LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)

TECHNICAL SPECIFICATION
FOR
WATER TREATMENT PACKAGES

SPECIFICATION NO.: PE-TS-508-404-W001

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

CONTENT

PROJECT INFORMATION

CLAUSE NO.	PROJECT INFORMATION

1.00.00 BACKGROUND

Lara STPP Stage-I(2X800 MW) units are in operation near Lara village in Raigarh Distt. of Chhattisgarh. The Present proposal is for Lara STPP, Stage-II (2x800 MW) as extension of existing stage-I.

2.00.00 LOCATION AND APPROACH

The project is located in Raigarh district of Chhattisgarh State. The project is located south-east of Raigarh town near village Lara, bounded by villages Lara, Chhapora & Lohakhan and on the western side of Odisha State boundary.

2.01.00 RAIL LINK

The project site is approachable from NH-200 (Raigarh–Sarangarh) via Kondatarai through State PWD Road.

The nearest rail head Raigarh Railway Station (on South East Central Railway, Howrah-Bilaspur Broad Gauge), is approximately 30 kms from the project site.

2.02.00 AIRPORT

The nearest commercial airport, Raipur is about 250 kms from the project site.

Vicinity Plan is placed at **Annexure-I.**

3.00.00 CAPACITY

Stage-I	:	1600 MW (2x800 MW) – Under Operation
Stage-II	:	1600 MW (2x800 MW) - Present proposal

4.00.00 LAND

About 2450 Acre of Land has been acquired for Lara Super Thermal Power Project. The expansion project is envisaged to be accommodated with in the land already acquired during Stage-I.

5.00.00 WATER

Water Cooled Condenser is envisaged for Lara Stage-II of 2 X 800 MW units. Make up water requirement for this project would be about 4800 Cu.M/hr.

The make-up water will be drawn from Mahanadi river. Raw water will be drawn to supply to PT Plant & Ash Handling Plant.

WRD, Govt. of Chhattisgarh have accorded Water availability confirmation of 45 MCM for Stage-I (2x800 MW) and 68 MCM for Stage-II of Lara STPP from Saradih Barrage on river Mahanadi. Thus the total committed water by WRD, Govt. of Chhattisgarh for Lara STPP is available for 113 MCM.

Closed cycle cooling water system using cooling towers is envisaged for Stage-II of the project.

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6.00.00	**COAL**
6.01.00	Coal requirement for Lara STPP, Stage-II (2x800 MW) would be about 7.0 MTPA million at 90% PLF and shall be met from Talaipalli coal blocks (Mand-Raigarh coal fields) allotted to NTPC.
6.02.00	**Coal Transportation** The envisaged mode of coal transportation from the coal mines to the power plant is by MGR/IR in BOBR wagons.
6.03.00	**Coal Quality** The primary fuel for the main steam generator shall be coal. The coal quality parameters are indicated in **Annexure-IV-2** are to be considered for steam generator design.
7.00.00	**Fuel Oil** The fuel oils to be used for start-up, coal flame stabilization and low load operation of the steam generator shall be Light Diesel Oils having the characteristics given at **Annexure-IV-1**.
8.00.00	**MODE OF OPERATION** : Middle load (two shifting and load cycling)
9.00.00	**STEAM GENERATOR TECHNOLOGY** The steam generators shall be super critical, once through, water tube type, direct pulverized coal fired, top supported, balanced draft furnace, single reheat, radiant, dry bottom type, suitable for outdoor installation. The gas path arrangement shall be single pass (Tower type) or two pass type.
10.00.00	**FLUE GAS DESULPHURIZATION SYSTEM (FGD) & DeNOx ready System:** The project is envisaged with Flue Gas Desulfurization (FGD) system and DeNOx ready System.Limestone to be used for design of FGD system shall be as per the characteristic given at **Annexure-IV-5.**
11.00.00	**CONSTRUCTION POWER** The requirements of the construction power supply for the project would be met from the stage-I 11 kV Miscellaneous Switchgear located in Stage-I area. Necessary 11 kV interconnection, Ring main/LT sub-stations shall be provided by the bidder for the required power plant area.
12.00.00	**POWER EVACUATION SYSTEM** LARA STPP -II shall be the extension project of LARA STPP-I (2X800 MW) and would comprise of two (2) Nos. of coal fired unit of capacity 800 MW each. Step up/power evacuation voltage of Stage-I of the project is 400KV. Under Stage-I of the project, provision of One no. 400kV twin D/C line up to Raigad Kotra pooling station has been considered for connectivity. One no. 400kV Quad D/C line to Champa pooling has also been kept for evacuation of power as finalized in Western Region Standing Committee Meeting/LTA& Connectivity meeting. Under stage-II, two more units of 800 MW units are considered making the ultimate project capacity as 3200 MW.. A number of IPPs are coming in this vicinity of Raigarh-Korba complex of Chhattisgarh., the bulk power generated in this region

shall be exported to power deficit region of WR and NR. Major 765 kV/400 kV pooling stations in this vicinity are being implemented by Central Transmission utility for bulk transmission of power through high capacity 765 kV and 800 kV HVDC corridors to facilitate exchange of the quantum of power from generation projects proposed to be located in eastern part of WR to Central/Western part of WR and NR. Considering above aspect, the step up/power evacuation voltage for stage-II has been considered at 400 kV.

As elaborated above, the power generated need to be transmitted through high capacity corridors to load centers in Central/western part of WR and NR. The nearest 765/400 kV pooling station located to this project is Kotra pooling station in Raigarh. This pooling station is interconnected to other two pooling station in this vicinity i.e. Champa and Tamanar pooling station. Also Kotra pooling station is planned to be interconnected with Dhule (PG) thorough a high capacity +/- 600 kV HVDC corridor under common regional transmission system strengthening. Considering overall scenario, presently 4 nos. of 400 kV line bays have been kept in the Generation Switchyard for connecting to 400 kV Raigarh (Kotra) pooling station. 400kV D/C Twin Moose Lara-I-Raigarh (Kotra) line is already available in stage-I. It is proposed to upgrade this line to Quad capacity and use it for evacuation of power from stage-II. However, in line with CERC regulation on Grant of Connectivity, Long term Access (LTA) and Medium term open access in Inter State Transmission System (ISTS) and related matter, connectivity and LTA application shall be submitted to Power Grid (CTU) for finalization of ISTS connectivity and Associated Transmission System (ATS) of the project.

Based on Connectivity & LTA applications indicating beneficiaries, the ATS would be finalized by Central Transmission Utility (PGCIL) /CEA in the regional Standing Committee Meeting/LTA & Connectivity meeting

13.00.00 PLANT WATER SCHEME

13.01.00 Equipment Cooling Water (ECW) System (Unit Auxiliaries)

All plant auxiliaries and station auxiliaries shall be cooled by De-mineralized water (DM) in a closed circuit. The primary circuit DM water shall be cooled through plate type heat exchangers by Circulating Water tapped from CW system in a closed secondary circuit.

It is proposed to provide independent primary cooling water circuit for TG & its auxiliaries and Steam Generator & auxiliaries (including FGD & station auxiliaries) on Unit basis.

13.02.00 Other Miscellaneous Water Systems

CW system blow down water shall be used in Ash Handling System, FGD process water and CHP dust suppression, service water etc. (Refer Plant Water Scheme). Further, the plant service water requirement, sealing of Vacuum pumps (if applicable) of Ash Handling plant, make-up to fire water system, APH wash & FGD system (gypsum cake wash) make up shall be met from PT plant of CW system (PT-CW). The waste service water collected from various areas and coal-laden water from coal handling plant shall be treated as per requirement and reused.

The quality of Raw water, & DM water is given in this sub-section at **Annexure-III-A, and IIIB**.

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13.03.00 Condenser Cooling (CW) Water System

It is proposed to adopt a recirculating type cooling water system with Induced Draft type cooling towers for the project. For the re-circulating type CW system it is proposed to supply clarified water as make up. Circulating water from CW pumps to TG area and from TG area to cooling tower will be carried through pipes/ducts. Cooled water from Cooling Tower will be led to CW pump house through the cold water channel by gravity.

Plant water scheme is included in **Part-E** of the technical specification.

14.00.00 ENVIRONMENTAL ASPECTS

Lara STPP, Stage-II is proposed to be constructed on the land already acquired for ultimate capacity of Lara STPP, which conforms to the siting criteria for thermal power plants. Environment and Forest Clearances for Lara STPP Stage-I have already been accorded by MoEF&CC.

16.00.00 METEOROLOGICAL DATA

The meteorological data from nearest observatory is placed at **Annexure-II.**

17.00.00 CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed for seismic forces as given in Part-B of this section.

18.00.00 CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given as given in Part-B of this section

19.00.00 Vulnerability Atlas of India(VAI), prepared by Building Materials, Training and Promotion Council (BMTPC) under Ministry of Housing and Urban Affairs, is a comprehensive document which provides existing hazard scenario for the entire country and presents the digitized State/UT-wise hazard, maps with respect to earthquakes, winds and floods for district-wise identification of vulnerable areas. It also includes additional digitized maps for thunderstorms, cyclones and landslides. The main purpose of this Atlas is its use for disaster preparedness and mitigation at policy planning and project formulation and construction stage. The VAI provides necessary information for risk analysis and hazard assessment and is available at website www.bmtpc.org.

As per Government's directive, it is mandatory for the bidders to refer VAI for multi-hazard risk assessment and include the relevant hazard proneness specific to project location while planning, designing and execution of the project in terms of following details:

i) Seismic zone (II to V) for earthquakes
ii) Wind velocity
iii) Area liable to floods and Probable max. surge height
iv) Thunderstorms history
v) Number of cyclone storms/sever cyclone storms and max sustained wind specific to coastal region
vi) Landslides incidences with Annual rainfall normal
vii) District wise Probable Max. Precipitation

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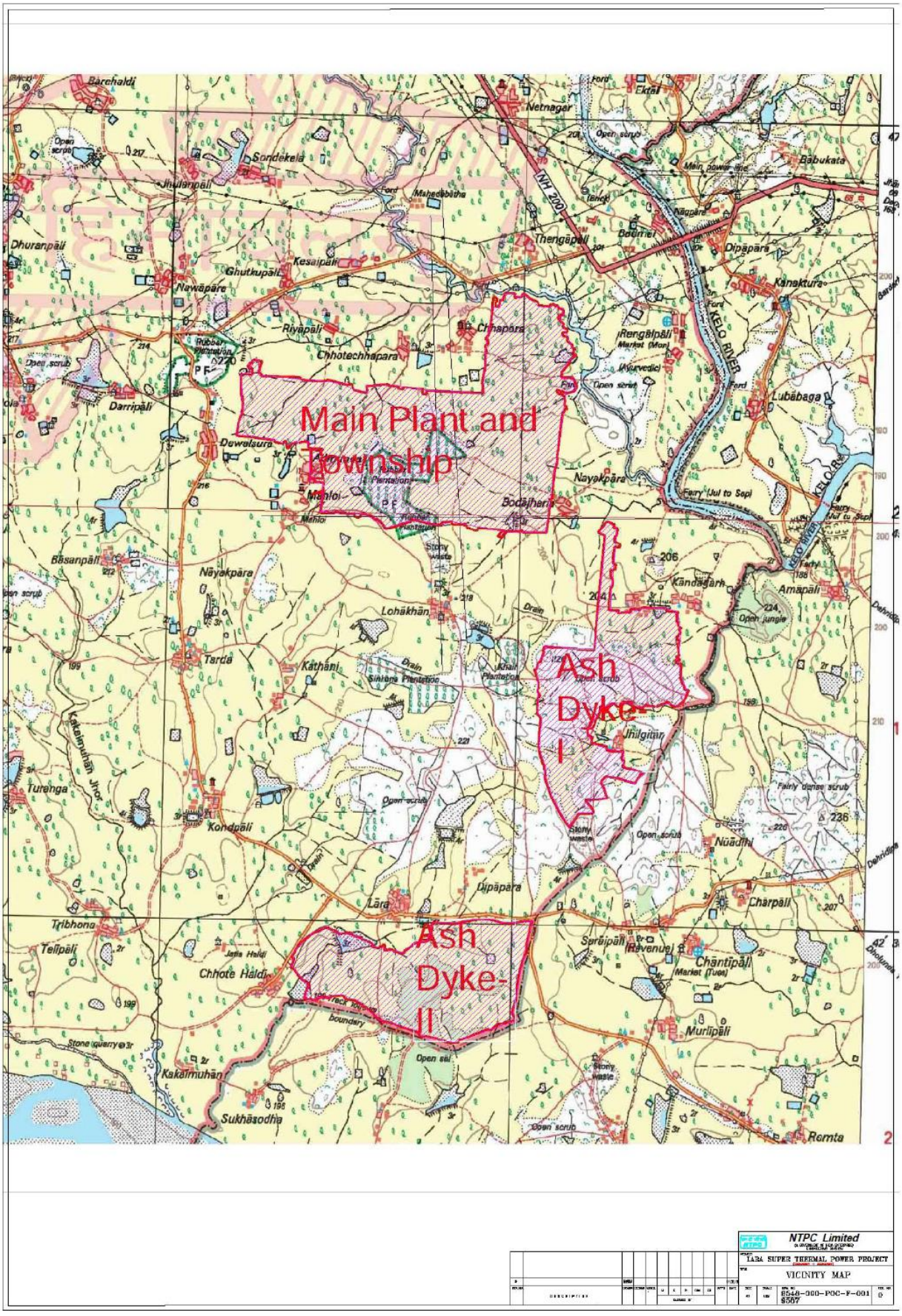
	Accordingly, bidder should refer VAI while planning, designing and execution of the project. However, for design of structures/facilities and equipment, the criteria for earthquake resistant design of structures and equipment, the criteria for Wind Resistant Design of Structures and Equipment and design parameters for drainage facilities, stipulated in the Technical Specification shall be followed. For other information like area liable to floods, probable max. surge height, landslide, thunderstorm, cyclone etc. agencies are required to refer the VAI.

Annexure-I


Main Plant and Township
Ash Dyke-I
Ash Dyke-II
NH 200
KELO RIVER
Barehaldi
Netnagar
Ektal
Sondekela
Jhulanpali
Mahadebtha
Babukata
Dhuranpali
Ghutkupali
Kesaipali
Nawapara
Riyapali
Chhapara
Chhotechhapara
Rengalipali
Dipapara
Kanaktura
Darripali
Dewelsara
Manloi
Bodajhara
Lubabaga
Nayakpara
Bosanpali
Kandagarh
Arnapali
Lohakhan
Tarda
Kathani
Jhilgitan
Turenga
Kondpali
Nuadihi
Lara
Charpali
Tribhona
Telipali
Chhote Haldi
Chantipali
Murlipali
Kakalmuhan
Sukhasodha
Ramta
NTPC Limited
LARA SUPER THERMAL POWER PROJECT
VICINITY MAP

जलवायवी सारणी
CLIMATOLOGICAL TABLE

BACK

स्टेशन : रायगढ़ अक्षांश देशांतर समुद्री तल माध्य से ऊंचाई मीटर प्रक्षणों पर आधारित
STATION : Raigarh LAT. 21°53' LONG. 83°23' HEIGHT ABOVE M.S.L. 220 METRES BASED ON OBSERVATIONS 1971-2000

माह		स्टेशन का मतह दाब	वायु तापमान										आर्द्रता		मेघ की मात्रा		मासिक योग	वर्षा के दिनोंकी संख्या	वर्षा				
			माध्य						चरम										सर्वाधिक वर्षावाले नम महीने का योग	सर्वाधिक वर्षावाले शुष्कतम महीने का योग	24 घंटोंकी सर्वाधिक भारी वर्षा	दिनांक और वर्ष	माध्य पवन गति
			शुष्क बल्ब	नम बल्ब	दैनिक अधिक तम	दैनिक न्यून तम	माह में उच्चतम	माह में निम्नतम	उच्चतम	दिनांक और वर्ष	निम्नतम	दिनांक और वर्ष	सापेक्ष आर्द्रता	वाष्प दाब	समग्र मेघ	निम्न मेघ							
			AIR TEMPERATURE																RAINFALL				
			MEAN						EXTREMES				HUMIDITY		CLOUD AMOUNTS								
MONTH		STATION LEVEL PRESSURE	DRY BULB	WET BULB	DAILY MAX	DAILY MIN	HIGHEST IN THE MONTH	LOWEST IN THE MONTH	HIGHEST	DATE AND YEAR	LOWEST	DATE AND YEAR	RELATIVE HUMIDITY	VAPOUR PRESSURE	ALL CLOUDS	LOW CLOUDS	MONTHLY TOTAL	NO. OF RAINY DAYS	TOTAL IN WETTEST MONTH WITH YEAR	TOTAL IN DRIEST MONTH WITH YEAR	HEAVIEST FALL IN 24 HOURS	DATE AND YEAR	MEAN WIND SPEED
		एच.पी.ए hPa	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C		डि. से °C		प्रतिशत %	एच.पी.ए hPa	आकाश के अष्टमाश Oktas of sky		मि.मि. mm		मि.मि. mm	मि.मि. mm	मि.मि. mm		कि.मी. प्र. पं. Kmph
जनवरी	I	991.6	17.9	14.2	28.0	13.4	31.3	9.1	33.4	2	6.8	22	65	13.5	1.5	0.3	14.5	1.2	88.4	0.0	50.8	8	3.2
JAN	II	987.6	25.1	17.8						1986		1963	46	14.6	1.9	0.3			1985			1985	
फरवरी	I	989.4	20.9	16.1	30.8	16.3	35.0	11.5	38.2	22	7.8	8	60	14.8	1.2	0.2	14.5	1.1	76.2	0.0	29.0	1	4.2
FEB	II	985.6	28.4	18.7						1967		1997	36	13.9	1.7	0.3			1958			1973	
मार्च	I	987.4	26.2	18.5	35.8	20.7	40.1	16.1	43.0	29	12.5	4	46	15.3	1.4	0.2	17.6	1.5	143.5	0.0	61.0	26	4.3
MAR	II	982.6	33.6	20.4						1972		1965	26	13.4	1.5	0.2			1967			1951	
अप्रैल	I	983.5	31.4	21.5	40.3	25.1	43.4	21.0	46.0	28	16.8	26	39	17.7	1.7	0.0	12.8	1.2	78.0	0.0	64.6	23	4.8
APR	II	978.5	38.0	22.3						1973		1963	22	14.3	2.4	0.3			1977			1984	
मई	I	979.7	33.3	23.8	41.8	27.7	45.3	23.1	48.3	8	20.0	4	44	22.0	2.3	0.1	38.8	2.6	184.6	0.0	80.2	30	5.3
MAY	II	974.8	39.5	24.1						1973		1987	26	17.7	3.4	0.5			1990			1990	
जून	I	976.1	30.7	25.2	37.6	27.1	43.6	23.2	47.2	6	19.5	19	64	27.5	5.2	2.3	204.3	9.4	543.7	36.2	212.4	29	5.9
JUN	II	972.2	34.6	25.6						1955		1963	51	25.7	6.1	2.5			1961	1987		1976	
जुलाई	I	976.4	27.4	25.2	31.9	25.0	36.0	22.5	41.8	6	18.6	25	83	30.4	6.7	4.6	399.3	17.5	952.7	131.6	281.0	10	5.1
JUL	II	973.5	29.5	25.9						1982		1995	75	30.6	6.9	4.6			1961	1979		1958	
अगस्त	I	977.2	27.2	25.3	31.2	25.0	34.3	22.9	37.0	1	19.5	20	84	30.7	6.8	4.7	441.9	16.8	813.5	117.2	315.2	25	5.1
AUG	II	974.3	29.0	25.9						1972		1975	78	31.0	7.0	4.6			1973	1965		1970	
सितम्बर	I	981.3	27.8	25.2	32.3	24.7	34.9	22.5	38.0	1	20.2	4	80	30.1	4.8	2.9	234.0	10.9	886.2	51.4	212.0	14	3.9
SEP	II	977.8	29.3	25.7						1969		1991	74	30.0	5.9	3.1			1961	1982		1961	
अक्तूबर	I	986.6	26.6	22.8	32.6	22.3	34.9	18.2	37.1	11	13.4	23	71	25.0	2.3	0.8	42.2	3.0	140.2	0.0	83.6	14	3.3
OCT	II	982.8	29.5	23.7						1976		2000	60	24.7	3.5	1.4			1955			1966	
नवम्बर	I	990.3	22.6	18.3	30.3	17.9	33.1	13.5	36.6	3	9.3	30	64	17.8	1.5	0.3	7.5	0.7	39.4	0.0	51.2	10	3.1
NOV	II	986.4	27.1	20.2						2000		1970	51	18.4	2.2	0.5			1991			1995	
दिसम्बर	I	992.5	18.0	14.2	28.0	13.2	30.5	10.0	33.0	4	6.4	24	65	13.3	1.2	0.0	2.0	0.2	65.5	0.0	27.3	11	2.8
DEC	II	988.3	24.6	17.7						1962		1959	47	14.8	1.8	0.1			1967			1967	
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	I	984.2	25.9	21.0	33.3	21.5	45.2	8.9	48.3	8	6.4	24	64	21.7	3.1	1.4	1429.3	65.9	2973.8	957.3	315.2	25	4.3
	II	980.2	30.7	22.4					5	1973	12	1959	49	20.8	3.7	1.6			1961	1965	8	1970	
वर्षोंकी सं NUMBER OF YEARS	I	28	28	28	29	29	29	29	50		50		28	28	28	28	23	23	44	44	47		23
	II																						

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : रायगढ़
STAION : Raigarh

	मौसम परिघटना						पवन											मेघ										दृश्यता				
	के साथ दिनों की संख्या						पवन की गती के साथ दिनों की संख्या (कि. मी. प्र. घं.)				पवन की दिशा के दिनों की संख्या का प्रतिशत										मेघ मात्रा (सभी मेघ) सहित दिनों की संख्या - अष्टमांश					निम्न स्तरी मेघ मात्रा सहित दिनों की संख्या - अष्टमांश						दृश्यता सहित दिनों की संख्या				
माह	वर्षण 0.3 मि.मि.या अधिक	ओले	गर्जन	कुहरा	धूल भरी आंधी	छंद वात	62 या अधिक	20-61	1-19	0	उ	उपू	पू	दपू	द	दप	प	उप	शांत	0	ले-2	3-5	6-7	8	0	ले-2	3-5	6-7	8	कुहरा 8	1 कि.मी. तक	1-4 कि.मी.	4-10 कि.मी.	10-20 कि.मी.	20 कि.मी. से अधिक
	WEATHER PHENOMENA						WIND											CLOUD										VISIBILITY				
	No. OF DAYS WITH						No. OF DAYS WITH WIND SPEED (Km. p. h.)				PERCENTAGE No. OF DAYS WIND FROM										No. OF DAYS WITH CLOUD AMOUNT (ALL CLOUDS) O K T A S					No. OF DAYS WITH LOW CLOUD AMOUNT O K T A S						No. OF DAYS WITH VISIBILITY				
MONTH	PPT 0.3 mm Or more	HAIL	THUNDER	FOG	DUST STORM	SQUALL	62 Or more	20-61	1-19	0	N	NE	E	SE	S	SW	W	NW	CALM	0	T-2	3-5	6-7	8	0	T-2	3-5	6-7	8	FOG 8	UP TO 1 Km.	1-4 Kms.	4-10 Kms.	10-20 Kms.	OVER 20 Kms.
जनवरी I	1.5	0.0	0.0	0.0	0.0	0.0	0	0	30	1	0	87	0	7	0	2	0	2	2	23	1	2	3	2	30	0	0	0	1	0	0.0	0.1	1.0	29.9	0.1
JAN II							0	0	27	4	1	30	1	13	0	11	1	30	13	21	2	3	3	2	28	1	1	0	1	0	0.0	0.0	0.2	30.4	0.4
फरवरी I	1.6	0.0	0.0	0.0	0.0	0.0	0	0	27	1	1	84	0	9	0	2	0	2	2	21	1	2	2	2	27	0	0	0	1	0	0.0	0.1	0.1	25.6	2.1
FEB II							0	0	26	2	1	28	1	10	0	18	2	32	8	18	2	3	3	2	26	1	1	0	0	0	0.0	0.0	0.1	26.9	1.0
मार्च I	1.7	0.0	0.0	0.0	0.0	0.0	0	0	28	3	1	63	0	18	0	7	0	3	8	25	0	2	2	2	31	0	0	0	0	0	0.0	0.0	0.1	28.5	2.5
MAR II							0	0	28	3	2	14	0	6	0	25	3	42	8	22	2	3	2	2	29	1	1	0	0	0	0.0	0.0	0.0	29.5	1.5
अप्रैल I	1.4	0.0	0.3	0.0	0.0	0.0	0	0	29	1	0	37	1	27	0	23	0	8	4	22	1	2	2	3	30	0	0	0	0	0	0.0	0.0	0.0	28.0	2.0
APR II							0	0	29	1	0	13	0	10	0	30	4	39	4	17	3	4	3	3	28	1	1	0	0	0	0.0	0.0	0.1	28.4	1.5
मई I	2.8	0.0	0.4	0.0	0.0	0.0	0	0	31	0	1	30	0	28	0	30	0	10	1	19	2	2	4	4	31	0	0	0	0	0	0.0	0.0	0.0	28.6	2.4
MAY II							0	0	30	1	1	18	0	13	0	26	1	39	2	12	3	6	5	5	25	2	2	1	1	0	0.0	0.0	0.2	30.5	0.3
जून I	9.9	0.0	0.0	0.0	0.0	0.0	0	0	30	0	1	13	0	22	0	51	0	12	1	5	1	4	6	14	19	1	3	1	6	0	0.0	0.3	2.0	24.8	2.9
JUN II							0	0	29	1	0	16	0	20	0	41	1	18	4	2	1	4	7	16	19	2	3	1	5	0	0.0	0.1	1.7	27.3	0.9
जुलाई I	18.8	0.0	0.0	0.0	0.0	0.0	0	0	31	0	0	6	0	14	1	67	0	11	1	1	2	2	5	21	8	1	4	3	15	0	0.0	0.5	3.3	25.2	2.0
JUL II							0	0	29	2	0	11	0	14	0	52	1	16	6	1	0	2	5	23	8	2	4	2	15	0	0.0	0.1	3.7	25.6	1.6
अगस्त I	19.7	0.0	0.0	0.0	0.0	0.0	0	0	30	1	1	11	0	18	0	52	0	15	3	1	1	2	5	22	7	1	5	3	15	0	0.0	0.7	2.8	25.3	2.3
AUG II							0	0	29	2	1	12	0	16	0	50	1	15	5	1	0	2	6	22	7	3	4	2	15	0	0.0	0.6	3.3	25.7	1.4
सितम्बर I	12.8	0.0	0.0	0.0	0.0	0.0	0	0	28	2	1	20	0	24	0	36	0	12	7	6	3	4	6	11	15	2	4	3	6	0	0.0	0.3	2.0	24.2	3.5
SEP II							0	0	26	4	1	15	0	19	0	35	2	16	12	2	2	5	6	15	14	4	3	2	7	0	0.0	0.2	2.4	25.6	1.9
अक्तूबर I	4.1	0.0	0.0	0.0	0.0	0.0	0	0	27	4	1	54	0	20	0	8	0	5	12	18	2	4	3	4	26	1	1	1	2	0	0.0	0.1	0.4	24.5	6.0
OCT II							0	0	26	5	0	30	1	22	0	16	0	16	15	12	3	7	4	5	23	2	2	1	3	0	0.0	0.0	0.8	27.9	2.3
नवम्बर I	1.1	0.0	0.0	0.0	0.0	0.0	0	0	28	2	1	81	0	7	0	2	0	3	6	22	1	2	2	3	29	0	0	0	1	0	0.0	0.0	0.2	25.9	3.9
NOV II							0	0	24	6	0	42	1	17	0	4	0	17	19	18	3	4	2	3	28	1	0	0	1	0	0.0	0.0	0.3	28.7	1.0
दिसम्बर I	0.4	0.0	0.0	0.0	0.0	0.0	0	0	30	1	1	86	0	5	0	2	0	2	4	23	1	2	3	2	31	0	0	0	0	0	0.0	0.0	0.4	29.0	1.5
DEC II							0	0	25	6	1	38	0	11	0	9	0	23	18	19	3	4	3	2	31	0	0	0	0	0	0.0	0.0	0.0	30.7	0.3
वार्षिक योग I या माध्य ANNUAL II TOTAL OR MEAN	75.8	0.0	0.6	0.0	0.0	0.0	0	0	348	17	1	49	0	16	0	23	0	7	4	197	14	31	43	80	290	6	19	11	39	0	0.0	2.0	12.3	319.4	31.2
							0	0	328	37	1	22	0	14	0	28	1	25	9	156	24	47	50	88	271	19	22	10	43	0	0.0	1.1	12.7	337.1	14.1
वर्षों की सं I NUMBER II OF YEARS	29						25				28									29					29						29				

SECTION-I

SPECIFIC TECHNICAL REQUIRMENT

SECTION- I A: SPECIFIC TECHNICAL REQUIRMENT-MECHANICAL
SECTION- I B: SPECIFIC TECHNICAL REQUIRMENT-ELECTRICAL
SECTION- IC: SPECIFIC TECHNICAL REQUIRMENT-CONTROL & INSTRUMENTATION

SECTION- I A

SPECIFIC TECHNICAL REQUIRMENT-MECHANICAL

1. **INTENT OF SPECIFICATION**

1.1 Water Treatment packages includes **Pre-Treatment Plant (PT Plant), Demineralization Plant (DM Plant), Condensate Polishing Plant (CPU), CW Chemical Treatment (CWT), CHP Run-Off Water Treatment System (CHP WTP), Effluent Treatment Plant (ETP/LET), Chlorine Dioxide Dosing System (CLO2), Sewage Treatment Plant (STP), Lime Dosing System (LDS), Oxygen Dosing System (ODS) & Chemical Dosing System (CDS).**

1.2 This specification is intended to cover SUPPLY PART, SERVICES PART & MANDATORY SPARES comprising of design, engineering, manufacture, fabrication, assembly, inspection & testing at vendor's & sub-vendor's works, painting, forwarding, supply and delivery at site including start up and commissioning spares, mandatory spares, properly packed for transportation, supply of chemicals as specified, unloading / handling and storage at site, in site transportation, assembly, erection and commissioning, trail run, preparation and submission of "As Built" drawings, preparation of drawings in 3D, site testing, carrying out performance guarantee tests at site, Annual Maintenance Services (As per details in Section IC & IIC), Operation & Maintenance (for CW Treatment plant), Supervision of civil works in PT plant, CHP run off Water treatment plant and handover of complete **Turkey Packages i.e. Pre Treatment Plant (PT Plant), Demineralization Plant (DM Plant), Condensate Polishing Plant (CPU), CW Chemical Treatment (CWT), CHP Run-Off Water Treatment System (CHP WTP), Effluent Treatment Plant (ETP/LET), Chlorine Dioxide Dosing System (CLO2) & Sewage Treatment Plant (STP)** as per the details and scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order for **Lara Super Thermal Power Project Stage-II (2X800 MW).**

1.3 This specification is intended to cover SUPPLY PART, SERVICE PART & MANDATORY SPARES comprising of design, engineering, manufacture, fabrication, assembly, inspection & testing at vendor's & sub-vendor's works, painting, forwarding, supply and delivery at site including erection, start up and commissioning spares, mandatory spares, properly packed for transportation, preparation and submission of "As Built" drawings, Annual Maintenance Services (As per details in Section IC & IIC), handover of complete **Supply Packages i.e Oxygen Dosing System (ODS), Chemical Dosing System (CDS) and Lime Dosing System (LDS), along with** Supervision of Erection and commissioning for **Lime Dosing System (LDS)** and as per the details and scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order for **Lara Super Thermal Power Project Stage-II (2X800 MW).**

1.4 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve them of the responsibility of providing such facilities to complete the supply, erection and commissioning of Water Treatment Packages within quoted price.

1.5 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgment is not in full accordance herewith.

1.6 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.

1.7 Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.

1.8 The general terms and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification are subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.9 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Section-III of the specification as **"**PRE BID CLARIFICATION SCHEDULE". In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of BHEL/ Customer shall prevail and shall be complied by the bidder without any commercial and delivery implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by BHEL/ Customer as and when brought to their notice either by the bidder or by BHEL/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.10 This bid is to be treated as no technical deviation bid, hence any clarification required by bidder, must be asked before bid submission. Thereafter, no deviation/ clarifications shall be entertained.

1.11 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.12 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder/ vendor and Customer/ Purchaser/ Employer will mean BHEL and Customer as interpreted by BHEL in the relevant context. Please refer GCC/SCC for better clarity.

1.13 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and dispatch release issued by BHEL/Customer.

1.14 BHEL's/Customer's representative shall be given full access to the shop in which the equipment's are being manufactured or tested and all test records shall be made available to him.

1.15 "Contractor"/ "Vendor" referred in this specification shall be read as "bidder".

1.16 Bidder to comply complete specification given under specific (Section I) and general technical requirements (Section II). However, in case of any contradiction, Specific technical requirement shall prevail over general technical requirements.

2. CHEMICAL DOSING SYSTEM

2.1 SCOPE OF SUPPLY

Chemical Dosing System, complete with all accessories for the total scope as specified hereinafter for the following systems: -

a) AMMONIA DOSING SYSTEM - 2 Nos. Skids.
b) NaOH DOSING SYSTEM - 4 Nos. Skids.

2.2 DESIGN CRITERIA

The following drawings/ data sheets are enclosed for the reference:

a) P&ID for Ammonia dosing system.
b) P&ID for NaOH dosing system.
c) DATA SHEET – A for all above systems.

The LP dosing consists of ammonia dosing system for boiler feed water and NaOH dosing skids for ECW system. The details of each dosing system are given below:

2.1.1 AMMONIA DOSING SYSTEM: (TOTAL NO. OF SKIDS= 2 NOS.) (Refer Drawing no. PE-DG-508-154-W101)

One skid of Ammonia Dosing System shall consist of the following:

a) One number Ammonia Measuring Tank.
b) One number Ammonia Mixing cum storage tank.
c) Two (2 X 100%) Ammonia Dosing Pumps.
d) One Hand Pump with flexible hose.
e) Associated Piping, valves, fitting as indicated in the P&ID of Ammonia Dosing System and data sheet-A enclosed and as required to make the system complete.

CONTROL PHILOSPOHY FOR AMMONIA DOSING SYSTEM

The control of all dosing systems shall be realized in DDCMIS including ON/OFF command of the individual pumps and stirrers. All controls, fault indicators/ alarms, interlocks, logics shall be implemented in DDCMIS. Separate local panel shall be provided ammonia dosing system.

The starter of all the motors shall be clubbed with main plant MCC. Power to all pumps, agitators etc. shall be fed from MCC. DDCMIS commands shall extend to MCC.

A local panel comprising of ‘START’ push button, 'STOP' push button along with ‘ON/OFF/TRIP’ indication, local/ remote indication, stroke position indicator, raise/ lower push button for stroke position and local annunciation shall be provided for local operation. The 'START' push button and ‘STOP’ push button shall be routed to DDCMIS.

The ON/OFF operation of all motorized stirrers and pumps shall also be provided in DDCMIS with local ON, OFF facility.

The auto stroke controllers of each pump shall be mounted on the local panel of respective dosing skid. The stroke position & adjustment will be done from DDCMIS and the stroke controller shall be suitable for accepting 4-20 mA DC signals. The pumps shall be provided with 24 V DC, 2- wire

LVDT Type Position feedback transmitter to generate 4-20 mA DC signals to indicate stroke position in DDCMIS & Local panel.

The Local/ Remote selection switch (soft) shall be provided in DDCMIS and its indication shall be provided in LCP. LCP shall be located on the dosing skid.

INDICATION

1. Following interlocks shall be provided at low-low Level in the mixing cum storage tank:
   i) Running Dosing pump shall be tripped.
   ii) Stirrer motor of the respective tank shall be tripped.

2. Following conditions to be ensured before starting a stirrer:
   i) Level in the tank adequate.
   ii) MCC not disturbed.

3. Following conditions to be ensured before starting a pump:

   i) Level in the tank adequate.
   ii) MCC not disturbed.
   iii) Duplex strainer- not choked

4. Following shall be provided on LCP:

   i) ON/ OFF/ Fault- Lamp Indications for all drives (pumps & agitator).
   ii) Operation 'Local selected' / operation 'Remote selected'- Lamp Indication, common for all drives.
   iii) Pump- Start/ Stop & Agitator-Start/ Stop- Push Buttons.
   iv) Auto stoke controller.
   v) Stoke position indicator (may be a part of controller).
   vi) Local LED based annunciation driven by DDCMIS.

5. Following fault indications with alarm annunciations shall be provided on LCP:

   i) Low level in the mixing cum storage tank.
   ii) Low-low level in the mixing cum storage tank
   iii) High level in the measuring tank
   iv) High level in the mixing cum storage tank
   v) High-high level in mixing cum storage tank
   vi) High pressure at pump discharge header
   vii) Low pressure at pump discharge header
   viii) Strainer choked
   ix) Dosing pump-1-tripped
   x) Dosing pump-2-tripped
   xi) Stirrer motor-tripped

SIGNAL EXCHANGE

6. Following signals shall be wired from DDCMIS to LCP. These shall be 24V DC powered signals. (PF contacts are not used to avoid the higher voltage LCP power supply reaching DDCMIS while contact interrogation).

   i) Operation local selected.

ii) Operation remote selected.
iii) Pump- 1/2 & stirrer (ON/OFF/FAULT).
iv) Process conditions (as per clause 5 above).
v) Pump- 1/2 stroke length demand signal (4-20 mA).

7. Following signals shall be wired from LCP to DDCMIS. Binary signals shall be P.F. contacts.
   i) All field signals.
   ii) START & STOP–PB commands for all drives (pumps & agitator).
   iii) Pump- 1/2 stroke length feedback signal (4-20 mA).

8. Signal Exchange between DDCMIS & MCC:

   i) START & STOP command from DDCMIS to MCC.
   ii) ON, OFF & MCC Disturbed feedback from MCC to DDCMIS.

9. Signal Exchange between LCP & MCC shall be
   i) EMERGENCY STOP-PB for all drives (pumps & agitators) shall also be wired directly to MCC.

All the field instruments i.e. level transmitter, differential pressure transmitter, pressure transmitter etc. & stroke actuator shall be terminated at local panel by the vendor, for taking further to DDCMIS by BHEL.

Further, Control & instrumentation shall be as per P&ID of Ammonia Dosing System, Data Sheet-A.

2.1.2 NaOH DOSING SYSTEM FOR ECW SYSTEM: (TOTAL NO. OF SKID = 4 NOS) (Refer Drawing. No. PE-DG-508-154-W101)

One skid of NaOH Dosing System consists of the following:

a) One number NaOH Mixing cum storage tank.
b) Two (2 X 100%) NaOH Dosing Pumps.
c) Associated Piping, valves, fitting as indicated in the P&ID of NaOH dosing system and data sheet-A enclosed and as required to make the system complete.

CONTROL PHILOSPOHY FOR NaOH DOSING SYSTEM

The control of all dosing systems shall be realized in DDCMIS including ON/OFF command of the individual pumps and stirrers. All controls, fault indicators/alarms, interlocks, logics shall be implemented in DDCMIS. Separate local panel shall be provided for each of the above said system.

The starter of all the motors shall be clubbed with main plant MCC. Power to all pumps, agitators etc. shall be fed from MCC. DDCMIS commands shall extend to MCC.

A local panel comprising of ‘START’ push button, 'STOP' push button along with ‘ON/OFF/TRIP’ indication, local/ remote indication, stroke position indicator, raise/ lower push button for stroke position and local annunciation shall be provided for local operation. The 'START' push button and ‘STOP’ push button shall be routed to DDCMIS.

The ON/OFF operation of all motorized stirrers and pumps shall also be provided in DDCMIS with local ON, OFF facility.

The auto stroke controllers (I/E converter) of each pump shall be mounted on the local panel of respective dosing skid. The stroke position & adjustment will be done from DDCMIS and the stroke

controller (I/E converter) shall be suitable for accepting 4-20 mA DC signals. The pumps shall be provided with 24 V DC, 2- wire LVDT Type Position feedback transmitter to generate 4-20 mA DC signals to indicate stroke position in DDCMIS & Local panel.

The Local/ Remote selection switch (soft) shall be provided in DDCMIS and its indication shall be provided in LCP. LCP shall be located on the dosing skid.

INDICATION

1. Following interlocks shall be provided at low-low Level in the mixing cum storage tank:
   i) Running Dosing pump shall be tripped.
   ii) Stirrer motor of the respective tank shall be tripped.

2. Following conditions to be ensured before starting a stirrer:

   i) Level in the tank adequate.
   ii) MCC not disturbed

3. Following conditions to be ensured before starting a pump:

   i) Level in the tank adequate.
   ii) MCC not disturbed.
   iii) Duplex strainer- not choked

4. Following shall be provided on LCP:

   i) ON/ OFF/ Fault- Lamp Indications for all drives (pumps & agitator)
   ii) Operation ‘Local selected’ / operation ‘Remote selected’- Lamp Indication, common for all drives.
   iii) Pump- Start/ Stop & Agitator-Start/ Stop –Push Buttons
   iv) Auto stoke controller
   v) Stoke position indicator (may be a part of controller)
   vi) Local LED based annunciation driven by DDCMIS.

5. Following fault indications with alarm annunciations shall be provided on LCP:

   i) Low level in the mixing cum storage tank.
   ii) Low-low level in the mixing cum storage tank
   iii) High level in the mixing cum storage tank
   iv) High-high level in mixing cum storage tank
   v) High pressure at pump discharge header
   vi) Low pressure at pump discharge header
   vii) Strainer choked
   viii) Dosing pump-1--tripped
   ix) Dosing pump-2--tripped
   x) Stirrer motor—tripped

SIGNAL EXCHANGE

6. Following signals shall be wired from DDCMIS to LCP. These shall be 24V DC powered signals. (PF contacts are not used to avoid the higher voltage LCP power supply reaching DDCMIS while contact interrogation).

   i) Operation local selected.

ii) Operation remote selected.
iii) Pump- 1/2 & stirrer (ON/OFF/FAULT).
iv) Process conditions (as per clause 5 above).
v) Pump- 1/2 stroke length demand signal (4-20 mA).

7. Following signals shall be wired from LCP to DDCMIS. Binary signals shall be P.F. contacts.

   i) All field signals.
   ii) START & STOP–PB commands for all drives (pumps & agitator).
   iii) Pump- 1/2 stroke length feedback signal (4-20 mA).

8. Signal Exchange between DDCMIS & MCC:
   i) START & STOP command from DDCMIS to MCC.
   ii) ON, OFF, MCC Disturbed feedback from MCC to DDCMIS.

9. Signal Exchange between LCP & MCC shall be

   i) EMERGENCY STOP-PB for all drives (pumps & agitators) shall also be wired directly to MCC.

   All the field instruments i.e. level transmitter, differential pressure transmitter, pressure transmitter etc. & stroke actuator shall be terminated at local panel by the vendor, for taking further to DDCMIS by BHEL.

   Further, Control & instrumentation shall be as per P&ID of NaOH Dosing System, Data Sheet-A.

2.3 TERMINAL POINTS (also refer P&I Diagrams enclosed)

a) All piping beyond battery limit of skid as indicated in P&ID's enclosed with the technical specification is excluded from bidder's scope.
b) Electrical scope shall be as per Std. Electrical Scope Matrix attached in Section IB of the technical specification.
c) All drains shall be brought at one point on the skid by the bidder via a drain header and further connection to the nearest plant drain shall be done by BHEL/ Customer.
d) Counter flanges for all the piping terminal points (as per P&IDs) and for the terminal point of drain header shall be in bidder's scope.

2.4 SPECIAL TOOLS AND TACKLES

a) One set of all special tools shall be furnished and shipped with each piece of equipment for dismantling, maintenance, adjustment, and calibration of the equipment. The tools shall be shipped in separate heavily constructed wooden boxes provided with hinged covers and padlock hasps.
b) The Contractor shall supply under this contract all maintenance tools for each piece of equipment/ system and it shall be boxed separately and the boxes shall be appropriately marked for shipment and identification of contents.
c) A weather-proof itemized list of the contents shall also be attached to the outside of each container.
d) The maintenance tools shall include all special handling rigs, bars, slings, cable and all specialized equipment for control system maintenance such as extender boards, scopes, and all software and hardware. Further, Bidder shall also include a full set of regular maintenance tools and tackles required. Bidder shall also include all maintenance tools and tackles in their scope. Total price of all the maintenance tools and tackles shall be included in the quoted lump sum price.

2.5 The material of construction specified in Data Sheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subjects to Customer/ BHEL approval during detailed engineering.

2.6 All instrument-wetted parts will be suitable for requested application.

2.7 All high points on any, tanks, pumps, piping or instrumentation will be vented and provided with valve. All low points on any, tanks, pumps, piping or instruments will be drained and provided with valve.

2.8 5 mm (min.) thick IS 2062 Checker plate shall be provided by bidder covering the skid frame and for elevated platform for the preparation/ measuring tank, wherever applicable. The tanks support, pumps and pipe support and LCP/ LCP support shall be welded to the checker plate.

