BHEL DOC NO: PE-V0-412-164-A015			
Clear Water Limited **B- 14/1, Okhla Industrial Area, Phase II** **New Delhi – 110 020**	**Data Sheet for** **Diaphragm Type Pressure Gauge**	**CWL DOC. NO.**	**DS-01/17-04M(92-PG)**
		REV	**00**
		Sheet	**3 of 3**

A) Under noted Gauges shall have sealed Diaphragm with Chemical Seal for use on Raw effluent line , Alum , PE Chemical lines ; Air Line with ½ " Connectors; PG isolation shall be thru ½" Gauge cock.

	Tag No.	Dia Size	Max. Working Process Pressure(Kg/cm2)	Scale Range (Kg/Cm^2)	Qty (No.)	Location
1	Refer P&I Drg.	150	1.0	0 to 6	22	Field Sump Transfer Pumps ; Air Blower
2		150	3.0	0 to 6	4	CMB & Guard Pumps
3		150	0.5	0 to 2	10	Chemical Dosing Pumps
4.1	Mandatory Spares	150	2.0	0 to 2	2	--
4.2	Mandatory Spares	150	3.0	0 to 6	2	--
	Sub Total				**40**	

B) Undernoted Gauges shall have sealed Diaphragm with Chemical Seal but with additional 1 1/2"bore flange for sludge and Lime application. Flange shall conform to ANSI B 16.5 cl. 150; For application on Lime and Sludge lines. PG isolation for shall be thru 40 dia GM Globe valve

1	1GBN62 CP501, 502	150	2.0	0 to 4	2	Lime Solution dosing Pump
2	1GBR17 CP501, 502	150	2.0	0 to 4	2	Sludge Transfer Pump
3	Mandatory Spare	150	2.0	0 to 4	2	---
	Sub Total				**6**	
				Total	**46**	

Rev	Description	Date
01	For approval	13.11.18

Project: 2x660 MW Ennore Sez STPP
Client: Ennore
Consultant: Desein Pvt Ltd

MOUNTING & CONNECTION DETAIL

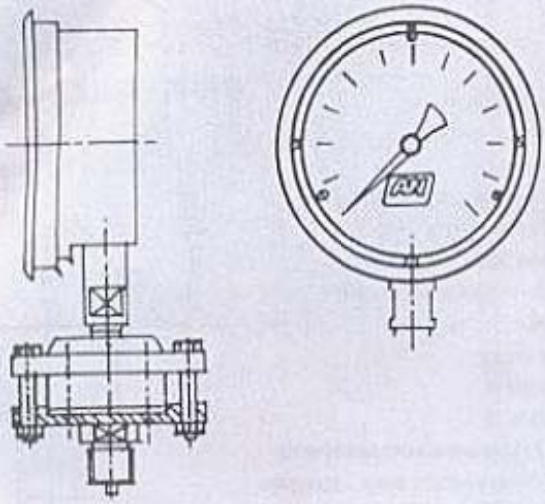


FIGURE — 1

TITLE : SEALED UNIT DIAPHRAGM PRESSURE GAUGE WITH SCREWED CONNECTION

TYPE	DIRECT
CONSTRUCTION	WELDED/LOOSE DIAPHRAGM
PROCESS CONNECTION AVAILABLE	1/2" BSP 1/2" NPT & M20 X 1.5 mm (OTHER CONNECTION AVAILABLE ON REQUEST.)

