TYPICAL QAPs

FLOWMORE PUMPS	MANUFACTURER'S NAME & ADDRESS **FLOWMORE LIMITED (UNIT – I)** 9th Mile Stone, G.T. Road Mohan Nagar, Ghaziabad (U.P.) **FLOWMORE LIMITED (UNIT – II)** 28 A, Site IV, Sahibabad Industrial Area Ghaziabad (U.P.)	**MANUFACTURING QUALITY PLAN** **(Vertical Sump Pump Set)**	QAP NO – 2788 REV – 00 Dt. 21.01.2017 PAGE 1 OF 1	CLIENT: - SOPHISTICATED INDUSTRIAL MATERIAL ANALYTICS LABS PVT.LTD. PROJECT:- WSS – TSGENCO - KOTHAGUDEM ORDER NO:- SIMA/P-929/FM/2016 DATED:- 15.DEC.2016

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUATUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N					M	C	N	
1.	2.	3.	4.	5.	6		7.	8.	9.	D	10			11
1.	**RAW MATERIAL**													
1.1	Casing / Volute, Impeller, Shaft & Shaft Sleeve	Chemical & Physical Properties	Major	Chemical Analysis & Mechanical Hardness	Each Heat	Each Heat	Approved C.S. Drawings & Relevant IS	Approved C.S. Drawings & Relevant IS	TR	✓	P	R	R	
2	**IN PROCESS INSPECTION**													
2.1	Casing / Volute, Impeller, Shaft & Shaft Sleeve	Surface Defects	Major	DPT on Machined Surface	100%	100%	ASTME-165	No Liner Indications	TR	✓	P	R	R	
2.2	Impeller	Balancing	Critical	Dynamic Balancing	100%	100%	ISO 1940 Gr. 6.3	ISO 1940 Gr. 6.3	TR	✓	P	R	R	
2.3	Casing	Soundness of Parts	Critical	Hydro Test	100%	100%	Relevant IS	No leakage	TR	✓	P	R	R	Refer Note 1
2.4	Shaft > 50 mm dia.	Ultrasonic Test	Critical	Ultrasonic Test	100%	100%	ASTME 114, ASME Sec V	ASTME 114, ASME Sec V	TR	✓	P	R	R	
3	**FINAL INSPECTION**													
3.1	**PERFORMANCE TEST OF PUMP WITH SHOP MOTOR AT REDUCED SPEED**	Discharge V/S Head Discharge V/S Eff. Discharge V/S Power	Critical	Performance Test	100%	One of each Type	Approved G.A. Drawings & Relevant IS	Approved G.A. Drawings & Relevant IS	IR	✓	P	W	W	
4	**Electric Motor**	Routine Test	Major	Electrical	100%	100%	IS 325	IS 325	TR	✓	P	V	V	Test Certificate will be provided for review
5		Painting & Packing	Major	Visual	100%	-	Manufacturer Standard	Manufacturer Standard	—	–	P	–	–	

LEGEND:
RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
M: MANUFACTURER , **C:** CLIENT, **N:** INSPECTION AGENCY
P: PERFORM **W:** WITNESS AND **V:** VERIFICATION
TR: INTERNAL TEST REPORTS, **IR:** INSPECTION REPORTS

MANUFACTURER / SUB-SUPPLIER	MAIN-SUPPLIER	REVIEWED BY	APPROVED BY	APPROVAL SEAL
		APPROVED Sig. 18.01.17		Chief Engineer, Thermal Projects Construction TSGENCO, Vidyut Soudh Khairatabad, Hyderabad

NOTE : This approval does not absolve / relieve the supplier from his responsibilities regarding the compliance of PO / Contract and other Engg / Quality approved documents.

TYPICAL QAPs

FLOWMORE PUMPS	MANUFACTURER'S NAME & ADDRESS **FLOWMORE LIMITED (UNIT – I)** 9th Mile Stone, G.T. Road Mohan Nagar, Ghaziabad (U.P.) **FLOWMORE LIMITED (UNIT – II)** 28 A, Site IV, Sahibabad Industrial Area Ghaziabad (U.P.)	**MANUFACTURING QUALITY PLAN** **(Vertical Sump Pump Set)**	QAP NO – 2788 REV – 00 Dt. 21.01.2017 PAGE **2** OF 2	CLIENT: - SOPHISTICATED INDUSTRIAL MATERIAL ANALYTICS LABS PVT.LTD. PROJECT:- WSS – TSGENCO - KOTHAGUDEM ORDER NO:- SIMA/P-929/FM/2016 DATED:- 15.DEC.2016

NOTE:
1. TEST PRESSURE SHALL BE 1.5 TIMES THE SHUT OFF HEAD OR TWICE THE DUTY POINT HEAD WHICHEVER IS HIGHER

SAP: RANIPET APPROVED Sign: Dt: 13.01 QUALITY ASSURANCE

NOTE : ...oval does not absolve / relieve the supplier from his responsibilities regarding the compliance of PO / Contract and other Engg / Quality approved documents.

		LEGEND: RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. **M:** MANUFACTURER , **C:** CLIENT, **N: INSPECTION AGENCY** **P:** PERFORM **W:** WITNESS AND **V:** VERIFICATION **TR:** INTERNAL TEST REPORTS, **IR:** INSPECTION REPORTS			
MANUFACTURER / SUB-SUPPLIER	**MAIN-SUPPLIER**		**REVIEWED BY**	**APPROVED BY**	**APPROVAL SEAL**

Chief Engineer,
Thermal Projects Construction
TSGENCO, Vidyut Soudha
Khairatabad, Hyderabad -

TYPICAL QAPs

FLOWMORE PUMPS	MANUFACTURER'S NAME & ADDRESS **FLOWMORE LIMITED (UNIT – I)** 9th Mile Stone, G.T. Road Mohan Nagar, Ghaziabad (U.P.) **FLOWMORE LIMITED (UNIT – II)** 28 A, Site IV, Sahibabad Industrial Area Ghaziabad (U.P.)	**MANUFACTURING QUALITY PLAN** **(Vertical Turbine Pump Set)**	QAP NO –2788 REV – 00 Dt. 19.01.2017 PAGE 1 OF 1	CLIENT: SOPHISTICATED INDUSTRIAL MATERIAL ANALYTICS LABS PVT.LTD. PROJECT: WSS – TSGENCO - KOTHAGUDEM ORDER NO:SIMA/P-929/FM/2016 DATED: 15.DEC.2016

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUATUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N					M	C	N	
1.	2.	3.	4.	5.	6		7.	8.	9.	D	10			11
1.	**RAW MATERIAL**													
1.1	Bowl, Impeller, Shaft & Shaft Sleeve	Chemical & Physical Properties	Major	Chemical Analysis & Mechanical Hardness	Each Heat	Each Heat	Approved C.S. Drawings & Relevant IS 1710 / IS 9137	Approved C.S. Drawings & Relevant IS 1710 / IS 9137	TR	✓	P	R	R	
2	**IN PROCESS INSPECTION**													
2.1	Bowl, Impeller, Shaft & Shaft Sleeve	Surface Defects	Major	DPT on Machined Surface	100%	100%	ASTM E-165	No Liner Indications	TR	✓	P	R	R	
2.2	Shaft	Internal Defects	Major	Ultrasonic Test	100%	100%	ASTM A745	ASTM A745	IR	✓	P	R	R	
2.3	Impeller	Balancing	Major	Dynamic Balancing	100%	100%	ISO 1940 Gr. 6.3	ISO 1940 Gr. 6.3	TR	✓	P	R	R	
2.4	Bowls, Col. Assly., S.D. Head	Soundness of Parts	Major	Hydro Test	100%	100%	Relevant IS	No leakage	TR	✓	P	R	R	**Refer Note 1**
3	**FINAL INSPECTION**													
3.1	**PERFORMANCE TEST OF PUMP WITH SHOP MOTOR AT REDUCED SPEED**	Discharge V/S Head Discharge V/S Eff. Discharge V/S Power	Critical	Performance Test	100%	One of each Type	Approved G.A. Drawings & Relevant IS / HIS	Approved G.A. Drawings & Relevant IS / HIS	IR	✓	P	W	W	
4	**Electric Motor**	Routine Test	Major	Electrical	100%	100%	IS 325	IS 325	TR	✓	P	V	V	**Test Certificate will be provided for review**
5		Painting & Packing	Major	Visual	100%	100%	Manufacturer Standard	Manufacturer Standard	—	–	P	–	–	

NOTE:
1. **TEST PRESSURE SHALL BE 1.5 TIMES THE SHUT OFF HEAD OR TWICE THE DUTY POINT HEAD WHICHEVER IS HIGHER**

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TR: INTERNAL TEST REPORTS, **IR:** INSPECTION REPORTS

NOTE : ... does not absolve ... supplier from his respo... regarding the compliance of P.O. / contract and other Engg / Quality appro... documents.
13.01.17

APPROVED
Sig. 13.01.17
Dt.:

MANUFACTURER / SUB-SUPPLIER	MAIN-SUPPLIER	REVIEWED BY	APPROVED BY	APPROVAL SEAL

Chief Engineer,
Thermal Projects Construction,
TSGENCO, Vidyut Soudha,
Khairatabad, Hyderabad - 82.

TYPICAL QAPs

FLOWMORE	MANUFACTURER'S NAME & ADDRESS **FLOWMORE LIMITED (UNIT – I)** 9th Mile Stone, G.T. Road Mohan Nagar, Ghaziabad (U.P.) **FLOWMORE LIMITED (UNIT – II)** 28 A, Site IV, Sahibabad Industrial Area Ghaziabad (U.P.)	**MANUFACTURING QUALITY PLAN** **(Vertical Turbine Pump Set)**	QAP NO –2788 REV – 00 Dt. 19.01.2017 PAGE 2 OF 2	CLIENT: SOPHISTICATED INDUSTRIAL MATERIAL ANALYTICS LABS PVT.LTD. PROJECT: WSS – TSGENCO - KOTHAGUDEM ORDER NO:SIMA/P-929/FM/2016 DATED: 15.DEC.2016

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13.01.17

MANUFACTURER / SUB-SUPPLIER	MAIN-SUPPLIER	**LEGEND:** RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. **M:** MANUFACTURER , **C:** CLIENT, **N: INSPECTION AGENCY** **P:** PERFORM **W:** WITNESS AND **R:** REVIEW **TR:** INTERNAL TEST REPORTS, **IR:** INSPECTION REPORTS	REVIEWED BY	APPROVED BY	APPROVAL SEAL

APPROVED
Sig.
Dt.: 13-01-17

Chief Engineer,
Thermal Projects Construction,
TSGENCO, Vidyut Soudha,
Khairatabad, Hyderabad - 82.

TYPICAL QAPs

FLOWMORE PUMPS	MANUFACTURER'S NAME & ADDRESS **FLOWMORE LIMITED (UNIT – I)** 9th Mile Stone, G.T. Road Mohan Nagar, Ghaziabad (U.P.) **FLOWMORE LIMITED (UNIT – II)** 28 A, Site IV, Sahibabad Industrial Area Ghaziabad (U.P.)	**MANUFACTURING QUALITY PLAN** **(Vertical Turbine Pump Set)**	QAP NO –2788 REV – 00 Dt. 19.01.2017 PAGE 1 OF 1	CLIENT: SOPHISTICATED INDUSTRIAL MATERIAL ANALYTICS LABS PVT.LTD. PROJECT: WSS - TSGENCO - KOTHAGUDEM ORDER NO:SIMA/P-929/FM/2016 DATED: 15.DEC.2016

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUATUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N					M	C	N	
1.	2.	3.	4.	5.	6		7.	8.	9.	D	10			11
1.	**RAW MATERIAL**													
1.1	Bowl, Impeller, Shaft & Shaft Sleeve	Chemical & Physical Properties	Major	Chemical Analysis & Mechanical Hardness	Each Heat	Each Heat	Approved C.S. Drawings & Relevant IS 1710 / IS 9137	Approved C.S. Drawings & Relevant IS 1710 / IS 9137	TR	✓	P	R	R	
2	**IN PROCESS INSPECTION**													
2.1	Bowl, Impeller, Shaft & Shaft Sleeve	Surface Defects	Major	DPT on Machined Surface	100%	100%	ASTM E-165	No Liner Indications	TR	✓	P	R	R	
2.2	Shaft	Internal Defects	Major	Ultrasonic Test	100%	100%	ASTM A745	ASTM A745	IR	✓	P	R	R	
2.3	Impeller	Balancing	Major	Dynamic Balancing	100%	100%	ISO 1940 Gr. 6.3	ISO 1940 Gr. 6.3	TR	✓	P	R	R	
2.4	Bowls, Col. Assly., S.D. Head	Soundness of Parts	Major	Hydro Test	100%	100%	Relevant IS	No leakage	TR	✓	P	R	R	**Refer Note 1**
3	**FINAL INSPECTION**													
3.1	**PERFORMANCE TEST OF PUMP WITH SHOP MOTOR AT REDUCED SPEED**	Discharge V/S Head Discharge V/S Eff. Discharge V/S Power	Critical	Performance Test	100%	One of each Type	Approved G.A. Drawings & Relevant IS / HIS	Approved G.A. Drawings & Relevant IS / HIS	IR	✓	P	W	W	
4	**Electric Motor**	Routine Test	Major	Electrical	100%	100%	IS 325	IS 325	TR	✓	P	V	V	**Test Certificate will be provided for review**
5		Painting & Packing	Major	Visual	100%	100%	Manufacturer Standard	Manufacturer Standard	—	–	P	–	–	

NOTE:
1. **TEST PRESSURE SHALL BE 1.5 TIMES THE SHUT OFF HEAD OR TWICE THE DUTY POINT HEAD WHICHEVER IS HIGHER**

LEGEND:
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NOTE : ... does not absolve ... supplier from his respon... regarding the compliance of PO / Contract and other Engg / Quality appro... documents.
12.01.17

MANUFACTURER / SUB-SUPPLIER	MAIN-SUPPLIER	REVIEWED BY	APPROVED BY	APPROVAL SEAL
			Chief Engineer, ...rmal Projects Construction TSGENCO, Vidyut Soudha, Khairatabad, Hyderabad - 8...	

RANI ... Approved Sig. 12.01.17 Dt. QUALITY ASSURANCE

TYPICAL QAPs

QUALITY ASSURANCE PLAN

("ROTOMAC" PROGRESSIVE CAVITY PUMPS) Page 1/1

Party's Name	M/s SOPHISTICATED INDUSTRIAL MATERIAL		
Party's Enquiry No. & Dt.	27-07-16		
Your P.O. No. & Dt.	BHEL P.O. No. 7761795 Dt. 11/08/2016		
Pump Model No : BARESHAFT PUMP SAM05201CINI09R1B6R00	Tag No. GNB-01-AP-001/002	Qty. (Nos.) : (1W+1S) = 2 Nos.	
Pump Model No : BARESHAFT PUMP SAM05201CINI09R1B6R00	Tag No. GNB-02-AP-001/002	Qty. (Nos.) : (1W+1S) = 2 Nos.	
Pump Model No : BARESHAFT PUMP SAP07281CINI09R1B6R00	Tag No. GNB-04-AP-001/002	Qty. (Nos.) : (1W+1S) = 2 Nos.	
Pump Model No : BARESHAFT PUMP SAM05201CINI09R1B6R00	Tag No. GNB-03-AP-001/002	Qty. (Nos.) : (1W+1S) = 2 Nos.	
Pump Model No : BARESHAFT PUMP SAP07282CINI09R1B6R00	Tag No. GNB-08-AP-001/002	Qty. (Nos.) : (1W+1S) = 2 Nos.	

Legend:

Type of Check:	"C" Chemical Composition Test; "M" Material Test based on Manufacturers T/C
	"T" Physical Test; "I" Dimensional Confirmity Test; "H" Hydraulic Test
	"P" Performance Test; "V Visual InspectionTest

Class of Test: "A" Critical comp.; "B" Less Critical Comp.; "Z" Nil Critical Comp. — "P" Perform, "W" Witness, "R" Review

RAW MATERIAL (For Own Manufactured Items)

ITEM / Activity	Test Class Characteris	Type of Check	Extent of Check	Material of Constuction	Ref. Std. / Accept. Norm	Record Format/Doc	Insp. RIPL	Insp. SIMA	Insp. 3rd Party
BARE PUMP									
Pump Housing	B	C	100%	CI, 2% NI IS: 210, FG: 260	AS PER datasheet	RIPL Record	P	R	R
Shaft	A	C	100%	AISI-316 HCP STD	AS PER datasheet	Spectro Analysis	P	R	R
Rotor	A	C	100%	AISI-316 HCP UG	AS PER datasheet	Spectro Analysis	P	R	R
Bonded Stator	A	T	100%	Nitrile Rubber	AS PER datasheet	RIPL Mfg. Std	P	R	R
Base Plate	A	I,V	One of each Set		GA Drawing	RIPL Controled Drawing	P	R	R
HYDRAULIC PRESSURE TEST									
Pump Housing	A	H	100%	As Per API 676	1.5 Times the Max. Pressure	RIPL Test Certificate	P	R	R
End Cover	A	H	100%	As Per API 676	1.5 Times the Max. Pressure	RIPL Test Certificate	P	R	R
PERFORMANCE TEST									
Bare Shaft Pump	A	P,V	100% P& 50%R		As Per Specification	RIPL Test Certificate	P	W	W
FINAL DIMENSION CHECK WITH B/P									
Complete Assly.	A	I,V	50%		As per Specn		P	W	R
PAINTING									
	A	V	50%		As Per BHEL painting Specs.	As Per BHEL painting Specs.	P	R	R
PRIME MOVER	B	V	100%		IS: 12615/IEC Norms	Test Certificate	R	R	R

NOTES:

1. Physichal Test 'T' on Stator : Includes check for Shore A hardness and verified against RIPL STD
2. "RIPL" abbreviation for "Rotomac Ind. Pvt. Ltd (Manufacturer)"
2. "RIPL" Standard Paint shade is RAL 6001

Prepared By: Manish Sahu		Checked & Approved By: Abhai Gupta (RIPL)	Rev No. : R0
Date:	02-01-17	Date:	02-01-17

Send 25.1.17

We: This QP to be read alongwith Relevant P.O / Approved Drawing of Packing and preservation to be ensured for all the items, Pasta Steel Fe.

NOTE : This approval does not absolve / relieve the supplier from his responsibilities regarding the compliance of PO / Contract and other Engg / Quality approved documents.

SIGNATURE

BHEL : BAP : RANIPET APPROVED Sig. Dt.: 25/01/17 QUALITY ASSURANCE

Chief Engineer,
Thermal Projects Construction,
TSGENCO, Vidyut Soudha,
Khairatabad, Hyderabad - 82.

493 of 1251

ROS-6278

PROCON ENGINEERS
Mfgs of Pneumatic & Manual Diaphragm Valves.
101, ARK Industrial Estate, Off. Andheri Kurla Rd. Marol, Mumbai-59.

Client: SOPHISTICATED INDUSTRIAL MATERIALS ANALYTIC LABS
P.O. No: SIMA/P-929/PE/2016/4140 DT 21.1.17
Project: BHEL

QAP No: QAP-9280-Rev.0
Date: 02.02.2017

Quality Assurance Plan

(Item: Manual & Pneumatically Operated Diaphragm Valves)

Sr. No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check Mfg	Quantum of Check C / TPI	Reference Document	Acceptance Norms	Format of Record	Insp. Agency Mfg.	Insp. Agency C	Insp. Agency TPI	Remarks
1	**RAW MATERIAL INSPECTION**												
1.1	Body, Bonnet & Compressor	Physical	Major	Mechanical Properties	1 Sample / Heat	-	Relevant Material Specs.	Relevant Material Specs.	Foundry TC	P	R	R	
		Chemical	Major	Chemical Analysis	1 Sample / Heat	-	Relevant Material Specs.	Relevant Material Specs.	Foundry TC	P	R	R	Not Applicable for Cast Iron
1.2	Bar Stock for Stem / Spindle	Physical & Chemical	Major	Mechanical & Chem. Analysis	1 Sample / Lot	-	Relevant Material Specs.	Relevant Material Specs.	Lab TC	P	R	R	
		Internal Defects	Major	UT	1 Sample / Lot	-	Approved Mfg Drg / Data Sheet	Approved Mfg Drg / Data Sheet	Lab TC	P	R	R	Applicable for Dia. ≥ 50 mm
2	**IN PROCESS INSPECTION**												
2.1	After Machining for Body, Bonnet, Compressor & Stem	Dimensions	Major	Measurement	100%	-	Approved Mfg Drg / Data Sheet	EN 13397 / Mfg Std	IR	P	R	R	
		Surface Quality	Major	Visual	100%	-	-	No Blow Holes	IR	P	R	R	
		Before Lining Hydro Test	Major	Body Hydro Test	100%	-	EN 12266 (PART-I) / BS 6755 (PART-I)	No Leakage	IR	P	R	R	
2.2	Body Diaphragm	Dimensions	Major	Measurement	Random	-	Mfg Std	Mfg Std	IR	P	R	R	
		Surface Quality	Major	Visual	100%	-	-	Smooth Finish	IR	P	R	R	
		Hardness	Major	Measurement	Random	-	IS 3400 (Part 2 / 23)	Mfg Drg / Mfg Std	IR	P	R	R	
		Tensile & Elongation	Major	Physical	1 Sample / Batch	-	IS 3400 (Part 1)	Mfg Drg / Mfg Std	IR / TC	P	R	R	Not Applicable for PTFE Diaphragm (If Applicable)
		Rubber - Fabric Bond	Major	Physical	1 Sample / Batch	-	IS 3400 (Part 5)	Mfg Drg / Mfg Std	IR / TC	P	R	R	Not Applicable for PTFE Diaphragm (If Applicable)
		Flex Test	Major	Physical	1 Sample / Batch	-	1500 Flexes	No Cracks	IR / TC	P	R	R	
		Bleed Resistance	Major	Chemical	1 Sample / Batch	-	Sample kept in 33% HCL, 48% NaOH & DM Water Separately for 72 Hrs	No Discoloration, Weight Gain Limit: 0% To +2%	IR / TC	P	R	R	Not Applicable for PTFE Diaphragm (If Applicable)
2.3	Body Lining	Dimensions	Major	Measurement	100%	-	Approved Mfg Drg / Data Sheet	EN 13397 / Mfg Std	IR	P	R	R	
		Surface Quality	Major	Visual	100%	-	-	Smooth Finish	IR	P	R	R	
		Hardness & Thickness	Major	Measurement	Random	-	Approved Mfg Drg / Data Sheet	Approved Mfg Drg / Data Sheet	IR	P	R	R	
		Spark Test	Critical	HV Test	100%	-	IS 4682 (PART-I)	IS 4682 (PART-I) / No Spark at 5KV per mm of Thick.	IR	P	R	R	
		Bleed Resistance	Major	Chemical	1 Sample / Batch	-	Sample kept in 33% HCL, 48% NaOH & DM Water Separately for 72 Hrs	No Discoloration, Weight Gain Limit: 0% To +2%	IR / TC	P	R	R	
3	**FINAL INSPECTION**				% per Size per Type								
3.1	Complete Valve (As Applicable)	Pressure Test	Critical	Hydrostatic Test (Body & Seal)	100%	10%	Approved Mfg Drg / Data Sheet	No Leakage	IR	P	W	R	Body Hydro Test applicable only for Unlined Valves
		Functional	Critical	Operations	100%	10%	-	Smooth Operation	IR	P	W	R W	Open / Closing of valve with Job Actuator
		Seat Pneumatic Test	Critical	Pneumatic Test (Seat)	100%	10%	Approved Mfg Drg / Data Sheet	No Leakage	IR	P	W	R	
		Lining Hardness / Thickness / Spark Test	Major	Measurement	100%	10%	Approved Mfg Drg / Data Sheet	Approved Drg / Data Sheet / IS 4682 (PART-I) / No Spark at 5KV per mm of Thick.	IR	P	W	R	
		Dimensions	Major	Measurement	100%	10%	Approved Mfg Drg / Data Sheet	Approved Mfg Drg / Data Sheet	IR	P	W	R W	

NOTES
1. Life Cycle Test (POD) for body diaphragms to be reviewed by BHEL. If Life Cycle Test is not carried out for the diaphragm material under consideration (by ~~NTPC~~ / BHEL), the same shall be offered for ~~NTPC~~ / BHEL witness (50,000 Cycles) on any one size of diaphragm.
2. For Manual Valves: Body Hydro (Shell) Test to be carried out at 1.5 Times the PN rating of the valve; Hydro Seat Test to be carried out at 1.1 Times the PN rating of the valve.
   For Pneumatic / Motorized Valves: Body Hydro (Shell) Test to be carried out at 1.5 Times the Design Pressure of the valve; Hydro Seat Test to be carried out at 1.1 Times the Design Pressure of the valve.
3. Air Seat Test to be carried out at 5 Kg/Cm2 Subject to Engg acceptance

LEGEND					
P - Perform	Mfg - Manufacturer	IR - Inspection Report	PO - Purchase Order
W - Witness	C - Client / Contractor	TC - Test Certificate	Mfg Std - Manufacturer's Standard
R - Review	TPI - Third Party Inspection / Consultant / Owner	Mfg Drg - Manufacturer's Drawing	COC - Certificate of Compliance

- For PROCON ENGINEERS

V. Amarnath

CLIENT / CONSULTANT APPROVALS

NOTE : This ... absolve / relieve the supplier from his responsibilities regarding the compliance of PO / Contract and other Engg / Quality approved documents.
12.01.17
DATE

APPROVED
Dt. 13.01.2017

Chief Engineer,
Thermal Projects Construction,
TSGENCO, Vidyut Soudha,
Khairatabad, Hyderabad - 82.

ISO 9001:2008 CERTIFIED

A. V. VALVES LTD.
16, Industrial Estate, Nunhai, Agra - 282 006 (INDIA)
Phone : +91–562–2281202, 203, 204, 205 Fax : +91-562-2281201
E-mail: avvalves@sancharnet.in & avengg@dataone.in

QUALITY ASSURANCE PLAN
For CHECK VALVES

Client : **M/s. ANDHRA PRADESH POWER GEN. CORPN. LTD., (APGENCO)**
Contractor: **M/s. Sophisticated Industrial Materials Analytic Labs Pvt. Ltd., New Delhi**
Pur. Order : **SIMA / P-929 / AVVL / 2016 / 4052** **PO DATED : 11-JAN.-2017**

Sheet No. Page 1 of 1 | O. A. No. **4056**
QAP. No. **AV / QP – CHVS– 4056 / 16** Rev.- 0 Dated : 18 / 01 / 2017
Project : **VALVES FOR BHEL ETP - 1×800MW, KOTHAGUDEM**

Sr. No.	Description	Characteristics	Class / Category	Type / Method of Check	Quantum Extent of Check	Reference Document No(s)	Acceptance Norms	Format of Record	INSPECTION BY AVVL	CLIENT	TPIA	Remarks
1.0	**RAW MATERIAL**											
1.1	Body, Cover, Disc/ Piston, Body-seat and Hinge-pin	Physical Properties	MA	Physical Analysis	1 / Lot	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Lab Rep.	P	R	R	All T/C's shall be submitted
1.2		Chemical Properties	MA	Chemical Analysis	1 / Lot	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Lab Rep.	P	R	R	
1.3		Surface Defects	MA	Surface Defect	100%	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Insp. report	P	R	R	
1.5	Body, Bonnet & Spindle	PMI Test	MA	PMI Test (if applicable)	**100%	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Insp. report	P	W	R	For SS Valves Only.
2.0	**STAGE / IN – PROCESS INSPECTION**											
2.1	Machining of Component	Dimensional Check	MA	Measurement	100%	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Log Book	P	R	R	
2.2	Assembly	Visual : DPT	MA	Surface Defect	100%	Spec./ Appd Drg / Datasheet	ASTM E – 165	Insp. report	P	R	R	
3.0	**FINAL INSPECTION**											
3.1	Testing of Complete Valve	Dimension, Surface Defect	MA	Measurement, Visual	100%	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Insp. report	P	R	W	**100%by AVVL & ~~10%~~ by TPIA / As per sampling plan. Client
3.2		Valve Operation	MA	Operation Check	100%	Approved Drawing	Smooth Operation	Insp. report	P	R	W	
3.3		Hydro Test of Body	MA	Hydraulic Test	100%	API 598 / IS : 778	APPROVED DRAWING	Insp. report	P	R	W	
3.4		Hydro Test of Seat	MA	Hydraulic Test	100%	API 598 / IS : 778	APPROVED DRAWING	Insp. report	P	R	W	
4.0	**PAINTING, PROTECTION, MARKING, PACKING & COLOUR CODING :**											
4.1	Complete Valve	Appearance	MA	DFT Check	100%	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Insp. report	P	R	R	
4.2	Marking & Stamping	Verification	MA	Visual	100%	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Insp. report	P	R	R	

Legends : 1. MA : Major, **2. I/R :** Inspection Report, **3. T/C :** Test Certificate, **4. P :** Performed, **5. W :** Witness, **6. R :** Review **7. H :** Hold

NOTE : This approval does not relieve / relieve the supplier from responsibilities regarding the compliance of PO / Contract and other Engg / Quality approved documents.
14.01.17

(Prepared by)
ANIL BHARADWAJ (Mgr- QA)
For A. V. VALVES LIMITED

(Reviewed by)
14.01.17

(Approved by)
Chief Engineer,
Thermal Projects Construction,
TSGENCO, Vidyut Soudha,
Khairatabad, Hyderabad - 82.

qap-SIMA Labs-4056

TYPICAL QAPs

ROS-6278

A. V. VALVES LTD.
16, Industrial Estate, Nunhai, Agra - 282 006 (INDIA)
Phone : +91–562–2281202, 203, 204, 205 Fax : +91-562-2281201
E-mail: avvalves@sancharnet.in & avengg@dataone.in
ISO 9001:2008 CERTIFIED

QUALITY ASSURANCE PLAN
For GATE VALVES

Client : **M/s. ANDHRA PRADESH POWER GEN. CORPN. LTD., (APGENCO)** Sheet No. Page 1 of 1 O. A. No. **4056**

Contractor: **M/s. Sophisticated Industrial Materials Analytic Labs Pvt. Ltd., New Delhi** QAP. No. **AV / QP – VLVS– 4056 / 16** Rev.- 0 Dated : 18 / 01 / 2017

Pur. Order : **SIMA / P-929 / AVVL / 2016 / 4052 PO DATED : 11-JAN.-2017** **Project :** **VALVES FOR BHEL ETP - 1×800MW, KOTHAGUDEM**

Sr. No.	Description	Characteristics	Class / Category	Type / Method of Check	Quantum Extent of Check	Reference Document No(s)	Acceptance Norms	Format of Record	INSPECTION BY			Remarks
									AVVL	CLIENT	TPIA	
1.0	**RAW MATERIAL**											
1.1	Body, Bonnet, Wedge, Body-seat & Wedge-seat and Stem / Spindle	Physical Properties	MA	Physical Analysis	1 / Lot	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Lab Rep.	P	R	R	All T/C's shall be submitted
1.2		Chemical Properties	MA	Chemical Analysis	1 / Lot	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Lab Rep.	P	R	R	
1.3		Surface Defects	MA	Surface Defect	100%	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Insp. report	P	R	R	
1.5	Body, Bonnet & Spindle	PMI Test	MA	PMI Test (if applicable)	**100%	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Insp. report	P	W	R	For SS Valves Only.
2.0	**STAGE / IN – PROCESS INSPECTION**											
2.1	Machining of Component	Dimensional Check	MA	Measurement	100%	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Log Book	P	R	R	
2.2	Assembly	Visual : DPT	MA	Surface Defect	100%	Spec./ Appd Drg / Datasheet	ASTM E – 165	Insp. report	P	R	R	
3.0	**FINAL INSPECTION**											
3.1	Testing of Complete Valve	Dimension, Surface Defect	MA	Measurement, Visual	100%	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Insp. report	P	R	W	**100%by AVVL & ~~10%~~ by TPIA / Client As per Surfacing Plan
3.2		Valve Operation	MA	Operation Check	100%	Approved Drawing	Smooth Operation	Insp. report	P	R	W	
3.3		Hydro Test of Body	MA	Hydraulic Test	100%	IS : 14846 / API 598 / IS 778	APPROVED DRAWING	Insp. report	P	R/W	W	
3.4		Hydro Test of Seat	MA	Hydraulic Test	100%	IS : 14846 / API 598 / IS 778	APPROVED DRAWING	Insp. report	P	R/W	W	
3.7		Air (Pneu.) Test of Seat	MA	Pneumatic Test	100%	IS : 14846 / API 598 / IS 778	APPROVED DRAWING	Insp. report	P	R/W	W	
4.0	**PAINTING, PROTECTION, MARKING, PACKING & COLOUR CODING :**											
4.1	Complete Valve	Appearance	MA	DFT Check	100%	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Insp. report	P	R	R	
4.2	Marking & Stamping	Verification	MA	Visual	100%	Spec./ Appd Drg / Datasheet	Spec./ Appd Drg / Datasheet	Insp. report	P	R	R	

Legends : 1. MA : Major, **2. I/R :** Inspection Report, **3. T/C :** Test Certificate, **4. P :** Performed, **5. W :** Witness, **6. R :** Review **7. H :** Hold

Note :- This QAP to be read alongwith relevant P.O. approved drawing / Data sheet etc.

NOTE : ... does not absolve / relieve the supplier from his responsibilities regarding the compliance of PO / Contract and other Engg / Quality approved documents.
14.01.17

(Prepared by)
ANIL BHARADWAJ (Mgr- QA)
For A. V. VALVES LIMITED

(Reviewed by)

(Approved by)
Chief Engineer,
Thermal Projects Construction,
TSGENCO, Vidyut Soudha,
Khairatabad, Hyderabad - 82

qap-SIMA Labs-4056

TYPICAL QAPs

ROS-6278

TYPICAL QAPs

MANUFACTURER'S NAME AND ADDRESS: KRISHNA ENGINEERING Plot No.4406,GIDC, Ankleshwar – 393002, Gujarat	MANUFACTURING QUALITY PLAN	PROJECT : KOTHAGUDEM TPS - 1 X 800 MW
	ITEM : INCLINED SURFACE SETTLER QP NO.: QAP/ISS/16-17/SIMA REV. NO.: 00 DATE: 16.12.2016 SUB-SYSTEM: PAGE: 01 OF 01	PACKAGE : OILY WATER SEPARATOR CONTRACT NO. : P - 929 MAIN-SUPPLIER: SIMA LABS PVT. LTD.

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
				M	C / B					M	C	B	
1.	2.	3.	4.	5.		6.	7.	8.	D*	** 9.			10.
A	FRP ITEMS (PLATE PACKS)	MATERIAL IDENTIFICATION	CHEMICAL	100%	RANDOM	APPROVED DATASHEET	REVIEW OF RAW MATERIAL TEST CERTIFICATE	MATERIAL TEST CERTIFICATE		P	V	V	REVIEW OF RECORD
		VISUAL AND DIMENTIONAL CHECK	MAJOR DIMENTION	100%	RANDOM	APPROVED DATASHEET / GA DRAWING	MAJOR DIMENTIONAL CHECK (VISUAL / DIMENSIONAL)	APPROVED DATASHEET / GA DRAWING / INTERNAL INSPECTION REPORT		P	V/W	W	FINAL INSPECTION
B	PACKING & MARKING	PACKING & MARKING	VISUAL	100%	RANDOM	APPROVED DATASHEET / GA DRAWING/ PACKING LIST	MANUFACTURERS REQUIREMENT	INTERNAL INSPECTION REPORT		P	V/W	V/W	FINAL INSPECTION

NOTE : ... absolve / relieve the supplier from his responsibilities regarding the compliance of PO / Contract and other Engg / Quality approved documents.