2.9 Stuffing box shall be provided for mounting the agitator to avoid air ingress.

2.10 Vent/ overflow pipe from tank shall at least reach the bottom half of the breather/ water seal/ CO_2 absorber.

2.11 SS pad shall be provided for welding MS structural supports to SS tanks.

2.12 Step ladder and chemical charging platform shall be provided for easy access to top of tank.

2.13 All the terminal points shall be easily accessible and towards one side of skid.

2.14 All valves shall be easily accessible for the operator.

2.15 All tanks/ pumps shall have name plate clearly indicating the equipment name.

2.16 Pipe fittings of the system shall be done using elbows and tees. Pipe bending is not acceptable.

2.17 All equipment shall have SS name plate.

2.18 All LCP shall be mounted in their respective dosing skids only.

2.19 Energy efficient level IE3 LT Motors shall be provided by the bidder.

2.20 All the terminal points where flange joints are involved, bidder shall terminate it along with matching counter flange, nuts, bolts, gaskets etc.

2.21 KKS codes for all drives and instruments for the project have to be followed.

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

3. OXYGEN DOSING SYSTEM

3.1 SCOPE OF SUPPLY

Broad scope of work of this package includes all equipment and accessories.

The Oxygen dosing system as specified in Technical Specification shall consist of the followings:

- Entire Oxygen dosing system mounted on skid as per P&IDs and Data Sheet-A.
- Instrumentation (minimum) as per the enclosed P&ID.
- Start-up & commissioning spares as required, mandatory spares as specified.
- Racks (2 Nos.) hold 32 cylinders, cylinders (64 Nos.), injector assemblies (8 nos.), tees (20 nos.), elbows (20 nos.), loose tubing (500 meter), compression fittings (85 nos.) for loose tubing.
- Foundation nuts & bolts to fix each skid on the floor, as required.

3.2 DESIGN CRITERIA

The following drawings/ data sheets are enclosed for the reference:

a) P&ID for Oxygen Dosing System.
b) DATA SHEET – A.

The objective of providing the dosing systems is to maintain the chemistry of the boiler feed water and also to comply with different modes of operation i.e. “Combined Water Treatment mode” during continuous plant operation and “Ammoniacal mode or AVT (O) mode” during start-up & shutdown conditions for super critical boiler of main plant.

The chemical feed for Combined Water Treatment (CWT) involves the feed of only aqueous ammonia and gaseous oxygen.

Erection and commissioning shall be in BHEL scope however, supervision of Erection and commissioning shall be in bidder’s scope. Details of supervision are included in Annexure XIV (Section IA).

3.2.1 OXYGEN DOSING SYSTEM: (4 SKIDS FOR UNIT, TOTAL 8 SKIDS FOR STATION) (Refer Drawing. No. PE-DG-508-154-W001)

One skid of Oxygen Dosing System consists of the following: -

- One number of bank of two oxygen cylinders, dosing at downstream of Deaerator/ CPU outlet.
- Two number of Pressure Regulator as per Data Sheet – A.
- Associated Piping, valves, fitting as indicated in the P&ID of oxygen dosing system and Data Sheet-A enclosed and as required to make the system complete.

CONTROL AND INSTRUMENTATION

The mode of operation of the oxygen dosing system shall be from DDCMIS only. All the logics, controls and interlocks shall be implemented in DDCMIS. Local manual intervention is not envisaged. Both manual/ automatic controls shall be implemented in DDCMIS. The provision to select “Auto” or “Manual” mode shall be provided in DDCMIS OWS only.

Control of all dosing system shall also be done from SWAS room in addition to the CCR and one no. OWS shall be provided for control & operation of all dosing system from SWAS room.

The oxygen gas shall be at high pressure (204 Kg/cm2) in the cylinders. The same shall be brought to a lower pressure by the Pressure Regulator (set pressure of 45 Kg/cm2 for skid dosing at CPU outlet and set pressure of 20 Kg/cm2 for skid dosing at deaerator outlet) attached with each cylinder.

Each of the two oxygen cylinders in the skid shall have a dedicated set of solenoid valve, pressure gauge and pressure transmitter. Two cylinders provided on skid are connected and one cylinder will serve at a time based on the pressure at the inlet of solenoid valve. In case the pressure at the inlet of SV1 reaches at the set point, the solenoid valve SV1 will close and solenoid vale SV2 will open and other cylinder shall be taken in to service provided the pressure at the inlet of SV2 is not low and vice versa. Alarm for pressure low at the inlet of solenoid valves shall be provided in DDCMIS.

A pressure relief valve shall be fitted at the upstream of solenoid valve to relieve system pressure if the system pressure goes above set pressure.

The pressure of the oxygen shall be further reduced & set by pressure reducing valve in the skid {set point –"ADEQUATE--(Set points–44 kg/cm2 for skid dosing at CPU outlet & 17 kg/cm2 for skid dosing at deaerator outlet). The flow and pressure of oxygen can be monitored from DDCMIS by the signal from mass flow controller (MFC) and from pressure transmitter provided at the downstream of pressure reducing regulating valve. The flow of oxygen dosing will be controlled manually/automatically from DDCMIS by adjusting mass flow controller (MFC) provided on skid based on the feedback from the dissolved oxygen analyzer located in the economizer inlet. The MFC shall have a position feedback transmitter that shall transmit the feedback signal to DDCMIS.

The flow of Oxygen Dosing shall be controlled manually/ automatically from DDCMIS by adjusting MFC provided on skid based on feedback from the dissolved oxygen analyzer located at the economizer inlet.

All solenoid valves mounted on the oxygen dosing skids shall be 24 V DC powered from DDCMIS and routed through the local skid mounted junction box. All the field instruments, MFC and solenoid valves (SV1 & SV2) shall be terminated at a junction box in the skid by oxygen dosing vendor for further connection to DDCMIS.

At each dosing point, viz. CPU outlet and deaerator outlet, an injection assembly containing 15 NB tubing, fixing collar, solenoid valve and NRV shall be supplied loose by oxygen dosing vendor.

The set points indicated below for operation of pressure reducing valve are tentative. Final value of the same shall be decided by oxygen dosing vendor during detailed engineering as per the requirement of the flow meter-cum-transmitter manufacturer.

Bidder to provide a flame arrestor in the vent header of each of oxygen dosing skids.

Further, Control & instrumentation shall be as per P&ID of Oxygen Dosing System, Data Sheet-A

3.3 TERMINAL POINTS (also refer P&I Diagrams enclosed)

a) All piping beyond battery limit of skid as indicated in P&ID's enclosed with the technical specification is excluded from bidder's scope.
b) Electrical scope shall be as per Std. Electrical Scope Matrix attached in Section IB of the technical specification.
c) All wiring for field instruments (pressure and flow transmitters), solenoid valves and MFC shall be terminated at JB by the oxygen dosing vendor for further connection to DCS by BHEL.
d) All vent connections shall be connected via vent header and terminated at one point of the skid for further connection to atmosphere, if required, by BHEL.

e) Dosing termination point shall be after MFC and terminated at one point by the oxygen dosing supplier for further interconnection till dosing locations by BHEL.
f) 24 V-DC connection to SV-3, SV-4 SV-5, SV-6 shall be directly connected by BHEL.

3.4 SPECIAL TOOLS AND TACKLES

a) One set of all special tools shall be furnished and shipped with each piece of equipment for dismantling, maintenance, adjustment, and calibration of the equipment. The tools shall be shipped in separate heavily constructed wooden boxes provided with hinged covers and padlock hasps.
b) The Contractor shall supply under this contract all maintenance tools for each piece of equipment/ system and it shall be boxed separately and the boxes shall be appropriately marked for shipment and identification of contents.
c) A weather-proof itemized list of the contents shall also be attached to the outside of each container.
d) The maintenance tools shall include all special handling rigs, bars, slings, cable and all specialized equipment for control system maintenance such as extender boards, scopes, and all software and hardware. Further, Bidder shall also include a full set of regular maintenance tools and tackles required. Bidder shall also include all maintenance tools and tackles in their scope. Total price of all the maintenance tools and tackles shall be included in the quoted lump sum price.

3.5 TEST PROCEDURE FOR OXYGEN DOSING SYSTEM

a) A Factory Acceptance Testing will be conducted at vendor's Factory. This will be for verification of the functional performance of critical equipment/instruments and hardware design when run at design pressure, temperature and flow.

b) FAT will be carried out using only the inert gas such as Nitrogen. Following will be the FAT protocol.

c) Checking the completeness of the system. This will include visual inspection of equipment and instruments as per the P & ID s & GA along with skid after assembling on skid.

d) Soap joint leak test of tubing/fittings/valves using nitrogen at 1.25 times of maximum operating pressure.

e) (ANSI B31.8), for 2 hours. The allowable pressure drop would be up to 0.5 bar over 2 hours.

f) Functional testing of calibrated components (equipment/ instruments) using nitrogen. The test controller will be connected to Mass flow controller. The set point will be given from test controller & this will be monitored.

g) Testing of Assembly of skid, instruments, termination box will be done by BHEL as per approved Quality Assurance Plan.

h) Inert test run using nitrogen to demonstrate flow.

i) Final Assembly & Factory Acceptance Test will be witnessed by BHEL & CUSTOMER.

3.6 The material of construction specified in Data Sheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subjects to Customer/ BHEL approval during detailed engineering.

3.7 All instrument-wetted parts will be suitable for requested application.

3.8 5 mm (min.) thick IS 2062 Checker plate shall be provided by bidder covering the skid frame. LCP/ JB supports shall be welded to the checker plate.

3.9 All the terminal points shall be easily accessible and towards one side of skid.

3.10 All valves shall be easily accessible for the operator.

3.11 All equipment shall have SS name plate.

3.12 KKS codes for all drives and instruments for the project have to be followed.

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

4. CHLORINE DI OXIDE SOSING SYSTEM (Refer P & I D no. PE-DG-508-154-13000-W001)

Chlorine dioxide treatment shall be used mainly to control microbial activity in cooling tower circulating water system (CW) and raw water systems (PT). Chlorine dioxide shall be used for this purpose shall be generated at site (in situ safe generation that takes place completely in water) from Acid-Chlorite process using 33% commercial grade HCL and 31% Sodium Chlorite (NaCLO2) Solution in presence of motive water. The Chlorine dioxide plant shall be located indoor in building except the bulk chemical storage tanks & unloading systems which shall be kept outdoor. Pressure regulation, if any, as per ClO2 generator system requirement shall be done by Bidder. Booster pumps, if required, shall be provided for the system. Separate Chlorine dioxide plant (ClO2) for CW & PT systems shall be provided at one location i.e. in CW area. Typical schematic diagram for each system (CW & PT) is enclosed for better understanding of the proposed systems. However, Bidder shall develop the detailed drawings during detailed engineering based on this basic scheme, other requirements in this Specification & as necessary to make the systems/ plants complete. Bidder shall also ensure proper diffusion and distribution of ClO2 at the dosing point(s).
Minimum Scope of supply is listed below however bidder to consider additional items / equipment required as per system requirement for safe and trouble-free operation:

4.1 SCOPE OF SUPPLY

4.1.1 2 (Two) Nos. (2W) automatic Chlorine-di-oxide underwater generators of submerged/ encapsulated type for CW systems.

4.1.2 2 (Two) Nos. (1W+1S) automatic Chlorine-di-oxide underwater generators of submerged/ encapsulated type for PT systems.

4.1.3 1x100% HCL dosing pump for each Chlorine-di-oxide generator of CW system with a common standby. Total nos. of HCL dosing pumps shall be three (3) nos (2W+1S) for CW system. Pumps shall be complete with motor, automatic stroke adjustment, along with suction strainer, suction solenoid valve, valves, pressure relief valves and associated controls and instrumentation.

4.1.4 1x100% HCL dosing pump for each Chlorine-di-oxide generator of PT system as one working and one standby. Total nos. of HCL dosing pumps shall be two (2) nos (1W+1S) for PT system. Pumps shall be complete with motor, automatic stroke adjustment, along with suction strainer, suction solenoid valve, valves, pressure relief valves and associated controls and instrumentation.

4.1.5 1x100% NaCLO2 dosing pump for each Chlorine-di-oxide generator of CW system with a common standby. Total nos. of NaCLO2 dosing pumps shall be three (3) nos (2W+1S) for CW system. Pumps shall be complete with motor, automatic stroke adjustment, along with suction strainer, suction solenoid valve, valves, pressure relief valves and associated controls and instrumentation.

4.1.6 1x100% NaCLO2 dosing pump for each Chlorine-di-oxide generator of PT system one working and one standby. Total nos. of NaCLO2 dosing pumps shall be two (2) nos (1W+1S) for PT system. Pumps shall be complete with motor, automatic stroke adjustment, along with suction strainer, suction solenoid valve, valves, pressure relief valves and associated controls and instrumentation.

4.1.7 Two (2) Nos (2x100%) horizontal centrifugal type unloading cum transfer pumps (33% HCL) along with motor and all other accessories.

4.1.8 Two (2) Nos (2x100%) horizontal centrifugal type unloading cum transfer pumps (31% NaCLO2) along with motor and all other accessories.

4.1.9 Three (3) Nos (3x100%) horizontal centrifugal type dilution water pump along with drive motors, VFD to control the speed for varying the flow rate, suction strainer, valves and other accessories for CW system.

4.1.10 Two (2) Nos (2x100%) horizontal centrifugal type dilution water pump along with drive motors, VFD to control the speed for varying the flow rate, suction strainer, valves and other accessories for PT system.

4.1.11 2 Nos. Online Residual Chlorine dioxide analyser in the PT CLO2 systems.

4.1.12 2 Nos. Online Residual Chlorine dioxide analyser (one per unit) in the cooling water return header.

Location of tapping shall be provided by BHEL in each CW return header near to TG hall area for sampling. CLO2 analysers shall be installed by bidder in common SWAS room of both TG units.

4.1.13 1 No. hand held Calorimeter for on-spot measurement of residual ClO2.

4.1.14 1 no portable ORP meter (common for CW & PT ClO2 systems)

4.1.15 1 no portable pH meter (common for CW & PT ClO2 systems)

4.1.16 2 Nos. safety shower and eye wash facility (common for both CW & PT ClO2 systems).

4.1.17 Safety equipment (common for both CW & PT ClO2 systems): 4 Nos. respiratory equipment; 4 Nos. canister type gas mask; 4 Nos. safety helmets, goggles, rubber boots, gloves and coloured vests (aprons), 4 nos. of ammonia torches, 4 Nos. of emergency repair kit, 4 Nos Weather socks provided at a suitable location on the building, display charts, safety checks, maintenance procedure, Emergency action plan etc.

4.1.18 2 Nos. ClO2 leak sensor with detector inside the room (common for PT & CW). Industrial type-high decibel hooter shall also be provided.

4.1.19 Three (3) Nos (3x100%) of Bulk Acid Storage Tanks (33% HCl) with all nozzles, vents, fume collection/absorber, Density indicator, neutralization system, drain, overflows etc. These tanks shall be of FRP (with UV protection) construction.

4.1.20 Three (3) Nos (3x100%) of Sodium Chlorite Bulk Storage Tanks (31% NaClO2) with all nozzles, vents, fume collection/absorber, Density indicator, neutralization system, drain, overflows etc. These tanks shall be of FRP (with UV protection) construction.

4.1.21 Two (2) Nos. (1W+1S) (2x100%) horizontal centrifugal type Unloading cum Transfer pumps (33% HCl) along with all accessories.

4.1.22 Two (2) Nos. (1W+1S) (2x100%) horizontal centrifugal type Unloading cum Transfer pumps (31% NaClO2) along with all accessories.

4.1.23 The cell assemblies shall have a maximum design operating pressure of 10 kg/cm2 and should be tested for 1.5 times system design pressure before shipment.

4.1.24 Necessary Ventilation equipment & systems for CLO2 generators, if required.

4.1.25 Chemical dosing piping along with all fittings, valves and diffusers / venturi injectors for Dosing chlorine dioxide solution in the process stream.

4.1.26 Dilution water piping from terminal point to the point of injection of chlorine dioxide Solution into the required dosing points for both PT & CW systems.

4.1.27 All equipment as indicated in the P & ID and as required for safe and trouble-free operation of the system, along with necessary accessories like isolating valves, drain valves, zeroing valves, pulsation dampers, nipples, instrument piping, instrument connections / contacts for operation, interlock etc. The instrumentation shall include pressure gauges, pressure switches, level gauges; level switches, transmitters, etc complete with all root valves, interconnecting piping, fittings etc. The instrumentation shall include all special analytical instruments, pH sensor with transmitter, flow meters etc.

4.1.28 Flow meters on all chemical feed lines, dilution water lines, and chlorine dioxide solution lines.

4.1.29 Pressure indicator & controller on the water inlet line to ClO2 generators, chlorine dioxide dosing controller, low vacuum switch, solenoid valves, etc., all complete and as required shall be provided.

4.1.30 The dosing in inlet shall be automatically controlled based on the signal received from residual chlorine dioxide analyser in the header.

4.1.31 All interconnecting piping, supports, valves and instruments, sampling, drain and vent as specified and as required for safe and trouble-free operation, within the terminal points.

4.1.32 Supply of reagents, buffer solution and calibration pots for instruments.

4.1.33 Flushing arrangement with drain valves for chemical / waste lines.

4.1.34 Mandatory spares as per list attached in ANNEXURE -VI.

4.1.35 Flexible hose pipe (10-meter minimum) for each unloading pump.

4.1.36 Neutralization system for HCL spillage/ leakage: Proven neutralization system complete with chemical dosing/ preparation day tanks, dissolving basket, agitators, dosing pumps (if required) (2nos. 1W+1S), neutralized waste transfer pumps (2nos. 1W+1S), piping up to DMP N-PIT, level transmitters, pressure transmitters, pH analyser & other instrumentation, valves, fitting, internal piping, motors etc.

4.1.37 Neutralization system for NaCLO2 spillage/ leakage: Proven neutralization system complete with

chemical dosing/ preparation day tanks, dissolving basket, agitators, dosing pumps (2nos. 1W+1S), neutralized waste transfer pumps, piping DMP N-PIT, level transmitters, pressure transmitters, pH analyser & other instrumentation, valves, fitting, internal piping, motors etc.

4.2 CONTROL PHILOSOPHY OF CHLORINE DI OXIDE DOSING SYSTEM

Chlorine di oxide dosing system shall be controlled from DDCMIS (BHEL scope).
Following basic process related interlocks, alarms /pre-warning signals shall be implemented in the control system as per system requirement. The annunciation, interlock, signals provided shall include but not be limited to the following:

Following minimum safety features/ interlocking shall be available in the offered ClO2 plants.

A. Safety features at Chemical Storage Facility

- Chemical Storage Facility (Bulk storage tanks for NaCLO2 & HCL) is provided with dyke wall.
- Chemical Storage Facility is provided with neutralizing pits.
- Chemical Storage Facility shall have safety shower with arrangements for eye wash.

B. Safety features at Equipment Room

- ClO2 gas detector (leak sensor) shall be installed inside the Equipment room with chemical dosing pumps tripping-interlock, thereby stopping the generator.
- ClO2 generator along with dosing skid shall be located in a well-ventilated building.
- Typical Safety equipment shall be provided as specified and as per system requirement
- The ClO2 generation system stops on no/very low dilution water flow condition.

C. Safety features (Interlock Protection) in the Process control

- Bulk storage tanks' (NaClO2 & HCl) very low level stops the dosing pumps, dry run pump protection.
- Interlock / Protection shall be there for single chemical pump running or dozing.
- Dilution water low flowrate trips the related skid.
- Either NaClO2 or HCl low flowrate will cause the tripping of the skid.
- Emergency push button of local control panel trips all the dosing skids.

4.3 DESIGN REQUIREMENTS

The minimum technical requirements equipment shall include, but not be limited to the following:

4.3.1 The Contractor shall offer only proven design in successful operation in similar application at previous installations. Design capacity of generator(s) for CW system & PT system shall meet requirement for ClO2 dozing for the total circulating water flow to maintain a free chlorine dioxide residual of at least 0.2 mg/l in the far reaches of the distribution system at all times. However, the minimum capacity of chlorine di-oxide plant(s) shall be as follows:
CW System - Shock dosing is proposed to be provided, which shall be done minimum 3 times a day (once per shift).

PT System - Continuous dosing is proposed to be provided.

No stand-by generator is proposed in ClO2 system for CW. However, stand-by equipment w.r.t pumps, tanks, piping & valves etc. shall be considered by Contractor. Chlorine-di-oxide dosing shall be provided at aerators, stilling chambers of PT systems. For controlling organics in circulating water system, ClO2 dosing may be provided in CW Forebay channel and/ or in Cooling tower

basins as per system requirement for disinfection and maintaining residual CLO2.

4.3.2 The chlorine di-oxide generators (Submerged / encapsulated type) shall ensure that the formation of the ClO2 solution takes place completely underwater and the reaction chamber shall be surrounded by water to avoid any ClO2 gas leak.

4.3.3 The ClO2 shall be generated in diluted solution of concentration of ≤ 1500 mg/l. The generator/ reactor shall have a yield of 90% or higher. For consumption of reagents, 90% yield should be considered. Provision for measuring the yield shall be provided.

4.3.4 The system shall also have necessary sampling valve for periodic measurement of concentration of CLO2 at the generator outlet to prove and monitor the conversion efficiency of CLO2 generator.

4.3.5 The design of chlorine dioxide system should include safety, handling of precursor chemicals viz NaClO2 and HCl, water source, chlorine dioxide distribution and physical location of all generation equipment & associated accessories.

4.3.6 The contractor must include all the necessary additional features, functions & equipment for safe & consistent operation of chlorine di-oxide system, as per national & international guidelines and safety requirements. Certifications/Statutory clearances from directorate of explosives or any other authorities; if any required, shall be obtained by the contractor.

4.3.7 Certifications/ Statutory clearances from directorate of explosives or any other authorities; if any required, shall be obtained by the contractor.

4.3.8 The ClO2 generation system shall have variable dosing rate of 10% to 100% of the design dosing rate or better.

4.3.9 To have optimum accuracy, the dosing pumps used shall be with powerful variable speed stepper motor with internal stroke speed control and have a minimum turn down ratio of 1:800 for precise control of ClO2 generation. Accuracy should be +/-1 % or better. Dosing pump should have LCD display to see the capacity set and alarms if any.

4.3.10 Dilution water pumps shall be equipped with suitable VFD to control the speed for varying the flow rate. Contractor shall provide neutralization system for HCl and NaClO2 and shall design the with all required accessories. Separate Neutralization pits for HCl and NaClO2 shall be provided.

4.3.11 Chemical preparation tanks with necessary agitation requirement shall be provided by bidder as required. After neutralization, the neutralized wastewater shall be pumped to DMP N-pit by bidder.

4.3.12 The bulk storage Tanks shall be provided with dyke wall of suitable height (minimum 500mm). The dyke area shall be provided with Acid proof lining. The Unloading Pumps area shall be provided with a kerb wall and the kerbed area shall also be provided with Acid proof lining. Suitable dyke wall/barrier shall also be given in between HCl & NaClO2 tanks to avoid any kind of mixing. Arrangements shall be made to transfer the chemical from one tank to another for greater flexibility & in case of leakage; provision shall be made to recycle the chemicals back to tanks from the dyke area for both chemicals (NaClO2 & HCl).

4.3.13 Bidder shall take full responsibility that all the materials and components of valves, pumps, piping and any other equipment and appurtenances shall be proven and compatible with the respective fluid therein.

4.3.14 ClO2 leak sensor with detector shall be installed inside the room. The least count of sensor shall be 0.1 ppm or better and the complete ClO2 generation system including the dosing pumps shall stop automatically. The ClO2 leak sensor shall be of reputed make with proven track record. Industrial type-high decibel hooters shall be provided for each of the ClO2 plants (PT & CW).

4.3.15 Air contact with chlorine dioxide solution should be controlled to limit the potential for explosive concentrations possibly building up within the reactor.

4.3.16 The skid MOC shall be of carbon steel with suitable painting/ coating having sufficient strength and rigidity to support the equipment contained in the skid.

4.3.17 The ClO2 generating system should be provided with all the necessary instrumentation and control system including necessary check points, measuring on-line instruments, sampling point to draw a sample of chlorine dioxide solution produced, control valves, interlock, trip facility and to be operated on fully auto mode through DDCMIS based system.

4.3.18 Each reaction chambers must have suitable flow transmitters to ensure uniform flow of chlorine dioxide into the water as per requirement and should have necessary isolation arrangement so that it can be handled safely for any maintenance, repair work or for inspection etc.

4.3.19 Separate Neutralization pits for HCL and NaCLO2 shall be provided. Discharge pumps (1W+1S) shall be provided by bidder in neutralization pit. Storage facility shall be provided for all neutralizing chemical within the plant. Chemical preparation tanks with necessary agitation requirement shall be provided by bidder.

4.3.20 Chlorine di oxide dosing system shall be located adjacent to the CW Forebay. Space available for Chlorine di oxide dosing system has been indicated in plot plan attached in Section-IA of this specification. Bidder to accommodate their equipment within the space provided. HCI and NaClO2 storage tank shall be located outdoor however dosing skids shall be located inside building. NaClO2 storage tanks shall kept under shed.

4.3.21 Any statutory requirement / clearance required for the packages from government / local body shall be in bidder's scope.

4.3.22 Bidder to design diffuser system to ensure proper mixing of CLO2 in Cooling tower basins and/ or in CW Forebay.

4.3.23 Bidder to design diffuser system to ensure proper mixing of CLO2 in PT plant dosing points.

4.3.24 Following controls shall be provided with the following instruments & controls as a minimum.

- pH in Chlorine dioxide solution dosing line.
- Residual chlorine dioxide (ClO2) analyzer.
- Flow meters on all chemical feed lines, dilution water lines, and chlorine dioxide solution lines.
- Pressure indicator & controller on the water inlet line to ClO2 generators, chlorine dioxide dosing controller, low vacuum switch, solenoid valves, etc., all complete and as required shall be provided.
- The dosing in inlet shall be automatically controlled based on the signal received from residual chlorine dioxide analyzer in the header.
- All chemical storage tanks shall have automatic high and low level cut off.
- Chlorine dioxide leak detection system.

4.3.25 In case of water supply to the generator stops, the chemical dosing pumps shall also stop automatically.

4.3.26 Generator must be equipped with systems of dosing and/ or measurement for reagents and diluting water. These systems must be able to shut down the operation of the generator in case any of the supplies is cut off.

4.3.27 Inhouse layout cum civil input drawing prepared by BHEL is enclosed with this technical specification. Bidder to follow the same and accommodate all the items within this layout. Sizes indicated of all the items are to be complied as a minimum requirement, bidder to design & select the items accordingly. Any hold marked in the layout drawing shall be released by the bidder during detailed engineering as per approved sizing calculation. Bidder to further develop the detailed layout and civil input drawing during detailed engineering, maintaining the details as indicated in attached drawing.

4.4 APPLICABLE CODES AND STANDARDS

The design, material, construction, manufacture, inspection, testing and performance of the chlorine-dioxide plant shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest editions of all standards and codes (along with all addenda), mentioned below and elsewhere in the specification. Nothing in this specification shall be construed to relieve the bidder of this responsibility.

- ASME Standards for various tests and materials.
- ASME – Boiler and Pressure Vessels Code Section VIII, Div.1 and sect. IX.
- ANSI B 16.5 Standard for Steel pipe flanges and flanged fittings.
- IS – 5120 – Technical requirement for Rotodynamic pumps.

- Chlorine Institute Manual of USA
- ASTM D 1784 and F 441 & F 439 - CPVC Pipe and Fittings.
- ASTM and BIS Specifications for CPVC, PP, FRP

4.5 VALVES

- All valves in Chemical dosing lines (Acid, Sodium chlorite, chlorine dioxide etc.,) shall be of industrial grade CPVC PN16 rating (minimum).
- Type of valves and material of construction for various other applications in the ClO2 plant shall be selected by the bidder as per its proven practice unless specified elsewhere. However, all the valves in contact with chlorine dioxide solution should be leak tight and preferably of diaphragm valves with Teflon diaphragm.

4.6 TERMINAL POINTS (also refer P&I Diagrams enclosed)

4.6.1 Service water (40 NB) - At 5-meter distance from chlorine di oxide dosing system area at 0.5 meters above FGL at end closer to pie rack/ pedestal. Further distribution piping is in bidder's scope.

4.6.2 Cooling (CW) water (200 NB) - At 5-meter distance from chlorine di oxide dosing system area at 0.5 meters above FGL at end closer to pipe rack/ pedestal for dilution water requirement for CW CLO2 dosing system. Further distribution piping is in bidder's scope.

4.6.3 Potable water for dilution water requirement for PT CLO2 dosing system shall be taken by bidder from PT CLO2 pumps feed pumps located in Filtered water storage tanks (Potable).

4.6.4 Instrument air (25 NB) - At 5-meter distance from chlorine di oxide dosing system area at 0.5 meters above FGL at end closer to pie rack/ pedestal. Further distribution piping is in bidder's scope.

4.6.5 Distance between Chlorine di oxide dosing area and CW forebay channel is 296 m and piping for the same is in bidder's scope. Further, Bidder to refer plot plan attached with this specification and consider additional piping distribution in side CW cooling tower basin and forebay as per dimension given elsewhere in this specification. Piping for ClO2 dosing from ClO2 area up to both cooling tower basins is also in bidder's scope, if CLO2 dosing is required in cooling tower basins, further distance shall be considered by bidder as per plot plan attached.

4.6.6 Distance between Chlorine di oxide dosing area and PT plant dosing location shall be 450 m. Piping for the same is in bidder's scope. Further distribution piping is in bidder's scope.

4.6.7 Distance between CW return header to residual ClO2 analyser located in CLO2 area for sampling shall be 325 meters for each cooling tower. Hence, total sampling Piping of 650-meter length is in bidder's scope. In case, sample required intermediate pressure boosting, then booster pumps (1W+1S) along with motor for each sampling system and all other accessories shall be provided by bidder. Pumps shall be complete with motor. Instrumentation, valves, fittings etc.

4.6.8 Neutralised waste transfer piping upto DM PLANT N PIT for HCL shall be in bidder's scope. Distance between Chlorine di oxide dosing area and N PIT is 620 m. Further distribution piping inside Chlorine di oxide dosing area is also in bidder's scope.

4.6.9 Neutralised waste transfer piping upto dm Plant N PIT for NaClO2 shall be in bidder's scope. Distance between Chlorine di oxide dosing area and N PIT is 620 m. Further distribution piping inside Chlorine di oxide dosing area is also in bidder's scope.

4.7 Provenness Requirements for Chlorine Di oxide Dosing system

Bidder/ Sub vendor has to meet following criteria w.r.t provenness during detailed engineering.

4.7.1 Bidder/ Sub vendor should have capabilities for design/ manufacture and having in-house/ out-sourced facility for testing of Chlorine Di oxide dosing System. Chlorine Di oxide dosing System should have minimum capacity of 45 kg/hr comprising of Chlorine Di oxide generator (s) and associated dosing system.

4.7.2 The supplier has to submit following supporting documents meeting above mentioned provenness requirement

a. Copy of minimum one (1) performance certificate in English from end user along with copy of related Purchase Order (PO) or letter of intent (LOI) or letter of award (LOA) or work order (WO) specifying that the system / package is running successfully for one (1) year from date of commissioning meeting the minimum pre-qualifying requirement as on date of BHEL's bid opening.

5. LIME DOSING SYSTEM

Lime dosing system is to be provided by bidder to dose lime solution in wastewater tank of FGD system to increase pH from acidic zone to neutral (or slightly basic pH) (i.e. from 5.3 to 7.0) and after mixing of the effluent (using agitator/ re-circulation system of the pumping system), the effluent shall be discharged once the waste water has been neutralized to desired pH. The lime dosing is envisaged to be done in wastewater tank continuously.

Lime powder is to be stored in sacks in storage room provided at the ground floor of Gypsum Dewatering Building. Lime powder is filled manually in surge hopper(s), which shall feed lime to vibrating feeders/ Bucket Elevators (Bucket conveyor). Bucket elevator discharges lime powder in lime silo, from where the lime powder is fed to neutralization tank via outlet chute/ pipe using rotary feeder and screw conveyor provided at the bottom of lime silo. The lime is being dissolved in service water inside neutralization tank with the help of the motorized agitator (provided in neutralization tank). The dilute solution of lime prepared in neutralization tank is then fed to the wastewater tank by means of lime slurry pumps (1W + 1SB - common for LDS). The dosing is controlled as per requirements of desired pH in wastewater. Lime dosing system shall be located indoor in GDW building.

REFERENCE DOCUMENTS

- **Datasheet A – Lime Dosing System**
- **P&I Diagram of Lime Dosing System**

5.1 SCOPE OF SUPPLY

BILL OF QUANTITY (SUPPLY)			
S. NO.	**ITEM DESCRIPTION**	**QTY.**	**UNIT**
1.	Surge Hopper	1	Nos.
2.	Vibrating Feeder	1	Nos.
3.	Continuous Discharge Twin Feed Type Bucket Elevator with standard components like buckets, belt, drive/ tail pulleys with shaft & bearing assemblies, middle/ top/ bottom casings, take up unit, drive base frame, drive unit- geared motor (IE3), chain for final power transmission, zero speed switch, complete along with all accessories, 2-way (motorised) Diverter Flap Gate, interconnecting flanges/ chutes, hardware & gaskets.	1	Nos.
4.	Lime Silos (MS with SS 304 lining on conical portion) complete with supporting steel structure, platforms, ladders, railings, level switches, air relief devices, aeration pads/ flexible vibro pads/ electro-magnetic vibrators (for conical portion of silo) along with all accessories, interconnecting flanges/ chutes, hardware & gaskets.	2	Nos.
5.	Self-cleaning Bag Filter System of suitable capacity along with blowers, automatic/ on-load cleaning system.	2	Set
6.	Manual Knife Gates with interconnecting flanges, hardware & gaskets.	2	Nos.
7.	Motorized knife Gates along with accessories, interconnecting flanges, hardware & gaskets.	2	Nos.
8.	Rotary vane feeders/ Rotary air lock feeders (MOC –Stainless Steel) along with motor (IE3), interconnecting flanges, hardware & gaskets.	2	Nos.

9.	Screw Conveyors complete with screw flight with pipe, trough, end plates, inlet/outlet standard chutes, end shafts with bearings & plumber blocks, drive base frame, dust seals, drive geared motor (IE3), output coupling, zero speed switch, with interconnecting flanges, hardware & gaskets along with all accessories.	2	Set
10.	Neutralisation Tanks (MSRL) with SS dissolving basket, drain, manholes and all necessary arrangement/ nozzles.	2	Nos.
11.	Agitators of SS construction with motor/ reduction gear and its mounting arrangement.	2	Nos.
12.	Lime Slurry Dosing Pumps along with motor (IE3).	2	Set
13.	Complete interconnected piping (slurry, air and water pipes) along with valves, rubber lining (wherever applicable), supports, gaskets, fasteners and accessories which is integral to Lime Feeding/ Dosing system - Process water piping from TP outside building to neutralisation tanks along with overflow and drain piping of tanks, back-flushing pipeline along with valves, fittings.	1	Set
14.	Complete interconnected piping (slurry, air and water pipes) along with valves, rubber lining (wherever applicable), supports, gaskets, fasteners and accessories which is integral to Lime Feeding/ Dosing system - Lime slurry piping from Neutralization Tanks to dosing pumps inlet & from feeding/ dosing pumps outlet to Waste water tank inlet along with re-circulation line with all required valves, fittings.	1	Set
15.	Complete interconnected piping (slurry, air and water pipes) along with valves, rubber lining (wherever applicable), supports, gaskets, fasteners and accessories which is integral to Lime Feeding/ Dosing system - All Interconnecting pipe/ ducts, valves and all chutes (Instrument air, water line, slurry lines).	1	Set
16.	Complete interconnected piping (slurry, air and water pipes) along with valves, rubber lining (wherever applicable), supports, gaskets, fasteners and accessories which is integral to Lime Feeding/ Dosing system - Instrument air piping from TP outside building unto equipment related to the system.	1	Set
17.	Supporting steel structure, platforms, ladders, railings, and holdback as applicable along with all accessories and necessary hardware for complete Lime Feeding/ Dosing System.	1	Set
18.	Complete instruments associated with equipment and integral piping for Lime Feeding/ Dosing system as per P&ID.	1	Set
19.	Special tools & Tackles/ Erection and start-up/ commissioning spares	1	Set

All piping, valves & instrumentation up to the employer's terminal point shall be in the bidder's scope. Supply of complete lime storage, feeding & dosing system shall be in supplier's scope. The complete waste water neutralization system shall be automated and controlled from the control room (DCS control system-by BHEL).

Bidder shall provide complete Instrumentation along with necessary fittings, accessories and valve manifold etc. for control, monitoring and operation of entire LDS except marked as BHEL's scope in P&ID attached in specification.

5.2 DESIGN REQUIREMENTS

Bidder to note that design requirement of the chemical dosing skids shall be as below: -

a) In addition to the requirements of Section-I & II the following shall also be complied under scope

of this specification: The P&ID is enclosed herein in this section for bidder's compliance.

b) The material of construction specified in Data Sheet - A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subjects to Customer/ BHEL approval during detailed engineering.
c) All instrument-wetted parts will be suitable for requested application.
d) All high points on any, tanks, pumps, piping or instrumentation will be vented and provided with valve. All low points on any, tanks, pumps, piping or instruments will be drained and provided with valve.
e) Stuffing box shall be provided for mounting the agitator to avoid air ingress.
f) Vent/ overflow pipe from tank shall at least reach the bottom half of the breather/ water seal/ CO_2 absorber.
g) Step ladder and chemical charging platform shall be provided for easy access to top of tank.
h) All tanks/ pumps shall have name plate clearly indicating the equipment name.
i) Pipe fittings of the system shall be done using elbows and tees. Pipe bending is not acceptable.
j) All equipment shall have SS name plate.
k) Energy efficient level IE3 LT Motors shall be provided by the bidder.
l) All the terminal points where flange joints are involved, bidder shall terminate it along with matching counter flange, nuts, bolts, gaskets etc.
m) KKS codes for all drives and instruments for the project have to be followed.
n) All the instruments/ equipment/ electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply.

5.3 TERMINAL POINTS

a) Process water & instrument air will be provided at one location, located at 5 m from building boundary. Further piping from terminal point to LDS system utilities are in bidder's scope.
b) Inlet at Lime feeding surge hopper.
c) Lime dosing inlet flange of waste water tank.

6. SEWAGE TREATMENT PLANT (STP)

Complete Sewage Treatment Plant for facilities within the plant is in bidder's scope. Bidder shall provide 'De-centralized Sewage Treatment' units. The capacity of the Decentralized Sewage Treatment' units should be as per the design requirements, subject to minimum combined capacity of 75 Cum/day. Design of Sewage treatment plant shall be as per CPHEEO manual. Primary, Secondary and Tertiary treatment to be provided. Treated sewage water shall be used for horticulture purpose as per quality requirement of CPHEEO manual.

Bidder shall have to provide complete arrangement for sewage disposal up to the sewage treatment plant including pumping facilities.

REFERENCE DOCUMENTS

A. DATASHEET-A
B. PROCESS FLOW DIAGRAM
C. PLOT PLAN

6.1 SCOPE OF SUPPLY FOR SEWAGE TREATMENT PLANT

6.1.1 SCOPE OF SUPPLY (MECHANICAL) for de-centralised sewage treatment plant -1 (near SWITCH YARD area)

6.1.1.1 One no.(1W) coarse bar screen in S1 sewage sump (Outside STP area).

6.1.1.2 One no. (1W) of sewage sump S1 below ground (RCC work in BHEL scope) along with valves, piping, fittings, instruments and required accessories.

6.1.1.3 Two (2) nos. (1W+1S) submersible grinding type sewage transfer pumps for sewage sump (S1) complete with all instrumentation, valves, piping, fittings, motor and other accessories.

6.1.1.4 One no.(1W) coarse bar screen in S4 sewage sump (Outside STP area).

6.1.1.5 One no. (1W) of sewage sump S4 below ground (RCC work in BHEL scope) along with valves, piping, fittings, instruments and required accessories.

6.1.1.6 Two (2) nos. (1W+1S) submersible grinding type sewage transfer pumps for sewage sump (S4) complete with all instrumentation, valves, piping, fittings, motor and other accessories.

6.1.1.7 One (1) no. Of bar screen chamber (RCC work in BHEL scope) along with valves, piping, fittings, instruments and required accessories located inside STP area.

6.1.1.8 One (1) nos.(1W) coarse bar screen in bar screen chamber (RCC work in BHEL scope) along with, fittings, isolation gates and required accessories.

6.1.1.9 One (1) no. (1W) of oil & grease chamber (RCC work in BHEL scope) along oil skimmer, oil collection tank, instruments, fittings, valves and required accessories.

6.1.1.10 One (1) nos. (1W) De-centralised STP module is required along with valves, pipes, fittings, instruments and required accessories

6.1.1.11 Two (2) nos. (1W+1S) sludge recirculation pumps for STP Skid complete with all instrumentation, valves, piping, motor, etc., if required as per supplier recommendation.

6.1.1.12 Two (2) nos. (1W+1S) oil free type air blowers with piping, instrumentation, valves, fittings, air diffusers, electric motor drives for supplying air required for STP skid, if required as per supplier recommendation. 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.

6.1.1.13 One (1) no. filter feed tank for effluent storage after treatment in STP skid along with valves, piping, fittings, instruments and required accessories.

6.1.1.14 Two (2) nos. (1W+1S) filter feed pumps complete with all instrumentation, valves, piping, motor, etc. for feeding water to multi grade filter & activated carbon filter for tertiary treatment.

6.1.1.15 One no. (1W) (1x100%) multi grade filter along with filter media, media, trap piping, valves, electrically operated multiport valve, backwashing arrangement, fittings, instrumentation and accessories associated with automatic backwash arrangement.

6.1.1.16 One (1) no. (1W) (1x100%) Activated Carbon filter along with filter media, media, trap piping, valves, electrically operated multiport valve, fittings, instrumentation and accessories associated with automatic backwash arrangement.

6.1.1.17 One (1) no. (1W) sodium hypochlorite dosing tank for dosing chemical to treated water storage tank feed line, complete with valve, fittings, instrumentation and accessories.

6.1.1.18 Two (2) (1W+1S) no. Electronic type Sodium hypochlorite dosing pump with auto stroke controller complete with all instrumentation and accessories, valves, piping, motor, etc.

6.1.1.19 One (1) no. treated water tank for effluent storage after tertiary treatment along with valves, piping, fittings, instruments and required accessories.

6.1.1.20 Two (2) nos. (1W+1S) treated water disposal pumps for treated water tank complete with all instrumentation, valves, motor, piping and required accessories etc.

6.1.1.21 50-meter hose pipe from treated water disposal pumps for STP shall be provided by bidder for horticulture purpose.

6.1.1.22 All sewage transfer piping from sewage sump up to Sewage treatment plant shall be routed on pedestals/ buried. Wrapping, coating and protection of all the buried pipe is also in bidder's scope & shall be as per AWWA C 203. However, all auxiliary steel structure (U-clamps, nuts, bolts, channels etc.) for fixing pipes on pedestal shall be in bidder's scope. Inputs for pipe pedestals as per requirement and layout shall be furnished.

6.1.1.23 Bidder to take care of the length of piping as included elsewhere in the technical specification. Pipe routings shall be decided during detailed engineering.

6.1.1.24 All necessary drains, vents, breathers, CO2 absorbers, seal pots, fume absorbers and sampling points with valves as specified and as required are in bidder's scope.

6.1.1.25 Any statutory requirement / clearance required from government / local body shall be in bidder's scope. Bidder to also comply local body / government norms.

6.1.1.26 All Valve, piping, fitting, and instrument shall be of minimum PN 10/ 150 class rating.

6.1.1.27 Initial charge of all lubricants & grease in bidder's scope.

6.1.1.28 Diaphragm seal for instruments shall be provided by bidder as per technical requirement.

6.1.1.29 One (1) no. Chain Pulley Block with tripod arrangement of adequate capacity, to meet the erection and maintenance requirements shall be provided by bidder.

6.1.2 SCOPE OF SUPPLY (MECHANICAL) for de-centralised sewage treatment plant -2 (near WTP area)

6.1.2.1 One no.(1W) coarse bar screen in S2 sewage sump (Outside STP area).

6.1.2.2 One no. (1W) of sewage sump S2 below ground (RCC work in BHEL scope) along with valves, piping, fittings, instruments and required accessories.

6.1.2.3 Two (2) nos. (1W+1S) submersible grinding type sewage transfer pumps for sewage sump (S2) complete with all instrumentation, valves, piping, fittings, motor and other accessories.

6.1.2.4 One no.(1W) coarse bar screen in S3 sewage sump (Outside STP area).

6.1.2.5 One no. (1W) of sewage sump S3 below ground (RCC work in BHEL scope) along with valves, piping, fittings, instruments and required accessories.

6.1.2.6 Two (2) nos. (1W+1S) submersible grinding type sewage transfer pumps for sewage sump (S3) complete with all instrumentation, valves, piping, fittings, motor and other accessories.