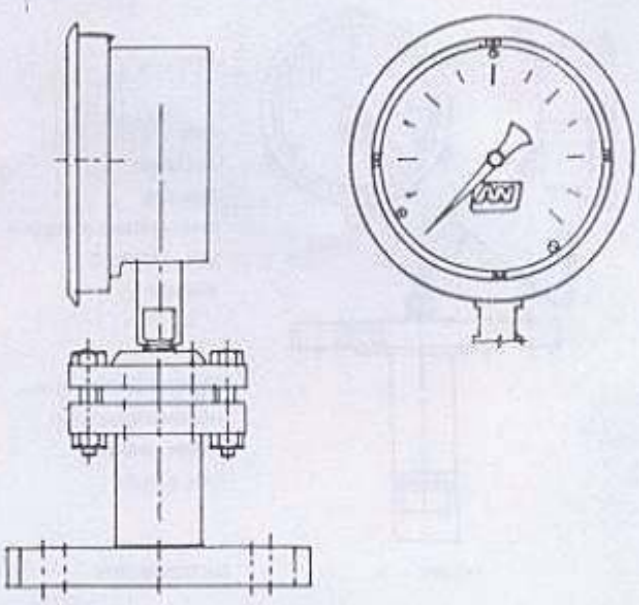


FIGURE — 2

TITLE : SEALED UNIT DIAPHRAGM PRESSURE GAUGE WITH NECK TYPE FLANGE CONNECTION

TYPE	DIRECT
CONSTRUCTION	WELDED/LOOSE DIAPHRAGM
PROCESS CONNECTION AVAILABLE	½", 1" & 1½", NB AS PER BS ASA & DIN STANDARD

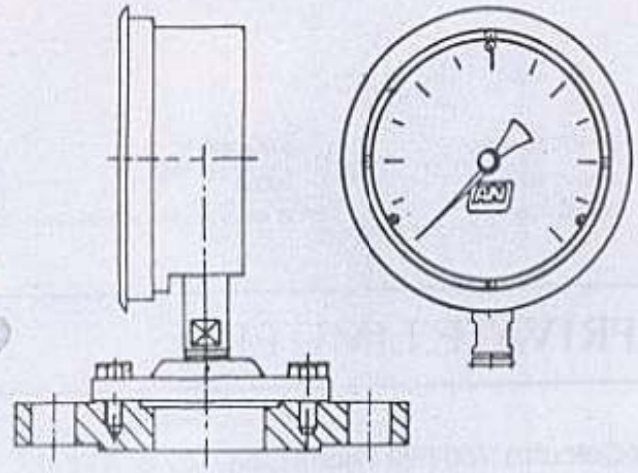
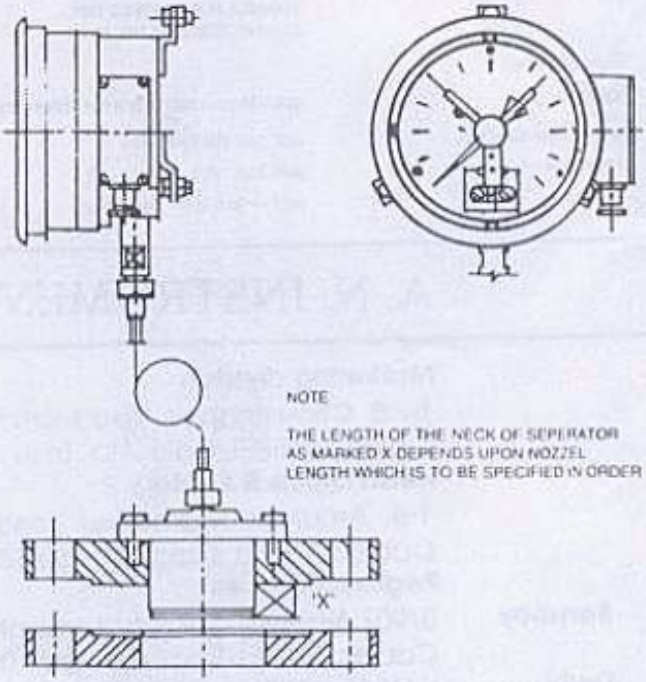