APPROVED

Paresh Mistry
For KRISHNA ENGINEERING
Partner

MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER
SIGNATURE	

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

FOR BIFPCL USE	DOC. NO.:	REV..... CAT.....	
	REVIEWED BY	APPROVED BY	APPROVAL SEAL

Chief Engineer,
Thermal Projects Construction
TSGENCO, Vidyut Soudha
Khairatabad, Hyderabad -

TYPICAL QAPs

MANUFACTURER'S NAME AND ADDRESS: KRISHNA ENGINEERING Plot No.4406,GIDC, Ankleshwar – 393002, Gujarat	**MANUFACTURING QUALITY PLAN**	PROJECT : KOTHAGUDEM TPS - 1 X 800 MW
	ITEM : OILY WATER SEPARATOR / QP NO.: QAP/TPI/16-17/SIMA / REV. NO.: 00 / DATE: 06.12.2016	PACKAGE : OILY WATER SEPARATOR
	SUB-SYSTEM: / PAGE: 01 OF 01	CONTRACT NO. : P - 929
		MAIN-SUPPLIER: SIMA LABS PVT. LTD.

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK M	QUANTUM OF CHECK C / B	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	AGENCY M	AGENCY C	AGENCY B	REMARKS
1.	2.	3.	4.	5.		6.	7.	8.		** 9.			10.
A	FRP ITEMS (PLATE PACKS AND BAFFLE)	MATERIAL IDENTIFICATION	CHEMICAL	100%	RANDOM	APPROVED DATASHEET	REVIEW OF RAW MATERIAL TEST CERTIFICATE	MATERIAL TEST CERTIFICATE		P	V	V	REVIEW OF RECORD
		VISUAL AND DIMENTIONAL CHECK	MAJOR DIMENTION	100%	RANDOM	APPROVED DATASHEET / GA DRAWING	MAJOR DIMENTIONAL CHECK (VISUAL / DIMENSIONAL)	APPROVED DATASHEET / GA DRAWING / INTERNAL INSPECTION REPORT		P	V/W	V/W	FINAL INSPECTION
B	STEEL ITEMS (OIL SKIMMER PIPE & WEIR PLATE)	MATERIAL IDENTIFICATION	CHEMICAL / PHYSICAL	100%	RANDOM	APPROVED DATASHEET	REVIEW OF RAW MATERIAL TEST CERTIFICATE	MATERIAL TEST CERTIFICATE		P	V	V	REVIEW OF RECORD
		VISUAL AND DIMENTIONAL CHECK	MAJOR DIMENTION	100%	RANDOM	APPROVED DATASHEET / GA DRAWING	MAJOR DIMENTIONAL CHECK (VISUAL / DIMENSIONAL)	APPROVED DATASHEET / GA DRAWING / INTERNAL INSPECTION REPORT		P	V/W	V/W	FINAL INSPECTION
	PACKING & MARKING	PACKING & MARKING	VISUAL	100%	RANDOM	APPROVED DATASHEET / GA DRAWING/ PACKING LIST	MANUFACTURERS REQUIREMENT	INTERNAL INSPECTION REPORT		P	V/W	V/W	FINAL INSPECTION

NOTE : This approval does not absolve / relieve the supplier from his responsibilities regarding the compliance of PO / Contract and other Engg / Quality approved documents.

SIGNATURE & DATE

Paresh Mistry
For KRISHNA ENGINEERING
Partner

MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER
SIGNATURE	

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
** M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER,
P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE,
CHP: BIFPCL SHALL IDENTIFY IN COLUM "B" AS ' W"
B-BHEL or BHEL Authorised Insp. Agc

FOR BIFPCL USE

DOC. NO.: REV..... CAT.....

APPROVED

REVIEWED BY APPROVED BY APPROVAL SEAL

Chief Engineer,
rmal Projects Construction,
TSGENCO, Vidyut Soudha,
Khairatabad, Hyderabad - 82.

1/1

TYPICAL QAPs

SOPHISTICATED INDUSTRIAL MATERIALS ANALYTIC LABS PVT LTD.

QUALITY ASSURANCE PLAN FOR CSEP & MSRL TANKS

QAP NO. : 000-MST-001-14
EDITION : 01
REV. : ~~00~~ 01
DATE : 09/~~02/2017~~ 25.02.2017
PAGE : 01 of 01

S. No.	COMPONENT AND OPERATION STAGES	CHARACTERISTIC	CLASSIFICATION	TYPE OF CHECK	QUANTUM OF CHECK		Reference Doc. & Acceptance Norms	Format Records	Remarks
					M/S	T			
I	Welder Qualification Test	WPS, PQR, QW	Major	Perform/Verification	CH	V	ASME-IX, WPS/PQR	IR	
II	Raw Material Identification for Shell, Bottom, Plates & Pipes, Nozzle	Mechanical & chemical property chk	Major	Verification with respect standard.	CH	V	Approved Drawing	TC	
III	Inspection of dished ends	workmanship &dimensions	Major	Visual and measurment	CH	V	Approved Drawing	IR	
IV	Joint preparation weld set-ups & nozzles fittings.	Alignment & dimension	Major	Visual and measurment	CH	V	Approved Drawing	IR	
V	**Final Inspection**								
	Final Inspaction before R/L / Coating of completed Tank	Dimension	Major	Measurment	W	V	Approved Drawing	IR	
		Visual Check For Defects	Major	Visual	W	V	Free From Surface Defects	IR	
		Hydro test	Major	Water Fill Test	W	W	Tank Full of Water	IR	
		Surface Prepration	Major	Visual / Surface Profile	W	V	Approved Drawing	IR	
	Final Inspaction After Rubber Linning (For Rubber linning Tank)	Hardness Test	Major	measurment	W	V	Approved Drawing	IR	
		Visual Check For Surface Defects	Major	Visual	W	V	Approved Drawing	IR	
		Pill of Test	Major	Adhesion Test	W	V	Approved Drawing	IR	
		Thickness of Rubber lining	Major	Measurement	W	V	Approved Drawing	IR	
		Holiday Test	Major	Spark Test at 5kV/mm	W	W	Approved Drawing	IR	
VII	Stamping/Marking & identification	Name Plates, Tag No. Verification	Major	Visual	W	V	Approved Drawing	IR	
VIII	Final inspection after Coating/ Painting	Surface finish, DFT, Shade	Major	Visual	W	V	Approved Drawing	IR	

NOTE : This approval does not absolve / relieve the supplier from his responsibilities regarding the compliance of PO / Contract and other Engg / Quality approved documents.

SIGNATURE & DATE

Note: This QP to be read alongwith relevant Standard codes/ APPD Doc / Data sheet etc.

ABBREVIATIONS Quantum of check 100%.

CH	: CHECK 100%	V	: VERIFY DOCUMENTS
R	: REVIEW	M	: MANUFACTURER
W	: WITNESS/CHECK (HOLD POINT)	S	: SIMA LAB PVT LTD
IR	: INSPECTION REPORT	T	: THIRD PARTY
TC	: TEST CERTIFICATE	R/L	RUBBER LINNING

(2) Fairness and Presentation to be ensured for all the component.
(3) Comply the requirements as noted.

FOR SIMA LABS PVT. LTD.

Chief Engineer,
Thermal Projects Construction
TSGENCO, Vidyut Soudha.
Khairatabad, Hyderabad -

ROS-6278

TYPICAL QAPs

JINDAL PIPES LIMTED (ERW PIPES)
QUALITY ASSURANCE PLAN FOR CARBON STEEL ERW PIPES

Customer : SIMA LABS PVT.LTD.
Project : BHEL TELANGANA
Specification : IS: 1239 & 3589 Gr. 410

QAP No. : JPL/ERW/IS:1239-3589/001
Rev. No. : 01
Date : 17/02/2017
Page : 1of 3

Sl. No	Inspection / Test Stage	Checks	Type of Inspection	Frequency of Check	Reference Documents	Acceptance Norms	Format of Record	Inspection By P	W	R	Remarks
1.0	**Receiving Inspn & Testing**										
1.1	Inspection of H.R. Coils.	Suppliers approval	Review of records	On receipt of material	Suppliers Heat No. / Coil No. / P.O / Material specification	Approved vendor list / IS 10748 / IS 1239 & 3589	H.R coil Inspn. & Test Report / Suppliers T.C	1	-	-	
		Results of supplier's T.C	-do-	T.C for each coil				1	-	-	Chemical & Mechanical testing for one sample per heat to be witnessed by BHEL or BHEL AIA.
		Marking & Heat No	Visual	Each coil	P.O / Material specification	IS 10748	H.R coil Inspn. & Test Report	1	-	-	
		Width and Thickness	Measurement	Each coil	P.O / Material specification	IS 10748	H.R coil Inspn. & Test Report	1	-	-	
		Surface defects & packaging condn.	Visual	Each coil	P.O / Material specification	IS 10748	H.R coil Inspn. & Test Report	1	2	3	
		Chemical Elements	~~wet analysis~~ XRF Analyzer	One sample Per heat	P.O / Material specification	IS 10748 / IS 1239 & 3589	H.R coil Inspn. & Test Report	1	3	3	
		Mechanical Properties	Mechanical Testing	One Sample Per Heat	P.O / Material specification	IS 10748 / IS 1239 & 3589	H.R coil Inspn. & Test Report	1	2, 3	3	

P – Perform By, R – Review By, W - Witness By, 1- JPL , 2 - Third Party / Customer / SIMALABS PVT LTD
3 - BHEL or BHEL AIA

Acceptance Norms - Appd Drg / Appd Datasheet

JINDAL PIPES LIMITED:

Approved By

Chief Engineer,
Thermal Projects Construction
TSGENCO, Vidyut Soudha
Khairatabad, Hyderabad

Note :- This QAP to be read alongwith relevant P.O / Appd Drg / Data Sheet etc.
Packing and preservation to be ensured.

NOTE : ... does not absolve ... from his responsibility regarding the compliance ... and other Engg / ... documents.
Engg / ... DATE

ROS-6278

TYPICAL QAPs

JINDAL PIPES LIMTED (ERW PIPES)
QUALITY ASSURANCE PLAN FOR CARBON STEEL ERW PIPES

Customer : SIMA LABS PVT.LTD.
Project : BHEL TELANGANA
Specification : IS: 1239 & 3589 Gr. 410

QAP No. : JPL/ERW/IS:1239-3589/001
Rev. No. : 01
Date : 17/02/2017
Page : 2of 3

Sl. No	Inspection / Test Stage	Checks	Type of Inspection	Frequency of Check	Reference Documents	Acceptance Norms	Format of Record	Inspection By P	W	R	Remarks
2.0	**In-Process Inspn**										
2.1	Edge Preparation Trimming/Milling	Width & thickness	Measurement	5 times/coil		Strip width Chart & IS 1239 & 3589	Slitting/Milling Rpt.	1	-	-	
		Surface defects	Visual	Continuous monitoring	P.O / Material specification	IS 1239 & 3589	Slitting/Milling Rpt.	1	-	-	For Pipe. one sample Per heat mech. Property (YS, UTS, % EL) to be witnessed by BHEL or BHEL AIA)
2.2	Pipe manufacture	**Dimensional**									
		Out side diameter	Measurement	As per relevant specification	Material specification	As per IS 1239 & 3589	Mill Inspn. Rpt.	1	-	-	
		Thickness	Measurement	-DO-	Material specification	As Per P.O/ IS 1239 & 3589	Mill Inspn. Rpt.	1	-	-	
		Length	Measurement	-DO-	Material specification	As Per IS 1239 & 3589	Mill Inspn. Rpt.	1	-	-	
		Straightness	Measurement	-DO-	Material specification.	As Per IS 1239 & 3589	Mill Inspn. Rpt.	1	-	-	
		Mech. Property									
		YS, UTS, %El	Mechanical Test	As Per Relevant Specification	Material specification	As Per IS 1239 & 3589	Mech. Testing Rpt.	1	2,	3	
		Flattening	Flattening	As per relevant specification	Material specification	As Per IS 1239 & 3589	Flattening Test Rpt.	1	-	-	
2.3	End Preparation	Bevel Angle & Root Face	Measurement	Hourly	Material specification	As Per IS 1239 & 3589	Bevelling Inspn. Rpt.	1	-	-	

P – Perform By, R – Review By, W - Witness By, 1- JPL , 2 - Third Party / Customer / SIMALAB
3 - BHEL or BHELAIA.

Note : This QAP to be read along with the Relevant PO / approved Drgs / Data Sheet etc.
Acceptance Norms — Appd Drg / Appd Datasheet.

JINDAL PIPES LIMITED:

Approved By

Chief Engineer,
Thermal Projects Construction
TSGENCO, Vidyut Soudh
Khairatabad, Hyderabad

NOTE : This approval does not absolve / relieve the supplier from its responsibilities regarding the compliance of PO / Contract and other Engg / Quality approved documents.

SIGN. & DATE

ROS-6278

TYPICAL QAPs

ROS-6278

JINDAL PIPES LIMTED (ERW PIPES)
QUALITY ASSURANCE PLAN FOR CARBON STEEL ERW PIPES

Customer : SIMA LABS PVT.LTD.
Project : BHEL TELANGANA
Specification : IS: 1239 & 3589 Gr. 410

QAP No. : JPL/ERW/IS:1239-3589/001
Rev. No. : 01
Date : 17/02/2017
Page : 3of 3

Sl. No	Inspection / Test Stage	Checks	Type of Inspection	Frequency of Check	Reference Documents	Acceptance Norms	Format of Record	Inspection By			Remarks
								P	W	R	
2.4	Hydrostatic Test	Leakage	Visual	Each Pipe	Material specification	As Per IS 1239 & 3589	Hydrostatic Test Rpt.	1		2	
3.0	**Final Inspection**	Y.S, U.T.S, % El & Flattenting	Mechanical Test	As Per IS:4711		-do-.	Test Report	1	-	2	
		Visual & Dimn.					Inspn. Rpt				
		Surface condition	Visual	As Per IS: 4711	-do-	-do-		1	2	3	
		O.D	Measurement	-do-	-do-	-do-		1	2	3	
		Wall Thickness	Measurement	-do-	-do-	-do-		1	2	3	
		Length									
		Marking	Visual	-do-	-do-	-do-		1	2	3	
		Straightness	Measurement	-do-	-do-	-do-		1	2	3	
4.0	**Issue of Test Certificate**	Conformance to specification	Review of all Tests	All Test	-do-	-do-	Works Mill T.C	-	-	2 & 3	

P – Perform By, R – Review By, W - Witness By, 1- JPL , 2 - Third Party / Customer / SIMA LABS PVT LTD

3- BHEL or BHEL AIA.

Acceptance Norms - As per Dwg / Appd Datasheet;

JINDAL PIPES LIMITED:

Approved By

NOTE : This approval does not absolve / relieve the supplier from his responsibilities regarding the compliance of PO / Contract and other Engg / Quality approved documents.

DATE

Chief Engineer,
Thermal Projects Construction,
TSGENCO, Vidyut Soudha,
Khairatabad, Hyderabad - 82.

Note - This QAP to be read alongwith relevant P.O / Approved Dwg / Datasheet.

Painting and Preservation to be ensured for all the Components

TYPICAL QAPs

ROS-6278

QUALITY ASSURANCE PROGRAM FOR PLC PANEL

Project Name	PLC BASED CONTROL SYSTEM FOR ETP PLANT	QAP No	16100037-12-SL-014-QAP-01
Client	TELENGANA STATE POWER GENERATION CORPORATION	Revision	R0
EPC Contractor	M/s. BHARAT HEAVY ELECTRICALS LTD	Date	07-03-2017
PT Contractor	M/S SIMA LABS PVT LIMITED	Contract No	-
Vendor	M/s. SUN INDUSTRIAL AUTOMATION & SOLUTIONS		
Item Description	QAP FOR PLC CONTROL PANEL		

P: Performer	R:REVIEW	W:WITNESS	1: SIAS	2: SIMA	3: BHEL	4.TSPGC
SUN Industrial Automation &				M/s. BHARAT HEAVY ELECTRICALS LTD		

Sl.No.	Components/Operation	Characteristics	Remarks	Method of Check	Extent of Check	Reference/ Acceptance Document	Acceptance Norm	Format of Record	1	2	3	4
1.0	IN COMING MATERIALS											
1.1	PLC, HMI, Hardwares / Softwares	Physical Inspection * Indentification Labels * Physical Damages	Rejected Products are identified with rejected Sticker pasted on product	Physical	100%	Purchase Order on vendor & literature enclosed with PLC & Panel BOM	Should be as per approved drawing. No physical damages to the product. All necessary accessories like connectors should be in place.	Vendor TC	P	R	R	R
1.2	PLC Panel	Physical Inspection *Dimensions *Painting *Cut-outs *Lifting Hooks *Locking Arrangements *Components Drawing Pocket Laying Accessories Mounting Accessories Plinth & AV pads Cable Gland Plates Hardware's Hinges Louver's & Filters	Panel accepted with Product identification to the tag on the Panel. In case of any deviations the same is informed to vendor to correct the defect.	Measuring Tape, Visual, Vernier & Depth Gauge	100%	Purchase Order on vendor & literature enclosed with PLC & Panel BOM	Dimensions to be as per drawings Painting should be free from scales, unevenness, and peelings, to be of correct shade. Cutouts should as per the drawings. Lifting hooks should be as per drawings. Locking arrangement should be as per specification. All components should be fitted in this panel as specified. Protection Class Certification	Vendor TC	P	R	R	R
1.3	Cables / Wires	Physical Inspection, Data Transfer to SCADA for Communication cables	-	Visual, Wire Gauge, Screw Gauge	100%	Purchase Order on vendor & literature enclosed with PLC & Panel BOM	Products should be as specified in the approved drawing. Product is accepted based on the test certifications of the Vendor	Vendor TC	P	R	R	R

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QUALITY ASSURANCE PROGRAM FOR PLC PANEL

Project Name	PLC BASED CONTROL SYSTEM FOR ETP PLANT	QAP No	16100037-12-SL-014-QAP-01
Client	TELENGANA STATE POWER GENERATION CORPORATION	Revision	R0
EPC Contractor	M/s. BHARAT HEAVY ELECTRICALS LTD	Date	07-03-2017
PT Contractor	M/S SIMA LABS PVT LIMITED	Contract No	-
Vendor	M/s. SUN INDUSTRIAL AUTOMATION & SOLUTIONS		
Item Description	QAP FOR PLC CONTROL PANEL		

P: Performer	R:REVIEW	W:WITNESS	1: SIAS	2: SIMA	3: BHEL	4.TSPGC
SUN Industrial Automation &				M/s. BHARAT HEAVY ELECTRICALS LTD		

Sl.No.	Components/Operation	Characteristics	Remarks	Method of Check	Extent of Check	Reference/ Acceptance Document	Acceptance Norm	Format of Record	1	2	3	4
1.5	Relay Boards MCB's	Physical Damages Dimensions Accessories	Accepted with Product identification No. Tag on the Product /Carton In case of defect the product is sent back to vendor.	Visual	100%	Purchase Order on vendor & literature enclosed with PLC & Panel BOM	Product should be as per approved drawing. No physical damages to the product Dimensions should be as per specification All necessary mounting accessories supplied	Vendor TC	P	R	R	R
1.6	Power Supplies (24 V DC)	Physical Inspection Physical Damages Dimensions Mounting accessories	Accepted with Product identification No. Tag on the Product In case of defect the product is sent back to vendor	Visual	100%	Purchase Order on vendor & literature enclosed with PLC & Panel BOM	No physical damages to the product Dimensions should be as per specification All necessary mounting accessories supplied	Vendor TC	P	R	R	R
1.7	Laptop & Ethernet switch	Physical Inspection Physical Damages Dimensions.	Accepted with Product identification No. tag on the Product In case of defect the product is sent back to vendor	Visual	100%	Purchase Order on vendor& literature enclosed with PLC& Panel BOM Installation Record of Vendor	No physical damages to the product All necessary accessories supplied	Internal IR	P	R	R	R
1.8	Pushbutton/indication lamps,Selector Switch	Physical Inspection Physical Damages Dimensions.	Accepted with Product identification No. tag on the Product In case of defect the product is sent back to vendor	Visual	100%	Purchase Order on vendor& literature enclosed with PLC& Panel BOM	No physical damages to the product All necessary accessories supplied	Vendor TC	P	R	R	R

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TYPICAL QAPs

QUALITY ASSURANCE PROGRAM FOR PLC PANEL

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Sl.No.	Components/Operation	Characteristics	Remarks	Method of Check	Extent of Check	Reference/ Acceptance Document	Acceptance Norm	Format of Record	1	2	3	4
2.0	IN PROCESS											
2.1	PLC Panel	Mechanical Completion mounting of components/Equipments Mounting of terminal blocks Labelling of the equipments Fixing of Cable Troughs Connecting Ethernet Switch for Data Into PLC	Comments & Observations are recorded in the Process / Inspection Tag Deviation in Ferruling are recorded and rectified Deviation in Crimping's are recorded and rectified Deviation in Termination are recorded and rectified	Visual	100%	Approved Wiring Diagrams Termination Schedules Inter-connection Diagrams	Mounting of components as per approved drawings	Vendor TC	P	R	R	R
		Point To Point Wiring Check Checking Of Wire size used Checking of wire Colours Checking of Ferrules Checking of Crimping's Checking of termination Continuity Check Conductance & Insulation	Comments & Observations are recorded in the Process / Inspection Tag Deviation in Ferruling are recorded and rectified Deviation in Crimping's are recorded and rectified Deviation in Termination are recorded and rectified	Visual	100%	Approved Wiring Diagrams Termination Schedules Inter-connection Diagrams	Wire Colouring to be as per requirement All ferruling are as per requirements No Loose Crimps. Correct size lugs used terminations to equipments & TB's are as per requirement	Vendor TC	P	R	R	R
2.2	Pushbuttons Indicating Lights Fuse & fuse Holders Terminal Block Lugs, Wirings	Physical Ventilation	Accepted if as per approved final BOM and drawings Deviations are recorded and modified	Visual	100%	Bill of Materials Test Certificates of Vendors For Wires	All Materials to be as per approved final BOM and drawings	Vendor TC	P	R	R	R

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ROS-6278

QUALITY ASSURANCE PROGRAM FOR PLC PANEL

Project Name	PLC BASED CONTROL SYSTEM FOR ETP PLANT	QAP No	16100037-12-SL-014-QAP-01
Client	TELENGANA STATE POWER GENERATION CORPORATION	Revision	R0
EPC Contractor	M/s. BHARAT HEAVY ELECTRICALS LTD	Date	07-03-2017
PT Contractor	M/S SIMA LABS PVT LIMITED	Contract No	-
Vendor	M/s. SUN INDUSTRIAL AUTOMATION & SOLUTIONS		
Item Description	QAP FOR PLC CONTROL PANEL		

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SUN Industrial Automation &				M/s. BHARAT HEAVY ELECTRICALS LTD		

Sl.No.	Components/Operation	Characteristics	Remarks	Method of Check	Extent of Check	Reference/ Acceptance Document	Acceptance Norm	Format of Record	1	2	3	4
3.0	FACTORY ACCEPTANCE TESTS											
3.1	Assembled System	Mechanical Completion mounting of components/Equipments Mounting of terminal blocks Labelling of the equipments Fixing of Cable Troughs Fixing of bus bars	Comments & Observations are recorded in the Process tag, inspection Report Observations in Layouts are recorded and corresponding drawings revised Overlapping due to use of wrong component equipment entities change of component/ equipment	Visual, Vernier, Measuring tape	100%	Approved G.A Drawings	Mounting of Components as per drawings. Use of Materials as per Bill Of Materials	Internal TR	P	W	W	R
3.2	Checking of hardware used Checking of component used BOM Check	Point To Point Wiring Check Checking of Wire sizes used Checking of Wire colours Checking of ferrules Checking of Crimping Type Checking of Termination Continuity Check Megger Test	Comments and observation are recorded in the process Tag. Inspection Report	Visual, Multimeter	100% Cables (Sample basis for Pre –fabricated Cables)	Approved wiring Diagrams, Interconnection Diagrams.	Wire sizes to be as per requirement Wire colour to be as be as per requirements All Ferruling is as per requirements No loose Crimps. Correct size lugs used. Terminations to equipments & tb's are as per requirements. Continuity between the ends of wires as per requirement Crimping & Termination with Sizing	Internal TR	P	W	W	R

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QUALITY ASSURANCE PROGRAM FOR PLC PANEL

Project Name	PLC BASED CONTROL SYSTEM FOR ETP PLANT	QAP No	16100037-12-SL-014-QAP-01
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Sl.No.	Components/Operation	Characteristics	Remarks	Method of Check	Extent of Check	Reference/ Acceptance Document	Acceptance Norm	Format of Record	1	2	3	4
3.3	Power UP for PLC Panel & Mimic Panel	Power UP Tests & Power Distribution Test.	Materials accepted based on the indications & readings Any deviations are corrected and equipment passed on to next stage Comments and observations are reported in the process Tag Inspection Report	Visual, Multimeter	100%	Schematic Diagrams BOM & Approved Testing Procedure	All equipments should get powered ON as per Specification All indications as per the requirements should get indicated Measurement of corresponding voltages as per the distributor diagram	Internal TR	P	W	W	R

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TYPICAL QAPs

QUALITY ASSURANCE PROGRAM FOR PLC PANEL

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EPC Contractor	M/s. BHARAT HEAVY ELECTRICALS LTD	Date	07-03-2017
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Item Description	QAP FOR PLC CONTROL PANEL		

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Sl.No.	Components/Operation	Characteristics	Remarks	Method of Check	Extent of Check	Reference/ Acceptance Document	Acceptance Norm	Format of Record	1	2	3	4
3.4	Input/Output	Input/Output Tests	Materials are accepted based on the input & output recognition in the software. Any deviations are corrected and materials passed on to next stage of inspection. Observations are reported in the process Tag Inspection Report	Visual indication	100%	Schematic Diagrams Wiring Diagrams, Interconnection Diagrams. Approved Testing Procedure	All Inputs & Outputs Should get energised as per the Simulation	Internal TR	P	W	W	R
3.5	Communication	MMI communication	Subject acceptance based on through communication. Any deviations are corrected Observations are reported in the process Tag Inspection Report	Visual indication	100%	Schematic Diagrams Wiring Diagrams, Interconnection Diagrams. Approved Testing Procedure	All Inputs & Outputs Should get energised as per the Simulation	Internal TR	P	W	W	R
3.6	Redundancy	Redundancy checks	CPU ,Communication redundancy checks	Visual indication	100%	Schematic Diagrams Wiring Diagrams, Interconnection Diagrams. Approved Testing Procedure	Results marked in the FAT procedure document	Internal TR	P	W	W	R

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INDICATIVE MASTER DRAWINGS LIST (ETP PLANT)

PROJECT : YADADRI 5X800MW

PACKAGE : BOP - WATER SYSTEM

CLIENT :

Sr. No.	BHEL_DRG_NO	VENDOR_DRG_NO.	DRAWING TITLE	SCH DATE OF SUB	CAT
1			Process Sizing Calculation for Effluent Treatment Plant		A
2			P & I Diagram of Effluent Treatment Plant		A
3			Layout for Effluent Treatment Plant		A
4			Control Write-up		A
5			Electrical Load List		A
6			GA of Common Collection Pit & Pump House		A
7			GA of STG and GTG area Oily Waste Collection Pit & Pump House		A
8			GA of Lamella Clarifier		A
9			GA of TPI Separator		A
10			GA of Lamella Sludge Collection Pit & Pump House		A
11			GA of NaOH Dosing Tank		A

12			GA of Acid Dosing Tank		A
13			GA of Polymer Dosing Tank		A
14			GA of HRSG Blowdown sump 1 and 2.		A
15			GA of HRSG Floor Wash Collection Pit 1 and 2.		A
16			GA of GUARD POND		A
17			UNDERGROUND PIPE ROUTING FROM VARIOUS SUMPS TO ETP AREA		A
18			G.A, Cross Sectional Drawing, Performance Curve & Technical Data Sheet of HRSG-1 & 2 blow down sump pump & Motor		A
19			G.A, Cross Sectional Drawing, Performance Curve & Technical Data Sheet of Transformer Yard Pit-1 & 2 Dewatering Pump & Motor		A
20			G.A, Cross Sectional Drawing, Performance Curve & Technical Data Sheet of STG & GTG Area Oily Waste Collection Pit-1 & 2 Dewatering Pump & Motor		A
21			G.A, Cross Sectional Drawing, Performance Curve & Technical Data Sheet of HRSG Area Floor Wash Collection Pit-1 & 2 Dewatering Pump& Motor		A
22			G.A, Cross Sectional Drawing, Performance Curve & Technical Data Sheet of Common Collection Pit Dewatering Pump & Motor		A
23			G.A, Cross Sectional Drawing, Performance Curve & Technical Data Sheet of Lamella Sludge Transfer Pump & Motor		A
24			G.A, Cross Sectional Drawing, Performance Curve & Technical Data Sheet of Treated Effluent disposal pump & Motor		A
25			G.A, Cross Sectional Drawing, Performance Curve & Technical Data Sheet of Polymer Dosing pump & Motor		A
26			Technical Datasheet of Non-Return Valve including GA & C/S drg		A

27			Technical Datasheet of Manual Operated Gate Valve including GA & C/S drg.		A
28			Technical Datasheet of Diaphragm Valve(Manual operated) including GA & C/S drg.		A
29			Technical Datasheet of Butterfly Valve(Manual operated) including GA & C/S drg.		A
30			GA of Agitator Assembly (ETP)		A
31			GA of Sluice Gate		A
32			Valve Schedule		I
33			Pipe Schedule		I
34			Painting Schedule		I
35			Operation & Maintenance Manual		I
36			PG Test procedure		I
37			G.A & R.C DETAIL OF HRSG AREA FLOOR WASH COLLECTION PIT 1/2 & PUMPS FOR ETP		A
38			CIVIL DESIGN CALCULATION OF OF HRSG AREA FLOOR WASH COLLECTION PIT 1/2 & PUMPS FOR ETP		A
39			CIVIL G.A & R.CC HRSG BLOW DOWN SUMP PIT 1 / 2 & PUMPS FOR ETP		A
40			DESIGN CALCULATIONS FOR HRSG BLOW DOWN SUMP PIT 1 / 2 & PUMPSFOR ETP		A
41			Civil Design Basis Report		I
42			Civil G.A & RCC Details of Common Collection Pit & Pump House		A
43			Civil Design Calculation of Common Collection Pit & Pump House		I

44			Civil G.A & RCC Details of Lamella Sludge Collection Pit & Pump House		A
45			Civil Design Calculation of Lamella Sludge Collection Pit & Pump House		I
46			CIVIL G.A & R.CC DETAIL STG & CTG AREA OILY WASTE COLLECTION PIT 1 / 2 & PUMPS FOR E T P		A
47			DESIGN CALCULATIONS FOR STG & CTG AREA OILY WASTE COLLECTION PIT 1 / 2 & PUMPS FOR E T P		A
48			CIVIL GA & RCC DRAWING OF GUARD POND (ETP)		A
49			CIVIL DESIGN CALCULATION OF GUARD POND (ETP)		A
50			Cable Tray Layout for Effluent treatment Plant		A
51			Earthing Layout for Effluent treatment Plant		A
52			Control Cable Schedule		A
53			Instrument Cable Schedule & Interconnection Chart		I
54			Instrument Schedule		I
55			Technical Datasheet for Pressure Guage		A
56			Technical Datasheet for Level Switch		A
57			Technical Datasheet for Level Gauge		A
58			Technical Datasheet for Pressure Switch		A
59			Technical Datasheet for Temperature Indicator		A
60			Technical Datasheet for Residual Chlorine Analyser		A

61			Technical Datasheet for pH Analyser		A
62			GA OF LOCAL CONTROL PANEL		A
63			Technical Datasheet for FLOW INDICATOR		A
64			FQP for Civil Works		I
65			FQP for Material Receipt and Storage		I
66			FQP for Erection Works		I
67			MQP for Vertical Centrifugal Pumps		A
68			MQP for TPI		A
69			MQP for Chemical Mixing Agitator		A
70			MQP for Butterfly Valves		A
71			MQP for CI Gate Valves		A
72			MQP for CI/CIRL Diaphragm Valve		A
73			MQP for Field Instruments		A
74			MQP for metering pump		A
75			MQP for MS/MSRL TANK		A
76			MQP of Check valve		A
77			MQP OF SLUICE GATE FOR ETP AREA		A

Performance Guarantee Test Procedure

a. Effluent treatment plant outlet water guarantee shall be as per approved attached Design memorandum document
b. The performance test shall be conducted once in fair season when turbidity is moderate, and once in rainy season, when turbidity is high. In case the turbidity at the time of test during rainy season is found less than the design turbidity, the test shall be conducted with that turbidity only. The duration, type and mode of conducting the above tests shall be mutually decided upon between the Purchaser and the Bidder.
c. The duration of the test shall not be less than 72 hours on continuous basis. These tests will be carried out within a reasonable period from the date of commissioning of the System. Basically the test shall be such as to prove beyond doubt that the guaranteed performance of the System under varying flow conditions (within the specified units) to the satisfaction of the Purchaser. The test procedures shall be as per relevant equivalent standards from recognized origins.
d. The test shall be deemed to be a failure when either of the limits as indicated in Design philosophy is exceeded and retesting will have to be arranged.
e. Each pump shall be guaranteed for capacity, total dynamic head and power consumption
f. Each blower shall be guaranteed for head and power consumption.
g. The System must meet the guarantee with reference to suspended solids / turbidity, chemical consumption & ensure satisfactory performance of the chemical injection and sludge disposal system in each test run.

Water system packages fall under Category - B of this Performance Guarantee document. Bidder to refer below document in specific correlation w.r.t water system package only.

PERFORMANCE GUARANTEES

1.00.00 **PERFORMANCE GUARANTEES, PERFORMANCE/ACCEPTANCE TESTS & LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE**

1.01.00 The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in this specification. The guarantees are categorised as:

a) Those which attract liquidated damages, as listed below (Category-"A"). The Bidder shall furnish signed declarations in the manner prescribed in the bid proposal schedules for these guarantees.

b) Those which do not attract liquidated damages, as listed below (Category-"B"). This guarantee list indicated in this section is not exhaustive and the Owner reserves the right to call upon the Bidder to demonstrate any parameter, operation, etc. of any equipment as specified and as required to meet the duty conditions.

