for assistance related to process correctness. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.

51.0 Bidder's representative (process/ C&I owner) shall be present at BHEL-PEM Office for minimum 03 man-days, for preparation of Control scheme and operation and control philosophy of AC and ventilation system. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope

52.0 Number of pairs to be selected for Screen/ Control cable

(a) F-Type: 2P/4P/8P/12P(Size : 0.5 mm2)

(b) G-Type: 2P/4P/8P/12P(Size : 0.5 mm2)

(c) Core Cable: 3CX2.5sqmm2/ 5CX2.5sqmm2/ 12CX1.5sqmm2

53.0 Bidder to provide mandatory spares as per mandatory spares list. Attached elsewhere in the specification.

54.0 Comprehensive Annual Maintenance Contract (AMC) for three (03) years after warranty period shall be provided by the contractor for analyser instruments of CPU plant. All weather Local Panel fitted with integral Air Conditioner shall be provided for housing analyzers etc if the same are not kept in AC rooms.

55.0 Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract: List of Drawings/Documents and data to be furnished by bidder after award of the contract are mentioned under section" List Of Documents/Deliverables".

- Power requirement.
- instruments data sheet.
- Instrument schedule
- Alarm Schedule
- Control scheme
- Control write-up
- Any other document decided during detailed engineering

Note:-

1. All equipment items shall be of latest design with proven on track record.

2. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.

3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.

LIST OF DOCUMENTS/DELIVERABLES

	C&I SPECIFICATION FOR CPU SYSTEM	SECTION: C SUB SECTION: C&I

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT			
Sl. No.	**DRAWING NO.**	**DRAWING/DOCUMENT TITLE**	**CATEGORY**
1	PE-V9-475-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM WITH SET POINTS	A
2	PE-V9-475-145-I902	CONTROL SCHEME/LOGIC DIAGRAM (TO BE IMPLEMENTED IN DDCMIS)	A
3	PE-V9-475-145-I903	HMI PICTURES/PLANT SCHEMATICS	A
4	PE-V9-475-145-I904	INSTRUMENT SCHEDULE WITH SET POINTS	A
5	PE-V9-475-145-I905	I/O LIST (ANALOG & BINARY)	A
6	PE-V9-475-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
7	PE-V9-475-145-I907	FIELD JB/LIE/LIR,DRIVES TERMINATIONS	A
8	PE-V9-475-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V9-475-145-I909	QUALITY PLANS (INSTRUMENTS, etc.)	A
10	PE-V9-475-145-I910	INSTRUMENT HOOK-UP DRAWING	A
11	PE-V9-475-145-I911	THERMOWELL SIZING CALCULATION	A
12	PE-V9-475-145-I913	CABLE SCHEDULE & INTERCONNECTION	A
13	PE-V9-475-145-I914	ANNUNCIATION & SOE LIST	A

NOTES:
ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.

CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL, MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST, FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc.
SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.

GENERAL TECHNICAL REQUIREMENT (GTR)

PART - C

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GENERAL TECHNICAL REQUIREMENTS

1.00.00 **INTRODUCTION**

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

2.00.00 **BRAND NAME**

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

3.00.00 **BASE OFFER & ALTERNATE PROPOSALS**

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

4.00.00 **COMPLETENESS OF FACILITIES**

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

4.02.00 All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable

codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

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

4.03.00 For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.

5.00.00 **CODES & STANDARDS**

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

(a.) Indian electricity act

(b.) Indian electricity rules

(c.) Indian Explosives Act

(d.) Indian Factories Act and State Factories Act

(e) Indian Boiler Regulations (IBR)

(f.) Regulations of the Central Pollution Control Board, India

(g.) Regulations of the Ministry of Environment & Forest (MoEF), Government of India

(h) Pollution Control Regulations of Department of Environment, Government of India

(i.) State Pollution Control Board.

(j.) Rules for Electrical installation by Tariff Advisory Committee (TAC).

(k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996

(l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998

(m.) Explosive Rules, 1983

(n.) Petroleum Act, 1984

(o.) Petroleum Rules, 1976,

(p.) Gas Cylinder Rules, 1981

(q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981

(r.) Workmen's Compensation Act, 1923

(s.) Workmen's Compensation Rules, 1924

(t.) NTPC Safety Rules for Construction and Erection

(u.) NTPC Safety Policy

(v.) Any other statutory codes / standards / regulations, as may be applicable.

5.02.00 Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:

(a) Bureau of Indian Standards (BIS)

(b.) Japanese Industrial Standards (JIS)

(c.) American National Standards Institute (ANSI)

(d.) American Society of Testing and Materials (ASTM)

(e.) American Society of Mechanical Engineers (ASME)

(f.) American Petroleum Institute (API)

(g.) Standards of the Hydraulic Institute, U.S.A.

(h.) International Organisation for Standardization (ISO)

(i.) Tubular Exchanger Manufacturer's Association (TEMA)

(j.) American Welding Society (AWS)

(k.) National Electrical Manufacturers Association (NEMA)

(l.) National Fire Protection Association (NFPA)

(m.) International Electro-Technical Commission (IEC)/European Norm (EN)

(n.) Expansion Joint Manufacturers Association (EJMA)

(o.) Heat Exchange Institute (HEI)

p) IEEE standard

q) JEC standard

5.03.00 Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned else where in the specification together with the complete word to word translation of the standard that is normally not published in English.

5.04.00 As regards highly standardized equipments such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.

5.05.00 In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.

5.06.00 Two (2) English language copies of all-national and international codes and/or standards used in the design of the plant, equipment, and structural works shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.

5.07.00 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall

have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.

6.00.00 **EQUIPMENT FUNCTIONAL GUARANTEE**

6.01.00 The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A & B of technical specification .These guarantees shall supplement the general functional guarantee provisions covered under General Conditions of Contract.

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

7.00.00 **DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS**

7.01.00 **Design of Facilities**

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

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

7.02.00 **Maintenance and Availability Considerations**

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

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the turbine and equipments, inspection of the

steam path and the minor and major overhauls shall be specified in terms of running hours, clearly defining the spare parts and manhour requirement for each stage.

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

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

8.00.00 **DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR**

8.01.00 Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope.

Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated.

The Contractor shall furnish engineering data/drawings. in accordance with the schedule of information as specified in Technical Specification and Technical data sheet.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of documents is given in Annexure-I to this Part-C, Section-VI of the Technical Specification.

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

8.03.01 (a.) **BASIC ENGINEERING DOCUMENTATION**

Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:

i. System description of all the mechanical, electrical, control & instrumentation & civil systems.

ii. Technology scan for each system / sub-system & equipment.

iii. Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.

iv. Optimization studies including thermal cycle optimization.

v. Sizing criteria of all the systems, sub-systems including various piping systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins.

vi. Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.

vii. Operation Philosophy and the control philosophy of the equipments / system covered under the scope.

viii. General Layout plan of the power station incorporating all facilities in Contractor's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope.

ix. Basic layouts and cross sections of the TG building (various floor elevations), and other areas included in the scope of thebidder.

x. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer.

(b) **DETAILED ENGINEERING DOCUMENTS**

i. General layout plan.

ii. Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.

iii. Flow diagrams, Process & Instrumentation Diagrams alongwith write-up and system description.

iv. Start-up curves for turbine, for various start-ups, viz. cold, warm and hot start-up.

v. Piping isometric, composite layout and fabrication drawings.

vi. Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.

vii. Technical data sheets for all bought out and manufactured items. Contractor shall use the NTPC specifications as a base for placement of orders on their sub-vendors.

viii. Detailed design calculations for components, system/sub-system, piping etc., wherever applicable including sizing calculations for all auxiliaries like BFPs, CEPs, Heaters/ Deaerators, Condensers, vacuum pumps etc.

ix. Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes.

x. Thermal cycle information (heat balance diagrams, condenser and heat exchanger thermal calculations etc.).

xi. Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters.

xii. Comprehensive list of all terminal points which interface with Employer's facilities giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.

xiii. Power supply single line diagram, block logics, control schematics, electrical schematics, etc.

xiv. Protection system diagrams and relay settings.

xv. Interconnection diagrams.

xvi. Cable routing plan.

xvii. Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.

xviii. Alarm and annunciation list / Sequence of Event (SOE) list and alarms & trip set points.

xix. Sequence and protection interlock schemes.

xx. Type test reports and power system stability study report.

xxi. Control system configuration diagrams.

xxii. Detailed DDCMIS system manuals

xxiii. Detailed flow chart for digital control system.

xxiv. Mimic diagram layout, Assignment for other application engg.

xxv. Civil & Structural works drawings and documents for all structures, facilities, foundations, underground and overground works and super-structural works as included in the scope of the Bidder.

xxvi. Model study reports wherever applicable.

xxvii. Functional & guarantee test procedures and test reports.

xxviii. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

xxix. Documentation in respect of commissioning as listed out elsewhere in this specification.

The Contractor while submitting the above documents / drawings for approval / reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.

8.03.02 **INSTRUCTION MANUALS**

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

(a.) **Erection Manuals**

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

a) Erection strategy.

b) Sequence of erection.

c) Erection instructions.

d) Critical checks and permissible deviation/tolerances.

e) List of tool, tackles, heavy equipments like cranes, dozers, etc.

f) Bill of Materials

g) Procedure for erection .

h) General safety procedures to followed during erection/installation.

i) Procedure for initial checking after erection.

j) Procedure for testing and acceptance norms.

k) Procedure / Check list for pre-commissioning activities.

l) Procedure / Check list for commissioning of the system.

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

(b.) **Operation & Maintenance Manuals**

a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

b) The arrangement and contents of O & M manuals shall be as follows :

1) Chapter 1 - Plant Description : To contain the following sections specific to the equipment/system supplied

(a) Description of operating principle of equipment / system with schematic drawing / layouts.

(b) Functional description of associated accessories / controls. Control interlock protection write up.

(c) Integrated operation of the equipment alongwith the intended system. (The is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).

(d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries.

(e) Design data against which the plant performance will be compared.

(f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets.

(g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).

(h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).

2) Chapter 2.0 - Plant Operation: To contain the following sections specific to the equipment supplied

(a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc.

(b) Limiting values of all protection settings.

(c) Various settings of annunciation/interlocks provided.

(d) Startup and shut down procedure for equipment alongwith the associated systems in step mode.

(e) Do's and Don'ts related to operation of the equipment.

(f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.

(g) Parameters to be monitored with normal value and limiting values.

(h) Equipment isolating procedures.

(i) Trouble shooting with causes and remedial measures.

(j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing.

(k) Routine Operational Checks, Recommended Logs and Records

(l) Change over schedule if more than one auxiliary for the same purpose is given.

(m) Preservation procedure on long shut down.

(n) System/plant commissioning procedure.

3) Chapter 3.0 - Plant Maintenance- To contain the following sections specific to the equipment supplied.

(a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population.

(b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.

(c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.

(d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.

(e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out.

(f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done.

(g) Long term maintenance schedules

(h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.

(i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement..

(j) Tolerance for fitment of various components.

(k) Details of sub vendors with their part no. in case of bought out items.

(l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC.

(m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.

(n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.

(o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

8.03.03 After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.

If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.

8.03.03 **PLANT HANDBOOK AND PROJECT COMPLETION REPORT**

(a.) PLANT HANDBOOK

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

1. Design and performance data.

2. Process & Instrumentation diagrams.

3. Single line diagrams.

4. Sequence & Protection Interlock Schemes.

5. Alarm and trip values.

6. Performance Curves.

7. General layout plan and layout of main plant building and auxiliary buildings

8. Important Do's & Don't's

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

(b.) **Project Completion Report**

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

8.03.04 **DRAWINGS**

(a.) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-I of Part-C. The soft copies shall be uploaded by the vendors in c-folder, a web based system of NTPC ERP, for which a username and password will be alloted to the new vendor by NTPC.

Similarly, the vendor can download the drawings / documents, approved / commented by NTPC , through above site.
The soft copies of identified drawings / documents shall be in pdf format, whereas the attachements / reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats.

(b.) Final copies of the approved drawings alongwith requisite number of hard copies shall be submitted as per Annexure-I of Part-C.

(c.) Contractor shall prepare the model of all the facilities located in TG building (including all facilities), and any other facility located in TG building area in an integrated & intelligent 3D software solution using rule-based, data centric 3D Design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams

etc. attached to the respective equipment / systems in the aforesaid 3D model.

All piping layouts, equipment layouts, floor plans, ducting layout (A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings.

Contractor shall prepare and provide 3D design review model (network ready, which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc.), which is extracted from intelligent 3D model and shall make a presentation of the same every 3 months from LOA to enable NTPC to review the progress of engineering or as and when required by employer.. After the completion of engineering of facilities covered under this package, the corresponding complete 3D review model shall be handed over to the employer for its reference.

(d.) All documents/text information shall be in latest version of MS Office/ MS Excel/ PDF Format as applicable.

(e.) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

(f.) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

(g.) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.

Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission.

Further, space shall be identified on each drawing for approval stamp and electronic signature.

(j.) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer / Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract.

(k.) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer.

(l.) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

(m.) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority / representative of Employer based on requirements of such piping indicated in approved / finalized Flow Scheme / Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.

(n.) Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.

(o.) As Built Drawings

After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to "as built" conditions and submit number of coppies as per **Annexure-I**.

(p.) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

(q.) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.

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

8.03.05 **e-Learning Package:**

e-learning packages shall be supplied for the equipment / system for the following Steam Turbine Generator & auxiliaries along with associated electrical and C&I system.

8.03.05.01 **Steam Turbine Generator & Auxiliaries**

Steam Turbine including stop valves, control valves, overload valves and cross over piping. Steam Turbine Auxiliary Systems including Quick Closing and Ordinary NRVs, Turbine gland sealing system, Lubricating oil system and its purification system, Centralised oil storage and its purification system, Control fluid and its purification system, governing and protection system, exhaust hood spray cooling system, drainage and vent system, turbine preservation system, HP/LP Bypass system.

Generator and Auxiliary System including Generator, complete hydrogen cooling, carbon dioxide and nitrogen gas systems as applicable, complete seal oil system, complete water cooling system where applicable and complete excitation system.

Condensing Plant including Condenser, Condenser air evacuation system and Condenser on load tube cleaning system as applicable.

Drip Pump along with all accessories as applicable, Condensate Extraction Pumps along with all accessories, Deaerator level Control Station, Feed Water Heating Plant including Drain Cooler, low pressure heaters, deaerator and feed storage tank, high pressure heaters and associated accessories, Boiler Feed Pumps along with all accessories, Drive Turbine for Boiler Feed Pump along with all accessories, Feed regulating station, Make up system to Condenser, Gland Steam Condenser Recirculation System, Turbine Hall EOT Cranes and EOT Crane for Boiler Feed Pump as applicable.