FIGURE-3

TITLE : SEALED UNIT DIAPHRAGM PRESSUR GAUGE WITH DIRECT TYPE FLANGED CONNECTION

TYPE	DIRECT
CONTRUCTION	LOOSE DIAPHRAGM
PROCESS CONNECTION AVAILABLE	2" NB & ABOVE AS PER BS, ASA DIN STANDARD (TOP CHAMBER BOLTED TO BOTTOM CHAMBER)



NOTE

THE LENGTH OF THE NECK OF SEPERATOR AS MARKED X DEPENDS UPON NOZZEL LENGTH WHICH IS TO BE SPECIFIED IN ORDER

FIGURE 4

TYPE	DISTANT (CAPILLARY)
CONSTRUCTION	WELDED DIAPHRAGM
PROCESS CONNECTION AVAILABLE	FLANGED — 2" NB & ABOVE AS PER BS ASA & DIN STANDARD (TOP CHAMBER BOLTED TO BOTTOM CHAMBER)

PRINCIPLE OF OPERATION

Diaphragm sealed gauge commonly known as "chemic .l seal" gauge are designed and recomended to isolate the measuring system of a pressure gauge from corrosive, pasty or dangerou s fluid depending on the viceosity, pressure, temperature, solidifiction of a particular process medium.

The diaphragm seal has been filled under vacuuam with the transmitt ng liquid, the pressure gauge/diaphragm seal assembly must never be dismantled.

A carefully designed corrogated diaphragm is used to achieve maximum flexibility and linearity with sufficient stroke to provide the displacement needed to produce full deflection of the sensing element.

The diaphragm is argon are welded to the top chamber to ensure a perfect sealing "No. LEAK". In some cases the diaphragm is coated OR lined with a second membrane (teflon). The welded construction facilitates removal of the gauge for repair service without process shut down.

The displacement of the diaphragm is transmitted to the bourdon sensing element, through solidly filled liquid having low cubical expansion with greater temperature stability.

The gauge indicator is either directly fitted with the sealed chamber OR by means of capillary tube, thus permitting easier mounting OR the remote reading of the pressure.

TECHNICAL SPECIFICATION

TYPE	DIAPHRAGM SEALED
ACCURACY	± 1% of range span
PRESSURE GAUGE	
DIAL SIZE	100 & 150 mm
DIAL MATERIAL & COLOUR	Aluminium, Stove enamelled white
DIAL MARKINGS	Black on white ground
WINDOW	Clear glass-standard
	shatter proof glass-optional
BOURDON TUBE MATERIAL	AISI 316 ss
MOVEMENT MATERIAL	AISI 304 SS
SHANK MATERIAL	AISI 316 SS
ENCLOSURE	Die cast aluminium weather proof
	Stove enamelled balck—Standard
	Epoxy black painted—Optional
	Pressed AISI 304 ss — Optional
ENCLOSURE TYPE	IP-54/55/65
MOUNTING	LoCal (Direct)
	Local (Surface/Wall Projection)
	Flush Panel (remote sensing)
CONNECTION LOCATION	Bottom for direct & surface / Wall/ Projection mounting ; Back for flush panel mounting
CAPACITY	Spiral / Sheath
LENGTH OF CAPILLARY	Standard— 2 Metres
	Available upto 10 Metres
CAPILLARY MATERIAL	AISI 304 ss — Standard
	AISI 316 ss optional

Standard Fitment	Blow out disc
	Micro adjustable pointer
Standard ranges	Pressure : 0 – 1, 1.6, 2, 2.5, 4, 6, 10, 16, 25, 40, 60, 100, 160, 250, 400 & 600 kg/cm2
	Vacuum : 0 to 760 mm Hg Vac.
	Compound : (–)1 to (+)3, 5, 9, 15 & 24 kg/cm2
SEALED UNIT	
Construction	Diaphragm welded with SS chamber
	Diaphragm Loosely placed in between
	Top & Bottom chamber
Sensing element	Diaphragm
Diaphragm material	AISI 316 ss
Diaphragm Protection	Teflon coating Teflon foil (Loose)
Sealing liquid	Silicone oil
Top chamber	AISI 304 SS
Bottom chamber & connection material	AISI 316 SS – Standard Teflon coating – Optional
Connection	¼ BSP (M) ¼" NPT (M) M 20 x 1.5 mm (M) -Standard
	Flange as per BS, ASA & DIN Standard— Optional
ACCESSORIES AVAILABLE	ELECTRIC CONTACT BOOSTER RELAX
	Screwed 2 way 3 way
	ISOLATION VALVE COCK