1.02.00 The guaranteed parameters shall be without any tolerance values. The Bidder shall demonstrate all the guarantees covered in various volumes and sections of this specification during Performance/Acceptance test. In case during tests it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modification to make the equipment/system comply with guaranteed requirements. However, if the Contractor is not able to demonstrate the guarantees, even after the modifications within ninety (90) days of notification by the Owner, the Owner will at his discretion :

i. reject the equipment and recover the payment already made or accept the equipment only after levying liquidated damages as identified in this section for those guarantees which are covered under category "A".

OR

ii. reject the equipment and recover the payment already made or accept the equipment only after assessing and deducting from the contract price an amount equivalent to the deficiency of the equipment/system as assessed by the Owner, for those guarantees which are covered under Category-B.

1.03.00 All guaranteed parameters shall necessarily be quoted by the Bidder based on the established proven results obtained from similar units in successful operation. Evidence for this shall necessarily include the test codes used, acceptance test results, accuracies of various instruments used for the performance test, details of tolerances, if allowed, etc. While quoting the guaranteed parameters, the Bidder shall keep in view the requirements

specified in the specification especially regarding the reliability, operability and maintainability of the equipment proposed. The Owner reserves the right to evaluate the parameters quoted by the Bidder based on his experience and published material available.

1.04.00 The liquidated damages shall be calculated prorata for the fractional parts of the unit unless stated otherwise.

1.05.00 The turbine generator, boiler, auxiliaries, and all other plant equipment and system shall perform continuously without the noise level (individual or collectively) exceeding the values specified in respective equipment specification over the entire range of output and operating frequencies.

1.06.00 **Performance/Acceptance Tests**

1.06.01 The performance/acceptance tests for various equipment and systems shall be carried out as specified under the respective equipment specifications and those specified below shall be specifically applicable. All the guarantees shall be tested together as far as practicable.

1.06.02 In case of systems with stand-by equipment the liquidated damages for non-performance will be levied for normal operating number of equipment only. However, for this purpose all the equipment including standby equipment shall be tested and average values arrived at.

1.06.03 For instrument inaccuracies during PG Test, refer subsequent clauses of this section.

1.06.04 For Total Auxiliary Power Consumption, the transformers listed under the respective clauses, shall be taken together for purposes of guarantee and not individually.

2.00.00 **START-UP, INITIAL OPERATION, RELIABILITY RUN AND PERFORMANCE TESTS**

For the purpose of Taking over of the Plant, the following activities shall have to be completed successfully.

i) Mechanical Completion
ii) Preliminary Operation
iii) Initial Operation
iv) Reliability Operation
v) Trial Operation
vi) Performance Guarantee Tests

2.01.00 **Mechanical Completion**

(a) Mechanical completion is defined as the state of readiness of works and completeness of Field Quality checks under the scope of contract to undergo the pre-commissioning checks, followed immediately thereafter by commissioning including preliminary operation, initial operation, reliability operation, performance tests including unit characteristics tests for functional or operational occupation of the

works.

(b) Mechanical completion shall be deemed to occur when the contract erection/installation/construction and Field Quality check works are completed as per specifications for all equipment / systems including standby. It also include but not limited to the following:

(i) all installation/erection and Field Quality checks duly carried out and individual protocol viz. erection, FQA (Field Quality Assurance) and commissioning protocol to be signed.

(ii) all defects/deficiencies notified by the Purchaser during installation/erection rectified to the satisfaction of Purchaser which, in the opinion of the Purchaser, will not affect the safe operability and maintainability of the works, and

(iii) the contract works, in the opinion of Purchaser, subject to sub-clause (ii) above, being fit, sound, safe and operable for undertaking the pre-commissioning checks, preliminary operation, initial operation, reliability operation and performance tests including unit characteristics tests followed by subsequent commercial operation without interruption for reason of defect/deficiency or unfulfilled obligations of the Contractor in the erection/installation work.

2.02.00 **Specific Requirements of Mechanical Completion**

(a) Mechanical completion in different disciplines shall be determined based on the following characteristics, signifying the readiness of the works/plants and systems for undertaking the pre-commissioning checks and subsequent preliminary operation, initial operation, reliability operation and performance tests including unit characteristics tests as applicable to the contract works:

(i) All plant construction/installation in various disciplines, as detailed under (b) below and as applicable to the contract are completed including aesthetic and workmanship and safety aspects, with all installation/construction checks as per specification, relevant codes, standards and practices ensuring conformity to contract and meeting any applicable statutory requirements.

(ii) All contractual obligations up to the stage of completion of construction / installation are fulfilled to the satisfaction of the Purchaser.

(b) All contract works or otherwise ready to be taken into service, or for functional or operational occupation save pre-commissioning/ commissioning checks, preliminary operation, initial operation, reliability operation, performance tests, unit characteristics tests are to be carried out as per approved commissioning procedure submitted by the contractor including but not limited to the following:

(i) Areas inclusive of all roads, accesses, structures, housings, platforms, walkways, stairs, ladders, safe approach to equipments, safety/ protective guards, covers, hand rails and such items of work are constructed as per specification and approved for use.

(ii) Drains, sewers, waste disposal channels, vents, chutes, ducts and such works are constructed and connected to treatment and other disposal systems.

(iii) Equipment and piping in different systems/disciplines with all appurtenances, auxiliaries and accessories along with supporting structures, hangers, mounts, etc., are erected/ installed, supported, anchored, aligned, grouted and adjusted for operating conditions.

(iv) Electrical power supply, control, communication and lighting equipment along with control panels, control desks, switchgear, local starters and such accessories along with protective systems, interlocks and integral and auxiliary systems are permanently installed, aligned and adjusted, with megger, continuity and specified installation checks duly carried out.

(v) Cables are laid, routed, supported, dressed, clamped, tagged, ferruled and terminated with clamp terminals designated and all continuity and megger checks duly carried out.

(vi) Safety/relief valves are calibrated and set to operating conditions and tried out. All safety systems are installed, calibrated, checked and accepted.

(vii) Plant identification numbers, colour codes, tags, nameplates are duly mounted / painted/affixed.

(viii) All painting, lining and insulation works are completed with specified checks to the satisfaction of the Purchaser.

2.03.00 **Other Prerequisites for Mechanical Completion**

The Contractor shall also meet the following prerequisites for mechanical completion:

(a) Submit a compilation of all reports of shop tests, material tests and various stage inspection establishing total compliance to contract specification in manufacturing items of supply of contract.

(b) Submission of a certificate by the Contractor in a format agreed by the Purchaser that the contract works have been designed, selected, manufactured, furnished and installed under the full responsibility of the Contractor.

(c) All erected plants, structures, equipment and systems are maintained and preserved in sound condition and are fit and sound to undertake

pre-commissioning checks and 'tests before commercial operation' for operational and functional occupation immediately thereafter.

(d) All areas and constructed works are cleared daily upto the satisfaction of the Owner of all construction materials, temporary works, debris, rubbish water and all such impediments to render the contract works safe, sound and operable.

(e) All safety features and safety equipment are functional.

(f) Fire prevention and fire extinguishing system in all fire prone areas are to be made functional.

(g) Any specific statutory approvals pre-requisite to commissioning of the plant are duly obtained.

2.04.00 **Preliminary Operation**

Preliminary operation shall mean all activities undertaken as part of commissioning after mechanical completion upto commencement of initial operation and shall include mechanical and electrical checkouts, calibration of instruments and protection devices, commissioning of sub/supporting systems covered under the contract.

2.05.00 **Initial Operation**

Initial operation shall include all operations undertaken as part of commissioning after completion of preliminary operation upto commencement of reliability operation. It shall be the first integral operation of the complete BOP integrated with Boiler, Turbine Generator package covered under the contract and shall include first light up / initial equipment rolling, equipment stretch-out, dry-out no-load / partial load /full loads runs for mechanical / electrical tryout and gathering of operational data, calibration, setting and commissioning of controls systems; and shutdown inspection and adjustment after running trails of the plant under the contract.

During initial operation each and every activity wise commissioning protocols are to be jointly signed by the Purchaser and Contractor commissioning team.

The auto loop control tuning shall continue upto the commencement of 72 hour full load operation of trial run.

The initial operations shall include operation of unit as a whole under normal operating conditions for twenty four (24) consecutive hours at the 100% TGMCR load or twelve (12) consecutive hours for two (2) consecutive days at the 100% TGMCR load unless otherwise agreed to by the Purchaser or restricted by system load conditions. The completion of initial operation will be certified in writing by the Purchaser.

2.06.00 **Reliability Operation**

(a) After the initial operations, the plant shall be on reliability operation. During the reliability operation, the Contractor will be allowed to make

minor adjustments as may be necessary, provided that such adjustments do not interfere with or prevent the commercial use of the plant or result in significant reduction of output. The duration of the reliability operation of plant shall be spread over a period of thirty (30) days. The maximum number of interruption attributable to Contractor shall be of four (4) numbers each not exceeding four (4) hours duration. In case either the number of interruptions, attributable to the Contractor, exceeds four (4) or the duration of any of the four (4) interruptions exceeds four (4) hours the reliability test shall be repeated.

(b) For the period of reliability operation, the time of actual operation shall be counted. In case the duration of actual continuous operation of any of the above modes is discontinued for reasons, which are not due to Contractor's fault or negligence, that particular test would be deemed to have satisfied the reliability operation test. However, should the test be discontinued due to Contractor fault, the test shall be restarted for that particular case.

(c) Should any failure (other than of an entirely minor nature) due to or arising out of faulty design, materials, or workmanship (but not otherwise) occur in any item of the plant, sufficient to prevent commercial use of the plant, the reliability test period of thirty (30) days shall recommence for that item after the defect has been remedied by the manufacturer/Contractor. The onus of proving that any failure is not due to faulty design, materials and workmanship will lie with the Contractor.

(d) A 'reliability operation' report comprising observations and recordings of various parameters measured in respect of the 'reliability operation' shall be prepared and submitted to the Purchaser. This report, besides recording the details of various observations during 'reliability operation' shall also include the dates of start and finish of the reliability operation and shall be signed by the representatives of both the parties. The report shall have recordings of all details of interruptions that occurred, adjustments made and any repairs carried out during the 'reliability operation'.

Also a punch list is to be prepared during the reliability test and the defects are to be rectified by the contractor before commencement of 72 hour operation at full load during trial operation.

(e) Should any failure or interruption occur in any portion of the tests due to or arising from faulty design, materials, workmanship, omissions, incorrect erection, or inadequate instructions by the Contractor's supervisors, sufficient to prevent safe commercial use of the plant, the reliability operation test at the particular load shall be considered void and the reliability test shall recommence after the Contractor has remedied the cause of the defect.

(f) During the reliability operation all the equipments, Raw/ DM water system and sub-systems, control loops, interlocks and protection including switchyard installations will be in service and change over to standby equipments are to be done on running condition of the unit.

(g) The 'reliability operations' shall be considered successful, provided that each item of plant can meet the above requirements.

(h) Upon the completion of 'reliability operations', as soon as practicable, or at such time as may be otherwise agreed to by the parties concerned, the Contractor shall notify in writing to the Purchaser that the Plant is ready for performance tests.

2.07.00 **TRIAL OPERATION:**

1. On completion of erection of any major items along with its auxiliaries, the same shall be thoroughly inspected by the Contractor together with the TSGENCO's Engineers for correctness and completeness and acceptability for pre-commissioning tests. Though the TSGENCO's Engineers associate themselves with such inspection, the responsibility for declaration for correctness, completeness and acceptability shall rest with the Contractor and the pre-commissioning tests and inspections shall be carried out after such declaration. The pre-commissioning tests to be performed at site as well as necessary documentation and formats for the protocols to be signed during and after the tests shall be prepared by the Contractor taking into account relevant Indian/International/ Manufacturers standard as applicable and finalized by the TSGENCO sufficiently in advance through mutual discussions. On conclusion of satisfactory pre-commissioning tests of each individual equipment, the trial operation of the unit shall start consistent with parameters of the technical specifications.

2. The duration of trial operation shall be for 14 days during which period the unit shall be run from half to full load or any other load cycle mutually agreed to during which period the unit shall run at full load for 72 hours continuously. However, if required, the Purchaser and the Contractor may mutually agree for economical load operation for 48 hours continuously. Any interruption caused by the Contractor up to 24 hours will not effect the period of 14 days indicated above. In case of such interruption occurring for more than 24 hours, the above period shall be extended correspondingly. During the above trial operation the standby auxiliary equipment shall also be run for a minimum period of more than 72 hours during which period the equipment shall run at its rated capacity for a minimum period of 24 hours. Further the above trial operation shall be carried out in full fledged manner with the associated instruments and controls. The unit is deemed to be commissioned on successful completion of the above trial operation.

3. A document shall be prepared on the results of trial operation. This document besides recording of the details of the various observations during the trial run will also include the date of start and finish of the trial operation and will be signed by the representative of both the parties. The document of the trial operation shall have log sheets and all adjustments, repairs, interruptions etc., shall be recorded therein. If any major adjustment is carried out which has been changed from the initial operation value, then the reason for it is to be furnished in the

report in detail.

The Purchaser and the Contractor will observe the plant overall reliability and shall test the equipment runback, rundown, auto start of equipments, CMC function and its reliability, complete automation of the plant system etc.

4. The readiness of the unit for the trial operation shall be intimated by written notice to the TSGENCO after mutual discussions. After receipt of such notice if the trial operation could not be performed or could not be completed due to any reasons not attributable to the Contractor and if the situation continues, the Contractor shall be absolved of the responsibility for the delay and the plant shall be deemed to have been taken over by the TSGENCO at the end of 60 days after the Contractor's notifications of readiness of the same.

5. The trial operation shall be carried out in compliance with relevant manufacturer's standards and/or relevant Indian/International standards and manufacturer's operation directions before starting them.

6. Defects which are minor in nature and do not endanger the safe operation of the plant, shall not be considered as reasons for not taking over the plant by the TSGENCO. These defects shall be listed in the above mentioned documents and shall be rectified by the Contractor in accordance with the agreement made in this respect.

2.08.00 **Performance Tests**

(a) PG test notification to be given by the contractor to the purchaser after COD. The performance tests shall be conducted at site on all major systems by the Contractor. The Contractor's commissioning Engineers shall make the entire plant ready for such tests and assist the Purchaser in operation during the tests. The test shall be commenced after the 'Plant/Equipment' has attained stable operation at the end of 'reliability operation'. The date of commencement of the performance tests shall be as soon as practicable on completion of the 'reliability operation' or as may be mutually agreed upon between the Contractor and Purchaser.

Final trail operation shall be carried out for a period of seventy two (72) hours at 100% TGMCR before 'taking over'.

(b) **Independent Inspector**

The Purchaser reserves his right to appoint an independent inspector at his own cost as his representative to discuss the test programme, to approve the instrumentation, to witness the tests and to analyze the test results.

(c) The tests shall be binding on both the parties of the contract to determine compliance of the 'plant'/'equipment' with the performance

guarantees.

(d) The performance tests shall be carried out to prove the guarantees. The purpose of the performance tests is to check whether the plant meets the guaranteed performances.

(e) The performance test procedure, the instrumentation to be installed, the instrument accuracy classes, including the definition of the calculation method to be used, the areas of responsibility and the items which specifically require preparation and agreement shall be submitted by the Contractor for review and approval during detail engineering phase. The schematics identifying the guarantee test instrumentation shall be submitted along with procedure. It shall be ensured that necessary test points and spool pieces are installed during the detail-engineering phase and also identified in process and instrumentation drawings. Code of the PG test is to be fixed up during detail engineering stage. The Contractor shall furnish detail test programme during detail engineering stage.

(f) The performance test instruments shall be of precision type with instrument accuracy limits as required and defined in the applicable performance test codes such that measurement uncertainty does not exceed the values agreed to by the Contractor in the Schedule of Performance Guarantees.

(g) All test instrumentation for the performance tests as required shall be supplied by the Contractor on loan basis. All costs associated with the supply, calibration, installation and return of the test instrumentation are deemed to have been included in the contract price. The test shall be in accordance with those specified or as per agreed performance test codes. Batch calibration shall not be accepted.

(h) Any special equipment, tools and tackle required for successful completion of the performance tests shall be provided by the Contractor.

(i) It is Contractor's responsibility to co-ordinate for carrying out the performance tests. The duration of the test shall be in accordance with the agreed test codes. All other tests to prove the guarantees as indicated in the Contractor's offer shall also be conducted.

(j) The plant parameters during the performance test shall be adjusted as far as practicable to the guaranteed performance test conditions. The tests shall be conducted to provide guaranteed parameters as defined in the contract.

(k) Category-B tests are to be completed before Category-A PG test. Protocols are to be signed jointly by the Purchaser and Contractor for each Category-B test.

(l) **Reporting of Test Results**

(a) Within two weeks after the conclusion of the performance test,

the Contractor shall submit ten (10) copies of test reports to the Purchaser stating whether the plant passed or failed such test(s), accompanied by sufficient test data and calculations to demonstrate the level of performance attained with respect to each of the tested parameters.

(b) The report(s) shall include as a minimum, the following:-

(i) Scope

(ii) Various guaranteed parameters & tests as per the contract.

(iii) Codes/standards used

(iv) . Description of the test procedures

(v) Full schematic diagrams with indication of test instruments locations and identification tags of same.

(vi) Instrumentation details and calibration.

(vii) Duration of test, frequency of readings and number of test runs

(viii) Test logs and summary of test readings used for performance calculations.

(ix) Full set of correction curves.

(x) Computation of test results.

(xi) Sample calculation

(xii) Performance calculation

(xiii) Computations to prove measurement uncertainty is within acceptable limits.

(xiv) Acceptance criteria

(xv) Any other information required for conducting the test

(xvi) Conclusions of performance tests.

(m) Within fifteen (15) days of receipt of such test report(s), the Purchaser shall submit a notice to the Contractor stating either:-

(i) That Purchaser concurs with the information provided in the test report(s), or

(ii) That Purchaser disputes some or all of the information provided

in the Contractor's test report(s), the areas being disputed, and the levels of performance being disputed.

(n) If Purchaser concurs with the information in the Contractor's test report(s), the Purchaser shall, within fifteen (15) days of receipt of the test report, provide a written notice to the Contractor accepting the results of the tests.

(o) If Purchaser disputes any or all of the results contained in the Contractor's test report(s), the Contractor and Purchaser shall meet within fifteen (15) days of the receipt of the Purchaser notice at a mutually acceptable location to review and discuss the dispute.

All the category-B test results are to be computed and to be submitted along with the PG test report for detail study by the Purchaser.

2.08.00 **Notice of Tests**

The Contractor shall issue 21 days notice to the Purchaser of the date after which he will be ready to commence the tests and the Contractor shall commence the tests promptly thereafter.

2.09.00 **Delayed Tests**

(a) If the tests could be carried out but are being unduly delayed by the Contractor, the Purchaser may by notice inform the Contractor to conduct the tests within 14 days after the receipt of such notice. The Contractor shall conduct the tests on such days within that period as the Contractor may fix and of which he shall issue notice to the Purchaser.

(b) If the Contractor fails to conduct the tests within such notice period, the Purchaser may himself proceed with the tests. All tests so conducted by the Purchaser shall be at the risk and cost of the Contractor and the cost thereof shall be deducted from the contract price or charged to the Contractor. The tests shall then be deemed to have been conducted by the Contractor and the test results shall be binding on the Contractor.

(c) **Facilities for Tests on Completion**

Except where otherwise specified, the Contractor shall provide and bear costs for these items, as may be required to carry out the tests on completion.

(d) **Retesting**

If the plant fails to pass the test (which in the case of performance tests means not achieving the acceptable limits), the Purchaser may require such tests to be repeated on the same terms and conditions save that only reasonable notice of the date and time of such tests shall be required to be given by the Contractor to the Purchaser.

(e) **Disagreement as a Result of Tests**

If the Purchaser and the Contractor disagree on the interpretation of the test results, each shall give a statement of his views to other within 14 days after such disagreement arises. The statement shall be accompanied by all relevant evidence.

ANNEXURE -6

DRAWINGS & DOCUMENT'S ATTACHED

The following drawing/document are enclosed as a part of the specification:

1. Design Memorandum: 4-WT-060-01389 Rev: 04
2. Specification for ESP/ APH wash water pumps
3. P& ID for ETP System: 1-WT-060-01597, Rev: 02
4. P& ID for ESP, APH wash water - 3-WT-060-01459
5. Effluent collection pit, pump & piping details
6. Plot plan with location details of ETP and collection pits

ETP design memorandum is given approval
However, BHEL requested to follow the instrument redundancy and control philosophy as per specification

Also the DM shall be updated (control philosophy etc) after finalization of ETP vendor as per vendor approved P&ID and other documents

TATA CONSULTING ENGINEERS LIMITED
VENDOR DOCUMENT REVIEW STATUS
☑A Drawing/Document approved as submitted. Proceed with fabrication/construction.
☐B Drawing/Document approved subjected to comments noted. Proceed with fabrication/ construction considering our commnets.
☐C Our comments are noted on this marked up print.
☐D Our commnets are noted in memo attached to the forwarding transmittal letter No. .....Dated.....
☐E Correct original of this drawing/document to reflect our comments and resubmit for approval.
☐F Correct original of this drawing/document to reflect our comments and resubmit for records.
☐G Drawings/Documents of this category are for information only and not for approval. Information furnished on the drawing/document is noted.
☑H Drawing/Document reviewed against our previous comments and other revisions highlighted and identified by the vendor.
☐ I Drawing/Document returned without review.
☐J Print not enclosed.
Approval conveyed herein neither relieves the Vendor/Contractor of his contractual obligations and his responsibilities for correctness of dimensions, materials of construction, weights, quantities, design details, assembly fits, performance requirements and conformity of the supplies with the Indian Statutory Laws as may be applicable, nor does it limit the purchaser's rights under the contract.
Reviewed by.....MB.....Date.28-07-2021

		ABH Sd/-	SS Sd/-	MSM Sd/-	Based on comnts dt.23.01.21
		ABH Sd/-	SS Sd/-	MSM Sd/-	Based on comnts dt.20.11.20
02	04.11.20	ABH Sd/-	SS Sd/-	MSM Sd/-	Based on comnts dt.27.09.19 & ETP pits updated
01	18.09.19	ABH Sd/-	SS Sd/-	MSM Sd/-	Based on resoln. Dt.23.07.19
00	08.06.19	ABH Sd/-	SS Sd/-	MSM Sd/-	Fresh Issue
Rev.No	Date	Prepared	Checked	Approved	Remarks

TELANGANA STATE POWER GENERATION CORPORATION LTD
TELANGANA STATE, INDIA
5 X 800 MW YADADRI - NALGONDA THERMAL POWER STATION

OWNER's CONSULTANT

TATA CONSULTING ENGINEERS LIMITED
BANGALORE

BHARAT HEAVY ELECTRICALS LTD
BOILER AUXILIARIES PLANT
RANIPET – 632 406.

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DEPT CODE		NAME	SIGN	DATE
9776	PRPD	ABH	Sd/-	08.06.19
	CHD	SS	Sd/-	08.06.19
	APPD	MSM	Sd/-	08.06.19

TITLE	DOCUMENT NO.	REV.NO
DESIGN MEMORANDUM FOR EFFLUENT TREATMENT PLANT	**4-WT-060-01389**	**04**

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2) **Annexure-1 – Pumps & pipe selection criteria 68**

1.0 INTRODUCTION

The scope of this design memorandum covers the basis of design, system philosophy, equipment selection and layout aspects and Control Philosophy of Effluent Treatment Plant for **5x800 MW TSGENCO YADADRI TPS, NALGONDA**

The purpose of the system is to collect the waste from various areas in the Power plant and treat the water, to make it suitable for reuse in Circulating water system within the Power plant.

2.0 SYSTEM DESCRIPTION FOR EFFLUENT TREATMENT PLANT

2.1 Effluent collection & neutralization system

Following effluents will be collected /treated as minimum in the Effluent treatment plant (ETP):

1. Regeneration waste from DM plant.
2. Boiler & TG area wash water
3. Oily Wastes from Fuel oil area.
4. Oily waste from Transformer Yard.
5. Oily waste from Central Lube oil system area (Stage-1 & Stage-2).
6. Oily waste from Switchyard area
7. Oily waste from Auxiliary boiler area
8. Waste from Ammonia Storage area
9. Backwash Waste Water from Side Stream Filtration.
10. Waste from Softening plants of AC systems across Power plant.
11. Condensate Polishing Unit regeneration area regeneration waste.
12. Cooling Tower Blow down (CTBD) – (provision considered)
13. Central Monitoring Basin Waste Treatment & Reuse System.

Brief description is mentioned below:

a) Regeneration waste from DM plant.

DM Plant Regeneration Waste will be generated due to periodic regeneration of resin-beds by acid or alkali. It will contain high amount of dissolved solids and also may be acidic or alkaline based on sequence of the regeneration. The regeneration waste comprising of acid, alkali and backwash water from the DM plant is led to the Neutralization Pit through drain channels. The pH of neutralized waste is maintained in the range of 7.2-8.0 by dosing acid/alkali in Npit in DM plant area.
Once the pH level in the waste is achieved within desirable range the same is pumped to the Central Monitoring Basin by means of Neutralized Waste Disposal Pumps (DM plant scope). As the treatment of regeneration waste of DM Plant is carried out in DM Plant itself, no further treatment scheme for control of pH has been envisaged. All the pumps, Npit, Acid & Alkali dosing system, piping etc. shall be under DM plant scope.

b) Boiler & TG Area Wash Water

Boiler and TG Area Wash Water is generated from floor washings, leakages from bearing cooling systems, leakage from pumps etc. This waste basically contains suspended solids. Underground

Retention Pits shall be provided to collect the waste from Boiler and TG Area. From Retention Pit, the waste shall be transferred by Pumps to Central Monitoring Basin for equalization.

c) Oily Wastes from Fuel oil area/transformer yard area/Central Lube oil system area/switchyard area and Auxiliary boiler area.

The oily waste run off during regular washing/cleaning, leakage and draining from Fuel Oil Unloading Area shall be treated in Oily Waste Treatment System. An underground Retention Pit shall be provided to collect run off water. Oily waste from the all the above Retention Pits shall be directed to Pre-OWS collection pit and transferred to Oil water separator (OWS) (Plate or tube type) for removal of oil and suspended solids. The Pre-OWS collection pit will be located near Oil water separator in ETP area. This system also receives service oily waste effluent from Central Lube Oil system area and oily waste from Transformer Yard area.

Separated oil shall be collected in a Slop Oil Storage Tank. The treated water from OWS may be discharged in another collection pit from where treated water shall be pumped to Central Monitoring Basin.

Sludge produced from CPI will be collected in a pit and then transferred by means of CPI Sludge Transfer Pumps for land filling purpose.

Oily waste from switchyard area shall be collected in local pit and pumped to Pre-OWS collection pit and then to OWS for further treatment.

Oily waste from Auxiliary boiler area will be collected in local pit and pumped to Pre-OWS collection pit.

4 Central Lube Oil system area oily waste is generated from oil leakage from Oil tanks, purification and transfer system or during floor wash. This effluent basically contains suspended solids and some oil and grease. An underground Retention Pit shall be provided to collect oily waste from Central Lube Oil system area. From Retention Pit, the waste shall be transferred by Pumps to Pre-OWS collection pit and then to OWS for further treatment.

The Oily Waste Treatment System viz. Pre-OWS collection pit, Oil Water Separator, Slop Oil Storage Tank etc. shall be located outdoor.

d) Waste from Ammonia storage area

Waste from SCR system is mainly due to possibility of ammonia leakage in Ammonia storage area. Ammonia drains shall be collected in waste ammonia dilution tank, diluted with Service water and collected in waste water retaining basin and pumped to CMB for further treatment. Scope of waste collection and pumping upto CMB is covered in SCR area. Please refer drg. 0-SR-056-00042 for further reference. This waste is generated only in rare cases of leakage of ammonia. 4

e) Cooling tower blowdown waste

Cooling tower blowdown waste is utilized in CHP and Ash water sump. A provision for diverting Cooling tower blowdown waste to CMB is provided. This waste is received at CMB only in rare event of nil consumption in CHP & Ash water sump.

f) Backwash Waste Water from Side Stream Filtration

Backwash waste from Side Stream Filters will be collected in a pit and then transferred to inlet of Central Monitoring Basin by means of Backwash Water Transfer Pumps.
The System viz. Backwash Waste Water Pit, Backwash Waste Water Transfer Pumps etc. shall be located outdoor.

Sizing Calculation of Side Stream Filtration Backwash pit

Velocity criteria of Backwash = 2.5 times of inlet velocity.

Capacity of one AVGF = 200 M^3/Hr.

Backwash cycle happens for 6 mints (typ.) per AVGF.

Accordingly, maximum back wash water generated per AVGF = 200*2.5*6/60 = 50 M3.

Maximum back wash water generated for four AVGF = 50*4 = 200M3.

Capacity of back wash pit selected for Stage-1 = 300 m3 & Stage-2 = 450m3

Total waste expected from SSF in a day = 50*60 working filters = 3000m3; 125m3/hr ⚠4

g) Waste from Softening plants of AC systems across Power plant

Waste from water softening plants for AC system across Power plant are collected in a local pits as identified in the table below and transferred to CMB as part of ETP system. Waste from softening plant from DM plant shall be transferred to N.pit of DM plant..

Following are the details of waste expected from softening plant of AC system.

S.No.	Location of Pit	Capacity of water softening Plant	Water Quantity per day to ETP	Remarks
1.	POWER HOUSE # 1 & 2	10 m3/hr	22 m3	Terminated at nearest TG area wash pit
2.	POWER HOUSE # 3 & 4	10 m3/hr	22 m3	Terminated at nearest TG area wash pit
3.	POWER HOUSE # 5	8 m3/hr	18 m3	Terminated at nearest TG area wash pit
4.	SERVICE BUILDING #1	10 m3/hr	22 m3	Terminated at nearest TG area wash pit
5.	SERVICE BUILDING #2	10 m3/hr	22 m3	Terminated at nearest TG area wash pit
6.	ESP CONTROL BUILDING #1	2 m3/hr	4 m3	Terminated at nearest Boiler wash pit
7.	ESP CONTROL BUILDING #2	2 m3/hr	4 m3	Terminated at nearest TG area wash pit
8.	ESP CONTROL BUILDING #3	2 m3/hr	4 m3	Terminated at nearest TG area wash pit
9.	ESP CONTROL BUILDING #4	2 m3/hr	4 m3	Terminated at nearest TG area wash pit
10.	ESP CONTROL BUILDING #5	2 m3/hr	4 m3	Terminated at nearest TG area wash pit
11.	FGD CONTROL BUILDING #I	2 m3/hr	4 m3	Collection in a Separate pit
12.	FGD CONTROL BUILDING #II	2 m3/hr	4 m3	Collection in a Separate pit
13.	DM PLANT BUILDING	2 m3/hr	4 m3	Terminated at N. Pit
	Total	4	**138 m^3/day (5.75m3/hr)**	TDS: ~20000ppm

h) Condensate Polishing Unit (CPU) regeneration area regeneration waste.

The regeneration waste from Condensate Polishing Plant regeneration area shall be collected in neutralization pit to be constructed under CPU regeneration area. This regeneration waste will contain high amount of dissolved solids and also may be acidic or alkaline based on sequence of the regeneration. The regeneration waste is led to the Neutralization Pit through drain channels. The pH of neutralized waste is maintained in the range of 7.2-8.0 by dosing acid/alkali in N.pit in Condensate Polishing Unit regeneration area.
Once the pH level in the waste is achieved within desirable range the same is pumped to the Central Monitoring Basin by means of Neutralized Waste Disposal Pumps (CPU plant scope). As the treatment of regeneration waste of CPU Plant is carried out in CPU Plant itself, no further treatment scheme for control of pH has been envisaged. All the pumps, N.pit, Acid & Alkali dosing system, piping etc. shall be under CPU plant scope.

i) Central Monitoring Basin (CMB) Waste Treatment & Recycling System

Waste water streams after required treatment as addressed above will be led to a Central Monitoring Basin, which acts as an equalization basin.

From Central Monitoring Basin wastewater will be pumped by means of Two (2) numbers Central Monitoring Basin Effluent Transfer Pump/ clarifier feed pumps to Clarifier – UF – RO system for

Reuse in CW system. RO reject will be terminated in CWBD pipeline of Stage-1 for further usage in AHP/ CHP. 4

A Chemical storage area shall be provided to handling, storage, solution preparation and injection of chemicals for treatment of waste water.

2.2 Effluent treatment for reuse system

The neutralized effluent from CMB is admitted to ETP- Reuse system. The following equipment are envisaged in ETP reuse system

1. High rate solids contact (HRSC) clarifier
2. Ultra filtration systems (submerged)
3. RO system
4. Common Membrane cleaning & protection system
5. Valves & piping
6. Electrical, Controls & Instrumentation

The waste water in the CMB is neutralized and passed through a HRSC Clarifier for settlement of suspended solids. Dosing system is envisaged before Clarifier to ensure proper coagulation followed by flocculation of the raw effluent. Dosing system for removal of hardness and silica if required are also envisaged. The sludge accumulated at the bottom of the Clarifier is led to the sludge sump. Water from sludge is recovered through centrifuge and is sent back to feed of Clarifier/ CMB. Solid waste from centrifuge is collected for further disposal by Customer. Clarified water is then admitted directly to UF feed chamber and to membrane tank.

The clarified water is then drawn through the submerged UF membranes by means of UF permeate pumps. UF system is provided for removal of Fouling elements (Colloids, Organics etc) and Suspended Solids respectively. UF system filtered water is stored in UF permeate cum backwash tank. Backwash pumps are provided for periodic backwash of UF system. The backwash reject UF system is collected in UF backwash waste water pit and pumped to CMB. A Clean in place (CIP) system is envisaged for periodic cleaning of the UF system.

The UF permeate water is pumped to Reverse Osmosis system by RO feed pumps. Cartridge filters in the downstream of the RO feed pumps prevent intrusion of any foreign particles from contacting the RO membranes. Necessary pretreatment dosing system involving HCl (for pH correction), anti-scalant and SBS are envisaged prior to RO system. A CIP system is envisaged for periodic cleaning of the RO membranes. The RO system consists of feed pump, Cartridge Filter, HP pump, RO membrane block.

The RO permeate output is stored in RO permeate storage tank and the RO reject (brine) is connected to CW blowdown (CWBD) pipeline of Stage-1 leading to AHP/ CHP.

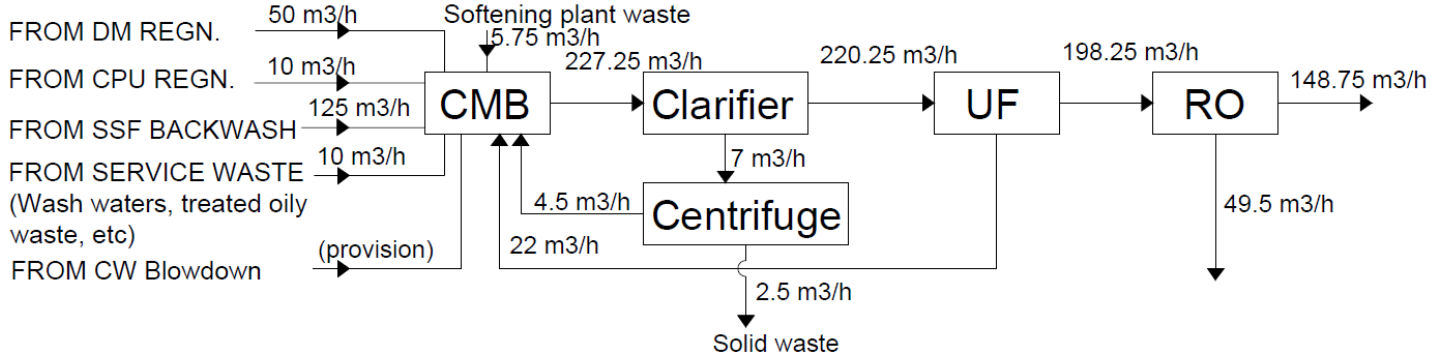
The RO permeate is further pumped to CW fore-bay of Stage-1 for further use. 4

Necessary piping and valves are envisaged for interconnecting / isolating the equipment. Main Control Panel (MCP) along with Instruments & controls are envisaged for safe operation.