8.03.05.02 These packages shall be installed on the Learning Management Server (LMS) of Power Management Institute (PMI) , NTPC located at Noida . The Engineer- In-Charge (EIC) for the e-learning modules shall be from PMI.

1. The objective of the e-Learning package consisting of courses for erection, commissioning, operation and maintenance of equipment / system as specified above is to facilitate the employees to have first hand information /requirement with respect to above activities for the supplied equipment /system.

2. The bidder shall submit e-learning courses each for erection, commissioning, operation and maintenance of each of the equipment / system supplied as above.
   a. The erection course(s) should include instructions on pre-checks, prerequisites, erection strategy, erection procedure etc.
   b. The commissioning course(s) should include instructions on recommissioning,commissioning, initial operation etc.
   c. The operation course(s) should include instructions on the permissive, interlocks, physical check ups, start up , shutdown and protections etc.
   d. The maintenance course(s) should include instructions on predictive, preventive, breakdown and overhauling.

   Depth of coverage of above courses shall be as specified for “Instruction Manuals” in above clauses. A literature on caution / safety while handling equipment / system for the above modules shall follow the description of the said equipment /system.

3. The e-Learning packages on equipment / system shall be installed by the vendor and shall be successfully test run in the presence of EIC or representative before acceptance by NTPC. The vendor will also give the master copy in form of Flash Drive/CD/DVD. The respective module for erection & commissioning shall be delivered and successfully test run at least three months before the scheduled start of the corresponding activity at site.

The respective module for operation & maintenance shall be delivered and successfully test run at least three months before scheduled first synchronization of first unit.

4. **e-Learning course broad requirements:**

a. The courses shall be web based and mobile based Application type.

It shall run on all possible versions of web browser like Internet Explorer, Google Chrome, Firefox etc. on Laptop/Desktop and shall be Smartphone/Tablet/Mobile responsive. The Mobile responsive courses shall run on Android, Windows Mobile, Blackberry, iOS etc.

b. The courses shall support liquid/fluid page layout so that the entire screen gets adjusted to PC, Laptop, Smartphone/Mobile, Tablet and any other display devices.

c. Course content text shall be in English language and be associated with a voiceover in English language with Indian accent.

d. Courses shall be SCORM (Sharable Content Object Reference Model) compliant, version 1.2 which is compatible with LMS at PMI.

e. Each course shall have every physical and functional detail of the equipment / system supplied.

f. Each of the e-Learning course shall be based on multiple web pages and mobile pages with multiple modules.

g. There shall be option for self-assessment test after every course. In case the user doesn't opt for self assessment test the user shall be able to go to the next course. There shall be no restriction in no. of times for repeating the assessments. All correct answers along with the answers marked by the users shall be displayed at the end of test/quiz.

h. If Java and Flash, as applicable are not available in the system to run the package, then there shall be a prompt message for updation of the same.

i. Each course shall have a self-running interactive content with navigation buttons containing forward, backward, pause, bookmark and menu options in the course window.

j. The course shall contain chapter titled 'Introduction/overview' that explains the purpose of the course.

k. The course content shall contain descriptive text shall be factual, specific, terse, clearly worded, and simply illustrative, so that the user can understand it.

l. The system shall provide the user with the ability to select the information with a Cursor.

m. The course menu should contain table of content linked to concerned pages. The user shall be given the capability to access all of the functions available on the system through a menu system. This shall consist of active buttons, which shall control a hierarchy of pull down/pop up menus. Menu shall appear quickly and exist only while a selection is being made. The user shall be given the capability to position the cursor or pointer on the menu item and use pointer device such as mouse to activate the function.

n. Every course shall contain the 3D design/drawing/exploded view/360$_0$ turn around view of the equipment/system, textual description of the equipment/system and its functionality with video (as applicable), animation and audio.

o. The users shall be able to control audio sound level associated with the courses.

p. Drawings / text in the courses shall be scalable (Zoom In/ Out).'

q. The user shall have the capability to record a **bookmark** to mark displayed information for later recall, whenever he accesses the same course next time.

Notes:

1. e-learning Package of an equipment / system shall include e-learning courses for each of erection, commissioning, operation and maintenance of that equipment / system.

2. e-learning courses on erection, commissioning, operation and maintenance of an equipment / system shall include e-learning lessons/chapters/modules (as required) for erection, commissioning, operation and maintenance respectively of that equipment / system.

3. The vendor shall get the approval of one sample course from EIC before proceeding for further courses.

8.04.00 Engineering Co-ordination Procedure

8.04.01 The following principal coordinators will be identified by respective organizations at time of award of contract:

NTPC Engineering Coordinator (NTPC EC) :

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

Contractor's/ Vendor's Engineering Coordinator (VENDOR EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

8.04.02 All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.

8.04.03 Contractor's/Vendor's Drawing Submission and Approval Procedure:

a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings".

b) Not used

c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance.

d) Not used

e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

f) **Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission.**

g) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within three (3) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories :

CATEGORY- I:	Approved
CATEGORY- II	Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments.
CATEGORY –III	Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted.
CATEGORY -IV	For information and records.

h) Contractor shall resubmit the drawings approved under Category II, III & IVR within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number enclosed in a triangle (eg. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawing identifying the changes for Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**

i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing.

l) These comments will be taken care by the contractor while submitting the revised drawing.

The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.

8.05.00 **ENGINEERING PROGRESS AND EXCEPTION REPORT**

8.05.01 The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including

(a.) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission.

(b.) Drawings which were not submitted as per agreed schedule.

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

8.06.00 **TECHNICAL CO-ORDINATION MEETING**

8.06.01 The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.

8.06.02 The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule.The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing .The comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.

8.06.03 The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.

8.06.04 Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.

8.06.05 Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.

8.07.00 **DESIGN IMPROVEMENTS**

The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

8.07.01 **Testing of major design features:**

The major design features of the system shall be conducted by the Contractor at the Contractor's works or any other place mutually agreed within six months from the date of LOA. These are the system function tests, which have a major impact on the detailed system design & finalization of important engineering documents like configuration, functional grouping, BOM etc., but do not require a fully engineered system for conductance. Bidder shall identify these features & include detailed test procedures in the bid, which shall be finalized during discussions with the bidder before award. The developments and any augmentation of standard features undertaken by the Bidder to fulfill the various specification requirements, shall be also be tested during these major design tests. This shall include but not be limited to the following.

a) System accuracy tests of DDCMIS for the various type of inputs identified in Part-B.

b) Loop reaction time for sample loops/ logics.

c) N/A.

d) Server changeover.

e) Various response times, having serious implication on operation & maintenance philosophy.

f) Duty cycle of controller/ HMIPIS with simulated load, representative of the final engineered load.

g) Unified HMI for DDCMIS as indicated in IIC-01, Scope of supply & services chapter of Part-A, Section-VI.

The results of the above tests, after its acceptance by the Employer, shall be properly documented and submitted to Employer. If any of the envisaged tests have

been carried out by Bidder in a previous NTPC project, then the same need not be specifically conducted by the Bidder for this project, provided it is clearly established by the Bidder & accepted by the Employer that there is no difference between the system offered for this project & the previous NTPC project w.r.t. the test. However, even in such a case, test report of the previous project shall be submitted by the Bidder as a part of MDFT (Major Design Feature Test) report.

8.07.02 **Demonstration of Application Engineering**

A) The Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following.

(i) Logics/Loops:

a) Drive logics implementation for each type of binary drive along with its display in HMI.

b) Sequence implementation along with its display in HMI.

c) Single non-cascade controller implementation.

d) Cascade loop implementation.

e) Master slave implementation with different slave combination.

f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable.

(ii) HMI Functions:

a) LVS Annunciation.

b) Graphics.

c) HSR

d) Logs/Reports.

e) N/A.

B) The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings.

After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor. After implementation of these

logics & loops, the Contractor shall test each logic/loop and record the observations in a format to be provided by the Employer and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.

C) During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.

8.08.00 **EQUIPMENT BASES**

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate which support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

8.09.00 **PROTECTIVE GUARDS**

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

8.10.00 **LUBRICANTS, SERVO FLUIDS AND CHEMICALS**

8.10.01 All the first fill and one year's topping requirements of consumables such asgreases, oil, lubricants, servo fluids / control fluids, gases (excluding H2, CO2 and N2 for Generator) and essential chemicals etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be supplied by the Contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.

Bidder scope shall also include supply of H2 , CO 2 and N2 as applicable for the Generator till successful commisioning of the Generator.

Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc (as detailed above) which is expected to be utilised during the first year of operation. This additional quantity shall be supplied in separate Containers.

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

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

8.11.00 **Lubrication**

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

8.12.00 **Material of Construction**

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

8.13.00 **RATING PLATES, NAME PLATES & LABELS**

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

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

8.13.03 Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear sides.

8.13.04 Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel.

The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.

8.13.05 Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support/hanger.

8.13.06 Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.

8.13.07 Safety and relief valves shall be provided with the following :

(a.) Manufacturer's identification.

(b.) Nominal inlet and outlet sizes in mm.

(c.) Set pressure in Kg/cm² (abs).

(d.) Blowdown and accumulation as percentage of set pressure.

(e.) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.

8.13.08 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

8.13.09 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system

8.14.00 **TOOLS AND TACKLES**

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

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

8.15.00 **WELDING**

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

8.16.00 **COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES**

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

8.17.00 **PROTECTION AND PRESERVATIVE SHOP COATING**

8.18.00 **PROTECTION**

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

8.19.00 **PRESERVATIVE SHOP COATING**

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

after installation or require corrosion protection until installation, shall be shop painted as per the requirement covered in the relevant part of the Technical Specification.

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

8.19.01 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

8.19.02 All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Employer.

8.19.03 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.

8.19.04 Painting for Civil structures shall be done as specified under technical requirements on civil works in relevant part of this specifications.

9.00.00 **QUALITY ASSURANCE PROGRAMME**

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

(a.) His organisation structure for the management and implementation of the proposed quality assurance programme

(b.) Quality System Manual

(c.) Design Control System

(d.) Documentation and Data Control System

(e.) Qualification data for bidder's key personnel.

(f.) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

(g.) System for shop manufacturing and site erection controls including process, fabrication and assembly.

(h.) Control of non-conforming items and system for corrective actions and resolution of deviations.

(i.) Inspection and test procedure both for manufacture and field activities.

(j.) Control of calibration and testing of measuring testing equipment.

(k.) System for Quality Audits.

(l.) System for identification and appraisal of inspection status.

(m.) System for authorising release of manufactured product to the Employer.

(n.) System for handling, storage and delivery.

(o.) System for maintenance of records, and

(p.) Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

9.02.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

9.02.01 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification which shall be finalised giving due consideration to the manufacturer's standard and proven practices being followed. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities

shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award. Monthly progress reports on MQP/FQP submission/approval shall be furnished on enclosed format No. QS-01-QAI-P-02/F1.

9.02.02 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through c-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM.

9.02.03 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.

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

9.02.05 No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).

9.02.06 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of

heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

9.02.07 The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the enclosed format No.: QS-01-QAI-P-02/F2. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.

9.02.08 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.
All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.

9.02.09 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.

9.02.10 Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.

9.02.11 For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, for other piping system ASME B31.1 or other relevant code as applicable shall be followed. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.

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

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

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

9.02.15 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination) / EN /

Equivalent. NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

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

9.02.16 The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished on enclosed on format no. QS-01-QAI-P-02/F1. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

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

9.02.18 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.

9.02.19 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

9.02.20 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

9.02.21 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

9.02.22 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

9.02.23 Environmental Stress Screening

All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub - contractor should meet the following.

1) The Contractor / Sub - contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub - contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.

OR

In case the Contractor / Sub - contractor do not have any established procedure to eliminate infant mortile components then two or 10% which ever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C.

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

2) Burn in Test Cycle

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

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

During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature.

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

quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.

9.03.00 **QA DOCUMENTATION PACKAGE**

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

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

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

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

9.03.02 Typical contents of QA Documentation is as below:-

(a.) Quality Plan

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

(c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

(d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

(e.) Heat Treatment Certificate/Record (Time- temperature Chart)

(f.) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).

(g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.

(h.) Certificate of Conformance (COC) wherever applicable.

(i.) MDCC

9.03.03 NOT USED.

9.03.04 NOT USED.

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

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

(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.

(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

(c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment.

9.03.07 **TRANSMISSION OF QA DOCUMENTATION**

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

For the particular case of phased/part derivatives of equipment, the complete quality document of that particular equipment to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.

9.04.00 **Project Manager's Supervision**

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

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

(a.) Interpretation of all the terms and conditions of these documents and specifications:

(b.) Review and interpretation of all the Contractor's drawing, engineering data, etc:

(c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract :

(d.) Inspect, accept or reject any equipment, material and work under the contract:

(e.) Issue certificate of acceptance and/or progressive payment and final payment certificates

(f.) Review and suggest modifications and improvement in completion schedules from time to time, and

(g.) Supervise Quality Assurance Programme implementation at all stages of the works.

9.05.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

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

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

9.05.02 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

9.05.03 The Contractor shall give the Project Manager/Inspector ten (10) working days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within ten (10) working days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.

9.05.04 The Project Manager or Inspector shall within ten (10) working days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

9.05.05 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect ten (10) working days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within ten (10) working days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

9.05.06 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel,

water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

9.05.07 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.

9.05.08 To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

9.05.09 All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

9.06.00 **ASSOCIATED DOCUMENT FOR QUALITY ASSURANCE PROGRAMME:**

9.06.01 List of items requiring Quality Plan & Sub-supplier approval.
Format No. QS-01-QAI-P-01/F3-R0

9.06.02 Status of Quality Plan and Sub-supplier approval
Format No. QS-01-QAI-P-02/F1-R0

9.06.03 Field Welding Schedule Format No.: QS-01-QAI-P-02/F2-R0

9.06.04 Manufacturing Quality Plan Format No.: QS-01-QAI-P-09/F1-R0

9.06.05 Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R0
The above formats are enclosed as Annexure-III to VII

10.00.00 **PRE-COMMISSIONING AND COMMISSIONING FACILITIES**

(a.) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems

forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications.

(b.) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant.

(c.) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness.

(d.) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.

(e.) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule to be agreed by the Employer.

(f.) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

(g.) Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain:

(1.) Biodata including experience of the Commissioning Engineers.

(2.) Role and responsibilities of the Commissioning Organisation members.