DIAPHRAGM SEALED PRESSURE GAUGE

Diaphragm sealed gauge commonly known as "chemical seal" gauge are designed and recommended to isolate the measuring system of a pressure gauge from corrosive, pasty or dangerous fluid depending on the viceosity, pressure, temperature, solidification of a particular process medium.

The diaphragm seal has been filled under vacuum with the transmitting liquid, the pressure gauge/diaphragm seal assembly must never be dismantled.

A carefully designed corrogated diaphragm is used to achieve maximum flexibility and linearity with sufficient stroke to provide the displacement needed to produce full deflection of the sensing element.

The diaphragm is argon arc welded to the top chamber to ensure a perfect selling "No LEAK". In some cases the diaphragm is coated OR lined with a second membrane (teflon). The welded construction facilitates removal of the gauge for repair/service without process shut down.

The displacement of the diaphragm is transmitted to the bourdon sensing element, through solidly filled liquid having low cubical expansion with greater temperature stability.

The gauge indicator is either directly fitted with the sealed chamber OR by means of capillary tube, thus permitting easier mounting OR the remote reading of the pressure.

TECHNICAL SPECIFICATIONS :

TYPE	DIAGHRAM SEALED	**STANDARD FITMENT**	Blow out disc
ACCURACY	+/- 1% of range span		
DIAL SIZE	100 & 150 mm	**STANDARD RANGES**	Pressure : 0 – 1,1.6,2,2.5,4,6,10,16,25, 40,60,100,160,250,400 & 600 kg/cm^2
WINDOW	Clear glass-standard shatter proof glass-optional		Vacuum: 0 to 760 mm Hg Vac Compound: (-)1 to (+)3, 5, 9, 15 & 24 kg/cm^2
BOURDON TUBE MATERIAL	AISI 316 ss		
MOVEMENT MATERIAL	AISI 316 SS	**SEALED UNIT CONSTRUCTION**	Diaphragm welded with SS chamber
SHANK MATERIAL	AISI 316 SS		Diaphragm Loosely placed in between Top & Bottom chamber
ENCLOSURE	Die cast aluminium weather proof Stove enamelled black-Standard	**SENSING ELEMENT**	Diaphragm
		DIAPHRAGM MATERIAL	AISI 316 ss

	Pressed AISI 304 ss- Optional		
ENCLOSURE TYPE	IP65		
MOUNTING	Local (Direct) Local (Surface/Wall Projection) Flush Panel (remote sensing)	**SEALING LIQUID**	Silicone oil
		TOP CHAMBER	AISI 304 SS
CONNECTION LOCATION	Bottom for direct & surface / Wall / Projection mounting Back for flush panel mounting	**BOTTOM CHAMBER & CONNECTION MATERIAL**	AISI 316 SS
		CONNECTION	½ BSP (M) ½" NPT (M) M20 x 1.5mm (M) – Standard
CAPILLARY PROTECTION	Spiral / Sheath		Flanged as per BS, ASA & DIN
LENGTH OF CAPILLARY	Standard-2 Metres Available upto 10 Metres		
CAPILLARY MATERIAL	AISI 316 ss		
CAPILLARY PROTECTION MATERIAL	AISI 304 ss		

- **Diaphgram operated chemical sealed pressure gauge bottom entry**
- **Diaphgram operated chemical sealed pressure gauge back entry**