6.1.2.7 One no.(1W) coarse bar screen in S5 sewage sump (Outside STP area).

6.1.2.8 One no. (1W) of sewage sump S5 below ground (RCC work in BHEL scope) along with valves, piping, fittings, instruments and required accessories.

6.1.2.9 Two (2) nos. (1W+1S) submersible grinding type sewage transfer pumps for sewage sump (S5) complete with all instrumentation, valves, piping, fittings, motor and other accessories.

6.1.2.10 One (1) no. Of bar screen chamber (RCC work in BHEL scope) along with valves, piping, fittings, instruments and required accessories located inside STP area.

6.1.2.11 One (1) nos.(1W) coarse bar screen in bar screen chamber (RCC work in BHEL scope) along with, fittings, isolation gates and required accessories.

6.1.2.12 One (1) no. (1W) of oil & grease chamber (RCC work in BHEL scope) along oil skimmer, oil collection tank, instruments, fittings, valves and required accessories.

6.1.2.13 One (1) nos. (1W) De-centralised STP module is required along with valves, pipes, fittings, instruments and required accessories.

6.1.2.14 Two (2) nos. (1W+1S) sludge recirculation pumps for STP Skid complete with all instrumentation, valves, piping, motor, etc., if required as per supplier recommendation.

6.1.2.15 Two (2) nos. (1W+1S) oil free type air blowers with piping, instrumentation, valves, fittings, air diffusers, electric motor drives for supplying air required for STP skid, if required as per supplier recommendation. 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.

6.1.2.16 One (1) no. filter feed tank for effluent storage after treatment in STP skid along with valves, piping, fittings, instruments and required accessories.

6.1.2.17 Two (2) nos. (1W+1S) filter feed pumps complete with all instrumentation, valves, piping, motor, etc. for feeding water to multi grade filter & activated carbon filter for tertiary treatment.

6.1.2.18 One no. (1W) (1x100%) multi grade filter along with filter media, media, trap piping, valves, electrically operated multiport valve, fittings, instrumentation and accessories associated with automatic backwash arrangement.

6.1.2.19 One (1) no. (1W) (1x100%) Activated Carbon filter along with filter media, media, trap piping, valves, electrically operated multiport valve, fittings, instrumentation and accessories associated with automatic backwash arrangement.

6.1.2.20 One (1) no. (1W) sodium hypochlorite dosing tank for dosing chemical to treated water storage tank feed line, complete with valve, fittings, instrumentation and accessories.

6.1.2.21 Two (2) (1W+1S) no. Electronic type Sodium hypochlorite dosing pump with auto stroke controller complete with all instrumentation and accessories, valves, piping, motor, etc.

6.1.2.22 One (1) no. treated water tank for effluent storage after tertiary treatment along with valves, piping, fittings, instruments and required accessories.

6.1.2.23 Two (2) nos. (1W+1S) treated water disposal pumps for treated water tank complete with all instrumentation, valves, motor, piping and required accessories etc.

6.1.2.24 50-meter hose pipe from treated water disposal pumps for STP shall be provided by bidder for horticulture purpose.

6.1.2.25 All sewage transfer piping from sewage sump up to Sewage treatment plant shall be routed on pedestals/ buried. Wrapping, coating and protection of all the buried pipe is also in bidder's scope & shall be as per AWWA C 203. However, all auxiliary steel structure (U-clamps, nuts, bolts, channels etc.) for fixing pipes on pedestal shall be in bidder's scope. Inputs for pipe pedestals as per requirement and layout shall be furnished.

6.1.2.26 Bidder to take care of the length of piping as included elsewhere in the technical specification. Pipe routings shall be decided during detailed engineering.

6.1.2.27 All necessary drains, vents, breathers, CO2 absorbers, seal pots, fume absorbers and sampling points with valves as specified and as required are in bidder's scope.

6.1.2.28 Any statutory requirement / clearance required from government / local body shall be in bidder's scope. Bidder to also comply

6.1.2.29 All Valve, piping, fitting, and instrument shall be of minimum PN 10/ 150 class rating.

6.1.2.30 Initial charge of all lubricants & grease in bidder's scope.

6.1.2.31 Diaphragm seal for instruments shall be provided by bidder as per technical requirement.

6.1.2.32 One (1) no. Chain Pulley Block with tripod arrangement of adequate capacity, to meet the erection and maintenance requirements shall be provided by bidder.

6.1.3 SCOPE OF SUPPLY (MECHANICAL) for de-centralised sewage treatment plant -3 (near CHP area)

6.1.3.1 One no.(1W) coarse bar screen in S6 sewage sump (Outside STP area).

6.1.3.2 One no. (1W) of sewage sump S6 below ground (RCC work in BHEL scope) along with valves, piping, fittings, instruments and required accessories.

6.1.3.3 Two (2) nos. (1W+1S) submersible grinding type sewage transfer pumps for sewage sump (S6) complete with all instrumentation, valves, piping, fittings, motor and other accessories.

6.1.3.4 One (1) no. Of bar screen chamber (RCC work in BHEL scope) along with valves, piping, fittings, instruments and required accessories located inside STP area.

6.1.3.5 One (1) nos.(1W) coarse bar screen in bar screen chamber (RCC work in BHEL scope) along with, fittings, isolation gates and required accessories.

6.1.3.6 One (1) no. (1W) of oil & grease chamber (RCC work in BHEL scope) along oil skimmer, oil collection tank, instruments, fittings, valves and required accessories.

6.1.3.7 One (1) nos. (1W) De-centralised STP module is required along with valves, pipes, fittings, instruments and required accessories.

6.1.3.8 Two (2) nos. (1W+1S) sludge recirculation pumps for STP Skid complete with all instrumentation, valves, piping, motor, etc., if required as per supplier recommendation.

6.1.3.9 Two (2) nos. (1W+1S) oil free type air blowers with piping, instrumentation, valves, fittings, air diffusers, electric motor drives for supplying air required for STP skid, if required as per supplier recommendation. 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.

6.1.3.10 One (1) no. filter feed tank for effluent storage after treatment in STP skid along with valves, piping, fittings, instruments and required accessories.

6.1.3.11 Two (2) nos. (1W+1S) filter feed pumps complete with all instrumentation, valves, piping, motor, etc. for feeding water to multi grade filter & activated carbon filter for tertiary treatment.

6.1.3.12 One no. (1W) (1x100%) multi grade filter along with filter media, media, trap piping, valves, electrically operated multiport valve, fittings, instrumentation and accessories associated with automatic backwash arrangement.

6.1.3.13 One (1) no. (1W) (1x100%) Activated Carbon filter along with filter media, media, trap piping, valves, electrically operated multiport valve, fittings, instrumentation and accessories associated with automatic backwash arrangement.

6.1.3.14 One (1) no. (1W) sodium hypochlorite dosing tank for dosing chemical to treated water storage tank feed line, complete with valve, fittings, instrumentation and accessories.

6.1.3.15 Two (2) (1W+1S) no. Electronic type Sodium hypochlorite dosing pump with auto stroke controller complete with all instrumentation and accessories, valves, piping, motor, etc.

6.1.3.16 One (1) no. treated water tank for effluent storage after tertiary treatment along with valves, piping, fittings, instruments and required accessories.

6.1.3.17 Two (2) nos. (1W+1S) treated water disposal pumps for treated water tank complete with all instrumentation, valves, motor, piping and required accessories etc.

6.1.3.18 50-meter hose pipe from treated water disposal pumps for STP shall be provided by bidder for horticulture purpose.

6.1.3.19 All sewage transfer piping from sewage sump up to Sewage treatment plant shall be routed on pedestals/ buried. Wrapping, coating and protection of all the buried pipe is also in bidder's scope & shall be as per AWWA C 203. However, all auxiliary steel structure (U-clamps, nuts, bolts, channels etc.) for fixing pipes on pedestal shall be in bidder's scope. Inputs for pipe pedestals as per requirement and layout shall be furnished.

6.1.3.20 Bidder to take care of the length of piping as included elsewhere in the technical specification. Pipe routings shall be decided during detailed engineering.

6.1.3.21 All necessary drains, vents, breathers, CO_2 absorbers, seal pots, fume absorbers and sampling points with valves as specified and as required are in bidder's scope.

6.1.3.22 Any statutory requirement / clearance required from government / local body shall be in bidder's scope. Bidder to also comply local body / government norms.

6.1.3.23 All Valve, piping, fitting, and instrument shall be of minimum PN 10/ 150 class rating.

6.1.3.24 Initial charge of all lubricants & grease in bidder's scope.

6.1.3.25 Diaphragm seal for instruments shall be provided by bidder as per technical requirement.

6.1.3.26 One (1) no. Chain Pulley Block with tripod arrangement of adequate capacity, to meet the erection and maintenance requirements shall be provided by bidder.

6.2 TERMINAL POINTS

- Service water connection (40 NB connections) at 5-meter distance from all three sewage treatments plants area battery limit. however, distribution and piping inside STP area shall be in bidder's scope.
- Potable water connection (40 NB connections) at 5-meter distance from all three sewage treatments plants area battery limit. however, distribution and piping inside STP area shall be in bidder's scope.

6.3 PIPING

a) Complete piping of Sewage treatment plant is in bidder's scope of supply and erection. In addition, any additional piping required to make the system complete inside STP area shall be in bidder's scope. Pipe length inside STP area has to be considered by bidder in their scope as per layout. The below indicated pipes shall be designed, supplied, erected, laid and tested by the bidder. Elbows, tees, flanges, counter flanges, Hangers and supports etc. required for the below given piping shall also be provided by the bidder.

b) Pipe distances are given below:

SL. NO.	FROM	TO	DISTANCE (In meters)
1.	Sewage sump (S1)	STP -1	375
2.	Sewage sump (S4)	STP -1	720
3.	Sewage sump (S2)	STP -2	520
4.	Sewage sump (S3)	STP -2	65
5.	Sewage sump (S5)	STP -2	700
6.	Sewage sump (S6)	STP -3	60
7.	STP-1 Area	Nearest Drain	20
8.	STP-2 Area	Nearest Drain	20
9.	STP-3 Area	Nearest Drain	20

Sewage sump, S1, S2, S3. S4, S5 & S6 shall be located outside STP area however rest facilities of STP shall be located inside STP area provided in plot plan included in this specification.

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

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

6.4 OPERATION AND CONTROL

Control of Complete Sewage treatment plant along with sewage lifting sumps located outside STP area shall be from DDCMIS (DCS) based control system. DDCMIS (DCS) shall be in BHEL scope.
The control philosophy of system is described below. Basic process related interlocks, alarms/ prewarning signals are to be implemented in the control system as per system requirement.

a) Among the equipment, it shall be possible to select a specific pump or tank or sump for working/ standby/ maintenance etc. through control system.
b) Permissive & Interlocks:

- Starting & tripping of pumps with respect to liquid level in the respective sump/ tanks or liquid pressure in the suction lines.
- Tripping of pumps when the discharge pressure is very high to avoid operation of the pump under shutoff head.
- Stopping/ tripping of equipment due to abnormal parameters related to safety of equipment like high vibration, very high bearing lubrication water (and /or oil) temperature to the drive/pumps, very high bearing temperature of the of pump/drive etc. as applicable based on the recommendations of Equipment Supplier.
- Automatic starting of standby pumps upon failure of starting of selected pump or tripping of running pump as the case may be.
- Various annunciations related to low level of the chemical tanks & sumps shall be provided.

c) Alarms/ signals:

- Abnormal parameters such as low & high level in tanks/sumps, high pressure at pump discharge, low header pressure, low lubrication water flow to pumps (provided with forced water lubrication system) etc.
- Failure of starting of equipment such as pumps, blowers etc. upon start command.
- Tripping of equipment due to protection logic.
- In addition, the control system shall facilitate the operator to know the status of various equipment (Whether equipment is running or stopped or tripped etc., whether the equipment is selected for operation/ standby duty /maintenance mode etc. as the case may be).

7. EFFLUENT TREATMENT PLANT (ETP OR LET)

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

REFERENCE DOCUMENTS

A. DATASHEET-A
B. P & ID OF ETP
C. PLOT PLAN

7.1 SCOPE OF SUPPLY EFFLUENT TREATMENT PLANT

7.1.1 Two (2) nos. (1W+1S) TRANSFORMER YARD UNIT-1 OILY WASTE TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling etc.
7.1.2 Two (2) nos. (1W+1S) TRANSFORMER YARD UNIT-2 OILY WASTE TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling etc.
7.1.3 Two (2) nos. (1W+1S) TG UNIT-1A WASTE WATER TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling etc.
7.1.4 Two (2) nos. (1W+1S) TG UNIT-1B WASTE WATER TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling etc.
7.1.5 Two (2) nos. (1W+1S) TG UNIT-2A WASTE WATER TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling etc.
7.1.6 Two (2) nos. (1W+1S) TG UNIT-2B WASTE WATER TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling etc.
7.1.7 Two (2) nos. Portable type Belt type Oil Skimmers complete with all instrumentation, valve, piping, fittings etc., along with two (2) nos. MS oil drum of 200 litre capacity.
7.1.8 Two (2) nos. (1W+1S) MRS UNIT-1 WASTE WATER TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling etc.
7.1.9 Two (2) nos. (1W+1S) MRS UNIT-2 WASTE WATER TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling etc.
7.1.10 Two (2) nos. (1W+1S) ESP UNIT-1 WASTE WATER TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling, re-circulation line, etc.
7.1.11 Two (2) nos. (1W+1S) ESP UNIT-2 WASTE WATER TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling, re-circulation line etc.
7.1.12 Two (2) nos. (1W+1S) SG UNIT-1 WASTE WATER TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling, re-circulation line etc.
7.1.13 Two (2) nos. (1W+1S) SG UNIT-2 WASTE WATER TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling, re-circulation line etc.
7.1.14 Two (2) nos. (1W+1S) COT/DOT WASTE WATER TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling, re-circulation line etc.
7.1.15 Two (2) nos. (2W) trolley mounted TROLLEY MOUNTED SCREW PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling, hose pipe, slope oil tank, etc.
7.1.16 One (1) no. WASTE SERVICE WATER SUMP (in twin section, CIVIL WORK by BHEL including RCC) with common inlet and outlet chamber interconnected through isolation gates (in bidder's scope).
7.1.17 Three (3) nos. (2W+1S) WASTE SERVICE WATER SUMP (WSWS) TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling, re-circulation line for full flow, etc.
7.1.18 Two (2) nos. (2W) Drum type Oil Skimmers each complete with all instrumentation, valve, piping, fittings etc., along with MS oil drum of 200 litre capacity.
7.1.19 Two (2) nos. trolley mounted portable oil Centrifuge complete with all accessories as required.

7.1.20 Two (2) nos. (1W+1S) LAMELLA CLARIFIER/TUBE SETTLER (RCC Works by BHEL) each complete with flocculation tank, flash mixer, fittings, media, plate packs and all accessories.

7.1.21 One (1) no. CENTRAL MONITORING BASIN (in twin section, CIVIL WORK by BHEL including RCC) with common inlet and outlet chamber interconnected through isolation gates (in bidder's scope).

7.1.22 Three (3) nos. (2W+1S) CENTRAL MONITORING BASIN (CMB) TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling, re-circulation line for full flow etc.

7.1.23 Sludge disposal system from Lamella clarifiers with piping, valves, up to sludge sump as indicated in P & ID of Effluent Treatment Plant.

7.1.24 One (1) no. SLUDGE SUMP (in twin section, RCC by BHEL) with common inlet and outlet chamber interconnected through isolation gates (in bidder's scope).

7.1.25 Two (2) nos (1W+1S) Air blowers of oil free type of required capacity, its drives and associated accessories, air piping from blowers to SLUDGE SUMP for air scouring.

7.1.26 Two (2) nos. (1W+1S) SLUDGE SUMP TRANSFER PUMPS complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling etc.

7.1.27 Two (2) nos. RCC lime dosing tank (CIVIL WORK by BHEL including RCC) for Lamella clarifier / tube settler including basket strainer, slow speed gear operated agitator driven by motor complete with overflow seal, integral pipe works, valves, instrumentation and all other accessories required.

7.1.28 Two (2) (1W+1S) nos. pumps of Horizontal Screw type suitable for dosing lime in Lamella Clarifier at design dosage rate specified and head as required. Pumps shall be provided with accessories such as Y-type suction strainers, pressure dampeners, safety relief valves, re-circulation line etc. for lamella clarifier / tube settler.

7.1.29 Two (2) nos. RCC alum dosing tank (CIVIL WORK by BHEL including RCC) for Lamella clarifier / tube settler including basket strainer, slow speed gear operated agitator driven by motor complete with overflow seal, integral pipe works, valves, instrumentation and all other accessories required.

7.1.30 Two (2) (1W+1S) nos. pumps of positive displacement type suitable for dosing alum in Lamella Clarifier at design dosage rate specified and head as required. Pumps shall be provided with accessories such as Y-type suction strainers, pressure dampeners, safety relief valves etc. for lamella clarifier / tube settler.

7.1.31 Two (2) nos. RCC service water overhead tank (CIVIL WORK by BHEL including RCC) complete with integral pipe works, valves, instrumentation and all other accessories required.

7.1.32 Two (2) nos. (1W+1S) flushing pumps complete with all instrumentation, valves, piping, fittings, motor, base plate, coupling etc.

7.1.33 Two sets of safety equipment each comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided by the bidder. Near chemical area, the bidder shall provide one nos. personnel drench safety shower and eye fountains.

7.1.34 Instrumentation, valves etc. indicated in P & ID of effluent treatment plant are bare minimum requirement; however, bidder has to provide complete system for trouble free operation meeting technical specification requirement.

7.1.35 Effluent lifting sumps, E1A, E1B, E1C, E2A, E2B, E3, E4, E5, E6, E7, E8, E9, E10, E11, E15 AND E16 shall be located outside ETP area. However, rest facilities indicated in P & ID of ETP shall be located inside ETP area provided in plot plan included in this specification.

7.1.36 One (1) Electric hoist of capacity of 1 ton to be installed in Chemical shed.

7.1.37 Chain pulley block as per specification requirement.

7.2 TERMINAL POINTS

7.2.1 Service water line (40 NB) will be provided by BHEL at 5 m distance from ETP area. Further distribution inside ETP area will be in bidder's scope. Bidder to note that pressure available at terminal point for service water will be 2 kg/cm2 approx. (max.); hence bidder will take care for their pump lubrication / cooling accordingly.

7.2.2 Instrument air pipe (25 NB) will be provided by BHEL at 5 m distance from ETP area. Further

distribution inside ETP area will be in bidder's scope.

7.2.3 Service air pipe (25 NB) will be provided by BHEL at 5 m distance from ETP area. Further distribution inside ETP area will be in bidder's scope.

7.2.4 Cooling Tower blow down (300 NB) shall be terminated by BHEL at 5 m distance from ETP area. Further piping to Central Monitoring Basin shall be in bidder's scope.

7.2.5 Potable Water line (40 NB) will be provided by BHEL at 5 m distance from ETP area. Further distribution inside ETP area will be in bidder's scope.

7.3 PIPING

7.3.1 Complete piping indicated in P & ID of Effluent treatment plant is in bidder's scope of supply and erection. In addition, any additional piping required to make the system complete inside ETP area shall be in bidder's scope. Pipe length inside ETP area has to be considered by bidder in their scope suitably.

7.3.2 Pipe distances from sumps outside ETP area up to inside ETP area and inside ETP area to respective location have been listed below. Bidder to note that no commercial settlement / adjustment shall be entertained for variation upto +/- 10% of pipe lengths during detailed engineering.

S. No.	Piping From	Piping To	Distance to be considered in Bidder's scope for supply (in Meters)
1.	COT/DOT PIT	TG Unit-1B Floor Wash Water Sump	144
2.	Transformer Yard Oily Waste Sump Unit-2	Node 1 (As indicated in P&ID)	203
3.	Transformer Yard Oily Waste Sump Unit-1	Node 1 (As indicated in P&ID)	70
4.	Node 1 (As indicated in P&ID)	ETP AREA	1445
5.	TG Unit-1A Floor Wash Water Sump	NODE 2 (As indicated in P&ID)	112
6.	NODE 2 (As indicated in P&ID)	ETP AREA	1103
7.	TG Unit-1B Floor Wash Water Sump	NODE 2 (As indicated in P&ID)	51
8.	TG Unit-2A Floor Wash Water Sump	NODE 3 (As indicated in P&ID)	51
9.	TG Unit-2B Floor Wash Water Sump	NODE 4 (As indicated in P&ID)	51
10.	MRS Waste Water Sump Unit-2	TP-18 / CHP Area	456
11.	MRS Waste Water Sump Unit-1	Node 5 (As indicated in P&ID)	77
12.	ESP Unit-2 Floor Wash Water Sump	Ash Slurry Sump Unit-2	93
13.	ESP Unit-1 Floor Wash Water Sump	Ash Slurry Sump Unit-1	72
14.	SG Unit-2 Floor Wash Water Sump	Ash Slurry Sump Unit-2	174
15.	SG Unit-1 Floor Wash Water Sump	Ash Slurry Sump Unit-1	135
16.	Sludge Sump	PT Plant Sludge Sump	545

17.	Central Monitoring Basin (CMB) in ETP Area	Ash Handling Plant	1090
18.	Central Monitoring Basin (CMB) in ETP Area	Future Use	10
19.	Central Monitoring Basin (CMB) in ETP Area	Service Water Pump House	393

Distances given are from one area to other area only, however inside piping in respective area shall be in bidder's scope which has to be suitably consider by bidder as additional.

7.3.3 Isolation gates as per P & ID enclosed.
7.3.4 Bidder to adhere Format of operation and maintenance manual requirement as per Annexure VIII during detailed engineering.
7.3.5 Bidder to adhere packaging requirements as per Annexure VII during detailed engineering.
7.3.6 Bidder to refer Plot plan as per Annexure IX. Location of effluent sumps is located in plot plan along with tentative routing for bidder's information.
7.3.7 Bidder to refer Annexure III for Functional / performance / demonstration guarantee requirements.
7.3.8 Bidder to refer Annexure VI for water analysis.
7.3.9 Sumps E1A, E1B, E1C, E2A, E2B, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13 E14, E15 AND E16 (RCC work by BHEL) along with piping, valves, fittings, instrumentation and associated accessories.
7.3.10 Bidder to refer datasheet A for technical requirements.

7.4 DESIGN/ CONSTRUCTION REQUIREMENTS

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

7.4.1 Minimum thickness of 6 mm shall be provided for Atmospheric Tanks and Pressure Vessels.
7.4.2 For all pumps, while calculating the pump head, 10% margin shall be considered on friction losses.
7.4.3 The overflow & drains from the various chemical tanks and floor wash drains shall be led to the sludge sump.
7.4.4 Hydraulics of the Effluent Treatment Plant shall be such as to take an occasional overloading of 20% of the
7.4.5 design flow rate.
7.4.6 Maximum operating speed of all the pumps and blowers shall be limited to 1500 rpm or less unless specified otherwise
7.4.7 All the tanks shall be provided with vent, overflow, drain and sample connections. Effective capacity for chemical tanks & water retaining structures/ tanks/sumps means the capacity between the bottoms of the overflow nozzle to the top of the outlet nozzle. Outlet nozzle center line shall be kept at least 200 mm from the Invert Level of the Chemical tanks /Water retaining structures /Tanks/Sumps. A minimum free board of 300 mm shall be provided in all the water retaining structures of Effluent treatment plant above the maximum water level at design flow condition/overflow level.
7.4.8 Depth of ETP sump may vary from 2 to 4 meters.
7.4.9 Span for Max. support length for MS/CS pipes shall be as per ANSI B31.1.
7.4.10 Cranes and Hoist should be sized to handle heaviest component to be handled with 25% margin (with minimum capacity if specifically indicated elsewhere for any system/equipment) and should comply to IS:3177/ IS:3938 (as applicable).
7.4.11 Unless specifically mentioned, design criteria of piping, valves, rubber expansion, should be as per sub section LP Piping.
7.4.12 Painting requirement shall be as per Painting Specification unless otherwise specified.

7.4.13 **Tube Settlers/ Lamella Clarifiers**

a. The tube settler/Lamella Clarifier (counter flow or cross flow type) with flash mixer and Flocculation Chamber at its upstream (all RCC), with minimum 1-minute storage for flash mixer and 10-minute storage for flocculation chamber at the design flow rate. Design of the sludge removal system should be such as to reduce loss of water
during sludge blow off within 5% of rated flow. Design flow velocity shall be not more than 5 m3/hr/m2. Minimum side water depth of the unit is 4 M.
b. The cross-sectional area of each tube shall be such that the effective hydraulic diameter is 60 mm (min). The material of tube pack shall be UV inhibited virgin PVC. In case of plate type separator, the plates shall be made of GRP (glass reinforced plastic). The resin for the manufacturing of GRP plates shall be orthophthallic type.
c. The length of the tubes/plates through which the water flow shall not be less than 1.5 m, the tubes/plates shall be inclined by 50-80 deg. angle to the horizontal.
d. Sludge removal system shall be designed to thicken the sludge to minimum 2% consistency before disposing from separator bottom, angle of inclination of sludge hopper shall be minimum 55o to horizontal plane.
e. Walkway (bridge) and platform to approach all the internals shall be provided. Clear width of the bridge shall not be less than 1200 mm. Suitable walkway around periphery of tube settler/clarifier with hand-railing, access ladder with platform, hand railing to be provided. Suitable water jet arrangement shall be provided. All the pipelines carrying the sludge shall be provided with flushing connection. Separate pumps and piping shall be provided.
f. Suitable Sampling connections shall be provided by bidder for performance monitoring.
g. Tube Settler/Lamella Clarifier shall be of double hopper type as indicated in P&ID.

7.4.14 Lamella clarifier dosing system shall be located inside building. Rest all equipment / facilities shall be located outside open to sky. Chemical storage for lime and alum shall be located inside building for 15 days regular operation.

7.4.15 Analysers shall be kept in EQMS room.

7.4.16 Sumps E1A, E1B, E1C, E2A, E2B, E3, E4, E5, E6, E7, E8, E9, E10 and E11 effluent sumps are located outside ETP area.

7.5 OPERATION AND CONTROL

Effluent Treatment Plant along with effluent collection located outside ETP area shall be controlled and operated from DDCMIS (BHEL Scope) based control system.
The control philosophy of various systems is described below. However, for all the systems, following basic process related interlocks, alarms/ pre-warning signals shall be implemented in the control system as per system requirement.

a) Among the equipment, it shall be possible to select a specific pump or tank or sump for working/standby/ maintenance etc. through control system.

b) Permissive & Interlocks:

(i) Starting & tripping of pumps with respect to liquid level in the respective sump/ tanks or liquid pressure in the suction lines.

(ii) Starting & tripping of agitators with respect to liquid level in the respective sump/tanks.

(iii) Starting & tripping of pumps (which are provided with forced water lubrication) with respect to lubricating water flow (through low pressure/ low flow signal as the case may be).

(iv) Tripping of pumps when the discharge pressure is very high to avoid operation of the

pump under shutoff head.

(v) Stopping/ tripping of equipment due to abnormal parameters related to safety of equipment like high vibration, very high bearing lubrication water (and /or oil) temperature to the drive/pumps, very high bearing temperature of the of pump/drive etc. as applicable based on the recommendations of Equipment Supplier.

(vi) Automatic opening of the re-circulation valve to pre-set percentage, in case of failure of opening of pump(s) discharge valve to ensure minimum flow through the pump, as per the recommendation of manufacturer.

(vii) Automatic starting of standby pumps upon failure of starting of selected pump or tripping of running pump as the case may be.

(viii) Capacity of the metering pump shall be controllable from 10-100% continuously by adjusting the stroke length manually by a micro meter dial calibrated for 0–100% of pump capacity integral with the pump.

(ix) Various annunciations related to low level of the chemical tanks & sumps shall be provided.

(x) Alarms/ signals

(xi) Abnormal parameters such as low & high level in tanks/sumps, high pressure at pump discharge, low header pressure, low lubrication water flow to pumps (provided with forced water lubrication system) etc.

(xii) Failure of starting of equipment such as pumps, blowers etc. upon start command.

(xiii) Tripping of equipment due to protection logic.

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

8. CONDENSATE POLISHING UNIT (CPU OR CPP)

There shall be three numbers Condensate polishing service vessels (3X50% capacity) and two numbers back washable type cartridge pre-filters (2x50% capacity) for each 800 MW unit. There are two 800 MW TG units. There shall be one complete set of external regeneration systems common for both the TG units Condensate Polishers.

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

Condensate pre filters followed by polisher unit (service vessels) shall be located in the TG hall of corresponding units. Condensate polisher service vessels along with the pre filters will be provided on the discharge side of the high pressure condensate extraction pumps.

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.

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

REFERENCE DOCUMENTS:

A. DATASHEET-A OF CONDENSATE POLISHER PLANT
B. P & ID OF CONDENSATE POLISHER PLANT

8.1 SCOPE OF SUPPLY

Broad scope of supply (mechanical) for this package is detailed below and as indicated in relevant portion of this specification and same shall be in the scope of the bidder. Please refer Electrical and C&I specifications also for respective scope of Electrical and C&I items and same shall be in the scope of the bidder.

A. SERVICE VESSEL FACILITY

Condensate Polisher plant of service vessel area in each TG units shall consist of following

1) There shall be three numbers service vessels (3X50%) for each 800 MW TG unit, each polishing 50 % of the condensate flow. Each Condensate polisher vessels shall be complete with condensate inlet and outlet connections, pre-filter, 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 required.

2) There shall be two numbers (2x50%) back washable type cartridge pre-filters for each 800 MW TG Unit, at the upstream of condensate polishing service vessels along with all associated piping, valves, instrumentation etc. The pre-filters shall be designed for start-up period, commissioning period as first cleaning step as well as normal continuous operation, complete with automatically operated by-pass, associated piping, pumps (with at least one stand-by), pneumatically operated

valves etc.

3) **Backwash Waste water from Pre-Filter**: DM Water used for backwashing shall be collected in a RCC Pit in Service Vessel area having holding capacity 1.5 times the capacity of DM water required for backwashing the one Pre filter and the same shall be pumped to CPU regeneration area N-Pit by means of two (2) numbers (1Working+1Standby) (2x100%) backwash waste water pumps for each TG unit.

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

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

6) Resin transfer headers and pipe lines connecting the external regeneration facilities to the condensate polisher vessels of each installation.

7) Rinse water outlet headers from condensate polisher vessels of each installation upto the condenser hot well.

8) Gland sealing water piping for the valves in the rinse water line.

9) Emergency bypass system as mentioned in P&ID for the total system (i.e. Pre filters and Service Vessel) shall also be provided. This emergency bypass system will open automatically in case of pressure differential exceeding 3.5 Kg/cm^2.

10) Two (2) nos. (2X100%) capacity (1Working+1Standby) oil free type, air blowers to supply necessary air for mixing the resins in the service vessels for each 800 MW TG unit CPU. 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.

11) All necessary drains, vents and sampling points, with valves as specified and as required.

12) Complete Instrumentation and Control for automatic operation.

13) Nine (9) complete charges of resins. One charge will be defined as cation, anion & inert resin (if applicable) requirement for one service vessel.

14) Complete instrumentation and controls for this system, including the differential pressure transmitters, panel mounted indicating type controller with provision for remote manual operation, actuator for the control valve with positioner etc. All tubing, wiring, airsets, and other fittings, required to complete the system.

15) All necessary valves, piping, instrumentation & 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 Condensate polishing plant service vessel area.

16) Operating platforms, ladders, supports and other structural works for each Condensate Polisher vessels and each pre-filter to facilitate accessibility for operation and other equipment etc. shall be provided.

17) All analysers (Sodium, silica, conductivity, ph etc) shall be provided in air-conditioned panel/ cabinet. Air conditioning equipment required for all analysers panel shall be in bidder's scope

18) Multistream for Silica and Sodium Analysers shall be provided as per P&ID and Multistream analysers shall have at least one stream as spare. Hence, minimum 5 stream Silica and Sodium

Analysers for each TG unit shall be provided by bidder.

19) A common drain header for the condensate polisher service vessels of each unit up to the hot well.

20) One Number Air Receiver for each 800 MW TG unit CPU as required for the backwashing of Pre-Filter.

21) Emergency bypass system: (Please refer P&ID also)

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 downstream sides of the control valve.

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.

1x100% control valve to achieve proper control under all operating conditions shall to be provided.

Complete instrumentation and controls required to complete the system, shall also be installed.

The isolation valves may be provided with 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.

The control system shall be designed so that the control valve is able to bypass 50% of rated flow, when one working service vessel is out of service, 100% of flow when two working service vessels are taken out of service.

a. Pre-Filter bypass control system as indicated in the P&ID shall be in bidder's scope.

b. Service vessel and Pre-filter bypass control system (Emergency bypass system) as indicated in the P&ID shall be in bidder's scope.

c. Service vessel bypass control system as indicated in the P&ID shall be in bidder's scope.

B. REGENERATION SYSTEM

Regeneration area shall be considered as low-pressure area. One (1) common external regeneration system for regeneration of the ion exchange resins from the condensate polishers for all the turbo generator units shall be provided. 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 following:

1) One No. Resin Separation & Cation Regeneration Vessel.

2) One No. Anion resin regeneration vessel.

3) Two (2) Numbers Mixed resin storage vessels.

4) The regeneration vessels arrangement shall be as per the supplier recommendation/ process utilising three (3) tank concept as defined above. However, there shall be two numbers identical mixed resin storage vessels. If the process envisages the chemical regeneration arrangement in mixed resin storage vessel, then additional mixed resin storage should also have chemical regeneration arrangement.

5) All internals, fittings and appurtenances for these vessels.

6) Common waste effluent header with one (1) number resin trap, total one (1) number for station designed for in place manual backwashing.

7) One (1) number Resin injection hopper to handle upto 150 litre of as received new resins.

8) Two (2) nos. (2X100%) (1Working+1Standby) oil free type air blowers with electric motor drives, for supplying all the process air required for cleaning of the resins and their regeneration processes. Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter/silencer, flexible couplings discharge snubber, all mounted on a single base. Relief valve(s) shall be provided as required

9) Two (2) nos. (2X100%) (1Working+1Standby) DM water pumps with electric motor drives for water supply for chemical preparation, dilution water supply during dosing & regeneration etc. These DM water pumps will take suction from DM water storage tanks provided for CPU Package.

10) Two (2) nos. (2X100%) (1Working+1Standby) 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 provided for CPU Package.

    Waste water generated during regeneration: The DM water used for resin transfer operations shall be collected in a RCC pit 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 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).

11) One (1) number alkali preparation tank complete with electrically driven stirrer, dissolving basket, carbon dioxide absorber, overflow seal, integral pipe works, valves, instruments, ladders, platforms, lifting lugs etc. and all other required accessories.

12) Two (2) nos. (2x100%) (1Working+1Standby) alkali solution transfer-cum-recirculation pumps of suitable capacity and head to meet the system requirements. These pumps shall be provided with a pulsation dampener at the outlet header of each pump along with necessary valves & instrumentation & accessories.

13) One (1) number alkali day tank complete with electrically driven stirrer, dissolving basket, carbon dioxide absorber, overflow seal, integral pipe works, valves, instruments, ladders, platforms, lifting lugs etc. and all other required accessories.

14) Two (2) nos. (2x100%) (1Working+1Standby) Alkali dosing pumps for dosing NaOH (48% conc.) along with electric motor drive, pulsation dampener & safety relief valve at the outlet header of each pump all other required accessories etc.

15) One (1) no. Activated carbon filter for alkali complete with internals, integral pipe works, valves, instruments, ladders, platforms, lifting lugs, carbon trap etc. and all other accessories as required.

16) One (1) no. hot water tank complete with heaters (2X50%), internals, integral pipe works, valves, instruments, ladders, platforms, lifting lugs etc. and all other accessories as required.

17) Two (2) numbers acid measuring tank, complete with fume absorber, overflow seal, integral pipe works, valves, instruments, ladders, platforms, lifting lugs etc. and all other required accessories.

18) Two (2) nos. (2x100%) (1Working+1Standby) Acid dosing pumps for dosing hydrochloric acid (30% conc.) along with electric motor drive, pulsation dampener & safety relief valve at the outlet header of each pump all other required accessories etc.

19) 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.

20) One (1) number lime tank, complete with electrically driven stirrer, dissolving basket, carbon dioxide absorber, overflow seal, integral pipe works, valves, instruments, ladders, platforms, lifting lugs etc. and all other required accessories.

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

22) All analysers (pH, conductivity, concentration etc) shall be provided in air conditioned panel/ cabinet. Air conditioning equipment required for all analysers panel shall be in bidder's scope

23) There shall be Bulk Acid storage tanks (two numbers) and Bulk Alkali storage tanks (two numbers) along with acid unloading pumps (two numbers (2X100%)) and alkali unloading pumps (two numbers (2X100%)) for CPU Regeneration system.

24) There shall be two numbers DM water storage tanks. These Two (2) numbers of DM 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 CO2 absorber and over flow seal pit. Effective 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 and also for back washing of Pre-Filters of one TG unit. However, the capacity of each DM water storage tank shall be 600 m3 minimum. Water inlet pipe shall led up to the bottom of DM tanks (preferably through perforated pipe) to avoid turbulence/agitation

25) Total two (2) numbers mixing tee for Acid and alkali dosing facility.

26) Neutralising pit of RCC construction with acid/alkali resistant tiles shall be provided to receive drains from the regeneration in two (2) sections and each section shall have a holding capacity of 1.5 times the waste effluent from each regeneration of one vessel & 1.5 times the capacity of DM water required for backwashing the one Pre-filter. For disposal of neutralized effluent pumping, pumps shall be provided. Proven agitation system like air agitation/ venturi mixing shall be provided, in addition to recirculation from pumps.

27) Total three (3) numbers (1W+1S+1Maint. standby) the waste recirculation/disposal pumps for Neutralising pit.

28) 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) minimum.

29) All the atmospheric vessels shall be at least 6 mm thickness.

30) Grouting material required for equipment grouting.

31) Safety equipment as indicated elsewhere in the specification.

32) All necessary drains, vents and sampling points, with valves as specified and as required.

33) All necessary piping, valves & fittings, complete instrumentation, controls etc. necessary for automatic operation.

34) 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 except Acid and alkali measuring Tank for which excess margin is defined under Datasheet.

35) Adequate number of safety shower units and Eye-fountains to protect against any chemical hazard

or at least 2 nos. shall be provided by bidder. The same shall be in bidder's scope of Supply.

36) Platform/ operating platform, Ladder, supporting structure for service vessel area and regeneration area vessels and tanks and necessary cross over for piping shall be in bidder's scope.

Four (4) 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.

C. PIPING

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

1) Service vessel inlet header shall be seamless carbon steel ASTM A-106 Gr B (OD 406.4 X 12.7 mm thick).

2) Service vessel outlet header shall be seamless carbon steel ASTM A-106 Gr B (OD 406.4 X 12.7 mm thick).

3) Rinse water outlet piping to Condenser Hotwell shall be seamless carbon steel ASTM A 106 Gr -B (OD 168.3 x 7.11 mm). The distance between CPU service vessel to condenser Hotwell shall be considered as 110 meters approx. for each unit and this piping shall also be in bidder's scope.

4) Resin transfer piping shall be minimum 80 NB and of SS 304 Sch. 40 (minimum) seamless. One-way piping distance for resin Transfer Piping between farthest service vessel and regeneration area shall be 450 meters approx. Complete resin transfer piping shall be in bidder's scope. Other details have been attached elsewhere in the tender technical specification. Further all the resin transfer piping inside each service vessel area and common regeneration area shall be in bidder's scope.

5) Piping handling DM water shall be Stainless steel SS 304 Schedule 40 (minimum). One-way piping distance for DM water piping between farthest service vessel and regeneration area shall be 450 meters approx. Complete DM water piping shall be in bidder's scope. Other details have been attached elsewhere in the tender technical specification. Further all the DM water piping inside each service vessel area and common regeneration area shall be in bidder's scope.

6) Piping handling pre-filter backwash waste water shall be Stainless steel SS 304 Schedule 40 (minimum). One-way piping distance for waste water piping between farthest service vessel and regeneration area shall be 450 meters approx. Complete waste water piping shall be in bidder's scope. Other details have been attached elsewhere in the tender technical specification. Further all the waste water piping inside each service vessel area and common regeneration area shall be in bidder's scope.

7) The material of piping handling DM waste water generated during regeneration and resin transfer shall be of stainless-steel type 304 Sch.40 (Min). The piping distance from CPU regeneration area to CW channel is 600 meters approx. Complete DM waste water piping shall be in bidder's scope. Other details have been attached elsewhere in the tender technical specification.

8) Pipeline handling Alkali shall be of stainless-steel type 316 Sch.10 (minimum).

9) Piping for Acid service (HCl) shall be carbon steel Poly propylene lined/CPVC as per ASTM F441(Sch.80).

10) Piping for air service shall be shall be of hot dip galvanized (heavy grade) steel.

11) All piping within each of the above skids/equipment shall also be in bidder's scope.

12) There shall be a Neutralisation Pit (N pit) for CPU regeneration and the Neutralisation pit Civil work shall be under BHEL scope. The regeneration waste from CPU regeneration area shall be led to this N-pit via drain.

13) Service water piping in CPU service vessel area (used for cooling of condensate sample), Service water piping in each CPU regeneration area, instrument air piping for each CPU service vessel area & regeneration area and service air piping for each CPU service vessel area & regeneration area, potable water piping for each CPU regeneration area etc. shall also be in bidder's scope.

14) Similarly, all piping between each external regeneration facility and the skids for chemical dosing and acid/alkali preparation shall also be designed, supplied, erected and tested by the bidder. These shall include demineralized water piping to the chemical dosing, acid /alkali piping from external bulk storage tanks to respective preparation skids, the alkali preparation skids from the external regeneration facility, alkali solution from its preparation facility to the alkali dosing skid, dilute chemical solution piping for acid and alkali from the dosing skids to the external regeneration facility, piping to the preparation/dosing facilities, instrument air piping and power supply for immersion heaters of the diluent water tank from the regeneration facility, and all instrumentation and control wiring between these skids, etc.

15) Bidder shall design, supply and erect the piping between the service vessel units and the common external regeneration facility, for transferring the exhausted and regenerated resins as required.

16) All piping shall be laid above ground and generally laid in pipe trestles including crossing of road/pipe/cable trenches if any. Piping of between chemical tanks area and regeneration area etc. may be laid on pedestals if layout permits.

17) 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.

18) The resin transfer pipeline shall be sized for a flow velocity of between 2.3 and 3.0 meters/sec. For other services, design criteria shall be generally in line with design philosophy described elsewhere in technical specification.

19) 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.

20) All lined vessel connections and connections in unlined vessels (25 NB and larger) shall be flanged to ANSI 125 lb class minimum except the polisher service vessels which shall be ANSI 300 lb class minimum, Flat face flanges shall be used throughout. Nozzle material shall be ASTM-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 pipeline in service vessels area where pressure may attain same as service vessel shall be designed for 300 lb class minimum.

21) Complete supporting system for the pipeline shall be designed, fabricated and supplied by the Bidder. Inside the building, the overhead portion of the pipeline may be supported from the building structures. In outdoors, the pipeline may run on steel posts. Crossing of the roads shall be on a pipe bridge with a clear height of at least 6.1 meters over the road surface. All the steel structures of the pipe bridge and the supporting posts along with all necessary hanger, clamps, connecting steel, fixing bolts, nuts, etc. shall be supplied and erected by the bidder.

22) Effluent from N-Pit shall be transferred unitized ash slurry sumps. The provision to be made to transfer total effluent to each ash slurry sumps. Piping from Neutralisation Pit (N pit) of CPU regeneration area to each Ash Slurry Sump (Unit-1 & Unit 2) shall be of MSRL construction and piping distance to farthest Ash Slurry Sump-2 shall be 1250 meters approx. Complete N-Pit waste

transfer piping up to each Ash Slurry Sump along with motorised isolation valves in each lines shall be in bidder's scope. Other details have been attached elsewhere in the tender technical specification.

23) Routing of all pipe line shall be developed by the bidder and shall be finalized in coordination with the BHEL/Customer, based on the space available and the final layout.

24) Complete Piping of stainless-steel type 304 Sch.40 (Min) of 100NB for filling the DM water storage tank from the TP (by BHEL) at 10-meter distance shall be in bidder's scope. Complete piping of DM water suction, discharge and recirculation of both the DM water storage tank shall be in bidder's scope.

25) Bidder to submit BBU during detailed engineering after approval of Basic documents. Incomplete BBU shall not be reviewed by BHEL.

26) Bidder to consider suitable arrangement i.e. Compressor, associated piping & instruments, isolation valves etc for the Service & Instrument air, in case the pressure provided at terminal point is not sufficient for intended application.

D. VALVES

All the valves in service vessel area and regeneration area as indicated in P&ID and to meet the system requirement as mentioned elsewhere in the specification shall be in the bidder's scope of supply.

1) All valves shall be designed as per applicable AWWA/BID/BS or equivalent international standard /codes.

2) The isolation valves on the resin transfer line shall be of eccentric plug type/ball valve (full bore type) of stainless-steel construction (SS 316).

3) 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 downstream sides of the control valve. Other Butterfly valves in Service Vessel Area shall be 300lb class (minimum) and end connection shall be lugged wafer (min.).