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

10.02.00 **Initial Operation**

a) On completion of all pre-commissioning activities / tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.

b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours.

The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.

The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect.

c) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation.

In the event of test interruptions as a result of Force Majeure or Employer-Caused-Delay during Initial Operation test, where.

(i) The total cumulative interrupted time during the test is more than twenty-four (24) hours.

(ii) The total number of interruptions during the test is more than four (4).

The test shall not be deemed a successful Initial Operation Test.

The interrupted test resulting from Force Majeure or Employer-Caused-Delay shall be extended by an amount of time equal to the cumulative length of the interruptions, including time to return to steady-state operation; the test data for the period of interruptions shall be excluded from analysis; and the test data that were collected both before and after the interruptions shall be included in the analysis.

d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with holding the aforesaid permission.

(g) **Grid Restriction**

Any loss in generation in terms of power (KW) or energy (KWH) during Initial operation Test due to grid restrictions shall be treated as deemed generation. however, the total cumulative deemed generation shall not exceed 5% of the total generation during the test period failing which the test shall be extended to limit the deemed generation to 5% of the total generation.

11.00.00 **GUARANTEE TESTS**

a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's Commissioning, Start-up Engineer shall make the unit ready to conduct such test before start of initial operation. Such test shall be conducted along with Initial Operations.

b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.

c) For performance/ demonstration tests instrumentations, accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters

shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.

d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost.

e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specification.

12.00.00 **TAKING OVER**

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

13.00.00 **TRAINING OF EMPLOYER'S PERSONNEL**

13.01.00 The scope of service under training of Employer's engineers shall include a training module in the areas of Operation & Maintenance.

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

(a.) Training for TG and related equipments.

(b.) TG related C&I system like turbine supervisory system (TSS) etc.

(c.) DDCMIS as detailed in Part-B

(d.) Training for Electric Power Supply systems

(e.) Training for power cycle piping / critical piping

13.02.00 The scope of services under training shall also necessarily include training of Employer's Engineering personnel covering entire scope for the package This shall

cover all disciplines viz, Mechanical, Electrical, C&I, & QA etcand shall include all the related areas like Design familiarization, training on product design features and product design softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc.

13.03.00 Contractor shall also arrange for training of Employer's personnel in respect of fire detection and protection systems and other Balance of Plant equipments.

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

13.05.00 In all the above cases, the lodging and boarding of the Employer's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.

13.06.00 Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award.

Note:

1. For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.
2. The total man months in each area shall be divided into suitable number of modules which shall be discussed and finalized during post award stage.
3. Duration of each module shall not be less than 10 (ten) working days out of which 20 % shall be for plant/manufacturers' works visits and 80% shall be class room training.
4. A) Location of class room training for engineering shall be at Design/Engineering office.

   B) Class room training for erection/O&M shall be at location of Manufacturers' works.

TRAINING REQUIRED IN MAN MONTH

Area	Engineering (Man months)	Erection (Man months)	O&M (Man months)

Steam Turbine Generator and its Auxiliaries including electricals	6.5	9.0	23
Station C&I (Control and Instrumentation)	3.5	5.5	10
Total			

Area	Topics	MANDAYS
Condensate Polishing Plant (CPU)	**System/Product Design** - Basic design features including Pre-filters - Theory & principle of operation - Latest technological trends in CPU & Pre-filters and design aspects & Selection criteria. **Plant Visit** - Operational feedback - O&M history / problems related to CPU plant **Visit to Manufacturer's Work** -Manufacturing process of pre-filters and major equipment -Testing facilities **Operation & Maintenance of Plant** -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	**3**

14.00.00 **SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION**

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

(a.) Working platforms should be fenced and shall have means of access.

(b.) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

15.00.00 **NOISE LEVEL**

The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment / machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA except for

(a.) Safety valves and associated vent pipes for which it shall not exceed 105 dBA-115 dBA.

(b.) Regulating drain valves in which case it shall be limited to 90 dBA-115dBA.

(c.) TG unit in which case it shall not exceed 90 dBA.

(d.) For HP-LP bypass valves and other intermittantly operating control valves, the noise level shall be within the limit of 90 dBA.

(e) For BFP motor, the noise level shall be within the limit of 90 dBA

16.00.00 **PACKAGING AND TRANSPORTATION**

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.

17.00.00 **ELECTRICAL ENCLOSURE**

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

18.00.00 **INSTRUMENTATION AND CONTROL**

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

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

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

a)	Temperature	-	Degree centigrade (deg C)
b)	Pressure	-	Kilograms per square centimetre (Kg/cm2). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
c)	Draught	-	Millimetres of water column (mm wc).
d)	Vacuum	-	Millimeters of mercury column (mm Hg) or water column (mm Wcl).
e)	Flow (Gas)	-	Tonnes/ hour
f)	Flow (Steam)	-	Tonnes/ hour
g)	Flow (Liquid)	-	Tonnes / hour
h)	Flow base	-	760 mm Hg. 15 deg.C
i)	Density	-	Grams per cubic centimetre.

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

18.03.00 **NOT USED**.

19.00.00 **ELECTRICAL NOISE CONTROL**

The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal.

20.00.00 **INSTRUMENT AIR SYSTEM**

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

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

21.00.00 **TAPPING POINTS FOR MEASUREMENTS**

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

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

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

(a.) Temperature test pockets with stub and thermowell

(b.) Pressure test pockets

22.00.00 SYSTEM DOCUMENTATION

The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/

commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum documentation requirements for C&I systems shall be as stipulated under C&I "Techncial Data Sheets" Part of specifications. In addition to this, system documentation for DDCMIS shall include as a minimum to that specified elsewhere in the Technical Specification.

The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.

22.01.00 Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer.

23.00.00 **MAINTENANCE MANUALS OF ELECTRONIC MODULES**

The Contractor shall have to furnish two (2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him. The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further, the contractor shall furnish a set of operating manuals which should include block diagrams, make, model/type, details wiring and external connection drawings etc as required to do the testing and maintenance of the electronic modules.

ANNEXURE-I

S.NO.	DESCRIPTION OF DOCUMENTS	NO OF PRINTS	NO. OF CD-ROMs
1.	PLANT DEFINITION MANUAL-	2 sets	4 CD-ROMs
2.	Drawings "FOR APPROVAL"		
	i) Layout drawings / P&IDs	6	2 CD - ROMs
	ii) Other drawings	2	2 CD - ROMs
3.	Drawings "FOR INFORMATION"	2	2 CD - ROMs
4.	Drawings "FINAL DRAWING"	15	4 CD-ROMs
5.	Drawings "AS BUILT "	15	4 CD-ROMs
6	DATASHEETS, DESIGN CALCULATIONS, PURCHASE SPECIFICATIONS, etc. and Other type of documents		
	i) For Approval	2	2 CD - ROMs
	ii) FINAL	15	4 CD-ROMs -
	iii) Analysis reports of equip-ments/ piping/ structures components/ systems employing software packages as detailed in the specifications	2	2 CD - ROMs
7.	Erection manual "1st Submission"	4 Sets	2 CD - ROMs
8	Erection manual "FINAL"	4 Sets	4 CD ROMs
9	Operation & Maintenance manual "1st submission"	4	2 CD - ROMs

S.NO.	DESCRIPTION OF DOCUMENTS	NO OF PRINTS	NO. OF CD-ROMs
10	Operation & Maintenance manual "FINAL"	4 Sets	4 CD-ROMs
11	Plant Hand Book "1st Submission"	4 Sets	2 CD ROMs
12	Plant Hand Book "FINAL"	4 Sets	4 CD ROMs
13	Commissioning and Performance Procedure manual "1st Submission"	4 Sets	2 CD-ROMs
14	Commissioning and Performance Procedure manual "FINAL"	4 Sets	4 CD ROMs
15	Performance and Functional GURANTEES TEST REPORT	4 Sets	4 CD ROMs
16	Project completion report	15	4 CD ROMs
17	QA programme including Organi-sation for implement-ation and QA systemmanual (with revision-servicing)	1	1 CD ROM
18	Vendor details in respect of pro-posed vendors including contractor's evaluation report.	1	1 CD ROM
19	Manufacturing QPs, Field QPs, Field welding schedules and their reference documents like test procedures, WPS, PQR etc.		
	(i) For review/comment	2	2 CD-ROMs
	(ii) For final approval	2	2 CD ROMs

S.NO.	DESCRIPTION OF DOCUMENTS	NO OF PRINTS	NO. OF CD-ROMs
20	Welding Manual, HeatTreatment Manuals, Storage & preservation manuals		
	1st Submission	4 Sets	2 CD ROMs sets
	Final	4 sets	4 CD ROMs
21	QA Documentation Packagefor items / equipmentmanufactured and and despatched to site	2 sets	4 CD ROMs
22	QA Documentation Package for field activities on equipment / systems at site	2 sets	4 CD ROMS

ANNEXURE-II

LIST OF CODES AND STANDARDS

Indian Standards	Title	International and Internationally recognised standards
IS:277	Galvanised steel sheets (plain or corrugated)	
IS:655	Specification for metal air duct	
IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952
IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Associa-tion of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev
IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1

IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958) (ISO/R-65-1958) (BS 1387 : 1957)
IS:1239 Part-II	Mild steel tubulars and other wrought steel pipe fittings	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965
IS:2825	Code for unfired vessels	
IS:1520	Horizontal centrifugal pumps for clear cold and fresh water	
IS:1600	Code for practice for performance of constant speed IC Engines for general purpose	
IS:1601	Specification for perform-ance of constant speed IC Engines for general Purpose	
IS:1893	Criteria for earthquake resistant design of structures	
IS1978-1971	Line Pipe April 1969.	API Standards 5L
IS:2254-1970	Dimensions of vertical shaft motor for pumps	IEC Pub 72-1 part I NEMA Pub MG 1 1954
IS:2266	Steel wire ropes for general engineering purposes	BS :302 : 1968
IS:2312	Propellant type Ventilation fans	

IS:2365	Steel wire suspension ropes for lifts and hoists	BS : 1957
IS:3346	Method for the determin-ation of thermal conductivity of thermal insulation materials (two slab guarded hot plate method)	DIN 52612 (Deutscher Normenausschuss) ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963
IS:3354	Outline dimensions for electric lifts.	
IS:3401	Silica gel	
IS:3588	Specification for electrical axial flow fans	
IS:3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre)	
IS:3677	Unbonded rock and slag wool for thermal insulation	
IS:3815	Point hook with shank for general engineering purposes	BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)
IS:3895	Specification for monocry-stallines semiconductor rectifier cells and stacks	
IS:3963	Roof extractor unit	
IS:3975	Mild steel wires, strips and tapes for armouring cables	

IS:4503	Shell and tube type heat Exchanger	
IS:4540	Specification for monory-stallines rectifire assembly equipment	
IS:4671	Expanded polystyrene for thermal insulation purpose	
IS:4736	Hot dip zinc coating on steel tubes	
IS:4894	Centrifugal fans	
IS:5456	Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only)	
IS:5749	Forged ramshorn hooks	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958
IS:6392	Steel pipe flanges	BS 4504 : 1969
IS:6524 Part-I	Code of practice for design of tower cranes Static and rail mounted	BS 2799 : 1956
IS:7098	Cross linked Polyethylene insulated PVC sheathed cables	Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524
IS:7373	Specification for wrought aluminium and aluminium sheet and strips	
IS:7938	Air receivers for compressed air installation	

ISO:1217	Displacement compressor-Acceplance test
ASHRAE-33	Methods of testing for rating of forced circulation air cooling and air heating coils.
ASHRAE-52-76	Air cleaning device used in general ventilation for removing particle matter.
ASHRAE-22-72	Method of testing for rating of water cooled refrigerant condensers.
ASHRAE 23-67	Methods of testing for rating of positive displacement refrigerant compressors.
ARI-450-6	Standard for water cooled refrigerant condensers.
ARI-550	Standard for centrifugal water chilling packages.
ARI-410	Standard for forced circulation air cooling and air heating coils
ARI-430/435	Central station AHU/Application of Central Station AHU
BS:848 (Part-1,2)	Fans
BS:400	Low carbon steel cylinders for the storage & transport of permanent gases.
BS:401	Low carbon steel cylinders for the storage & transport of liquified gases.
CTI Code ACT-105	Acceptance test code for Water Cooling Tower.
ANSI-31.5	Refrigerant piping
ASME-PTC-23-1958	Atmospheric Water Cooling Equipment
AMCA A-21C	Test Code for air moving devices
API:618	Reciprocating Compressor for general refinary services.

HYDRAULIC INSTITUTE STANDARDS.

HYDRANT SYSTEM MANUALS OF TAC.

TAC MANUALS OF SPRAY SYSTEM

NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS.

INDIAN EXPLOSIVES ACT.

INDIAN FACTORIES ACT.

STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.

CODE AND STANDARD FOR CIVIL WORKS

Some of the applicable Standards, Codes and references are as follows:

Excavation & Filling

IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc.

IS: 4701 Code of practice for earth work on canals.

IS: 9758 Guide lines for Dewatering during construction.

IS: 10379 Code of practice for field control of moisture and compaction of soils for embankment and sub-grade.

Properties, Storage and Handling of Common Building Materials

IS: 269 Specification for ordinary Portland cement, 33 grade.

IS: 383 Specification for coarse and fine aggregates from natural sources for concrete.

IS: 432 Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement.

IS: 455 Specification for Portland slag cement.

IS: 702 Specification for Industrial bitumen.

IS: 712 Specification for building limes.

IS: 808	Rolled steel Beam channel and angle sections.
IS: 1077	Specification for common burnt clay building bricks.
IS: 1161	Specification of steel tubes for structural purposes.
IS: 1363	Hexagon head Bolts, Screws and nuts of production grade C.
IS: 1364	Hexagon head Bolts, Screws and Nuts of Production grade A & B.
IS: 1367	Technical supply conditions for Threaded fasteners.
IS: 1489	Specification for Portland-pozzolana cement:
(Part-I)	Fly ash based.
(Part-II)	Calcined clay based.
IS: 1542	Specification for sand for plaster.
IS: 1566	Specification for hard-drawn steel wire fabric for concrete reinforcement.
IS: 1786	Specification for high strength deformed bars for concrete reinforcement.
IS: 2062	Specification for steel for general structural purposes.
IS: 2116	Specification for sand for masonry mortars.
IS: 2386 (Parts-I to VIII)	Testing of aggregates for concrete.
IS: 3150	Hexagonal wire netting for general purpose.
IS: 3495 (Parts-I to IV)	Methods of tests of burnt clay building bricks.
IS: 3812	Specification for fly ash, for use as pozzolana and admixture.
IS: 4031	Methods of physical tests for hydraulic cement.
IS: 4032	Methods of chemical analysis of hydraulic cement.