Top

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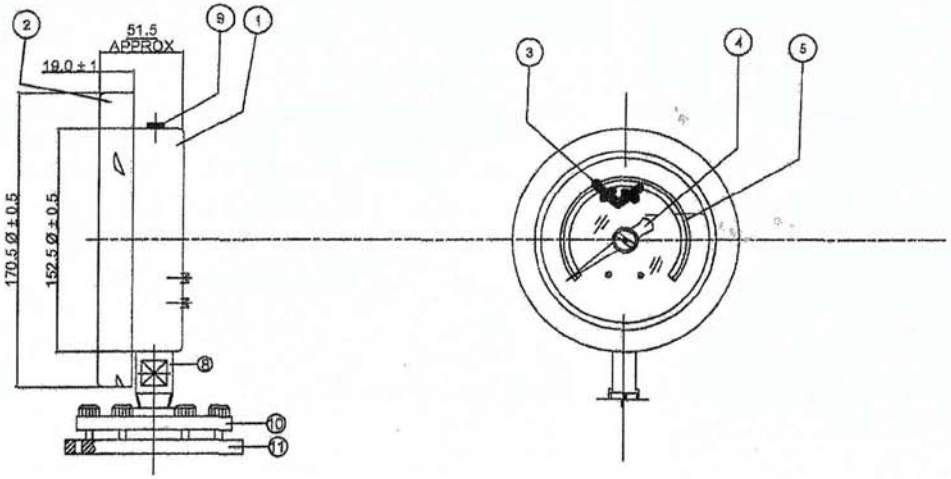
2A, Chowringhee Square, Calcutta – 700 069, India



BILL OF MATERIALS

SL NO	DESCRIPTION	MATERIAL	REMARKS
1	CASE	PRESSED AISI 304 SS	SELF COLOUR FINISH
2	BEZEL (BAYONET TYPE)	DO	DO
3	DIAL WINDOW	GLASS	SHATTER PROOF
4	POINTER	ALUMINIUM	ANODISED BLACK
5	DIAL	ALUMINIUM	WHITE WITH BLACK LETTERS
6	MOVEMENT ASSY	AISI 304SS	
7	SENSING ELEMENT	AISI 316 SS	DIAPHRAGM
8	SHANK	AISI 316 SS	
9	BLOW OUT DISC	NEOPRENE	AT TOP
10	TOP CHAMBER		
11	PROCESS CONN.	AISI 316 SS	FLANGE WITH COUNTER FLANGE

SPECIFICATION

DIAL SIZE	150 mm	CASE	WEATHER PROOF IP-65
CONNECTION	1½" N.B. (M) ANSI150 LBS RF SERR		
ACCURACY	±1% OF F.S.D.		
OVERRANGE PROTECTION	AS PER IS- 3624 1987		
MOUNTING	DIRECT WITH BOTTOM ENTRY		