4) 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.

5) Isolation Valves handling Alkali, Ammonia etc shall be diaphragm type in SS-316 construction.

6) Isolation Valves handling Acid (HCL) shall be diaphragm type in MSRL (Mild Steel Rubber lined) or CPVC construction.

7) Isolation Valves handling DM water shall be Butterfly or gate or globe type and shall be of SS -304 construction.

8) Non-return valves shall be constructed of SS-304 for DM Water & SS316 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.

9) All valves in service vessels area where pressure may attain same as service vessel shall be designed for 300 lb class minimum. Bidder to select the class/ pressure rating of the valves of service vessel area to meet the system design requirement. In case it has been found that the class/ pressure rating as required is higher than 300lb class then the same shall be considered by bidder in their scope.

8.2 TERMINAL POINTS

A. CONDENSATE POLISHING PLANT - SERVICE VESSEL AREA

- Service vessel inlet – (OD 323.9 X 9.53 mm thick, ASTM A-106 Gr- B seamless) - Single piping connection near to service area.
- Service vessel outlet – (OD 323.9 X 9.53 mm thick, ASTM A-106 Gr-B seamless) - Single piping connection near to service area.
- Rinse water outlet- Rinse water outlet piping (OD 168.3 x 7.11 mm, ASTM A-106 Gr-B seamless) till condenser hotwell nozzle for each unit is in the scope of bidder.
- 25 NB connection of Instrument air supply at 5 to 7 kg/cm2 (g) – At 5-meter distance from service vessel area.
- 50 NB connection of Service air supply at 5 to 7 kg/cm2 (g) – At 5-meter distance from service vessel area.
- Gland sealing water supply & analyser rack cooling water supply piping - Service water connection (50 NB) at 5-meter distance from service vessel area.

B. EXTERNAL REGENERATION AREA

- 25 NB Instrument air supply at 5 to 7 kg/cm2 (g) – At 5-meter distance from the regeneration building at 0.5 meters above FGL at end closer to pipe rack/ pedestal.
- 25 NB Service air supply at 5 to 7 kg/cm2 (g) - At 5-meter distance from the regeneration building at 0.5 meters above FGL at end closer to pipe rack/ pedestal.
- Service water (50 NB) - At 5-meter distance from the regeneration building at 0.5 meters above FGL at end closer to pipe rack/ pedestal.
- Potable water (25 NB) - At 5-meter distance from the regeneration building at 0.5 meters above FGL at end closer to pipe rack/ pedestal.
- DM water (100NB) for DM Tank filling – At 5-meter distance from the regeneration building at 0.5 meters above FGL at end closer to pipe rack/ pedestal.

8.3 DESIGN REQUIREMENTS FOR CPU

8.3.1 SALIENT DESIGN DATA

A) NORMAL RUN (PRE-FILTERS)

PARAMETERS	INFLUENT	EFFLUENT
Crud, ppb (mostly black oxide of Iron)	25	<5

Under the above operating and design flow through pre-filter, the pre-filter service run shall be not less than 30 days (720 hrs) of continuous operation while maintaining the above effluent quality. The effluent values indicated above shall be the maximum values.

B) NORMAL RUN (CONDENSATE POLISHER UNIT (SERVICE VESSEL))

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.

PARAMETERS	INFLUENT	EFFLUENT
Ammonia, ppb	150	---
Total dissolved solids, ppb	100	20
Silica, ppb	30	5 (refer Note 1)
Iron, ppb	50	5

Sodium, ppb	10	2
Chloride, ppb	10	2
pH	8.5-9.0	--
Effluent conductivity after removal of ammonia and amines (micro mhos/cm) at 25 deg. C.	--	0.1 or less
Crud, ppb (mostly black oxide of Iron)	25	<5

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

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.

C) START-UP CONDITION

START-UP CONDITION FOR PRE FILTERS

The condensate quality during start-up operation for Pre filters design shall be as follows:

PARAMETERS INFLUENT	PARAMETERS INFLUENT	PARAMETERS EFFLUENT
Crud, ppb (mostly black oxide of Iron)	1000 maximum	Removal not less than 99.98% (At the outlet of Pre-Filter)

The pre-filter shall be designed for a crud loading of 1000 ppb. Service length of Pre Filter shall be minimum 50 hours.

START-UP CONDITION FOR CONDENSATE POLISHER UNIT (SERVICE VESSEL)

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.
Useful service run between two successive regenerations at design flow rate with above conditions should not be less than 50 hours.

D) CONDENSER LEAK CONDITION:

Under condenser tube-leakage condition, the plant shall be designed for 2000 ppb TDS in addition to the normal influent contaminants specified at cl. 4.1 (B) above.

PARAMETERS INFLUENT	PARAMETERS INFLUENT	PARAMETERS EFFLUENT
Total dissolved solids, ppb	2000 plus normal influent contaminants	Sodium <= 20ppb Silica <= 20ppb

The anion and cation load in influent design TDS shall be based on circulating water analysis.

Useful service run between two successive regenerations at design flow rate with above conditions should not be less than 50 hours.

8.3.2 The bed cross section shall be such that the velocity of condensate through it, shall not exceed 2 meters/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 varies, the diameter (excluding the rubber lining) of the vessel shall be selected considering velocity not exceeding 1.75 meters/minute. The effective depth of the mixed resin bed in the condensate polisher service vessels shall not be less than 1100 mm. Uniform bead size of resin shall be provided for better separation of resins and performance.

8.3.3 At the design flow rate, the pressure drop in clean condition across the Pre filters including polisher service vessels shall not exceed 2.1 Kg/sq.cm. This pressure drop shall include losses due to pre-filters, service vessel, entrance and exit nozzles, distributors, under drains, resins and the effluent resin traps. Maximum pressure drops under dirty conditions across the Pre-filters and service vessels including pre-filters, service vessel, entrance and exit nozzles, distributors, under drains, resins and the effluent resin traps will be restricted to 3.5 kg/sq.cm including the pressure drop across effluent resin traps.

8.3.4 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 cannot 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.

8.3.5 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/cm2 and a pressure reducing valve from 2 kg/cm2 to condenser vacuum.

8.3.6 While calculating pump head, 10% margin (minimum) shall be considered of 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 this specification. Pump recirculation with a regulating valve shall be provided for all the pumping system.

8.3.7 All the design parameters listed above in this chapter, i.e. the effluent quality, the design flow, design service length, Chemical consumption for regeneration and Pressure drop across the pre filters & Service vessels resin bed in clean and dirty condition at rated design flow shall be guaranteed by the Bidder.

8.3.8 SYSTEM REQUIREMENT

- The regeneration process offered by the bidder, shall be of proven design and shall essentially be the same process by virtue of which the bidder is qualified and shall give resin-separation compatible with the desired effluent quality. Documentary evidence shall be submitted by the bidder to the Customer/BHEL to establish this requirement during detailed engineering stage as desired by BHEL/ Customer.

- Back washable type Pre-filters (cartridge filter) shall be provided by bidder and same may be horizontal or vertical as per system requirement. The bidder shall offer only proven design, which should be in successful operation in previous installation under similar working condition. Documentary evidence shall be submitted by the bidder during detailed engineering stage as desired by BHEL/ Customer for sub vendor acceptance with respect to pre-filter to establish this requirement.

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

- In case, after separation of resins, there are undesired contaminant resins, the bidder 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.

8.3.9 Exchange Resins

a. 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 quaternary ammonium (type I) functional group.
Inert : Nonionic, compatible with the above resin types.

Cation resins shall be supplied in hydrogen form and Anion resins shall be supplied in hydroxide form. Cation Resin of gel type may also be offered meeting the criteria as mentioned below in d) & c) iv.

b. Physical Properties:

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 percent shall be retained on a no. 16 sieve, and more than 2 percent 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 percent of the beads tested in each batch shall get fractured by forces less than 200 grams.

c. Chemical Properties:

i. Total wet volume ion-exchange capacities in equivalents/ litre 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

process requires any non-ionic resin the same shall represent at least 10 percent of the bed volume, but not less than 15 cm of the bed depth in the resin separation tank of the external regeneration facility.

iv. Manufacturer: The resins shall be of reputed manufacturer with adequate past record of successful service for not less than 3 years in similar application.

d. 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 Deg.C.

8.3.10 VESSELS 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.

8.3.11 PRESSURE VESSELS, ATMOSPHERIC TANKS & MISCELLANEOUS ITEMS

1) Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and other chemicals shall conform to IS: 803

2) Unless otherwise mentioned design temperature of all pressure vessels and storage tanks shall be 10 deg.C higher than the maximum temperature that any part of the vessel/tank is likely to attain during operation.

3) All vessels/tanks without inside rubber lining shall have a corrosion allowance of minimum 2 mm and mill allowance (minimum 0.3 mm) for shell and dished ends. Thinning allowance of 2 mm (minimum) shall be considered for dished end of torospherical type.

4) All the atmospheric tanks shall have sufficient free board above the ‘‘Level High /Normal Level’’ as the case may be. The overflow level shall be kept at least 20 cm or 10% of vessel height above the ‘‘Level High /Normal Level’’ for all the tank except for the DM tanks for which a minimum height of 300 mm shall be provided over the ‘‘High Level’’. Further, a minimum 100 mm free board shall be provided above the top of overflow level to the top of tank.

5) 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.

6) 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.

7) 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 plus/minus 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.

8) Vessel internals shall meet the following requirements:

9) 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.

10) 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).

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

12) Design temperature of service vessel and their internals/appurtenances shall take care of all operating regimes including HP-LP bypass operation and minimum 70 Deg.C. Process design temperature shall be based on all operating regimes of TG cycle and minimum 52 Deg. C. However, short term excursion of temperature up to 60 Deg.C is also expected.

13) **Resin Traps:** Outlet of each condensate polisher vessel, activated carbon filter 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 percent 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.

14) **Carbon Trap (for ACF):** Outlet of each Activated Carbon filler on Carbon trap (media trap) shall be provided by bidder as per manufacturer standard.

15) **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.

16) **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 activated carbon shall be of good quality suitable for removal of odour, chlorine, and dissolved organic substances. Suitable free board shall be provided over the filtering medium below the backwash outlet nozzle and in straight portion of vessel to facilitate backwashing. The inlet distribution (preferably header-lateral type) and under drain collecting system (header lateral/strainer-on-plate) shall be so designed as to give uniform distribution and flow without channelling and obstruction.

8.3.12 Operating platforms, permanent ladders (not rugs), supports and other structural works for each

vessel, tanks, valves etc. to facilitate accessibility for operation and maintenance for all the condensate polisher mixed beds, regeneration vessels, storage tanks, alkali and acid measuring tanks & preparation tanks and other equipment's etc. is also in bidder's scope.

8.3.13 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.

8.3.14 MCC shall be located in CPU regeneration area.

8.3.15 Space available for CPU service Vessels area & CPU Regeneration area (Vide ref. Dwg. No. PE-DG- 508-100-M003 & Plot Plan Dwg. No. PE-DG-508-100-M001) are attached in this specification. Bidder to accommodate their equipment within the space provided. The location of DM waste water pit shall be in CPU regeneration area.

8.3.16 For Skid Mounted dosing equipment. 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 bidder 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.

8.3.17 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. Alkali solution preparation, alkali dosing and acid dosing system are a recommended listing of the main equipment skids to be furnished under this package. The bidder may also supply and install this equipment independently instead of assembling the skids.

8.4 CONTROL & OPERATION

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 bidder 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) The control & operation of various systems described below is indicative only and the actual control & operation philosophy shall be finalized with during detailed engineering based on which the control logic is to be built in DDCMIS.

c) Complete system operation shall be through mimics on OWS/LVS. The sequence startup mode (Automatic, semi-automatic and operator guided mode) shall be provided.

d) 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.

e) '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.

f) '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.

g) On control system failure, it shall be possible to operate the valves by means of manual

operator of solenoid valves too.

h) 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.

i) 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.

j) 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.

k) 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.

l) A mimic shall be provided 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.

m) 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.

n) 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.

o) Wherever standby equipment is provided, it shall be possible to select each of the drive on ‘standby’ duty.

p) The detailed logic for the sequence and for each of the drive shall be subject to the BHEL/Customer’s approval.

q) Start, progress and stop of each of the sequence shall be annunciated.

r) 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.

8.4.1 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) Exhausted Resin Transfer from CPU vessel to Regeneration plant.

(5) Regenerated Resin Transfer from Regeneration plant to CPU vessel

(6) Rinse mode.

Each mode or operation is described as below:

Standby Mode:

(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.

Service mode:

(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 needs 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. This conductivity analyzer shall also provide contacts for an alarm at the power station main control room. 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.

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.

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.

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.

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 fully 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.

8.4.2 External Regeneration Control System

a) 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.

b) 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.

c) 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 layer of inert, intermediate density resin may be inserted 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.

d) 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.

e) 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.

f) Upon resin transfer operation from regeneration plant as described by the operator from the I 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.

g) Demineralized water shall be used throughout the regeneration process for backwashing, diluting the regenerant, rinsing and resin transfer.

h) A conical bottom hopper having a water ejector will be used for resin make-up.

i) At any time only one of the sequences shall be in progress.

8.4.3 Interlocks

- All interlocks for safe operation of the plant shall be provided. They shall specifically include the following as minimum requirement.
- Service vessels can be back in service, only after they have been pressurized.
- Service vessels can be taken up for resin transfer only after they have been completely isolated from the condensate system and depressurized.
- Resin can be transferred to and from only one service vessel at a time.
- Resin transfer between the service and the regeneration skids shall be permitted only when

the receiving vessel is initially empty.

- Regeneration sequence can commence, only when the level in the waste neutralization pit is low enough to receive the entire waste quantity of waste water from the regeneration operation.
- 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 override 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.
- 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.
- 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.
- Adequate diluent water flow shall be established before starting of the ejectors/ dosing pumps for acid and alkali.
- The immersion heater in the hot water tank can be put on only when there is adequate water level in the tank.
- CPU service vessel inlet & isolate valves will close automatically in the event of tripping of condensate extraction pump.

9. CW CHEMICAL TREATMENT PLANT (CWT)

CW Treatment plant is required to maintain Circulating Water quality by preventing scaling, fouling, microbial growth etc in CW system of thermal power plants with the help of dosing of acid and Certain speciality chemicals such as corrosion inhibitor, antiscalant, biocides etc.

REFERENCE DOCUMENTS

D. PE-V0-508-156A-W001	:	P&ID FOR CW TREATMENT PLANT
E. DATASHEET – A	:	FOR ABOVE SYSTEM
F. PE-DG-508-100-M001	:	PLOT PLAN

9.1 SCOPE OF SUPPLY

Broad scope of supply for this package is detailed below and as indicated in relevant portion of this specification. Please refer Electrical and C&I specifications also for respective scope of Electrical and C&I items.

The CW Treatment Plant, as specified in Technical data sheets & technical specifications, and shall consist of at least the followings:

9.1.1 Entire CW TREATMENT PLANT as per P&ID (PE-DG-508-156-W001), Data Sheet-A and technical specification requirements.

9.1.2 Supply of all CWT specialty chemicals i.e. HEDP & PBTC (common), Polymeric dispersant, Bio-dispersant, Corrosion inhibitor (Zn) for first fil, pre-commissioning, commissioning, trial run, PG test and One (1) year operation after PG test of CW system at full load of all units shall be in bidder's scope of supply.

9.1.3 Operation & Maintenance for complete CW Chemical Treatment System for One (1) year operation after PG test of CW system, for all the units at partial/ full load. Bidder to note that O&M activities of both the units will be staggered and time gap from Unit#1 to Unit#2 may please be considered as 6 months.

9.1.4 Three (3) Nos acid storage tank (H_2SO_4) of capacity adequate for minimum 15 days' requirement (minimum capacity of each tank 50 cum) complete with moisture absorber with Silica gel, overflow seal, integral pipe works, valves, instruments, ladders, platforms, lifting lugs etc. and all other required accessories. The tank shall be Horizontal, with dished (Torospherical) ends. Material of construction of tank will be MS.

9.1.5 Two (2) numbers Acid day tanks complete with moisture absorber with Silica gel, overflow seal, integral pipe works, valves, instruments, ladders, platforms, lifting lugs etc. and all other required accessories.

9.1.6 Chemical day tanks (2 x 100%) for each of HEDP & PBTC (common), Polymeric dispersant, Bio-dispersant, Corrosion inhibitor (Zn) & Dosing System consisting of dosing pumps (2 x 100% for each chemical) piping, valves, instruments, fittings etc. Capacity of each tank shall be adequate for minimum 1-day requirement.

9.1.7 Dosing pumps (2 x 100%) for each of the above chemicals compatible with handling of these chemicals shall be provided.

9.1.8 Mixing tee for acid dosing system.

9.1.9 Two (2) numbers Sulphuric acid Unloading cum transfer pumps along with electric motor drive, pulsation dampener & all other required accessories etc.

9.1.10 Two (2) numbers Lime pit pumps along with electric motor drive & all other required accessories etc.

9.1.11 Two (2) numbers Sulphuric acid dilution pumps of suitable capacity along with electric motor drive, pulsation dampener & all other required accessories etc.

9.1.12 Safety equipment as specified in Datasheet –A.

9.1.13 Monitoring equipment like depositor monitor/ fouling monitor (01), bio-fouling monitor (01), Corrosion test coupon test racks (6 nos.), on-line instant corrosion rate monitor (01), one (1) number online pH meter, one (1) number online ORP monitor, one (1) number Conductivity meter shall be provided by bidder.

9.1.14 Two (2) nos. safety shower units and adequate nos. of eye fountains to protect against any chemical hazard.

9.1.15 Other instruments as indicated in the P&ID and tender technical specification.

9.1.16 Test racks (corrosion, scaling, and bio-fouling) with coupons. Corrosion test coupon test racks (6 nos.). Analysis kits with reagents etc.

9.1.17 All necessary drains, vents, and sampling points, with valves, as specified and as required.

9.1.18 Hangers and supports as per the requirement.

9.1.19 Instrumentation (minimum) as per the enclosed P&ID (PE-DG-508-156A-W001).

9.1.20 All necessary structural steel for pipe supporting structure, platforms, walkways/ pathways and access stairs for mechanical plant and equipment, mechanical services and pipe work associated with CW treatment Plant.

9.1.21 Supply and erection of Hand railing as required for safety purpose will be in bidder’s scope.

9.1.22 Grouting of equipment and grouting material required are in bidder’s scope.

9.1.23 All necessary structural steel for pipe supporting structure, platforms, walkways / pathways and access stairs for mechanical plant and equipment, mechanical services and pipe work associated with system.

9.1.24 Flexible hose pipe (10-meter minimum) for each unloading pump shall be in bidder’s scope.

9.1.25 Set of special tools and tackle that may be required for maintenance, overhaul and replacement of various equipment under this specification.

9.1.26 Start up, erection and commissioning spares and all spares as required for erection, commissioning and operation and maintenance till handing over of the complete plant.

9.1.27 One no. hand operated barrel pump for each chemical (other than acid).

9.1.28 Diffusers of adequate size for each chemical shall be provided by the bidder.

9.2 TERMINAL POINTS

9.2.1 Service water (40 NB) - At 5-meter distance from CW TREATMENT PLANT area. Further distribution piping is in bidder's scope.

9.2.2 Potable water (40 NB) - At 5-meter distance from CW TREATMENT PLANT area. Further distribution piping is in bidder's scope.

9.2.3 Cooling water (25 NB) - At 5-meter distance from CW TREATMENT PLANT area. Further piping is in bidder's scope.

9.2.4 Distance between CW Chemical Treatment Area and CW Fore-bay is approx. 250 m and piping for each chemical to CW Fore-bay is in bidder's scope. Bidder to refer plot plan attached with this specification and consider additional piping distribution inside CW cooling tower basin and fore-bay as per dimension given elsewhere in this specification. Piping for dosing from CWTP area up to both cooling tower basins shall also be in bidder's scope, if CWTP dosing is required in cooling tower basins, further distance shall be considered by bidder as per plot plan attached.

9.2.5 All drains: Drains from all the dosing systems shall be connected to a lime pit.

9.2.6 Distance between CW Chemical Treatment Area and CW Fore-bay is 250 m and piping from Lime pit to CW Fore-bay is in bidder's scope.

9.3 DESIGN DATA AND BASIC DESIGN CRITERIA

a. The design C.O.C. of the CW System shall be 5.0 (minimum) for design of Chemical Treatment programme. Bidder shall include chemicals required (other than Sulfuric acid) for passivation of metals during commissioning also. Chemicals required after a major shutdown for re-commissioning the system shall also form part of the bidder's scope of supply.

b. Bidder shall supply the chemicals with sufficient self-life, ensuring they don't get expire if some quantity of chemical(s) is remained/ left at site after completion of contractual O&M period.

c. CW TREATMENT PLANT shall be located at space available for CW TREATMENT PLANT in plot plan (Dwg. No. PE-DG-508-100-M001) attached in Section IA of this specification. Bidder to accommodate their equipment within the space provided. All the instruments for monitoring the quality of Cooling Water shall be housed in CW TREATMENT PLANT shed.

d. Bidder to maintain the alkalinity of cooling water at 150 ppm after H_2SO_4 acid dosing, at COC: 5. Accordingly, CW chemical treatment program is to be designed by the bidder.

e. Chlorine dioxide dosing (shock dosing) is being done in cooling water.

f. Provision of transfer of acid from one tank to other tanks shall be provided by bidder.

g. The entire system responsibility and maintaining the guaranteed parameters of the system along with supply of chemicals shall rest with Bidder during O&M period.

h. The Bidder shall offer proven type of chemical treatment program for CW system.

i. Complete chemical analysis and micro-biological analysis of water is to be carried out by the bidder periodically at least once in a fortnight. Periodic report on the performance of the treatment program along with analysis report chemical consumption pattern and observation/ recommendation shall be furnished by bidder to site. At mutually agreed intervals, the performance and guarantee of the scale, corrosion, fouling and biofouling shall be monitored and verified.

j. All materials and components of valves, pumps, piping and other equipment and appurtenances shall be compatible with the respective fluid herein.

k. Fasteners like bolts, nuts etc. shall be stainless steel for those coming in contact with water and for others high tensile carbon steel.

l. Base plate, sole plates for pumps, blowers etc. shall be carbon steel with epoxy coated.

m. Suitable permanent flushing connections shall be provided for all pipelines carrying sludge, acid and alkali.

n. Bidder shall indicate the constituents of the chemicals formulation used for the treatment.

o. Bidder to submit BBU during detailed engineering after approval of Basic documents. BBU shall be equal to BOQ for the package and there shall be no price and delivery implication is applicable to BHEL/ customer for the same. None of the items supplied for the project as non-billable. Incomplete BBU shall not be reviewed by BHEL.

p. Inhouse layout cum civil input drawing prepared by BHEL is enclosed with this technical specification. Bidder to follow the same and accommodate all the items within this layout. Sizes indicated for all the items are to be complied as a minimum requirement, bidder to design & select the items accordingly. Any hold marked in the layout drawing shall be released by the bidder during detailed engineering as per approved sizing calculation. Bidder to further develop the detailed layout and civil input drawing during detailed engineering, maintaining the details as indicated in attached drawing.

9.4 PLANT OPERATION AND CONTROL PHILOSOPHY

DDCMIS shall be used for control and operation of CW Treatment Plant (DDCMIS is in BHEL scope).

The operation of Sulphuric Acid Dosing Pumps shall be auto, remote manual and local manual. In the auto mode, the stroke shall be adjusted by sensing pH of Circulating Water. During normal operation, Sulphuric Acid Injection Pumps will operate in the auto-mode and inject sulphuric acid to maintain the pH of circulating water at a desired level so that scale deposition or corrosion can be avoided.

Provision to adjust the stroke of Sulphuric Acid Dosing Pumps, Scale Inhibitor Dosing Pumps, Corrosion Inhibitor Dosing Pumps & Bio-Dispersant Dosing Pumps through DDCMIS shall be provided by the bidder.

All effluents from Sulphuric acid storage tanks and dosing area will pass through a lime pit for neutralization before pumping it to cooling tower basin.

The operation of other chemical dosing Pumps shall be operated remote manually & as well as local manual.

Monitoring equipment with reference to scale formation, corrosion and biological growth etc. shall be provided by bidder to supervise the performance of the treatment systems.

Following basic process related interlocks, alarms/ pre-warning signals shall be implemented in the control system as per system requirement.

a) Among the equipment, it shall be possible to select a specific pump or tank for working/ standby/ maintenance etc. through control system.

b) Permissive & Interlocks:

- Starting & tripping of pumps with respect to liquid level in the respective tanks/ sump or liquid pressure in the suction lines.

- Starting & tripping of agitators with respect to liquid level in the respective tanks.
- Tripping of pumps when the discharge pressure is very high to avoid operation of the pump under shutoff head.
- Automatic starting of standby pumps upon failure of starting of selected pump or tripping of running pump as the case may be.
- Alarms/ signals.
- Abnormal parameters such as low & high level in tanks/ sumps, high pressure at pump discharge, low header pressure etc.
- Failure of starting of equipment such as pumps, agitators etc. upon start command.
- Tripping of equipment due to protection logic.

10. CHP RUN OFF WATER TREATMENT PLANT (CHP WTP)

Runoff water from coal slurry settling pond is to be treated in CHP run off Water treatment plant. Details are listed below for bidder's adherence.

REFERENCE DOCUMENTS

A. PE-DG-508-157-W001 :P & ID for Coal Handling Plant Run-Off Water Treatment System.
B. DATASHEET – A : FOR ABOVE SYSTEM
C. PE-DG-508-100-M001 : PLOT PLAN

10.1 SCOPE OF SUPPLY (MECHANICAL)

Bidder to note that Coal Handling Plant Run-Off Water Treatment System shall include associated Mechanical, Electrical, Control & instrumentation work. Broad scope of work of this package includes all equipment and accessories as listed below.
Following are in bidder's scope of supply:

10.1.1 One (1) number decanted water sump (in 2 sections) of RCC Construction (Civil in BHEL Scope) to receive decanted water from settling ponds.
10.1.2 Two (2) Nos Clarifier feed pumps (2x50%), along with motors, piping, valves, fittings, instrumentation etc.
10.1.3 Water Discharge piping from Clarifier feed pumps discharge to stilling chamber complete with fittings, valves and instruments.
10.1.4 One (1) number stilling chamber of RCC Construction (Civil in BHEL Scope) of required capacity for both clarifiers.
10.1.5 One (1) number of inlet channels of RCC Construction (Civil in BHEL Scope) along with isolation gates & flow measuring element (Parshall flume) in channel.
10.1.6 One (1) number of inlet chamber of RCC Construction (Civil in BHEL Scope) of required capacity for clarifier.
10.1.7 One (1) no. Reactor Clarifiers (1x100%) with sampling points at different elevation along with concrete encased pipe from inlet channel/chamber to clarifier inlet shaft and sludge blow off pipes etc. The associated civil works shall be in BHEL's Scope.
10.1.8 Clarifier bridge assemblies, hand railings, required motors, valves, piping, insert plates, instrumentation etc.
10.1.9 Outlet channels of RCC Construction (Civil in BHEL Scope) from Clarifier up to the distribution chamber,
10.1.10 Sludge disposal system from clarifier, with piping, manholes, valves, instrumentation up to sludge collection pit as indicated in P & ID of CHP Run-Off Water Treatment System.
10.1.11 One (1) no. RCC Sludge Pit (Civil in BHEL Scope) with common sump of pumps.
10.1.12 Two (2) Air Blowers (2x100%) for air agitation system of the sludge pit with acoustic enclosure, motor, piping, valves, instrumentation etc.
10.1.13 Two (2) nos. Sludge Transfer Pumps (2x100%) with motor, piping, valves, fittings and instrumentation up to Filter Press.
10.1.14 Filter press (2 Nos.) of required capacity, along with associated Flushing/Cleaning pumps with motors (1W+1S), elevated platform in RCC construction, valves, piping, instrumentation etc.
10.1.15 One (1) No. Service Water Overhead Storage Tank (Civil in BHEL Scope). The associated float type valve, overflow & drain arrangement, valves, instrumentation etc shall be in bidder's scope.
10.1.16 One (1) no. RCC Distribution Chamber in twin section (Civil in BHEL Scope).
10.1.17 Two (02) Nos Supernatant Transfer Pumps (2x50%) for Plant along with motors, piping, valves, fittings, instrumentation etc.
10.1.18 One (1) no. Chemical storage cum Dosing shed to store chemicals, tanks, pumps, etc. Chemical

storage shall be designed to meet 15 days requirement. The associated civil works shall be in BHEL's Scope.

10.1.19 Two (2) nos. Lime slaking tanks with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the Lime preparation tank. The associated civil works shall be in BHEL's Scope.

10.1.20 Two (2) nos. Lime slurry transfer Pumps (2x100%) with motor, Piping, valves & instrumentation etc.

10.1.21 Two (2) nos. Lime Solution dosing Tanks with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the Clarifiers. The associated civil works shall be in BHEL's Scope.

10.1.22 Two (2) nos. Lime dosing Pumps (2x100%) with motor, Piping, valves & instrumentation etc.

10.1.23 Two (2) nos. Alum Solution Preparation Tanks with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the Clarifiers. The associated civil works shall be in BHEL's Scope.

10.1.24 Two (2) nos. Alum Dosing Pumps (2x100%) with motor, Piping, valves & instrumentation etc.

10.1.25 Two (2) nos. Synthetic flocculent dosing Tanks with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the all Clarifiers.

10.1.26 Two (2) nos. Synthetic flocculent dosing Pumps (2x100%) with Motor, Piping, valves & instrumentation etc for all the clarifiers.

10.1.27 Two (2) nos. coagulant-aid dosing Tanks with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the all Filter Press.

10.1.28 Two (2) nos. coagulant-aid dosing Pumps (2x100%) with Motor, Piping, valves & instrumentation etc for all the Filter Press.

10.1.29 Two (2) nos. Weighing Scales, one (1) no. electrically operated monorail hoist with trailing cable in Chemical storage cum Dosing shed.

10.1.30 Instruments to be used for PG test shall be additionally supplied over and above the instruments shown in tender P&IDs. PG test equipment being supplied, installed and commissioned for each unit, shall be retained by employer (NTPC) after completion of PG test. All instruments, reagents, monitoring gadgets used for monitoring and carrying out, pre-commissioning, trial run, commissioning, Performance guarantee test shall be retained by end customer/BHEL.

10.1.31 All sluice gates along with suitable protection shall be in the scope of bidder only.

10.1.32 Sufficient numbers of portable type ladders with plate form to be supplied for ease of maintenance.

10.1.33 Necessary pipe, piping, fitting, valves, drains, vents, sampling etc. required for the complete Plant. Pipe racks shall be provided by BHEL wherever available. Wherever pipe racks are not available, pipe shall be laid on pedestal. All auxiliary steel structure (U-clamps, nuts, bolts, channels etc.) for fixing pipes on pedestal or racks for complete CHP Run-Off Water Treatment system shall be in bidder's scope.

10.1.34 Hand Railings and Ladders-All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS: 4736.

10.1.35 All channels & brackets, mounting plates as required for mounting of motors, pumps, stirrers, tank etc.

10.1.36 All other things are also included in scope of supply as specified in other part of the specification.

10.2 PIPING

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

10.2.1 All piping within the Coal Handling Plant Run-Off Water Treatment System.
10.2.2 600 NB of Minimum 70-meter Water Discharge piping from Clarifier feed pumps discharge to stilling chamber.
10.2.3 Carbon Steel Pipe from inlet channel/chamber to clarifier inlet shaft, encased with concrete for buried portion and externally epoxy painted inside the clarifier.
10.2.4 Sludge blow off pipe from clarifier to sludge sump.
10.2.5 600 NB of Minimum 1350-meter piping from Supernatant Transfer Pump to Cooling Tower basin (Cooling Tower area). (Refer Detail of Piping Length for Treated Water Indicated in P&ID of Coal Handling Plant Run-Off Water Treatment System).
10.2.6 300 NB of Minimum 650 meter piping up to Waste Service Water Sump (ETP Area). (Refer Detail of Piping Length for Treated Water Indicated in P&ID of Coal Handling Plant Run-Off Water Treatment System).
10.2.7 300 NB of Minimum 30-meter piping from Distribution chamber to nearest storm water drain. (Refer Detail of Piping Length for Treated Water Indicated in P&ID of Coal Handling Plant Run-Off Water Treatment System).
10.2.8 Inlet and outlet pipes for each sump, pits, pumps, other equipment, etc. with pipe connections to the respective sumps, pits, equipment.
10.2.9 Service water piping, instrument air piping, service air piping, potable water piping, etc. as applicable as per the Terminal Points.
10.2.10 In addition, any additional piping and associated accessories required to complete the system shall be in bidder's scope.

10.3 DESIGN CRITERIA AND TECHNICAL DETAILS

The proposed schematic arrangement of the CHP Run-Off Water Treatment System is detailed out in this specification. The P & ID for Coal Handling Plant Run-Off Water Treatment System (Dwg. No.- PE-DG-508-157-W001) is enclosed herein in this section for bidder's compliance.

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

10.3.1 STILLING CHAMBER

The stilling chamber shall be provided with a baffle wall so that water shall enter the chamber from the bottom and velocity of water rise through the stilling chamber shall be selected to avoid any turbulence of the incoming water and volume of stilling chamber shall have a retention time of 1 minute and velocity of water rise through the stilling chamber shall be 0.05 m/sec. Draining arrangement with a valve shall be provided for the stilling chamber.

10.3.2 REACTOR CLARIFIER UNIT

1) The clarifier shall be solid contact reactor type with integral variable speed impeller/ turbine to internally re-circulate water and sludge at adjustable rate to produce consistent water quality at varying hydraulic load and turbidity. The unit shall be designed with a minimum retention time of 90 minutes in the settling zone.
2) The overall area of the unit shall be based on an average flow velocity of 2.5 M3/M2/hr to 3 M3/M2/hr. Weir loading shall not exceed 300 M3/m/day. For uniform overflow over weirs, triangular notches (saw tooth weir) shall be provided as necessary.
3) Clear width of the bridge shall not be less than 1200 mm. All the Reactor Clarifiers shall be equipped with full bridge.

4) Design of the sludge removal system should be such as to reduce loss of water during sludge blow off within 3% of rated flow.
5) The clarifier periphery (all around) shall have a walkway (minimum width 1000 mm) with handrail and access ladder (RCC) (at least from two locations) for good approach. All the Reactor clarifiers shall be equipped with full bridge of sufficient width. Permanent ladders shall also be provided (not rungs) for approaching the sludge pipeline valves for maintenance. However, the sludge valves shall be operatable from the top of the sludge chamber through head stock and extended spindle arrangement.
6) The Clarifiers shall be provided with following features:
   I. The sludge blanket shall be suspended and maintained in the lower portion. The clarifier unit shall be circular, central feed type with concentric recirculation zone (rapid mixing), reaction zone (slow mixing) and clarification zone in RCC construction. Clarifiers shall be provided with radial launders.
   II. Bridge type rake arm and suitable equipment such as turbine/ impeller shall be provided for internal sludge recirculation.
   III. The design of the turbine/impeller shall be such as not to break the flocs during recirculation.
   IV. Suitable mechanism for varying the recirculation rate shall also be provided such that the reactor clarifier shall be capable of operating at varying hydraulic load and turbidity with consistent effluent quality.
   V. The bottom of clarifier shall be sloped towards the center and mechanically driven sludge scraper and collector shall be used to remove the settled sludge down the sloping bottom to the central sludge area. Rubber squeezer pads shall be provided on sludge scraper and skimmer.
   VI. Sludge removal system design shall consist of central sludge area with rotating pickets and back flush arrangement for proper control of sludge accumulation at the bottom. Suitable scum collecting arrangement shall be provided in the clarifying section for removal of floating debris, foam etc. if possible. The scrapper shall consist of blades which are inclined to the radius in the opposite direction to that of the floor scrapper.
   VII. The rake bridge and agitators shall be constructed of structural steel and suitably braced to provide rigidity.
   VIII. Sludge blow off shall be affected by the static head of water in the clarifier unit. Main sludge disposal line, which includes a blow-off valve, shall drain sludge to the sludge disposal pump sump. This is an intermittent operation. Continuous sludge disposal line consists of telescopic standpipe, the top of which is maintained at a desired elevation to ensure trickle flow of water or sludge water mixture to the sludge sump.
   IX. Suitable sampling connections from the various levels and zones of clarifier and at the outlet shall be provided for performance monitoring.
   X. Each of the clarifier shall be provided with a gate at the outlet for isolation of any of the clarifier for maintenance.

10.3.3 OVERHEAD WATER STORAGE TANK

The overhead tank in HDPE construction shall be provided on raised platform in the vicinity of chemical storage cum dosing shed. The water level in the tank shall be maintained by means of a float operated valve. The tank shall be provided with an overflow and drain connection with valve. The capacity of the overhead water tank shall 2 m3 (min.) to cater the water requirement such as

chemical preparation, flushing etc.

10.3.4 CHEMICAL STORAGE CUM DOSING SHED

1) Chemical dosing equipment, pumps, tanks, piping etc. of CHP Run-Off Water Treatment System shall be located in shed. The Chemical Storage cum dosing shed shall store chemicals and other dosing equipment, pumps, tanks etc. Suitable acid/alkali resistance lining/tiling shall be provided by bidder as per detail indicated elsewhere in the specification.
2) Bidder to consider the minimum clear Height of 5.5 m (Min) from FGL for chemical storage cum dosing shed. However, Bidder to ensure minimum 2.5 m clear height above the equipment/tank for suitably handling of agitator, motor etc.
3) Preparation & dosing equipment of each type of chemical shall be isolated/segregated to avoid mixing of chemicals, facilitate safe operation, easy movement of personnel during plant operation and emergency condition like chemical leakage etc.
4) Suitable platforms, ladders etc. to facilitate approach to various tanks, manholes/hand-holes, sight-glass, operation & maintenance of valves, instruments etc. shall be provided. Chemical storage cum dosing shed shall have sufficient unloading space, wide corridors for movement of chemicals.
5) Storage area (Alum, Lime, other chemicals etc.), Chemical preparation tanks area, Chemical drain trench & dyke wall shall be provided with corrosion resistant (AR) tiles/lining to protect the surface due to spillage/drains etc.
6) Drains from chemical storage & preparation facility/equipment shall be designed so that the same are not mixed with storm water drainage.
7) Chemical storage cum dosing shed shall be designed to store the chemicals for 15 days period considering working of all the clarifiers, filter press etc.
   a) Alum as Al2(SO4)3 : 70 ppm on 100% basis
   b) Lime as Ca(OH)2 : 30 ppm on 100% basis
   c) Synthetic Flocculent : 1 ppm
   d) Coagulant aid : 2 ppm
8) The overflow & drains from the various chemical tanks and floor wash drains of chemical storage cum dosing shed shall be led to CSSP.
9) Any other system/equipment required to meet the System requirement shall be provided.

10.3.5 CLARIFIER SLUDGE DISPOSAL SYSTEM

1) One (1) number RCC sludge pit in two (2) sections to collect sludge from all the clarifiers of CHP Run-Off Water Treatment system shall be provided. Sludge pit shall be able to store the sludge generated in clarifiers and any other drain/effluent connected to this sump. Each section of the pit shall be provided with agitation by recirculation (jetting nozzles) system and air agitation system.
2) Two (2) (1W + 1S) Air Blowers, common for Sludge Pit for air agitation system of the sludge pit to avoid settlement of solids, with piping, valves, instrumentation etc. with its internals (i.e.) casing, impeller, shaft etc. Blower speed shall be limited to 1500 rpm. Noise level of blowers should be limited to 85 dBA at 1 m from blowers. All the air blower shown in the P&IDs & referred in the technical specification, shall be provided in the acoustic enclosures.
3) Two (2) numbers of sludge feed pumps (2x100%) (1W+1S) (Vertical sump pumps) shall be provided to pump sludge to the Filter Press.

10.3.6 FILTER PRESS

1) The filter press (2 Nos) shall be used for dewatering the sludge coming out of preceding Sludge Sump. Each filter press shall be designed for the handling of total sludge generated while the other filter press will be under backwash/cleaning operation ensuring continuous desludging of the sludge generated.
2) The filter press shall be designed for continuous operation.
3) The feed shall be pumped into the filter press by the help of pumps. The filter press shall be located at an elevated platform. The solids from the filter press shall flow by gravity. The elevation of the filter press platform shall be at least 3.5 M above ground level so that clearance below the chute shall be suitable for truck/trolley movement. The centrate shall be sent back to clarifier by pumping.
4) For dewatering the fine suspended solids, suitable polyelectrolyte shall be dosed in the filter press. The solids cake discharge from filter press shall have minimum 20% to 25 % solids and shall be of tractable consistency.
5) The filter press shall be provided with washing lines which shall allow clearing of filter press.
6) The filter press shall be provided with anti-vibration arrangement for reducing the vibrations.
7) Polyelectrolyte dosing facility shall be provided. Necessary piping, pumps, valves, etc. shall be supplied by bidder for this purpose.
8) Suitable flushing connection with plug/tanks shall be provided for all pipe lines carrying sludge. Pressurized water supply for flushing shall be provided as shown in P&ID.
9) Suitable access rungs, ladder, platform, hand railing etc. shall be provided as per manufacturer's standard design.

10.3.7 The top water level in the distribution chamber shall be 4.5 meter (Min) from finished ground level. However, the exact level shall be decided during detail engineering.

10.3.8 The hydraulic circuit of the complete plant shall be designed in such a way that water from Stilling Chamber shall flow by gravity up to the distribution chamber under various flow rates up to maximum flow.

10.3.9 The effluent water from the CHP Run Off Water Treatment plant shall meet the guaranteed parameters specified elsewhere.

10.3.10 Layout for plant shall be designed in such a way that all units (e.g.- stilling chamber, clarifier, inlet channel, distribution chamber, sludge pit, Filter Press Platform etc.) shall be interconnected by at least 1 M wide walkway at appropriate elevations with hand-railing on both sides and pathway at ground level. Minimum head room clearance to be maintained.

10.3.11 Space available for the complete plant is indicated in attached layout tilted as "Layout for CHP Run-Off Water Treatment System ". Bidder to accommodate all facilities in given area.

10.3.12 All the chemicals to be used in the CHP Run- Off Water Treatment plant shall generally conform to the requirement of technical grade as per relevant IS.

10.3.13 All materials and components of valves, pumps, piping and other equipment and appurtenances shall be compatible with the respective fluid herein.

10.3.14 The pipelines routed in RCC trenches shall be provided with coating and wrapping. Road, Rail or pipe trench crossing be through trestle/RCC Hume pipes of appropriate pressure class and the pipe lines shall be provided with coating and wrapping as per specification.

10.3.15 Capacity of monorail hoists, chain pulley block wherever indicated in Datasheet– A are minimum and capacity of such hoists, chain pulley block etc. shall be suitable for handling 125% of maximum weight to be handled during erection and maintenance of the equipment in the pump house, buildings etc. as the case may be.

10.3.16 All the metallic parts of equipment of Complete CHP run-Off Water Treatment system, which are embedded in concrete or in contact with water, shall be painted with bitumastic heavy duty paint over a coat of primer with total thickness of 400 microns. All the other parts of the plant shall be

painted with one coat of primer and three coats of chlorinated rubber paint and total thickness shall be 200 microns.

10.3.17 All the tanks shall be provided with vent, overflow, drain and sample connections. Effective capacity for chemical tanks & water retaining structures/ tanks/ sumps means the capacity between the bottoms of the overflow nozzle to the top of the outlet nozzle. Outlet nozzle centre line shall be kept at least 200 mm from the Invert Level of the chemical tanks/ water retaining structures/ tanks/ sumps.

10.3.18 A minimum free board of 300 mm shall be provided in all the water retaining structures of CHP Run-Off Treatment Plant (such as Stilling chamber, all the channels, Clarifiers, Distribution chamber, overhead filtered water tank, Sludge sump, Chemical tanks etc.) above the maximum water level/ overflow level as the case may be excluding the thickness of the slab / beam thickness if any.

10.3.19 Maximum operating speed of all the pumps shall be limited to 1500 RPM or less unless specified otherwise.

10.3.20 Wherever local instruments for measurement of Flow, Pressure, Level is indicated in the P&ID, Bidder to provide Diaphragm seal type instrument for Chemical (all type and concentration), corrosive, viscous fluids application.

10.3.21 For calculation of pump head, bidder to follow the technical specification requirement. Wherever pipes are running on pipe rack, Bidder will consider 12 m static head, in addition to the losses in straight length and bend in pipes and valves etc. 10% overall margin shall be considered, while selection of pump head during detailed engineering.

10.3.22 The pumps shall be designed to operate under discharge valve open and close condition. Pump suction valves, re-circulation valves and discharge valves shall be provided with required limit switches for interlock & control.

10.3.23 The starting of pumps (wherever applicable) which are provided with forced water lubrication shall be interlocked with the availability of lube water by means of starting of lubrication water pumps, availability of adequate flow, pressure etc. The standby lubrication pump shall be started automatically during inadequate pressure or while tripping of working pump(s).

10.3.24 Vertical wet pit type pumps handling waste service water and decanted water shall be provided with forced water lubrication using a set of lubrication water pumps and an overhead tank filled from plant service water system.