Other sub-systems like membrane flushing & cleaning system are also envisaged in the design and their operations are intermittent whenever required. The Proposed ETP is semi-automatic based on reject flow adjustment (Recovery & feed design parameter).

The other drains from the plant equipment etc. are let out in the nearby common trenches leading to UF backwash waste water pit and to CMB for further disposal. A provision to terminate excess water from Clarified water tank to storm water drain is envisaged and will be operated only during monsoon.

2.3 MASS BALANCE FOR EFFLUENT TREATMENT PLANT



Ref. drg: Water balance diagram: PE-DG-417-172-N008 4

2.4 Effluent WATER QUALITY (INPUT WATER TO ETP)

The raw water constituents considered for Design of the plant is as per the latest Water analysis (dt.05.03.19) provided by Customer. The combined effluent water received at Central Monitoring Basin (CMB) of Effluent treatment plant is considered for design of ETP

Table-1

S.No	Parameter	Service water waste (mg/l)	SSF waste (mg/l)	Waste from Softening plant of AC system	N.pit waste (CPU + DM) (mg/l)	Combined water (mg/l)
1)	Flow rate	10 m^3/hr	125 m^3/hr	5.75 m^3/hr	60 m^3/hr	200.75m^3/hr
2)	Calcium as Ca^{2+}	48.82	317.33	48.8	-	201.4
3)	Magnesium as Mg^{2+}	18	117	18	-	74.3
4)	Sodium as Na^{+}	84.7	550.5	7848.4	3000	1468.5
5)	Potassium as K^{+}	0.84	5.5	0.9	-	3.5
6)	Iron as Fe^{2+}	0	0	0	-	0
7)	Manganese as Mn^{2+}	0	0	0	-	0
8)	Strontium as Sr^{2+}	0	0	0	-	0
9)	Barium as Ba^{2+}	0	0	0	-	0
10)	Chloride as Cl^{-}	114	741.3	12086.5	3000	1710.1
11)	Sulphate as SO_4^{2-}	77.6	504.5	77.6	-	320.2
12)	Nitrate as NO_3^{-}	4.3	27.9	4.3	-	17.7

13)	Bicarbonates as HCO^{3-}	164.4	183	164.4	-	126.8
14)	Carbonate as CO_3^{2-}	0	0	0	-	0
15)	Bromide as Br^-	0	0	0	-	0
16)	Fluoride as F^-	0.5	3.25	0.5	-	2.1
17)	Phosphate as PO_4^{3-}	0	0	0	-	0
18)	Silica (as SiO_2)	14	91	14	-	57.8
19)	Total Suspended Solids (TSS)	10	1500	10	-	935
20)	Total dissolved solids (TDS)	527	3427	20264	6000	3983
21)	pH	7 - 8	7 - 8	7 - 8	7 - 8	7 – 8

2.5 FEED FLOW DATA

Feed water flow rate, temperature and quality at the inlet of CMB is as specified below.

Sl. No.	Parameters	Capacities
1	Flow rate at the inlet of CMB	200.75 m^3/hr
2	Total water to be treated after considering UF b/w waste and water recovered in centrifuge	227.25 m^3/hr
3	Temperature (°C)	25 – 30
4	TDS	3983 ppm
5	TSS	935 ppm

2.6 PRODUCT WATER QUALITY

The pre-treatment and various permeate qualities for the above waste water are as specified below.

1. CLARIFIER OUTLET:

Sl. No.	Description	Unit	Value
1	Max. Permeate Flow Rate from Clarifier System(total)	m3/hr	220.25
2	Turbidity	NTU	<10

2. UF PERMEATE:

Sl. No.	Description	Unit	Value

1	Net Permeate Flow Rate from UF System(total)	m3/hr	198.25
2	SDI_{15}		≤3
3	Recovery	%	90%

3. RO PERMEATE:

Sl. No.	Description	Unit	Value
1	Net Permeate Flow Rate from RO System(total)	m3/hr	148.75
2	Total Dissolved Solids	ppm	≤200
3	Recovery	%	75

3.0 PLANT CAPACITY

The capacity of each system of the Water treatment plant is described in this section.

1. Pre-treatment plant
   a. Clarifier: 1x100%
   b. Centrifuge: 1x100%
   Net clarified water Capacity: 220.75 m^3/hr (total)

2. RO plant
   a. UF system (submerged): 3x50%
   b. RO system: 2x50%
   Net Treated water capacity: 148.75 m^3/hr

4.0 CONTROL PHILOSOPHY

The control of the ETP shall be from a hot redundant PLC based control panel.
PLC is a Programmable Automation unit consisting of a Processor. PLC has I/O Modules, redundant Power Supply Modules, redundant communication interface modules, Ethernet networking components etc., One PC with 24" monitor & key board is provided as Operator workstation and One PC is provided for Operator and Engineering workstation. One Large video screen and Mimic back up panel with push buttons, lamps, annunciation windows are also provided. One printer is also provided. RIO panels are provided for remotely located sumps. Please refer Control System for Mechanical Auxiliary Packages (PE-DM-417-145-I900) and ETP PLC configuration 4-WT-060-01143 for details.

Controllers are configured in redundant mode. The automation unit caters to the composite requirements of measurement, signal conditioning, algorithm execution and final element(s) control of each process sub-system.

The UF-RO Plant is designed for remote operation through the PLC system. Taking the equipment into Service and initiation of RO units shall be initiated by the operator from the operator station and balance operation shall be carried out sequentially by the PLC system. Taking the streams out of operation shall be automatic based on throughputs or effluent quality. Detailed programming will be based on UF & RO membrane OEM guidelines.

Effluent treatment plant PLC shall be housed in an AC room.

PLC shall be connected to BOP network for remote operation / maintenance from CCR. BOP network shall be interface with DDCMIS through soft links. There shall be redundant bidirectional OPC interface between the PLC and common DDCMIS network.

2 No: of Remote I/Os considered for remote sumps. Remote I/O Panels shall be provided with push buttons, indicating lamps and annunciation system. RIO panels are provided as follows

1. RIO Panel-1 (Located at ESP Control Room Unit#1) takes signals from the following remote sumps
   a) Transformer Yard Oily Waste collection pit-1 (unit#1)
   b) Transformer Yard Oily Waste collection pit-2 (unit#2)
   c) Transformer Yard Oily Waste collection pit-6 (FGD Transformer)
   d) Switchyard Area OWS collection pit
   e) FGD control room HVAC softener plant pit #1
   f) Central lube oil system pit station #1
   g) Auxiliary boiler area collection pit
   h) Boiler Area wash pit Unit#1
   i) Boiler Area wash pit Unit#2
   j) TG Area wash pit Unit#1
   k) TG Area wash pit Unit#2

2. RIO Panel-2 (Located at ESP Control Room Unit#5) takes signals from the following remote sumps
   a) Transformer Yard Oily Waste collection pit-3 (unit#3)
   b) Transformer Yard Oily Waste collection pit-4 (unit#4)
   c) Transformer Yard Oily Waste collection pit-5 (unit#5)
   d) Fuel oil Area Oily waste retention pit
   e) FGD control room HVAC softener plant pit #2
   f) Central lube oil system pit station #2
   g) Boiler Area wash pit Unit#3
   h) Boiler Area wash pit Unit#4
   i) Boiler Area wash pit Unit#4
   j) TG Area wash pit Unit#3
   k) TG Area wash pit Unit#4
   l) TG Area wash pit Unit#5
   m) SSF backwash pit stage 2

All equipment in ETP area shall be controlled and connected to main PLC located in ETP control room. All sump pumps shall be controlled through PLC only.

One (1) number Local Control Panel (LCP) shall be provided within first floor of Centrifuge Building for control and monitoring of Centrifuge & Accessories:

All the drives control shall be as per approved drive control philosophy (PE-DM-417-145-I002).

Unidirectional LT drives shall be operable from Remote i.e. from ETP Control Room. Drives shall be provided with Local Emergency Stop Push Button (EPB). All dosing tank agitators are operable from PLC. Remote manual operation of all drives shall be done from OWS/OEWS.

Remote control commands i.e. start/stop, shall be generated from PLC and shall be issued to MCC through interposing relays mounted in respective MCC. PLC output command shall be latched in MCC. EPB (stay put type), in MCC supplier's scope, shall be wired directly to MCC to stop the motor irrespective of motor being in remote/local mode. The EPB shall be provided with press to lock and turn to release type, keyless mechanism. Under its locked position, the drive operation shall be inhibited.

Necessary electrical protections for the drives shall be realized at MCC, whereas process interlocks and protections shall be realized in PLC.

Following signal exchange shall take place between MCC & PLC
i. Drive Start & Stop commands.
ii. Drive ON & OFF feedback.
iii. MCC disturbed (Thermal O/L /Control supply fail/ EPB operated/ MCC isolated.

Current transducers, 4-20mA types (in MCC suppliers scope), shall be mounted in the MCC for monitoring the current in PLC for all the drives > 30 KW.

Instrument redundancy shall be. triple redundancy for protection, Dual redundancy for Interlock & permissive and for monitoring single instrument shall be provided.

A collection pit/sump will typically have the following instrumentation
i. 3 Level Transmitters in each sump for trip interlock on 'Level Low Low' of pumps and start permissive on 'Level Not Low'
ii. 1 Level gauge in each sump for local indication.
iii. 1 Pressure gauge at each pump discharge for local indication.
iv. 2 pressure transmitters at common discharge of the sump pumps for monitoring and alarm.
v. 1 Flow transmitter at common discharge of the sump pumps for monitoring

Transformer Yard Oily Waste Collection pit & Pumps

Each pit is provided with two transfer pumps with 1 working 1 standby philosophy for transferring waste from the above sump to Pre OWS collection pit. In auto mode any pump shall be selected in Standby duty, which would start after pre-set running hours of working pump. Each pit is also provided with Level Transmitters. The pumps are interlocked with the level of the pits. On level 'Low

Low' the working pump will trip & on Level 'High' alarm will be generated. The pumps shall also trip on Level 'High High' of Pre OWS collection pit. Pressure transmitters are provided at pump common discharge to monitor and alarm in case of high or low discharge pressure. Standby changeover is also envisaged at Low pressure. Flow transmitter is provided at common discharge to monitor flow.

Switchyard Area Oily Waste Collection pit & Pumps

The pit is provided with two transfer pumps with 1 working 1 standby philosophy for transferring waste from the above sump to Pre OWS collection pit. In auto mode any pump shall be selected in Standby duty, which would start after pre-set running hours of working pump. Each pit is also provided with Level Transmitters. The pumps are interlocked with the level of the pits. On level 'Low Low' the working pump will trip & on Level 'High' alarm will be generated. The pumps shall also trip on Level 'High High' of Pre OWS collection pit. Pressure transmitters are provided at pump common discharge to monitor and alarm in case of high or low discharge pressure. Standby changeover is also envisaged at Low pressure. Flow transmitter is provided at common discharge to monitor flow.

Fuel Oil Area Oily Waste Retention pit & Pumps

Each pit is provided with two transfer pumps with 1 working 1 standby philosophy for transferring waste from the above sump to Pre OWS collection pit. In auto mode any pump shall be selected in Standby duty, which would start after pre-set running hours of working pump. Each pit is also provided with Level Transmitters. The pumps are interlocked with the level of the pits. On level 'Low Low' the working pump will trip & on Level 'High' alarm will be generated. The pumps shall also trip on Level 'High High' of Pre OWS collection pit. Pressure transmitters are provided at pump common discharge to monitor and alarm in case of high or low discharge pressure. Standby changeover is also envisaged at Low pressure. Flow transmitter is provided at common discharge to monitor flow.

Auxillary Boiler Area Oily Waste Retention pit & Pumps

The pit is provided with two transfer pumps with 1 working 1 standby philosophy for transferring waste from the above sump to Pre OWS collection pit. In auto mode any pump shall be selected in Standby duty, which would start after pre-set running hours of working pump. Each pit is also provided with Level Transmitters. The pumps are interlocked with the level of the pits. On level 'Low Low' the working pump will trip & on Level 'High' alarm will be generated. The pumps shall also trip on Level 'High High' of Pre OWS collection pit. Pressure transmitters are provided at pump common discharge to monitor and alarm in case of high or low discharge pressure. Standby changeover is also envisaged at Low pressure. Flow transmitter is provided at common discharge to monitor flow.

Central Lube Oil System Area Oily Waste pit & Pumps

Each pit is provided with two transfer pumps with 1 working 1 standby philosophy for transferring waste from the above sump to Pre OWS collection pit. In auto mode any pump shall be selected in Standby duty, which would start after pre-set running hours of working pump. Each pit is also provided with Level Transmitters. The pumps are interlocked with the level of the pits. On level 'Low Low' the working pump will trip & on Level 'High' alarm will be generated. The pumps shall also trip on Level 'High High' of Pre OWS collection pit. Pressure transmitters are provided at pump common discharge to monitor and alarm in case of high or low discharge pressure. Standby changeover is also envisaged at Low pressure. Flow transmitter is provided at common discharge to monitor flow.

TG Area Wash pit & pumps 4

Each pit is provided with two transfer pumps with 1 working 1 standby philosophy for transferring waste from the above sump to Pre-OWS collection pit. In auto mode any pump shall be selected in Standby duty, which would start after pre-set running hours of working pump. Each pit is also provided with Level Transmitters. The pumps are interlocked with the level of the pits. On level 'Low Low' the working pump will trip & on Level 'High' alarm will be generated. The pumps shall also trip on Level 'High High' of Pre-OWS collection pit. Pressure transmitters are provided at pump common discharge to monitor and alarm in case of high or low discharge pressure. Standby changeover is also envisaged at Low pressure. Flow transmitter is provided at common discharge to monitor flow

Pre OWS Collection pit & Pumps

The pit is provided with two transfer pumps with 1 working 1 standby philosophy for transferring waste from the above sump to OWS. In auto mode any pump shall be selected in Standby duty, which would start after pre-set running hours of working pump. The pit is also provided with two number (2) Level Transmitters. The pumps are interlocked with the level of the pits. On level 'Low Low' the working pump will trip & on Level 'High' alarm will be generated. Pressure transmitters are provided at pump common discharge to monitor and alarm in case of high or low discharge pressure. Standby changeover is also envisaged at Low pressure. Flow transmitter is provided at common discharge to monitor flow.

CPI Sludge Pit & Pumps

The sludge from OWS is collected in the sump. Each pit is provided with two transfer pumps for transferring waste from the above sump to Sludge pit of ETP Clarifier. Level transmitter is provided to trip the pump in case of level 'Low Low'. The pumps shall also trip on Level 'High High' of Sludge pit of ETP Clarifier. Pressure transmitters are provided at pump discharge for standby changeover and monitoring. Flow transmitter is provided for monitoring.

CPI sludge pit blowers are interlocked with level of sludge pit. Blowers trip on level low low of sludge pit. Pressure transmitters are provided for standby changeover and monitoring. Flow transmitter provided for monitoring.

Boiler Area Wash pit & pumps

Each pit is provided with two transfer pumps with 1 working 1 standby philosophy for transferring waste from the above sump to Central Monitoring Basin(CMB). In auto mode any pump shall be selected in Standby duty, which would start after pre-set running hours of working pump. Each pit is also provided with Level Transmitters. The pumps are interlocked with the level of the pits. On level 'Low Low' the working pump will trip & on Level 'High' alarm will be generated. The pumps shall also trip on Level 'High High' of CMB. Pressure transmitters are provided at pump common discharge to monitor and alarm in case of high or low discharge pressure. Standby changeover is also envisaged at Low pressure.Flow transmitter is provided at common discharge to monitor flow.

SSF Backwash pit & pumps

Each pit is provided with two transfer pumps with 1 working 1 standby philosophy for transferring waste from the above sump to Central Monitoring Basin(CMB). In auto mode any pump shall be selected in Standby duty, which would start after pre-set running hours of working pump. Each pit

is also provided with Level Transmitters. The pumps are interlocked with the level of the pits. On level 'Low Low' the working pump will trip & on Level 'High' alarm will be generated. The pumps shall also trip on Level 'High High' of CMB. Pressure transmitters are provided at pump common discharge to monitor and alarm in case of high or low discharge pressure. Standby changeover is also envisaged at Low pressure.Flow transmitter is provided at common discharge to monitor flow.

HVAC softener waste pits & pumps in FGD Control Room area

The pit is provided with two transfer pumps with 1 working 1 standby philosophy for transferring waste from the above sump to Central Monitoring Basin(CMB). In auto mode any pump shall be selected in Standby duty, which would start after pre-set running hours of working pump. Each pit is also provided with Level Transmitters. The pumps are interlocked with the level of the pits. On level 'Low Low' the working pump will trip & on Level 'High' alarm will be generated. The pumps shall also trip on Level 'High High' of CMB. Pressure transmitters are provided at pump common discharge to monitor and alarm in case of high or low discharge pressure. Standby changeover is also envisaged at Low pressure. Flow transmitter is provided at common discharge to monitor flow.

Central Monitoring Basin and Accessories:

The Central Monitoring Basin receives the effluents from different sources as described in above. The overflow from the Central Monitoring Basin is collected in a common collection outlet chamber connected to Central Monitoring Basin Effluent Transfer pumps, to transfer effluent to the Clarifiers for further treatment. These pumps upon selection can be started from PLC and stop automatically through the level transmitter. The pump will trip at preset low low level in Central Monitoring Basin. Flow transmitter is provided to monitor flow.

Clarifier Feed Pumps

Start Permissive
- Level Not Low in CMB
- Discharge Valve open

Standby Changeover
- Pump outlet pressure Low

Trip interlock
- Level Low Low in CMB
- Discharge Valve closed

The pump operation is operator initiated based on CMB level.

Clarifier System

Ferric Chloride dosing system, Lime Dosing System, polyelectrolyte dosing system are provided for effective Clarification.

Water from Stilling Chamber will flow to Parshall Flume for measurement of flow in open Channel. It will flow further to Feed well/ Distribution Chambers. From Distribution Chambers water will be

directed to High Rate Solid Contact Clarifier (HRSCC). Rake Mechanism Drive Motor and Recirculator Drive Motor for the Clarifier will be operated from PLC.

Treated Water from Clarifier HRSCC shall be transferred to Clarified water tank. Clarified water tank is provided with Level Transmitters. In auto mode the Pumps will be started when the sump level reaches high level and trips automatically when the level reaches low low level. UF system will be put in production mode during the pump operation.

The Clarified water tank is provided with three numbers of Transfer Pumps with 2 working 1 standby philosophy for transferring treated water through to UF membrane.

Clarified water transfer pump

Start Permissive
- Level Not Low in Clarified Water Tank
- Discharge Valve open

Standby Changeover
- Pump outlet pressure Low

Auto On
- As per OEM sequence of operation for UF

Auto Off
- As per OEM sequence of operation for UF

Trip interlock
- Level Low Low in Clarified Water Tank
- Discharge Valve closed

Centrifuge Feed pumps

Start Permissive
- Level Not Low in Sludge Collection Pit
- Discharge vale open

Standby Changeover
- Outlet Pressure Low

Auto On and Off
- As per OEM sequence of operation for centrifuge

Trip interlock
- Level Low Low in Sludge Collection Pit
- Discharge vale close

Sludge Pit Blowers

Start Permissive
- Level Not Low in Sludge Collection Pit
- Discharge valve open

Standby Changeover
- Outlet Pressure Low

Auto On and Off
- As per OEM sequence of operation for centrifuge

Trip interlock
- Level Low Low in Sludge Collection Pit
- Discharge vale close

Slaked Lime Transfer Pumps/Lime Dosing Pumps

Start Permissive
- Suction Valve open
- Discharge Valve open

Standby Changeover
- Outlet pressure Low

Auto On and Off
- -NA-

Trip interlock
- Suction Valve closed
- Discharge valve closed

Polyelectrolyte Dosing/Dewatering Polyelectrolyte

Start Permissive
- Level Not Low in Dosing Tank
- Discharge Valve open
- Suction Valve open

Standby Changeover
- Outlet pressure Low

Auto On and Off
- -NA-

Trip interlock
- Level Low Low in Dosing Tank

- Discharge valve closed
- Suction Valve closed

Ferric Chloride Dosing/Acid Dosing (to CMB)/Alkali Dosing(to CMB) Pumps

Start Permissive
- Level Not Low in Dosing Tank
- Discharge Valve open

Standby Changeover
- Outlet pressure Low

Auto On and Off
- -NA-

Trip interlock
- Level Low Low in Dosing Tank
- Discharge valve closed

UF system

Self-cleaning strainer

Auto Cleaning Strainers (2W + 1S) , Strainer with 1 mm mesh size are provided to protect the UF membranes from coarse solids, Trash and non-biodegradable solids. Diff. Pressure transmitter is provided across the strainers to monitor the diff. Pressure across the Strainer. Cleaning of strainer is based on Timer. At high differential pressure (DP) across the strainers, Cleaning Timer Override & Starts Cleaning.

3 streams of (2 Working + 1 Standby) Submerged UF are provided. The service and backwash of each stream will be fully automated. Pressure and level transmitters are provided in each UF tank to monitor TMP (trans-membrane Pressure) of each system. TMP measurement is dependent on membrane OEM.

Membrane Tank Feed Inlet Control Valve

Auto control valves are provided at the inlet of each membrane tank and also level transmitters are provided for the membrane tanks for level control and isolation purpose of membrane tank. Respective control valves are closed during MAINTENANCE CLEAN and RECOVERY CLEAN during all other modes PLC controls the control valve position based on the operator set point in Membrane tank level, at Low level alarm respective membrane tank will go to standby mode and at high level alarm respective membrane tank inlet control valve will close to avoid tank overflow.
Permeate flow transmitters are provided to monitor flow. The system will maintain the production flow rate up to a maximum Trans membrane Pressure (TMP) or a minimum tank level.

Permeate water is stored in UF Product water Tank, Level Transmitters are provided for Level control & monitor purpose. At the high level alarm All Three train will go to standby mode to avoid tank overflow.
The PLC continuously calculates the TMP value based on the pressure transmitter and level transmitter values. The permeate pump speed is regulated such that the TMP never exceeds the set value.
Several triggers may cause a train to go to STANDBY rather than shutting it down. These triggers include a low membrane tank level and low net permeate demand. If a low membrane tank level occurs, the train will immediately proceed to STANDBY. If the STANDBY triggers no longer exist, the train will proceed into PRODUCTION.
UF permeate/backwash pumps are provided with 1 working and 1 standby configuration for each stream. The pumps starting and stopping and opening and closing of associated valves shall be as per operating sequence requirements of UF membranes. The pump operation is always dependent on the membranes' modes of operation as per the OEM sequence charts. Hence separate permissive and interlocks are not applicable.
In the Production Cycle, the trains alternate between PRODUCTION and either BACKPULSE or RELAX. In RELAX mode, the PLC stops permeating and the membranes sit for an operator entered duration before returning to PRODUCTION mode. During this time, solids that have concentrated around the membrane are distributed away from the membrane surface by the aeration. When Backpulse is selected, the membranes are Backpulsed. VFD runs at pre set back pulse rpm. Treated water is periodically reversed back through the membranes to maintain stable Transmembrane pressures. A Pressure transmitter on the Permeate header is used to calculate the BACKPULSE TMP. This provides membrane protection against over-pressurization. In case of TMP alarm VFD speed is regulated to deactivate the TMP trigger.
Backpulse tank is provided to store permeate water for backwash operation. The inlet flow control valve is interlocked with the level transmitter provided in the tank. On Level high the valve closes and level Low the valve opens.

Membrane Aeration

Two membrane aeration blowers (1W + 1S) are provided for Membrane aeration purpose. The blowers supply low-pressure air into a common air header for all of the trains. This common air header then divides into multiple air headers to the membrane tanks.

Start Permissive
- Discharge valve open

Standby Changeover
- Blower outlet pressure Low

Auto On and Off
- As per OEM sequence of operation

Trip interlock
- Discharge valve closed

The turbidity Analyser is provided at membrane common product water line to monitors permeate water quality during production mode.

Clean In Place (CIP) Controls

Clean in Place Tanks and pumps are provided for maintenance and recovery cleaning of the UF tanks. The membranes require cleaning to maintain peak performance.
Sodium hypochlorite is used to remove organic contaminants from the membranes. The PLC will request a sodium hypochlorite pump for MAINTENANCE CLEANS and RECOVERY CLEANS per operator selection, to run in specific steps during the cleaning procedure.

NaOCL Dosing Pump

Start Permissive
- Level Not-Low of dosing tank
- Discharge Valve open

Standby Changeover
- Outlet pressure low

Auto On and Off
- As per OEM sequence of operation

Trip interlock
- Level Low Low of dosing tank
- Discharge Valve close

Citric acid is periodically used to remove inorganic contaminants from the membranes. The PLC will request a citric acid pump for MAINTENANCE CLEANS and RECOVERY CLEANS per operator selection, to run in specific steps during the cleaning procedure.

Citric Dosing Pump

Start Permissive
- Level Not-Low of dosing tank
- Discharge Valve open

Standby Changeover
- Outlet pressure low

Auto On and Off
- As per OEM sequence of operation

Trip interlock
- Level Low Low of dosing tank
- Discharge Valve close

Hydrochloric Acid is periodically used to remove inorganic contaminants from the membranes such as calcium carbonate, manganese and iron compounds. This cleaning is used only for RECOVERY CLEANS as per the cleaning procedure.

HCL Dosing Pump

Start Permissive
- Level Not-Low of dosing tank
- Discharge Valve open

Standby Changeover
- Outlet pressure low

Auto On and Off
- As per OEM sequence of operation

Trip interlock
- Level Low Low of dosing tank
- Discharge Valve close

MAINTENANCE CLEANS can be scheduled through the PLC or as initiated by operator. RECOVERY CLEANS is operator-initiated and should have the operator present during the majority of the clean.

The CIP drain pump delivers the cleaning solution into the membrane tank during MAINTENANCE CLEAN and RECOVERY

CIP/Drain Pump

Start Permissive
- Level Not-Low in CIP tank during CIP operation & Level Not Low Low in corresponding membrane tank during drain operation.
- Discharge Valve open

Standby Changeover
- Outlet pressure Low

Auto On and Off
- As per OEM sequence of operation

Trip interlock
- Level Low Low in CIP tank during CIP operation & Level Low Low in corresponding membrane tank during drain operation.
- Discharge valve closed

Priming System Control

Each train is provided with an ejector, which uses compressed air to operate and primes the membrane permeate pump during the priming step, and at the beginning of BACKPULSE. When the TMP in PRODUCTION exceeds a threshold value, the ejector on the train also operates at the beginning of PRODUCTION.

UF permeate is collected in UF product water tank. Level transmitters are provided to monitor and interlock with RO feed pumps.

UF Backwash Waste Collection Pit

Provide to collect backwash waste from UF skids.

UF backwash waste disposal pumps

Start Permissive
- Level Not-Low in UF backwash waste collection Pit.
- Discharge Valve open

Standby Changeover
- Outlet pressure low

Auto On and Off
- -NA-

Trip interlock
- Level Low Low in UF backwash waste collection Pit.
- Discharge valve closed

RO system

UF product water is treated in RO system. There are two (2) working streams of RO. Each stream consists of two banks.

The RO system Stage-I consists of the following equipment.
- RO feed pumps(2W+1S)
- Cartridge filters(2W)
- Chemical dosing system
- RO High Pressure Pumps
- RO Membrane banks of Stream 1&2
- Chemical cleaning system(CIP)

RO feed pumps are provided with 2 working 1 standby philosophy for transferring water form UF product water tank to cartridge filters. Pressure transmitters are provided at each pump outlet to monitor pressure of the pumps.The pump will trip on level low of UF product water tank.

HCL dosing system is provided to dose HCL at the upstream of Cartridge filter to maintain the pH value of RO feed water. Antiscalant dosing system is provided to avoid membrane scaling. De-chlorination dosing system is provided to dose the SBS (sodium bisulphite) solution at the downstream of CFs to remove the residual chlorine from RO Feed water.

RO feed pump

Start Permissive
- Level in UF product water tank not Low.
- Discharge valve open.

Standby Changeover
- Pump outlet pressure Low

Auto On and Off
- As per OEM sequence of operation for RO skids.

Trip interlock
- Level in UF product water tank Low Low.
- Discharge valve not open.

RO Cartridge Filter

The UF Permeate water is fed to the RO Cartridge filter to make quality water feed RO System.

The Maintenance of the RO Cartridge filter will be initiated by the monitoring differential pressure across the filter through DP transmitter.

Below instruments are required for monitoring Quality of water to RO Unit at CF Outlet Header Line to HP Pump Suction.

1. Temperature Transmitter- The High Temperature alarm triggered if the Temperature value exceeds the set point
2. pH Transmitter- The high pH alarm triggered if the pH value exceeds the set point. The Low pH alarm triggered if the pH value decreases the set point
3. Conductivity Transmitter- The HH conductivity alarm trigger if the conductivity value exceeds the set point
4. ORP Transmitter- The HH ORP alarm trigger and dump valve will open if the ORP value exceeds the set point.
5. Pressure Transmitter is provided to monitor suction pressure of HP pumps

RO High Pressure Pump:

High pressure pumps three numbers are provided to feed water to the RO membranes for Reverse Osmosis to occur. For each RO-1 stream one dedicated high pressure pump and one common standby high pressure pump is provided.

High Pressure Pump Operation is monitored by Suction & Discharge Pressure Transmitters.

If HP pump suction pressure is below low set point the pump stops and if HP pump discharge is above high set point also the pump stops.

VFDs are provided for RO HP pumps. Speed of pumps are increased over years as RO inlet pressure requirement increases.

Start Permissive
- Any RO feed pump ON
- Suction Valve open
- Discharge valve open.
- Dump Valve close
- Suction Pressure Not Low

Standby Changeover
- -NA-

Auto On and Off
- As per OEM sequence of operation for RO skids.

Trip interlock
- All RO feed pump OFF
- Suction Valve closed
- Discharge valve closed.
- Dump Valve open
- Suction Pressure Low Low
- Discharge pressure High High

RO Vessel (RO Bank-1/2):

RO System is provided with 2 W configuration with 2 Stage (Bank-1/2) Vessel.

Below instrument also required monitoring/Flow of water to RO Vessel.

1. Pressure Indicator- At Bank-1/2 RO Concentrate Line
2. Pressure Transmitter- At Bank-1/2 RO Concentrate Line
3. Flow Transmitter -At RO Concentrate Line
4. Pressure Indicator –At RO Permeate Line
5. Flow Transmitter -At RO Permeate Line
6. Conductivity Transmitter-At RO Permeate Line

RO Stage-I Permeate water flow to Inter Permeate Storage Tank. The flow & cumulative flow are indicated in PLC. The Hi Flow alarm trigger if the flow value exceeds the set point.

RO Concentrate water flow to CW blow down. The flow & cumulative flow are indicated in PLC. The Low Flow alarm trigger if the flow value decrease the set point.

Conductivity at the RO Permeate outlet of RO System is measured through Conductivity Transmitter. The conductivity value is indicated in PLC. The HH conductivity alarm trigger if the conductivity value exceeds the set point.

RO permeate is stored in RO permeate water tank. RO permeate transfer pumps are provided with 2 working 1 standby philosophy for transferring water form RO permeate tank to CW forebay of stage-1 & stage-2.

The auto operation of RO streams shall be as per operational requirements of membranes as defined by OEM.

Clean in Place (CIP) System

RO Chemical Cleaning operation (CIP) is done in manual mode only.

CIP system consists of the following equipment.

- Chemical cleaning tank(CIP)
- CIP Pumps (1W+1S)
- CIP cartridge filter

Chemical Cleaning Tank

The RO permeate/Utility water is filled in tank.

Below instruments are required for monitoring/Level/Temperature Control of CIP Solution at CIP Tank

1. Level transmitter
2. Level Indicator (Glass Tube)-
3. Temperature Indicator

CIP Tank water/Solution feed to RO system for cleaning purpose.

CIP Pumps P-A/B is used to feed water/Solution to RO System. Pump is stopped at LL level.

CIP Pump-A/B

Pump Operation monitored by Discharge Pressure Indicator.

Below instruments are required for monitoring/Flow of water/Solution to RO Vessel.

1. Pressure Indicator –At Pump Discharge
2. Flow Transmitter - At Pump Discharge Header Line

Start Permissive

- CIP tank level Not Low

Standby Changeover

- -NA- as RO CIP is done in manual mode.

Auto On and Off

- -NA- as RO CIP is done in manual mode.

Trip interlock

- CIP tank level Low Low

CIP Cartridge Filter

The Maintenance of the CIP Cartridge filter will be initiated by the monitoring inlet outlet pressure across the filter, which is measured by Inlet/Outlet CF Pressure Indicator.

The differential pressure (DP) across the filters measured by DP Indicator transmitter.

RO Dosing System:

This system provides the chemical Dosing to RO System.

Chemical Preparation operation done by operator in manual.

RO Systems have below Chemical Dosing System.

- Antiscalant Dosing System
- SBS Dosing System
- Acid Dosing System

Antiscalant Dosing System

The Utility water is filled in tank.

Below instruments are required for monitoring/Level Control of Antiscalant Solution at Tank

1. Level transmitter
2. Level Indicator (Glass Tube)

Preparation Tank is supplied with Agitator for mixing homogenous Solution.

Tank Chemical Solution feed to RO system for dosing purpose.

Antiscalant Dosing Pumps P-A/B is used to feed Chemical solution to RO System.

Start Permissive

- Dosing tank level Not Low
- Discharge valve open

Standby Changeover
- Outlet pressure low.

Auto On and Off
- As per OEM sequence of operation for RO skids

Trip interlock
- Dosing tank level Low Low
- Discharge valve closed

SBS Dosing System

The Utility water is filled in tank.

Below instruments are required for monitoring/Level Control of SBS Solution at Tank

1. Level transmitter
2. Level Indicator (Glass Tube)-

Preparation tank is supplied with Agitator for mixing homogenous Solution.

Tank Chemical Solution feed to RO system for dosing purpose.

SBS Dosing Pumps P-A/B is used to feed Chemical solution to RO System.

Start Permissive
- Dosing tank level Not Low
- Discharge valve open

Standby Changeover
- Outlet pressure low.

Auto On and Off
- As per OEM sequence of operation for RO skids

Trip interlock
- Dosing tank level Low Low
- Discharge valve closed

Acid Dosing System

The Utility water is filled in tank by any pump.