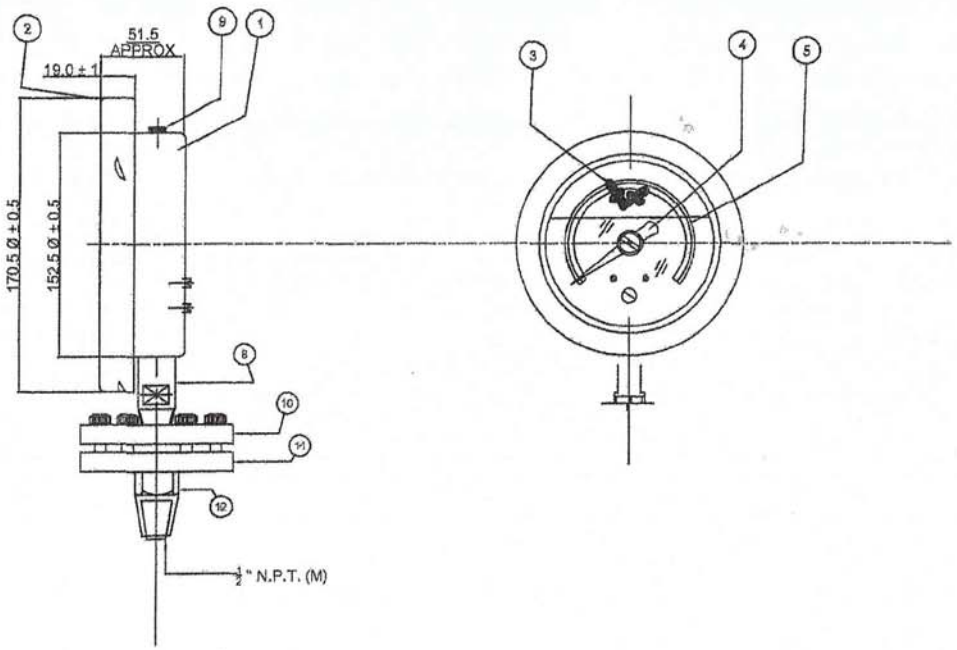
SL NO	RANGE	QTY
1	0 - 2 KG/CM²	NOS
2	0 - 6 KG/CM²	NOS

CLEAR WATER LTD. NEW DELHI

CUSTOMER	CLEARWATER LIMITED
PROJECT	ETP, ENNORE, TPP
OUR REF. NO.	
YOUR REF. NO.	17-04
MODEL NO.	6SUDG SD-F
	A.N. INSTRUMENTS(P) LTD.
TITLE	150 mm DIAL SEALED PRESSURE GAUGE(BOTTOM ENTRY)
DRAWN	
CHECKED	
APPROVED	

NOTES:-
1. GENERAL TOLERANCE = ± 1.0 mm
2. ALL DIMENSUIONS ARE IN
3. MAX STATIC PRESSURE :- 60kg/cm2
4. SCALE ARC - 270°

NO.	DATE	REVISION		REMARKS	BY	APPROV



BILL OF MATERIALS

SL NO	DESCRIPTION	MATERIAL	REMARKS
1	CASE	PRESSED AISI 304 SS	SELF COLOUR FINISH
2	BEZEL (BAYONET TYPE)	DO	DO
3	DIAL WINDOW	GLASS	SHATTER PROOF
4	POINTER	ALUMINIUM	ANODISED BLACK
5	DIAL	ALUMINIUM	WHITE WITH BLACK LETTERS
6	MOVEMENT MATERIAL	AISI 304SS	
7	SENSING ELEMENT	AISI 316 SS	DIAPHRAGM
8	SHANK	AISI 316 SS	
9	BLOW OUT DISC	NEOPRENE	AT TOP
10	TOP CHAMBER	AISI 304 SS	
11	BOTTOM CHAMBER	AISI 316 SS	
12	PROCESS CONN	AISI 316 SS	

SPECIFICATION

DIAL SIZE	150 mm	CASE	WEATHER PROOF IP-65
CONNECTION	1/2" N.P.T. (M)		
ACCURACY	±1% OF F.S.D.		
OVERRANGE	130%		
MOUNTING	DIRECT WITH BOTTOM ENTRY		