10.3.25 Facilities for maintenance of the pumps by means of mobile cranes or jib crane or gantry cranes shall be provided based on pumps layout and as specified in Chapter titled ‘Layout Requirements'. Hoist, mobile cranes shall be generally conforming to the requirements specified in Chapter titled ‘Layout Requirements'.

10.3.26 Storage tanks shall be provided with vent, overflow, drain connections with required valves. Stair case, operating platform etc. shall be provided. Agitators shall be of SS-316 construction with motor driven reduction gear units.

10.3.27 Fasteners like bolts, nuts etc. shall be stainless steel for those coming in contact with water and for others high tensile carbon steel.

10.3.28 Base plate, sole plates for pumps, blowers etc. shall be carbon steel with epoxy coated.

10.3.29 Suitable permanent flushing connections shall be provided for all pipelines carrying sludge, acid and alkali.

10.3.30 Rotary type actuators for butterfly valves are also acceptable.

10.3.31 Max. support length in meters for MS pipe shall be as follows: -

a)	PIPE DIAMETER (MM)	1200	1000	800
b)	SPAN (METERS)	12	10	10

For pipe sizes less than 800 NB, span shall be as per ANSI B31.1.

10.3.32 Space available for CHP Run-off Water Treatment System is attached, elsewhere in this specification. Bidder to accommodate their equipment within the space provided. Further during

detail engineering some arrangement of facilities may have variation. Bidder to accommodate the same without any commercial & delivery implication.

10.3.33 Wherever gravity flow is not possible the bidder shall provide suitable storage & pumping system (2x100%) along with Piping, valves & instrumentation etc to meet the system & process requirement.

10.3.34 Service water shall be available near to CHP Run-off Water Treatment System / system building/ area at approximately 1.5 to 2.0 Kg/Cm2. Hence, bidder to take care for cooling/ lubrication of the pumps being supplied by the bidder under this technical specification. If service water pressure requirement is more than available pressure, bidder to consider two (2) nos. cooling pump/lubrication pump for CHP Run-off Water Treatment System.

10.4 TERMINAL POINTS

10.4.1 CHP Run-off Water Treatment System -As per P&I diagram of CHP Run-Off Water Treatment System.

10.4.2 Supernatant Transfer to CT basin – At the Cooling Tower Basin (Refer P&I diagram of CHP Run-Off Water Treatment System).

10.4.3 Supernatant Transfer to WSWS – At the Waste Service Water Sump Inlet (Refer P&I diagram of CHP Run-Off Water Treatment System).

10.4.4 Supernatant Transfer to Storm Water Drain – At the Nearest Storm Water Drain (Refer P&I diagram of CHP Run-Off Water Treatment System).

10.4.5 25 NB Instrument air supply at 5 to 7 kg/cm2 (g) – At 5-meter distance from CHPWT Plant Chemical storage cum Dosing shed. However, distribution and piping inside CHPWT Plant area shall be in bidder's scope.

10.4.6 25 NB Service air supply at 5 to 7 kg/cm2 (g) - At 5-meter distance from CHPWT Plant Chemical storage cum Dosing shed. However, distribution and piping inside CHPWT Plant area shall be in bidder's scope. If service air required is more than provided by BHEL, bidder to provide necessary compressors/blowers and associated valves, piping, fittings, flanges, instruments etc. to meet the system requirement.

10.4.7 Service water connection (40 NB connections) at 5 meter distance from CHPWT Plant Chemical storage cum Dosing shed. Piping inside CHPWT Plant area for mentioned services will be in bidder's scope.

10.4.8 Drinking water (or potable water) of 40 NB connections to CHPWT Plant - At 5 meter distance from CHPWT Plant Chemical storage cum Dosing shed. However, distribution and piping inside CHPWT Plant area shall be in bidder's scope.

10.5 CONTROL & OPERATION

Treatment plant shall be controlled from DDCMIS (BHEL Scope) located at water system control room. The control & operation of various systems described below is indicative only and the actual control & operation philosophy shall be finalized with during detailed engineering. However, for all the systems, following basic process related interlocks, alarms /pre-warning signals shall be implemented in the control system as per system requirement.

All the drives shall be started and stopped from DDCMIS (BHEL Scope).
The following pumps shall be started and stopped from DDCMIS (BHEL Scope).

a. Alum dosing pumps.
b. Lime dosing pumps.
c. Flocculent dosing pumps.
d. Sludge transfer pump.
e. Blowers for sludge pit.

f. Supernatant Transfer Pumps.

In addition to above Local Emergency Stop facility from individual pump shall be provided.

The following shall be monitored and controlled from DDCMIS (BHEL Scope).

1) Agitators of chemical dosing tanks.
2) The motor operated inlet control valve to clarifiers shall be regulated with respect to the water level in the distribution chamber. A variable frequency drive (VFD) shall be provided for turbine/impeller drive of all the clarifiers to control the speed for varying the recirculation rate. The scrapper drives of clarifiers shall be interlocked with torque limit switches on the motors.
3) All the pumps shall be interlocked with the level at sump/reservoir/tank for pumps start permissive as well as pump protection. Annunciation prior to trip shall also be provided.
4) Agitator can be started only when the level in the corresponding dosing tank is adequate. The agitator shall trip when the level in the dosing tank comes below a pre-defined set point.
5) Capacity of the metering pump shall be controllable from 10-100% continuously by adjusting the stroke length manually by a micro meter dial calibrated for 0–100% of pump capacity integral with the pump.
6) Various annunciations related to low level of the chemical tanks shall be provided.
7) Each High Rate Solid Contact Clarifier (HRSCC) will have a local control panel, VFD and other part of panel accessories. The local control panel will be provided with a Remote/Local selector switch on panel. When the switch is in “Local” position, the flocculator operation will be from Local panel, however, when the selector switch is in “Remote” position, it will be controlled from DCS. This is related to flocculator operation only. However, the Rake drive will not have any local operation, it will be operated from DCS only.
8) A mimic with the status of drives including ON, OFF, TRIP indication of respective motors/pumps and control valve shall be provided on the DDCMIS.
9) Torque trip for all the clarifier shall be provided.
10) All the dosing pumps shall be capable of being adjusted manually to any out put with in the stated range.
11) All pumps shall trip at level low in respective tanks or Sumps.
12) Alarms pertaining to tank/sump- Very High (VH), High (H), Low (L), Very Low (VL) shall be indicated in Treatment Plant DDCMIS.
13) Among the equipment, it shall be possible to select a specific pump or tank or sump for working/standby/ maintenance etc. through control system.
14) **Permissive & Interlocks:**
    a. Starting & tripping of pumps with respect to liquid level in the respective sump/tanks or liquid pressure in the suction lines.

    b. Starting & tripping of agitators with respect to liquid level in the respective sump/tanks.

    c. Starting & tripping of pumps (which are provided with forced water lubrication) with respect to lubricating water flow (through low pressure/low flow signal as the case may be).

    d. Tripping of pumps when the discharge pressure is very high to avoid operation of the pump under shutoff head.

    e. Stopping/ tripping of equipment due to abnormal parameters related to safety of equipment like high vibration, very high bearing lubrication water (and /or oil) temperature to the

drive/pumps, very high bearing temperature of the of pump/drive etc as applicable based on the recommendations of Equipment Supplier.

f. Automatic opening of the re-circulation valve to pre-set percentage, in case of failure of opening of pump(s) discharge valve to ensure minimum flow through the pump, as per the recommendation of manufacturer.

g. Automatic starting of standby pumps upon failure of starting of selected pump or tripping of running pump as the case may be.

15) **Alarms /Signals:**

a. 1) Abnormal parameters such as low & high level in tanks/sumps, high pressure at pump discharge, low header pressure, low lubrication water flow to pumps (provided with forced water lubrication system) etc.

b. Failure of starting of equipment such as pumps, blowers etc. upon start command.

c. Tripping of equipment due to protection logic.

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

11. PRETREATMENT PLANT (PTP/ WTP)

The Pre-treatment plant would be designed to remove suspended/colloidal matter in the raw water. Pre-treatment plant shall be provided for Circulating water system (PT-CW System) and Demineralised water system (PT-DM system). The plant shall consist of clarifiers for PT-CW & PT-DM system.

REFERENCE DOCUMENTS

A. PE-DG-508-158-W001 : P & ID FOR PRE TREATMENT PLANT
B. DATASHEET – A : FOR ABOVE SYSTEM
C. PE-DG-508-100-M001 : PLOT PLAN

11.1 SCOPE OF SUPPLY (MECHANICAL)

Bidder to note that Pre-treatment Plant for cooling water system (PT-CW), DM system (PT-DM) & potable water system (PT-Potable) shall include associated Mechanical, Electrical, Control & instrumentation work. All the work i.e. Mechanical work, C&I, Electrical works (refer electrical, C&I for respective scope), Broad scope of supply has been listed below: -

11.1.1 Raw water inlet piping to each aerator complete with piping, fitting and valves. Each inlet piping is to include motorized butterfly type control valve (With Position Transmitters) with manual upstream and downstream isolation valves along with by-pass motorized butterfly valve with necessary instrumentation.
11.1.2 Two (2) number Aerator and Two (2) number stilling chamber of RCC Construction of required capacity along with isolation gates at the inlet channels for PT-CW & PT-DM system clarifiers.
11.1.3 Channel from Aerator to Stilling Chamber as per P & ID enclosed for pre-treatment plant.
11.1.4 Four (4) numbers of inlet chambers of RCC Construction.
11.1.5 Pipes from Inlet Chamber to each Clarifier.
11.1.6 Four (4) numbers of inlet channels with flow measuring element in each channel (parshall flume) of RCC Construction.
11.1.7 One (1) number bypass channel of RCC Construction to by-pass PT-CW clarifier(s) with required isolation gate(s).
11.1.8 One (1) number bypass channel of RCC Construction to by-pass PT-DM clarifier with required isolation gate(s).
11.1.9 Four (4) nos. High Recovery Solid Contact Type Clarifiers with sampling points at different elevation of clarifiers.(03 Nos. For PT-CW & 01 No. for PT-DM as detailed in specification.)
11.1.10 Clarifiers bridges assemblies, hand railings, required motors, valves, piping, insert plates, instrumentation etc.
11.1.11 Outlet channels of RCC Construction from Clarifiers up to the Clarified Water Storage Tank/Clarified water distribution chamber, PT-DM & PT Potable Gravity Filters.
11.1.12 Interconnection between the clarified water outlet channel and outlet channel of PT-DM System.
11.1.13 Sludge disposal system from clarifiers, with piping, valves, instrumentation up to sludge collection pit as indicated in P & ID of Pre-treatment plant.
11.1.14 One (1) no. RCC Sludge Pit (in twin section) with common sump interconnected through valves along with Puddle pipes etc..
11.1.15 Two (2) Air Blowers for air agitation system of the sludge pit & backwash sump with acoustic enclosure, piping, valves, instrumentation etc.
11.1.16 Three (3) nos. Sludge Disposal Pumps with piping, valves, fittings and instrumentation up to ash slurry sump/tank.
11.1.17 Two (2) nos. Gravity Filters (twin section) of RCC construction including necessary shuttering plates & filter medium with piping, Nozzles, instruments, valves, etc. up to Filter Water Reservoir of potable water.
11.1.18 One (1) number filtered water reservoir (in twin sections located below the filters) of RCC

Construction of each of required capacity, filtered water sump and common filtered water pump house for PT–Potable water & PT DM systems.

11.1.19 Two (2) number of air blowers of oil free type of required capacity, its drives and associated accessories, air (Galvanised CS) piping from blowers to each section of the PT- Potable Gravity filters for air scouring of filters during backwash operation.

11.1.20 Two (02) Nos Potable Water Pumps for Plant along with motors, piping, valves, fittings, instrumentation etc.

11.1.21 Two (02) Nos Potable Water Pumps for PT ClO2 feed along with motors, piping, valves, fittings, instrumentation etc.

11.1.22 One (1) no. conductivity analyser (indicating corresponding TDS values) (Range 0-2000 ppm) is to be provided at the outlet of potable water pumps discharge header. Analysers shall be provided in air-conditioned panel/ cabinet. Air conditioning equipment required for analysers panel shall be in bidder's scope

11.1.23 Two (2) nos. Gravity Filters (twin section) including necessary shuttering plates & filter medium with piping, instruments, valves, etc. up to Filter Water Reservoir of DM plant.

11.1.24 One (1) number filtered water reservoir (in twin sections located below the filters) of RCC Construction of each of required capacity, filtered water sump and common filtered water pump house for PT–Potable water & PT DM systems.

11.1.25 Two (2) number of air blowers of oil free type of required capacity, its drives and associated accessories, air (Galvanised CS) piping from blowers to each section of the PT- DM Gravity filters for air scouring of filters during backwash operation.

11.1.26 Required interconnecting air (Galvanised CS) piping, valves, instrumentation etc from the blowers to each Gravity filter for air scouring of filters during backwash operation for both PT-Potable & PT-DM Gravity Filters.

11.1.27 One (1) number electrically operated monorail hoist along with mono rail and trailing cable (common for both PTDM & PT-Potable System) in gravity filters pump house of required capacity for handling all the pumps, blowers, drives etc.

11.1.28 Pipe & Valves to facilitate future expansion for both PT DM & PT-Potable System, as detailed in tender specification.

11.1.29 One (1) no. RCC Filter Backwash Pit (in twin section) for both PTDM & PT-Potable System with common sump interconnected through valves along with Puddle pipes etc..

11.1.30 Three (3) nos. Filter Backwash Pumps with piping, valves, fittings and instrumentation up to Stilling Chambers of PT-CW & PT-DM Clarifiers.

11.1.31 One (1) no. two story chemical house building to store chemicals, tanks, pumps, etc. for both Pre-treatment plant. Along with the chemical tanks (Other than RCC), dosing pumps, transfer pumps, instruments, piping, valves, platforms along with handrails, weighing & handling equipment, ladders, piping supports, puddle pipe auxiliary structures for pipe fixing etc. along with all structural steel, inside the chemical house shall be in the scope of bidder.

11.1.32 Two (2) nos. Lime slaking tanks (RCC Construction is in BHEL's Scope) with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the Lime preparation tank.

11.1.33 Two (2) nos. Lime slurry transfer Pumps with Piping, valves & instrumentation etc.

11.1.34 Three (3) nos. Lime Solution dosing Tanks (RCC Construction is in BHEL's Scope) with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the Clarifiers.

11.1.35 Two (2) nos. Lime dosing Pumps with Piping, valves & instrumentation etc.

11.1.36 Four (4) nos. Alum Solution Preparation Tanks (RCC Construction is in BHEL's Scope) with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the Clarifiers.

11.1.37 Six (6) nos. Alum Dosing Pumps [4 nos. (3W + 1S) for PT-clarifiers of CW system], [2 nos. (1W + 1S) for PT-clarifiers of DM system (in case of Ion exchange based DM Plant)] with Piping, valves & instrumentation etc.

11.1.38 Two (2) nos. FeCl3 Tanks with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the DM Clarifiers for Option-2 (UF+RO+MB BASED DM PLANT)

11.1.39 Two (2) nos. FeCl3 dosing Pumps with Piping, valves & instrumentation etc for all the clarifiers Option-2 (UF+RO+MB BASED DM PLANT).

11.1.40 Two (2) nos. Coagulant aid Preparation Tanks with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the all Clarifiers.

11.1.41 Two (2) nos. Coagulant aid dosing Pumps with Piping, valves & instrumentation etc for all the clarifiers.

11.1.42 Two (2) nos. PAC storage Tanks with flushing arrangement, instrumentation, valves, fittings and piping up to the all Clarifiers.

11.1.43 Two (2) nos. PAC unloading Pumps with Piping, valves & instrumentation etc for all the clarifiers.

11.1.44 Two (2) nos. PAC Preparation/dosing Tanks with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the all Clarifiers.

11.1.45 Two (2) nos. PAC dosing Pumps with Piping, valves & instrumentation etc for all the clarifiers.

11.1.46 One (1) No. Filtered Water Overhead Storage Tank (RCC Construction is in BHEL's Scope). The associated float type valve, overflow & drain arrangement, valves, instrumentation etc shall be in bidder's scope.

11.1.47 Two (2) nos. Weighing Scales, two (2) nos. electrically operated monorail hoist with trailing cable in chemical house for Pre treatment plant.

11.1.48 Two (2) nos. flushing pumps shall be provided by the bidder for flushing chemical and sludge lines including connection of all drains through a common header to stilling chamber/sludge sump.

11.1.49 Mandatory spares. .(Refer attached, Annexure-V/Section-C1).Bidder to consider all applicable spares, in case any spares is not applicable the relevant equivalent spares shall be provided by bidder within quoted price.

11.1.50 All motorized valves to be supplied with Non-intrusive Profibus based Electric Actuator for PT plant package along with necessary interface units for linking to corresponding Control System as applicable.

11.1.51 Bidder to provide Profibus based PT (Pressure Transmitters)/ DPT (Differential Pressure Transmitters/TT (Temperature Transmitters) for entire PT Plant package.

11.1.52 Operating platforms shall be provided for all the structures such as aerator, stilling chamber, clarifier, sludge chamber, thickener etc. along with ladders and hand railing.

11.1.53 All channels & brackets, mounting plates as required for mounting of motors, pumps, stirrers, tank etc.

11.1.54 Four (4) 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 the bidder. Two (2) number safety shower units and adequate nos. of eye fountains to protect against any chemical hazard shall also be provided by the bidder.

11.1.55 Tentative Space/Arrangement available for gravity filter house and chemical house is attached, elsewhere in this specification. Bidder to follow the same during detail engineering.

11.1.56 All other things are also included in scope of supply as specified in other part of the specification including under design criteria and technical details.

11.2 PIPING

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

a. All piping within the Pre-Treatment Plant.
b. Puddle pipe, Inlet and outlet pipes, for each sumps, pits, pumps, other equipments, etc. with pipe connections to the respective sumps, pits, equipment.
c. Minimum 900 NB of 20 meter Raw water inlet piping to PT plant clarifiers as per Terminal point.
d. Carbon Steel Pipe from inlet channel/chamber to clarifier inlet shaft, encased with concrete for buried portion and externally epoxy painted inside the clarifier. However, concrete encasing shall be in BHEL scope.

e. Sludge from PTP Sludge Pit shall be transferred to unitized ash slurry sumps. The provision to be made to transfer total sludge to each ash slurry sumps. Total pipe of 800 meters to be provided by bidder to transfer PT sludge to ash slurry sump Unit 1 and 2. Bidder to refer P & ID for arrangement required. Other details have been attached elsewhere in the tender technical specification.
f. Service water piping, instrument air piping, service air piping, potable water piping, etc. as applicable as per the Terminal Points.
g. Filtered water transfer piping from filtered water storage tank to DM plant shall be in bidder's scope and pipe distance of 200 m shall be considered by bidder.
h. 550 meter piping from filtered water sump to ClO2 building as per terminal point.

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

11.3 TERMINAL POINTS

a. PT Plant inlet-As per P&I diagram of Pre Treatment Plant. (Pressure at inlet of control valves station shall be of 1.2 kg/cm2 (g).
b. Filtered water to DM plant- As per P&I diagram of Pre Treatment Plant.
c. 25 NB Instrument air supply at 5 to 7 kg/cm2 (g) – At 5 meter distance from PT Plant Chemical House. However distribution and piping inside PT Plant area shall be in bidder's scope.
d. 25 NB Service air supply at 5 to 7 kg/cm2 (g) - At 5 meter distance from PT Plant Chemical House. However distribution and piping inside PT Plant area shall be in bidder's scope. If service air required is more than provided by BHEL, bidder to provide necessary compressors/blowers and associated valves, piping, fittings, flanges, instruments etc. to meet the system requirement.
e. Service water connection (40 NB connections) at 5 meter distance from PT Plant Chemical House. Piping inside PT Plant area for mentioned services will be in bidder's scope.
f. Drinking water (or potable water) of 40 NB connections to PT Plant - At 5 meter distance from PT Plant Chemical House. However, distribution and piping inside PT Plant area shall be in bidder's scope.
g. Potable water pipe to Plant shall be terminated at 5 meter from pump discharge. The pressure at Terminal Point will be 6 Kg/cm2(g) with respect to the elevation FGL.

11.4 GENERAL DESIGN REQUIREMENT OF PT SYSTEMS

a. The Pre-treatment plant would be designed to remove suspended/colloidal matter in the raw water. Gravity Filters shall be envisaged for DM and Potable water system. The filtered water shall be used in DM plant to produce demineralized water of specified quality. Chemical house and Filter house shall be RCC buildings.

b. The hydraulic circuit of the complete Pre-treatment plant shall be designed in such a way that Water from aerator shall flow by gravity up to the clarified water storage tank (for PTCW) and Filtered Water sump (for PT–DM & PT-Potable) under various flow rates up to maximum flow. The system shall be designed with Top water level in the Clarified water storage tank as (+) 4.5 M from the FGL or higher. Maximum water level in the filtered water reservoirs shall not exceed the local FGL. Hydraulics of the Complete PT system shall be designed to take an occasional over loading of 20% over the design flow.

c. All the clarifiers shall be designed to operate simultaneously. PT plant shall be designed such that following units can be bypassed if required a) Any one clarifier/two clarifiers/all clarifiers of PT-CW system b) Clarifier PT-DM system c) Interconnection of Clarifiers of various system(s)

d. Pre-treatment Plant should be designed to run continuously.

e. The various units of PT plant like Aerator, Stilling chambers, Clarifiers, inlet channels, Chemical house first floor, Gravity filter operating floor, Clarified water tank etc. shall be interconnected by at least 1 M wide walkway at appropriate elevations with hand-railing on both sides and pathway at ground level as required by Employer.

f. Raw water temperature varies seasonally from 10 deg C to 36 deg C.

g. Cascade aerators shall be designed based on the surface flow rate of not less than 0.03 m2/m3/hr. The velocity of water rise through the stilling chamber shall be 0.05 m/sec and volume of stilling chamber shall have a retention time of 1 minute.

h. The Chemical unloading pumps area shall be provided with a kerb wall and the kerbed area shall also be provided with Acid proof lining. Suitable dyke wall/barrier shall also be given in between chemical tanks to avoid any kind of mixing.

11.4.1 REACTOR CLARIFIER UNIT

a. The unit shall be designed with a minimum retention time of 90 minutes in the settling zone. Larger retention time may be provided to meet the equipment guarantee.

b. The overall area of the unit shall be based on an average flow velocity of 2.5 m3/m2/hr to 3 m3/m2/hr. Weir loading shall not exceed 300 m3/m/day. For uniform overflow over weirs, triangular notches (saw tooth weir) shall be provided as necessary.

c. Clear width of the bridge shall not be less than 1200 mm. All the Reactor Clarifiers shall be equipped with full bridge.

d. Design of the sludge removal system should be such as to reduce loss of water during sludge blow off within 3% of rated flow.

e. The clarifier periphery (all around) shall have sufficient width (minimum 850 mm) to have an easy walkway for general inspection. The walkway shall be provided with handrails along with periphery access (staircase) at least from two (2) locations with platforms and hand railing for the clarifiers for good approach. Permanent ladder shall also be provided (not rungs) for approaching the sludge pipeline valves for maintenance.

f. The sludge valves shall be operatable from the top of the sludge chamber through head stock and extended spindle arrangement.

11.4.2 CHEMICAL HOUSE

a. The storage rooms shall have suitable bins/partitions sufficiently large to accommodate for lime and alum. The chemical house shall have sufficient unloading space, wide corridors for movement of chemicals, office, toilet etc. as required.

b. In the first floor of chemical house, all chemical preparation tanks and dosing equipment shall be located. Suitable staircases, walkways, platforms etc. shall be provided to have clear access to different units.

c. Quick lime (purity of 75% CaO) shall be dissolved in the slaking tanks and the resultant slurry (about 10% W/V) from the slaking tanks shall be transferred to the lime solution preparation tanks by the lime slurry transfer pumps. The lime solution dosing system shall be of re-circulating type.

d. Alum solution preparation tanks and dosing equipment shall be sized for a continuous alum dosage of 70 ppm considering the clarifiers to be operating at the maximum capacity.

e. Operating platforms shall be provided for all the structures such as Aerators, Stilling chambers, Clarifiers, Sludge chamber etc. along with step ladders and hand railings. All the sumps, tanks, reservoirs, and other water retaining structures shall be provided with approach ladders (i.e. step ladders with hand railing) from operating platforms/ground level.

f. All the metallic parts of equipment of Pre-treatment plant (PT) and effluent treatment plant (ETP) which are embedded in concrete or in contact with water shall be painted with three coats of bitumastic heavy duty paint over a coat of primer to prevent corrosion unless otherwise specified and total thickness shall be 400 microns.

g. All the other parts of the PT Plant and ETP shall be painted with one coat of primer and three coats of chlorinated rubber paint and total thickness shall be 200 microns. The concrete parts encountering water shall be painted with three (3) coats of bitumastic heavy-duty paint of 400 microns thick.

h. All the tanks shall be provided with vent, overflow, drain and sample connections. Effective capacity for chemical tanks & water retaining structures/ tanks/sumps means the capacity between the bottoms of the overflow nozzle to the top of the outlet nozzle. Outlet nozzle center line shall be kept at least 200 mm from the Invert Level of the Chemical tanks /Water retaining structures /Tanks/Sumps. A minimum free board of 300 mm shall be provided in all the water retaining structures of Pre-treatment plant and Effluent treatment plant above the maximum water level at design flow condition/overflow level.

i. Maximum operating speed of all the pumps shall be limited to 1500 rpm or less unless specified otherwise.

j. Various equipment in the PT Plant will be sized for the following minimum Chemical Dosing Requirements:

a)	Alum	70 mg/litre on 100% basis
b)	Lime	30 mg/litre on 100% basis

k. For all pumps, while calculating the pump head, 10% margin shall be considered on friction losses.

l. The maximum support length in meters for MS pipe shall be as follows

a)	Pipe dia (mm)	1200	1000	800
b)	Span (meters)	12	10	10
For pipe sizes less than 800 NB, span shall be provided as per ANSI B31.1				

11.4.3 GRAVITY FILTER

a. The inlet channel from clarifiers to gravity filters shall be designed considering operation of all the gravity filters including standby filters under exigency.

b. Only one filter shall be backwashed at a time. Backwashing of filters shall be done in not less than 24 hours. The velocity of water during backwashing shall not exceed 35.0 m/hr., when air scouring is employed. Air blower shall be used for air scouring of filter bed.

c. At least 50% free board shall be left over the filtering media to facilitate backwashing. The filtering medium shall be washed, screened, and hydraulically graded anthracite coal or sand having an aggregated depth not less than 1200 mm.

d. Anthracite shall have the following properties: -

Uniformity coefficient	1.6
Hardness	2.5 to 3.5 (Mho scale)
Dust content	Less than 1%
Specific gravity	1.75 (Approx.)

Anthracite shall be free from iron sulfide, clay, shale, long, thin or scale pieces

e. Sand shall have the following properties: -

Sand shall be of hard and resistant quartz or quartzite and free of clay particles, soft grains, and dirt. Effective size shall be 0.45 to 0.70 mm. Uniformity coefficient shall not be more than 1.7 or less than 1.3. Ignition loss should not exceed 0.7 per cent by weight. Soluble fraction in hydrochloric acid shall not exceed 5.0% by weight. Silica content should not be less than 90%. Wearing loss shall not exceed 3%. Specific gravity shall be in the range between 2.55 to 2.65.

Sand should be clean and well graded. Sand filter shall have a HCL solubility of less than 5% when tested in accordance with AWWA B 11.53.

11.5 OTHER DESIGN AND CONSTRUCTION FEATURES

11.5.1 AERATOR & STILLING CHAMBER

The aerator shall be of stepped design and shall allow water to flow downward after spreading over inclined thin sheets and the turbulence is secured by allowing the water to pass through a series of steps and baffles. The chlorine di-oxide dosing shall be done in the stilling chamber before and after aerator by using diffusers of proven design.

11.5.2 CLARIFIERS

The clarifier shall be solid contact reactor type with integral variable speed impeller/ turbine to internally re-circulate water and sludge at adjustable rate to produce consistent water quality at varying hydraulic load and turbidity.

The Clarifiers shall be provided with following features:

a. The sludge blanket shall be suspended and maintained in the lower portion. The clarifier unit shall be circular, central feed type with concentric recirculation zone (rapid mixing), reaction zone (slow mixing) and clarification zone in RCC construction. Clarifiers shall be provided with radial launders.

b. Bridge type rake arm and suitable equipment such as turbine/ impeller shall be provided for internal sludge recirculation.

c. The design of the turbine/impeller shall be such as not to break the flocs during recirculation.

d. Suitable mechanism for varying the recirculation rate shall also be provided such that the reactor clarifier shall be capable of operating at varying hydraulic load and turbidity with consistent effluent quality.

e. The bottom of clarifier shall be sloped towards the centre and mechanically driven sludge scraper and collector shall be used to remove the settled sludge down the sloping bottom to the central sludge area. Rubber squeezer pads shall be provided on sludge scraper and skimmer.

f. Sludge removal system design shall consist of central sludge area with rotating pickets and back flush arrangement for proper control of sludge accumulation at the bottom. Suitable scum collecting arrangement shall be provided in the clarifying section for removal of floating debris, foam etc. if possible. The scrapper shall consist of blades which are inclined to the radius in the opposite direction to that of the floor scrapper.

g. The rake bridge and agitators shall be constructed of structural steel and suitably braced to provide rigidity.

h. Sludge blow off shall be affected by the static head of water in the clarifier unit. Main sludge disposal line, which includes a blow-off valve, shall drain sludge to the sludge disposal pump sump. This is an intermittent operation. Continuous sludge disposal line consists of telescopic standpipe, the top of which is maintained at a desired elevation to ensure trickle flow of water or sludge water mixture to the sludge sump.

i. Suitable sampling connections from the various levels and zones of clarifier and at the outlet shall be provided for performance monitoring.

j. Each of the clarifier shall be provided with a gate at the outlet for isolation of any of the clarifier for maintenance.

11.5.3 FILTERS BACK WASHING

a. Filter Box shall be of watertight RCC structure. Gravity Filters of Potable Water System & DM System shall be covered with RCC roof.

b. The capacity of the overhead filtered water tank shall meet the backwash flow rate for simultaneous backwash of one (1) number of gravity filter (both the sections) each of Potable System and DM system.

c. The inlet distribution shall be designed to give uniform distribution and flow without channeling and obstruction. Proven type under drain collecting system provided.

d. Each filter bed outlet shall be provided with rate of flow controller and rate of flow indicator and a loss of head gauge. The manual extension spindles of all the valves of filters shall be operatable from the operating floor of filter bed. Each of the Gravity filter shall be provided with drain connections with isolating valves for draining complete filter water channel and filter bed.

e. Platform over each of the gravity filters with hand railing shall be provided for the inspection of backwashing operation and filter bed. These platforms shall be approachable from the operating floor of gravity filters through doors.

f. Only valves shall be used for different process of filters. Suitable sampling point with sample valve shall be provided at the effluent of each filter.

11.5.4 FILTERED WATER SUMPS

Filtered water from the two (2) sections of the filtered water reservoir shall enter the sump through two (2) numbers of isolation valves.

11.5.5 OVERHEAD FILTERED WATER STORAGE TANK

The overhead tank shall have approach from chemical house through permanent staircases (RCC) and door.

11.5.6 OVERFLOW & DRAIN DISPOSAL SYSTEM

The overflow & drains from the various chemical tanks and floor wash drains shall be led to the PT Plant clarifier sludge sump. The overflow & drains from structures and piping handling clear raw water, clarified water and filtered water in the Pre-treatment plant such as Stilling chamber, Inlet chamber shall be led to the filter backwash sump. The overflow & drains from the filtered water reservoir, filtered water sump etc. shall be led to the filter backwash sump. Overflow from filtered water overhead tank shall be led to the inlet channel of Gravity Filters of PT-DM. Concrete sewerage pipe/Hume pipe shall not be used for any of the drain disposal system.

11.5.7 PT PLANT CLARIFIER SLUDGE DISPOSAL SYSTEM

One (1) number sludge pit, in twin sections shall be provided to collect the sludge from all the clarifiers/tube settlers/lamella periodically. The sludge shall be transferred to the unitized ash slurry sumps by means of sludge transfer pumps. Provision to be made to transfer complete sludge in each ash slurry sump (unit-1 & 2). Each section of the pit shall be provided with agitation by recirculation (jetting nozzles) system and air agitation system. Two (2) numbers air blowers shall be used for the air agitation system of the sludge pit.

11.5.8 FILTER BACKWASH WATER DISPOSAL SYSTEM

Filter backwash water shall be led to a separate sump (twin section). Each section of the sump shall be provided with agitation by recirculation (jetting nozzles) system and air agitation system. Air blower shall be used for the air agitation system of the sump.

11.5.9 OTHER STORAGE TANKS

The water tank shall be provided with access rungs and dewatering pits.

12. DM PLANT

The bidder shall provide either Ion exchange-based DM plant or RO based DM plant. The capacity of DM plant either by Ion exchange process or RO process shall be sized to meet the capacity mentioned elsewhere in the specification.

REFERENCE DOCUMENTS

A. DATASHEET-A
B. P & ID OF DM PLANT (9587-999-POM-A-002 & 9587-999-POM-A-003)
C. PLOT PLAN

12.1 SCOPE OF SUPPLY

Broad scope of supply (mechanical) for this package is detailed below and as indicated in relevant portion of this specification. Please refer Electrical and C&I specifications also for respective scope of Electrical and C&I items.

DM Plant (either by Ion exchange process or RO process) & DM plant regeneration system shall be kept under steel shed open from sides and Bulk Chemical Storage Tanks and associated unloading system shall be located outdoor. Reject from RO plant shall be recycled and reused in coal handling plant suitably. Pump houses shall be envisaged under steel shed unless otherwise specified.

A) OPTION – 1 (ION EXCHANGE BASED DM PLANT)

Ion Exchange Demineralising Plant (2x100%) shall be provided. Weak acid Cation exchangers, Strong acid Cation exchangers, Weak base anion exchangers, Strong base anion exchangers shall be designed for 12 hours of operation cycle followed by 4 hours regeneration period. MB unit shall be regenerated after minimum 108 hours of operation followed by regeneration period not exceeding 6 hours.

a. Three (3) numbers (3X100%) (1Working + 2Standby) DM Plant Supply (Feed) pumps (Filtered Water Pumps) along with motors, piping, valves, fittings, instrumentation & all other accessories as required.
b. Two (2X100%) numbers of Activated carbon filters with all accessories.
c. Two (2X100%) numbers of Weak Cation exchanger units & Two (2X100%) numbers of Strong Cation exchanger units with all accessories.
d. Two (2X100%) numbers of Degasser system comprising of Degasser Tower, storage tank, Air Blowers [two (2X100%) numbers per degasser tower] & its drives and Three (3X100%) numbers of Degassed water transfer pumps & its drives with all accessories.
e. Two (2X100%) numbers of Weak Anion exchanger units & Two (2X100%) numbers of Strong Anion exchanger units with all accessories.
f. Two (2X100%) numbers of Mixed bed unit along with Two (2X100%) numbers air blowers with its drives and all accessories.
g. Two (2) numbers of UF feed Tanks complete with all accessories, three (3X50%) nos. ultrafiltration UF feed pumps complete with drive motors and accessories as required, two (2X100%) nos. Ultrafiltration skids (Polishing UF) complete with all necessary piping, valves and, instrumentation etc.
h. Two (2X100%) nos. UF backwash pumps, two (2X100%) nos. of UF fast flush pumps (if applicable) complete with drive motors and accessories as required.
i. One (1) no. UF CIP/ CEB system for chemical cleaning with tanks, agitators with motor, piping arrangements with accessories, two (2) nos. (2X100%) CIP/ CEB pumps complete with drive motors.

j. Complete Hydrochloric acid handling, bulk acid storage tanks, measuring tank, and dosage system with three (3) bulk acid tanks, each tank sized for minimum 50T or capacities of all tanks together shall be sized for one-month storage, whichever is higher. The tank shall be fitted with vent, drain, fume absorber, overflow seal pots etc., Two (2) nos. Acid measuring cum dilution tanks, one each for Cation units and MB units, 2X100% Dosing/Metering pumps with associated accessories each, two (2X100%) acid unloading pumps with 50 mm dia. Heliflex hoses of 30m length.

k. Complete Alkali handling, storage, and dosage system with two (2) bulk alkali tanks, each tank sized for minimum 50T OR capacities of both tanks together shall be sized for one-month storage, whichever is higher. The tank shall be fitted with vent, drain, CO2 absorber, overflow seal pots etc. Two (2) nos. alkali measuring cum dilution tanks with a motorized agitator, one each for each Anion units and MB units. One (1) no. alkali preparation and dilution tanks (from alkali flakes), with dissolving baskets & motorised agitators, one (1) number of activated carbon filter for alkali, one (1) number of alkali diluent water heating tank, 2X100% metering pumps with associated accessories, two (2X100%) alkali unloading pumps with 15 mm dia. Heliflex hoses of 30 m length.

l. Two numbers of safety shower units and two numbers of Eye- fountains to protect against any chemical hazard.

a. Two nos. (2X100%) DM water pumps for regeneration system and its drives.

b. Neutralizing waste disposal system - All DM plant Effluent drains (except backwash water from AC filters and fast/final rinse waste water of Ion-Exchangers units) shall be connected to the Neutralisation Pit. Neutralised waste shall be pumped to Ash Slurry Sump/ tank. Additionally, provision for diverting N-Pit waste to CMB shall also be provided. UF back wash water shall also be led to this N-Pit.

c. Backwash water from AC filters and fast/final rinse waste water of Ion-Exchangers units shall be connected to the backwash sump and same shall be led into the inlet channel of PT-DM clarifier of Water Pre-treatment Plant.

d. First fill of filter media for AC filters & First fill of resins for all Ion Exchange units.

e. Interconnecting piping, valves, fittings and accessories including Pre-Cast RCC pipes at road crossing as required.

f. Supply and application of final painting to all the equipment, piping & accessories.

g. All approach ladders and operation/maintenance platforms, handrails as required for various equipment, valves and instruments, support trestles, bridges, brackets, bolts, nuts, clamps etc. for the associated piping are under bidder's scope.

h. One (1) No Filtered Water Overhead Tank (MOC: RCC by BHEL) Complete valves, fittings, instrumentation and all other accessories for Priming and Chemical (Lime) preparation purpose in DM Plant.

i. Two (2x100%) numbers of backwash disposal pumps shall be provided. Two (2) numbers air blowers (2x100%) for the air agitation system of the filter backwash pit shall be provided.

j. Safety equipment as per Data Sheet.

k. One (1) no. Central Sampling Rack.

l. Provision of hot water supply to the ACF units from the hot water tank shall be made for rejuvenation of activated carbon and the DM regeneration pumps to be sized considering above requirement in addition to require for regeneration.

m. First fill of filter media, resin, and degasser tower packings for all the units complete with make-up filter media, resin and packings material.

n. Suitable MS Epoxy painted elevated access platform of permanent type to be provided for inspection of all the units like AC Filters, Ion Exchanger vessels, UF, RO skids, Hot water tank, dosing tanks, degasser tower and tank etc.

o. All vessels as per 'Flow Diagram-1' & Data Sheet-A complete with inlet and outlet connections, bed support cum under drain system, inlets water distributors, all fittings and appurtenances etc. as specified and as required.

a. External resin/ media traps at the outlet of each of the vessels, designed for in place manual backwashing.

b. All tanks as per 'Flow Diagram-1' & Data Sheet-A complete with inlet and outlet connections, drain system, inlets water connection, all fittings and appurtenances etc. as specified and as required.

c. Bidder to note that the equipment, valves, instruments indicated in the 'Flow Diagram-1' attached in the technical specification are minimum and are in bidder's scope. During detailed engineering, bidder to furnish complete and detailed scheme in all respects including all valves, equipment's etc. for smooth, safe, efficient and trouble-free operation of the plant meeting the specification requirement and also considering the applicable statutory requirement.

B) OPTION - 2 (UF+RO+MB BASED DM PLANT)

I. ULTRAFILTRATION (UF) SYSTEM

a. Three (3) numbers (3X100%) (1Working + 2Standby) DM Plant Supply (Feed) pumps (Filtered Water Pumps/ UF Feed Pumps) along with motors, piping, valves, fittings, instrumentation & all other accessories as required.

b. Ultra-filtration system membranes skids (UF) (2X60%) (Pressurized type) along with simplex strainers and necessary valves, piping, fittings etc.

c. UF backwash pumps (2X100%) along with flushing tanks and pumps, CEB tank, chemical dosing system, required storage tank etc. CIP system (as applicable) shall be provided as per manufacturer's standard.

d. UF streams shall be pressurized type. Details of UF are furnished in Part-B of Technical Specification. UF system headers shall be designed such that all the UF streams can run simultaneously utilizing the stand-by pump.

a. Two (2) numbers of UF permeate water storage tanks of required capacity/sizes with required isolation Valves.

b. UF permeate transfer pumps (3X50%) of required capacity, its drives, associated valves, piping etc.

c. Platform, ladders etc. to facilitate approach to various tanks, manholes/ hand-holes, sight-glass, operation & maintenance of valves, instruments etc shall be provided.

d. Associated Piping, Valves, Instrumentation & Fittings etc to make the system complete.

II. MICRON CARTIRDGE FILTERS

a. 3X50% Micron Cartridge Filters (MCF).

b. Micron Cartridge Filters (MCF) shall be sized for rated capacity of UF permeate transfer pumps.

c. The design pressure of vessel shall be at least 115% of sum of shut-off head of UF permeate transfer pumps and suction head available.

III. RO SYSTEM

a. a) High Pressure (HP)-RO feed pumps (3x50%) with one(1) store standby, RO Streams/trains (3x50%) with module rack assemblies, RO Permeate transfer pumps (3x50%), sampling facilities, reject control valves, Complete system for Chemical cleaning (CIP) and Flushing system comprising of necessary tanks and pumps for RO trains/ streams etc.

b. Complete Degassifier system for removal of CO_2 in permeate water from RO units, consisting of minimum one (1) Degasser tower, Degasser/ RO permeate water storage tank (2), Degassed Water Pumps (3x100%), RO Chemical dosing system consisting of Anti-oxidant dosing tank and pumps, Anti-Scalant dosing tank and pumps etc.

c. Two (2) numbers of RO permeate water storage tanks of required capacity and 2X100% numbers of Degasser Blowers for Degasser.

d. Required number of Degassed water/ RO permeate transfer pumps of required capacity with electrical motor drives, suction & discharge pipe, valves, accessories etc.

e. Four (4) (4x50%) (2W+2S) numbers of Mixed Bed units along with two (2X100%) numbers air blowers with its drives and all accessories. The regeneration system shall be designed to regenerate two (2) MB units simultaneously.

f. Complete Hydrochloric acid handling, bulk acid storage tanks, measuring tank, and dosage system with two (2) bulk acid tanks, each tank sized for minimum 25T OR capacities of both the tanks together shall be sized for one-month storage with design dose. The tank shall be fitted with vent, drain, fume absorber, overflow seal pots etc., Two (2) no Acid measuring cum dilution tanks, one each for pH control and regeneration of MB units, 2X100% acid dosing/ metering pumps with associated accessories for pH control, 2X100% acid dosing/ metering pumps with associated accessories, two (2) (2X100%) acid unloading & transfer pumps with 50 mm dia. Heliflex hoses of 30m length.

g. Complete Alkali handling, storage, and dosage system with two (2) bulk alkali tanks, each tank sized for minimum 25T OR capacities of both tanks together shall be sized for one-month storage with design dose. The tank shall be fitted with vent, drain, CO2 absorber, overflow seal pots etc. Two (2) nos. alkali measuring cum dilution tanks with a motorized agitator, one each for each pH control and regeneration of MB units. One (1) No. alkali preparation and dilution tanks (from alkali flakes), with dissolving baskets & motorised agitators, 2X100% alkali dosing/ metering pumps with associated accessories for pH control in RO and 2x100% alkali dosing/ metering pumps with associated accessories for MB regeneration, two (2) (2X100%) alkali unloading, two (2) (2X100%) alkali transfer cum recirculation pumps with 15 mm dia. Heliflex hoses of 30 m length.

h. Two (2) numbers of safety shower units and Two (2) numbers of. Eye-fountains to protect against any chemical hazard.

i. Neutralizing waste disposal system - All DM plant Effluent drains (except backwash water from AC filters and fast/final rinse waste water of Ion-Exchangers units) shall be connected to the Neutralisation Pit. Neutralised waste shall be pumped up to Ash Slurry Sump/ tank. Additionally, provision for diverting N-pit waste to CMB shall also be provided.

j. Approach ladders and operation/maintenance platforms, handrails as required for various equipment, valves and instruments. Construction of support trestles, bridges, brackets, bolts, nuts, clamps etc. for the associated piping and fittings etc.

k. Adequate space for access and maintenance shall be provided for HP pumps (at the end of pump bay) and UF & RO membrane racks (at the sides).

l. Two (2) (2 X 100%) of DM water pumps for regeneration system and its drives.

m. Supply of Anti-Scalant and Antioxidant applicable as offered for RO skids for a period of one (1) year from the date of successful commissioning of the proposed water treatment plant.

n. RO Reject water piping from RO trains up to CHP tank. The effluent of RO chemical cleaning shall be led to the sludge pit.

o. Provision of hot water supply to the ACF units from the hot water tank shall be made for rejuvenation of activated carbon and the DM regeneration pumps to be sized considering above requirement in addition to require for regeneration.

p. Required platform, ladders etc. to facilitate approach to various tanks, manholes/ hand-holes, sight-glass, operation & maintenance of valves, instruments etc. shall be provided.