IS: 4082	Recommendations on stacking and storage of construction materials at site.
IS: 8112	Specification for 43 grade ordinary portland cement.
IS: 8500	Medium and high strength structural steel.
IS: 12269	53 grade ordinary portland cement.
IS: 12894	Specification for Fly ash lime bricks.

Cast-In-Situ Concrete and Allied Works

IS: 280	Specification for mild steel wire for general engineering purposes.
IS: 456	Code of practice for plain and reinforced concrete.
IS: 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.
IS: 516	Method of test for strength of concrete.
IS: 650	Specification for standard sand for testing of cement.
IS: 1199	Methods of sampling and analysis of concrete.
IS: 1791	General requirements for batch type concrete mixers.
IS: 1838 (Part-I)	Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).
IS: 2204	Code of practice for construction of reinforced concrete shell roof.
IS: 2210	Criteria for the design of reinforced concrete shell structures and folded plates.
IS: 2438	Specification for roller pan mixer.
IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
IS: 2505	General requirements for concrete vibrators, immersion type.

IS: 2506	General requirements for concrete vibrators, screed board type.
IS: 2514	Specification for concrete vibrating tables.
IS: 2645	Specification for Integral cement water proofing compounds.
IS: 2722	Specification for portable swing weigh batches for concrete. (single and double bucket type)
IS: 2750	Specification for Steel scaffolding.
IS: 2751	Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.
IS: 3025	Methods of sampling and test waste water.
IS: 3366	Specification for Pan vibrators.
IS: 3370 (Part I to IV)	Code of practice for concrete structures for the storage of liquids.
IS: 3414	Code of practice for design and installation of joints in buildings.
IS: 3550	Methods of test for routine control for water used in industry.
IS: 3558	Code of practice for use of immersion vibrators for consolidating concrete.
IS: 4014 (Parts I & II)	Code of practice for steel tubular scaffolding.
IS: 4326	Code of practice for earthquake resistant design and construction of buildings.
IS: 4461	Code of practice for joints in surface hydro-electric power stations.
IS: 4656	Specification for form vibrators for concrete.
IS: 4925	Specification for batching and mixing plant.
IS: 4990	Specification for plywood for concrete shuttering work.

IS: 4995 (Parts I & II)	Criteria for design of reinforced concrete bins for the storage of granular and powdery materials.
IS: 5256	Code or practice for sealing joints in concrete lining on canals.
IS: 5525	Recommendations for detailing of reinforcement in reinforced concrete work.
IS: 5624	Specification for foundation bolts.
IS: 6461	Glossary of terms relating to cement concrete.
IS: 6494	Code of practice for water proofing of underground water reservoirs and swimming pools.
IS: 6509	Code of practice for installation of joints in concrete pavements.
IS: 7861	Code of practice for extreme weather concreting. (Parts I & II)
IS: 9012	Recommended practice for shot concreting.
IS: 9103	Specification for admixtures for concrete.
IS: 9417	Recommendations for welding cold worked steel bars for reinforced concrete construction.
IS: 10262	Recommended guidelines for concrete mix design.
IS: 11384	Code of practice for composite construction in structural steel and concrete.
IS: 11504	Criteria for structural design of reinforced concrete natural draught cooling towers.
IS: 12118	Specification for two-parts poly sulphide.
IS: 12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams.
IS: 13311	Method of non-destructive testing of concrete.
Part-1	Ultrasonic pulse velocity.

Part-2	Rebound hammer.
SP:23	Handbook of concrete mixes
SP: 24	Explanatory Handbook on IS: 456-1978
SP: 34	Handbook on concrete reinforcement and detailing.

Precast Concrete Works

SP: 7(PartVI/	National Building Code- Structural design of prefabrication and Sec.7) systems building.
IS: 10297	Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units.
IS: 10505	Code of practice for construction of floors and roofs using pre-cast reinforced concrete units.

Masonary and Allied Works

IS: 1905	Code of Practice for Structural Safety of Buildings-Masonry walls.
IS: 2212	Code of Practice for Brickwork.
IS: 2250	Code of Practice for Preparation and use of Masonry Mortar.
SP: 20	Explanatory hand book on masonry code.

Sheeting Works

IS:277	Galvanised steel sheets (plain or corrugated).
IS: 459	Unreinforced corrugated and semi-corrugated asbestos cement sheets.
IS: 513	Cold-rolled carbon steel sheets.
IS: 730	Specification for fixing accessories for corrugated sheet roofing.

IS: 1626	Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings.
IS: 2527	Code of practice for fixing rain water gutters and down pipe for roof drainage.
IS: 3007	Code of practice for laying of asbestos cement sheets.
IS: 5913	Methods of test for asbestos cement products.
IS: 7178	Technical supply conditions for tapping screw.
IS: 8183	Bonded mineral wool.
IS: 8869	Washers for corrugated sheet roofing.
IS: 12093	Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets.
IS: 12866	Plastic translucent sheets made from thermosetting polyster resin (glass fibre reinforced).
IS: 14246	Specification for continuously pre-painted galvanised steel sheets and coils.

Fabrication and Erection of Structural Steel Work

IS: 2016	Specification for plain washers.
IS: 814	Specification for covered Electrodes for Metal Arc Welding for weld steel.
IS: 1852	Specification for Rolling and Cutting Tolerances for Hot rolled steel products.
IS: 3502	Specifications for chequered plate.
IS: 6911	Specification for stainless steel plate, sheet and strip.
IS: 3757	Specification for high strength structural bolts
IS: 6623	Specification for high strength structural nuts.

IS: 6649	High Tensile friction grip washers.
IS: 800	Code of practice for use of structural steel in general building construction.
IS: 816	Code of practice for use of Metal Arc Welding for General Construction.
IS: 4000	Code of practice for assembly of structural joints using high tensile friction grip fasteners.
IS: 9595	Code of procedure of Manual Metal Arc Welding of Mild Steel.
IS: 817	Code of practice for Training and Testing of Metal Arc Welders.
IS: 1811	Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes).
IS: 9178	Criteria for Design of steel bins for storage of Bulk Materials.
IS: 9006	Recommended Practice for Welding of Clad Steel.
IS: 7215	Tolerances for fabrication steel structures.
IS: 12843	Tolerance for erection of structural steel.
IS: 4353	Recommendations for submerged arc welding of mild steel and low alloy steels.
SP: 6 (Part 1 to 7)	ISI Hand book for structural Engineers.
IS: 1608	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube.
IS: 1599	Method of Bend Tests for Steel products other than sheet, strip, wire and tube
IS : 228	Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel.
IS : 2595	Code of Practice for Radio graphic testing.

IS : 1182	Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates.
IS : 3664	Code of practice for Ultra sonic Testing by pulse echo method.
IS : 3613	Acceptance tests for wire flux combination for submerged Arc Welding.
IS : 3658	Code of practice for Liquid penetrant Flaw Detection.
IS : 5334	Code of practice for Magnetic Particle Flaw Detection of Welds.

Plastering and Allied Works

IS : 1635	Code of practice for field slaking of Building lime and preparation of putty.
IS : 1661	Application of cement and cement lime plaster finishes.
IS : 2333	Plaster-of-paris.
IS : 2402	Code of practice for external rendered finishes.
IS : 2547	Gypsum building plaster.
IS : 3150	Hexagonal wire netting for general purpose.

Acid and Alkali Resistant Lining

IS : 158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting.
IS : 412	Specification for expanded metal steel sheets for general purpose.
IS : 4441	Code of practice for use of silicate type chemical resistant mortars.
IS : 4443	Code of practice for use of resin type chemical resistant mortars.
IS : 4456	Method of test for chemical resistant tiles. (Part I & II)

IS : 4457	Specification for ceramic unglazed vitreous acid resistant tiles.
IS : 4832	Specification for chemical resistant mortars.
	Part I Silicate type
	Part II Resin type
	Part III Sulphur type
IS : 4860	Specification for acid resistant bricks.
IS : 9510	Specification for bitumasitc, Acid resisting grade.

Water Supply, Drainage and Sanitation

IS : 458	Specification for concrete pipes.
IS : 554	Dimensions for pipe threads, where pressure tight joints are made on thread.
IS : 651	Specification for salt glazed stoneware pipes.
IS : 774	Flushing cisterns for water closets and urinals.
IS : 775	Cast iron brackets and supports for wash basins and sinks.
IS : 778	Copper alloy gate, globe and check valves for water works purposes.
IS : 781	Cast copper alloy screw down bib taps and stop valves for water services.
IS : 782	Caulking lead.
IS : 783	Code of practice for laying of concrete pipes.
IS : 1172	Basic requirements for water supply, drainage and sanitation.
IS : 1230	Cast iron rain water pipes and fittings.
IS : 1239	Mild steel tubes, tubulars and other wrought steel fittings.

IS : 1536	Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.
IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
IS : 1538	Cast iron fittings for pressure pipe for water, gas and sewage.
IS : 1703	Ball valves (horizontal plunger type) including float for water supply purposes.
IS : 1726	Cast iron manhole covers and frames.
IS : 1729	Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.
IS : 1742	Code of practice for building drainage.
IS : 1795	Pillar taps for water supply purposes.
IS : 1879	Malleable cast iron pipe fittings.
IS : 2064	Code of practice for selection, installation and maintenance of sanitary appliances.
IS : 2065	Code of practice for water supply in building.
IS : 2326	Automatic flushing cisterns for urinals.
IS : 2470 (Part-I & II)	Code of practice for installation of septic tanks.
IS : 2501	Copper tubes for general engineering purposes.
IS : 2548	Plastic seat and cover for water-closets.
IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).
IS : 2963	Non-ferrous waste fittings for wash basins and sinks.
IS : 3114	Code of practice for laying of cast iron pipes.

IS : 3311	Waste plug and its accessories for sinks and wash basins.
IS : 3438	Silvered glass mirrors for general purposes.
IS : 3486	Cast iron spigot and socket drain pipes.
IS : 3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).
IS : 3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4111 (Part I to IV)	Code of practice for ancillary structure in sewerage system.
IS : 4127	Code of practice for laying of glazed stone-ware pipes.
IS : 4764	Tolerance limits for sewage effluents discharged into inland-surface waters.
IS : 4827	Electro plated coating of nickel and chromium on copper and copper alloys.
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.
IS : 5822	Code of practice for laying of welded steel pipes for water supply.
IS : 5961	Cast iron grating for drainage purpose.
IS : 7740	Code of practice for road gullies.
IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.
IS : 8934	Cast copper alloy fancy pillar taps for water services.
IS : 9762	Polyethylene floats for ball valves.

IS : 10446	Glossary of terms for water supply and sanitation.
IS : 10592	Industrial emergency showers, eye and face fountains and combination units.
IS : 12592	Specification for precast concrete manhole covers and frames.
IS : 12701	Rotational moulded polyethylene water storage tanks.
SP: 35	Hand book on water supply and drainage.
-	Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.

Doors, Windows and Allied Works

IS : 204	Tower Bolts
Part-I	Ferrous metals.
Part-II	Nonferrous metals.
IS : 208	Door Handles.
IS : 281	Mild steel sliding door bolts for use with padlocks.
IS : 362	Parliament Hinges.
IS : 420	Specification for putty, for use on metal frames.
IS : 1003 Part-I door	Specification for timber panelled and glazed shutters- (Part-I) shutters.
IS : 1038	Steel doors, windows and ventilators.
IS : 1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
IS : 1341	Steel butt hinges.
IS : 1361	Steel windows for industrial buildings.
IS : 1823	Floor door stoppers.

IS : 1868	Anodic coatings on Aluminium and its alloys.
IS : 2202 (Part-II)	Specification for wooden flush door shutters (solid core type); particle board face panels and hard board face panels
IS:2209	Mortice locks (vertical type).
IS:2553	Safety glass
IS:2835	Flat transparent sheet glass.
IS:3548	Code of practice for glazing in buildings.
IS:3564	Door closers (Hydraulically regulated).
IS : 3614	Fire check doors; plate, metal covered and rolling type.
IS:4351	Steel door frames.
IS:5187	Flush bolts.
IS:5437	Wired and figured glass
IS:6248	Metal rolling shutters and rolling grills.
IS:6315	Floor springs (hydraulically regulated) for heavy doors.
IS:7196	Hold fasts.
IS:7452	Hot rolled steel sections for doors, windows and ventilators.
IS:10019	Mild steel stays and fasteners.
IS:10451	Steel sliding shutters (top hung type).
IS:10521	Collapsible gates.

Roof Water Proofing and AlliedWorks

IS:1203	Methods of testing tar and bitumen.

IS:1322	Specification for bitumen felts for water proofing and damp proofing.
IS:1346	Code of practice for water proofing of roofs with bitumen felts.
IS:1580	Specification for bituminous compound for water proofing and caulking purposes.
IS:3067	Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.
IS:3384	Specification for bitumen primer for use in water proofing and damp proofing.

Floor Finishes and Allied Works

IS:1237	Specification for cement concrete flooring tiles.
IS:1443	Code of practice for laying and finishing of cement concrete flooring tiles.
IS:2114	Code of practice for laying in-situ terrazzo floor finish.
IS:2571	Code of practice for laying in-situ cement concrete flooring.
IS:3462	Specification for unbacked flexible PVC flooring.
IS:4971	Recommendations for selection of industrial floor finishes.
IS:5318	Code of practice for laying of flexible PVC sheet and tile flooring.
IS:8042	Specification for white portland cement.
IS:13801	Specification for chequered cement concrete flooring tiles.

Painting and Allied Works

IS:162	Specification for fire resisting silicate type, brushing, for use on wood, colour as required.
IS:1477	Code of practice for painting of ferrous metals in buildings.
Part-I	Pretreatment.

Part-II	Painting.
IS:1650	Specification for colours for building and decorative finishes.
IS:2074	Specification for red oxide-zinc chrome, priming, ready mixed paint air drying.
IS:2338	Code of practice for finishing of wood and wood based materials.
Part-I	Operations and workmanship
Part-II	Schedules
IS:2395	Code of practice for painting concrete, masonry and plaster surfaces.
Part-I	Operations and workmanship.
Part-II	Schedule.
IS:2524	Code of practice for painting of nonferrous metals in buildings.
Part-I	Pretreatment.
Part-II	Painting.
IS:2932	Specification of synthetic enamel paint, exterior, under-coating and finishing.
IS:2933	Specification enamel paint, under coating and finishing.
IS:4759	Code of practice for hot dip zinc coating on structural steel and other allied products.
IS:5410	Specification for cement paint
IS:5411 (Part-I)	Specification for plastic emulsion paint-for exterior use
IS:6278	Code of practices for white washing and colour washing.
IS:10403	Glossary of terms relating to building finishes.