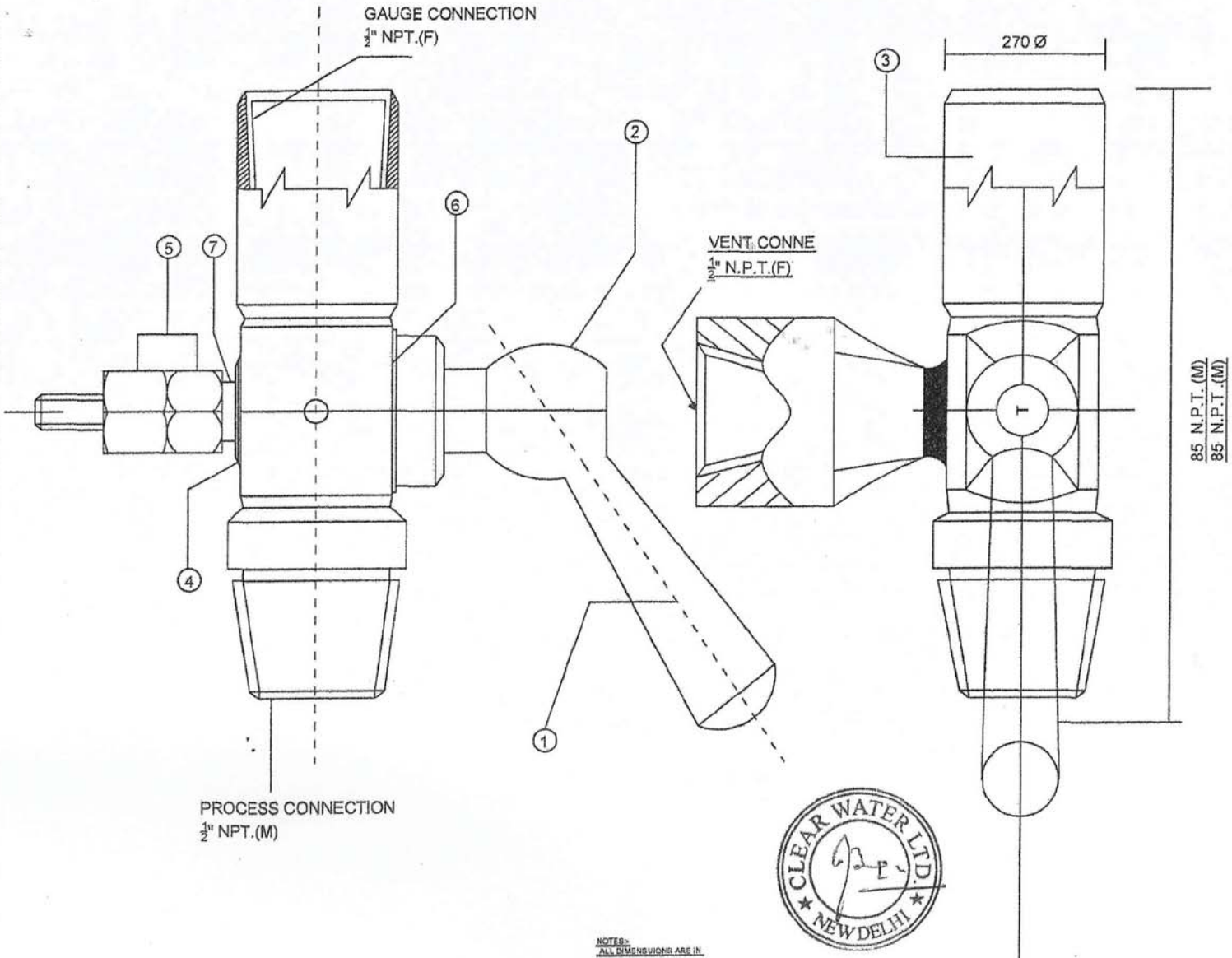
SL. NO.	RANGE	QTY
1	0 - 2 kg	
2	0 - 6 kg	

CUSTOMER	CLEARWATER LIMITED
PROJECT	ETP, ENNOR TPP
OUR REF. NO.	
YOUR REF. NO.	17-04
TAG NO	AS ANNEXURE
MODEL NO	6 SUDG SD
A. N. INSTRUMENTS PVT. LTD.	
TITLE :-150mm DIAL SEALED PRESSURE GAUGE (BOTTOM ENTRY)	
DRAWN	
APPROVED	