Below instruments are required for monitoring/Level Control of Acid Solution at Tank

1. Level transmitter
2. Level Indicator (Glass Tube)-

Tank Chemical Solution feed to RO system for dosing purpose.

Acid Dosing Pumps P-A/B is used to feed Chemical solution to RO System.

Start Permissive
- Dosing tank level Not Low
- Discharge valve open

Standby Changeover
- Outlet pressure low.

Auto On and Off
- As per OEM sequence of operation for RO skids

Trip interlock
- Dosing tank level Low Low
- Discharge valve closed

RO PERMEATE TRANSFER PUMP:

RO permeate is transferred to CW forebay Stage-I. Discharge pressure transmitter is provided to monitor and alarm in case of pressure beyond set points.

Start Permissive
- RO permeate tank level Not Low

Standby Changeover
- Outlet pressure Low

Auto On and Off
- -NA-

Trip interlock
- RO permeate tank level Low Low

LAYOUT:

All the sumps along with the pumps, surface settlers, Oil water separator etc. shall be located outdoor. The dosing system of Effluent treatment plant shall also be housed inside UF-RO building.

5.0 MEMBRANE WARRANTIES

UF membranes shall be guaranteed for 5years (2 years' full replacement + 3 years pro-rated replacement) as per the guidelines of membrane manufacturer.
RO membrane shall be guaranteed for 3years pro-rata with replacement. RO membrane replacement shall be prorated as per the guidelines of membrane manufacturer.

6.0 DESIGN STANDARDS

Sl. No.	DESCRIPTION	STANDARD
1	Design, Fabrication Of Cylindrical Storage Tanks	IS:803
2	Design of pressure vessels	IS 2825/ASME SEC VIII DIV I
3	CS Piping Material	IS:1239 / IS:3589
4	FRP tanks	BS 4994
5	PVC Piping & Fittings	IS 4985 or Equivalent IS 7834 or Equivalent
6	HDPE Pipes	IS 4984
7	SS HP Piping (RO) Material	ASTM A312 TP316
8	Code For CS Flanges & Pipe Fittings	ANSI B.16.5, B 16.9
9	Code For SS Flanges & Pipe Fittings	ASTM A403, ASTM A182 F 316L, ANSI B16.5, B16.9
9	Centrifugal pumps	Speed: 1450/3000 rpm Std: IS5120.

7.0 REFERENCES

1. P& ID for ETP plant (1-WT-060-01597)
2. Equipment layout of ETP (1-WT-060-01598)
3. Drive Control Philosophy (PE-DM-417-145-I002)
4. Control System for Mechanical Auxiliary Packages (PE-DM-417-145-I900)
5. **Enclosures:**

   a) Data Sheet-A for Effluent Treatment plant.
   b) ANNEXURE I Pumps and pipe selection criteria.

DATASHEET –A

1.0	**BACKWASH WASTE WATER FROM SIDE STREAM FILTRATION**	
	Suspended solid at inlet waste water	1500 ppm (maximum)
1.1	**SSF BACKWASH WASTE WATER PIT**	**Stage-1 & Stage-2**
(A)	Number	One (1) per stage
(B)	Description (applicable for each sump)	
(i)	Type	Underground, Rectangular with flat bottom.
(ii)	Type of fluid to be handled	Backwash waste from Side stream filtration system
(iii)	Effective capacity, m^3	Suitable to receive the backwash waste from four numbers filters at a time from each stage. However it shall not be less than 300cu.m for Stage-1 & 450cu.m for Stage-2
(iv)	Material of Construction	RCC
1.2	**BACKWASH WASTE WATER TRANSFER PUMP**	**Stage-1 & Stage-2**
(A)	Number	Two (2) [1Working + 1 standby] per Stage
(B)	Description (applicable for each pump)	
(i)	Type	Vertical Centrifugal type
(ii)	Location	Outdoor
(iii)	Fluid to be handled	Backwash waste from Side stream filtration system
(iv)	Duty	Intermittent
(v)	Rated capacity, each m^3/hr.	Not less than 150
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	**Material of Construction**	
	• Casing	2.5 % Ni CI as per IS 210 FG 260
	• Impeller	Stainless Steel – Gr. 316
	• Shaft	Stainless Steel – Gr. 410
2.0	**BOILER / TG AREA WASH WATER**	
2.1	**BOILER AREA WASH WATER PIT**	
(A)	Number	One (1) / Unit
(B)	Description	
(i)	Type	Underground, Rectangular with flat bottom.
(ii)	Type of fluid to be handled	Boiler Area Wash Water
(iii)	Effective capacity, m^3	Not less than 10
(iv)	Material of Construction	RCC
2.2	**BOILER AREA WASH WATER TRANSFER PUMPS**	
(A)	Number	Two (2) [1Working + 1 standby]/ Unit
(B)	Description (applicable for each pump)	
(i)	Type	Vertical Centrifugal type
(ii)	Location	Outdoor
(iii)	Fluid to be handled	Boiler Area Wash Water

(iv)	Duty	Intermittent
(v)	Rated capacity, each m^3/hr ,	Not less than 10
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	Material of Construction	
	• Casing	2.5 % Ni CI to IS 210 FG 260
	• Impeller	Stainless Steel – Gr. 316
	• Shaft	Stainless Steel – Gr. 410
2.3	**TG AREA WASH WATER PIT**	
(A)	Number	One (1) / Unit
(B)	Description	
(i)	Type	Underground, Rectangular with flat bottom.
(ii)	Type of fluid to be handled	TG Area Wash Water
(iii)	Effective capacity, m^3	Not less than 10
(iv)	Material of Construction	RCC
2.4	**TG AREA WASH WATER TRANSFER PUMPS**	
(A)	Number	Two (2) [1Working + 1 standby]/ Unit
(B)	Description (applicable for each pump)	
(i)	Type	Screw type 4
(ii)	Location	Outdoor
(iii)	Fluid to be handled	TG Area Wash Water
(iv)	Duty	Intermittent
(v)	Rated capacity, each m^3/hr ,	Not less than 10
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	**Material of Construction**	
	• Casing	2 % Ni CI to IS 210 FG 260
	• Impeller	SS 316
	• Shaft	Nitrile /EPDM
2.5	**HVAC SOFTENER WASTE PIT(FGD CONTROL BUILDING AREA)**	
(A)	Number	One (1) / stage
(B)	Description	
	Type	Underground, Rectangular with flat bottom.
	Type of fluid to be handled	HVAC Softener waste Water
	Effective capacity, m^3	Not less than 10 4
	Material of Construction	RCC
2.6	**HVAC SOFTENER WASTE WATER TRANSFER PUMPS**	
(A)	Number	Two (2) [1Working + 1 standby]/ stage
(B)	Description (applicable for each pump)	
	Type	Vertical Centrifugal type
	Location	Outdoor
	Fluid to be handled	HVAC Softener waste Water
	Duty	Intermittent
	Rated capacity, each m^3/hr ,	Not less than 10 4

	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
	Pump Speed, RPM	1500 (maximum)
	Material of Construction	
	Casing	Stainless Steel – Gr. 316
	Impeller	Stainless Steel – Gr. 316
	Shaft	Stainless Steel – Gr. 410
3.0	**OIL HANDLING AREA/SERVICE WASTE WATER EFFLUENT**	
	• Range of free oil concentration in retention pit.	0-1000 mg/ l
	• Total suspended solids.	300 mg/ l (max)
	• Sp. gravity of oil	0.9
3.1	**OILY WASTE FROM FUEL OIL STORAGE AREA**	
3.1.1	**RETENTION PIT FOR OILY WASTE FROM FUEL OIL STORAGE AREA** (WATER PIT)	
(A)	Number	One (1)
(B)	Description (applicable for each sump)	
(i)	Type	Please refer to PE-DG-417-166-A001 Rev-01
(ii)	Type of fluid to be handled	Oily waste from Fuel Oil Storage area.
(iii)	Effective capacity,m^3	Existing pit in Fuel Oil area. Please refer to PE-DG-417-166-A001 Rev-01
(iv)	Material of Construction	RCC
3.1.2	**FUEL OIL STORAGE AREA OILY WASTE TRANSFER PUMP**	
(A)	Number	Two (2) [1Working + 1 standby].
(B)	Description (applicable for each pump)	
(i)	Type	Screw type
(ii)	Location	Outdoor
(iii)	Fluid to be handled	Oily Waste form Fuel Oil Storage Area.
(iv)	Duty	Intermittent
(v)	Rated capacity each, m^3/hr,	Not less than 20
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	Material of Construction	
	• Casing	2 % Ni CI to IS 210 FG 260
	• Rotor	SS 316
	• Stator	Nitrile /EPDM
	• Shaft	SS 316
3.2	**OILY WASTE FROM CENTRAL LUBE OIL SYSTEM AREA (Stage-1 & Stage-2)**	
3.2.1	**RETENTION PIT FOR OILY WASTE FROM CENTRAL LUBE OIL SYSTEM AREA**	
(A)	Number	One (1) / Stage
(B)	Description (applicable for each sump)	
(i)	Type	Underground, Rectangular with flat bottom.
(ii)	Type of fluid to be handled	Service waste from Power House area.
(iii)	Effective capacity, m^3	Not less than 10
(iv)	Material of Construction	RCC

3.2.2	**CENTRAL LUBE OIL SYSTEM AREA OILY WASTE TRANSFER PUMP**	
(A)	Number	Two (2) [1Working + 1 standby]/ Stage
(B)	Description (applicable for each pump)	
(i)	Type	Screw type
(ii)	Location	Outdoor
(iii)	Fluid to be handled	Service waste from Power House area.
(iv)	Duty	Intermittent
(v)	Rated capacity each, m^3/hr,	Not less than 10
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	Material of Construction	
	• Casing	2 % Ni CI to IS 210 FG 260
	• Rotor	SS 316
	• Stator	Nitrile /EPDM
	• Shaft	SS 316
3.3	**OILY WASTE FROM TRANSFORMER YARD AREA**	
3.3.1	**RETENTION PIT-1 FOR OILY WASTE FROM TRANSFORMER YARD AREA**	
(A)	Number	One (1)
(B)	Description (applicable for each sump)	
(i)	Type	Underground, Rectangular with flat bottom.
(ii)	Type of fluid to be handled	Service waste from Transformer Yard Area.
(iii)	Effective capacity, m^3	Not less than 151
(iv)	Material of Construction	RCC
3.3.2	**TRANSFORMER YARD AREA OILY WASTE TRANSFER PUMP FOR RETENTION PIT-1**	
(A)	Number	Two (2) [1Working + 1 standby]
(B)	Description (applicable for each pump)	
(i)	Type	Screw type
(ii)	Location	Outdoor
(iii)	Fluid to be handled	Service Waste from Transformer Yard area.
(iv)	Duty	Intermittent
(v)	Rated capacity each, m^3/hr,	Not less than 20
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	Material of Construction	
	• Casing	2 % Ni CI to IS 210 FG 260
	• Rotor	SS 316
	• Stator	Nitrile /EPDM
	• Shaft	SS 316
3.3.3	**RETENTION PIT-2 FOR OILY WASTE FROM TRANSFORMER YARD AREA**	

(A)	Number	One (1)
(B)	Description (applicable for each sump)	
(i)	Type	Underground, Rectangular with flat bottom.
(ii)	Type of fluid to be handled	Service waste from Transformer Yard Area.
(iii)	Effective capacity, m^3	Not less than 154
(iv)	Material of Construction	RCC
3.3.4	**TRANSFORMER YARD AREA OILY WASTE TRANSFER PUMP FOR RETENTION PIT-2**	
(A)	Number	Two (2) [1Working + 1 standby]
(B)	Description (applicable for each pump)	
(i)	Type	Screw type
(ii)	Location	Outdoor
(iii)	Fluid to be handled	Service Waste from Transformer Yard area.
(iv)	Duty	Intermittent
(v)	Rated capacity each, m^3/hr,	Not less than 20
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	Material of Construction	
	• Casing	2 % Ni CI to IS 210 FG 260
	• Rotor	SS 316
	• Stator	Nitrile /EPDM
	• Shaft	SS 316
3.3.5	**RETENTION PIT-3 FOR OILY WASTE FROM TRANSFORMER YARD AREA**	
(A)	Number	One (1)
(B)	Description (applicable for each sump)	
(i)	Type	Underground, Rectangular with flat bottom.
(ii)	Type of fluid to be handled	Service waste from Transformer Yard Area.
(iii)	Effective capacity, m^3	Not less than 152
(iv)	Material of Construction	RCC
3.3.6	**TRANSFORMER YARD AREA OILY WASTE TRANSFER PUMP FOR RETENTION PIT-3**	
(A)	Number	Two (2) [1Working + 1 standby]
(B)	Description (applicable for each pump)	
(i)	Type	Screw type
(ii)	Location	Outdoor
(iii)	Fluid to be handled	Service Waste from Transformer Yard area.
(iv)	Duty	Intermittent
(v)	Rated capacity each, m^3/hr,	Not less than 20
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	Material of Construction	
	• Casing	2 % Ni CI to IS 210 FG 260
	• Rotor	SS 316

	• Stator	Nitrile /EPDM
	• Shaft	SS 316
3.3.7	**RETENTION PIT-4 FOR OILY WASTE FROM TRANSFORMER YARD AREA**	
(A)	Number	One (1)
(B)	Description (applicable for each sump)	
(i)	Type	Underground, Rectangular with flat bottom.
(ii)	Type of fluid to be handled	Service waste from Transformer Yard Area.
(iii)	Effective capacity, m^3	Not less than 154
(iv)	Material of Construction	RCC
3.3.8	**TRANSFORMER YARD AREA OILY WASTE TRANSFER PUMP FOR RETENTION PIT-4**	
(A)	Number	Two (2) [1Working + 1 standby]
(B)	Description (applicable for each pump)	
(i)	Type	Screw type
(ii)	Location	Outdoor
(iii)	Fluid to be handled	Service Waste from Transformer Yard area.
(iv)	Duty	Intermittent
(v)	Rated capacity each, m^3/hr,	Not less than 20
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	Material of Construction	
	• Casing	2 % Ni CI to IS 210 FG 260
	• Rotor	SS 316
	• Stator	Nitrile /EPDM
	• Shaft	SS 316
3.3.9	**RETENTION PIT-5 FOR OILY WASTE FROM TRANSFORMER YARD AREA**	
(A)	Number	One (1)
(B)	Description (applicable for each sump)	
(i)	Type	Underground, Rectangular with flat bottom.
(ii)	Type of fluid to be handled	Service waste from Transformer Yard Area.
(iii)	Effective capacity, m^3	Not less than 169
(iv)	Material of Construction	RCC
3.3.10	**TRANSFORMER YARD AREA OILY WASTE TRANSFER PUMP FOR RETENTION PIT-5**	
(A)	Number	Two (2) [1Working + 1 standby]
(B)	Description (applicable for each pump)	
(i)	Type	Screw type
(ii)	Location	Outdoor
(iii)	Fluid to be handled	Service Waste from Transformer Yard area.
(iv)	Duty	Intermittent
(v)	Rated capacity each, m^3/hr,	Not less than 20
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements

(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	Material of Construction	
	• Casing	2 % Ni CI to IS 210 FG 260
	• Rotor	SS 316
	• Stator	Nitrile /EPDM
	• Shaft	SS 316
3.3.11	**RETENTION PIT-6 FOR OILY WASTE FROM TRANSFORMER YARD AREA**	
(A)	Number	One (1)
(B)	Description (applicable for each sump)	
(i)	Type	Underground, Rectangular with flat bottom.
(ii)	Type of fluid to be handled	Service waste from Transformer Yard Area.
(iii)	Effective capacity, m^3	Not less than 169
(iv)	Material of Construction	RCC
3.3.12	**TRANSFORMER YARD AREA OILY WASTE TRANSFER PUMP FOR RETENTION PIT-6**	
(A)	Number	Two (2) [1Working + 1 standby]
(B)	Description (applicable for each pump)	
(i)	Type	Screw type
(ii)	Location	Outdoor
(iii)	Fluid to be handled	Service Waste from Transformer Yard area.
(iv)	Duty	Intermittent
(v)	Rated capacity each, m^3/hr,	Not less than 20
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	Material of Construction	
	• Casing	2 % Ni CI to IS 210 FG 260
	• Rotor	SS 316
	• Stator	Nitrile /EPDM
	• Shaft	SS 316
3.4	**OILY WASTE FROM SWITCH YARD AREA**	
3.4.1	**RETENTION PIT FOR OILY WASTE FROM SWITCHYARD YARD AREA**	
(A)	Number	One (1)
(B)	Description (applicable for each sump)	
(i)	Type	Underground, Rectangular with flat bottom.
(ii)	Type of fluid to be handled	Service waste from Switchyard Area.
(iii)	Effective capacity, m^3	Not less than 160
(iv)	Material of Construction	RCC
3.4.2	**SWITCHYARD AREA OILY WASTE TRANSFER PUMP**	
(A)	Number	Two (2) [1Working + 1 standby]
(B)	Description (applicable for each pump)	
(i)	Type	Screw type
(ii)	Location	Outdoor

(iii)	Fluid to be handled	Service Waste from Switchyard Area
(iv)	Duty	Intermittent
(v)	Rated capacity each, m^3/hr,	Not less than 20
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	Material of Construction	
	Casing	2 % Ni CI to IS 210 FG 260
	Rotor	SS 316
	Stator	Nitrile /EPDM
	Shaft	SS 316
3.5	**OILY WASTE FROM AUXILIARY BOILER AREA**	
3.5.1	**RETENTION PIT FOR OILY WASTE FROM AUXILIARY BOILER AREA**	
(A)	Number	One (1)
(B)	Description (applicable for each sump)	
(i)	Type	Underground, Rectangular with flat bottom.
(ii)	Type of fluid to be handled	Service waste from Auxiliary Boiler Area.
(iii)	Effective capacity, m^3	Not less than 10
(iv)	Material of Construction	RCC
3.5.2	**AUXILIARY BOILER AREA OILY WASTE TRANSFER PUMP**	
(A)	Number	Two (2) [1Working + 1 standby]
(B)	Description (applicable for each pump)	
(i)	Type	Screw type
(ii)	Location	Outdoor
(iii)	Fluid to be handled	Service waste from Auxiliary Boiler Area.
(iv)	Duty	Intermittent
(v)	Rated capacity each, m^3/hr,	Not less than 10
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	Material of Construction	
	Casing	2 % Ni CI to IS 210 FG 260
	Rotor	SS 316
	Stator	Nitrile /EPDM
	Shaft	SS 316
3.6	**PRE OIL WATER SEPARATOR COLLECTION PIT**	
(A)	Number	One (1)
(B)	Description (applicable for each sump)	
(i)	Type	Underground, Rectangular with flat bottom.
(ii)	Type of fluid to be handled	Oily waste from Fuel Oil Storage Area, Transformer Yard Area, Aux. boiler, Central lube oil systems, switchyard area,
(iii)	Effective capacity, m^3	Not less than 200

(iv)	Material of Construction	RCC
3.7	**PRE OIL WATER SEPARATOR COLLECTION PIT TRANSFER PUMP**	
(A)	Number	Two (2) [1Working + 1 standby]
(B)	Description (applicable for each pump)	
(i)	Type	Screw type
(ii)	Location	Outdoor
(iii)	Fluid to be handled	Oily Waste from Pre Oil Water Separator Collection Pit
(iv)	Duty	Intermittent
(v)	Rated capacity, Cubic Meter per Hour.	Not less than 50
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	**Material of Construction**	
	• Casing	2 % Ni CI to IS 210 FG 260
	• Rotor	SS 316
	• Stator	Nitrile /EPDM
	• Shaft	SS 316
3.8	**OIL WATER SEPARATOR**	
(A)	Number	One (1)
(B)	Type	Plate or Tube with Counter Flow / Cross Flow.
(i)	Duty	Continuous
(ii)	Rated output capacity, Cubic Meter per Hour.	Not less than 50
(iii)	Treated water quality	• Free Oil content not to exceed 10 ppm for free oil concentration 1000 ppm max. in feed waste to the Separator. • Suspended Solids not to exceed 100 ppm for Suspended Solids 300 ppm max. in feed waste to the Separator.
(iv)	Design Criteria	
	• Angle of inclination of Plates or Tubes	60 degree maximum.
	• Rise Rate	Suitable to provide efficient coalescence and removal of oil from wastewater to maintain oil concentration 10 ppm max. in treated effluent.
(v)	Material of Construction	
	• Body	RCC
	• Plates or Tubes	UV inhibited virgin FRP or GRP or PVC.
(vi)	Oil Skimmer System	Shall be provided.
(vii)	Sludge Disposal System	By gravity. All accessories Shall be provided.
(viii)	Oil water separator plate/ tube cleaning pumps	1no. along with 10m hoze & nozzle
3.9	**SLOP OIL STORAGE TANK**	
(i)	Number	Two (2).
(ii)	Type	Vertical Cylindrical.
(iii)	Type of fluid to be handled	Slop Oil.

(iv)	Effective capacity,m^3	Not less than 2
(v)	Material of Construction	Carbon Steel
3.10	**CPI SLUDGE PIT**	
A)	Numbers Shall be provided	One (1)
B)	Description	
(i)	Type	Rectangular with flat bottom.
(ii)	Type of fluid to be handled	Sludge from Oil Water separator
(iii)	Effective capacity of each compartment, m^3,(min.)	Not less than 100 % of sludge generated from Oil Water Separator in 8 hours
(iv)	Material of Construction	RCC.
(v)	Type of protection	
(vi)	Internal	Epoxy painted.
3.11	**CPI SLUDGE PIT BLOWER**	
A)	Number	Two (2) [1Working + 1 standby].
B)	Description for each Blower	
(i)	Location	Outdoor
(ii)	Fluid to be handled	Ambient Air.
(iii)	Service	Sludge mixing
(iv)	Duty	Intermittent
(v)	Type of Blower	Rotary, twin lobe
(vi)	Rated Capacity	Suitable to meet 100% of system requirements
(vii)	Head to be developed at rated capacity	As per system requirements
(viii)	**Material of construction**	
	• Casing	CI to IS 210 FG 260
	• Lobes	CS to BS 970, EN9 Forged
	• Shaft	CS to BS 970, EN9 Forged
(ix)	Accessories Shall be provided	Common base frame, Pulley, V-Belt Guard, Acoustic Hood, Suction Filter, Suction Silencer, Discharge Silencer, Anti Vibration Pad, Safety Relief Valve, Non Return Valve
3.12	**CPI SLUDGE TRANSFER PUMP**	
A)	Number	Two (2) [1Working + 1 standby].
B)	Description (applicable for each pump)	
(i)	Type	Vertical Centrifugal type
(ii)	Location	Outdoor
(iii)	Fluid to be handled	CPI sludge
(iv)	Duty	Intermittent
(v)	Rated capacity, each m^3/hr.	Suitable to transfer 100 % of sludge generated from Oil Water Separator in 8 hours, within 1 hour.
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Pump Speed, RPM	1500 (maximum)
(viii)	**Material of Construction**	
	• Casing	2.5 % Ni CI as per IS 210 FG 260

	• Impeller	Stainless Steel – Gr. 316
	• Shaft	Stainless Steel – Gr. 410
4.0	**CENTRAL MONITORING BASIN**	
(i)	Number	One (1)
(ii)	Number of compartments	Two (2)
(iii)	Type	Underground, Rectangular truncated pyramid type
(iv)	MOC	Earthen
(v)	Minimum Effective capacity (Each Compartment), m3	Not less than 1500
(vi)	Inlet Arrangement	Inlet chamber with gate
(vii)	MOC of Inlet Chamber	Earthen
5.0	**CLARIFIER FEED PUMPS**	
A)	Number	Two (2) [1Working + 1 standby].
B)	Description for each Pump	
(i)	Type of Pump	Vertical Centrifugal type
(ii)	Location	Indoor
(iii)	Fluid to be handled	Water from Central Monitoring Basin
(iv)	Duty	Continuous
(v)	Rated Capacity each, m^3/hr,	Not less than 227.25 + 10% margin
(vi)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vii)	Range of Operation (%)	10 – 100
(viii)	Pump Speed, (RPM)	1500 (maximum)
(ix)	**Material of construction**	
	a) Casing	2.5 % Ni CI as per IS 210 FG 260
	b) Impeller	Stainless Steel – Gr. 316
	c) Shaft	Stainless Steel – Gr. 410
6.0	**ACID DOSING TANK**	
A)	Numbers required	One (1)
B)	Description (applicable for each Tank)	
(i)	Type	Vertical rectangular with flat bottom
(ii)	Location	In the vicinity of Central Monitoring Basin
(iii)	Type of fluid to be handled	Acid Solution
(iv)	Effective capacity, m3	Suitable to meet 100% requirement.
(v)	Material of Construction	FRP
7.0	**ACID DOSING PUMP**	
A)	Number	Two (2) [1Working + 1 standby].
B)	Description for each Pump	
(i)	Type of Pump	Metering pumps, Simplex, mechanically actuated (hydraulically operated)diaphragm type
(ii)	Location	In the vicinity of Central Monitoring Basin Pump House
(iii)	Fluid to be handled	Acid Solution.
(iv)	Rated Capacity each, m3/hr	Suitable to meet 100% requirement.

(v)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vi)	Range of Operation (%)	10 – 100
(vii)	Pump Speed, (RPM)	1500 (maximum)
(viii)	**Material of construction**	
	• All wetted parts	SS-316.
	• Diaphragm	PTFE
8.0	**ALKALI DOSING TANK**	
A)	Numbers required	One (1)
B)	Description (applicable for each Tank)	
(i)	Type	Vertical rectangular with flat bottom
(ii)	Location	In the vicinity of Central Monitoring Basin Pump House
(iii)	Type of fluid to be handled	Alkali Solution
(iv)	Effective capacity, m3	Suitable to meet 100% requiremen
(v)	Material of Construction	FRP
(vi)	Agitator	
	a) Number	One (1)
	b) MOC	SS 316/ CS-FRP lined
9.0	**ALKALI DOSING PUMP**	
A)	Number	Two (2) [1Working + 1 standby].
B)	Description for each Pump	
(i)	Type of Pump	Metering pumps, Simplex , mechanically actuated (hydraulically operated)diaphragm type
(ii)	Location	In the vicinity of Central Monitoring Basin
(iii)	Fluid to be handled	Alkali Solution.
(iv)	Rated Capacity each, m3/hr	Suitable to meet 100% requirement.
(v)	Minimum Head to be developed at rated capacity, MLC	As per System Requirements
(vi)	Range of Operation (%)	10 – 100
(vii)	Pump Speed, (RPM)	1500 (maximum)
(viii)	**Material of construction**	
	• All wetted parts	SS-316.
	• Diaphragm	PTFE
10.0	**SAFETY EQUIPMENT**	Six (6) 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. One (1) numbers safety shower units and adequate nos. of eye fountains to protect against any chemical hazard shall also be provided.

Datasheet for ETP – Reuse RO system		
1.0	**HRSC Clarifier**	
A	Quantity	1 No.

B	Description of each clarifier	
i)	Type	Solids contacts type
ii)	Output capacity at rated condition	220.25 m^3/hr
iii)	Design Criteria	
	• Residence time in Draft Tube	Not less than 15 seconds
	• Residence time in Flocculation zone	15 min minimum
	• Residence time in Clarification zone	100 min minimum
	• Surface flow rate in Clarification zone	Not to exceed 2.5 m^3/hr/m^2 , Side water depth = 4.5 meters (minimum)
iv)	Material of Construction	RCC
	• Recirculation Drive	
	• Number	One (1) for each Clarifier
	• Material of construction	SS 316
v)	Rake mechanism	
	• Number	One (1) for each Clarifier
	• Material of construction	Epoxy painted carbon steel complete rubber squeezers
vi)	Sludge disposal arrangement	
	• Continuous	By gravity through telescopic standpipe
	• Intermittent	Main sludge disposal line shall consist of manual adjustable timer operated blow-off valve with manual over riding facilities
vii)	Accessories	Shall be provided as per system requirements in line with attached P&ID.
viii)	Instruments	Shall be provided as per system requirements in line with attached P&ID.
ix)	Painting	Shall be provided
x)	Walkway	Shall be provided with handrails around launder periphery of each clarifier. Width of the walkway shall not be less than 1200 mm.
2.0	**SLUDGE SUMP**	
A)	Numbers	One (1) number
B)	Description	
i)	Type	Rectangular and Underground, Outdoor Location.
ii)	Type of fluid to be handled	Sludge from Clarifier
iii)	Effective capacity	Not less than 30m^3
iv)	Minimum Free Board, in mm.	500
v)	Material of Construction	RCC.
vi)	Type of protection	
	a) Internal	Epoxy painted
	b) External	Not applicable
3.0	**AIR BLOWERS FOR SLUDGE SUMP**	
A)	Quantity	2 Nos. (1W + 1S)
B)	Description for each Blower	
i)	Location	Outdoor.
ii)	Fluid to be handled	Ambient Air.
iii)	Service	To scour the sludge bed
iv)	Duty	Intermittent.
v)	Type of Blower	Rotary Twin Lobe Oil Free.
vi)	Type of Impeller	Involutes.
vii)	Design standard	As per supplier standard practice
viii)	Service temperature, in0C	60 maximum.
ix)	Rated Capacity, (each) in m^3/hr	100% requirement of each Sludge Sump

x)	Permissible tolerance in rated capacity, in %	As per BS-1571-Part II.
xi)	Head to be developed at rated capacity	To ensure the desired performance.
xii)	Material of construction	
	a. Casing	CI
	b. Lobe	CI
	c. Common Base plate	Fabricated Carbon Steel
	d. Coupling Pulley	C.I./Carbon Steel
	e. Coupling Guard	Carbon Steel.
	f. Safety Relief Valve	SS-316
	g. Nuts and bolts	Carbon Steel
xiii)	Type of drive	Electrical Motor
xiv)	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no be less than the maximum power required by the Blower.
xv)	Rated speed (RPM)	1500 (Sync.) maximum.
xvi)	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 (+5%), HZ
xvii)	Type of coupling between Blower & Motor	V Belt.
xviii)	Noise level (for complete set of Blower & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
xix)	Tests and Inspection	
	a) Material Test required for	Casing and Lobe
	b) Hydro-test	BS-1571-Part II.
	c) Dynamic Balancing Test	Shall be provided
xx)	Performance Test	
	a) Test Code	BS-1571-Part II.
	b) Tests to be done for determination of	Head-Capacity Curve and BHP-Capacity Curve.
	c) Test to be carried out	On prototype model at rated speed.
	d) Test for satisfactory operation of Blower at site	Required.
xxi)	Instruments and alarm	Shall be provided as per P&ID.
xxii)	Trip interlock	Not required.
xxiii)	Accessories	Common base frame, Pulley, V-Belt Guard, Acoustic Hood, Suction Filter, Suction Silencer, Discharge Silencer, Anti Vibration Pad, Safety Relief Valve, Non Return Valve
4.0	**CENTRIFUGE FEED PUMPS**	
A)	Quantity	Two (2) (1Working +1Standby)
B)	Description for each Pump	
i)	Type	Vertical Centrifugal Non Clog type
ii)	Type of Impeller	Open
iii)	Location	Outdoor
iv)	Fluid to be handled	Sludge-water Slurry
v)	Duty	Intermittent
vi)	Design Standard	As per supplier standard practice to meet system requirements
vii)	Design Temperature in degree Celsius	60
viii)	Rated Capacity m^3/hr	Not less than 10 m^3/hr
ix)	Suction Condition	Flooded.
x)	Tentative Head to be developed at rated capacity, MLC	Shall be specified during detailed engineering considering 10% margin to meet the requirements of the system As per supplier standard practice (C should be considered as

		120 to calculate frictional loss in pipe as per Hazen Williams Equation).
xi)	Shut off Head	To be suitable for stable operation at rated duty point.
xii)	Range of operation	20% - 120%
xiii)	Pump speed (RPM)	1500 (maximum)
xiv)	Material of construction	
	• Inner Casing	SS316
	• Shaft	SS410
	• Impeller	SS316
	• Nuts and Bolts	SS-316 (under wetted condition) and MS Cadmium plated (in other places)
xv)	Type of drive	Electrical Motor
xvi)	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
xvii)	Rated speed (RPM)	1500 (Sync.) maximum.
xviii)	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+5%).
xix)	Type of coupling between Pump & Motor	Flexible Spacer.
xx)	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
xxi)	Painting for complete set of Pump & Motor	
	Primer	Shall be provided
	Finish paint	Shall be provided
xxii)	Tests and Inspection	
	Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
	a) Hydro-test	As per Relevant Code
	b) Dynamic Balancing Test	Shall be provided
	c) Performance Test	Shall be provided
xxiii)	Instruments along with alarms, interlocks and accessories	Shall be provided as per system requirements in line with attached P&ID.
xxiv)	Trip interlock	Shall be provided.
5.0	**CENTRIFUGE**	
i)	Capacity	Not less than 10m3/hr
ii)	MOC of Bowl/ Shaft/ Scroll/ Casing	SS316
iii)	Wear lining	Tungsten carbide
6.0	**CLARIFIED WATER TANK**	
	Number	One (1)
	Type	Above ground, rectangular
	MOC	RCC
	Minimum Effective capacity (Each Compartment), m3	Not less than 230 4
7.0	**CLARIFIED WATER TRANSFER PUMPS**	
A	Quantity	3 Nos. (2W+1S)
B	Description of Each pump	
(i)	Location	Indoor.
(ii)	Fluid to be handled	Clarified water
(iii)	Service	To Transfer clarified water to UF system
(iv)	Duty	Continuous and to be suitable for parallel operation.
(v)	Type of Pump	Horizontal Centrifugal Non Clog type
(vi)	Type of Impeller	Closed
(vii)	Design standard	As per IS-5659 & IS-5120.
(viii)	Service temperature, in degree Celsius	60