Piling and Foundation

IS:1080	Code of practice for design and construction of simple spread foundations.

IS:1904	Code of practice for design and construction of foundations in Soils; General Requirements.
IS:2911	Code of practice for designs and construction of Pile foundations (Relevant Parts).
IS:2950	Code of practice for designs and construction of Raft (Part-I) foundation.
IS:2974	Code of practice for design and construction of machine
(Part-I TO V)	foundations.
IS:6403	Code of practice for determination of Allowable Bearing pressure on Shallow foundation.
IS:8009	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads.
Part-I	Shallow foundations.
Part-II	Deep foundations.
IS:12070	Code of practice for design and construction of shallow foundations on rocks.
DIN:4024	Flexible supporting structures for machines with rotating machines.
VDI:2056	Criteria for assessing mechanical vibrations of machines.
VDI:2060	Criteria for assessing rotating imbalances in machines.
Stop Log and Trash Rack	
IS:4622	Recommendations for fixed - wheel gates structural design.
IS:5620	Recommendations for structural design criteria for low head slide gates.
IS:11388	Recommendations for design of trash rack for intakes.
IS:11855	General requirements for rubber seals for hydraulic gates.
Roads	
IRC:5	Standard specifications and Code of practice for road bridges, section-I general Features of Design.
IRC:14	Recommended practice of 2cm thick bitumen and tar carpets.
IRC:16	Specification for priming of base course with bituminous primers.

IRC:19	Standard specifications and code of practice for water bound macadam.
IRC:21	Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced).
IRC:34	Recommendations for road construction in waterlogged areas.
IRC:36	Recommended practice for the construction of earth embankments for road works.
IRC:37	Guidelines for the Design of flexible pavements.
IRC:56	Recommended practice for treatment of embankment slopes for erosion control.
IRC:73	Geometric design standards for rural (non-urban) highways.
IRC:86	Geometric Design standards for urban roads in plains.
IRC:SP:13	Guidelines for the design of small bridges & culverts.
IRC - Public-	Ministry of Surface Transport (Roads Wing), Specifications
ation	for road and bridge works.
IS:73	Specification for paving bitumen
Loadings	
IS:875	Code of practice for design loads other than earthquake) for
(Pt. I to V)	buildings and structures.
IS:1893	Criteria for earthquake resistant design of structures.
IS:4091	Code of Practice for design and construction of foundation for transmission line towers & poles.
IRC:6	Standard specifications & code of practice for road bridges, Section-II Loads and stresses.
M.O.T.	Deptt. of railways Bridge Rules.
Safety	
IS:3696	Safety code for scaffolds and ladders.
(Part I & II)	
IS:3764	Safety code for excavation work.
IS:4081	Safety code for blasting and related drilling operations.
IS:4130	Safety code for demolition of buildings.

IS:5121	Safety code for piling and other deep foundations.
IS:5916	Safety code for construction involving use of hot bituminous materials.
IS:7205	Safety code for erection on structural steelwork.
IS:7293	Safety code for working with construction machinery.
IS:7969	Safety code for handling and storage of building materials
IS:11769	Guidelines for safe use of products containing asbestos.

- Indian Explosives Act. 1940 as updated.

Architectural design of buildings

SP:7	National Building Code of India
SP:41	Hand book on functional requirements of buildings (other than industrial buildings)

Miscellaneous

IS:802	Code of practice for use of structural steel in
(Relevant parts)	overhead transmission line towers.
IS:803	Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks.
IS:10430	Creteria for design of lined canals and liner for selection of type of lining.
IS:11592	Code of practice for selection and design of belt conveyors.
IS:12867	PVC handrails covers.
CIRIA	Design and construction of buried thin-wall pipes.
Publication	

REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION

The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents.

Temperature Measurements

1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).

2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982.

3. Temperature measuremnet by electrical Resistance thermometers - IS:2806.

4. Thermometer - element - Platinum resistance - IS:2848.

Pressure Measurements

1. a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964).

   b) Electonic transmitters BS:6447.

2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966.

3. Process operated switch devices (Pr. Switch) BS-6134.

Flow Measurements

Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II.

Measurement of fluid flow in closed conduits - BS-1042.

Electronic Measuring Instrument & Control Hardware/ Software

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319.

2. Safety requirements for electrical and electronic measuring and controling instrument - ANSI C 39.5 - 1974.

3. Compatability of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.

4. Dynamic response testing of process control instrumentation ISA - S 26 (1968).

5. Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472.

6. Printed circuit boards - IPC TM - 650, IEC 326 C.

7. General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973.

8. Edge socket connectors - IEC 130-11.

9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.

10. Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980).

11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R).

12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990.

13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989.

14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985.

15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.

16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985.

17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985.

18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984.

19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983.

20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978.

21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987.

22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984.

Instrument Switches and Contact

1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000.

2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600.

Enclosures

1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13).

2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972).

3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962.

Apparatus, enclosures and installation practices in hazardous area

1. Classification of hazardous area - NFPA 70 - 1984, Article 500.

2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973.

3. Instrinsically safe apparatus - NFPA 493 1978.

4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982.

5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.

Sampling System

1. Stainless steel material of tubing and valves for sampling system - ASTMA 296-82, Grade 7 P 316.

2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977.

3. Water and steam in power cycle - ASME PTC 19.11.

4. Standard methods of sampling system - ASTM D 1066-99.

Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979.

2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472

3. Damp heat cycling test - IS:2106

4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78

Protections

1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989.

2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973.

3. Turbine water damage prevention - ASME TDP-1-1980.

4. Boiler safety interlocks - NFPA Section 85 B - 1984, 85 C - 1991.

UPS System

1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973.

2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983.

3. Surge withstand capability test - ANSI C 37.90 1 -1989.

4. Performance testing of UPS - IEC 146.

5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.

6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985.

7. Printed Circuit Board - IPC TM 650, IEC 326C.

8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973.

Control Valves

1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985.

2. Face to face dimensions of control valves - ANSI B 16.00 - 1973.

3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2).

4. Codes for pressure piping - ANSI B 31.1

5. Control Valve leak class - ISA RP 39.6

Process Connection & Piping

1. Codes for pressure piping "power piping" - ANSI B 31.1.

2. Seamless carbon steel pipe ASTM - A - 106.

3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182.

4. Material for socket welded fittings - ASTM - A - 105.

5. Seamless ferritic alloy steep pipe - ASTM - A - 335.

6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234.

7. Composition bronze of ounce metal castings - ASTM - B - 62.

8. Seamless Copper tube, bright annealed - ASTM - B - 168.

9. Seamless copper tube - ASTM - B - 75.

10. Dimension of fittings - ANSI - B - 16.11.

11. Valves flanged and butt welding ends - ANSI - B - 16.34.

Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A 106.

2. Material of socketweld fittings - ASTM - A105.

3. Dimensions of fittings - ANSI - B - 16.11.

4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1.

Cables

1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992.

2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815.

3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorugh 2/83.

4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6).

5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977.

6. Rules for Testing insulated cables and flexible cables : VVDE - 0472

7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980)

8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81.

9. Oxygen index and temperature index test - ASTM D - 2863.

10. Smoke density measurement test - ASTMD - 2843.

11. Acid gas generation test - IEC - 754 - 1.

12. Swedish Chimney test - SEN - 4241475 (F3).

13. Teflon (FEP) insulation & sheath test - ASTMD - 2116.

14. Thermocouple compensating cables - Testing requirements & sampling plan IS:8784.

15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I).

Cable Trays, Conduits

1. Guide for design and installation of cable systems in power generating staiton (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984.

2. -do- Test Standards. NEMA VE-1-1979.

3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTMA - 386-78.

Public Address System

1. Specifications for lod speakers - IS:7741 (Part-I, II and III)

2. Code of safety requirement for electric mains operated audio amplifiers - IS:1301

3. Specification for Public Address Amplifiers - IS:10426.

4. Code of practice for outdoor installation of PA system - IS:1982.

5. Code of practice for installation for indoor amplifying and sound distribution system - IS:1881.

6. Basic environmental testing procedures for electronic and electrical items - IS:9000.

7. Characteristics and methods of measurements for sound system equipment - IS:9302

8. Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732

9. Rigid steel conduits for electric wiring - IS:9537 (Part-I and II)

10. Fittings for rigid steel conduits for electrical wiring - IS:2667

11. Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147.

Vibration Monitoring System

1. API 670 - 1994

2. BS : 4675 Part-2

ANNEXURE - III

एनटीपीसी NTPC	Project : Stage : Package : Supplier : Contractor No. :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL SUB-SYSTEM :	DOC. NO. : REV. NO. : DATE : PAGE : OF

S.No.	ITEM	QP/ Insp. Cat.	QP No.	QP Sub-Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-Suppliers approval status/ category	Sub-supplier Details submission schedule	Remarks

LEGENDS :

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

A - For these items proposed vendor is acceptable to NTPC. To be indicated with letter "A" in the list alongwith the condition of approval, if any.

DR - For these items "Detailed required" for NTPC review. To be identified with letter "DR" in the list.

NOTED - For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with "NOTED".

2. **QP/INSPN CATEGORY :**

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

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

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

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

FORMAT NO. : QS-01-QAI-P-1/F3-R0 1 / 1 Engg.Div./QA&I

ANNEXURE - IV

एनटीपीसी NTPC	Project : Stage : Package : Contractor : Contractor No. :	STATUS OF ITEM REQUIRING QP & SUB-SUPPLIER APPROVAL	DOC. NO. : REV. NO. : DATE : PAGE : OF

S.No.	ITEM/SERVICE	QP/Insp. Cat.	QP Sub. Schedule Approval Schedule	Date of Sub-mission	Date of commt. Appl.	Status Code C/II/I	Proposed Sub-suppliers	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks

FORMAT NO. : QS-01-QAI-P-02/F1-R0 1 / 1 Engg.Div./QA&I

ANNEXURE - V

Project : Stage : Contractor : Contractor No. : System :	FIELD WELDING SCHEDULE (To be raised by the contractor) Welding Code	DOC. NO. : REV. NO. : DATE : PAGE : OF	

Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	RFF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	

NOTES:

SIGNATURE

FORMAT NO.: QS-01-QAI-P-02/F2-R0	1/1	Engg. Div./QA&I

MFGR.s LOGO	Manufacturer's Name & Address	MANUFACTURING QUALITY PLAN		PROJECT :
		ITEM	QP NO. :	PACKAGE :
			REV.NO. :	CONTRACT NO. :
		SUB-SYSTEM	DATE :	MAIN-SUPPLIER :
			PAGE : OF	

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1	2	3	4	5	6		7	8	9	D*	**	10.		11

MANUFACTURER / SUB-SUPPLIER	MAIN-SUPPLIER
SIGNATURE	

LEGEND : * RECORDS, IDENTIFIED WITH "TICK" ( ) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION
** M : MANUFACTURER / SUB-SUPPLIER
C : MAIN SUPPLIER, N : NTPC
P : PERFORM W : WITNESS AND V : VERIFICATION, AS APPROPRIATE
CHP : NTPC SHALL IDENTIFIED IN COLUM "N" AS 'W'

FOR NTPC USE

DOC. NO. :		REV.....CAT.....
REVIEWED BY	APPROVED BY	APPROVAL SEAL

FORMAT - QS-01-QAI-P-09/F1-R1 1/1 ENGINEERING DIV. / QA&I

	Supplier's Name & Address	FIELD QUALITY PLAN		PROJECT :
		ITEM	QP NO. :	PACKAGE :
			REV.NO. :	CONTRACT NO. :
		SUB-SYSTEM	DATE :	MAIN-SUPPLIER :
			PAGE : OF	

SL. NO.	ACTIVITY AND OPERATION	CHARACTERISTICS/INSTRUMENTS	CLASS# OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		REMARKS
1	2	3	4	5	6	7	8	9	D*	10.

MANUFACTURER / SUB-SUPPLIER	MAIN-SUPPLIER	LEGEND : * RECORDS, IDENTIFIED WITH "TICK" ( ) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION LEGEND TO BE USED : CLASS # : A - CRITICAL, B = MAJOR, C = MINOR; "A' SHALL BE WITNESSED BY NTPC FQA, 'B' SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY ERECTION SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)	FOR NTPC USE	DOC. NO. :		REV.....CAT.....
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL

FORMAT - QS-01-QAI-P-09/F2-R0 1/1 ENGINEERING DIV. / QA&I

CONDENSATE POLISHING UNIT

1.00.00 GENERAL

1.01.00 The Condensate Polishing Plant (CPP) shall treat the condensate of the respective Turbine-Generator (TG) Units of the Power station.

1.02.00 The proposed schematic arrangement of the Condensate Polishing Plant has been shown in the relevant Tender Drawing (P&ID). The Contractor shall propose the complete system including regeneration facilities as per their standard design and as elaborated in this specifications meeting the basic functional requirements. Arrangement of piping and valves shown in Tender drawings are for guidance only.

1.03.00 The Condensate polishing Plant shall consist of one (1) set of Condensate Polishing Unit (CPU) for each TG unit inside TG Building and a common regeneration system. Each CPU shall consist of either four (4) service vessels (4 x 33.33% capacity) or three (3) service vessels (3 x 50% capacity) for each TG Unit.

1.04.00 The regeneration systems shall be external and common to the CPU of all the TG units. For regeneration, resin from the exhausted exchanger vessel will be transferred hydraulically/hydro-pneumatically to this facility. The exhausted resin charge will be cleaned, separated, regenerated, mixed and rinsed before being stored for the next use.

1.05.00 The common influent and effluent headers of each CPU, will be connected to an automatic bypass line(s) to be provided by Contractor. On high pressure signal across the service vessel, the automatic control valve(s) in the bypass line(s) shall open, bypassing the service vessel(s).

1.06.00 Make-up water to the turbine cycle will be added to the condenser hotwell as required. The analysis of the cycle makeup water (DM Water) is exhibited in the specification elsewhere.

1.07.00 In the event of a tube failure in the condenser, circulating water will enter the condensate system and will contaminate it. The design clarified water analysis is exhibited elsewhere in the technical specification and the condensate polishing plant shall be designed for such tube leakage condition as mentioned.

1.08.00 The Condensate Polisher Service vessels, blowers etc. will be located indoor near corresponding units. Regeneration system equipment shall be kept under shed and one meter height parapet wall shall be provided around this shed. Effluent re-circulation/disposal pumps, Bulk chemical storage tanks, unloading transfer pumps and DM water storage tanks for regeneration system etc. shall be kept in open area.