IV. One (1) No Filtered Water Overhead Tank (MOC: RCC by BHEL) Complete valves, fittings, instrumentation and all other accessories for Priming and Chemical (Lime) preparation purpose in DM Plant.

V. Two (2x100%) numbers of backwash disposal pumps shall be provided. Two (2) numbers air blowers (2x100%) for the air agitation system of the filter backwash pit shall be provided.

VI. Safety equipment as per Data Sheet.

VII. One (1) no. Central Sampling Rack.

VIII. First fill of filter media, resin, and degasser tower packings for all the units complete with make-up filter media, resin and packings material.

IX. Suitable MS Epoxy painted elevated access platform of permanent type to be provided for inspection of all the units like AC Filters, Ion Exchanger vessels, UF, RO skids, Hot water tank, dosing tanks, degasser tower and tank etc.

X. All vessels as per 'Flow Diagram-2' & Data Sheet-A complete with inlet and outlet connections, bed support cum under drain system, inlets water distributors, all fittings and appurtenances etc. as specified and as required.

XI. External resin/ media traps at the outlet of each of the vessels, designed for in place manual backwashing.

XII. All tanks as per 'Flow Diagram-2' & Data Sheet-A complete with inlet and outlet connections, drain system, inlets water connection, all fittings and appurtenances etc. as specified and as required.

XIII. Bidder to note that the equipment, valves, instruments indicated in the 'Flow Diagram-2' attached in the technical specification are minimum and are in bidder's scope. During detailed engineering, bidder to furnish complete and detailed scheme in all respects including all valves, equipment's etc. for smooth, safe, efficient and trouble-free operation of the plant meeting the specification requirement and also considering the applicable statutory requirement.

XIV. Adequate space for access and maintenance shall be provided for HP Pumps (at the end of the pump bay) and RO membrane (at the sides) of assembly.

XV. Two (2) numbers of portable and movable ladders with platform to be supplied for RO plant upto the highest reach.

I. Interconnecting piping, valves, fittings etc.

C) CHEMICAL STORAGE & DOSING SYSTEM (AS APPLICABLE FOR OPTION – 1 & 2)

a. Bulk Anti-Scalant storage tank(s), required numbers of Anti-Scalant preparation tanks & its accessories, required number of Anti-Scalant dosing pumps, its drives, required suction & discharge piping, valves, fittings, etc., dosing piping from the pumps up to the dosing point as required for the process.

b. Bulk antioxidant storage tank(s), required numbers of Anti-oxidant preparation tanks & its accessories, required numbers of Anti-oxidant dosing pumps, its drives, required suction & discharge piping, valves, fittings, etc., dosing piping from the pumps up to the dosing point as required for the process.

c. Required numbers of Hydrochloric Acid unloading cum transfer pumps, its drives, two (2) nos. of hose stations (80 NB), required suction & discharge piping, valves, fittings etc., required numbers of Bulk storage tanks for Hydrochloric acid of 30-33% concentration & its accessories, required numbers of Acid (HCl) measuring tanks & its accessories, required numbers of Acid (HCl) dosing pumps/ ejectors (Ebonite Lined) for pH control of RO system and for Mixed Bed regeneration, its drives, required piping, valves, controls etc., dosing piping from the pumps up to dosing points and whenever pH control is required as per process requirement.

d. Required numbers of Sodium Hydroxide (Alkali) unloading pumps, its drives, two (2) nos. of hose stations (80 NB), required suction & discharge piping, valves, fittings etc., required numbers of Sodium Hydroxide (Alkali) transfer cum re-circulation pumps, its drives, required suction & discharge piping, valves, fittings etc., required numbers of Bulk storage tanks for Alkali (NaOH in lye form), operating platforms, ladders, etc., required number of Alkali preparation tank & its accessories, required numbers of Alkali measuring tanks for pH control of RO System & its accessories, required numbers of Alkali (NaOH) dosing pumps/ ejectors (Ebonite Lined) for pH control of RO system and Mixed Bed regeneration, its drives, required piping, valves, fittings, etc., dosing piping from the pumps up to dosing point wherever pH control is required as per process requirement.

e. Required platform, ladders etc. to facilitate approach to various tanks, manholes/ hand-holes, sight-glass, operation & maintenance of valves, instruments etc. shall be provided.
f. Required (2) numbers emergency safety shower with eye wash units in the Chemical Storage Handling facility at each location such as Acid/Alkali Storage area, Chemical storage area, Chlorination plant area and Chemical preparation & doing equipment area.
g. All Interconnecting piping, valves, fittings etc.
h. Any other equipment envisaged by the bidder to meet the system requirement.

12.2 PIPING

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

OPTION – 1 (ION EXCHANGE BASED DM PLANT)

a. Complete piping within the DM Plant.
b. Inlet and outlet pipes for each vessel, pumps, other equipment, etc. with pipe connections to the respective vessels/ equipment.
c. Piping from Filtered Water Feed Pumps to DM plant is in bidders' scope of supply. Bidder to refer enclosed Plot Plan for distance between these Water Treatment Plants.
d. 50-meter DM water piping from DM plant area to each DM Water storage tanks.
e. 50-meter DM water recirculation piping from DM water regeneration pumps to each DM Water storage tanks.
f. 50-meter DM water piping from common suction header of DM Water storage tanks to DM water regeneration pumps and UF backwash pumps.
g. DM Plant's N-PIT waste shall be transferred to unitized Ash Slurry Sumps. The provision is to be made to transfer DM Plant's N-PIT waste to each ash slurry sumps (ASPH-1 & 2). Total pipe of 960 meters to be provided by bidder to transfer DM Plant's N-PIT waste to ash slurry sump Unit 1 and 2.
h. Distance between DM plant area and ETP area is approx. 60 meters and piping from DM plant Neutralization pit to CMB at ETP shall be in bidder's scope.
i. Waste water disposal piping from ACF and UF Backwash Water Pit to PT Plant (at DM Clarifier Stilling Chamber) shall be in bidder's scope. Bidder to refer enclosed Plot Plan for distance between these Water Treatment Plants.
j. In addition, any additional piping and associated accessories required to complete the system shall also be in bidder's scope of supply.

OPTION - 2 (UF+RO+MB BASED DM PLANT)

a. Complete piping within the DM Plant.
b. Inlet and outlet pipes for each vessel, pumps, other equipment, etc. with pipe connections to the respective vessels/ equipment.
c. Piping from Filtered Water Feed Pumps to DM plant is in bidders' scope of supply. Further piping from UF skids to filtered water storage tank in PT plant shall be in bidder's scope. Bidder to refer enclosed Plot Plan for distance between these Water Treatment Plants.
d. 50-meter DM water piping from DM plant area to each DM Water storage tanks.
e. 50-meter DM water recirculation piping from DM water regeneration pumps to each DM Water storage tanks.
f. 50-meter DM water piping from common suction header of DM Water storage tanks to DM water regeneration pumps.
g. DM Plant's N-PIT waste shall be transferred to unitized Ash Slurry Sumps. The provision is to be made to transfer DM Plant's N-PIT waste to each ash slurry sumps (ASPH-1 & 2). Total

pipe of 960 meters to be provided by bidder to transfer DM Plant's N-PIT waste to ash slurry sump Unit 1 and 2.

h. Distance between DM plant area and ETP area is approx. 60 meters and piping from DM plant Neutralization pit to CMB at ETP shall be in bidder's scope.

i. Waste water disposal piping from UF Backwash Water Pit to PT Plant (at DM Clarifier Stilling Chamber) shall be in bidder's scope. Bidder to refer enclosed Plot Plan for distance between these Water Treatment Plants.

j. Approx. 720 meters RO Reject water piping from DM plant to CHP tank shall be in bidder's scope.

k. In addition, any additional piping and associated accessories required to complete the system shall also be in bidder's scope of supply.

12.3 TERMINAL POINTS

a. 25 NB Instrument air supply at 5 to 7 kg/cm2 (g) – at 5-meter distance from the DM Plant area. However, distribution and piping inside DM Plant area shall be in bidder's scope.

b. 25 NB Service air supply at 5 to 7 kg/cm2 (g) - at 5-meter distance from DM Plant area. However, distribution and piping inside DM Plant area shall be in bidder's scope.

c. Service water connection (40 NB connections) at 5-meter distance from DM Plant area. Piping inside DM Plant area for mentioned services will be in bidder's scope.

d. Drinking water (or potable water) of 40 NB connections at 5-meter distance from the DM Plant area. However, distribution and piping inside DM Plant area shall be in bidder's scope.

e. DM Water piping from nozzle flange of respective DM water storage tanks up to DM plant shall be in bidder's scope.

f. DM Water recirculation piping from DM water regeneration pumps up to nozzle flange of respective DM water storage tanks.

g. One number DM Water feed line to DM storage tanks shall be terminated at 5 meters distance from DM Plant area by bidder.

12.4 DESIGN REQUIREMENTS

Design and control requirements for DM Plant (Ion Exchange Based/ UF+RO+MB based) shall be as per attached NTPC's specification. Bidder shall strictly follow the same while conceptualizing DM plant.

Headers shall be designed such that both Ion Exchange - DM streams can run simultaneously during exigency utilizing the stand-by pumps. In case of RO based DM Plant, RO system headers shall be designed such that all three RO & MB streams can run simultaneously.

All wetted parts in the plant shall be constructed with suitable corrosion resistant material suiting to the fluid.

Complete DM plant shall be controlled from DDCMIS (DCS) based control system. DCS is in BHEL scope of supply, however necessary inputs w.r.t. control and operation shall be provided by bidder during detailed engineering for engineering of DCS system.

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	for recycle/reuse in CW system. Provision for diverting treated supernatant water to storm water drain & WSWS with pumps (2x100%) and isolating valves in the lines. 4) Adequate steps/stairs to be provided in coal settling pond for manual cleaning of pond.
4.00.0	**Demineralisation plant (DM plant) ((Option I)** The minimum technical requirements equipment shall include, but not be limited to the following:
4.01.0	**General requirement** 1) All the vessel internals of activated carbon filters, Ion-exchanges units, and degasser units such as inlet distributor, regenerant distributor, under drain system etc. shall be of proven design. 2) All valves used with vessels shall be suitably arranged in the front in accessible position, for manual operation in case of emergency. The valves under automatic operation of DM Plant shall be operated pneumatically by diaphragm actuator. 3) All dematerializing streams shall be designed to run continuously at its rated capacity and simultaneously under parallel operations. 4) Suitable permanent flushing connections shall be provided for all pipelines carrying acid and alkali. 5) The pipelines which are immersed inside the drain trench or in Neutralization pits shall be rubber lined to a height of at least 600 mm from the maximum liquid level apart from internal rubber lining. 6) All the external parts of equipment of complete DM Plant shall be painted chlorinated rubber paint unless specified otherwise. 7) The unloading pumps area shall be provided with a kerb wall and the kerbed area shall also be provided with Acid proof lining. Suitable dyke wall/barrier shall also be given in between chemical tanks to avoid any kind of mixing. 8) Suitable sampling points shall be provided for ACF, all Ion exchange units of DM plant.
5.00.00	**Design and construction features**
5.01.00	**Activated Carbon Filters (ACF)** 1) Design and Fabrication of the vessel should be according to subsection titled “Pressure & Storage vessel” of Part-B of this Technical Specification. 2) The activated carbon shall be of good quality suitable for removal of odor, chlorine, and dissolved organic substances. 3) Suitable (at least 75%) free board shall be provided over the filtering medium below the backwash outlet nozzle and in straight portion of vessel to facilitate backwashing. 4) The inlet distribution (preferably header-lateral type) and under drain collecting system (header-lateral/strainer-on-plate) shall be so designed as to give uniform distribution and flow without channeling and obstruction.
5.02.00	**Ion Exchange Units** 1) Design and Fabrication of the vessels should be according subsection titled “Pressure & Storage vessel” of Part-B of this Technical Specification.

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2) Under drainage system shall be header lateral or strainer-on-plate type. The inlet distribution system shall preferably be header lateral type. Material of construction shall be mild steel with rubber lining (MSRL) and rubber covered (RC).

3) The regenerant distributor and middle collector shall be mild steel rubber lined inside and rubber covered outside. All internal studs /nuts/washers shall be of AISI 304 L for alkali service and of suitable MOC for acid service.

4) At least 100% free board shall be provided over resin bed below the backwash outlet nozzle and in straight portion of vessel to allow for expansion during backwashing and for addition of extra resin, if required.

5) All the Ion Exchangers shall be provided with two additional nozzles for hydraulic transfer of resin as and when necessity arises. The nozzle shall be provided with manual valves of 100 mm NB.

6) Each exchanger unit shall be provided with resin traps on treated water outlet line. Resin traps shall also be provided both on the backwash and regenerant outlet lines. Flow measuring instrument shall also be provided at the regenerate outlet of preceding unit in case of thorough fare regeneration.

5.02.01 Surface Flow Rate for Ion –exchangers

1) The following shall be maximum surface flow rates for the various Ion-Exchangers at the design capacity.

i) Cation unit – 35 $m^3/hr/m^2$ (for both weak and strong Cation)
ii) Anion unit – 35 m^3 hr m^2 (for both weak and strong Anion)
iii) Mixed bed unit – 40 $m^3/hr/m^2$.

2) In case of both weak and strong Ion-exchange units (for Cation and/or Anion unit), the surface flow rate for the strong ion exchange unit(s) only may be increased as indicated below, in case the bidder/its sub-vendor has adequate experience of designing Demineralisation plants of such higher surface flow rate:

Maximum surface flow rate: -

i)Strong Cation unit – 40$m^3/hr/m^2$.
ii)Strong Anion unit – 40 $m^3/hr/m^2$.

5.03.0 Regeneration System

1) The ion exchange resin shall be regenerated by employing optimum regeneration level to prevent leakage of ions. Cation resins shall be regenerated by hydrochloric acid (30-33% w/v technical grade IS:265) and anion resins by sodium hydroxide (48% w/v rayon grade in flakes or lye form as per IS:252).

2) Regeneration system should be designed such that AC filter, cation, anion, and mixed bed units of a particular stream can be regenerated simultaneously/separately at a time.

3) For calculation of anion capacity and silica leakage the temperature of alkali regenerant shall be taken as 25 deg.C.

4) Bidder/its sub-vendor shall adopt co-current or counter-current regeneration technique provided the same technique of regeneration were adopted in the plants by him by virtue of which he is qualified to participate in this bid. The guaranteed chemical consumption figures must be supported by relevant published data such as performance of the resin system and/or actual field performances of plants using a similar technique, indicating

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	the quantity of chemicals required for regeneration, in particular, besides other parameters. 5) The process calculation shall be furnished by the bidder indicating the various steps of regeneration, regeneration level employed, total and used exchange capacity of resins in various exchangers, resin quantity provided in ion exchange vessel etc. The bidder shall furnish relevant resin literature & curves indicating various parameters and exchange capacity & regeneration levels selected along with the process calculations. 6) The process calculation along with the operating exchange capacity and regeneration levels vetted by resin manufacturer and the resin performance curves especially applicable for this plant shall also be submitted during detailed engg. 7) Regeneration facilities offered shall be complete with acid/alkali measuring tanks, ejectors for dosing of chemicals. Alkali flakes shall be used for preparing alkali solution of adequate strength in the preparation tanks. Acid or alkali from the measuring tank, shall be injected to exchangers by means of hydraulically operated ejector or metering pumps at suitable strength. 8) Separate acid measuring tank and ejector (one each) shall be provided for cation & MB and separate alkali measuring tank and ejector (one each) for anion & MB shall be provided. Suitable inter connection of dosing system shall be provided for flexibility of operation. 9) Automatic block and bleed valves shall be provided at the regenerant inlet line(s) to each exchanger of Strong Acid (SAC) Cation, Strong Basic (SBA) Cation & Mixed (MB) Bed. 10) Suitable sampling connection shall be provided for acid/ alkali storage, preparation & handling equipment.
5.04.00	**Alkali Diluent Water Heater.** For heating of alkali diluent water, 2x50% electrical heating coil in a tank of mild steel rubber lined construction shall be provided. The tank shall be sized based on 125% of the regeneration water requirement of one anion and one mixed bed (effective Capacity 10 cum (minimum). The tank shall be provided with burn out protection, pressure relief valve, temperature indicator, etc. The heater shall be controlled by the temperature switches provided on the tank. All tank internals, including the inlet water tail pipe shall be rubber lined inside and rubber covered outside or of SS-304 stainless steel.
5.05.00	**Exchange Resin** 1) Cation and anion resin shall be of reputed make and proven type and must have been in use in demineralising plants capable of producing water of quality as specified or better, for a period of not less than three (3) years. 2) Cation and anion resin charge shall consist of material properly selected washed, processed and graded to provide the guaranteed capacity and life and shall have adequate abrasion resistance during its guaranteed life. 3) The cation exchanger resin used in the strong cation unit and mixed bed exchanger shall be strongly acidic, high capacity polystyrene resin in the bead form. 4) The anion exchanger resin used in strong anion unit & mixed bed shall be strongly basic, high capacity resin (Type-I) in bead form to the satisfaction of the Engineer. The anion resin shall be able to withstand a temperature of 60 deg. C (minimum) continuously. Type-II anion resin shall not be accepted. Strong Base Anion resin (or weak base Anion in case of hookup) shall be MACROPOROUS type only.

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5) Each stream shall be provided with independent headers from the outlet of Activated carbon filters. However, suitable inter-connecting lines, valves shall be provided at outlet/inlet of each unit to facilitate the changeover.

6) Bidder shall design the DM water chains in such a way that any chain can be regenerated without the necessity of other chain being put into operation.

5.06.00 **Degasser System**

Degasser tower shall be designed to reduce dissolved CO_2 in treated water to the level as indicated in the guarantees. Blowers shall be provided to remove CO_2 from water. Each tower shall be provided with a storage tank to store degassed water.

5.07.00 Polishing UF

Commercially proven hollow-fiber, high volume pressurized type UF membranes of Polysulfone, Poly Vinylidene Di Fluoride (PVDF) or Poly Ether Sulfone (PES) with spiral glass outer wraps shall be supplied. Gross maximum design flux rate shall not be more than 60 $l/m^2/h$. Filtration direction may be either Out-to-In or In-to-Out. Minimum design UF recovery shall be at least 92% of the influent with a colloidal silica rejection of not less than 99.5%. Maximum Membrane pore size shall be 10000 Dalton MWCO (Molecular weight cut off).

5.08.0 Safety and Protection

Automatic safety shower units consisting drench shower and eye bath shall be provided near regeneration area & chemical storage area to provide adequate spray of water to protect operating personnel against any chemical hazard.

The shower shall receive supply of water from the filtered water system and will be actuated by standing on platform beneath the showers through mechanical linkage.

5.09.00 **Wastewater Neutralizing Arrangement**

Bidder shall design the demineralising plant in such a way that the regenerant effluent from cation and anion units and from the mixed bed unit are self neutralising. Provision shall however be made to dose acid, alkali, and lime to neutralise the effluent, whenever required.

5.09.01 **Sump & Trenches of wastewater**

Wastewater from all vessels namely Activated Carbon Filter, Cation, Anion and Mixed Bed exchangers will be led into individual sumps near each vessel. Bidder shall provide measuring orifice board into the sump. Wastewater after being metered through the orifice board, will be led by gravity into trench, suitably lined and finally to the neutralising pit. The backwash wastewater from Activated Carbon Filters and Rinse wastewater generated during regeneration of the DM stream shall be routed through separate effluent channel (acid/alkali proof tile lined) and shall be terminated in Backwash/ Rinse Wastewater sump. The Backwash/ Rinse Wastewater sump shall be lined with acid/alkali proof tile. The backwash water recycling/reused in Clarifier of Pre-treatment Plant.

5.09.02 **Waste Neutralising Pits**

One (1) number RCC pit in twin compartment design shall be provided. Suitable baffles shall be installed in the pits/effluent trench to mix the wastes during their passage to neutralise the effluent. Suitable priming chamber shall be provided in case horizontal pumps are offered. Chemical (Acid/Alkali) lines from bulk storage tanks (acid) & alkali preparation tanks shall be routed and terminated to neutralising pits. Provision shall be made to dose lime solution in the neutralising pit. Suitable proven agitation system (e.g. air agitation/venturi mixing etc.) shall be

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	provided for proper mixing and maintaining uniform pH value of the wastewater in addition to recirculation system.
5.09.05	**Filter Back Washing** Backwashing of filters shall be done once in 24 hours. The inlet distribution and under drain collecting system shall be so designed as to give uniform distribution and flow without channeling and obstruction. The under-drain system may either be of header lateral or manufacturer's standard design.
5.10.00	**Pressure Filter Design features** Pressure filters shall be designed for surface flow rate. Design and Fabrication of the vessel should be according to subsection titled "Pressure & Storage vessel" of Part-B of this Technical Specification. 1) Maximum velocity of filtration shall be 10 m/hr. at design capacity and velocity during backwashing shall not exceed 35.0 m /hr. when air scouring is employed. 2) Air blowers (2x100%) shall be used for air scouring of filter bed. The filter shall be designed to handle an inlet turbidity of 20 NTU. 3) At least 75% free board shall be left over the filtering media to facilitate backwashing. 4) The total design backwash quantity shall not exceed minimum 2% of the treated water flow over a period of twenty-four hours or between two successive backwashes from each filter. 5) The filtering medium shall be washed, screened, and hydraulically graded anthracite coal or sand having an aggregated depth not less than 1200 mm. 6) Details of layers of pressure filter medium and Anthracite and Sand properties: Refer Gravity filter.
6.00.00	**Control & operation of the DM plant** 1) The control & operation of various systems described below is indicative only and the actual control & operation philosophy shall be finalized with during detailed engineering based on which the control logic is to be built by the contractor in DDCMIS. Complete DM Plant operation shall be through mimics on OWS/LVS The sequence startup mode (Automatic, semi-automatic and operator guided mode) shall be provided shall be of the following types 2) In case of failure of control system, the DM plant valves shall be operated manually by means of manual operator of solenoid valves (as well as by hand wheel of valves) locally. 3) Acid and alkali unloading pumps, agitators of alkali preparation tanks & day tanks and alkali transfer pumps shall have provisions of local start also. 4) Complete stream shall be isolated automatically from SERVICE in case any of the following take place and an alarm displayed. 5) Differential conductivity of the effluent is less or totalised flow and sodium leakage from the cation is high. Conductivity of the effluent or totalised flows from anion is high. Conductivity or silica content of the effluent or totalised flow from mixed bed is high. 6) The operation of alkali/acid inlet valves at ejectors shall be interlocked with the availability of dilution water in the respective ejectors. 7) Common conductivity meter shall be employed for measuring conductivity in the effluent line and rinse lines for anion and mixed bed exchangers. During rinsing of

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	anion and mixed bed unit, the respective analyzer shall be connected to rinse line automatically, in the end of the rinse cycle. 8) During rinsing of mixed bed unit, the analyzer of silica shall automatically be connected to the stream which is under regeneration to ascertain the completion of rinsing operation. 9) Only one stream shall be regenerated at a time. However, all the streams can be put to service simultaneously. The alkali diluent heater shall be controlled by measuring the temperature of water in the heater. 10) For all the pumps, blowers etc. which form part of the automatic operation, facilities through control system shall be provided for Auto/remote manual/Local mode selection wherever specified. Wherever standby equipment is provided, selection of the same shall be possible from the control system. The selected standby equipment shall start automatically in case of failure of working equipment. For, other drives which are not involved in continuous running or automatic operation, facilities through control system shall be provided for remote/local selection.
6.01.00	**Backwash pit and pumping scheme** 1) At a specific water level in the sump, selected pump(s) shall start, and backwash wastewater shall be recycled back to the clarifiers. Upon reaching predetermined low level, one of the operating pumps shall be stopped and further reduction in level shall result into stoppage of all the operating pumps. 2) The pit level shall be available to operator and in case of very high level, the operator shall be alerted to avoid starting of backwash/rinse operation so that the pit does not overflow.
6.02.00	**Neutralization pit and pumping scheme** 1) At a specific water level in the sump, selected pump (s) shall start, and backwash wastewater shall be recycled back to the pit and after achieving desired pH level, the wastewater shall be pumped out to Ash slurry sump. Upon reaching predetermined low level, operating pumps shall be stopped and further reduction in level shall result into stoppage of all the operating pumps. 2) The pit(s) level status shall be available to operator and in case of very high level; the operator shall be alerted to avoid starting of regeneration operation so that the pits do not overflow.
	DM Plant (Option II)
7.00.00	**General**
7.01.00	The scope of work covered under this specification include but not limited to design, fabrication, manufacture and assembly, inspection, shop testing at manufacturers works and transportation to site, supply, erection of complete UF-RO Plant, Chemical Storage & Handling etc.
7.02.00	Contractor shall take full responsibility for system sizing based upon actual equipment to be provided. Contractor shall confirm sizing of all systems and components, including, pipes, pumps, and ancillary systems along with relevant calculations. All materials and components of valves, pumps, piping, tanks and other equipment and appurtenances shall be compatible with the respective fluid herein.
7.03.00	Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer as approved by the engineer.

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	The minimum technical requirements equipment shall include, but not be limited to the following:
8.00.00	**Technical requirements**
8.01.00	**Ultrafiltration (UF)**

UF system shall include, but not be limited to the following:

1) UF membrane shall be capable of producing UF permeate by removing colloidal silica level to the extent suitable for downstream reverse osmosis (RO) unit.

2) The system shall be designed to allow multiple starts and stops without affecting the service life of the membranes. The system may experience extended periods of no flow; system design shall protect the system against periods of no flow as recommended by membrane manufacturer.

3) Provisions for local grab sampling points shall be provided to monitor UF performance for UF feed, strainer backwash, UF permeate water, UF backwash, UF neutralized backwash water as a minimum.

4) Each stream/train shall be provided with 1x100% automatic self-cleaning strainers (SS) at inlet with about 100 microns.

5) UF membranes shall be hollow-fiber, pressurized type, MOC Polyvinylidene di fluoride (PVDF) or Polyether sulfone (PES). Gross maximum design flux rate shall not be more than 60 $l/m^2/h$. Design UF recovery shall not be less than 92%. Pore size of membrane shall not be more than 0.04 micron. In the event of fiber breakage, the affected module shall be easily identifiable on the Rack through use of clearly visible inspection window built into the filtrate discharge pipe.

6) An on-line membrane flushing system shall be provided to flush the UF membranes prior to shutting down.

7) UF feed pumps and UF backwash pumps shall be provided with variable speed drives (VFD). Capacity of each UF permeate water storage tank shall be sized for minimum one (1) hour retention

8) Spent chemicals from the chemically enhanced backwashing & CIP shall be neutralized in Neutralization pit.

9) Online Turbidity transmitter shall be provided to measure UF filtrate turbidity with high turbidity alarm interlocked to shut down of UF system if high turbidity is sustained for a pre-set time. Automatic on/off valves and filtrate flow transmitters shall be provided to automatically conduct air integrity test of UF membrane modules.

10) Membrane cleaning system shall be provided as per recommendation membrane designer and membrane manufacturer. The cleaning system shall be connected to the UF trains with permanent hard pipes.

11) After the manufacture, following tests for membrane shall be demonstrated at membrane manufacturer's works in the presence of Employer's representative and contractor:

    i). Bubble Point Test in one batch

    ii). Integrity test (Pressure decay test/vacuum hold test) for 1 % of total membrane population.

The responsibility for conducting the test (Bubble Point, Integrity) will be with the Contractor and Contractor shall make all the arrangements for carrying out tests at membrane manufacturer's works. In case the test facilities are not available at manufacturer's works, the test may be carried out at any other test facility with the approval of Employer. The cost associated with testing at contractor's works or at any

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	other test facility shall be borne by the contractor & shall be included in the contract price.
	12) Integrity test shall be carried out in accordance with ASTM D 6908-06, Standard Practice for Integrity Testing of Water Filtration Membrane Systems (Pressure decay test/vacuum hold test) and approved test procedure. Bidder shall submit the test procedure for Employer's approval. Design calculations of Ultra filtration system shall be vetted by membrane manufacturer
8.02.00	**Cartridge filters**
	The filter elements shall be cylindrical cartridges constructed from continuously wound polypropylene fibers, which have a 5-micron nominal 90% efficient rating. Polypropylene material shall be 100% polypropylene with no binders, resins lubricants or other residue from the manufacturing process. The filter vessel shall be designed in accordance with ASME boiler and pressure vessel code section VIII, division I.
9.00.00	**Reverse Osmosis system**
	RO system shall include, but not be limited to the following:
9.01.00	**Requirements of RO plant**
	1) Each RO stream shall be provided with a dedicated HP pump. The HP pump designed to operate in the entire range of operation of the feed system.
	2) The permeate water is discharged to product water system where it is treated to for removal of excess CO_2, correction of pH, correction of alkalinity (for potabilisation, if applicable) etc. and stored.
	3) Permeate shall be delivered to respective Degassifier thru dedicated Suck-back arrangement (if applicable). Cleaning and Flushing systems shall be provided for membrane protection.
	4) All wetted parts in the plant shall be constructed with suitable corrosion resistant material suiting to the fluid.
9.02.00	**RO membrane assembly**
	Each stream shall be capable of operating either independently or in combination with the other ones. The streams shall be skid-mounted and be furnished complete with all headers and related piping, mounted on the skid. The skid shall be designed to provide ample room for servicing and monitoring the equipment. The isolation or removal of an individual permeator for testing or servicing shall be possible while the RO-train is in operation, by means of flexible, self-closing couplings.
9.03.00	**RO membrane**
	The Reverse osmosis membrane shall be spiral wound type. The membrane shall be non-telescopic, non-flexing and leak free. The RO membranes shall be supplied from manufacturers well experienced in RO plant design of stream capacity comparable to that of this project. This shall be demonstrated by the Bidder with adequate references of his selected membrane manufacturer(s). He also shall include a design calculation of the RO plant by his preferred manufacturer(s)
	The process design shall take into consideration specified *fouling allowance and salt passage* during the guaranteed (specified) life of the membrane. Standard Length & Diameter of membrane used for design should be available from at least three

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manufacturers to deliver water of specified quality so that Employer may install membranes from other manufacturers during operation stage of the plant.

9.04.00 **Pressure vessels**

Pressure vessels shall have a diameter and length to contain required numbers standard diameter, standard length spiral wound elements Materials to be selected shall meet the following minimum requirements:

i)	Membranes	As per manufacturer
ii)	Pressure vessels	PP or proven material as per manufacturer
iii)	End caps or plates	Non-metallic material of proven reliability; Fliberglass epoxy as minimum requirement
iv)	Segmental rings, Connectors,	Corrosion resistant material conforming to ASTM A312 SS-316 or equiv.

The design, fabrication, and testing requirements for the pressure vessels shall be in accordance with ASME Section X to allow a code stamp, or meet the minimum requirements of ASME Section X.

9.05.00 **High pressure pump and Energy recovery units**

The HP feed pump (SS-316) shall be of centrifugal type. Selection of parameters (Capacity & Head) of HP Pump, its drive shall consider requirements of membrane manufacturer and shall be designed to deliver required parameters throughout the design life of membrane.

9.06.00 **Clean in place system (CIP)**

The cleaning system shall be designed for cleaning and sterilizing of minimum one train of the RO system separately. The RO-plant shall be provided with fixed pipe connections. Provisions must be made for the neutralization and disposal of chemical cleaning waste via the brine reject.

Flushing system (if applicable)

Flushing system consisting 2 x 100% flushing pumps shall be provided to enable flush-out of the RO unit stream including HP pump, with Low TDS permeate water during shut down of the stream.

09.07.00 **Sample panel**

Each RO unit/train shall be fitted with a fiberglass sample board, which shall be mounted adjacent to the unit. The panel and supports shall have all fiberglass constructions with a minimum 8" wide trough under the sample cocks with 1" PVC drainpipe routed to the trenches. Sample tubing shall be black tubing. The sample panel shall use ¼" SS sample cocks to sample the following

i) Feed (locate on common manifold)

ii) Concentrate (locate on common manifold)

iii) Permeate (locate on common manifold)

iv) Permeate from each pressure vessel

Sample valves shall be SS white snap-action valves and shall be fitted with plastic nozzles

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	tubes.
09.08.00	**Degasser system** Degasser tower shall be designed to reduce dissolved Carbon-dioxide (CO_2) in treated water to the level indicated in the guarantees. Fill Material of degasser tower shall be Polypropylene or equivalent. Blowers shall be provided to remove CO_2 from water. Degasser tower & degassed water tank shall be internally rubber lined of minimum thickness of 4.5 mm and externally painted with epoxy.
09.09.00	**Piping/Valves** The Technical requirement of Piping, Valves & fittings shall be as defined/specified under subsection titled "Piping, Valves & Fittings" in Part-B of Technical Specification
10.00.00	**Mixed Bed (MB) Polisher Units** The minimum technical requirements equipment shall include, but not be limited to the following: Design surface flow rate at design flow shall not be more than 35 $m^3/m^2/hr$. Resins-strongly acidic and strongly basic Type-I, both the resin shall be of high capacity polystyrene resins in bead form. Total resin bed depth shall be 1.0 m (min). Air-blowers for mixed beds shall be provided. Mixed Bed shall be regenerated after minimum 30 hours of operation followed by regeneration period not exceeding 6 hours.
10.00.00	**UF & RO system (Control & Operation philosophy)** 1) The control & operation of various systems described below is indicative only and the actual control & operation philosophy shall be finalized with during detailed engineering based on which the control logic is to be built by the contractor in DDCMIS. 2) Normally drawl of product water (either raw water or DM water) requirement plant shall be from a single tank while the other tanks shall be in filling mode from the RO streams/trains. Operation of pumps which draw water from the storage tanks shall be interlocked with the tank level and /or pressure at the suction header, high pressure at the discharge header. The field instruments provided by Contractor along with tanks & suction header shall be used for implementation of such logic. 3) It shall be possible by the Operator one or more tanks for drawl mode and other for filling mode. In auto mode, the tank (s) under drawl mode shall switch over to filling mode at a pre-set level in tank and drawl for the plant shall be continued from the tanks which were under filling mode. Upon reaching high level in all the storage tanks, the running streams/trains shall be shut down in sequence. Similarly, the low level in all the tanks shall initiate starting of stream(s) in sequence which are under standby mode/stopped. 4) Post treatment of RO Water flow to degassers shall be interlocked with the level in degassed water storage tanks as well as pH of permeate. Degasser blower's operation shall be interlinked with the operation of associated degasser tower. The standby blower associated with the tower in operation shall come into operation in the event of failure of running blower. The operation of pumps shall be interlocked with the level of the degassed water tank. The performance of respective degasser shall be monitored thru measurement of conductivity & pH of product water. **5) RO system.** RO plant shall be operated and controlled thru control system. The system shall provide the following:

CLAUSE NO.	TECHNICAL REQUIREMENTS

i) Alarms for high permeate conductivity of each skid, Low pH of feed water, High pH of feed water, high feed water temperature, availability of chemical dosing system such as low level in dosing tanks, status of dosing pumps etc.

ii) Continuous monitoring for Feed temperature, Feed pH, conductivity of feed water & permeate, SDI of Feed water, pressure of Feed water, permeate & concentrate, flow of feed water, Permeate & concentrate, residual chlorine of feed water.

The HP pumps shall be operated thru control system. Start/ Stop of HP pump shall be interlocked with opening & closing of suction & discharge valves. The pump shall start with its discharge valve closed and on stop/trip command the discharge shall be interlocked to close before the pump stops. Low pressure in the pump suction and high pressure in the pump discharge shall raise an alarm and trip the pump.

The operation and control philosophy & instrumentation of Variable Frequency Drive (VFD) and Energy recovery units (ERU) (if applicable) shall be as per the recommendation of the manufacturer.

6) Permeate transfer pumps.

The pump shall be provided with interlocks to trip the pump on Low suction level. The low-pressure signal from pressure transmitter in the discharge header shall start the standby pump when the system is in auto mode.

The HP pumps and motor bearings shall be provided with vibration monitoring for measuring vibration levels and vibration "High" and "High-High" alarm shall be annunciated.

Additionally HP pump shall be tripped/shutdown under High conductivity in the RO permeate line, high pH in the Feed water line, high feed water temperature, low level in chemical dosing tank, high feed pressure, high differential pressure across permeators, high residual chlorine of feed water, high SDI in feed water and failure of flow control valve,

7) Clean-in-place system

The operation of agitators/mixers of chemical tank can also be initiated manually by means of local start/stop through DDCMIS, apart from automatic operation. (Option for local/remote control shall be selected through OWS of the control system.) During normal operation mixing shall be automatically started on the initiation of cleaning operation. The cleaning system pumps shall be started during the cleaning cycle progress. The pumps shall be provided with interlocks to trip on low level of chemical tanks. The cartridge filter shall be provided with a differential pressure measurement to monitor the pressure drop across the filter. Selection of RO block/train to be cleaned shall be manual through control system.

8) Flushing system

These pumps shall be selected started and stopped either locally, envisaged under DDCMIS or remotely thru control system (Option for local / remote control shall be selected through OWS of the control system.) During normal operation pump operation shall be automatically started on the initiation of flushing operation. Auto / manual selection switch is provided to select the mode of operation. The pump shall be provided with interlocks to trip the pump on Low suction level. The low-pressure signal from Pressure transmitter in the discharge header shall start the standby pump, when the system is in auto mode. Selection of RO block / train to be flushed cleaned shall be shall be manual through control system.

9) Suck-back (If applicable) The operation of suck-back shall be automatic.

10.01.00 **UF system**

1) The control & operation of various systems described below is indicative only and the actual control & operation philosophy shall be finalized with during detailed engineering based on which the control logic is to be built by the contractor in DDCMIS.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	2) The system shall provide the following: i) Alarms for, High permeate SDI, availability of chemical dosing system such as low level in dosing tanks, status of dosing pumps etc. ii)Continuous monitoring for pressure of Feed water, flow of feed water & Permeate. 3) Start/ Stop of feed pump shall be interlocked with opening & closing of suction & discharge valves The pump shall start with its discharge valve closed and on stop/trip command the discharge shall be interlocked to close before the pump stops. Low pressure in the pump suction and high pressure in the pump discharge shall raise an alarm and trip the pump. 4) The operation and control philosophy & instrumentation of variable frequency drive for UF units (VFD) (If applicable) shall be as per the recommendation of the manufacturer. 5) Also feed pump shall be tripped/shutdown under high feed pressure, high Differential pressure across permeators. **Flushing system** Filter backwash operation shall be initiated whenever head loss across the filter reaches preset point or after specified filtration cycle or at the specified effluent quality of high SDI. The logic to be selected shall be decided by Operator through control system. Upon initiation, filter backwash shall proceed automatically.

13. COMMON SCOPE & TECHNICAL DETAILS APPLICABLE FOR ALL WATER TREATMENT PACKAGES

13.1 SCOPE OF SUPPLY (ELECTRICAL)

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

13.2 SCOPE OF SUPPLY (C&I)

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

13.3 SCOPE OF SUPPLY (CIVIL)

Total Civil work is in BHEL scope of work. However, the detailed civil assignment drawings shall be furnished by successful bidder during detailed engineering. The corresponding civil design & construction drawing prepared by BHEL/ Civil agency, based on civil assignment drawing of bidder, will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by bidder, BHEL reserves the right to debit cost of such rework to vendor.

13.4 SPARES

The Bidder shall include in his scope of supply all the necessary Mandatory spares, start up and commissioning spares as indicated in the relevant sections of specifications.

13.5 EXCLUSIONS

13.5.1 Dismantling or rerouting of any underground pipeline/ buried utilities.

13.5.2 Instrument air & service air up to terminal points.

13.5.3 H2SO4 chemical is in exclusion. However, all specialty chemicals applicable for CWTP and RO based DM plant shall be in bidder's scope, as included elsewhere in specification.

13.5.4 Air conditioning, ventilation & firefighting facilities. However, heat dissipation data for all motors & panels as applicable shall be finished by the bidder during detail engineering for sizing of HVAC equipment.

13.5.5 DM Water storage Tanks for DM plant.

13.5.6 All civil structural, architectural & construction works, civil works including foundation of equipment & acid resistant tilling, structural steel and works required for shed/ building, excavation and backfilling. However complete grouting for equipment, fixing and any concreting inside vessels shall be in the scope of the bidder.

13.5.7 Main pipe trestles.

13.5.8 Air conditioning, ventilation & firefighting facilities.

13.5.9 Supply of ISMB monorail (if applicable)

13.5.10 Service water, potable water and service air up to terminal points.

13.5.11 Other exclusions are mentioned in the electrical & C&I parts of this specification.

13.6 SITE VISIT BEFORE SUBMISSION OF OFFER.

Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details w.r.t existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.

13.7 SCOPE OF SERVICES FOR SUPPLY PACKAGES (CDS, ODS & LDS)

- Supervision of Complete Erection and Commissioning of Lime dosing system is in bidder's scope total duration of such activities shall be Thirty (30) man-days (Refer ANNEXURE-XIV for details).
- Bidder to provide Comprehensive Annual Maintenance Services (AMS) for three (03) years after warranty period for the Analyser instruments and Profibus instruments of **Supply Packages**. Refer complete details in Sub Section IC and IIC.

13.8 SCOPE OF SERVICES FOR TURN KEY PACKAGES (CLO2, STP, ETP, CPU, CWT, CHP WTP, PTP & DMP)

13.8.1 Unloading, Storage, handling and transportation at site.

13.8.2 Minor Civil work such as, Chipping of foundation, grouting below base plate for all structures, equipment, grouting of anchor bolts wherever these are not placed in the foundation during casting of foundation itself, excavation & filling of earth for buried MS pipes if and as required. To the extent possible, vendor shall ensure to supply all foundation bolts timely so as to facilitate placement of these bolts while casting the foundation.

13.8.3 Pre- Commissioning work such as flushing, hydraulic testing etc. Necessary consumables and

instrumentation as required for inspection and testing at works as well as at site including pre-commissioning activities shall be arranged by the successful bidder at their own cost.

13.8.4 Bidder to provide Comprehensive Annual Maintenance Services (AMS) for three (03) years after warranty period for the Analyser instruments and Profibus instruments of Turn Key Packages. Refer complete details in Sub Section IC and IIC.

13.8.5 Erection and Commissioning.

13.8.6 Bidder to refer Annexure-XII for pre-commissioning and commissioning.

13.8.7 Supervision of Complete civil structural, architectural & construction works of complete Pre Treatment plant is in bidder's scope. For Pre Treatment Plant, total duration of such activities shall be One Hundred Eighty (180) man-days.(Refer ANNEXURE-XIV for details).

13.8.8 Supervision of Complete civil structural, architectural & construction works of complete CHP Run-Off Water Treatment plant is in bidder's scope. For CHP Run Off Water Treatment Plant, total duration of such activities shall be Ninety (90) man-days.(Refer ANNEXURE-XIV for details).

13.8.9 Arrangement of all lubricants, instruments, reagents for carrying out trial run, commissioning and PG test.

13.8.10 Arrangement of all instruments, reagents, monitoring gadgets for monitoring, & lab facilities to carry out, pre-commissioning, trial run, commissioning, Performance guarantee test & till handover.

13.8.11 Monitoring gadgets, instruments and equipment's required for maintenance (till PG test & Plant Handover).

13.8.12 All personnel required during pre-commissioning, commissioning, trial run and PG Test / Demonstration test.

13.8.13 Trial run for requisite period.

13.8.14 Performance Guarantee testing. Refer Annexure-III (FUNCTIONAL GUARANTEE) for further details

13.8.15 Bidder shall perform the guarantee parameters as per specification requirement to the satisfaction of owner. The exact modalities of verifying guarantee for the parameters indicated in the specification shall be finally as agreed with the owner during detailed engineering & mutually agreed.

13.8.16 During FAT of DCS, bidder will depute his concerned representative for technical support as and when required by customer / BHEL.

13.8.17 Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance. Bidder to refer relevant details for other information also.

13.8.18 Relevant requirements as per GTR, GCC, ECC & SCC.

13.8.19 Any other service required for making the installation complete in all respect within battery limits and for satisfactory erection & commissioning of the system as well as to meet any statutory requirement relevant to the package, unless specifically EXCLUDED from scope of services.

13.8.20 Bidder to attend regular engineering meeting with BHEL and Customer fortnightly in BHEL or Customer office as decided during detail engineering. Vendor will depute his entire concerned engineering representatives along with the project manager for discussion and approval of engineering drawings/ documents during detailed engineering to meet project's various milestones and completion schedule, without any price implication to BHEL and Customer. Meeting can be held at site also.

13.8.21 Supply of all tools/ supporting tools/ items / equipment/ instruments required for performance guarantee test shall be bidder's scope. These shall remain the property of the BHEL/Customer after trial test/demonstration test/ PG test.