(ix)	Rated Capacity, in m3/hr	Not less than 111 + 10% margin
(x)	Permissible tolerance in rated capacity, in %	As per IS-5659 & IS-5120.
(xi)	Range of operation	20 % - 120 %.
(xii)	Suction Condition	Flooded.
(xiii)	Head to be developed at rated capacity	To pump water to UF system through basket strainers. (C should be considered as 120 to calculate the frictional loss in pipe as per Hazen Williams Equation).
(xiv)	Shut Off Head	To be suitable for stable operation at rated duty point.
(xv)	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659 & IS-5120.
(xvi)	Material of construction	
	a) Casing	AISI-316.
	b) Impeller	AISI-316.
	c) Shaft	AISI-316.
	d) Mechanical Seal	AISI-316.
	e) Common Base plate	Fabricated Steel as per IS 2062.
	f) Nuts and bolts	AISI-316.
(xvii)	Type of drive	Electrical Motor
(xviii)	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
(xix)	Rated speed (RPM)	1500 (Sync.) maximum.
(xx)	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+5%)
(xxi)	Type of coupling between Pump & Motor	Flexible Spacer.
(xxii)	Noise level (for complete set of Pump	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
(xxiii)	Tests and Inspection	
	a) Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
	b) Hydro-test	As per IS-5120.
	c) Dynamic Balancing Test	Shall be provided
(xxiv)	Performance Test	
	a) Test Code	Hydraulic Institute Standard.
	b) Tests to be done for determination of	Head-Capacity Curve, BHP-Capacity Curve and Efficiency- Capacity Curve and NPSH-Capacity Curve.
	c) Test to be carried out	On prototype model at rated speed.
	d) Test for satisfactory operation of pump at site	Required.
(xxv)	Instruments, alarm and Interlock	Shall be provided as per system requirements in line with attached P&ID.
(xxvi)	Suction Strainer along with flushing connection	Required. Material of construction of each strainer shall be SS316.
(xxvii)	Operation	Start/Stop from remote. Local emergency stop provided
(xxviii)	Trip interlock	Shall be provided.
8.0	**BASKET STRAINER**	
i)	Quantity	3 Nos. (2W+1S)
ii)	Capacity	Min. 111m3/hr each
iii)	MOC	SS316
9.0	**UF system**	
i)	Streams	3 Nos.
ii)	Capacity	198.25m3/hr total, 99.5m^3/hr/ stream

iii)	UF recovery	90% min.
iv)	Design flux	50 lmh (max.)
v)	UF modules MOC	PVDF (Hollow fiber, submerged)
vi)	UF cassette/ membrane housing/ skid frame	FRP/ suitable material
vii)	Guarantee life of membrane	2 years cliff + 3 years prorated
viii)	Membrane flow mode/ configuration	Outside to inside
ix)	Chlorine resistance	2,00,000 ppm hours
10.0	**UF membrane holding tank**	
i)	Tank size	To suit membrane installation as per Membrane manufacturer's recommendation.
ii)	MOC	RCC with suitable internal painting/ protection
11.0	**MEMBRANE AERATION BLOWERS WITH MOTOR**	
i)	No. of blowers	2Nos. (1W+1S)
ii)	Operation	Intermittent
iii)	Type of blower	Positive displacement – rotary twin lobe
iv)	Capacity	As per membrane manufacturer's recommendation
v)	Head	As per membrane manufacturer's recommendation
vi)	MOC	
vii)	Casing & Impeller (lobe)	Cast iron
viii)	Shaft	Carbon steel
12.0	**UF PERMEATE CUM BACKWASH PUMPS WITH MOTOR & ACC.**	
i)	No. of pumps	1W+1S/ train
ii)	Operation	Continuous with VFD
iii)	Type	Vertical/ Horizontal centrifugal
iv)	MOC	
v)	Impeller & Casing	SS316
vi)	Shaft	SS410
vii)	Speed of the pump	Not to exceed 2900rpm
viii)	Design flow	As per membrane manufacturer's recommendation
ix)	Head	As per membrane manufacturer's recommendation
x)	Impeller type	Closed
xi)	Seal	Mechanical seal
13.0	**UF BACKWASH TANK**	
i)	Quantity	1 Nos.
ii)	Type	Vertical Cylindrical with top cover hinged & dished bottom. The tank shall be fitted with vent, drain, overflow, etc.
iii)	Location	Outdoor
iv)	Useful capacity (for each tank)	Backwash requirement of 1 UF system stream plus 20% margin
v)	Pressure Rating	Atmospheric
vi)	Material of construction	FRP with suitable internal protection
vii)	Free board	300mm
viii)	Agitator with motor & reduction gears	As per chemical preparation requirement
ix)	Accessories for each tank	Manhole, handhold, approach ladder & charging platform etc
14.0	**UF CIP TANK**	
i)	Quantity	1 No.

ii)	Type	Vertical Cylindrical with top cover hinged & dished bottom. The tank shall be fitted with vent, drain, overflow, etc.
iii)	Location	Outdoor
iv)	Useful capacity (for each tank)	Cleaning requirement of 1 UF system stream plus 20% margin
v)	Pressure Rating	Atmospheric
vi)	Material of construction	FRP with suitable internal protection
vii)	Free board	300mm
viii)	Agitator with motor & reduction gears	As per chemical preparation requirement
ix)	Accessories for each tank	Manhole, handhold, approach ladder & charging platform etc
15.0	**UF CLEANING PUMPS**	
A)	Quantity	2 Nos. (1W+1S)
B)	Description for each Pump	
(i)	Location	Indoor.
(ii)	Fluid to be handled	UF permeate water
(iii)	Service	Chemical cleaning of UF system
(iv)	Duty	Continuous and to be suitable for parallel operation.
(v)	Type of Pump	Horizontal Centrifugal Non Clog type
(vi)	Type of Impeller	Closed
(vii)	Design standard	As per IS-5659 & IS-5120.
(viii)	Service temperature, in degree Celsius	60
(ix)	Rated Capacity, in m3/hr	As per UF system requirement
(x)	Permissible tolerance in rated capacity, in %	As per IS-5659 & IS-5120.
(xi)	Range of operation	20 % - 120 %.
(xii)	Suction Condition	Flooded.
(xiii)	Head to be developed at rated capacity	To pump meet UF system backwash requirement (C should be considered as 120 to calculate the frictional loss in pipe as per Hazen Williams Equation).
(xiv)	Shut Off Head	To be suitable for stable operation at rated duty point.
(xv)	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659 & IS-5120.
(xvi)	Material of construction	
	a) Casing	AISI-316.
	b) Impeller	AISI-316.
	c) Shaft	AISI-316.
	d) Mechanical Seal	AISI-316.
	e) Common Base plate	Fabricated Steel as per IS 2062.
	f) Nuts and bolts	AISI-316.
(xvii)	Type of drive	Electrical Motor
(xviii)	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
(xix)	Rated speed (RPM)	1500 (Sync.) maximum.
(xx)	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+5%)
(xxi)	Type of coupling between Pump & Motor	Flexible Spacer.
(xxii)	Noise level (for complete set of Pump	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
(xxiii)	Tests and Inspection	

	a) Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
	b) Hydro-test	As per IS-5120.
	c) Dynamic Balancing Test	Shall be provided
(xxiv)	Performance Test	
	a) Test Code	Hydraulic Institute Standard.
	b) Tests to be done for determination of	Head-Capacity Curve, BHP-Capacity Curve and Efficiency- Capacity Curve and NPSH-Capacity Curve.
	c) Test to be carried out	On prototype model at rated speed.
	d) Test for satisfactory operation of pump at site	Required.
(xxv)	Instruments, alarm and Interlock	Shall be provided as per system requirements in line with attached P&ID.
(xxvi)	Suction Strainer along with flushing connection	Required. Material of construction of each strainer shall be SS316.
(xxvii)	Operation	Start/Stop from remote. Local emergency stop provided
(xxviii)	Trip interlock	Shall be provided.
16.0	**UF Dosing systems**	
	Chemical cleaning system description	No. of Dosing systems shall be decided based on UF membrane manufacturer's recommendation. Each dosing system shall consists of the following.
16.1	**DOSING TANK**	
i)	Quantity	1 per dosing system
ii)	Type	Vertical Cylindrical with top cover hinged & dished bottom. The tank shall be fitted with vent, drain, fume absorber, overflow seal pots etc.
iii)	Location	Indoor
iv)	Useful capacity (for each tank)	Cleaning requirement of 1 UF system stream plus 25% margin
v)	Pressure Rating	Atmospheric
vi)	Material of construction	FRP with suitable internal protection
vii)	Free board	300mm
viii)	Dissolving basket	As per chemical preparation requirement
ix)	Agitator with motor & reduction gears	As per chemical preparation requirement
x)	Accessories for each tank	Handhole, approach ladder & charging platform etc
16.2	**DOSING PUMPS**	
i)	Quantity	2 (1W+1S) per dosing system
ii)	Type	Simplex positive displacement hydraulically operated diaphragm type
iii)	Suction strainers	Required
iv)	Pressure dampener	Required
v)	External safety relief valve (in addition to inbuilt safety valve)	PVC
vi)	Maximum pump stroke per minute	100 - 200
vii)	Motor rating	Minimum 15 % margin over BKW at rated duty point
viii)	Material of construction	
ix)	Liquid end (pump, head, valves, valve housing, valve spring, etc)	PP, for all wetted parts
x)	Diaphragm	PTFE
xi)	Packing	PTFE
xii)	Frame	MS fabricated, epoxy painted
17.0	**UF PRODUCT WATER TANK**	

i)	Number	One (1)
ii)	Type	Above ground, rectangular
iii)	MOC	RCC
iv)	Minimum Effective capacity (Each Compartment), m3	Not less than 200
18.0	**RO feed pumps**	
A)	Quantity	3 Nos. (2W+1S)
B)	Description for each Pump	
(i)	Location	Indoor.
(ii)	Fluid to be handled	UF filtered water
(iii)	Service	To transfer UF filtered water to RO system
(iv)	Duty	Continuous and to be suitable for parallel operation.
(v)	Type of Pump	Horizontal Centrifugal Non Clog type
(vi)	Type of Impeller	Closed
(vii)	Design standard	As per IS-5659 & IS-5120.
(viii)	Service temperature, in degree Celsius	60
(ix)	Rated Capacity, in m3/hr	Not less than 99.5m3/hr with 10% margin
(x)	Permissible tolerance in rated capacity, in %	As per IS-5659 & IS-5120.
(xi)	Range of operation	20 % - 120 %.
(xii)	Suction Condition	Flooded.
(xiii)	Head to be developed at rated capacity	3kg/cm2 min.
(xiv)	Shut Off Head	To be suitable for stable operation at rated duty point.
(xv)	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659 & IS-5120.
(xvi)	Material of construction	
	a) Casing	AISI-316.
	b) Impeller	AISI-316.
	c) Shaft	AISI-316.
	d) Mechanical Seal	AISI-316.
	e) Common Base plate	Fabricated Steel as per IS 2062.
	f) Nuts and bolts	AISI-316.
(xvii)	Type of drive	Electrical Motor
(xviii)	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
(xix)	Rated speed (RPM)	1500 (Sync.) maximum.
(xx)	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+5%)
(xxi)	Type of coupling between Pump & Motor	Flexible Spacer.
(xxii)	Noise level (for complete set of Pump	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
(xxiii)	Tests and Inspection	
	a) Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
	b) Hydro-test	As per IS-5120.
	c) Dynamic Balancing Test	Shall be provided
(xxiv)	Performance Test	
	a) Test Code	Hydraulic Institute Standard.
	b) Tests to be done for determination of	Head-Capacity Curve, BHP-Capacity Curve and Efficiency- Capacity Curve and NPSH-Capacity Curve.
	c) Test to be carried out	On prototype model at rated speed.
	d) Test for satisfactory operation of pump at site	Required.

(xxv)	Instruments, alarm and Interlock	Shall be provided as per system requirements in line with attached P&ID.
(xxvi)	Suction Strainer along with flushing connection	Required. Material of construction of each strainer shall be SS316.
(xxvii)	Operation	Start/Stop from remote. Local emergency stop provided
(xxviii)	Trip interlock	Shall be provided.
19.0	**Cartridge filters**	
i)	Quantity	2 Nos. (2W)
ii)	Capacity	99.5m3/hr each
iii)	MOC housing	SS316/ FRP
iv)	MOC elements	PP, 5 micron nominal (efficiency around 70%)
20.0	**RO HP pumps**	
A)	Quantity	3 Nos. (2W+1S)
B)	Description for each Pump	
(i)	Location	Indoor.
(ii)	Fluid to be handled	UF filtered water
(iii)	Service	To transfer UF filtered water to RO membrane
(iv)	Duty	Continuous and to be suitable for parallel operation.
(v)	Type of Pump	Horizontal/ vertical Centrifugal
(vi)	Type of Impeller	Closed
(vii)	Design standard	As per IS-5659 & IS-5120.
(viii)	Service temperature, in degree Celsius	60
(ix)	Rated Capacity, in m3/hr	Not less than 99.5m3/hr + 10% margin
(x)	Permissible tolerance in rated capacity, in %	As per IS-5659 & IS-5120.
(xi)	Range of operation	20 % - 120 %.
(xii)	Suction Condition	Flooded.
(xiii)	Head to be developed at rated capacity	15kg/cm2 min.
(xiv)	Shut Off Head	To be suitable for stable operation at rated duty point.
(xv)	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659 & IS-5120.
(xvi)	Material of construction	
	a) Casing	AISI-316.
	b) Impeller	AISI-316.
	c) Shaft	AISI-316.
	d) Mechanical Seal	AISI-316.
	e) Common Base plate	Fabricated Steel as per IS 2062.
	f) Nuts and bolts	AISI-316.
(xvii)	Type of drive	Electrical Motor
(xviii)	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
(xix)	Rated speed (RPM)	2900 (Sync.) maximum.
(xx)	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+5%)
(xxi)	Type of coupling between Pump & Motor	Flexible Spacer.
(xxii)	Noise level (for complete set of Pump	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
(xxiii)	Tests and Inspection	
	a) Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
	b) Hydro-test	As per IS-5120.
	c) Dynamic Balancing Test	Shall be provided

(xxiv)	Performance Test	
	a) Test Code	Hydraulic Institute Standard.
	b) Tests to be done for determination of	Head-Capacity Curve, BHP-Capacity Curve and Efficiency- Capacity Curve and NPSH-Capacity Curve.
	c) Test to be carried out	On prototype model at rated speed.
	d) Test for satisfactory operation of pump at site	Required.
(xxv)	Instruments, alarm and Interlock	Shall be provided as per system requirements in line with attached P&ID.
(xxvi)	Suction Strainer along with flushing connection	Required. Material of construction of each strainer shall be SS316.
(xxvii)	Operation	Start/Stop from remote. Local emergency stop provided
(xxviii)	Trip interlock	Shall be provided.
(xxix)	Vibration limits	As per ISO10816-7 2009 (E) standard
21.0	**RO system**	
i)	No. of skids required	2 Nos. (2W)
ii)	Qty. of permeate output/ stream	74.5m3/hr
iii)	Skid frame	CS-epoxy painted
iv)	RO membrane elements	
v)	Size of element	8”dia.x 40”length
vi)	Area per element	400 sq.ft max.
vii)	Membrane type	Thin film composite polyamide
viii)	Preferred make	Hydranautics/ Toray/ Suez/ Dow/ equivalent
ix)	Recovery	75%
x)	Quality of permeate	≤200 ppm at end of 3rd year at 35 Deg.C
xi)	Permeate flux (max.)	≤20 lmh
xii)	Feed water temperature range	25 to 35 Deg. C.
xiii)	Flux Decline Coefficient / Year	5%
xiv)	Salt passage increase factor (SPIF)	10% per Year
xv)	Life of RO membranes	3 years (with prorate replacement warranty)
xvi)	RO pressure vessels	
xvii)	MOC	FRP
xviii)	Elements per pressure vessel	6
xix)	Pressure rating	300 psi
xx)	Test pressure	As per design code (ASME Sec-X)
xxi)	Feed and Brine port MOC	SS316L
22.0	**RO PERMEATE TANK**	
i)	Number	One (1)
ii)	Type	Above ground, rectangular
iii)	MOC	RCC
iv)	Minimum Effective capacity (Each Compartment), m3	Not less than 150 4
23.0	**RO PERMEATE PUMPS**	
A)	Quantity	2 Nos. (1W+1S)
B)	Description for each Pump	
(i)	Location	Indoor.
(ii)	Fluid to be handled	RO permeate water
(iii)	Service	To transfer RO permeate water to CW forebays of each Stage
(iv)	Duty	Continuous and to be suitable for parallel operation.
(v)	Type of Pump	Horizontal Centrifugal Non Clog type
(vi)	Type of Impeller	Closed
(vii)	Design standard	As per IS-5659 & IS-5120.
(viii)	Service temperature, in degree Celsius	60

(ix)	Rated Capacity, in m3/hr	Not less than 149m3/hr with 10% margin
(x)	Permissible tolerance in rated capacity, in %	As per IS-5659 & IS-5120.
(xi)	Range of operation	20 % - 120 %.
(xii)	Suction Condition	Flooded.
(xiii)	Head to be developed at rated capacity	4kg/cm2 min.
(xiv)	Shut Off Head	To be suitable for stable operation at rated duty point.
(xv)	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659 & IS-5120.
(xvi)	Material of construction	
	a) Casing	AISI-316.
	b) Impeller	AISI-316.
	c) Shaft	AISI-316.
	d) Mechanical Seal	AISI-316.
	e) Common Base plate	Fabricated Steel as per IS 2062.
	f) Nuts and bolts	AISI-316.
(xvii)	Type of drive	Electrical Motor
(xviii)	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
(xix)	Rated speed (RPM)	1500 (Sync.) maximum.
(xx)	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+5%)
(xxi)	Type of coupling between Pump & Motor	Flexible Spacer.
(xxii)	Noise level (for complete set of Pump	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
(xxiii)	Tests and Inspection	
	a) Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
	b) Hydro-test	As per IS-5120.
	c) Dynamic Balancing Test	Shall be provided
(xxiv)	Performance Test	
	a) Test Code	Hydraulic Institute Standard.
	b) Tests to be done for determination of	Head-Capacity Curve, BHP-Capacity Curve and Efficiency- Capacity Curve and NPSH-Capacity Curve.
	c) Test to be carried out	On prototype model at rated speed.
	d) Test for satisfactory operation of pump at site	Required.
(xxv)	Instruments, alarm and Interlock	Shall be provided as per system requirements in line with attached P&ID.
(xxvi)	Suction Strainer along with flushing connection	Required. Material of construction of each strainer shall be SS316.
(xxvii)	Operation	Start/Stop from remote. Local emergency stop provided
(xxviii)	Trip interlock	Shall be provided.
24.0	**RO CIP TANK**	
i)	Quantity	1 Nos.
ii)	Type	Vertical Cylindrical with top cover hinged & dished bottom. The tank shall be fitted with vent, drain, overflow, etc.
iii)	Location	Outdoor
iv)	Useful capacity (for each tank)	10m3
v)	Pressure Rating	Atmospheric
vi)	Material of construction	FRP with suitable internal protection
vii)	Free board	300mm

viii)	Agitator with motor & reduction gears	As per chemical preparation requirement
ix)	Accessories for each tank	Manhole, handhold, approach ladder & charging platform etc
25.0	**RO CIP PUMPS**	
A)	Quantity	2 Nos. (1W+1S)
B)	Description for each Pump	
(i)	Location	Indoor.
(ii)	Fluid to be handled	RO permeate water
(iii)	Service	Chemical cleaning of RO system
(iv)	Duty	Continuous
(v)	Type of Pump	Horizontal Centrifugal Non Clog type
(vi)	Type of Impeller	Closed
(vii)	Design standard	As per IS-5659 & IS-5120.
(viii)	Service temperature, in degree Celsius	60
(ix)	Rated Capacity, in m3/hr	108m3/hr
(x)	Permissible tolerance in rated capacity, in %	As per IS-5659 & IS-5120.
(xi)	Range of operation	20 % - 120 %.
(xii)	Suction Condition	Flooded.
(xiii)	Head to be developed at rated capacity	5 kg/cm2
(xiv)	Shut Off Head	To be suitable for stable operation at rated duty point.
(xv)	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659 & IS-5120.
(xvi)	Material of construction	
	a) Casing	AISI-316.
	b) Impeller	AISI-316.
	c) Shaft	AISI-316.
	d) Mechanical Seal	AISI-316.
	e) Common Base plate	Fabricated Steel as per IS 2062.
	f) Nuts and bolts	AISI-316.
(xvii)	Type of drive	Electrical Motor
(xviii)	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
(xix)	Rated speed (RPM)	1500 (Sync.) maximum.
(xx)	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+5%)
(xxi)	Type of coupling between Pump & Motor	Flexible Spacer.
(xxii)	Noise level (for complete set of Pump	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
(xxiii)	Tests and Inspection	
	a) Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
	b) Hydro-test	As per IS-5120.
	c) Dynamic Balancing Test	Shall be provided
(xxiv)	Performance Test	
	a) Test Code	Hydraulic Institute Standard.
	b) Tests to be done for determination of	Head-Capacity Curve, BHP-Capacity Curve and Efficiency- Capacity Curve and NPSH-Capacity Curve.
	c) Test to be carried out	On prototype model at rated speed.
	d) Test for satisfactory operation of pump at site	Required.
(xxv)	Instruments, alarm and Interlock	Shall be provided as per system requirements in line with attached P&ID.

(xxvi)	Suction Strainer along with flushing connection	Required. Material of construction of each strainer shall be SS316.
(xxvii)	Operation	Start/Stop from remote. Local emergency stop provided
(xxviii)	Trip interlock	Shall be provided.
26.0	**RO CIP Cartridge filters**	
i)	Quantity	1 Nos. (1W)
ii)	Capacity	108m3/hr each
iii)	MOC housing	SS316/ FRP
iv)	MOC elements	PP, 5micron nominal
27.0	**UF BACKWASH WASTE WATER PIT** 4	
i)	Number	One (1)
ii)	Type	below ground, rectangular
iii)	MOC	RCC
iv)	Minimum Effective capacity m3	Not less than 100m3
28.0	**UF BACKWASH WASTE DISPOSAL PUMPS** 4	
A)	Quantity	2 Nos. (1W+1S)
B)	Description for each Pump	
(i)	Location	Outdoor.
(ii)	Fluid to be handled	UF Backwash waste
(iii)	Service	Backwash waste, plant drains to CMB
(iv)	Duty	Continuous
(v)	Type of Pump	Vertical Centrifugal Non Clog type
(vi)	Type of Impeller	Closed
(vii)	Design standard	As per IS-5659 & IS-5120.
(viii)	Service temperature, in degree Celsius	60
(ix)	Rated Capacity, in m3/hr	100m3/hr
(x)	Permissible tolerance in rated capacity, in %	As per IS-5659 & IS-5120.
(xi)	Range of operation	20 % - 120 %.
(xii)	Suction Condition	Flooded.
(xiii)	Head to be developed at rated capacity	5 kg/cm2
(xiv)	Shut Off Head	To be suitable for stable operation at rated duty point.
(xv)	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659 & IS-5120.
(xvi)	Material of construction	
	a) Casing	AISI-316.
	b) Impeller	AISI-316.
	c) Shaft	AISI-316.
	d) Mechanical Seal	AISI-316.
	e) Common Base plate	Fabricated Steel as per IS 2062.
	f) Nuts and bolts	AISI-316.
(xvii)	Type of drive	Electrical Motor
(xviii)	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
(xix)	Rated speed (RPM)	1500 (Sync.) maximum.
(xx)	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+5%)
(xxi)	Type of coupling between Pump & Motor	Flexible Spacer.
(xxii)	Noise level (for complete set of Pump	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
(xxiii)	Tests and Inspection	
	a) Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.

	b) Hydro-test	As per IS-5120.
	c) Dynamic Balancing Test	Shall be provided
(xxiv)	Performance Test	
	a) Test Code	Hydraulic Institute Standard.
	b) Tests to be done for determination of	Head-Capacity Curve, BHP-Capacity Curve and Efficiency- Capacity Curve and NPSH-Capacity Curve.
	c) Test to be carried out	On prototype model at rated speed.
	d) Test for satisfactory operation of pump at site	Required.
(xxv)	Instruments, alarm and Interlock	Shall be provided as per system requirements in line with attached P&ID.
(xxvi)	Suction Strainer along with flushing connection	Required. Material of construction of each strainer shall be SS316.
(xxvii)	Operation	Start/Stop from remote. Local emergency stop provided
(xxviii)	Trip interlock	Shall be provided.
29.0	**RO DOSING SYSTEMS**	
29.1	**ACID DOSING SYSTEM**	
29.1.1	**DOSING TANK**	
i)	Quantity	1 per dosing system
ii)	Type	Vertical Cylindrical with top cover hinged & dished bottom. The tank shall be fitted with vent, drain, fume absorber, overflow seal pots etc.
iii)	Location	Indoor
iv)	Useful capacity (for each tank)	Capacity for 1 day storage of HCl for 10ppm dosing of HCl (30%) for 2 streams of RO system
v)	Pressure Rating	Atmospheric
vi)	Material of construction	FRP with suitable internal protection
vii)	Free board	300mm
viii)	Dissolving basket	As per chemical preparation requirement
ix)	Agitator with motor & reduction gears	As per chemical preparation requirement
x)	Accessories for each tank	Handhole, approach ladder & charging platform etc
29.1.2	**DOSING PUMPS**	
i)	Quantity	3 (2W+1S) (1 dosing pump per stream)
ii)	Type	Simplex positive displacement hydraulically operated diaphragm type
iii)	Suction strainers	Required
iv)	Pressure dampener	Required
v)	External safety relief valve (in addition to inbuilt safety valve)	PVC
vi)	Maximum pump stroke per minute	100 - 200
vii)	Motor rating	Minimum 15 % margin over BKW at rated duty point
viii)	Material of construction	
ix)	Liquid end (pump, head, valves, valve housing, valve spring, etc)	PP, for all wetted parts
x)	Diaphragm	PTFE
xi)	Packing	PTFE
xii)	Frame	MS fabricated, epoxy painted
29.2	**ANTISCALANT DOSING SYSTEM**	
29.2.1	**DOSING TANK**	
i)	Quantity	1 per dosing system

ii)	Type	Vertical Cylindrical with top cover hinged & dished bottom. The tank shall be fitted with vent, drain, fume absorber, overflow seal pots etc.
iii)	Location	Indoor
iv)	Useful capacity (for each tank)	Capacity for 1 day storage of Antiscalant for 3ppm dosing for 2 streams of RO system
v)	Pressure Rating	Atmospheric
vi)	Material of construction	FRP with suitable internal protection
vii)	Free board	300mm
viii)	Dissolving basket	As per chemical preparation requirement
ix)	Agitator with motor & reduction gears	As per chemical preparation requirement
x)	Accessories for each tank	Handhole, approach ladder & charging platform etc
29.2.2	**DOSING PUMPS**	
i)	Quantity	3 (2W+1S) (1 dosing pump per stream)
ii)	Type	Simplex positive displacement hydraulically operated diaphragm type
iii)	Suction strainers	Required
iv)	Pressure dampener	Required
v)	External safety relief valve (in addition to inbuilt safety valve)	PVC
vi)	Maximum pump stroke per minute	100 - 200
vii)	Motor rating	Minimum 15 % margin over BKW at rated duty point
viii)	Material of construction	
ix)	Liquid end (pump, head, valves, valve housing, valve spring, etc)	PP, for all wetted parts
x)	Diaphragm	PTFE
xi)	Packing	PTFE
xii)	Frame	MS fabricated, epoxy painted
29.3	**SBS DOSING SYSTEM**	
29.3.1	**DOSING TANK**	
i)	Quantity	1 per dosing system
ii)	Type	Vertical Cylindrical with top cover hinged & dished bottom. The tank shall be fitted with vent, drain, fume absorber, overflow seal pots etc.
iii)	Location	Indoor
iv)	Useful capacity (for each tank)	Capacity for 1 day storage of Sodium bisulphite (SBS) for 3ppm dosing for 2 streams of RO system
v)	Pressure Rating	Atmospheric
vi)	Material of construction	FRP with suitable internal protection
vii)	Free board	300mm
viii)	Dissolving basket	As per chemical preparation requirement
ix)	Agitator with motor & reduction gears	As per chemical preparation requirement
x)	Accessories for each tank	Handhole, approach ladder & charging platform etc
29.3.2	**DOSING PUMPS**	
i)	Quantity	3 (2W+1S) (1 dosing pump per stream)
ii)	Type	Simplex positive displacement hydraulically operated diaphragm type
iii)	Suction strainers	Required
iv)	Pressure dampener	Required
v)	External safety relief valve (in addition to inbuilt safety valve)	PVC

vi)	Maximum pump stroke per minute	100 - 200
vii)	Motor rating	Minimum 15 % margin over BKW at rated duty point
viii)	Material of construction	
ix)	Liquid end (pump, head, valves, valve housing, valve spring, etc)	PP, for all wetted parts
x)	Diaphragm	PTFE
xi)	Packing	PTFE
xii)	Frame	MS fabricated, epoxy painted

30.0	**LIME SOLUTION SLAKING TANKS**	
A)	Numbers	One (1)
B)	Description for each Tank	
i)	Type	Vertical rectangular with Semicircular bottom.
ii)	Type of fluid to be handled	10 % w/w Lime Solution.
iii)	Effective capacity of each tank, m3/hr	Not less 120% of the quantity required for Clarifiers (design dosage rate not less than 20 mg/l)
iv)	Free Board, mm	300
v)	Design Pressure, Kg/sq. cm (g)	Atmospheric.
vi)	Design Temperature in degree Celsius	60
vii)	Design Code	As per supplier standard practice to meet system requirements
viii)	Code for Test and Inspection	As per supplier standard practice to meet system requirements
ix)	Material of Construction ⚠4	MS-epoxy or equivalent compatible with Lime
x)	Type of Protection	
	a) Internal	Epoxy painted as per painting sub section
	b) External	As per painting specification
	c) Agitator along with drive motor and all other accessories	
	• Number	One (1) per Tank
	• Material of Construction	MS with Epoxy painted/ equivalent compatible with lime
	c) Dissolving Basket	
	• Number	One (1) per Tank
	• Material of Construction	Dissolving Basket shall be of SS-316 construction with 10 mm dia. Holes with 50 mm triangular pitch.
xi)	Accessories	Shall be provided as per system requirements in line with attached P&ID.
xii)	Instruments	Shall be provided as per system requirements in line with attached P&ID.
31.0	**SLAKED LIME TRANSFER PUMPS**	
A)	Numbers	Two (2) (1W+1S)
B)	Description for each Pump	
i)	Location	Indoor
ii)	Fluid to be handled	10 % w/w Lime Solution.
iii)	Duty	Continuous and suitable for parallel operation
iv)	Type of Pump	Screw type
v)	Drive	Electric motor
vi)	Suction condition	Flooded
C)	Design data	
i)	Rated capacity of each pump	Shall be supplied to meet the requirement in order to produce clarified water at the rate of capacity 220.25m3/hr (with due consideration of water loss through clarifiers for disposal of sludge).

ii)	Total developed head at rated capacity, MLC	Shall be specified During detailed engineering to meet the system requirements
iii)	Pumping temperature	10 degree C/ 60 degree C (max)
iv)	Speed	1500 maximum
v)	No of stages	One (1) max.
D)	Constructional feature	
i)	Pump type	Single screw / Twin screw
ii)	Bearing lubrication	Grease / oil
iii)	Seal	Mechanical
iv)	Drive transmission	Direct
v)	Mounting	Common base plate
vi)	Flange drilling	ANSI B 16.5 Class 150
vii)	Nozzle orientation	
	1. Suction	End / Side
	2. Discharge	Top / Side
viii)	Gear box for speed reduction provided	Yes
ix)	Relief valve	Provided
E)	Material of construction	
i)	Casing	2% Ni CI to IS 210 FG 260
ii)	Rotor / gear	SS 316
iii)	Stator	Nitrile / EPDM
iv)	Shaft and shaft sleeve	ASTM A 276 Gr 410 & SS 316
F)	Accessories	
i)	Coupling with coupling guard, base plate, foundation bolts, counter flanges	Provided
ii)	Sealing and flushing connections for mechanical seal testing and inspection	Provided
iii)	Instruments along with alarms, interlocks and accessories	Shall be provided as per P&ID enclosed.
32.0	**LIME SOLUTION PREPARATION CUM DOSING TANKS**	
A)	Numbers	One (1)
B)	Description for each Tank	
i)	Type	Vertical rectangular with flat bottom.
ii)	Type of fluid to be handled	6 % w/w Lime Solution.
iii)	Effective capacity of each tank, m3	Not less 120% of the quantity required for each Clarifier at rated design output capacity (design dosage rate not less than 20 mg/l)
iv)	Material of Construction 4	MS-epoxy or equivalent compatible with Lime
v)	Type of Protection	
	a. Internal	Epoxy painted as per painting sub section.
	b) External	As per painting specification.
	c) Agitator along with drive motor and all other accessories	
	• Number	One (1) per Tank
	• Material of Construction 4	MS-epoxy or equivalent compatible with Lime
	d) Dissolving Basket	
	• Number	One (1) per Tank
	• Material of Construction	Dissolving Basket shall be of SS-316 construction with 10 mm dia. Holes with 50 mm triangular pitch.
vi)	Accessories	Shall be provided as per system requirements in line with attached P&ID.
vii)	Instruments	Shall be provided as per system requirements in line with attached P&ID.
33.0	**LIME DOSING PUMPS**	

A)	Numbers	2 Nos. (1W + 1S)
B)	Description for each Pump	
i)	Location	Indoor
ii)	Fluid to be handled	6 % w/w Lime Solution.
iii)	Duty	Continuous
iv)	Type of Pump	Screw type
v)	Drive	Electric motor
vi)	Suction condition	Flooded
C)	Design data	
i)	Rated capacity of each pump	Each dosing pump is provided to meet the requirement in order to produce clarified water at the rate of 220.25 m^3/hr/ clarifier water (with due consideration of water loss through clarifiers for disposal of sludge).
ii)	Total developed head at rated capacity, MLC	Shall be specified During detailed engineering to meet the system requirements
iii)	Pumping temperature	10 degree C/ 60 degree C (max)
iv)	Speed	1500 maximum
v)	No of stages	One (1) max.
D)	Constructional feature	
i)	Pump type	Single screw / Twin screw
ii)	Bearing lubrication	Grease / oil
iii)	Seal	Mechanical
iv)	Drive transmission	Direct
v)	Mounting	Common base plate
vi)	Flange drilling	ANSI B 16.5 Class 150
vii)	Nozzle orientation	
	1. Suction	End / Side
	2. Discharge	Top / Side
viii)	Gear box for speed reduction provided	Yes
ix)	Relief valve	Provided
E)	Material of construction	
i)	Casing	2% Ni CI to IS 210 FG 260
ii)	Rotor / gear	SS 316
iii)	Stator	Nitrile / EPDM
iv)	Shaft and shaft sleeve	ASTM A 276 Gr 410 & SS 316
F)	Accessories	
i)	Coupling with coupling guard, base plate, foundation bolts, counter flanges	Provided
ii)	Sealing and flushing connections for mechanical seal testing and inspection	Provided
iii)	Instruments along with alarms, interlocks and accessories	Shall be provided as per P&ID enclosed.
34.0	**FeCl3 PREPARATION CUM DOSING TANK** 4	
A)	Quantity	One (1)
B)	Description for each Tank	
i)	Type	Vertical rectangular with flat bottom.
ii)	Type of fluid to be handled	Ferric chloride (FeCl3) solution at concentration suitable for effective dosing
iii)	Effective capacity of each tank, m3	Not less 120% of the quantity required for each Clarifier at rated design output capacity (design dosage rate not less than 10mg/l) for 24 hours of continuous full load operation.
iv)	Material of Construction	MS-epoxy or equivalent compatible with FeCl3
v)	Type of Protection	

	a. Internal	Suitable coating
	b) External	As per painting specification.
	c) Agitator along with drive motor and all other accessories	
	• Number	One (1) per Tank
	• Material of Construction	SS316/ MS-FRP lined
vi)	Dissolving basket	1 no. per tank, MOC:SS316
vii)	Accessories	Shall be provided as per system requirements in line with attached P&ID.
viii)	Instruments	Shall be provided as per system requirements in line with attached P&ID.
35.0	**FeCl3 INJECTION PUMPS** 4	
A)	Numbers	2 Nos. (1W + 1S)
B)	Description (applicable for each Pump)	
i)	Type	Simplex positive displacement hydraulically operated diaphragm type
ii)	Location	Indoor.
iii)	Fluid to be handled	37 % Ferric chloride solution/ concentration suitable for effective dosing
iv)	Service	To dose FeCl3 solution to the Clarifier.
v)	Duty	Continuous and suitable for parallel operation
vi)	Suction Condition	Flooded
vii)	Rated Capacity, m^3/hr	Each dosing pump is provided to meet the requirement in order to produce clarified water at the rate of 220.25 m^3/hr/ clarifier water (with due consideration of water loss through clarifiers for disposal of sludge).
viii)	Tentative head to be developed at rated capacity, MLC	Shall be specified during detailed engineering stage to meet the system requirements
ix)	Design Standard	As per supplier standard practice to meet system requirements
x)	Design Temperature in degree Celsius	60
xi)	Range of Operation (%)	0 – 100
xii)	Rated Speed	1500 maximum
xiii)	Material of construction	
	a) All wetted parts	SS 316/ suitable for handling FeCl3
	b) Diaphragm	PTFE
xiv)	Type of drive	Electrical Motor
xv)	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
xvi)	Rated speed (RPM)	1500 (Sync.) maximum.
xvii)	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+5%).
xviii)	Type of coupling between Pump & Motor	Flexible Spacer.
xix)	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
xx)	Painting for complete set of Pump & Motor	
	a) Primer	Shall be provided
	b) Finish paint	Shall be provided
xxi)	Tests and Inspection	

	• Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
	• Hydro-test	As per applicable code.
	• Dynamic Balancing Test	Shall be provided
	• Performance Test	Shall be provided
xxii)	Instruments along with alarms, interlocks and accessories	Shall be provided as per the system requirements and P&ID enclosed.
xxiii)	Trip interlock	Shall be provided.
xxiv)	Accessories	
	a) Pulsation Dampener	Shall be provided.
	b) Pressure Relief Valve	Shall be provided.
36.0	**POLYELECTROLYTE PREPARATION CUM DOSING TANK**	
A)	Quantity	One (1)
B)	Description for each Tank	
i)	Type	Vertical rectangular with flat bottom.
ii)	Type of fluid to be handled	Polyelectrolyte solution
iii)	Effective capacity of each tank, m3	Not less 120% of the quantity required for each Clarifier at rated design output capacity (design dosage rate not less than 1mg/l) for 24 hours of continuous full load operation.
iv)	Material of Construction 4	MS-epoxy or equivalent compatible with Polyelectrolyte
v)	Type of Protection	
	a. Internal	Suitable coating
	b) External	As per painting specification
	c) Agitator along with drive motor and all other accessories	
	• Number	One (1) per Tank
	• Material of Construction	SS316
vi)	Dissolving basket	1 no. per tank, MOC:SS316
vii)	Accessories	Shall be provided as per system requirements in line with attached P&ID.
viii)	Instruments	Shall be provided as per system requirements in line with attached P&ID.
37.0	**POLYELECTROLYTE INJECTION PUMPS**	
A)	Numbers	2 Nos. (1W + 1S)
B)	Description for each Pump	
i)	Location	Indoor
ii)	Fluid to be handled 4	0.5 % Polyelectrolyte Solution.
iii)	Duty	Continuous
iv)	Type of Pump 4	Screw type
v)	Drive	Electric motor
vi)	Suction condition	Flooded
C)	Design data	
i)	Rated capacity of each pump	Each dosing pump is provided to meet the requirement in order to produce clarified water at the rate of 220.25 m^3/hr/ clarifier water (with due consideration of water loss through clarifiers for disposal of sludge).
ii)	Total developed head at rated capacity, MLC	Shall be specified During detailed engineering to meet the system requirements
iii)	Pumping temperature	10 degree C/ 60 degree C (max)
iv)	Speed	1500 maximum
v)	No of stages	One (1) max.
D)	Constructional feature	

i)	Pump type	Single screw / Twin screw
ii)	Bearing lubrication	Grease / oil
iii)	Seal	Mechanical
iv)	Drive transmission	Direct
v)	Mounting	Common base plate
vi)	Flange drilling	ANSI B 16.5 Class 150
vii)	Nozzle orientation	
	1. Suction	End / Side
	2. Discharge	Top / Side
viii)	Gear box for speed reduction provided	Yes
ix)	Relief valve	Provided
E)	Material of construction	
i)	Casing	2% Ni CI to IS 210 FG 260
ii)	Rotor / gear	SS 316
iii)	Stator	Nitrile / EPDM
iv)	Shaft and shaft sleeve	ASTM A 276 Gr 410 & SS 316
F)	Accessories	
i)	Coupling with coupling guard, base plate, foundation bolts, counter flanges	Provided
ii)	Sealing and flushing connections for mechanical seal testing and inspection	Provided
iii)	Instruments along with alarms, interlocks and accessories	Shall be provided as per P&ID enclosed.
38.0	**DEWATERING POLYELECTROLYTE PREPARATION CUM DOSING TANK**	
A)	Quantity	One (1)
B)	Description for each Tank	
i)	Type	Vertical rectangular with flat bottom.
ii)	Type of fluid to be handled	Polyelectrolyte solution
iii)	Effective capacity of each tank, m3	Not less 120% of the quantity required for each Clarifier at rated design output capacity (design dosage rate not less than 1mg/l) for 24 hours of continuous full load operation.
iv)	Material of Construction 4	MS-epoxy or equivalent suitable for Polyelectrolyte handling
v)	Type of Protection	
	a. Internal	Suitable coating
	b) External	Not applicable.
	c) Agitator along with drive motor and all other accessories	
	• Number	One (1) per Tank
	• Material of Construction	SS316
vi)	Accessories	Shall be provided as per system requirements in line with attached P&ID.
vii)	Instruments	Shall be provided as per system requirements in line with attached P&ID.
39.0	**DEWATERING POLYELECTROLYTE DOSING PUMP**	**To Centrifuge**
A)	Numbers	2 Nos. (1W + 1S)
B)	Description for each Pump	
i)	Location	Indoor
ii)	Fluid to be handled 4	0.5 % Polyelectrolyte Solution.
iii)	Duty	Continuous
iv)	Type of Pump	Screw type
v)	Drive	Electric motor

vi)	Suction condition	Flooded
C)	Design data	
i)	Rated capacity of each pump	Suitable to meet 100% of system requirements
ii)	Total developed head at rated capacity, MLC	Shall be specified During detailed engineering to meet the system requirements
iii)	Pumping temperature	10 degree C/ 60 degree C (max)
iv)	Speed	1500 maximum
v)	No of stages	One (1) max.
D)	Constructional feature	
i)	Pump type	Single screw / Twin screw
ii)	Bearing lubrication	Grease / oil
iii)	Seal	Mechanical
iv)	Drive transmission	Direct
v)	Mounting	Common base plate
vi)	Flange drilling	ANSI B 16.5 Class 150
vii)	Nozzle orientation	
	1. Suction	End / Side
	2. Discharge	Top / Side
viii)	Gear box for speed reduction provided	Yes
ix)	Relief valve	Provided
E)	Material of construction	
i)	Casing	2% Ni CI to IS 210 FG 260
ii)	Rotor / gear	SS 316
iii)	Stator	Nitrile / EPDM
iv)	Shaft and shaft sleeve	ASTM A 276 Gr 410 & SS 316
F)	Accessories	
i)	Coupling with coupling guard, base plate, foundation bolts, counter flanges	Provided
ii)	Sealing and flushing connections for mechanical seal testing and inspection	Provided
iii)	Instruments along with alarms, interlocks and accessories	Shall be provided as per P&ID enclosed.

DATASHEET OF PIPING, ISOLATION GATES & VALVES FOR EFFLUENT TREATMENT PLANT

1.0	**PIPING**	
SL NO.	**SERVICE**	**MATERIAL**
1.1	Raw water piping, Clarified Water piping, and service water piping.	Carbon Steel IS-1239 Heavy Grade upto 150 mm NB and IS-3589 for sizes above 150 mm with minimum pipe thickness as indicated in the P&ID.
1.2	Crude Oily Wastewater piping	Seamless Carbon Steel
1.3	Sludge handling piping.	• Cast Iron (underground) • Carbon Steel (overground)
1.4	Neutralized Wastewater piping	Carbon Steel (inside rubber lined)
1.5	Potable Water piping.	Carbon Steel IS-1239 Heavy Grade upto 150 mm NB and IS-3589 for sizes above 150 mm with minimum pipe thickness as indicated in the P&ID. The pipes shall be galvanized as per IS-4736.

1.6	Service and Instrument Air Piping less than and equal to 50 mm NB.	Stainless Steel as per ASTM A- 312 Gr. 304. Size- as per schedule 40 ANSI B36.10
1.7	Service and Instrument air piping for sizes equal to greater than 65 mm NB.	Stainless steel as per ASTM A-312 Gr. 304. Size-upto 150 mm NB as per schedule 10S, ANSI B-36.10.
1.8	Piping handling Alum, Lime, poly electrolyte.	CPVC (SCHD. 80)/ Carbon Steel Rubber lined to IS-1239 Heavy Grade upto 150 mm NB and IS-3589 for sizes above 150 mm with minimum pipe thickness of 6 mm. Rubber lining thickness shall be - 4.5 mm in three (3) layers) of shore hardness 60^{o} – 70^{o} A.
1.9	Sampling Pipe	Stainless Steel to ASTM Schedule-10.
2.0	**VALVES**	
2.1	**CAST IRON BODY BUTTERFLY VALVES :** i. Service: For raw water, waste water, clarified water, and filtered water. ii. Basic Design Code: All the Butterfly valves shall be of double flanged type of low leakage rate confirming to AWWA-C-504 class 150 (min.). **iii. Material of construction** • Body: 2% Ni Cast Iron as per IS-210 Gr. FG260 with 2% Ni. • Valve Disc: 2% Ni Cast Iron as per IS-210 Gr. FG260 with 2% Ni. • Shaft: Stainless Steel ASTM-A-296 type 316. • Seat ring: Nitrile rubber, EPDM (Ethylene propylene rubber),Hypalon • Shaft Bearing: Ferrobestos LA-33. • Gland Packing: Impregnated Teflon • Seal: Nitrile Rubber iv. Construction: Cast Body and Disc v. Pressure: To be suitably chosen according to requirement, but not less than class 75A as per AWWA-C-504. vi. All the butterfly valves shall be provided with Hand wheel or lever as per the requirements. vii. End preparation: Flanged, Drilled as per ANSI B16.5. Necessary counter flange nuts, bolts, gaskets are to be provided with each valve. viii. Testing: As per AWWA-C-504. However valve disc strength for both forward reverse flow is to be carried out as per BS5155. ix. All the butterfly valves shall be provided with an indicator to show the position of the disc.	
2.2	**CAST IRON BODY GATE/GLOBE/CHECK VALVE** i. Service: For Service Water, Clarified Water, Potable Water. ii. Basic Design Code • Gate valve - IS 14846 for 50 mm - 1200 mm NB • Gate valve- API 602 for below 50 mm. • Globe valve - MSS - SP – 85 • Check valve - IS-5312/MSS - SP -71 • Ball - BS-5351 iii. Pressure Class - To be suitably chosen considering the pressure requirement. iv. Construction: Cast body and bonnet / cover **v. Material of Construction** • Body & Bonnet/ cover: IS 210 Gr. FG 260 • Trim / Disc.: IS-210 Gr. FG 260 • Seating surface: 13% Cr steel as per IS 1570 • Stem: Stainless steel AISI 410/ 13% chrome steel. • End Preparation: Socket welded for size equal to and below 50mm NB and flanged with counter flanges for 65mm NB and above. vi. Testing • Gate: As per IS - 780 for 50 mm - 300 mm NB	

	• Gate:IS-2906 for sizes equal to and above 350 mm NB • Globe: Hydrostatic Test as per MSS-SP-85 Check: S-5312/MSS-SP-71
2.3	**STAINLESS STEEL BODY/ GATE/GLOBE /CHECK/BALL VALVE** i. Service: Potable Water, Service and Instrument Air. ii. Sizes: • Potable Water - For sizes less than and equal to 50 mm NB. • Service and Instrument Air- For all sizes. Ball valves shall be used in air line. iii. Basic Design Code • Gate valve - ANSI-B-16.34 • Globe valve - ANSI-B-16.34 • Check valve - ANSI-B-16.34 • Ball - BS-5351 iv. Pressure Class - To be suitably chosen considering the pressure requirement as indicated below: Unless otherwise specified, all pipe work shall be suitable for a minimum pressure of 10.0 kg/sq. cm(g) at 80 deg. C or as required by the design of the different piping system, if higher. v. Construction: Forged body up to 50mm NB and Cast body above that **vi. Material of Construction** • Body & Bonnet/ cover: ASTM-A-182 F304 for Ball Valves: • Body & Bonnet/ cover: A351 CF8M for cast body, A 182 F304 for forged body, • Trim / Disc/Ball.: ASTM-A-182 F304 for Gate, Globe, Check valves and Stainless steel ASME-SA 479 Grade 316 for Ball valves. • Seating surface: 13% Cr steel as per IS 1570. For Ball valves PTFE seats and seals. • End Preparation: Socket welded for size equal to and below 50mm NB and flanged with counter flanges for 65mm NB and above. vii. Testing : As per ANSI B-16.34
2.4	**STEEL BODY GATE/ GLOBE/CHECK VALVE/ BALL VALVE** i. Service: Clarified water i. Sizes: For sizes less than and equal to 50 mm NB ii. Basic Design Code • Gate valve - API 600 for 50mm NB. API 602 for size less than 50 mm NB. • Globe valve - BS-1873/ANSI-B-16.34 • Check valve - BS-1868/ANSI B16.34 • Ball - BS-5351 iii. Pressure Class - To be suitably chosen considering the pressure requirement as indicated below: Unless otherwise specified, all pipe work shall be suitable for a minimum pressure of 10.0 kg/sq. cm(g) at 80 deg. C or as required by the design of the different piping system, if higher. iv. Construction: Forged body **v. Material of Construction** • Body & Bonnet/ cover: ASTM-A-216 Gr. WCB for cast body & ASTM-A-105 for forged body. • Trim / Disc.: 13% Cr Steel as per ASTM-A- 182 Gr. F6 heat treated and hardened(min 250 NB) for cast body and ASTM-A-105 Hard faced with Stellite (min 350 HB) for forged body • Seating surface: 13% Cr. Steel as per ASTM-A- 182 Gr. F6 • End Preparation: Socket welded for size equal to and below 50mm NB and flanged with counter flanges for 65mm NB and above. vi. Testing : As per ANSI B-16.34 • Gate: As per API-598 • Globe: BS-1873 • Check: BS-1868

2.5	**DIAPHRAGM VALVE** i. Service: For alum and poly electrolyte chemical. ii. The Diaphragm shall conform to following requirement • Design standard: BS: 5156 or equivalent of required rating/class. (Minimum rating of valves shall be PN 10). • Type: Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type • **Material of Construction** • Body , Bonnet: Cast iron IS 210 Gr. FG 260 or equivalent or Cast steel ASTM A-216 Gr. WCB • Handwheel : Cast Iron • Compressor : Stainless Steel • Stem and Bush: Stainless Steel.	
2.6	**DIAPHRAGM VALVE** i. Service: Acid and alkali chemical. These valves shall conform to above (sl number 2.5) except that the diaphragm shall be of reinforced Teflon, EPDM/Black Butyl/ approved equivalent for acid services and reinforced neoprene/Hypalon/approved equivalent for alkali services and body and bonnet shall be of SS316.	
2.7	**ISOLATION GATES**	i. Design standard for each gate shall be IS:3042 or Eqv. ii. The gates shall be rectangular or square sluice, rising spindle type conforming to class-1 of IS:3042. iii. Material of Construction of each gate: • Frame and Door: Cast Iron IS:210 Gr. 20 • Spindles, bolts & nuts : M.S. to IS:2062 • Face & seat rings: Gun metal (as per IS:3042). • All the parts of each 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. • Each gate shall be FRP coated on both sides.

DATASHEET FOR PIPING IN ETP REUSE AREA

Sl. No.	Service	Sizes	Pipes	Fittings
1	NaOCl/Citric acid/ Antiscalant/ HCL/ other chemicals	All sizes	CPVC sch.80 of ASTM	CPVC sch.80 of ASTM
2	All Instrument/Plant air	All sizes	Galvanized as per IS 1239, heavy grade	Screwed fittings of galvanized as per IS 1239, heavy grade
3	High pressure discharge piping	All sizes	SS316 Sch 40	SS316 Sch 40
4	RO permeate	Upto DN150 >DN150	UPVC PN10 GRP PN10	UPVC PN10 GRP PN10
5	RO Reject high pressure piping	All sizes	SS316 Sch.40	SS316 Sch 40
6	RO Reject- Low pressure piping	All sizes	UPVC, PN 10	UPVC, PN 10

Sl. No.	Service	Sizes	Pipes	Fittings
7	Cleaning solution line	Upto DN150 >DN150	UPVC PN10 GRP PN10	UPVC PN10 GRP PN10
8	LP Valves	All	CI Body with Nylon coated	
9	Velocity		Pump suction: ≤1.4 m/s Pump discharge (Low pressure piping): ≤2.5 m/s HP Piping (RO Feed / Brine): ≤3.5 m/s	

Annexure-1

PUMPS AND PIPE SELECTION CRITERIA.

Pump and Pipeline carrying water and chemicals etc. shall generally be sized on the following velocities. However wherever minimum pipe sizes are defined in the drawing/datasheets, the selected size shall not be less than the specified size.

	VELOCITY IN m/sec.		
	BELOW 50 MM.	**50-150 MM**	**200 MM AND ABOVE**
Pump Suction for water	------	1.2-1.5	1.2-1.8
Pump discharge for water	1.2-1.8	1.8-2.4	2.1-2.5
Header for water	-------	1.5-2.4	1.8-2.4
Pump Suction for chemical solution	1.0-1.2	1.1-1.3	-------
Pump discharge for chemical solution	1.2-1.4	1.3-1.5	--------
Gravity flows	1.0 (maximum).		

Note 1- All piping system shall be capable of withstanding the maximum pressure in the corresponding line.

Note 2- TDH of all pumps shall be decided by the supplier assuming the following 'C values in Hazen & Williams equation for calculation of friction loss.

a) **Carbon steel pipes – 100**
b) **C. I pipes –100**
c) **Rubber lined steel pipe – 120**
d) **PVC/HDPE pipes – 140**

10% margin shall be taken over the pipe friction losses for calculating the pump head.

Specification for ESP/ APH wash water transfer pumps

1. ESP/ APH wash water will be terminated in ESP wash water pits (3nos.).
2. Each pit shall house 2nos. (1W+1S) ESP/APH wash water transfer pumps of capacity 420m3/hr.
3. ESP wash water shall be pumped and terminated in Ash slurry sumps 3Nos. as indicated in piping routing drawing & PID.
4. Details of pump MOC are provided below.

ANNEXURE-I

DATA SPECIFICATION SHEET

		Group-A	Group-B	Group-C	Group-D
1.	Pumps				
1.1	Rated Capacity (Cu.M/hr.)	<---------- Refer - II ---------->			
1.2	Total Head at rated Capacity (MLC)	<---------- DO ---------->			
1.3	Nos. Required	<---------- DO ---------->			
1.4	Duty	<---------- Intermittent ---------->			
1.5	Pump Design Standard	<---------- IS-5120/ IS:1710--------->			
1.6	Parallel operation required	Yes	No	No	Yes
1.7	Material of Construction				
	a) Base plate/Cover Plate	<---------- M.S. IS-2062 / Equivalent ---------->			
	b) Column Pipe	<---------- M.S. IS-2062 / Equivalent ---------->			
	c) Casing	<--------- 2% NiCI, IS-210, FG-260 (*)---------->			
	d) Impeller	<---------- 2% NiCI, IS-210, FG-260 (**)------->			
	e) Pump/Impeller Shaft	<---------- SS. AISI-316 ---------->			
	f) Shaft Sleeve	<---------- SS. AISI-316 (Hardened) ---------->			
	g) Shaft Coupling	<---------- SS. AISI-410 ---------->			
	h) Shaft Bearing	BUSH GM as per IS-306 Gr.1 / Equivalent			
	i) Gland	<----- C.I., IS-210, FG-260/Equivalent ---------->			
	j) Gland Packing	<------ Braided Graphite-free Teflon --> ***			
	k) Fasteners coming in contact with water	<---------- SS. AISI-304 ---------->			
	l) Fasteners not coming in contact with water	<---------- Carbon Steel ---------->			

Note : * Alloy CI (min 30 mm thick) BHN 350 min
** Ni-hard (min 25 mm thick) BHN 550 min.

		Group-A	Group-B	Group-C	Group-D
	*** S.S. Wire reinforced/impregnated graphite teflon.				
	m) Discharge pipe	MS IS-1239/Equivalent	--	--	MS IS-1239/ Equivalent
	n) Motor stool	<---------- Close Grained C.I.---------->			
1.8	Range of Operation	<---------- Refer -II ---------->			
1.9	Tests and Inspection	<-- As per Cl. No. 6.00.00 and lead specification -->			
1.10	Supply of Accessories & Services (Wherever Applicable) for each group and each rating of Pumps				
	a) Base plate	Yes			
	b) Sole Plate	Yes			
	c) Foundation bolts, nuts, sleeves etc.	Yes			
	d) Companion flanges with nuts, bolts & gaskets	Yes			
	e) Unions for external water for cooling/sealing/ lubrication	Yes, if required			
	f) Cooling/ sealing/lubrication system with all accessories, complete with pipes, valves and with instruments	Yes, if required			
	g) Discharge pressure gauge	Yes			
	h) Suction pressure gauge	Yes, for Group-B only			
	i) Pump-motor coupling and guard	Yes			
	j) Eye bolts, lifting tackle etc	Yes			
	k) Pre-lubrication tank and accessories	Yes, if required			
	l) Suction bell	Yes			

DRAWING NO. 1-WT-060-01597

ALL DIMENSIONS ARE IN MILLIMETRES

INSTRUMENTS

M	MOTOR OPERATED
DV	DRAIN VALVE
SP	SAMPLING POINT (LOCAL)
	DRAIN
AIT Turb	TURBIDITY ANALYZER
LG	LEVEL GAUGE
FIT	FLOW INDICATING TRANSMITTER
LIT	LEVEL TRANSMITTER
PG	PRESSURE GAUGE
FIT	PARSHALL FLUME FLOW TRANSMITTER
PT	PRESSURE TRANSMITTER
	CHEMICAL DIAPHRAGM SEAL
	TO PLC FOR MONITORING
PLC	TO PLC

VALVES

S	SOLENOID VALVE
	SLUICE/GATE VALVE
	NON RETURN VALVE
	DIAPHRAGM VALVE
	BALL VALVE
	GLOBE VALVE
	GAUGE COCK (2/3 WAY)
	3 WAY NEEDLE VALVE
	CHANNEL SHUTTER
	PRESSURE RELIEF VALVE
	BUTTERFLY VALVE (FLANGED)

EQUIPMENT

	SCREW PUMP
P	HYD. DIAPHRAGM METERING PUMP
R	MIXER WITH GEAR (HORIZONTAL)
	Y-STRAINER
PD	PULSATION DAMPENER
	EJECTOR
	SUBMERSIBLE PUMP
	DRIVE MOTOR
	BLOWER

O-LS	OPEN LIMIT SWITCH
C-LS	CLOSE LIMIT SWITCH
OC-LS	OPEN-CLOSE LIMIT SWITCH

KKS CODING SYSTEM

UNIT KEY
FUNCTION KEY
AREA KEY
xx xxx xx
xx xxx
EQUIPMENT / INSTRUMENT NO. KEY
EQUIPMENT / INSTRUMENT KEY

UNIT KEY

90 – COMMON

FUNCTION KEY

GTA – COMMON

EQUIPMENT/ INST. KEY

MECHANICAL :

AP – PUMPS
AN – BLOWERS
AA – VALVES
AT – FILTERING ELEMENT
AM – MIXERS
BB – VESSELS AND STORAGE TANKS

ELECT, C&I :

AE – MOTORS
CF – FLOW MEASUREMENT
CP – PRESSURE MEASUREMENT
CT – TEMPERATURE MEASUREMENT
CQ – ANALYTICAL MEASUREMENT
CL – LEVEL MEASUREMENT
DP – DIFF. PR. MEASUREMENT

EQUIPMENT/INST. NO. KEY

MECHANICAL :

001 TO 050 EQUIPMENTS
051 TO 099 MOTORISED VALVE
101 TO 150 PNEU. ACTUATED VALVES
201 TO 299 SOLENOID OPERATED VALVES
401 TO 499 NON RETURN VALVES
501 TO 599 MANUAL VALVES
701 TO 799 PR. RELIEF VALVES

ELECT, C&I :

001 TO 099 ANALOG INSTRUMENTS – REMOTE
101 TO 199 PROCESS SWITCHES
501 TO 599 PROCESS INDICATORS – LOCAL

REV	DATE	ALTERED:	CHECKED:	ZONE	
02	12.02.21	AJV	SS	4A	Revised for tender
01	12.02.21	AJV	SS	4A	Revised based on resolutions dt.23.01.21

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PROJECT: YADADRI THERMAL POWER STATION (5X800 MW)

OWNER: TELENGANA STATE POWER GENERATION CORPORATION LIMITED

OWNER'S CONSULTANT: TATA CONSULTING ENGINEERS LIMITED BANGALORE

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI
UNIT : BOILER AUXILARIES PLANT ; RANIPET
PACKAGE : PT PLANT

TITLE: P&ID DIAGRAM FOR EFFLUENT TREATMENT PLANT.

	NAME	SIGN.	DATE
DRAWN	M.V	Sd/-	27.05.19
CHECKED	S.S	Sd/-	27.05.19
APPROVED	M.S.M	Sd/-	27.05.19

ALL DIMENSIONS ARE IN MILLIMETRES

BHEL DRAWING NO. 1-WT-060-01597 SH. 1 OF 1

REV 02

DEPT CODE: DPG 8778
GRADE OF UNTOL DIM: PR-QA-500
PROJECTION
SCALE: N.T.S

Size A1

DRAWING NO. 1-WT-060-01597

ALL DIMENSIONS ARE IN MILLIMETRES

OILY WASTE FROM TRANSFORMER UNIT-1
PE-DG-417-100-E001

TRANSFORMER YARD OILY WASTE TRANSFER PUMP 1
QTY : 1W + 1S
CAP. -20 M³/ HR.

TRANSFORMER YARD OILY WASTE COLLECTION PIT 1
CAP.-151 M³
M.O.C.-RCC

EX1
PLC RIO-1

OILY WASTE FROM TRANSFORMER UNIT-2
PE-DG-417-100-E001

TRANSFORMER YARD OILY WASTE TRANSFER PUMP 2
QTY : 1W + 1S
CAP. -20 M³/ HR.

TRANSFORMER YARD OILY WASTE COLLECTION PIT 2
CAP.-154 M³
M.O.C.-RCC

EX2
PLC RIO-1

OILY WASTE FROM TRANSFORMER UNIT-3
PE-DG-417-100-E001

TRANSFORMER YARD OILY WASTE TRANSFER PUMP 3
QTY : 1W + 1S
CAP. -20 M³/ HR.

TRANSFORMER YARD OILY WASTE COLLECTION PIT 3
CAP.-152 M³
M.O.C.-RCC

EX3
PLC RIO-2

OILY WASTE FROM TRANSFORMER UNIT-4
PE-DG-417-100-E001

TRANSFORMER YARD OILY WASTE TRANSFER PUMP 4
QTY : 1W + 1S
CAP. -20 M³/ HR.

TRANSFORMER YARD OILY WASTE COLLECTION PIT 4
CAP.-154 M³
M.O.C.-RCC

EX4
PLC RIO-2

OILY WASTE FROM TRANSFORMER UNIT-5
PE-DG-417-100-E001

TRANSFORMER YARD OILY WASTE TRANSFER PUMP 5
QTY : 1W + 1S
CAP. -20 M³/ HR.

TRANSFORMER YARD OILY WASTE COLLECTION PIT 5
CAP.-169 M³
M.O.C.-RCC

EX5
PLC RIO-2

OILY WASTE FROM FGD TRANSFORMER
PE-DG-417-100-E001

TRANSFORMER YARD OILY WASTE TRANSFER PUMP 6
QTY : 1W + 1S
CAP. -20 M³/ HR.

TRANSFORMER YARD OILY WASTE COLLECTION PIT 6
CAP.-169 M³
M.O.C.-RCC

EX6
PLC RIO-2

OIL WASTE FROM FUEL OIL AREA
PE-DG-417-166-A001

FUEL OIL AREA OILY WASTE TRANSFER PUMPS
QTY : 1W + 1S
CAP:-20 M³/ HR.

FUEL OIL AREA WATER PIT
CAP.-40 M³
M.O.C.-RCC

EF1
PLC RIO-2

FROM TG AREA WASH DRAIN SUMP
(Ref. 1-WT-060-01597 Sheet 01 of 06)

PRE_OWS WASTE TRANSFER PUMPS
QTY : 1W + 1S
CAP :55 M³/ HR

PRE-OWS COLLECTION PIT
CAP : 200 M³
M.O.C : RCC

E26
MAIN PLC

OILY WASTE FROM SWITCHYARD AREA
TB-0-387-510-002

SWITCHYARD AREA OWS WASTE TRANSFER PUMPS #1
QTY : 1W + 1S
CAP :20 M³/ HR.

SWITCHYARD AREA OILY WASTE COLLECTION PIT #1
M.O.C.-RCC

EY1
PLC RIO-1

OILY WASTE FROM SWITCHYARD AREA
TB-0-387-510-002

SWITCHYARD AREA OWS WASTE TRANSFER PUMPS #2
QTY : 1W + 1S
CAP :20 M³/ HR.

SWITCHYARD AREA OILY WASTE COLLECTION PIT #2
M.O.C.-RCC

EY2
PLC RIO-1

WASTE FROM HVAC SOFTNER PLANT OF FGD CONTROL ROOM-1
PE-DG-417-100-M001

FGD CONTRL ROOM HVAC SOFTNER PLANT PIT TRF PUMPS #1
QTY : 1W + 1S
CAP :10 M³/ HR.

FGD CONTRL ROOM HVAC SOFTNER PLANT WASTE PIT #1
CAP.-10 M³
M.O.C.-RCC

EH1
PLC RIO-1

WASTE FROM HVAC SOFTNER PLANT OF FGD CONTROL ROOM-2
PE-DG-417-100-M001

FGD CONTRL ROOM HVAC SOFTNER PLANT PIT TRF PUMPS #2
QTY : 1W + 1S
CAP :10 M³/ HR.

FGD CONTRL ROOM HVAC SOFTNER PLANT WASTE PIT #2
CAP.-10 M³
M.O.C.-RCC

EH2
PLC RIO-2

TO CMB
(Ref. 1-WT-060-01597 Sheet 03 of 06)

OILY WASTE FROM AUX. BOILER AREA
PE-DG-417-100-M001

AUXILLARY BOILER AREA WASTE TRANSFER PUMPS
QTY : 1W + 1S
CAP :10 M³/ HR.

EA1
PLC RIO-1

AUXILLARY BOILER AREA OILY WASTE COLLECTION PIT
CAP.-10 M³
M.O.C.-RCC

OILY WASTE FROM CENTRAL LUBE OIL SYSTEM #1
PE-DG-417-167-M221

CENTRAL LUBE OIL SYSTEM OILY WASTE PIT TRF PUMPS STATION #1
QTY : 1W + 1S
CAP :10 M³/ HR.

CENTRAL LUBE OIL SYSTEM OILY WASTE COLLECTION PIT STATION #1
CAP.-10 M³
M.O.C.-RCC

EL1
PLC RIO-1

OILY WASTE FROM CENTRAL LUBE OIL SYSTEM #2
PE-DG-417-167-M221

CENTRAL LUBE OIL SYSTEM OILY WASTE PIT TRF PUMPS STATION #2
QTY : 1W + 1S
CAP :10 M³/ HR.

CENTRAL LUBE OIL SYSTEM PIT STATION #2
CAP.-10 M³
M.O.C.-RCC

EL2
PLC RIO-2

SLOP STORAGE TANK
Capacity : 2m³
MOC : MS

TO CMB
(REF 1-WT-060-01597 Sheet 03 of 06)

1no. Carbuoy with trolley

Platform

OIL WATER SEPARATOR
QTY : 1NO
CAP. -50 M³/ HR.

E27
MAIN PLC

TO ETP CLARIFIER SLUDGE PIT
(REF 1-WT-060-01597 Sheet 04 of 06)

CPI SLUDGE TRF PUMPS
QTY : 1W + 1S
CAP : 4 M³/ HR.

CPI SLUDGE PIT
Capacity : 4m³
MOC : RCC

E28
MAIN PLC
ZONE-02

CPI SLUDGE BLOWER ZONE-03
QTY : 1W + 1S
CAP : M³/ HR.

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PROJECT: YADADRI THERMAL POWER STATION (5X800 MW)

OWNER: TELENGANA STATE POWER GENERATION CORPORATION LIMITED

OWNER'S CONSULTANT: TATA CONSULTING ENGINEERS LIMITED BANGALORE

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI
UNIT : BOILER AUXILARIES PLANT ; RANIPET
PACKAGE : PT PLANT

TITLE: P&ID DIAGRAM FOR EFFLUENT TREATMENT PLANT.

	NAME	SIGN.	DATE
DRAWN	M.V	Sd/-	27.05.19
CHECKED	S.S	Sd/-	27.05.19
APPROVED	M.S.M	Sd/-	27.05.19

REV	DATE	ALTERED:	A.J.V
02	22.07.21	CHECKED:	S.S
ZONE	Revised for tender		
REV	DATE	ALTERED:	A.J.V
01	12.02.21	CHECKED:	S.S
ZONE	Revised based on resolutions dt.23.01.21		

ALL DIMENSIONS ARE IN MILLIMETRES

BHEL DRAWING NO. 1-WT-060-01597 REV 02

DEPT. DPG 2008 | DRG. NO. 9776 | GRADE OF UNTOL.DIM PR-QA-500 | PROJECTION | SCALE N.T.S | SH. 2 OF 6

Size A1

ROS-6278

DRAWING NO. 1-WT-060-01597

ALL DIMENSIONS ARE IN MILLIMETRES

WASTE WATER FROM BOILER AREA UNIT-1
PE-DG-417-100-M001
HVAC WASTE WATER FROM ESP CONROL BUILDING 1
PE-DG-417-100-M002

BOILER AREA WASTE WATER TRANSFER PUMPS#UNIT-1

QTY : 1W + 1S
CAP : 10 M³/ HR.

EB1 BOILER AREA WASH PIT #UNIT-1
CAP.-10 M³
M.O.C.-RCC
PLC RIO-1

WASTE WATER FROM TG AREA UNIT-1
PE-DG-417-100-M001
HVAC WASTE WATER FROM POWER HOUSE 1&2 & ESP CONTROL BUILDING 2
PE-DG-417-100-M002

TG AREA WASTE WATER TRANSFER PUMPS#UNIT-1

QTY : 1W + 1S
CAP : 10 M³/ HR.