2.00.00 SALIENT DESIGN DATA

2.01.00 The design flow (through working vessels) for each condensate polishing plant shall be the corresponding condensate flow of TG unit at VWO (Valve wide open) condition at 3% cycle make-up.

2.02.00 The following dissolved solids concentration and conditions shall be used as a basis of design for the condensate polishing system. The ionic concentrations indicated below are as such.

	Influent	Effluent
Ammonia ppb	100	--
Total solids, ppb	100	20
Silica, ppb	30	5 (refer Note 1 below)
Iron, ppb	50	5
Sodium, ppb	10	2
Chloride, ppb	10	2
pH	8 – 8.5	--
Effluent conductivity after removal of ammonia and amines (micro mhos/cm) at 25^{0}C.	--	0.1 or less

Note: 1. Silica value shall be 7 ppb as per resin supplier recommendations in case the temperature of the condensate is 50^{0}C & above.

However, the Contractor to check and reduce the ionic concentrations at the effluent based on their requirement. Under the above operating and design flow through the polisher units, the un-ammoniated resins shall not reach "ammonia break-point" in less than 30 days (720 hrs) of continuous operation while maintaining the above effluent quality. Whenever specific conductivity starts increasing from 0.1 micro mhos/cm in the effluent, it is deemed that "ammonia break point" is reached. The effluent values indicated above shall be the maximum values.

2.03.00 In addition to the dissolved solids, the influent condensate shall also contain some quantities of suspended solids (crud) derived from the corrosion of water and steam carrying pipelines, turbine condenser and steam side of the feed water heater. Normally this concentration will not exceed about 25 ppb and the Polisher beds shall provide sufficient filtering action to restrict the effluent crud content to less than 5 ppb & same shall be guaranteed.

2.04.00 During start up conditions, quality of the influent may deteriorate to –

TDS, ppb	2000 maximum
Silica, ppb	150 maximum
Crud, ppb (mostly black oxide of Iron)	1000 maximum

For design purposes, average crud loading shall be considered as 500 ppb. Under such conditions, total crud content of the effluent shall not exceed 150 ppb. However, the Contractor to check and reduce the crud content at the effluent based on their requirement.

2.05.00 Under condenser tube-leakage condition, the plant shall be designed for 2000 ppb TDS in addition to the normal influent contaminants stated in as specified at clause no 2.02.00 of this

Sub-section above. Under such condition, both sodium content and silica content of the effluent shall be limited to 20 ppb maximum. Useful service run between regenerations under the Startup conditions as specified at clause no 2.04.00 of this Sub-section and under condenser tube leakage condition as specified at clause no 2.05.00 of this Sub-section above, shall not be less than 50 hours each.

2.06.00 Influent water qualities as indicated in the above clauses are minimum only. Contractor to check the same and higher values, if felt by them, shall be considered in the design so as to meet the specified effluent quality.

2.07.00 The bed cross section shall be such that the velocity of condensate through it, shall not exceed 2 m/min at the design flow rate. Internal diameter of the service vessels (excluding the rubber lining) of cylindrical type shall be selected meeting the above mentioned velocity criteria. For vessels of spherical shape, where the bed cross section vary, the diameter (excluding the rubber lining) of the vessel shall be selected considering velocity not exceeding 1.75 m/min. The effective depth of the mixed resin bed in the condensate polisher service vessels shall not be less than 1100 mm.

2.08.00 At the design flow rate, the pressure drop across the polisher service vessels with clean resin bed shall not exceed 2.1 kg/cm². This pressure drop shall include losses due to entrance and exit nozzles, distributors, under drains, resins and the effluent resin traps. Maximum pressure drop under dirty conditions will be restricted to 3.5 kg/cm² including the pressure drop across effluent resin traps.

2.09.00 Cation resins shall be regenerated by technical grade hydrochloric acid to IS:265 (concentration 30-33% by volume) and anion resins by sodium hydroxide, rayon grade to IS:252 available as 48% lye or as flakes. In no case, the regeneration levels can not be lower than the values indicated below:

a) Cation resin : 125 kg of 100% HCl per cubic meter of resin

b) Anion resin : 160 kg of 100% NaOH per cubic meter of resin.

2.10.00 Rinse water outlet header of each condensate polishing unit shall be provided with a pressure reducing station with isolating valves, suitably designed to enable the water entry to the condenser hot well which is operating under vacuum. The pressure reducing station shall consist of either a pressure reducing valve from design pressure of service vessel to condenser vacuum or a combination of orifice plates to reduce pressure from design pressure of service vessel to 2 kg/cm^2 and a pressure reducing valve from 2 kg/cm^2 to condenser vacuum.

2.11.00 While calculating pump head, 10% margin (minimum) shall be considered on the value of friction losses. Pipe friction loss shall be calculated as per Willam-Hazen formula and "C" value to be adopted shall be as described elsewhere in the Technical Specification. Pump recirculation with a regulating valve shall be provided for all the pumping system.

3.00.00 All the design parameters at clause no 2.00.00 of above shall be guaranteed. The effluent quality, the design flow, design service length, chemical consumption for regeneration and the pressure drop across the resin bed in clean and dirty conditions at rated design flow shall be guaranteed by the Contractor.

4.00.00 SYSTEM REQUIREMENT

4.01.00 The regeneration process offered by the contractor/its sub-vendor, shall be of Proven Design and shall essentially be the same process by virtue of which the contractor/its sub-vendor is qualified and shall give resin-separation compatible with the desired effluent quality. Documentary evidence shall be submitted by the contractor/its sub-vendor to the employer to establish this requirement during detailed engineering stage, if required.

4.02.00 The contractor shall include inert resin in the system if they feel that it helps in better resin separation.

4.03.00 In case, after separation of resins, there are undesired contaminant resins, the Contractor shall provide a system either to eliminate this cross contamination of resins or to nullify the detrimental effect of entrapped resins to the effluent quality.

4.04.00 **Exchange Resins**

a) The contractor shall include with the plant adequate resins for all the condensate polisher service vessels. In addition, separate charge of resin shall also be included for using the resins during commissioning stage of unit. The total number of charges to be supplied by contractor shall be as mentioned in Scope of Supply & Services in technical specification.

b) The resins shall be in the form of spherical beads. Base of the ion-exchange resins shall be a copolymer of styrene and divinyl benzene forming a macroporous or macrorecticular structure. Other details are as follows:

Cation : Strong acid, with sulfonic acid functional group.

Anion : Strong base, with quanternary ammonium (type I) functional group.

Inert : Non ionic, compatible with the above resin types.

Cation resins shall be supplied in hydrogen form and Anion resins shall be supplied in hydroxide form.

c) <u>Physical Properties</u>:

(i) Particle size:

The resins shall be in the form of spherical beads. All resins, when wet screened with U.S. standard sieves, shall pass through a No.14 sieve not more than 2% shall be retained on a no. 16 sieve, and not more than 2% shall pass through a no. 40 sieve. The particle sizes and densities shall be carefully controlled to facilitate clear separation between the resins during regeneration process.

(ii) Bead Strength:

The average force required to fracture individual beads of cation resins in hydrogen form, anion resins in hydroxide form, and the inert resins, shall exceed 350 grams. Not more than 5% of the beads tested in each batch shall get fractured by forces less than 200 grams.

d) Chemical Properties:

(i) Total wet volume ion-exchange capacities in equivalents/liter shall not be less than the following:

Cation in hydrogen form	:	1.7
Anion in hydroxide form	:	0.8

(ii) The resins shall contain a minimum of metallic and organic impurities consistent with good processing. The processing procedure will include rinsing the resins with demineralized water before packing, so that further rinsing will not be required before use. Foreign objects in the resins shall constitute a basis for its rejection.

(iii) Cation-Anion resin ratio shall be 1.5 parts cation to 1.0 part anion by volume. In case the contractor's process require any non ionic resin the same shall represent at least 10% of the bed volume, but not less than 15 cm of the bed depth in the resin separation tank of the external regeneration facility.

(iv) Manufacturer:

It is not the intent to pre-select any specific brand name for this application. Resins will be accepted by the Employer strictly on their merits. The resins shall be of reputed manufacturer with adequate past record of successful service for not less than 3 years in similar application.

(iv) Contractor shall submit all necessary data and information in this regard along with his proposal. Some of these possible resin terms are as follows:

1) Duolite C - 26 TR & A - 161 TR Rohm and Hass 252 C & TRA-900C.
2) Dowex MSC-1, MSA-1 C grades.
3) Inert resin – Duolite sec, Rohm & Hass 359 or Dow-buffer beads.

Above listing is by no means exhaustive, and shall not be construed to be a recommendation for their selection for this plant. Contractor shall fully satisfy himself as to the suitability of the resin system selected by him before offering it in his proposal.

e) The resin shall be suitable for the condensate temperature that may be achieved in all operating regimes of TG cycle. However, the anion resin shall be suitable for a temperature of 60^0C.

4.05.00

Condensate Polishing Units

a) Condensate polishing unit of each TG unit shall consist of the following:

1) Condensate polisher vessels complete with condensate inlet and outlet connections, pre-filters, 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.

2) External resin traps at the outlet of each of the polisher vessels, designed for in-place manual back washing.

3) Condensate inlet and outlet headers for each installation with pipe connections to the condensate polisher vessels.

4) Resin transfer headers and pipe lines connecting the external regeneration facility to the condensate polisher vessels of each installation.

5) Rinse water outlet headers from condensate polisher vessels of each installation upto the condenser hotwell.

6) All necessary valves and fittings for the installations with actuators necessary for their remote operation. These shall include suitable fool-proof 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.

7) A common drain header for the condensate polisher service vessels of each unit upto the hotwell.

8) All necessary drains, vents and sampling points, with valves as specified and as required.

8) Gland sealing water piping for the valves in the rinse water line.

9) Emergency bypass between the condensate influent and effluent headers with its automatic valve, isolation valves on both sides and controls.

10) Two (2) nos. (2x100%) (1W+1S) capacity oil free type, air blowers to supply necessary air for mixing the resins in the service vessels for each TG unit CPP.

12) Complete instrumentation, controls etc for automatic operation.

b) Operating pressure for service vessels shall be normal operating pressure of condensate extraction pump. Service vessel design pressure shall be equal to shut off pressure of condensate extraction pumps plus 5% margin.

c) Design temperature of service vessel and their internals/appurtenances shall take care of all operating regimes including HP-LP bypass operation and minimum 70^{0}C. Process design temperature shall be based on all operating regimes of TG cycle and

minimum 52^{0}C. However, short term excursion of temperature upto 60^{0}C is also expected.

d) **Emergency bypass system**:

1) Each condensate polisher service unit shall be provided with an automatic bypass system for the condensate polisher on the condensate inlet and outlet headers of the unit with a set of control valve with its isolation valves on the upstream and down stream sides of the control valve.
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 all vessels/ two vessels/one vessel/no vessel is in operation.
3) Contractor to provide either 2x50% capacity valves or 1x100% control valve to achieve proper control under all operating conditions.
4) Complete instrumentation and controls required to complete the system, shall also be installed by him.
5) The isolation valves shall be provided with geared operators for manual operation. 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.
6) The control system shall be so designed that the control valve is able to bypass 33% or 50% of rated flow (based on offered vessel configuration) when any of the service vessel is out of service, 67% or 100% (based on offered vessel configuration) of flow when two vessels are taken out of service and 100% of flow when all the service vessels are out of service.

4.06.00 **External Regeneration Facility (Regeneration Plant)**

a) The Contractor shall propose the complete system including regeneration facilities as per their standard design and as elaborated in this specifications meeting the basic functional requirements. One (1) common facility for regeneration of the ion-exchange resins from the condensate polishers of all the turbo-generator units shall be provided utilizing three (3) tank concepts and consisting of:

1) Resin Separation & Cation Regeneration Vessel.
2) Anion Resin Regeneration Vessel.
3) Two (2) nos of Mixed Resin Storage Vessels.
4) Resin injection hopper, complete with a water ejector system for resin make-up. Resin injection hopper shall be sized to handle upto 150 litre of as received new resins.

5) All internals, fittings and appurtenances for these vessels. Common waste effluent header with one resin trap designed for in place manual backwashing.

6) Two (2) nos. (2x100%) (1W+1S) Oil free type air blowers with electric motor drives, for supplying all the process air required for cleaning of the resins and their regeneration processes.

7) Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter/silencer, flexible couplings discharge snubber, all mounted on a single base. Relief valve(s) shall be provided as required.

8) Two (2) nos. of (2x100%) (1W+1S) DM water pumps with electric motor drives for water supply for chemical preparation & for dilution water supply during dosing. These DM water pumps will take suction from DM water storage tanks.

9) Two (2) nos. of (2x100%) (1W+1S) DM water pumps with electric motor drives for water supply and transfer of resin from service vessel to regeneration vessels and vice-versa. These DM water pumps will take suction from DM water storage tanks.

10) Bulk Acid & Alkali Storage Tanks and Acid/alkali unloading facilities (if separately identified/included in the scope of the contractor as shown in relevant tender drawing).

11) Acid solution preparation & dosing facility.

12) Alkali solution preparation and dosing facility.

13) DM Water Storage tanks for regeneration system (if separately identified/included in the scope of the contractor as shown in relevant tender drawing)

14) Effluent neutralization system (if separately identified/ included in the scope of the contractor as shown in relevant tender drawing)

15) All necessary piping, valves & fittings i.e. all piping between the external regeneration facility and the skids for chemical dosing and acid/alkali preparation, demineralised water piping to the chemical dosing, acid/alkali piping from external bulk storage tanks to respective preparation skids, acid/alkali solution pipelines from preparation skids to respective dosing skids, chemical solution piping for acid and alkali from the dosing skids to the external regeneration facility, instrument air piping etc. These shall include all drains, vents and sampling points with valves as specified and as required. The entire installation shall be complete with all pipe supports, hangers etc.

16) Complete instrumentation, controls etc necessary for automatic operation.

17) The equipment and system of external regeneration facilities described above is indicative and for guidance only. Based on the regeneration process offered, the contractor may make suitable modifications in the equipment to make the system complete in all respect.