13.8.22 Successful bidder shall furnish detailed erection manual for each of the equipment as well as complete system supplier under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

13.9 QUALITY PLAN (QP) REQUIREMENTS

Minimum QP requirements are specified as ANNEXURE -I. However, any additional comments as given by BHEL/Customer shall be adhered by the bidder without any commercial & delivery implication to BHEL. BHEL & customer reserves the right for inspection of imported items by BHEL/customer officials (if felt necessary). The same shall be decided during detail engineering during approval of QP's. The cost of third-party inspection for all components shall also be in bidder's scope.

13.10 SUB-VENDOR ITEMS

The sub vendor list (Annexure- II) enclosed is indicative only and is subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.

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

1) Documentation to show that the equipment /system has been supplied for a plant of similar or higher capacity.
2) End user performance certificate that the equipment/system has been operating satisfactorily for minimum one year as on the scheduled date of bid opening.

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

For approval of Sub vendor list proposed by bidder, meetings shall be arranged by BHEL in Customer office for which bidder representative along with sub supplier as desired by BHEL/Customer will attend the meetings.

13.11 ATMOSPHERIC TANKS/ PRESSURE VESSELS

13.11.1 Design of all pressure vessels shall conform to ASME Section VIII or acceptable equivalent standard. Design pressure shall be the maximum expected pressure to which the vessels may be subjected to plus 5% additional margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shutoff head of the pumps plus static head at pumps suction if any. For all other pressure vessels, design pressure shall be at least 8 Kg/cm² (g).

13.11.2 Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali, and other chemicals shall conform to IS: 803.

13.11.3 Design of all horizontal cylindrical atmospheric storage tank containing water, acid, alkali, and other chemicals shall conform to BS: 2594.

13.11.4 Design temperature of all pressure vessels and storage tanks shall be 10 deg. C higher than the maximum temperature that any part of the vessel/tank is likely to attain during operation. In case, tank is subjected to vacuum, the same shall be taken care in designing the tank.

13.11.5 The design of DM water storage tanks (Vertical type) for CPU shall conform to IS: 803. Supporting frame where required shall be in accordance with IS: 800. The tank shall be "Non-pressure" fixed roof type with atmospheric vents.

13.11.6 All vessels/tanks without inside rubber lining shall have a corrosion allowance of minimum 2 mm and mill allowance (minimum 0.3 mm) for shell and dished ends. Thinning allowance of 2 mm (minimum) shall be considered for dished end.

13.11.7 All the atmospheric tanks shall have sufficient free board above the "Level High"/ "Normal Level" as the case may be. The overflow level shall be kept at least 20 cm or 10% of vessel

height above the "Level High"/" Normal Level" for all the tanks except for the DM tanks (for CPU) for which a minimum height of 300 mm shall be provided over the "High Level". Further, a minimum 100 mm free board shall be provided above the top of overflow level to the bottom of roof of the tank. Wall thickness of atmospheric tanks shall not be less than 6 mm.

13.11.8 Vessels coming under preview of IBR shall be designed accordingly.

13.11.9 Material of Construction

- The pressure vessels shall be fabricated from carbon steel plates conforms to SA 515 Gr.70 or SA 516 Gr. 70 if the pressure vessels are designed as per ASME Section VIII.
- If the pressure vessels are designed as per IS 2825 following criterion shall be followed: The pressure vessels shall be fabricated of steel as per IS: 2002 Gr. 3 (normalized condition) or SA: 515/516 Gr. 70 (normalized), in case the vessels are designed as per Class 1 or Class 2 of IS: 2825. If the pressure vessels are designed as per Class 3 of IS: 2825, the material of construction shall conform to IS: 2062 or IS: 2002 Gr. 3 (Normalized quality).or SA 515 /516 Gr. 70
- All atmospheric tanks shall be fabricated of steel conforming to IS: 2062.
- The pipe flanges, manhole/manhole covers reinforcement pads etc. shall be fabricated out of the same material as that one used for the vessel/tank.

13.11.10 Fabrication

- The vessel ends for storage tanks of vertical type shall have flat bottom. However, the ends of horizontal storage tanks, and all the pressure vessels shall be dished design of Torispherial type designed and constructed by forging, pressing or spinning. The dished ends shall have a minimum straight flange length of 60 mm. Conical or flat (with or without reinforcement) ends shall not be accepted.
- The plates to be used for fabrication shall preferably have a minimum width of 1500 mm. All welding shall be performed by ASME qualified welders under Section-IX of ASME Boiler and Pressure Vessel code and welding electrodes shall be as per relevant Codes/Standards viz. AISC Section 1.17 etc.
- All pressure vessels and storage tanks except DM water storage tanks, UF, RO Permeate water tanks shall be fabricated complete and tested at manufacturer's works to ensure better workmanship.

13.11.11 Appurtances, Connections, Lifting lugs

- Manholes/Hand Holes: All the pressure vessels and horizontal type storage tanks shall be provided with at least one manhole of 500 mm diameter. The vertical type storage tanks shall be provided with a manhole of 500 mm dia on the top cover, if the diameter of the tank is 1200 mm or more. For the vertical cylindrical atmospheric tanks, manholes shall be provided as per IS: 803.
- All the vessels and tanks shall be normally provided with a hand hole of 150 mm gasketed located near the bottom of the straight side.
- All lined vessels connections shall be conformed to required class/rating. Nozzle material shall be ASTM-106 Grade B, Schedule 80.
- All vessels of internal, diameter of 1200 mm or greater shall be provided with minimum four (4) lifting lugs for safe and effective handling during erection. Smaller vessels shall be provided with at least two (2) lifting lugs. Material of construction for these vessel supports, saddles, lugs shall conform to IS: 2062 of tested quality.

13.12 ADDITIONAL SCOPE OF BIDDER AND DETAILS

13.12.1 Charging platform for all the chemical tanks along with required handrails, accessories etc. Permanent ladder (not rungs) for approaching the top of tanks, valves for All steel inserts plates with lugs, plates, bolts, nuts, sleeves, edge angles and all other embedding components etc as required to grout in civil works and to support/hold the equipment's for opening/maintenance purpose, shall be in bidder's scope.

13.12.2 Slings & Lifting lugs shall be provided in all equipment.

13.12.3 The starting of pumps (wherever applicable) which are provided with forced water lubrication shall be interlocked with the availability of lube water by means of starting of lubrication water pumps, availability of adequate flow, pressure etc. The standby lubrication pump shall be started automatically during inadequate pressure or while tripping of working pump(s).

13.12.4 Wrapping, coating and protection of all the buried pipe shall be as per IS 10221 or AWWA C 203.

13.12.5 Diaphragm seal type instrument for Chemical (all type and concentration), corrosive, viscous fluids application.

13.12.6 Instrumentation, valves etc. indicated in P & ID of Water treatment packages are bare minimum requirement; however, bidder has to provide complete system for trouble free operation meeting technical specification requirement.

13.12.7 All pipes, fittings etc. required for hand railing, platforms, and ladders shall be in the scope of bidder. All ladders shall be non-civil work. All insert plates, nuts and bolts, puddle pipes, counter flanges wherever applicable shall be in the scope of bidder. Supply and erection of Hand railing as desired for safety purpose will be in bidder's scope.

13.12.8 Safety equipment for all water treatment packages shall be provided by bidder as per requirement included elsewhere in specification.

13.12.9 Special tools and tackles as required for the system. All special tools necessary for proper maintenance or adjustment of the equipment packaged in permanent box.

13.12.10 Complete civil analysis & design of all civil structural & architectural works of complete Pre - Treatment Plant. Relevant Civil specification shall be shared with Successful bidder during detail engineering.

13.12.11 Complete civil analysis & design of all civil structural & architectural works of complete CHP Run-Off water Treatment Plant. Relevant Civil specification shall be shared with Successful bidder during detail engineering.

13.12.12 All the first fill and one Year's topping requirements or 10 % of first fill quantity, whichever is more of consumable such as greases, oil, lubricants, servo fluids/control fluids, gases, reagent for analyzers and 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 furnished by the bidder. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.

13.12.13 Initial charge of all lubricants & grease in bidder's scope.

13.12.14 Instrument hook up material shall be in bidder's scope.

13.12.15 Painting shall be as specified in "Surface Preparation & Painting" ANNEXURE-V of this technical specification. Bidder to note that paint shed shall be finalized during detailed engineering as per customer & BHEL requirement and any variation in the painting schedule as finally approved by customer shall be taken care by bidder without any commercial and delivery implication.

13.12.16 Bidder shall also provide one final coat additionally of same DFT as specified in tender specification at site after completion of erection of each equipment / item.

13.12.17 Preparation of civil assignment drawings i.e. pedestals details; insert plates / embedment's plates required for supporting pipes and equipment etc. and review of civil drawing prepared by BHEL based on civil assignment drawing of bidder. In case any modification is required in the civil work already done based on civil inputs given by vendor, rework shall be done at the cost and risk of the vendor.

13.12.18 All the sumps, tanks, reservoirs and other water retaining structures shall be provided by bidder with access ladders/rungs from operating platforms/ground level as the case may be and de-watering pits one for each section (civil work by BHEL).

13.12.19 Preparation & submission of all drawings & documents as per drawing/documents requirement & distribution schedule enclosed as Annexure-IV.

13.12.20 Bidder to refer annexure-XIII for drawing list of all water treatment packages

13.12.21 Two sets of all special tools and tackles required for installation, commissioning, testing, calibration, modification and maintenance of equipment(s)/ system shall be supplied. One set of these tools and tackles shall be used during the installation, commissioning, testing, calibration, modification and maintenance. Another set consists of new and unused set of tools & tackles. These tools and tackles shall be separately packed, brought to site and handed over to customer.

13.12.22 Supply of any tools/ supporting tools/ items / equipment required for Erection and Commissioning shall be bidder's scope. These shall remain the property of the BHEL/Customer after trial test/demonstration test/ PG test.

13.12.23 Bidder to take care the length of piping as included elsewhere in specification of All Water Treatment packages, if not given any of the package bidder to consider pipe distances from plot plan. Pipe routing shall be decided during detailed engineering; Wherever pipes are running on pipe rack, Bidder will consider 12 m static head + 10% margin, in addition to the losses in straight length and bend in pipes and valves etc. while selection of pump head during detailed engineering.

13.12.24 Pipe racks shall be provided by BHEL wherever available. Wherever pipe racks are not available, pipes shall run on pedestals or below ground. All auxiliary structure & fixing items such as U clamps, nuts, bolts, channels, insert plates etc. required to lay the pipes on pedestals shall be in bidder's scope of work. Wrapping, coating and protection of all the buried pipe is also in bidder's scope & shall be as per IS 10221.

- Buried piping shall be protected as under (as per IS-10221).
- Surface cleaning by wire brush, power tool cleaning etc.
- Apply one coat of coal tar/primer/enamel.
- Apply one layer of tape comprising of coal tar. Application of tape shall conform to AWWA C- 203/IS 10221 (Appendix-B) with Minimum thickness of tape as 4MM +10%.

13.12.25 All steel inserts plates with lugs, rungs, ladder, puddle pipes, bolts, edge angle in desired shape, nuts, sleeves, and all other embedding components etc. as required to grout in BHEL civil works and to support/hold the equipment being supplied under this specification shall be in bidder's scope.

13.12.26 The pipe sizes indicated in the tender specification/ P & I diagram are minimum. Wherever pipe sizes are not indicated, the same shall be selected based on the specification requirement and shall be subject to BHEL /customer approval during detailing engineering. All pipes shall be carbon steel unless exclusively mentioned.

13.12.27 All necessary drains, vents and sampling points with valves as specified and as required are in bidder's scope. All above ground tanks /sumps shall have overflow and drain connections with isolation valves.

13.12.28 Manhole covers (Metallic) shall be in bidder's scope.

13.12.29 For Low pressure piping, based on the inside diameter so established, minimum thickness calculation shall be made asper ANSI B 31.1 OD. Manufacturing allowance shall be added to minimum calculated thickness and next higher standard thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B36.19 as the case may be. Alternatively, manufacturers standard thickness can also be accepted subject to that such thickness shall be equal to or more than the minimum calculated thickness after considering manufacturing allowance. Selected thickness then shall be checked for vacuum loading criterion as per the guidelines given in AWWA-M-11. However, in no case, the selected Thickness for various pipe sizes shall be less than the following for indicated Pipe Sizes as below:

- 200 NB - 6mm
- 250 NB – 6 mm
- 300 NB - 6 mm

- 350 NB- 6mm
- 400 NB- 6 mm
- 450 NB- 6 mm
- 500 NB- 6 mm
- 600 NB- 6mm
- 700 NB- 7mm
- 800 NB- 8 mm
- 900 Nb – 10 mm
- 1000 Nb – 10 mm
- 1100 Nb – 10mm
- 1200 Nb – 12 mm

13.12.30 All motorized valves shall be provided with integral starter.

13.12.31 Wherever gravity is not possible or pumping is required at any stage to make the system complete for process requirement of supplier. Then, 2x100% pumps are in bidder along with all accessories, all instrumentation, valves, piping, motor, etc.

13.12.32 Grouting of equipment and grouting material required are in bidder's scope.

13.12.33 Edge angle required in proper shape for protection of edges in civil works shall be in bidder's scope

13.12.34 Finish paints for touch-up painting of equipment after erection at site in sealed container.

13.12.35 All necessary structural steel for pipe supporting structure, platforms, walkways / pathways and access stairs for mechanical plant and equipment, mechanical services and pipe work associated with water treatment packages.

13.12.36 Chain pulley block and Electric monorail hoist along with travelling trolley and trailing cable. Refer criteria given elsewhere in this specification.

13.12.37 Hangers and supports for all the piping as per the requirement shall be in bidder's scope.

13.12.38 ISMC/ ISMB required to support Cable tray shall be supplied and erected by bidder.

13.12.39 Start up, erection and commissioning spares and all spares as required for erection, commissioning and operation and maintenance till handing over of the complete plant.

13.12.40 Complete piping (including interconnecting), all fittings, bends, tees, reducers, flanges, nuts & bolts, gaskets, specials, isolation valves, permanent strainers etc, supports, jointing etc, and any other work as required for the system.

13.12.41 Sufficient numbers of portable type ladders with plate form to be supplied for ease of maintenance.

13.12.42 Bidder to refer Annexure X w.r.t. Water analysis.

13.12.43 Bidder to follow site storage and preservation guidelines as per Annexure-IX

13.12.44 Bidder to follow format for operation & maintenance manual as per Annexure-VII

13.12.45 Operating platforms, permanent ladders (not rugs), supports and other structural works for each tank, valves etc. to facilitate accessibility for operation and maintenance in all water treatment packages.

13.12.46 During detailed engineering, bidder to furnish complete and detailed scheme in all respects including all valves, equipment's etc.as required for smooth, safe, efficient, trouble free operation and completeness of the respective packages, meeting the specification requirement.

13.12.47 All channels & brackets, mounting plates as required for mounting of motors, pumps, stirrers, tank etc. shall be in bidder's scope.

13.12.48 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and dispatch release issued by BHEL/Customer.

13.12.49 BHEL's/Customer's representative shall be given full access to the shop in which the equipment are being manufactured or tested and all test records shall be made available to him.

13.12.50 Pump suction valves, re-circulation valves and discharge valves shall be provided with required limit switches for interlock & control.

13.12.51 The starting of pumps (wherever applicable) which are provided with forced water lubrication

shall be interlocked with the availability of lube water by means of starting of lubrication water pumps, availability of adequate flow, pressure etc. The standby lubrication pump shall be started automatically during inadequate pressure or while tripping of working pump(s).

13.12.52 Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.

13.12.53 Preparation of drawings / document / P&ID's in 3D modelling software and providing soft copy of same to BHEL.

13.12.54 Service water shall be available near to all WATER TREATMENT PLANTS area at approximately 1.5 to 2.0 Kg/ Cm2. Hence, bidder to take care for cooling/ lubrication of the pumps being supplied by the bidder under this technical specification. If service water pressure requirement is more than available pressure, bidder to consider two (2) nos. cooling pump/lubrication pump.

13.12.55 Wherever local instruments for measurement of Flow, Pressure, Level is indicated in the P&ID, Bidder to provide Diaphragm seal type instrument for Chemical (all type and concentration), corrosive, viscous fluids application.

13.12.56 All drawings/documents shall be approved by BHEL/Customer during detailed engineering stage. Successful Bidder shall comply with the comment of the customer/BHEL without price & delivery implication.

13.12.57 Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval shall be taken from BHEL during detailed engineering. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

13.12.58 In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

13.12.59 All the vertical pumps shall be self-lubricated type.

13.12.60 Bidder shall indicate the constituents of the chemical's formulation used for the treatment.

13.12.61 Butterfly valves shall conform to design standard latest revision of AWWA C-504/EN 593/equivalent standard of required class/rating.

13.12.62 Plug valves shall be designed as per BS: 5353 Cl.150 or equivalent.

13.12.63 Valves for alum solution shall be Saunders's patented Diaphragm type designed as per BS: 5156 or approved equivalent standard.

13.12.64 Sluice/Gate Valves shall conform to BS: 5150 (BS: 5163 PN 16) PN16, IS:14846 of rating PN 1.0 (min.). Stem, seat ring and wedge facing ring shall be of stainless-steel construction. Other parts shall be as per IS: 14846 /BS:5163). Flanges shall be designed as per ANSI B 16.5 Cl. 150 (min.) to meet with the piping flanges. Valves shall be of outside screw and rising stem type. Gate valves for sizes below 50 NB and below shall conforms to IS:778 Class-2/ANSI B16.34 straight, rising stem; without side screw.

13.12.65 Sluice/Isolation gates shall be provided with the following accessories in addition to the standard items:

- Hand wheel
- Manual Gear reduction unit operator for valves 200 NB and above
- Bypass valve for valve of sizes 350 NB and above.
- Draining arrangement wherever required.
- Arrow indicating flow direction.
- Position indicator.
- Sluice/Isolation gates shall be provided with back seating bush to facilitate gland

renewal during full open condition.

- Design standard for Gates shall be IS: 3042 or Equivalent.
- Material of Construction
- Frame and Door: Cast Iron IS:210 Gr.260
- Spindles, bolts & nuts: M.S. to IS:2062
- Face & seat rings: Gun metal (as per IS: 3042).
- All the parts of gates shall be applied with the coats of heavy duty bitumastic paint. Each of the gates shall be provided with hand wheel and a position indicator.
- Sluice valve/knife edge type slide valves shall design by IS 14846. Plug valves shall be used for the application of lime slurry/lime solutions conforming to BS: 5353 Class 150 or Equivalent.
- Valves will be used to start/stop or control flow. Gates will be primarily used for isolation of flow in open channels although these should be capable of throttling the flow too. However, contractor can provide either isolation gates or butterfly valves in various RCC (IN BHEL SCOPE) tanks/pits/sumps such as sludge pit, etc. Sample valves will be used in sample collection lines. Unless otherwise specified all the valves shall be supplied with counter flanges by the Contractor.

13.12.66 All valves shall be suitable for service conditions i.e. flow, temperature and pressure under which they are required to operate. All the valves shall be of standard pressure rating of the relevant design standard. Nonstandard pressure rating shall not be accepted. The pressure and temperature rating of the valve shall not be less than the maximum expected pressure and temperature plus 5% additional margin of the system in which valves are proposed to be installed. The pressure rating of individual piping system components such as valves, flanges etc. shall however be not less than that specified.

13.12.67 Screen control cable is meant for electrical as well as signal/ instrumentation cables.

13.12.68 Recirculation lines for pumps shall be provided by bidder along with valves, instrumentation, fittings as per system requirement.

13.12.69 Bidder to follow latest version of all codes and standards.

13.12.70 Apart from package specific design requirement indicated in this technical specification, design of various systems/ sub-systems and all equipment/ items will also strictly meet stipulations of General Technical Requirements of Customer's Technical Specification (refer section II) as relevant to Package.

13.12.71 KKS numbering for all items/ equipment including electrical and control & instrumentation to be provided by bidder during detailed engineering. KKS numbering philosophy shall be furnished during detailed engineering.

13.12.72 All documents, including the installation as well as the related software shall be in fluent, legible English.

13.12.73 All interconnecting piping, valves, fittings including dosing piping, drain piping from acid storage dyke to nearby drain through neutralization pit provided in the dyke area, piping for monitoring equipment such as pH monitor/ deposit monitor/ corrosion rack etc., flushing lines from nearest available water source, valves, fittings and accessories.

13.12.74 Internal arrangement given in plot plan for all water treatment packages is indicative only. Bidder to develop internal arrangement layout during detail engineering as per technical specification

13.12.75 Bidder to adhere to Packing Procedure as per Annexure-VIII.

13.12.76 Bidder to adhere to Operation and Maintenance as per Annexure-XI.

13.12.77 Bidder to adhere to drawings as per Annexure-XIII.

13.12.78 Bidder to adhere to Supervision services as per Annexure-XIV.

13.12.79 Bidder shall ensure to supply all foundation bolts timely so as to facilitate placement of these bolts while casting the foundation. Wrapping, coating and protection of all the buried pipe shall be as per IS 10221.

13.12.80 Training of customer/ client O&M staff Training requirement of customer/ client O&M staff is

also in Bidder's scope. Man-days and schedule of training for customer/client O&M staff listed below. The training charges shall be inclusive of charges of Air-Fair/Rail-Fair, Boarding& Lodging, Local conveyance, medical, insurance, visa (as applicable), etc.

ANNEXURE - I

QUALITY PLAN

BHEL	MANUFACTURER'S NAME & ADDRESS :		QUALITY PLAN				PROJECT	2X800MW LARA STPP			
			ITEM: CHEMICAL DOSING SYSTEM		QP.NO : PE-QP-508-154-A001						
			SUB - SYSTEM : CHEMICAL DOSING SYSTEM		REV. : 0		PACKAGE	CHEMICAL DOSING SYSTEM			
					DATE :		CONTRACT NO.				
					PAGE : 1 OF 4		MAIN SUPPLIER	BHEL/PEM, NOIDA			

S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY**			REMARKS
									M	B	N	
1	2	3	4	5	6	7	8	9	10			11
1.0	**WELDER'S QUALIFICATION**											
1.1	WELDING PROCEDURE SPECIFICATION (WPS)	CORRECTNESS	MA	SCRUTINY	100%	ASME IX	ASME IX	QW 482	P	V	V	
1.2	WELDER PERFORMANCE & PROCEDURE QUALIFICATION RECORD	WELD SOUNDNESS & WELDING PERFORMANCE	MA	PHYSICAL TEST	ASME IX	ASME IX	ASME IX	QW 483 & QW 484	P	V	V	
2.0	**TANKS**											
2.1	**RAW MATERIAL :**											
2.1.1	PLATE	CHEMICAL.& PHY. PROPERTIES	MA	CHEM &.PHY TEST	1/PLATE/HT BATCH	ASTM A 240 GR.TP 304	ASTM A 240 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	IDENTIFICATION BY BHEL
		IGC TEST	MI	IGC TEST	1/PLATE/HT BATCH	ASTM A 262 PR.'E'	ASTM A 262 PR.'E'					
2.1.2	PIPE FOR NOZZLE	CHEMICAL.& PHY. PROPERTIES	MA	CHEM.& PHY.TEST	1/HT BATCH/SIZE	ASTM A 312 GR.TP 304	ASTM A 312 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		MICRO STRUCTURE	MI	GRAIN STRUCTURE	1/HT BATCH/SIZE	FOR HEAT TREATMENT	FOR HEAT TREATMENT	MFG.TC/LAB REPORT	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH/SIZE	ASTM A 262 PR.'E'	ASTM A 262 PR.'E'	MFG.TC/LAB REPORT	P	V	V	
		HYDRO TEST	NA	LEAKAGE	100%	NO LEAKAGE	NO LEAKAGE	MFG. TC/IR	P	V/W	V	REFER NOTE 4
2.1.3	FLANGES FOR TANKS	CHEMICAL & PHY PROPERTIES	MA	CHEM & PHY TEST	1/HT BATCH	ASTM A 182 GR. F 304	ASTM A 182 GR. F 304	MGF.TC/LAB REPORT	P	V	V	
2.2	**IN PROCESS**											
2.2.1	DISHED ENDS	DIMENSIONS	MA	MEASUREMENT WITH TEMPLATE	100%	APPD.DWG.(BY BHEL)	APPD.DWG.(BY BHEL)	MFG.TC./LAB REPORT	P	V	V	
		SURFACE DEFECTS ON WELDMENTS		DP TEST	100%	ASTM E 165	NO SURFACE DEFECTS	MFG.TC	P	V	V	
2.3	**FINAL ASSEMBLY FOR TANKS:**	DIMENSIONS &	MA	MEASUREMENT	100%	APPD.DWG.(BY BHEL)	APPD.DWG.(BY BHEL)	MFG.TC/INSP REPORT	P	W	W	TO BE OFFERED ALONG WITH FINAL SKID ASSEMBLY INSPECTION.
		ORIENTATION	MA	VISUAL		APPD.DWG.(BY BHEL)	APPD.DWG.(BY BHEL)	MFG.TC/INSP REPORT	P	W	W	
2.3.1		LEAKAGE	MA	WATER FILL FOR 2 HR	100%	N.A.	NO LEAKAGE	MFG.TC/INSP. REPORT	P	W	W	
3.0	**STIRRER :**											
3.1	RAW MATERIAL FOR SHAFT	CHEM.& PHY. PROPERTIES	MA	CHEM &.PHY TEST	1/BAR	ASTM A 479 GR.TP 304	ASTM A 479 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		IGC TEST	MA	IGC TEST	1/HT BATCH	ASTM A 262 PR.'E'	ASTM A 262 PR.'E'	MFG.TC/LAB REPORT				
3.2	IMPELLER	CHEMICAL PROP.	MA	CHEMICAL TEST	1/PLATE	ASTM A 240 GR.TP 316	ASTM A 240 GR.TP 316	MFG.TC/LAB REPORT	P	V	V	
3.3	COMPLETE STIRRER UNIT WITH MOTOR	PERFORMANCE IN WATER FILLED TANK										
		- VIBRATION	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		- WOBBLING	MA	VISUAL	100%	NO WOBBLING	NO WOBBLING	MFG.TC	P	V	V	
		- POWER CONSUMPTION/ CURRENT DRAWN	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
4.0	**MOTORS:**	ROUTINE TEST	MA	MFG. TC	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		TYPE TEST	MA	MFG. TC	1/ SIMILAR FRAME SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		DEGREE OF PROTECTION	MA	MFG. TC	1/ SIMILAR FRAME SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	

**** LEGEND :**

M : MANUFACUTRER/SUB-CONTRACTOR/SUB-VENDOR
B : BHEL/ NOMINATED INSPECTION AGENCY N:NTPC
"P" PERFORM, **"W"** WITNESS, AND **"V"** VERIFICATION

MANUFACTURER/ SUB CONTRACTOR	MAIN SUPPLIER--BHEL	SIGNATURE OF APPROVAL BY CUSTOMER
SIGNATURE		

		MANUFACTURER'S NAME & ADDRESS :		**QUALITY PLAN**				**PROJECT**	2X800MW LARA STPP			
				ITEM: CHEMICAL DOSING SYSTEM		**QP.NO : PE-QP-508-154-A001** **REV. :** 1		**PACKAGE**	CHEMICAL DOSING SYSTEM			
				SUB - SYSTEM :		**DATE :**		**CONTRACT NO.**				
				CHEMICAL DOSING SYSTEM		**PAGE :** 2 OF 4		**MAIN SUPPLIER**	BHEL/PEM, NOIDA			
S.NO.	**COMPONENTS/ OPERATION**	**CHARACTERISTICS CHECKED**	**CATEGORY**	**TYPE/ METHOD CHECK**	**EXTENT OF CHECK**	**REFERENCE DOCUMENT**	**ACCEPTANCE NORMS**	**FORMAT OF RECORDS**	**AGENCY****			**REMARKS**
									M	**B**	**N**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
5.0	**METERING PUMP:**											
5.1	**RAW MATERIAL :**											
5.1.1	WETTED PARTS	CHEM & PHY. PROPERTIES	MA	CHEM. & PHY. TEST	1/BAR	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
		SURFACE TEST	MI	UT ON BAR>25 MM DIA	100%	ASTM A 388	REF. NOTE # 1	MFG.TC/LAB REPORT	P	V	V	
				DP ON M/C SURFACE	100%	ASME - E - 165	NO SURFACE DEFECTS	MFG.TC/LAB REPORT	P	V	V	
5.2	**FINAL INSPECTION**											
5.2.1	PUMP WITH MOTOR	LINEARITY	MA	PERFORMANCE	100%	API 675	API 675	INSPECTION REPORT	P	W	V	SHALL BE TESTED WITH EITHER JOB MOTOR OR SHOP MOTOR OF SIMILAR FRAME SIZE
		STEADY STATE ACCURACY	MA	SHOP TEST	100%	API 675	API 675	INSPECTION REPORT	P	W	V	
		REPEATABILITY	MA	SHOP TEST	100%	API 675	API 675	INSPECTION REPORT	P	W	V	
		POWER DRAWN @ 100% STROKE	MA	MEASURED AT WORK	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	INSPECTION REPORT	P	W	V	
		LEAKAGE	MA	HYDRO TEST	100%	@1.5X DESIGN PRESSURE	NO LEAKAGE	INSPECTION REPORT	P	W	V	
		DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	V	
		NOISE	MA	MEASUREMENT	100%	--	< 85 dbA AT 1 M RADIUS	INSPECTION REPORT	P	W	V	
		VIBRATION	MA	MEASUREMENT	100%	--	≤45 MICRONS (PEAK TO PEAK)	INSPECTION REPORT	P	W	V	
7.0	**PRESSURE RELIEF VALVE**	SET & RESET PRESSURE.	MA	PERFORMANCE	100%	BHEL APPD.DATA SHEET & API RP-520	BHEL APPD.DATA SHEET & API RP-520	MFG. TC	P	V	V	
		DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG. TC	P	V	V	
		LEAKAGE DURING PERFORMANCE TEST	MA	VISUAL	100%	NO LEAKAGE	NO LEAKAGE	MFG. TC	P	V	V	
8	**VALVES (GATE, GLOBE & NRV)**											
8.1	**RAW MATERIAL :**											
8.1.1	BODY, BONNET COVER	CHEM.& PHY PROPERTIES	MA	CHEM.& PHY TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC/LAB REPORT	P	V	V	
		HEAT TREATMENT	MA	HEAT TREATMENT	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC/LAB REPORT	P	V	V	
8.1.2	TRIM MATERIAL	CHEM.& PHY PROPERTIES	MA	CHEM.& PHY TEST	1/BAR/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC/LAB REPORT	P	V	V	
8.2	**ASSEMBLY**											
		LEAKAGE (BODY & SEAT)		HYDRO TEST	100%	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG TC	P	V	V	
		LEAKAGE (SEAT)		PNEUMATIC TEST	100%	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG TC	P	V	V	
		DIMENSIONS		MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG TC	P	V	V	

MANUFACTURER/ SUB CONTRACTOR | **MAIN SUPPLIER--BHEL**

SIGNATURE

**** LEGEND :**
M : MANUFACUTRER/SUB-CONTRACTOR/SUB-VENDOR
B : BHEL/NOMINATED INSPECTION AGENCY N: NTPC
"P" PERFORM, **"W"** WITNESS, AND **"V"** VERIFICATION

SIGNATURE OF APPROVAL BY CUSTOMER

	MANUFACTURER'S NAME & ADDRESS :		QUALITY PLAN				PROJECT	2X800MW LARA STPP			
			ITEM: CHEMICAL DOSING SYSTEM		QP.NO : PE-QP-508-154-A001		PACKAGE	CHEMICAL DOSING SYSTEM			
			SUB - SYSTEM :		REV. :	1	CONTRACT NO.				
			CHEMICAL DOSING SYSTEM		DATE :						
					PAGE :	3 OF 4	MAIN SUPPLIER	BHEL/PEM, NOIDA			

S.NO	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY** M	AGENCY** B	AGENCY** N	
1	2	3	4	5	6	7	8	9	10			11
9.0	**FITTING/FLANGES FOR PIPING:**											
9.1	RAW MATERIAL	CHEM.& PHY PRPERTIES	MA	CHEM.& PHY TEST	1/HT BATCH	ASTM A 182 GR.TP 304	ASTM A 182 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		HEAT TREATMENT	MA	HEAT TREATMENT	100%	ASTM A 182 GR.TP 304	ASTM A 182 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH	ASTM A 262 PR. 'E'	ASTM A 262 PR. 'E'	MFG.TC/LAB REPORT	P	V	V	
9.2	FINAL INSPECTION	DIMENSIONS	NA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG/ ANSI B 16.11/16.5	BHEL APPD.DATA SHEET/DWG/ ANSI B 16.11/16.5	MFG.TC	P	V	V	
10.0	**STRAINERS :**											
10.1	RAW MATERIAL FOR BODY	PHY.& CHEM. PROPERTIES	MA	PHY. & CHEM.TEST	1/BAR/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TCLAB REPORT	P	V	V	
10.2	SCREEN	CHEMICAL	MA	CHEMICAL	1/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
		MESH SIZE	MA	MEASUREMENT	1/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
10.3	FINAL INSPECTION	DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		LEAKAGE		HYDRO TEST	1	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG.TC	P	V	V	
11.0	**PIPE (SEAMLESS)**											
11.1	MATERIAL	CHEMICAL	MA	CHEMICAL	1/HT BATCH/SIZE	ASTM A 312 GR.TP 304	ASTM A 312 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		MECHANICAL TEST	MA	MECHANICAL TEST	1/HT BATCH/SIZE	ASTM A 312 GR.TP 304	ASTM A 312 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		MICRO STRUCTURE	MI	GRAINS STRUCTURE	1/HT BATCH/SIZE	FOR HEAT TREATMENT	FOR HEAT TREATMENT	MFG.TC/LAB REPORT	P	V	V	IDENTIFICATION BY BHEL. REFER NOTE 4.
		IGC TEST	MI	IGC TEST	1/HT BATCH/SIZE	ASTM A 262 PR 'E'	ASTM A 262 PR 'E'	MFG.TC/LAB REPORT	P	V	V	
		HYDRO TEST	MA	LEAKAGE	100%	NO LEAKAGE	NO LEAKAGE	MFG.TC/IR	P	V/W	V	
12.0	**LEVEL GAUGE :**											
12.1	RAW MATERIAL	CHEM.PROPERTIES	MA	CHEM.TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MGF.TC/LAB REPORT	P	V	V	
12.2	FINAL INSPECTION	DIMENSION	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		LEAKAGE	MA	HYDRO TEST	100%	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG.TC	P	V	V	
13.0	**PRESSURE & DP GAUGE**											
13.1	MAT. FOR WETTED PARTS & BOU	CHEM.PROPERTIES	MA	CHEM.TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
13.2	FINAL INSPECTION	DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG.TC/LAB REPORT				
13.3	PERFORMANCE	ACCURACY & OVERLOAD PROTECTION	MA	CALIBRATION	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC	P	V	V	
14.0	**SWITCHES(LEVEL, PRESURE & DP) & TRANSMITTERS (LEVEL, PRESSURE & DP):**											
14.1	MAT. FOR WETTED PARTS	CHEM.PROPERTIES	MA	CHEM.TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
14.2	PERFORMANCE	FUNCTIONAL	MA	CALIBRATION & VISUAL	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		IR-HV-IR		ELECTRICAL	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		DIMENSIONS		MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG.TC	P	V	V	
		DEGREE OF PROTECTION	MI	VERIFICATION OF TYPE TEST CER	TYPE TEST	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	

MANUFACTURER/ SUB CONTRACTOR	MAIN SUPPLIER--BHEL	** LEGEND :	
SIGNATURE		**M** : MANUFACUTRER/SUB-CONTRACTOR/SUB-VENDOR **B** : BHEL/NOMINATED INSPECTION AGENCY **"P"** PERFORM, **"W"** WITNESS, AND **"V"** VERIFICATION	SIGNATURE OF APPROVAL BY CUSTOMER

	MANUFACTURER'S NAME & ADDRESS :		**QUALITY PLAN**				**PROJECT**	2X800MW LARA STPP			
			ITEM: CHEMICAL DOSING SYSTEM		**QP.NO : PE-QP-508-154-A001**						
					REV. : 1		**PACKAGE**	CHEMICAL DOSING SYSTEM			
			SUB - SYSTEM :		**DATE :**		**CONTRACT NO.**				
			CHEMICAL DOSING SYSTEM		**PAGE :** 4 OF 4		**MAIN SUPPLIER**	BHEL/PEM, NOIDA			

S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY**			REMARKS
									M	B	N	
1	2	3	4	5	6	7	8	9	10			11
15.0	**CONTROL PANEL :**	DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	CONTOL PANEL TEST TO BE OFFERED ALONG WITH FINAL SKID ASSEMBLY.
		CONTINUITY, IR-HV-IR	MA	ELECTRICAL	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		VERIFICATION OF MAKE	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		RATING OF COMPONENTS	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		PAINT SHADES, THICKNESS	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		ADHESION	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		DEGREE OF PROTECTION	MI	VERIFICATION OF TYPE TEST CERTIFICATE	TYPE TEST	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG.TC/LAB REPORT	P	V	W	
16.0	**COMPLETE SKID ASSEMBLY:**	DIMENSIONS & ORIENTATION	CR	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		LEAKAGE, CHECK ON WELDMENTS		VISUAL & HYDRO TEST	100%	DISCH.PIPING - 1.5 x DISCH PR. OF PUM	NO LEAKAGE	INSPECTION REPORT	P	W	W	
		FUNCTIONAL TEST FOR INTERLOCKS	MA	VISUAL	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
	PMI Test for SS	GRADE CONFIRMATION	MA	CHEM.TEST	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		PAINTING	MA	VISUAL & MEASUREMENT	100%	BHEL APPD PAINTING SCHEME	APPD DWG/PAINTING	INSPECTION REPORT	P	W	W	

NOTE-1) WHEN BACK WALL ECHO IS SET TO 100% OF FSH IN SOUND AREA, DEFECT ECHO SHALL NOT EXCEED 20% OF FSH. MAX BACH WALL ECHO IS 20% OF FSH. TOTAL NO OF DEFECTS SHALL BE MAX. 5 NO IN ONE METER LENGTH. MIN DISTANCE BETWEEN TWO DEFECTS SHALL BE 3 TIMES THE DIA OF BAR.

NOTE-2) CHEMICAL DOSING SKID VENDOR SHALL BE SELECTED FROM CUSTOMER APPROVED SOURCES. ALL THE BOUGHT OUT ITEMS OF THE CHEMICAL DOSING VENDOR SHALL BE PROCURED FROM BHEL APPROVED SOURCES.

NOTE- 3) ALL VENDOR DRAWINGS/DATASHEETS SHALL BE APPROVED BY BHEL. ONLY MANUFACTURING QP(PREPARED IN LINE WITH THIS STANDARD QP) OF THE VENDOR SHALL BE FORWARDED FOR CUSTOMER APPROVAL. ALL THE BHEL APPROVED DOCUMENTS SHALL BE FURNISHED TO CUSTOMER FOR INFORMATION/RECORDS ALONG WITH O&M MANUAL. COPY OF THE SAME SHALL ALSO BE FURNISHED TO INSPECTION AGENCY DURING INSPECTION.

NOTE 4) FOR PIPES PURCHASED DIRECTLY FROM MANUFACTURER'S OR AUTHORIZED DEALERS, APART FROM TC REVIEW, CHECK WILL BE AS PER CLAUSE 2.1.2 AND 10.0; HOWEVER FOR HYDRAULIC TEST, MANUFACTURER TC SHALL BE REVIEWED . IN CASE ON IMPORTED PIPES PURCHASED FROM OPEN MARKET, TEST SHALL BE PERFORMED AS PER CLAUSE 2.1.2 AND 10.0 (INCLUDING HYDRAULIC TEST).