ET1 TG AREA WASH PIT #UNIT-1
CAP.-10 M³
M.O.C.-RCC
PLC RIO-1

WASTE WATER FROM SSF BACKWASH#UNIT-1
REF:3-WT-070-00875 (Sheet 01)

SSF BACKWASH WASTE WATER TRANSFER PUMPS STAGE-I

QTY : 1W + 1S
CAP :150 M³/ HR.

ES1 SSF BACKWASH PIT 1 STAGE-I
CAP.-300 M³
M.O.C.-RCC
MAIN PLC

WASTE WATER FROM SSF BACKWASH#UNIT-2
REF:3-WT-070-00875 (Sheet 02)

SSF BACKWASH WASTE WATER TRANSFER PUMPS STAGE-II

QTY : 1W + 1S
CAP :150 M³/ HR.

ES2 SSF BACKWASH PIT 2 STAGE-II
CAP.-450 M³
M.O.C.-RCC
PLC RIO-2

WASTE WATER FROM BOILER AREA UNIT-2
PE-DG-417-100-M001

BOILER AREA WASTE WATER TRANSFER PUMPS#UNIT-2

QTY : 1W + 1S
CAP : 10 M³/ HR.

EB2 BOILER AREA WASH PIT #UNIT-2
CAP.-10 M³
M.O.C.-RCC
PLC RIO-1

WASTE WATER FROM TG AREA UNIT-2
PE-DG-417-100-M001
HVAC WASTE WATER FROM SERVICE BUILDING 1 & ESP CONTROL BUILDING 3
PE-DG-417-100-M002

TG AREA WASTE WATER TRANSFER PUMPS#UNIT-2

QTY : 1W + 1S
CAP : 10 M³/ HR.

ET2 TG AREA WASH PIT #UNIT-2
CAP.-10 M³
M.O.C.-RCC
PLC RIO-1

(REF :1-WT-060-01597 Sheet 02 of 06)
TO PRE-OWS PIT

WASTE WATER FROM BOILER AREA UNIT-3
PE-DG-417-100-M001

BOILER AREA WASTE WATER TRANSFER PUMPS#UNIT-3

QTY : 1W + 1S
CAP : 10 M³/ HR.

EB3 BOILER AREA WASH PIT #UNIT-3
CAP.-10 M³
M.O.C.-RCC
PLC RIO-2

WASTE WATER FROM TG AREA UNIT-3
PE-DG-417-100-M001
HVAC WASTE WATER FROM POWER HOUSE 3&4 & ESP CONTROL BUILDING 4
PE-DG-417-100-M002

TG AREA WASTE WATER TRANSFER PUMPS#UNIT-3

QTY : 1W + 1S
CAP : 10 M³/ HR.

ET3 TG AREA WASH PIT #UNIT-3
CAP.-10 M³
M.O.C.-RCC
PLC RIO-2

WASTE WATER FROM BOILER AREA UNIT-4
PE-DG-417-100-M001

BOILER AREA WASTE WATER TRANSFER PUMPS#UNIT-4

QTY : 1W + 1S
CAP : 10 M³/ HR.

EB4 BOILER AREA WASH PIT #UNIT-4
CAP.-10 M³
M.O.C.-RCC
PLC RIO-2

WASTE WATER FROM TG AREA UNIT-4
PE-DG-417-100-M001
HVAC WASTE WATER FROM POWER HOUSE 5 & ESP CONTROL BUILDING 5
PE-DG-417-100-M002

TG AREA WASTE WATER TRANSFER PUMPS#UNIT-4

QTY : 1W + 1S
CAP : 10 M³/ HR.

ET4 TG AREA WASH PIT #UNIT-4
CAP.-10 M³
M.O.C.-RCC
PLC RIO-2

WASTE WATER FROM BOILER AREA UNIT-5
PE-DG-417-100-M001

BOILER AREA WASTE WATER TRANSFER PUMPS#UNIT-5

QTY : 1W + 1S
CAP : 10 M³/ HR.

EB5 BOILER AREA WASH PIT #UNIT-5
CAP.-10 M³
M.O.C.-RCC
PLC RIO-2

WASTE WATER FROM TG AREA UNIT-5
PE-DG-417-100-M001
HVAC WASTE WATER FROM SERVICE BUILDING 2
PE-DG-417-100-M002

TG AREA WASTE WATER TRANSFER PUMPS#UNIT-5

QTY : 1W + 1S
CAP : 10 M³/ HR.

ET5 TG AREA WASH PIT #UNIT-5
CAP.-10 M³
M.O.C.-RCC
PLC RIO-2

ALKALI DOSING
ACID DOSING
(REFER SHEET 06 OF 06)

FROM OIL WATER SEPARATOR (REFER SHEET 03 OF 06)
DM PLANT WASTE (REF :1-WT-500-01295)
CT BLOW DOWN WASTE (REF PE-DG-417-145-M001)
CPU REGN. WASTE (REF PE-DG-417-159A-M001)
ETP UF BACKWASH WASTE (REFER SHEET 05 OF 06)
FGD CONTRL ROOM HVAC SOFTNER PLANT PITS (REF Sheet 02 of 06)

CENTRAL MONITORING BASIN(COMPARTMENT-A)
CAPACITY: 1500M3
MOC: RCC

CENTRAL MONITORING BASIN(COMPARTMENT-B)
CAPACITY: 1500M3
MOC: RCC

CENTRAL MONITORING BASIN (TWO COMPARTMENT) EACH
CAPACITY: 3000M3
QTY: 1 NO.
MAIN PLC

TO HRSCC CLARIFIER

CLARIFIER FEED PUMPS

QTY : 1W + 1S
CAP :228 M³/ HR.

REV	DATE	ALTERED:
02	22.07.21	CHECKED:
ZONE	Revised for tender	
REV	DATE	ALTERED: AJV
01	12.02.21	CHECKED: SS
ZONE	Revised based on resolutions dt.23.01.21	

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PROJECT	YADADRI THERMAL POWER STATION (5X800 MW)
OWNER	TELENGANA STATE POWER GENERATION CORPORATION LIMITED
OWNER'S CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BANGALORE
EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI
	UNIT : BOILER AUXILARIES PLANT ; RANIPET PACKAGE : PT PLANT

TITLE: P&ID DIAGRAM FOR EFFLUENT TREATMENT PLANT.

	NAME	SIGN.	DATE
DRAWN	M.V	Sd/-	27.05.19
CHECKED	S.S	Sd/-	27.05.19
APPROVED	M.S.M	Sd/-	27.05.19

ALL DIMENSIONS ARE IN MILLIMETRES | BHEL DRAWING NO. 1-WT-060-01597 | REV 02
DEPT CODE: DPG 8778 | GRADE OF UNTOL.DIM PR-QA-500 | PROJECTION | SCALE N.T.S | Sh. 1 Of 6

Size A1

DRAWING NO. 1-WT-060-01597

ALL DIMENSIONS ARE IN MILLIMETRES

From Clarifier feed pumps
Refer Sheet 3

STILLING CHAMBER
QTY:1
MOC:RCC
CAP:4M³

INLET CHAMBER

CLARIFIER HRSCC
QTY:1NO.
CAP:220.5M³/HR.

FLUSHING LINE

TO STORM WATER DRAIN

OVER FLOW LINE

CLARIFIED WATER TANK
Capacity 230m³
MOC: RCC

RECIRCULATION

CLARIFIED WATER TRANSFER PUMPS
QTY : 3nos. (2W+1S)
CAP : 111M3/HR @2.5 BAR(G)

TO UF BASKET STRAINERS
Refer Sheet 5 of 6

FROM CPI SLUDGE PIT
Refer Sheet 2 OF 6

SLUDGE COLLECTION PIT
CAP.- 30M3
M.O.C.- RCC

CENTRIFUGE FEED PUMPS
QTY:2Nos(1W+1S)
CAP:10M³/hr EACH
TYPE: Vertical Centrifugal

DEWATERING POLYELECTROLYTE FROM DOSING PUMP

CENTRIFUGE
1X100%
Capacity :10m³/hr

SLUDGE TROLLEY : 1No.
SLUDGE (DISPOSAL MANUALLY BY CUSTOMER)

TO CENTRAL MONITORING BASIN
Refer Sheet 3 of 6

SLUDGE PIT BLOWERS (1W+1S)
CAP.- 50 M3/HR EACH

Utility/ Service water

REFER DRG. NO.:
PE-DG-417-172-N003

LIME SOLUTION SLAKING TANKS
QTY : 1 NO.

SLAKED LIME TRANSFER PUMPS
QTY : 2 NOS. (1W+1S)
TYPE: HOR.CENTRIFUGAL

LIME SOLUTION PREP.CUM DOSING TANK
QTY : 1 NO.

LIME DOSING PUMPS
QTY : 2 NOS. (1W+1S)
TYPE: HOR.CENTRIFUGAL

POLYELECTROLYTE DOSING TANK
QTY : 1 NO.

POLYELECTROLYTE INJECTION PUMPS
QTY : 2 NOS. (1W+1S)

FeCL₃ DOSING SKID

PREPARATION / DOSING TANK

DOSING PUMPS
QTY : 2 NOS. (1W+1S)

TO STILLING CHAMBER OF ETP CLARIFIER

ACID DOSING SKID

DOSG. TANK

DOSING PUMPS
QTY : 2 NOS. (1W+1S)

TO CMB
Refer sheet 03 of 06

ALKALI DOSING SKID

PREPARATION / DOSING TANK

DOSING PUMPS
QTY : 2 NOS. (1W+1S)

TO CMB
Refer sheet 03 of 06

DEWATERING POLYELECTROLYTE DOSING TANK
QTY : 1 NO.

CPVC SCH.80

DEWATERING POLYELECTROLYTE INJECTION PUMPS
QTY : 2 NOS. (1W+1S)

TO STILLING CHAMBER OF ETP CLARIFIER

REV	DATE	ALTERED:	AJV
02	22.07.21	CHECKED:	SS
ZONE 2A	Revised for tender		
REV	DATE	ALTERED:	AJV
01	12.02.21	CHECKED:	SS
ZONE 1A	Revised based on resolutions dt.23.01.21		

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PROJECT	YADADRI THERMAL POWER STATION (5X800 MW)
OWNER	TELENGANA STATE POWER GENERATION CORPORATION LIMITED
OWNER'S CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BANGALORE
EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI UNIT : BOILER AUXILARIES PLANT ; RANIPET PACKAGE : PT PLANT

TITLE: P&ID DIAGRAM FOR EFFLUENT TREATMENT PLANT.

	NAME	SIGN.	DATE
DRAWN	M.V	Sd/-	27.05.19
CHECKED	S.S	Sd/-	27.05.19
APPROVED	M.S.M	Sd/-	27.05.19

ALL DIMENSIONS ARE IN MILLIMETRES | BHEL DRAWING NO. 1-WT-060-01597 | REV 02

DEPT. DPG | CODE 9776 | GRADE OF UNTOL.DIM PR/QA-500 | PROJECTION | SCALE N.T.S | SH. 4 OF 6

Size A1

ROS-6278

DRAWING NO. 1-WT-060-01597

ALL DIMENSIONS ARE IN MILLIMETRES

FROM CLARIFIED WATER TRANSFER PUMP
REFER SHEET 02
FLOW : 227.25 m3/hr

AUTO SELF CLEANING STRAINER
QTY: 2Nos(2W+1S)
CAP: 111m3/hr
MOC: SS316

FEED DISTRIBUTION CHANNEL (RCC)

MEMBRANE TANK-A (RCC)

MEMBRANE TANK-B (RCC)

MEMBRANE TANK-C (RCC)

UF SYSTEM
QTY: 3NOS(2W+1S)
TYPE:SUBMERGED
MOC:PVDF
CAP: 99.5M³/HR (EACH)

PERMEATE/BACKPULSE PUMP
QTY: 6NOs.(5W+1S)
CAP: 99.5m3/hr min Each
MOC:SS316

TO RO FEED PUMPS
REFER DRG. NO :
1-WT-060-01597 Sht. 6 of 6

UF PRODUCT WATER TANK
CAP:200m³
MOC:RCC

SERVICE WATER FROM PLANT SERVICE WATER SOURCE
REFER DRG. NO :
PE-DG-417-172-N003

BACKPULSE TANK
1NO. (FRP)

MEMBRANE AIR BLOWERS
QTY: 2Nos.(1W+1S)

Utility Service water
REFER DRG. NO :
PE-DG-417-172-N003

NaOCl DOSING SKID
TANK 1NO.
DOSING PUMPS 2NOS. (1W+1S)

CITRIC ACID DOSING SKID
TANK 1NO.
DOSING PUMPS 2NOS. (1W+1S)

HCl DOSING SKID
TANK 1NO.
DOSING PUMPS 2NOS. (1W+1S)

NaOCl SOLN FOR MC & RC FROM DOSING PUMP
HCL SOLN FOR MC & RC FROM DOSING PUMP
CITRIC ACID FOR MC & RC FROM DOSING PUMP

CLEAN IN PLACE /DRAIN PUMP
QTY: 2NOs. (1W+1S)

CLEAN-IN-PLACE TANK
1NO. (FRP)

UF BACWASH WASTE COLLECTION PIT
CAP:30Cu.m
MOC:RCC

UF BACWASH WASTE DISPOSAL PUMPS
QTY: 2NOs.(1W+1S)
CAP: m3/hr

TO CMB
Refer sheet 03 of 06

REV	DATE	ALTERED:	A/V
02	22.07.21	CHECKED:	SS
ZONE	Revised for tender		
REV	DATE	ALTERED:	A/V
01	12.02.21	CHECKED:	SS
ZONE	Revised based on resolutions dt.23.01.21		

CAUTION: THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

PROJECT: YADADRI THERMAL POWER STATION (5X800 MW)

OWNER: TELENGANA STATE POWER GENERATION CORPORATION LIMITED

OWNER'S CONSULTANT: TATA CONSULTING ENGINEERS LIMITED BANGALORE

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI
UNIT : BOILER AUXILARIES PLANT ; RANIPET
PACKAGE : PT PLANT

TITLE: P&ID DIAGRAM FOR EFFLUENT TREATMENT PLANT.

	NAME	SIGN.	DATE
DRAWN	M.V	Sd/-	27.05.19
CHECKED	S.S	Sd/-	27.05.19
APPROVED	M.S.M	Sd/-	27.05.19

ALL DIMENSIONS ARE IN MILLIMETRES

BHEL DRAWING NO. 1-WT-060-01597 SH. 1 OF 6

REV 02

DEPT. DPG CODE 8778

GRADE OF UNTOL DIM PR-QA-500

PROJECTION

SCALE N.T.S

Size A1

DRAWING NO. 1-WT-060-01597

ALL DIMENSIONS ARE IN MILLIMETRES

RETURN TO UF PRODUCT WATER TANK
REFER DRG. NO :
1-WT-060-01597 Sht. 5 of 6

CONTD WITH INST.
TAG NOS:
REFER DRG. NO :
1-WT-060-01597 Sht. 5 of 6

300 NB GRP PN10
FROM UF PRODUCT WATER TANK
REFER DRG. NO :
1-WT-060-01597 Sht. 5 of 6

RO FEED PUMPS
QTY: 3NOs.(2W+1S)
CAP: 110m3/hr @ 2 BAR

ACID DOSING FROM DOSING PUMP

ANTISCALANT DOSING FROM DOSING PUMP

DECHLORINATION DOSING FROM DOSING PUMP

STATIC MIXER

TO CLARIFIER WASH TANK

CART. FILTERS
QTY: 2W
CAP: 99.5m3/hr Each
PORE SIZE: 5 MICRON

DUMP TO UF BACKWASH WASTE PIT
REFER DRG. NO :
1-WT-060-01597 Sht. 5 of 6

HP PUMPS
(VERTICAL-CENTRIFUGAL)
QTY: 3NOs.(2W+1S)
CAP:110m3/hr @ 15BAR(g)
MOC: SS316

CLNG. PRODUCT RETURN TO CC TANK
100NB UPVC SCH40

RO, STAGE - 1

RO, STAGE - 2

CLNG. BRINE RTN.TO CC TANK

80NB UPVC SCH40

RO SYSTEM (2 STREAMS)
QTY:2W
CAP: 74.5m3/hr each
75% recovery

RO reject to CW blowdown pipeof stage-1

REFER DRG. NO :
PE-DC-417-165-N001
Sheet 1 of 5

TO CW FOREBAY STAGE-1
REFER DRG. NO :
PE-DC-417-165-N001 Sheet 1 of 5

RO PERMEATE TANK
1NO.(RCC-150m3)

RO PERMEATE TRANSFER PUMPS
QTY.3NOS.(1W+1S)
CAP: 165m3/hr each @2.5 BAR

CHEMICAL CLEANING TANK
QTY: 1 NO.
MOC: FRP
CAP: 10m3

CLEAN IN PLACE PUMPS
QTY: 2NOs.(1W+1S)
CAP: 108m3/hr @ 5.5 BAR

CARTRIDGE FILTER
QTY: 1 NO.
CAP: 108m3/hr
PORE SIZE: 5 MICRON

RO CHEMICAL CLENING SKID

REFER DRG. NO :
PE-DC-417-172-N003

DOSG. TANK
DOSING PUMPS
HCL DOSING SKID

PREP. TANK
DOSG. TANK
ANTISCALANT DOSING SKID

PREP. TANK
TANK
DECHLORINATION DOSING SKID

TO UF backwash waste pit
REFER DRG. NO :
1-WT-060-01597 Sht. 5 of 6

REV	DATE	ALTERED: AJV
02	22.07.21	CHECKED: S.S
ZONE	Revised for tender	
REV	DATE	ALTERED: AJV
01	03.02.21	CHECKED: S.S
ZONE	Revised based on CRS resolution on ETP Design Memo. dt.22.01.21	

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PROJECT: **YADADRI THERMAL POWER STATION (5X800 MW)**

OWNER: **TELENGANA STATE POWER GENERATION CORPORATION LIMITED**

OWNER'S CONSULTANT: **TATA CONSULTING ENGINEERS LIMITED BANGALORE**

EPC CONTRACTOR: **BHARAT HEAVY ELECTRICALS LIMITED,** NEW DELHI
UNIT : BOILER AUXILARIES PLANT : RANIPET
PACKAGE : PT PLANT

TITLE: P&ID DIAGRAM FOR EFFLUENT TREATMENT PLANT.

	NAME	SIGN.	DATE
DRAWN	Pugazh	Sd/-	27.05.19
CHECKED	AJV	Sd/-	27.05.19
APPROVED	S.S	Sd/-	27.05.19

ALL DIMENSIONS ARE IN MILLIMETRES

BHEL DRAWING NO. 1-WT-060-01597 SH: 6 OF 6

REV 02

DEPT CODE: DPG 9776

GRADE OF UNTOL DM PR-QA-500

PROJECTION

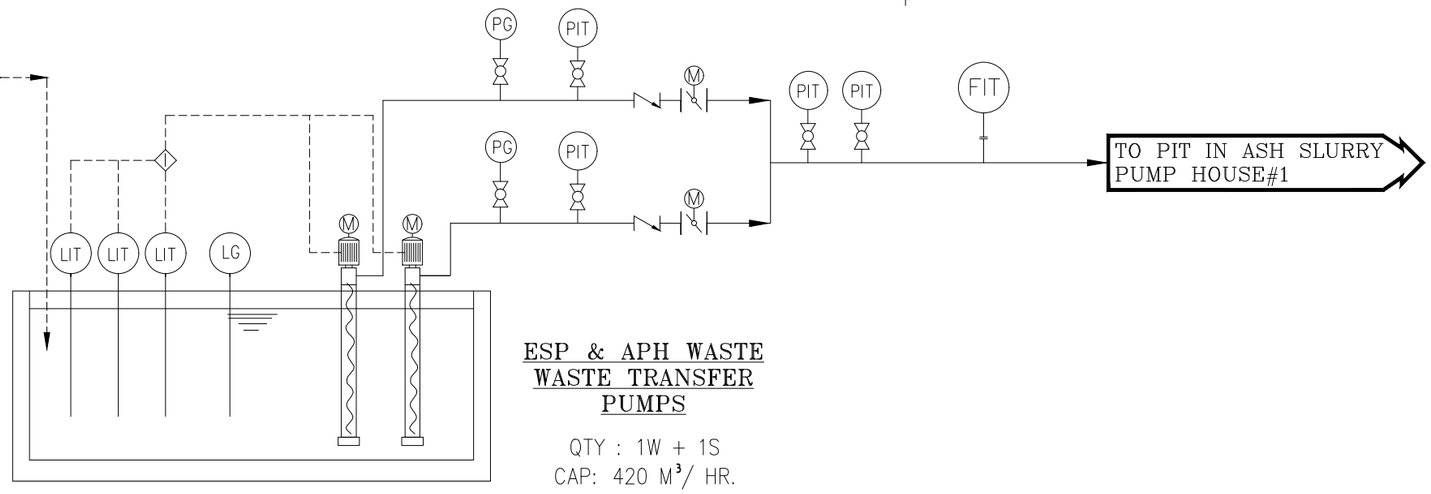
SCALE N.T.S

Size A1

DRAWING NO. 3-WT-060-01459

ALL DIMENSIONS ARE IN MILLIMETRES

ESP & APH WASTE WATER FROM UNITS 1 & 2



ESP & APH WASTE WASTE TRANSFER PUMPS

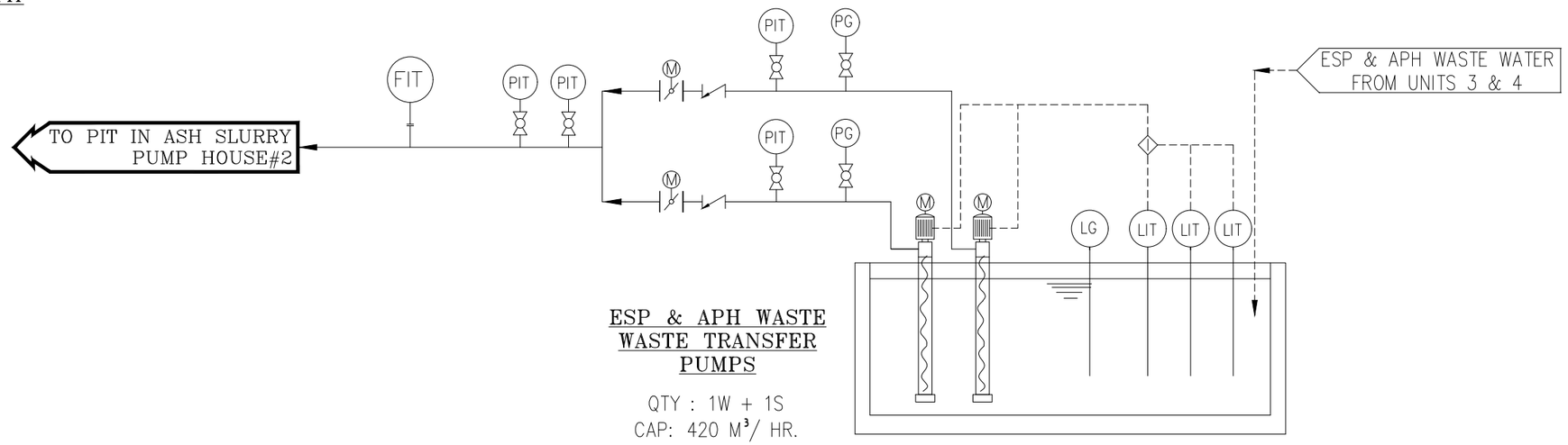
QTY : 1W + 1S
CAP: 420 M^3/ HR.

EE1

ESP, APH WASH PIT

CAP.–100 M^3
M.O.C.–RCC

ESP & APH WASTE WATER FROM UNITS 3 & 4



ESP & APH WASTE WASTE TRANSFER PUMPS

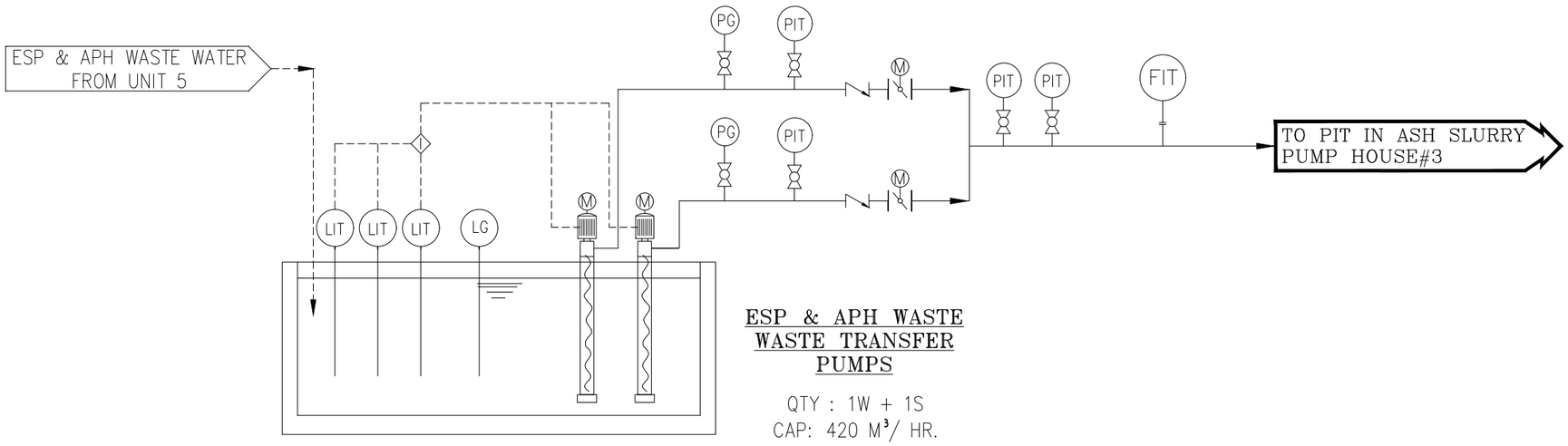
QTY : 1W + 1S
CAP: 420 M^3/ HR.

ESP, APH WASH PIT

CAP.–100 M^3
M.O.C.–RCC

EE2

ESP & APH WASTE WATER FROM UNIT 5



ESP & APH WASTE WASTE TRANSFER PUMPS

QTY : 1W + 1S
CAP: 420 M^3/ HR.

EE3

ESP, APH WASH PIT

CAP.–100 M^3
M.O.C.–RCC

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PROJECT: YADADRI THERMAL POWER STATION (5X800 MW)

OWNER: TELENGANA STATE POWER GENERATION CORPORATION LIMITED

OWNER'S CONSULTANT: TATA CONSULTING ENGINEERS LIMITED BANGALORE

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI
UNIT : BOILER AUXILARIES PLANT : RANIPET
PACKAGE : PT PLANT

TITLE: P&ID FOR EFFLUENT TREATMENT PLANT [ESP, APH WASH WATER]

	NAME	SIGN.	DATE
DRAWN	SV	Sd/-	04.08.21
CHECKED	BS	Sd/-	04.08.21
APPROVED	MSN	Sd/-	04.08.21

REV	DATE	ALTERED:
		CHECKED:
ZONE		

ALL DIMENSIONS ARE IN MILLIMETRES

DEPT. NR. CODE: 8076

UNITS ON PR.QA-585

PROJECTION

SCALE N.T.S

BHEL DRAWING NO. 3–WT–060–01459

REV 00

Project: Yadadri 5x800MW

Date: 04.08.21

EFFLUENT COLLECTION PIT, PUMP & PIPING DETAILS

Sl. no	Description	Pit / Sump					Pumps		Piping			Remarks
		ID	Capacity (m^3)	Qty (Nos.)	Size L x W x D (m)	Coordinates (m)	Qty (Nos.)	Capacity (m^3/hr)	Size	Line Tag	Length (m)	
1	SSF Backwash waste water pit - Stage-1	ES-1	300	1	15 x 10 x 2	S: 169.81 W: 238.00	2(1W+1S)	150	200NB	EPW-02	450	
2	SSF Backwash waste water pit - Stage-2	ES-2	450	1	15 x 15 x 2	S: 579.42 E: 858.00	2(1W+1S)	150	200NB	EPW-01	2110	
3	Boiler Area Wash Water pit Pit#1	EB-1	10	1	3 x 2 x 2	S: 167.99 W:112.23	2(1W+1S)	10	100NB	EPW-03	1550	
4	Boiler Area Wash Water pit Pit#2	EB-2	10	1	3 x 2 x 2	S: 169.44 E: 177.95	2(1W+1S)	10				
5	Boiler Area Wash Water pit Pit#3	EB-3	10	1	3 x 2 x 2	S: 168.20 E: 321.04	2(1W+1S)	10				
6	Boiler Area Wash Water pit Pit#4	EB-4	10	1	3 x 2 x 2	S: 168.05 E: 542.15	2(1W+1S)	10				
7	Boiler Area Wash Water pit Pit#5	EB-5	10	1	3 x 2 x 2	S: 167.97 E: 685.19	2(1W+1S)	10				
8	TG area wash water pit Pit#1	ET-1	10	1	3 x 2 x 2	S: 255.37 W: 136.30	2(1W+1S)	10	100NB	EPW-04	1730	
9	TG area wash water pit Pit#2	ET-2	10	1	3 x 2 x 2	S: 231.80 E: 129.25	2(1W+1S)	10				
10	TG area wash water pit Pit#3	ET-3	10	1	3 x 2 x 2	S: 242.75 E: 419.37	2(1W+1S)	10				
11	TG area wash water pit Pit#4	ET-4	10	1	3 x 2 x 2	S: 255.37 E: 561.24	2(1W+1S)	10				
12	TG area wash water pit Pit#5	ET-5	10	1	3 x 2 x 2	S: 264.38 E: 691.13	2(1W+1S)	10				
13	Retention pit for Oily Water from Fuel Oil area	EF-1	40	1	5 x 4 x 2	N: 419.93 E: 485.29	2(1W+1S)	20	100NB	EPO-03	1720	
14	Retention pit for Oily waste from Aux. Boiler area	EA-1	10	1	3 x 2 x 2	N: 10.00 E: 319.50	2(1W+1S)	10				
15	Oily waste from Transformer Yard Area Pit#1	EX-1	151	1	5.5 x 13 x 2.1	S: 385.95 W: 157.80	2(1W+1S)	20	150NB	EPO-01	2090	
16	Oily waste from Transformer Yard Area Pit#2	EX-2	154	1	5.5 x 13 x 2.145	S: 392.05 W: 22.67	2(1W+1S)	20				
17	Oily waste from Transformer Yard Area Pit#3	EX-3	152	1	5.5 x 13 x 2.125	S: 391.35 E: 314.95	2(1W+1S)	20				
18	Oily waste from Transformer Yard Area Pit#4	EX-4	154	1	5.5 x 13 x 2.15	S: 394.80 E: 504.94	2(1W+1S)	20				
19	Oily waste from Transformer Yard Area Pit#5	EX-5	169	1	5.5 x 13 x 2.35	S: 394.8 E: 649.06	2(1W+1S)	20				
20	Oily waste from Transformer Yard Area Pit#6	EX-6	169	1	5.5 x 13 x 2.35	S: 350.85 E: 172.85	2(1W+1S)	20				
21	Retention pit for Oily waste from Switch Yard area#1	EY-1		1	3 x 3 x 1	S: 463.65 E: 199.63	2(1W+1S)	20				
22	Retention pit for Oily waste from Switch Yard area	EY-2		1	3 x 3 x 1	S: 463.62 E: 683.64	2(1W+1S)	20				

Project: Yadadri 5x800MW

Date: 04.08.21

EFFLUENT COLLECTION PIT, PUMP & PIPING DETAILS

Sl. no	Description	Pit / Sump					Pumps		Piping			Remarks
		ID	Capacity (m^3)	Qty (Nos.)	Size L x W x D (m)	Coordinates (m)	Qty (Nos.)	Capacity (m^3/hr)	Size	Line Tag	Length (m)	
23	FGD control room HVAC softener plant pit #1	EH-1	10	1	2 x 1 x 2	N: 30.74 E: 98.53	2(1W+1S)	10	80NB	EPW-05	1430	
24	FGD control room HVAC softener plant pit #2	EH-2	10	1	2 x 1 x 2	N: 14.00 E: 562.00	2(1W+1S)	10				
25	Central Lube oil system pit Station#1 Location 1	EL-1	10	1	3 x 2 x 2	S: 269.27 W: 9.36	2(1W+1S)	10	100NB	EPO-02	1290	
26	Central Lube oil system pit Station#2 Location 2	EL-2	10	1	3 x 2 x 2	S: 269.27 E: 423.62	2(1W+1S)	10				
27	ESP, APH area wash pit #1 (common for units 1 & 2)	EE-1	100	1	7.5 x 7.5 x 2	S: 130.20 E: 152.46	2(1W+1S)	420	250 NB	EPW-06	480	
28	ESP, APH area wash pit #1 (common for units 3 & 4)	EE-2	100	1	7.5 x 7.5 x 2	S: 132.36 E: 591.61	2(1W+1S)	420	250 NB	EPW-07	440	
29	ESP, APH area wash pit #1 (for unit 5)	EE-3	100	1	6 x 6 x 3	S: 129.16 E: 733.90	2(1W+1S)	420	250 NB	EPW-08	340	

Other Terminal Piping

a ETP RO Permeate (from ETP to CW Forebay stage-1) Size: 200NB GRP Length: 500 m

b ETP RO Reject (from ETP to CW Blowdown Line stage-1) Size: 150NB Length: 300 m

NORTH

COMPARTMENT-1

RAW WATER RESERVOIR

TUNGAPAHAD VAGU

EFFLUENT COLLECTION NETWORK

BURIED PIPE CORIDOR 20 M WIDE

BURIED PIPE CORIDOR 20 M WIDE

BURIED PIPE CORIDOR

COMPARTMENT-II
CAP. 40250 CUB.M
(COVERED AT TOP)

COMPARTMENT-I
CAP. 40250 CUB.M
(COVERED AT TOP)

EL:4.0M
RL:85.5M(FGL)

EL:4.0M
RL:85.5M(FGL)

EL:4.0M
RL:85.5M(FGL)

EL:(-)0.25M
RL:81.25M(FFL)

EL:(-)1.5M
RL:80.0M(FGL)

EL:(-)3.5M
RL:78.0M(FGL)

EL:1.5M
RL:83.0M(FGL)

EL:1.5M
RL:83.0M(FGL)

CT#1

CT#2

CT#3

CT#4

CT#5

BOILER#1

BOILER#2

BOILER#3

BOILER#4

BOILER#5

ESP CONTROL ROOM #1

ESP CONTROL ROOM #2

ESP CONTROL ROOM #3

ESP CONTROL ROOM #4

ESP CONTROL ROOM #5

SPACE FOR SERIES REACTOR

SWITCHYARD
STORAGE
75X75 SQM

UNDER UTILISATION

UNCRUSHED LIMESTONE DUMPING AREA WITH STRUCTURAL SHED 80M(L) X 40M (W) X 16.7M (CLEAR HEIGHT)

AHP CLARIFIERS 1&2 DIA: 24m

CON.TRF.

REFERENCE : PE-DG-417-100-M001

ROS-6278

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