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

(i)	Mixed resin Storage vessel	:	50%
(ii)	Resin separation vessel	:	75%
(iii)	Cation regeneration vessel	:	75%
(iv)	Anion regeneration vessel and activated carbon filter	:	75%

However, if a vessel is used for more than one service, then the vessel design shall be based on the service which gives maximum freeboard.

c) Design pressure of the condensate Polisher Service Vessels is indicated elsewhere. For all other Pressure vessels, the design pressure shall be at least 8 kg/cm² (g).

d) 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.

e) In order to facilitate erection at site chemical dosing preparation equipment shall be mounted on structural steel skids and assembled (including piping) at the manufacturer's shop, to the maximum extent possible, prior to shipping. The number of mechanical connections shall be minimised by the use of pipe headers wherever possible. Following is a recommended listing of the main equipment skids to be furnished under this package. The Contractor may also supply and install these equipments independently instead of assembling the skids.

(i) Alkali Solution Preparation skid (1 no):

This shall comprise one (1) alkali preparation tank complete with electrically driven stirrer and dissolving basket, two (2) (2x100%) (1W+1S) nos. Alkali solution transfer-cum-recirculation pumps of suitable capacity and head to meet the system requirements, one (1) nos. alkali day tank, one (1) no. activated carbon filter for alkali, all interconnecting piping, valves and fittings as required for the system. This facility shall be used for preparing alkali solution from alkali flakes and prepared solution shall be transferred to bulk alkali storage tanks or in day tanks.

(ii) Alkali Dosing Skid (1 no) & Acid Dosing skid (1 no):

The acid and alkali dosing equipment for regeneration of condensate polishing resins shall be mounted on skid, which shall consist of at least the following:

1) Positive displacement type metering pumps with electric motor drive; two (2) (2x100%) (1W+1S) for dosing hydrochloric acid (30% conc.) and two (2) (2x100%) (1W+1S) for dosing sodium hydroxide solution.
2) All necessary suction and discharge piping for these pumps including all strainers, valves and fittings as required, upto the mixing tee with the diluent water.
3) Diluent water supply separately, for acid and alkali, each provided with an automatic on off valve, a throttling valve for setting of flow, a local flow indicator, and a mixing tee where the chemicals get injected into the water stream.
4) A hot water tank with electric immersion heater.
5) Two (2) acid measuring tanks of adequate capacity to hold acid for two (2) regenerations.

All the equipment, piping etc. shall be assembled on two (2) structural steel skids one (1) for acid and one (1) for alkali dosing equipment. The Contractor shall supply all anchor bolts, foundation plates, sleeves, nuts, inserts etc. to be embedded in concrete for these equipment skids. Each equipment skid shall be provided with suitable lifting lugs, eye bolts etc. to facilitate erection and maintenance.

5.00.00 TECHNICAL REQUIREMENTS OF EQUIPMENTS

5.01.00 **Bulk Acid & Alkali Storage Tanks (applicable if included in scope of supply)**

Description / Data	Acid Storage tanks	Alkali Storage Tanks
Numbers	Two (2)	Two (2)
Dimensions (Diameter, length & thickness)	——As per BS: 2594——	
Useful capacity	Each tank to store one (1) month requirement of all the units or minimum as specified in scope of supply in Part-A of Technical Specification.	Each tank to store one (1) month requirement of all the units or minimum as specified in scope of supply in Part-A of Technical Specification.
Type & pressure class	----Horizontal, with dished (Torospherical) ends, Atmospheric----	
MOC	——Mild Steel (as specified)——	

	Internal Painting/ lining	———Rubber lining (4.5 mm thick) ————	
	External painting	----As specified elsewhere----	
	Concentration	30-33% HCl	48% NaOH
	Accessories	Vent, overflow, drain, sample connections, fume absorbers, manholes, Operating platforms etc.	Vent, overflow, drain, sample connections, manholes, Operating platforms etc.

5.02.00 **Acid & Alkali Unloading Pumps (applicable if included in scope of supply)**

Description / Data	**Acid Unloading Pumps**	**Alkali Unloading Pumps and Alkali transfer cum recirculation pumps**
a) Numbers. Required	Two (1W+1S) (2x100%)	Two (1W+1S) (2x100%) Unloading pumps & Two (1W+1S) (2x100%) Alkali transfer pumps
b) Type	————Horizontal, Centrifugal ————	
c) Pump Speed	————Maximum 1500 rpm ———	
d) Capacity & head (min.)	As required	As required
e) Liquid to be handled	30-33% HCl	5 to 50% NaOH
f) MOC	Polypropylene or equiv. for HCl	Stainless Steel-316
g) Reinforced Rubber hoses	Minimum two (2) nos. of size 80 mm NB of Min. 10 m. with isolation valves	Minimum two (2) nos. of size 80 mm NB of min. 10 m. with isolation valves
h) Accessories	--Coupling Guards, Drain plug, Vent valve, Suction hoses,isolation valves, Y-type strainers etc. as required as per manufacturer's standard---.	

5.03.00 Chemical Preparation Tanks

Chemical Tanks	**Alkali Preparation Tank**	**Alkali Day Tank**	**Acid Measuring Tank**
a) Number required	One (1)	One (1)	Two (2)
b) Type	-Vertical Cylindrical, with dished end at bottom; Atmospheric-		

c) Useful capacity Minimum 10 Cu.m --Each tank shall be adequate to hold Chemical for 125% of one regeneration--

d) MOC ——M.S. with 4.5 mm thick rubber lining inside ———

e) External protection ———————— As specified elsewhere ————————

f) Accessories Required Vent, Overflow, Drain connection, motor driven stirrer (only for alkali preparation & day tanks), Dissolving basket in SS-316 construction (only for alkali preparation tanks), fume absorber etc. as required as per manufacturer's standard.

5.04.00 DM Water Pumps

Description / Data	DM Water (for Resin Transfer) Pumps	DM Water (for Regeneration) Pumps
a) Numbers	Two (1W+1S)(2x100%)	Two (1W+1S)(2x100%)
b) Type	————Horizontal, Centrifugal ————————	
c) Pump Speed	————————Maximum 1500 rpm —————	
d) Capacity & head	As required	As required
e) MOC		
i) Casing	——————ASTM A 351 CF 8M ————	
ii) Impeller	——————ASTM A 351 CF 8M ————	
iii) Wearing rings	————As per manufacturer's Standard ———	
iv) Shaft	———————— SS 316 ————————	
v) Shaft Sleeves	———————— SS 410 ————————	
vi) Mechanical Seal	———As per manufacturer's Standard ———	
vii) Accessories	Coupling Guards, drain plug, Vent valve, Suction hoses, isolation valves, Y-type strainer etc. as required as per manufacturer's standard.	

5.05.00 **Dosing Pumps**

Description / Data	Acid	Alkali
a) Numbers	Two (1W+1S) (2 x 100%)	Two (1W+1S) (2 x 100%)
b) Type	--------Simplex Positive Displacement Type; hydraulically Operated Diaphragm Type-----	
c) Whether suction strainer required	————— Yes ————————	

d) Accessories:

i) Pressure Dampeners ——Two (2)——

ii) External safety relief valve (in addition to in-built safety valve) Two (2) Two (2)

e) Maximum pump stroke speed —— 100 per minute——

f) **MOC**

1) Liquid End (Pump Head, Valve Valve housing, valve spring etc.).	PVC	AISI: 316
2) Diaphragm	P.T.F.E.	
3) Packing	P.T.F.E.	
4) Shaft	Hardened steel EN 8 (BS:970)	
5) Worm & worm wheel (If applicable)	Manganese Bronze	
6) Connecting rod	Manganese Bronze	
7) Cross head guide	Bronze	
8) Capacity & Head	As per system requirement	

5.06.00 **Pre Filter (Cartridge Filter)**

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a. Number : Two (2) x 50% for each TG unit CPP.

b. Type : Back washable

c. Design Code : ASME SEC-VIII DIV I

d. Mesh size : 20 micron/proven design

e. MOC of Cartridge : Polypropelene/ proven design

5.07.00 **Hot Water Tank (for alkali)**:

For heating of alkali diluent water, 2x50% electrical heating coil in a tank of mild steel rubber lined 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 transmitters/switches, temperature indicator etc. The heater shall be controlled by the temperature switches provided on the tank. The heaters shall be sized for heating the water from a temperature of 15 ^{o}C to 50 ^{o}C at the outlet. The water shall be heated to the required temperature within 5 hours.

5.08.00 **Activated Carbon Filter (For Alkali):**

Rated flow of the filter shall not be less than the design capacity of the alkali transfer-cum recirculation pump, and the maximum velocity through the filter for this flow shall not exceed 12 meters/hour. Depth of the filter material shall not be less than 1 meter.

The filtering medium shall be granulated activated carbon, meeting following minimum requirements.

Total Surface area	:	Not less than 850 m^2/g.
Bulk density	:	Not less than 400 kg/m^3.
Iodine number	:	850 minimum
Uniformity coefficient	:	1.9 or less
Abrasion number	:	70 minimum
Ash	:	8% maximum

Mean particle diameter shall be about 1.5-1.7 mm with following size distribution:

On 20 mesh	:	Less than 3%
Through 40 mesh	:	Less than 10%
Through 50 mesh	:	Less than 1%

The filter shall be provided with all necessary valves and connections for manual backwashing and rinsing with demineralized water. Rate set valves shall be provided with adjustable limit stops for setting backwash and rinse rates.

5.09.00 **Air Blowers**

Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter/silencer, flexible couplings and discharge snubber, all mounted on a single base. Relief valve (s) shall be provided as per manufacturer's standard.

5.10.00 **DM Water storage tanks for Condensate polishing Plant:**

5.10.01 Two (2) numbers of DM Tanks shall be provided (if included in scope of supply in Part-A of Technical Specification) and the tanks shall be of vertical cylindrical type in Mild steel construction internally painted with epoxy. The design features of the tanks & accessories shall be as per IS: 803. However, minimum thickness of shell plate, bottom plate and roof plate shall be 8 mm, 10 mm and 6 mm receptively.

The tanks shall be provided with CO_2 absorber and over flow seal pit. capacity of each tank shall be equivalent to 1.5 times the DM water required for one (1) regeneration operation of working vessels of one (1) TG unit including resin transfer operations from Condensate Polishing Plant to regeneration plant and regeneration plant to Condensate Polishing Plant and for preparation of chemicals for one (1) regeneration of working vessels of one (1) TG unit or as mentioned in Scope of Supply in Part-A of Technical Specification whichever is higher. However, the capacity of each DM water storage tank shall be 600 m^3 minimum. Water inlet

pipe shall led up to the bottom of DM tanks (preferably through perforated pipe) to avoid turbulence/agitation.

5.11.00 **Effluent Neutralisation System:**

Neutralising pit of RCC construction with acid/alkali resistant tiles shall be provided to receive drains from the regeneration. If separate pit is envisaged for Condensate Polishing Plant, (as shown in relevant Tender drawing), contractor shall design the system so that pit shall be provided in two (2) sections and each section shall have a holding capacity of 1.5 times the waste effluent from each regeneration of each vessel. For disposal of neutralized effluent pumping, required number of pumps (as mentioned in Scope in Part-A of Technical Specification & shown in relevant tender drawing) shall be provided. Proven agitation system like air agitation/venturi mixing shall be provided, in addition to recirculation from pumps.

The waste recirculation/disposal pumps shall conform to the following technical requirements:

Effluent re-circulation cum-disposal pumps:

a) Number : Three (3) numbers (1W+1S+1Maint. standby)

b) Type : Horizontal centrifugal single stage with priming system

c) Minimum Capacity and total head of each pump : Suitable to pump the total volume of one section in 8 hours (Minimum 50 Cu.m/hr). Head to suit the requirement

d) Suction condition : Suction from priming chamber

e) Casing & Impeller material : Rubber lined/ FRP lined, Cast iron IS: 210 Grade FG 260

f) Shaft material : SS-316

g) Number of priming chambers : Two (2)

Dosing of acid, alkali and lime shall also provided to neutralized effluents before disposal along with all piping, valves etc. including lime solution preparation facilities for neutralization. One (1) number of lime tank of Stainless steel construction of effective capacity of minimum 2 m^3 shall be provided with dissolving basket, agitator (slow speed), platform/ladder, manhole, overflow/drains etc.

<u>Waste water generated during regeneration:</u> The DM water used for resin transfer operations shall be collected in a RCC pit with solvent free epoxy coating in regeneration area having holding capacity 1.5 times the capacity of DM water required for transferring the resins or 50 m^3 (min) and the same shall be pumped to employer's CW channel for recycle/re-use by means of two (2) numbers (1W+1S) (2x100%) of waste water recycle pumps. The material of construction of pumps shall be SS-316 (casing, impeller and shaft).

5.12.00

Piping

a) Contractor shall design, supply and erect the piping between the service units and the common external regeneration facility, for transferring the exhausted and regenerated resins as required.

b) All outdoor piping shall be laid above ground and generally laid in pipe trestles including crossing of road/pipe/cable trenches if any. Piping between chemical tanks area and regeneration area etc may be laid on pedestals if layout permits.

c) The resin transfer pipeline arrangement shall avoid any sharp bends which cause segregation of the mixed resins, and pockets where the resins can get trapped. Suitable observation ports shall be provided in all critical areas to enable the operator to monitor completeness of the resin transfer operations. All necessary arrangements for venting and draining of the pipeline shall be provided.

d) The resin transfer pipeline shall be sized for a flow velocity of between 2.3 - 3.0 m/s. For other service, design criteria in piping shall be generally in line with design philosophy described elsewhere in Technical Specification.

e) Remotely operated valves suitably interlocked with the plant operation, shall ensure that the resins get transferred to and from only the particular service vessel which has been selected by the operator.

f) All lined vessel connections and connections in unlined vessels (25 NB and larger) shall be flanged to ANSI 125 lb class except the Polisher service vessels which shall be ANSI 300 lb class. Flat face flanges shall be used throughout. Nozzle material shall be ASTM A-106 Gr.B. Sch.80 pipe for all vessels. All flanged connections shall be supplied complete with matching counter flanges, nuts, bolts and full face gaskets. All the pipelines in service vessels area where pressure may attain same as service vessel shall be designed for 300 lb class.

g) MOC for piping:

1) Pipes handling DM Water and Resin transfer pipeline shall be of stainless steel type 304 Sch-40.

2) Pipeline handling Alkali shall be of stainless steel type 316 Sch.10 (minimum).

3) Piping for Acid service (HCl) shall be of carbon steel Polypropylene lined/MSRL/CPVC as per ASTM F441 (Sch.80).

4) Piping for air service shall be of hot dip galvanized (heavy grade) steel.

5) Piping for condensate near condenser Polisher service unit shall be of seamless carbon steel ASTM A-106 Gr B all welded construction with 300 lb flange connection or higher class as per requirement.