NOTE 5) FOR RAW MATERIAL (BARS/PIPES/CASTINGS/FORGINGS) WHERE HEAT TREATMENT ARE CARRIED OUT BY MATERIAL PRODUCERS ON BULK QUANTITIES, THEIR TEST CERTIFICATE SHALL BE REVIEWED (EXCEPT TIME TEMPERATURE CHART)

NOTE 6) NDT REQUIREMENT ON WELDING (TANK, PIPE, BREATHER/WATER SEAL/CO2 ABSORBER) SHALL BE AS -- A) ON BUTT WELD-- 25% DP & 25% RT FOR PUMP SUCTION SIDE & 100% DP & 100% RT FOR PUMP DISCHARGE SIDE. B) ON FILLET WELD--100% DP TEST

		**** LEGEND :**		
MANUFACTURER/ SUB CONTRACTOR	**MAIN SUPPLIER--BHEL**	**M** : MANUFACUTRER/SUB-CONTRACTOR/SUB-VENDOR **B** : BHEL/NOMINATED INSPECTION AGENCY N: NTPC		
SIGNATURE		**"P"** PERFORM, **"W"** WITNESS, AND **"V"** VERIFICATION		**SIGNATURE OF APPROVAL BY CUSTOMER**

0

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO:	DATE:
	CUSTOMER:		QP NO.: PE-QP-STD-563-A001	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: CHAIN PULLEY BLOCK	SYSTEM: MATERIAL HANDLING	SECTION: MH	SHEET 1 of 1

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY **			REMARKS
					M	B/C				D	M	B	C	
1	2	3	4	5	6		7	8	9					10
1	HOOK	-PROOF LOAD -MPI BEFORE & AFTER P/L TEST	MA	LOAD TEST DPT/MPI UT	100%	100%	IS 15560 ASTM E165 ASTM A388	IS 15560 NO DEFECT 20% DEF. MAX 80% BWE MIN.	MTC/IR	√	P	V	V	UT FOR SHANK DIA >40MM
2	LOAD CHAIN, HAND CHAIN HOIST, HAND CHAIN TROLLEY	GRADE & DIMENSION	MA	GRADE & DIMENSION	1 SAMPLE PER LOT		APPROVED DRAWING	APPROVED DRAWING	MTC	√	P	V	V	
3	RATHCHET PAWL RATCHET WHEEL	HARDNESS SURFACE CRACK	MA	HARDNESS DPT	100%	100%	ASTM 3832 /APP. DRAWINGS ASMT E165		MTC/IR	√	P	V	V	
4	GEAR PINION	SURFACE HARDNESS SURFACE CRACK UT IN PROOF MACHINED DPT ON TOOTH	MA	HARDNESS DPT FOR SURFACE CRACK	RANDOM ASTM E165 FOR DPT		APPROVED DRAWING/ MFG STANDARD NO DEFECT		MTC/ IR	√	P	V	V	GEAR TEETH DPT
5	WHEELS	UT IN PROOF MACHINED DPT ON TREAD AREA HARDNESS	MA	DPT/UT	RANDOM	RANDOM	APPROVED DRAWING/ MFG STANDARD NO DEFECT		IR	√	P	V	V	
6	COMPLETE ASSEMBLY	OVERALL DIMENSIONS, PROOF LOAD TEST AT 1.5 TIMES SWL (SAFE WORKING LOAD), HEIGHT OF LIFT, SWEVELING OF HOOK, LIGHT LOAD TEST FOR BRAKE CHECK, HEAD ROOM, MOVEMENT UNDER LOAD	MA	MEASURMENT/ LOAD TEST/ / VISUAL	100%	100%	IS 3832/ APPROVED DRAWING MFG-PROCEDURE		IR	√	P	W	V	.
7	PAINTING & SURFACE PREPARATION	CLEANING SHADE & DFT OF PAINT	MA	VISUAL	RANDOM	RANDOM	APPROVED DRAWING		IR	√	P	V	V	
8	NAME PLATE	VERIFICATION	MA	VISUAL	100%	100%	-		IR		P	V	-	
9	PACKING	VERIFICATION	MI	VISUAL	100%	100%	AS PER APPROVED PACKING PROCEDURE		IR		P	-	-	
10	REVIEW OF QA DOC	VERIFICATION	MA	VISUAL	100%	100%	APPD QAP		DOSSIER	√	V	V	V	

LEGENDS:
*D: *RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION, ** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **B**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, C: CUSTOMER, P: PERFORM, **W**: WITNESS, **V**: VERIFICATION, AS APPROPRIATE, E **MA**: MAJOR, **MI**: MINOR

BIDDER/ SUPPLIER		BHEL						FOR CUSTOMER REVIEW & APPROVAL			
Sign & Date		ENGINEERING			QUALITY			Doc No:			
			Sign & Date	Name		Sign & Date	Name		Sign & Date	Name	Seal
Seal		Prepared by:			Checked by:			Reviewed by:			
		Reviewed by:			Reviewed by:			Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO:	DATE:
		CUSTOMER:	QP NO.: PE-QP-STD-563-A002	DATE:
		PROJECT:	PO NO.:	DATE:
		ITEM: ELECTRIC HOIST	SYSTEM: EH / SECTION: MH	SHEET 1 of 5

SL NO.	COMPONENT & OPERATIONS	CHARACTERIST-ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					6						**			
					M	B/C				D	M	B	C	
1	2	3	4	5			7	8	9					10
A.	RAW MATERIAL													
A.1	MS PLATES FOR HOIST STRUCTURE, GEAR BOX, & ROPE DRUM (IF FABRICATED)	CHEMICAL & MECHANICAL PROPERTIES	MA	CHEMICAL & MECHANICAL	1 SAMPLE / HEAT		IS 2062 E250 GR- A/ BR APPROVED DRAWING/DATA SHEET		MTC/ LAB TEST REPORT	√	P	V	V	In the absence of correlated TC Lab testing shall be done.
		ULTRASONIC TEST OF PLATES (For Thk >25mm)	MA	NDT	100%	100%	ASTM A 435	ASTM A 435	IR	√	P	V	V	
A.2	PIPE FOR ROPE DRUM (IF SEAM LESS PIPE IS USED)	CHEMICAL & MECHANICAL PROPERTIES & ACID ETCHING	MA	CHEMICAL & MECHANICAL	1 SAMPLE / HEAT/SIZE		ASTM A106 GR A/B APPROVED DRAWING/DATA SHEET		MTC/IR/LAB TEST REPOT	√	P	V	V	In the absence of correlated TC Lab testing shall be done.
		ULTRASONIC TEST FOR SEAMLESS PIPE (For Thk >25mm)	MA	UT	100%	100%	ASTM E-213	ASTM E-213	IR	√	P	V	V	
A.3	FORGINGS / ROLLED BARS FOR GEARS, PINIONS & WHEELS	CHEMICAL & MECHANICAL PROPERTIES	MA	CHEMICAL & MECHANICAL	1 SAMPLE / HEAT/SIZE		APPROVED DRAWING/DATA SHEET.		MTC/ LAB TEST REPORT	√	P	V	V	In the absence of correlated TC Lab testing shall be done.
		ULTRASONIC TEST	MA	NDT	100%	100%	ASTM A 388	REFER NOTE-1	IR	√	P	V	V	Only for dia/thickness 40 mm & above
B.	BOUGHT OUT ITEMS													
B.1	HOOKS	MAKE & DIMENSIONS	MA	VISUAL	100%	100%	IS 15560/ AS PER APPROVED BOI LIST		TC	√	P	V	V	
		CHEMICAL & MECHANICAL	MA	CHEMICAL & MECHANICAL	1 SAMPLE / HEAT/SIZE		IS 1875/APPROVED DATA SHEETS /DRAWINGS.		IR	√	P	V	V	
		PROOF LOAD TEST	MA	MECHANICAL	100%	100%	IS-15560/IS 3815/APP. DRG./ DS	IS-15560/IS 3815/APP. DRG./ DS	IR	√	P	V	V	
		UT FOR INNER DEFECTS	CRITICAL	NDT	100%	100%	ASTM A 388	REFER NOTE-1	IR	√	P	V	V	On shank portion only
		DPT TEST BEFORE & AFTER PROOF LOAD TEST	CRITICAL	NDT ON MACHINED SURFACE	100%	100%	ASTM E-165	NO DEFECTS	IR	√	P	V	V	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO:	DATE:
		CUSTOMER:	QP NO.: PE-QP-STD-563-A002	DATE:
		PROJECT:	PO NO.:	DATE:
		ITEM: ELECTRIC HOIST	SYSTEM: EH / SECTION: MH	SHEET 2 of 5

SL NO.	COMPONENT & OPERATIONS	CHARACTERIST-ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	B/C				D	M	B	C	
1	2	3	4	5	6		7	8	9		**			10
B.2	WIRE ROPES	MAKE, TYPE & IDENTIFICATION	MA	VISUAL	100%	100%	AS PER APPROVED BOI LIST		MTC	√	P	V	V	
		DIMENSION, BRAKING STRENGTH, CONST.	MA	REVIEW	100%	100%	IS-2266 / APPROVED DRAWING/DATA SHEET		MTC	√	P	V	V	
B.3	PULLEY/SHEAVE	CHEMICAL, MECHANICAL VISUAL DIMENSION	MA	REVIEW	100%	100%	APPROVED DRAWING/DATA SHEET/MFG STD		MTC/IR/LAB REPORT	√	P	V	V	
B.4	MOTOR<30 KW	MAKE/TYPE/RATING, ROUTINE TEST	MA	VISUAL, REVIEW	100%	100%	APPROVED DRAWING/DATA SHEET/ AS PER APPROVED BOI LIST		MTC	√	P	V	V	
B.5	GEAR BOX	MAKE / TYPE / RATING / REDUCTION RATIO/ BACKLASH & TOOTH CONTACT	MA	VISUAL	100%	100%	APPROVED DRAWING/DATA SHEET/ AS PER APPROVED BOI LIST/ MFG STD		IR	√	P	V	V	
		NO LOAD RUN TEST (NOISE LEVEL, TEMP.RISE, OIL LEAKAGE, VIBRATION)	MA	VISUAL	100%	100%	NOISE LEVEL < 85 dB at 1 mtr TEMP. RISE= AMB+30 °C NO OIL LEAKGE APPROVED DRAWING/DATA SHEET		IR	√	P/V	V	V	
B.6	BRAKE	MAKE / TYPE / RATING	MA	VISUAL	100%	100%	APPROVED DRAWING / DATA SHEET / AS PER APPROVED BOI LIST		MTC/IR	√	P	V	V	
		ROUTINE TEST	MA	REVIEW	100%	100%			MTC	√	P	V	V	
B.7	LIMIT SWITCH, RELAY, CONTACTOR, TRANSFORMER/ PUSH BUTTON /TERMINAL BLOCK, SELECTOR SWITCH, INDICATION LAMP /SFU	MAKE/TYPE/RATING	MA	VISUAL	100%	100%	APPROVED DRAWING / DATA SHEET / AS PER APPROVED BOI LIST		IR	√	P	V	V	
B.8	CABLES - LT POWER / CONTROL	MAKE / TYPE / RATING	MA	VISUAL	100%	100%	APPROVED DRAWING / DATA SHEET / AS PER APPROVED BOI LIST		MTC/IR	√	P	V	V	
		ROUTINE TEST	MA	REVIEW	100%	100%			MTC	√	V	V	V	
B.9	VVVF DRIVE (AS APPLICABLE)	MAKE / TYPE / RATING	MA	VISUAL	100%	100%	APPROVED DRAWING / DATA SHEET / AS PER APPROVED BOI LIST		MTC/IR	√	P	V	V	
		ROUTINE TEST	MA	REVIEW	100%	100%				√	P	V	V	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
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Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO:	DATE:
		CUSTOMER:	QP NO.: PE-QP-STD-563-A002	DATE:
		PROJECT:	PO NO.:	DATE:
		ITEM: ELECTRIC HOIST	SYSTEM: EH / SECTION: MH	SHEET 3 of 5

SL NO.	COMPONENT & OPERATIONS	CHARACTERIST-ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6					*	**			
					M	B/C				D	M	B	C	
1	2	3	4	5			7	8	9					10
B.10	CONTROL PANEL & PANDENT STATION BOX	MAKE/TYPE/RATING	MA	VISUAL	100%	100%	APPROVED DRAWING / DATA SHEET / AS PER APPROVED BOI LIST		IR	√	P	V	V	
		SHEET /GLAND PLATE THICKNESS, PAINT SHADE, DFT, ADHESION	MA	VISUAL	100%	100%			IR	√	P	V	V	
C	IN PROCESS INSPECTION													
C.1	ROLLING & WELDING OF ROPE DRUM (IF FABRICATED)	WPS, PQR & WPQ	MA	REVIEW	100%	100%	AS PER ASME SEC-IX		QW 481-84	√	P	V	V	NTPC/BHEL/TUV/LLOYD/ DNV approved WPS& qualified welders to be used. In case of non availability of the same, WPS to be submitted for approval.
		ROLLING & WELD PREPARATION	MA	VISUAL & MEASURE	100%	100%	AS PER DRAWING.		IR	√	P	V	V	
		NDT TEST ON WELD	MA	DPT	100%	10%	ASTM E 165	ASME SECTION VIII DIV-1 APPENDIX-8 CL.NO.8.4	IR	√	P	V	V	
		RT OF BUTT WELD JOINTS (IF APPLICABLE)	CRTICAL	RT	100%	100%	ASME SEC-V	ASME SEC-VIII, DIV-1	IR	√	P	V	V	
C.2	ROPE DRUM, PULLEY & HOOK SHANK (AFTER FINAL MACHINING)	VISUAL & DIMENSION	MA	VISUAL & MEASURE	100%	100%	MANUFACTURE DRAWING		IR	√	P	V	V	
		NDT ON MACHINE SURFACE	MA	DPT	100%	100%	ASTM E 165	ASME SECTION VIII DIV-1 APPENDIX-8 CL.NO.8.4	IR	√	P	V	V	
C.3	TROLLEY STRUCTURE	WELD SOUNDNESS DIMENSIONS	MA	DPT & VISUAL & MEASUREMENT	100%	100%	ASTM E 165	ASME SECTION VIII DIV-1 APPENDIX-8 CL.NO.8.4	IR	√	P	V	V	
C.4	GEAR & PINIONS, WHEELS (AFTER FINAL MACHINING)	NDT ON MACHINE SURFACE	MA	DPT	100%	100%	ASTM E 165	ASME SEC-VIII, DIV-1 APPEND.8 CL.8.4	IR	√	P	V	V	

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO:	DATE:
		CUSTOMER:	QP NO.: PE-QP-STD-563-A002	DATE:
		PROJECT:	PO NO.:	DATE:
		ITEM: ELECTRIC HOIST	SYSTEM: EH / SECTION: MH	SHEET 4 of 5

SL NO.	COMPONENT & OPERATIONS	CHARACTERIST-ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6					*	**			
					M	B/C				D	M	B	C	
1	2	3	4	5			7	8	9					10
C.5	STRESS REVIEVING OF GEAR BOXES (IF FABRICATED)	SR OF GEAR BOX CASING	MA	SR>25mm Thick	100%	100%	ASME SEC. VIII DIV I UCS 56	ASME SEC. VIII DIV I UCS 56	SR REPORT	√	P	V	V	

D	FINAL INSPECTION													
D.1	COMPLETE ASSEMBLED HOIST ALONG WITH ACTUAL CONTROL PANEL, VVFD & PUSH BUTTON (AS APPLICABLE)	VISUAL & DIMENSION	MA	VISUAL & MEASURE	100%	100%	IS:3938/ APPROVED DRAWING / DATA SHEET	IR	√	P	W	V	
	NO LOAD TEST & FULL LOAD TEST	CURRENT DRAWN, SPEED OF HOIST ENCHING OPERATION, INTERLOCKING SEQUENCE OPEARTION	MA	VISUAL & MEASURE	100%	100%	IS:3938/ APPROVED DRAWING / DATA SHEET	IR	√	P	W	V	
	OVERLOAD TEST AT 125%	HOLDING CAPACITY OF BRAKES	MA	VISUAL	100%	100%	IS:3938/ APPROVED DRAWING / DATA SHEET	IR	√	P	W	V	
D.2	CONTROL PANEL	VISUAL, MAKE, VERIFICATION & DIMENSION	MA	VISUAL & MEASURE	100%	100%	IS:3938/ APPROVED DRAWING / DATA SHEET	IR	√	P	W	V	
		INGRESS PROTECTION BY PAPER INSERTION METHOD	MA	VISUAL	100%	100%	IS:3938/ APPROVED DRAWING / DATA SHEET	IR	√	P	W	V	
		HV/IR	MA	MEASURE	100%	100%	IS:3938/ APPROVED DRAWING / DATA SHEET	IR	√	P	W	V	
		PAINT SHADE, DFT	MA	VISUAL & MEASURE	100%	100%	IS:3938/ APPROVED DRAWING / DATA SHEET	IR	√	P	W	V	
D.3	SPARES (MANDATORY / RECOMMENDED SPARE / COMMISSIONING SPARES/ TOOLS & TACKLES)	VERIFICATION OF MAKE, TYPE, SIZE, RATING	MA	REVIEW OF INTERNAL INSPECTION REPORTS / MFR'S TC / COC	100%	-	APPROVED SPARE LIST	APPD DRG / DATA SHEET	IR / COC		P	W	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO:	DATE:
		CUSTOMER:	QP NO.: PE-QP-STD-563-A002	DATE:
		PROJECT:	PO NO.:	DATE:
		ITEM: ELECTRIC HOIST	SYSTEM: EH / SECTION: MH	SHEET 5 of 5

SL NO.	COMPONENT & OPERATIONS	CHARACTERIST-ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6					*	**			
					M	B/C				D	M	B	C	
1	2	3	4	5			7	8	9					10
D.4	PAINTING OF HOIST	VISUAL DFT, MEASUREMENT & PAINT SHADE	MA	VISUAL & MEASUREMENT	100%	100%	APPROVED DRAWING / DATA SHEET		IR	√	P	V	V	
D.5	PACKING	PACKING SOUNDNESS	MA	VISUAL	100%	100%	APPROVED DOCUMENT/ PACKING SPECIFICATION		IR	√	P	V	V	

LEGENDS:
*D: *RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION, ** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER,
B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, C: CUSTOMER, P: PERFORM, W: WITNESS, V: VERIFICATION, AS APPROPRIATE
MA: MAJOR, MI: MINOR, CR: CRITICAL

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

		MANUFACTURER'S NAME & ADDRESS :		MANUFACTURING QUALITY PLAN				PROJECT	: 2X800 MW, LARA STPP			
				ITEM: OXYGEN DOSING SYSTEM		QP. NO :	PE-QP-508-154-A002	PACKAGE	: OXYGEN DOSING SYSTEM			
				SUB - SYSTEM : DEAERATOR & CEP DISCHARGE DOSING		REV. :		CONTRACT NO.				
						DATE :		MAIN SUPPLIER	: BHEL/PEM/NOIDA			
						PAGE :		BHEL QP. NO				
								NTPC QP. NO				

S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	D*	AGENCY** M	AGENCY** B	AGENCY** N	REMARKS
1	2	3	4	5	6	7	8	9		10			11
1.0	**WELDER'S QUALIFICATION**												
1.1	WELDING PROCEDURE SPECIFICATION (WPS)	CORRECTNESS	MA	SCRUTINY	100%	ASME IX	ASME IX	QW 482		P	V	V	
1.2	WELDER PERFORMANCE & PROCEDURE QUALIFICATION RECORD	WELD SOUNDNESS & WELDING PERFORMANCE	MA	PHYSICAL TEST	100%	ASME IX	ASME IX	QW 483 & QW 484		P	V	V	
2	EMPTY OXYGEN CYLINDER	MTC, HYDRO TEST & RELEVANT TESTS AS PER IS 7285	MA	IS 7285	100%	APPROVED DATASHEET	AS PER APPROVED DATASHEET	MFRS CERTIFICATE		P	V	V	
3	VALVES (BODY & BONNET)	MATERIAL	MA	--	100%	APPROVED DATASHEET	AS PER MODEL DECODIFICATION MENTIONED IN MFRS CATALOGUE	MANUFACTURERS COC		P	V	V	
4	INSTRUMENTS												
4.A	PRESSURE GAUGE	MOC FOR WETTED PARTS, CALIBRATION & BOURDON OVER PRESSURE PROTECTION & TYPE	MA	MEASUREMENT	1/TYPE	APPROVED DATASHEET	AS PER APPROVED DATASHEET	MFRS CERTIFICATE		P	V	V	
4.B	PRESSURE TRANSMITTER	CALIBRATION, OVER LOAD PROTECTION & TYPE TEST CERTIFICATE	MA	MEASUREMENT	100%	APPROVED DATASHEET	AS PER APPROVED DATASHEET	MANUFACTURERS COC		P	V	V	
5	SOLENOID VALVES	MATERIAL	MA	VISUAL	100%	APPROVED DATASHEET	AS PER MODEL DECODIFICATION MENTIONED IN MFRS CATALOGUE	MANUFACTURERS COC		P	V	V	
6	CYLINDER PRESSURE REGULATOR	MATERIAL	MA	VISUAL	100%	APPROVED DATASHEET	AS PER MANUFACTURERS CATALOGUE	MANUFACTURERS COC		P	V	V	
7	TERMINATION BOX	COUNTUNITY,IR-HV-IR & DEGREE OF PROTECTION	MA	ELECTRICAL	100%	APPROVED DATASHEET	AS PER APPROVED DATASHEET	MFRS COC & INSPECTION REPORT		P	V	V	
8	TUBING	CHEMICAL & PHYSICAL	MA	CHEMICAL & PHYSICAL TEST	100%	APPROVED DRAWING DATASHEET	APPROVED DRAWING DATASHEET	LAB REPORT		P	V	V	
9	MASS FLOW CONTROLLER	CALIBRATION REPORT	MA	ELECTRICAL	100%	APPROVED DRAWING & DATASHEET	APPROVED DRAWING & DATASHEET	CALIBRATION REPORT		P	V	V	
10	FITTING	MATERIAL	MA	VISUAL	100%	APPROVED DRAWING	AS PER MODEL DECODIFICATION MENTIONED IN MFRS CATALOGUE	MANUFACTURERS COC		P	V	V	
11	FINAL ASSAMBLY	DIMENSION, ORIENTATION & COMPLETENESS.	MA	MEASUREMENT	100%	APPROVED DRAWING	APPROVED DRAWING	INSPECTION		P	W	W	
	FAT	LEAKAGE		N2 FILL FOR 2HR	100%	APPROVED DRAWING / FACTORY ACCEPTANCE TEST	NO LEAKAGE	INSPECTION REPORT		P	W	W	
12	POWDER COATING STAMPING	DFT MEASUREMENT	MI	VISUAL	100%	NTPC APPROVED PAINTING SCHEME				P	W	V	
13	PMI Test for SS	GRADE CONFIRMATION	MA	CHEM.TEST	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/ DWG	INSPECTION REPORT		P	W	W	

NOTES: ALL INSTRUMENTS SHALL BE OXYGEN CLEANED AND SUITABLE FOR OXYGEN SERVICE. MANUFACTURERS COC CERTIFYING THE SAME REGARDING OXYGEN CLEANED SHALL BE SUBMITTED FOR REVIEW DURING FINAL INSPECTION.

		LEGEND :		**DOC NO.**	**REV :** / **CAT :**
MANUFACTURER/ SUB SUPPLIER	**MAIN SUPPLIER**	* RECORDS IDENTIFIED WITH "TICKS" SHALL BE ESSENTIALLY INCLUDED BY CONTACTION IN QA DOCUMENTATION. ** **M** : MANUFACTURER/SUB-CONTRACTOR B : BHEL, N:NTPC	**FOR CUSTOMER USE**		
SIGNATURE		INDICATE **"P"** PERFORM, **"W"** WITNESS, AND **"V"** VERIFICATION AS APPROPRIATE, "CHP" SHALL BE IDENTIFIED IN COLUMN **"N".**		**REVIEWED BY**	**APPROVED BY** / **APPROVAL SEAL**

LOW PRESSURE PIPING

LOW PRESSURE PIPING

PIPES, FITTINGS, BENDS, VALVES, COATING-WRAPPING, STRAINERS EXPANSION, JOINTS, TANKS, FASTENERS, LINING ETC.

	Tests/Check / Items / Components	Material Test	DPT/MPI / RT	Ultrasonic Test	WPS/ WQS/PQR	Hydraulic / Water Fill Test	Pneumatic Test	Assembly Fit up	Dimensions	Functional/operational Test	Other Tests	All Tests as per relevant Std	REMARKS
1	Pipes & Pipe Fittings	Y[a]	Y[b]			Y1			Y			Y	
2	Diaphragm Valves	Y[a]				Y[5]			Y		Y[6]		
3A	Cast Butterfly Valves (Low Pressure)					Y		Y	Y	Y	Y[7]		
	Body	Y[a]	Y[b]										
	Disc	Y[a]	Y[b]										
	Shaft	Y[a]	Y	Y[c]									
3B	Fabricated Butterfly Valves	**REFER NOTE 14**											
4	Gate/ Globe/Swing Check / Ball Valves	Y[a]	Y[b]	Y[c]		Y[5]	Y	Y	Y	Y	Y[8]		
5	Dual Plate Check Valves	Y[a]	Y[b]	Y[c]		Y	Y	Y	Y	Y	Y[4]		
6	Rolled & Welded Pipes and Mitre Bends	Y[a]	Y[3]		Y	Y[3]			Y		Y[3&15]	Y	
7	Coating & Wrapping of Pipes	Y[2]									Y[2]		
8	Tanks & Vessels	Y[a]	Y[b]		Y	Y			Y		Y[16]		
9	Strainers	Y[a]	Y[b]		Y #	Y					Y[11]		#For Fabricated Strainer
10	Rubber Expansion Joints	Y[a]				Y[12]		Y	Y		Y[13]		
11	Internal Lining of Pipes	Y[a]							Y		Y[9]		
12	Site Welding		Y[10]		Y	Y							

NOTES (MEANING OF SUPERSCRIPTS)

a	One per heat/heat treatment batch/lot.
b	On machined surfaces only for castings and on butt welds.
c	For shaft/spindles > or = 40 mm
1	100% Hydraulic test shall be carried out. Weld joints not subjected to hydraulic test due to some unavoidable reasons, shall be subjected to 100% RT/PAUT.
2	Spark Test, Adhesion Test and Material Test for primer and enameled & Coal Tar Tapes as per AWWA-C-203-91/ IS-10221 & IS 15337 as applicable.
3	Followings are the testing requirements for fabrication of pipes at site

TESTS	**QUANTUM OF CHECKS**
WPS, PQR, Welder Qualification Test	100% Welders and WPS shall be qualified as per ASME- section IX
DPT on root run	100% for pipes up to 1200 mm diameter
DPT after back gauging	100% for pipes above 1200 mm diameter
RT / UT by (TOFD/PAUT) Technique	5% (100% of T Joints)

	DPT on finished butt weld joints	10%
	Hydraulic Test	100%, 1.5 times the design pressure or 2 times the working-pressure whichever is higher.
4	Dry Cycle Test on Dual Plate Check valve spring for one lakh Cycles shall be carried out as a type test. If Dry Cycle test carried out earlier for same material & diameter, Test report shall be reviewed.	
5	Seat Leakage Test for Actuator Operated Valves, shall be done with by closing the valves with actuator.	
6	Tests on rubber parts shall be conducted per batch of rubber mix for tensile, Elongation, hardness, adhesion, spark test, bleed resistance test. In addition, type test for 50,000 cycles of each type of diaphragm shall also be conducted.	
7	Hydraulic Test of Body, Seat and disc-strength shall be carried out in accordance with governing design standard in presence of owner / owner's representatives. Actuator operated valves shall be checked for Seat Leakage by closing the valves with actuator. For Proof of Design Test refer respective chapters of engineering portion in the technical specification.	
8	Blue matching, wear travel for gates, valves, pneumatic seat leakage, and reduced pressure test for check valves shall be done as per relevant standard. Maximum allowable vacuum loss is 0.5 mm of Hg abs. for valves to be tested for vacuum operation for internal pressure 25 mm of Hg abs. for a period of 15 minutes. Fire safe test for ball valve shall be done wherever specified. In case of already carried out, the test report shall be submitted for review and acceptance by owner / owner's representatives. Valves shall be offered for hydro test in unpainted condition.	
9	Tensile, Elongation, Hardness, Specific Gravity, Lining Thickness, Humidity Check, Pipe temperature check, Adhesion Test and Holiday Detection Test etc as per applicable standard shall be done for all lining material and application.	
10	10% of welds (Root and finished welds) shall be subjected to DPT. (100% DPT for compressed air line and boiler & deaerator fill line.).	
11	Pressure drop across the strainer for each type and size as a special test shall be carried out. In case of already carried out, the test report shall be submitted for review and acceptance by owner / owner's representatives.	
12	During hydraulic and vacuum tests at 25mm Hg abs in 3 positions, the change in the circumference of arch should not be more than 1.5%. 24 hrs after the test permanent set in dimension should not exceed 0.5%.	
13	Tests on rubber for tensile, elongation, hardness, hydraulic stability check as per ASTM D 471, ozone resistance test as per ASTM D 1149/IS 3400 Part 20 aging test and adhesion strength of rubber to fabric, rubber to metal adhesion shall be carried out.	
14	In addition of all tests as indicated for Cast Butterfly valve being applicable for fabricated butterfly valves, following test shall be done for Fabricated Butterfly Valve: a. UT as per ASTM A-435/IS 11630 & IS 4225 on plate material for body and disc shall be carried out for plate thickness 25mm and above. b. 100% RT and DPT as per ASTM, Section-VIII, Division-I, on butt joins of body and disc. 10% DPT on other welds shall be done. c. Post weld heat treatment as per ASME, Section-VIII, Division-I on butt joints of body and disc. d. Welders and WPS shall be qualified as per ASME- section IX	
15	Maximum number of segments in segmental flanges shall be four (04) only. All butt weld joints in the segmental flanges shall be examined by RT/UT. Segmental flanges exceeding 37.5 mm thickness shall be stress relieved as per norms of ASME Section VIII after welding.	
16	For pressure vessel welds RT shall be done as per design code requirements.	

All Valves shall be offered for inspection in unpainted condition.

No repair welding is permitted on Cast Iron / Alloy Cast Iron Castings.

PT PLANT, LETP/ ETP, DM PLANT, CW TREATMENT, CHEMICAL DOSING SKIDS, OXYGEN DOSING SKID, CHP RUN OFF WTP, STP, LIME DOSING SYSTEM AND CLO2 SYSTEM

CLAUSE NO	QUALITY ASSURANCE										
Test/Check / Items / Components	Material Test	WPS/PQR/Welder	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic test / Pneumatic test / Vacuum test	Performance Test	Test as per relevant Std / Appd. Data Sheets	Other Tests	Remarks
COMMON ITEMS:											
1. Horizontal Centrifugal Pumps				Y	Y			Y^1	Y		
1.1. Casing	Y^a		Y^b		Y		Y				
1.2. Impeller	Y^a		Y^b		Y					Y^d	
1.3. Shaft	Y^a		Y		Y					Y^c	
2. Vertical Pumps				Y	Y			Y^1	Y		
2.1. Casing	Y^a		Y^b		Y		Y				
2.2. Impeller	Y^a		Y^b		Y					Y^d	
2.3. Shaft	Y^a		Y		Y					Y^c	
2.4. Fabricated Parts	Y^a	Y	Y^b		Y	Y^2	Y				
3. Dosing/ Metering Pumps	Y^a				Y		Y	Y^1	Y		
4. Gate/ Globe/ Check Valves	Y^a		Y^b		Y		Y	Y	Y	Y^3, Y^6	
5. Dual Plate Check Valves	Y^a		Y^b		Y		Y	Y	Y	Y^6, Y^{12}	
6. Diaphragm Valves	Y^a				Y		Y		Y	Y^4, Y^3	
7. Butterfly Valves (Low Pr.)				Y	Y		Y	Y	Y	Y^3	
7.1 Body & Disc (Cast	Y^a		Y^b		Y						
7.2 Body and Disc (Fabricated)	Y^a	Y	Y^b		Y				Y	Y^2	
7.3 Shaft	Y^a		Y^b		Y					Y^c	

LEGENDS: Applicable tests are identified by 'Y'.

Y^a : One per Heat / Heat Treatment batch / Lot.

Y^b : On machined surfaces only. Also 100% on Butt Welds & 10% on Fillet Welds.

Y^c : UT shall be done for shafts with Dia 50 mm or above & Plates of Thickness 25 mm or above.

Y^d :Dynamic Balancing per IS: 21940, Grade 6.3 minimum shall be conducted for rotating assy.

Y^1 : As per Pump governing standard. Tolerences as per HIS, USA.

Y^2 : Random 10% RT to be conducted on butt welds for Thk $\geq$10 mm.

Y^3 : Seat Leakage Test for actuator operated valves shall be done by operating the valve with job actuator.

Y^4 : Tests on Rubber Diaphragms shall be conducted per batch of Rubber mix for Tensile, Elongation, Hardness, Thickness, Bleed Resistance. In addition, Type Test for 50,000 cycles for each type of diaphragm shall also be conducted.

Items / Components \ Test/Check	Material Test	WPS/PQR/Welder	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic test / Pneumatic test / Vacuum test	Performance Test	Test as per relevant Std / Appd. Data Sheets	Other Tests	Remarks
8. Plug/ Ball Valves (Low Pr.)	Y[a]		Y[b]	Y	Y		Y	Y	Y	Y[3]	Y[6] : Blue Matching, Wear Travel for Gate Valves and reduced pressure test for check valves shall be conducted as per relevant standards.
9. Blowers/ Compressors	Y[a]		Y[b]	Y	Y			Y	Y	Y[c, d]	Y[7] : Heat Treatment of the Tank/Vessel shall be done per fabrication code requirement. Welded dished ends shall be stress relieved. Dished ends manufactured by cold working shall also be stress relieved as per the requirement of code.
10. Tanks/ Pressure Vessels	Y[a]	Y	Y[b]	Y	Y	Y[8]	Y		Y	Y[7]	Y[8] : RT as per fabrication code requirements. However, dished ends welds, if manufactured by using welded plates shall be subjected to 100% RT.
11. Rubber Lining	Y[a]				Y				Y	Y[9]	Y[9] :Rubber Lining Mix shall be subjected to Bleed Resistance Test on mould sample. Adhesion Test, Spark Test and Hardness Test for the Rubber lined jobs shall also be conducted.
12. Strainers	Y[a]	Y	Y[b]	Y	Y		Y		Y		Y[10] :Gear Boxes shall be checked for smooth No Load Operation at shop to verify noise and vibration levels. Gear Ratio and Kerosene Leak Test shall also be conducted.
13. Pipe & Pipe Fittings	Y[a]	Y	Y		Y	Y[8]	Y		Y		Y[11] :One Fan of each type & size shall be routine performance tested as per corresponding code for air flow, static pressure, total pressure, speed, efficiency, power consumption, noise & temperature rise. Also all Fans shall be subjected to run test of 4 hours during which noise, vibration, temperature rise and current drawn shall be measured.
14. Agitators /Flash Mixer/ Flocculator	Y[a]	Y	Y[b]	Y	Y			Y		Y[10]	Y[12] :Dry cycle test on valve spring for 1, 00,000 cycles shall be carried out as
15. Ventilation/Exhaust Fan	Y[a]		Y[b]	Y	Y			Y[11]	Y	Y[c, d]	
16. Hoists & Cranes	Y[a]	Y	Y[b]	Y	Y	Y[8]		Y	Y		
17. Wrapping & Coatig Material	Y				Y				Y		
18. Package/ Split AC	Y							Y	Y	Y[14]	
PT & LET PLANT:											
1. Clariflocculator / Reactor Clarifier / Plate or Tube Settler	Y[a]	Y	Y[b]	Y	Y				Y	Y[10]	

CLAUSE NO	QUALITY ASSURANCE										
Test/Check / Items / Components	Material Test	WPS/PQR/Welder	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic test / Pneumatic test / Vacuum test	Performance Test	Test as per relevant Std / Appd. Data Sheets	Other Tests	Remarks
2. Pressure / Vacuum Relief valve / Pressure Regulating Valve	Y[a]			Y	Y		Y	Y	Y		type test, if not carried out earlier, for the similar MOC, size and type of spring. Y[13]: :Test as per approved supplier practice. Y[14] : Electronic leak test for condenser & evaporator unit. Note: 1.The complete Piping system along with valves & fittings shall be hydraulically tested at 1.5 times design pressure or 2 times working pressure whichever is higher after erection at site. 2. In case of items other than those identified above, the quality requirements shall be decided based on system design requirements.
DM PLANT											
1. Resins / Activated Carbon									Y		
2. Filter Membrane					Y				Y		
3. RO Pressure tube	Y[a]				Y		Y		Y		

EOT CRANES AND HOISTS

Shop Test for T.G.Hall EOT Cranes, Other Cranes & Hoist

1.0	**HOOKS**
1.01	ALL TESTS INCLUDING PROOF LOAD TEST AS PER RELEVANT IS/BS/DIN SHALL BE CARRIED OUT.
1.02	MPI/DPT SHALL BE CARRIED OUT AFTER PROOF LOAD TEST.
2.0	**STEEL CASTING**
2.01	DPT ON MACHINED SURFACE SHALL BE CARRIED OUT.
3.0	**GIRDERS, END CARRIAGE,CRAB, GEAR BOX AND ROPE DRUM**
3.01	THE PLATES OF THICKNESS 25MM AND ABOVE SHALL BE ULTRASONICALLY TESTED.
3.02	NDT REQUIREMENTS ON WELDMENTS SHALL BE AS FOLLOWS: a) BUTT WELDS IN TENSION:- 100% RT AND 100% DPT b) BUTT WELDS IN COMPRESSION:- 10% RT AND 100% DPT c) BUTT WELDS IN ROPE DRUM:- 100% RT AND 100% DPT d) FILLET WELDS:- RANDOM 10% DPT
4.0	**FORGING (WHEEL, GEARS, PINIONS, AXLE, HOOKS & HOOK TRUNION)**
4.01	ALL FORGINGS GREATER THAN OR EQUAL TO 50 MM DIAMETER OR THICKNESS SHALL BE SUBJECTED TO ULTRASONIC TESTING.
4.02	DPT/MPI SHALL BE DONE AFTER HARDFACING AND MACHINING.
5.0	WIRE ROPE SHALL BE TESTED AS PER RELEVANT STANDARD.
6.0	REDUCTION GEARS SHALL BE TESTED FOR REDUCTION RATIO, BACKLASH & CONTACT PATTERN. GEAR BOX SHALL BE SUBJECTED TO NO-LOAD RUN TEST TO CHECK FOR OIL LEAKAGE, TEMPERATURE RISE, NOISE AND VIBRATION.
7.0	THE CRANES SHALL BE COMPLETELY ASSEMBLED AT SHOP FOR FINAL TESTING. ALL TESTS FOR DIMENSION, DEFLECTION, LOAD, OVERLOAD, HOISTING MOTION, CROSS TRAVEL ETC. AS PER IS-3177 SHALL BE CARRIED OUT AT SHOP.
8.0	ALL ELECTRIC HOISTS SHALL BE TESTED AS PER IS-3938 AND CHAIN PULLEY BLOCKS SHALL BE TESTED AS PER IS-3832.
9.0	**LIFTING BEAM**:
9.01	THE PLATES OF THICKNESS 25MM AND ABOVE SHALL BE ULTRASONICALLY TESTED.

9.02 NDT REQUIREMENTS ON WELDMENTS SHALL BE AS FOLLOWS:

e) BUTT WELDS IN TENSION:- 100% RT AND 100% DPT
f) BUTT WELDS IN COMPRESSION:- 10% RT AND 100% DPT
g) FILLET WELDS:- RANDOM 10% DPT

9.03 ALL FORGINGS GREATER THAN OR EQUAL TO 50 MM DIAMETER OR THICKNESS SHALL BE SUBJECTED TO ULTRASONIC TESTING.

9.04 DPT/MPI SHALL BE DONE AFTER MACHINING.

9.05 Lifting Beam will be subjected to overload testing at @1.25 X SWL of Lifting Beam at manufacturer works.

CONDENSATE POLISHING PLANT

Condensate Polishing Plant

Items / Components \ Test/Check	Material Test	WPS/PQR/Welder	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic test / Pneumatic test / Vacuum test	Performance Test	Test as per relevant Std / Appd. Data Sheets	Other Tests	Remarks
COMMON ITEMS:											
1. Horizontal Centrifugal Pumps				Y	Y			Y^{1}	Y		**LEGENDS:** Applicable tests are identified by 'Y'.
1.1. Casing	Y^{a}		Y^{b}		Y		Y				Y^{a} : One per Heat / Heat Treatment batch / Lot.
1.2. Impeller	Y^{a}		Y^{b}		Y					Y^{d}	Y^{b} : On machined surfaces only. Also 100% on Butt Welds & 10% on Fillet Welds.
1.3. Shaft	Y^{a}		Y		Y					Y^{c}	Y^{c} : UT shall be done for shafts with Dia 50 mm or above & Plates of Thickness 25 mm or above.
2. Vertical Pumps				Y	Y			Y^{1}	Y		Y^{d} :Dynamic Balancing per IS: 21940, Grade 6.3 minimum shall be conducted for rotating assy.
2.1. Casing	Y^{a}		Y^{b}		Y		Y				Y^{1} : As per Pump governing standard. Tolerences as per HIS, USA.
2.2. Impeller	Y^{a}		Y^{b}		Y					Y^{d}	Y^{2} : Random 10% RT to be conducted on butt welds for Thk $\geq$10 mm.
2.3. Shaft	Y^{a}		Y		Y					Y^{c}	Y^{3} : Seat Leakage Test for actuator operated valves shall be done by operating the valve with job actuator.
2.4. Fabricated Parts	Y^{a}	Y	Y^{b}		Y	Y^{2}	Y				Y^{4} : Tests on Rubber Diaphragms shall be conducted per batch of Rubber mix for Tensile, Elongation, Hardness, Thickness, Bleed Resistance. In addition, Type Test for 50,000 cycles for each type of diaphragm shall also be conducted.
3. Dosing/ Metering Pumps	Y^{a}				Y		Y	Y^{1}	Y		
4. Gate/ Globe/ Check Valves	Y^{a}		Y^{b}		Y		Y	Y	Y	Y^{3}, Y^{6}	
5. Dual Plate Check Valves	Y^{a}		Y^{b}		Y		Y	Y	Y	Y^{6}, Y^{12}	
6. Diaphragm Valves	Y^{a}				Y		Y		Y	Y^{4}, Y^{3}	
7. Butterfly Valves				Y	Y		Y	Y	Y	Y^{3}	
7.1 Body & Disc (Cast	Y^{a}		Y^{b}		Y						
7.2 Body and Disc (Fabricated)	Y^{a}	Y	Y^{b}		Y				Y	Y^{2}	

Condensate Polishing Plant

Items / Components \ Test/Check	Material Test	WPS/PQR/Welder	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic test / Pneumatic test / Vacuum test	Performance Test	Test as per relevant Std / Appd. Data Sheets	Other Tests	Remarks
7.3 Shaft	Y[a]		Y[b]		Y					Y[c]	
8. Plug/ Ball Valves	Y[a]		Y[b]	Y	Y		Y	Y	Y	Y[3]	
9. Blowers/ Compressors	Y[a]		Y[b]	Y	Y			Y	Y	Y[c], Y[d]	
10. Tanks/ Pressure Vessels	Y[a]	Y	Y[b]	Y	Y	Y[8]	Y		Y	Y[7]	
11. Rubber Lining	Y[a]				Y				Y	Y[9]	
12. Strainers	Y[a]	Y	Y[b]	Y	Y		Y		Y		
13. Pipe & Pipe Fittings	Y[a]	Y	Y		Y	Y[8]	Y		Y		
14. Agitators /Flash Mixer/ Flocculator	Y[a]	Y	Y[b]	Y	Y			Y		Y[10]	
15. Ventilation/Exhaust Fan	Y[a]		Y[b]	Y	Y			Y[11]	Y	Y[c], Y[d]	
16. Hoists & Cranes	Y[a]	Y	Y[b]	Y	Y	Y[8]		Y	Y		
17. Package/ Split AC	Y							Y	Y	Y[13]	

Y[6] : Blue Matching, Wear Travel for Gate Valves and reduced pressure test for check valves shall be conducted as per relevant standards.

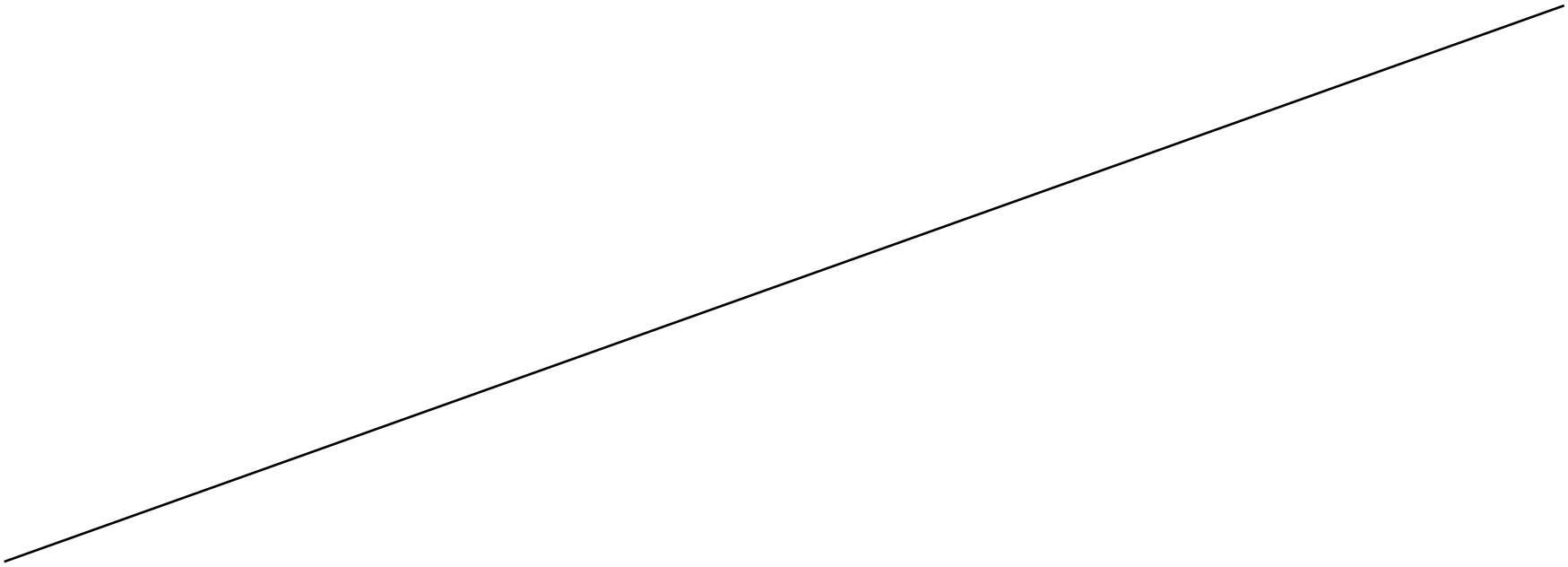
Y[7] : Heat Treatment of the Tank/Vessel shall be done per fabrication code requirement. Welded dished ends shall be stress relieved. Dished ends manufactured by cold working shall also be stress relieved as per the requirement of code.

Y[8] : RT as per fabrication code requirements. However, dished ends welds, if manufactured by using welded plates shall be subjected to 100% RT.

Y[9] : Rubber Lining Mix shall be subjected to Bleed Resistance Test on mould sample. Adhesion Test, Spark Test and Hardness Test for the Rubber

Condensate Polishing Plant											
Test/Check / Items / Components	Material Test	WPS/PQR/Welder	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic test / Pneumatic test / Vacuum test	Performance Test	Test as per relevant Std / Appd. Data Sheets	Other Tests	Remarks
18. Resins / Activated Carbon									Y		lined jobs shall also be conducted. Y^{10} :Gear Boxes shall be checked for smooth No Load Operation at shop to verify noise and vibration levels. Gear Ratio and Kerosene Leak Test shall also be conducted. Y^{11} :One Fan of each type & size shall be routine performance tested as per corresponding code for air flow, static pressure, total pressure, speed, efficiency, power consumption, noise & temperature rise. Also all Fans shall be subjected to run test of 4 hours during which noise, vibration, temperature rise and current drawn shall be measured. Y^{12} :Dry cycle test on valve spring for 1, 00,000 cycles shall be carried out as type test, if not carried out earlier, for the similar MOC, size and type of spring. Y^{13} : Electronic leak test for condenser & evaporator unit. Note: 1.The complete Piping system along with valves & fittings shall be hydraulically tested at 1.5 times design pressure or 2 times working pressure whichever is higher after erection at site. 2. In case of items other than those identified above, the quality requirements shall be decided based on system design requirements.

Condensate Polishing Plant											
Test/Check / Items / Components	Material Test	WPS/PQR/Welder	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic test / Pneumatic test / Vacuum test	Performance Test	Test as per relevant Std / Appd. Data Sheets	Other Tests	Remarks



ANNEXURE - II
SUB VENDORS LIST

(INDICATIVE)

Disclaimer for Indicative Vendor List

1.1 Reasonable efforts have been made to collate the sub-vendors proposed by the various bidders from time to time against different Projects/Packages and accepted by NTPC for various items. However, in case of error/omission, if any, and represented by the successful bidder this will be addressed during the execution of the contract based on the material evidence available with NTPC/ BHEL

1.2 The approved sub-vendor list drawn is not based on NTPC driven enlistment process but based on the sub- vendors proposed by various Main Contractors. As such, it is possible that some of the Suppliers/Manufacturers who may be involved in similar work/process may not be appearing in the list as such sub-vendors may not have been proposed by bidders against NTPC Contracts.

1.3 In case the successful bidder chooses to propose additional sub-vendors with relevant experience after the award of the contract such sub-vendors will be considered in terms GCC, provided the proposals are received sufficiently in time: 90 days prior to ordering date of a Bought Out Items/Start of Manufacturing so as not to impede the progress of the contract.

1.4 Sub-vendors have been grouped under different categories of items. It is possible that an item characterized by certain specific features such as range and type required as per bidder's design requirements may not be in the range of the listed sub-vendor's manufacturing process/capability. As such the main contractor to ascertain the vendor's capability to meet his specific requirements before considering a sub-vendor.