6) Pipe handling waste water during resin transfer shall be of stainless steel type 304 Sch.40

5.13.00 **Valves**

1) The isolation valves on the resin transfer line shall be of eccentric plug type/ball valve (full bore type) of Stainless steel construction.
2) Emergency bypass control valve shall be of double flanged/lugged wafer butterfly type. Isolation valves of wafer (lugged) type butterfly valves (resilient material seated, to ensure bubble-tight shut off) shall be provided on the upstream and down stream sides of the control valve. The material of construction of valves handling condensate in service vessel area shall be SS-316 (for body, disc and shaft). Seat/seat rings should be of Teflon/titanium back up rings. Seal shall be of Teflon or equivalent.
3) Isolation Valves handling Acid, Alkali, Ammonia etc shall be of diaphragm type in MSRL (Mild steel Rubber lined) construction.
4) Isolation Valves handling DM water shall be Butterfly or gate or globe type and shall be of SS - 304 construction.
5) Non-return valves shall be constructed of SS-304 for DM Water & SS-316 for alkali. For Hydrochloric acid, non-return valve shall be dual plate/swing check/lift ball check type of suitable material or as per manufacturer's standard practice.
6) All valves in service vessels area where pressure may attain same as service vessel shall be designed for 300 lb class minimum.

5.14.00 **Pressure Vessels & Miscellaneous Items**

a) All pressure vessels shall be designed and constructed in strict accordance with the ASME code Section VIII or acceptable equivalent international standard. 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 of torospherical type.

b) Pressure vessel ends shall be of dished design and constructed by forging, pressing or spinning process. Spherical vessels for CPU service vessels are acceptable. Conical or flat ends shall not be accepted. All the atmospheric vessels shall be at least 6 mm thickness.

c) All pressure vessels shall be fabricated from carbon steel plates to SA-515/516 Gr. 70 and lined internally. The lining shall be of rubber having a hardness of 65 (+/-) 5 Shore-A meeting the requirements of IS:4682, Part-I. 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.

e) Vessel internals shall meet the following requirements

1) Inlet water and regenerant distributor:-

Hub and internals diffuser splash plate or header and perforated laterals. Material of construction shall be SS-316 except for acid service which will be of Hastealloy-B.

2) Under drains:-

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

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

e) Resin Traps:

Outlet of each condensate polisher vessel and waste effluent header of the common regeneration shall be provided with a resin trap. Pressure drop at design flow through a clean resin trap shall not exceed 0.35 kg/sq.cm.

Resin trap shall be of rubber lined steel construction and internals (cord & screen) shall be of JOHNSON SCREENS IRELAND or equivalent (SS-316) construction. Resin traps of process effluent line shall have screen opening not exceeding 120% of associated process vessel under drain screen opening. Other resin traps shall have screen opening of 60 mesh. In place manual back flushing shall be provided for all resin traps. For activated carbon filter, resin trap/media trap shall be provided as per manufacturer's standard.

6.00.00 CONTROL & OPERATION

6.01.00 **General**

a) It is not the intent to specify here the complete details of the control system. Basic type of controls required has been specified below. The contractor shall submit the complete detail of the system offered by him like the extent of automation offered, operation of the complete system, logic/flow diagrams, type and details of the presentation of information, the type of mimic, hardware details etc. along with detailed circuit descriptions.

b) It shall be possible to operate 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 of the Control switches on the panel.

c) 'Close-Auto-Open' control facility shall be provided from OWS/control panel for solenoid valves. In 'Auto' position, the valves shall receive close / open command from the Control system.

d) 'Stop-Auto-Start' Control facility shall be provided from OWS/control panel for the various drives. In 'Auto' position, the drives shall receive stop/start command from the Control system.

e) On control system failure, it shall be possible to operate the valves by means of manual operator of solenoid valves too.

f) The control system shall link the various steps such as closing/opening of different valves, starting/stopping of various pumps etc. which form a sequence. The logic system shall adhere to the correct sequence of operation and predetermined time intervals. The system shall have interlocks so that, criteria necessary for each step are complete prior to proceeding to the next step.

g) It shall be possible to switch mode of operation from one to the other at any moment and the operation shall proceed on the newly selected mode from that time.

h) For steps, which require frequent time adjustment, it shall be possible to change the time setting from the front of the panel. For all other steps it shall be possible to adjust the time setting from inside the panel.

i) For all sequences, the current step number, set time of the step, elapsed time of the step and the total elapsed time of the sequence shall be indicated in the OWS/control panel.

j) A mimic for the CPP scheme and Regeneration system scheme shall be provided. Status of various vessels, drives, valves etc shall be indicated by on the mimic.

k) The system shall incorporate the necessary safety features. During automatic sequential operation, if any pre-requisite criterion is not fulfilled or missing for a pre determined time interval, the steps should not proceed further, and Alarm shall be provided. Missing criteria, sequence, which is under hold up etc., shall be displayed.

l) The safety system for any sequence/step shall check the opening of the required valves and closure of the remaining valves of the plant to avoid mal-operation.

m) Wherever standby equipments are provided, it shall be possible to select each of the drive on 'standby' duty.

n) The detailed logic for the sequence and for each of the drive shall be subject to the Employer's approval.

o) Start, progress and stop of each of the sequence shall be annunciated.

p) The status of vessels of Condensate Polishing Plants shall be available in all the CPP panels of all TG units and as well as in the regeneration plant control panel. Similarly,

the status of regeneration plant status shall be available in the panels of Condensate Polishing Plants of all TG units.

q) Details of control system specification and configuration details shall be as elaborated in the relevant C&I sub section of the technical specification.

6.02.00 **Control & Operation of the Condensate Polishing Unit**

a) It shall be possible to select each of the CPU vessel for any of the following operations or mode:

(1) Standby (Applicable for where spare service vessel (s) are provided)

(2) Service

(3) Isolation from service.

(4) Resin Transfer from CPU vessel to Regeneration plant.

(5) Resin Transfer from Regeneration plant to CPU vessel

(6) Rinse mode.

Each mode or operation is described as below:

b) <u>Standby Mode:</u>

(1) Among the vessels, any one of the vessels may be selected in this mode.

(2) Under this mode, the vessel, which was regenerated in previous cycle and filled with regenerated resin, shall be kept ready for next Service cycle.

(3) The selection of any vessel for Standby mode shall be initiated by operator and there shall be indication about the details such as "Condition of the resin; Whether it is filled with regenerated resin or exhausted resin, whether the standby vessel has undergone rinse cycle or not, date and time of receipt of regenerated resin and completion of rinse cycle etc.

c) <u>Service mode:</u>

(1) Service flow rate for each polishing vessel shall be monitored. During periods of low condensate flow the operator may select to remove one of the vessels from service by a manually initiated automatic sequence.

(2) High differential pressure across the influent and effluent headers will cause an alarm and bypass system shall be initiated as described elsewhere in this section.

(3) By observing the individual vessel flow indicators, or conductivity at vessel outlet the operator can determine which vessel is contributing most to the pressure drop and is in need of resin cleaning.

(4) Cation conductivity indicators shall monitor the polishing system influent and effluent streams as well as the discharge of each service vessel. A high influent conductivity alarm will alert the plant operator that a problem condition such as air or condenser cooling water leakage has occurred. An alarm at the

power station main control room shall also be initiated. A high effluent header or service vessel conductivity alarm will alert the operator to the need for regeneration of a polishing vessel.

(5) When the vessel under Service mode is ready for regeneration, the operator shall change the same into "Isolation mode" in the panel. Subsequently the "Standby vessel" shall be selected for "Service mode" from the OWS/control panel. The selection shall follow, required sequences such as pressurization of the vessel, checking of the effluent quality and putting the vessel in service on satisfactory effluent quality.

(6) The differential pressure (DP) across the inlet and outlet headers of CPU services vessels shall be measured and the bypass control valve will also modulate as per the DP. The bypass system shall also be actuated upon high condensate temperature.

e) Isolation from Service:

Normally "Service Vessel" once exhausted shall be isolated from service till the "Resin Transfer" operation is initiated. In addition, provision to be kept for isolation of one or all the vessels from service if required by operator from the panel.

f) Resin Transfer from CPU vessel to Regeneration plant:

(1) When a vessel in a service mode needs regeneration as stated above, the resin transfer from the particular vessel to the regeneration plant shall be initiated from the panel of the condensate polishing plant.

(2) The transfer of resin from the service vessel shall include operations such as isolation of the service vessel, hydraulic transfer of the resin to the external regeneration system (resin separation vessel) and the complete drain down of the service vessel.

(3) The sequence of "Resin Transfer" operation shall be initiated from the Control system in panel of CPP and shall be controlled in the regeneration Panel.

(4) The completion of the operation shall be exhibited in the panel.

g) Resin Transfer from Regeneration Plant to CPU Vessel:

(1) When the regeneration is completed in the regeneration plant, the resin shall be transferred to the empty vessel of Condensate Polishing plant.

(2) This shall be initiated by the operator from the control panel of condensate polishing plant of the unit from which resin was transferred to the regeneration plant in previous service. Provision shall also be kept to transfer the regenerated resin to any of the empty vessel of the CPP of any of the TG unit if required.

(3) The transfer of resin from the regeneration plant shall include operations such as hydraulic transfer of the resin and the complete drain down of the water.

(4) The sequence shall be initiated from the panel of CPP and shall be controlled in the regeneration Control Panel.

(5) The completion of resin transfer operation shall be exhibited in both the Control panels.

h) Rinse mode:

(1) After transfer of regenerated resin from the regeneration plant to the empty condensate polisher vessel, this rinse cycle shall be initiated from the Control system of the respective unit so that the vessel may be rinsed and kept ready for next service cycle.

(2) The rinse mode shall be a manually initiated full automatic sequence. This sequence shall include the rinse down step using condensate at a suitable rate until the unit effluent quality is acceptable for boiler feed water. Prior to rinsing, the resin shall be given air scrub by means of air blowers provided near the CPP.

(3) The effluent quality shall be determined by conductivity monitoring of the rinse water outlet, which is returned to the condenser hotwell for recycle.

(4) Cation conductivity values shall be monitored and interlocked to prevent advancing of the automatic sequence until the rinse down is complete.

(5) The completion of rinse operation shall be annunciated in the panel so that the rinsed vessel may be selected for “Standby mode” or “Service mode” as per requirement.

6.03.00 **Regeneration Control System**

6.03.01 A manually initiated automatic sequence for physical cleaning and chemical regeneration of the resin shall be provided. Control for chemical dosing system and alkali preparation facility shall also be provided in it.

6.03.02 Physical cleaning of the resin shall consist of three steps, drain to level, air scrub and rinse. The air scrub and rinse steps are of short duration, approximately 1 and 2 to 3 minutes respective time. However the program will allow the operator to increase or decrease the number of times the sequence is repeated to meet the requirements existing at that time.

6.03.03 The chemical regeneration is a many step sequence. This will include hydraulic reclassification of the resins and the transfer of the resins to the respective regeneration vessels. The Contractor may include a layer of inert, intermediate density resin to achieve a better separation of the cation and anion resins, improve resin regeneration, and reduce leakage. The separated resins are then back washed, regenerated with hydrochloric acid and sodium hydroxide solutions respectively and then rinsed. Following the rinse step the resins

shall be given an air scrub followed by a good backwash. The resin is then transferred back to the resin separation vessel and the resins are air mixed. The mixed resins after regeneration are given a final rinse with the discharge conductivity being monitored. The quality of this discharge will determine if the regeneration has been effective. If the quality is not satisfactory the regeneration sequence must be repeated. If satisfactory, the mixed resin is transferred to the resin storage vessel.

6.03.04 A resin mixing and final rinse may occur in the resin storage vessel provided that the system design will permit direct return of the resins to the resin separation vessel in the event of an unsatisfactory regeneration.

6.03.05 Upon satisfactory completion of regeneration, the status shall be annunciated audio-visually in the regeneration system OWS/control panel and as well as in the Balance of Plant Control System. This repeat annunciation in the CPP OWS/panel shall facilitate the operator to initiate resin transfer operation from the regeneration plant to the desired vessel of the Unit in which the service vessel is empty.

6.03.06 Upon resin transfer operation from regeneration plant as described by the operator from the Control System, the regeneration plant shall be ready to receive next batch of exhausted resin from any of the CPP. The status of regeneration plant (Whether ready to receive resin for regeneration or under regeneration etc) shall be available in the Control System of CPP.

6.03.07 Demineralized water shall be used through out the regeneration process for backwashing, diluting the regenerant, rinsing and resin transfer.

6.03.08 A conical bottom hopper having a water ejector will be used for resin make-up.

6.03.09 At any time only one of the sequence shall be in progress.

6.04.00 **Interlocks**

a) All interlocks for safe operation of the plant shall be provided. They shall specifically include the following as minimum requirement.
b) Service vessels can be back in service, only after they have been pressurized.
c) Service vessels can be taken up for resin transfer only after they have been completely isolated from the condensate system and depressurized.
d) Resin can be transferred to and from only one service vessel at a time.
e) Resin transfer between the service and the regeneration skids shall be permitted only when the receiving vessel is initially empty.
f) Regeneration sequence can commence, only when the level in the waste neutralisation pit is low enough to receive the entire waste quantity of waste water from the regeneration operation.
g) Wherever possible, completion of all timed steps in the regeneration and resin transfer process shall be physically verified by effluent conductivity etc, as applicable. The automatic sequence shall be prevented from advancing to next step, till these required

physical conditions are achieved, and at the same time this delay shall be annunciated in the control panel, to draw the attention of the operator. The automatic sequence of operations shall be interruptive at any time by the operator and he shall be able to take over the control to manual from that step onwards. Further operator should be able to over ride sequence, if required. It shall be possible for the operator to extend the timing of a particular step by isolating the timer for the duration. The timer will restart once the operator puts back the system on 'auto' and the other steps will then follow as programmed.

h) The regeneration sequence shall be prevented from advancing further in the event of tripping of a running motor or other fault condition, which do not permit the various desired parameter of this step to be achieved. A manual override for this shall also be provided.

i) Annunciation logic shall be carefully designed so that the alarms are activated only under abnormal conditions. As for example, low flow of diluent water is only relevant when the chemical dosing is in progress. All other times, when no diluent water flow is required, this annunciation should be blocked. In general, Normal and trouble free operation of the plant shall not activate any of these alarms.

j) Adequate diluent water flow shall be established before starting of the ejectors/ dosing pumps for acid and alkali.

k) The immersion heater in the hot water tank can be put on only when there is adequate water level in the tank.

7.00.00 **PAINTING**

7.01.00 Painting shall conform to the requirements specified in the chapter titled "Surface Preparation & Painting"