CLEAR WATER LTD. NEW DELHI

NOTES:-
1. GENERAL TOLERANCE = ± 1.0 mm
2. ALL DIMENSUIONS ARE IN

NO.	DATE	REVISION		REMARKS	BY	APPROV



BILL OF MATERIALS

SL NO	DESCRIPTION	MATERIAL	REMARKS
1	HANDLE	EBONITE	
2	PLUG	AISI 316 /304SS	
3	BODY	AISI 316 /304SS	
4	COLLAR	AISI 316 /304SS	
5	LOCK NUT	AISI 316 /304SS	
6	BUSH	TEFLON	
7	SPRING WASHER	SPRING STEEL	

SPECIFICATION

CONNECTION	½" N.P.T.(M) X (F) X (F)

NOTES:-
ALL DIMENSIONS ARE IN

NO.	DATE	REVISION		REMARKS	BY	APPROV

THIS DRAWING IS THE PROPERTY OF A. N. INSTRUMENTS (P) LTD.

CUSTOMER	CLEARWATER LIMITED
PROJECT	ETP - EMMOR
OUR REF. NO.	
YOUR REF. NO.	17-04
QTY	
RANGE	
TAG NO.	

TITLE:- 3 WAY GAUGE COCK

DRAWN			SCALE:-N.T.S.
CHECKED			
APPROVED			

BHEL DOC NO.: PE-V0-412-164-A015				
Clear Water Limited **B- 14/1, Okhla Industrial Area,** **Phase II, New Delhi-110020**		**Data Sheet** **TURBIDITY METER**	**Doc. No**	**DS-01/17-04M(92-TM)**
			Rev	**00**
			Sheet	**1 of 2**
A	**GENERAL**			
1.1	Location	Control Station ; Raw Water pipe ; Installation frame to be mounted on Cascade Aerator Shaft	Clarified water channel; Installation frame to be mounted on column supporting channel	
1.2	Quantity	1 controller Assly with one sensor complete with sensor adopter cable	2 controller Assly with one sensor complete with sensor adopter cable	
	Spare	NIL		
	Total	2 Nos.		
1.3	Application	Turbidity Measurement		
1.4	Ambient Temperature	Operating Temp. (10-40 ^{0} C)		
1.5	surrounding Atmosphere	Dusty , Humid & Corrosive atmosphere in a Thermal Power Plant		
1.6	Relative Humidity	5-95%		
1.7	Design Condition	To System Requirement		
1.8	Scope of Supply	Sensor , Analyzer (Controller) , Sensor Cable , Solution / Calibration Accessories		
2.	Make	Hach		
3.	Mounting Type	Flow Through		
4.	Model Number	SC 200 ; Hach Part No. 8626500; Hach part description KTO:TU5300SC- W/SC200 1 CH		
5.	Analyzer Tag No.		1GBD06(CQ001)	
6.			1GBD05 (CQ001;	
B				
	Method of Measurement	Nephelometry ; To comply with EPA		
1.	Range (Nephelometric Turbidity Units (NTU)	0-700		
2.	Displayed Resolution	Automatic according to measuring range ;0.001 ....1 NTU		
	Cleaning System	Manual		
3.	Repeatability	Better than ±1.0% of reading or		
		±0.002 NTU, whichever is greater		
4.	Response Time	Initial response in 1 minute, 15 seconds		
		for a full-scale step change		
5.	Signal Average Time	User selectable from 6, 30, 60, 90 seconds		
		default 30 seconds		
6.	Sample Flow Required	not required ; (100 to 1000 ML / Min)		
7.	Operating Temperature	0 to 50°C (32 to 122°F)		
8.	Operating Humidity	5 to 95% non-condensing		
9.	Storage Temperature	-5 to 60°C		
10.	Power Requirements	100-230 V-AC, 50/60 Hz; auto selecting; 40 VA		
11.	Sample Inlet Fitting	1/4" NPT female, 1/4" compression fitting (provided)		
12.	Drain Fitting	Required (1/4 inch OD piping)		
C	**Controller**	Single channel		

Rev	**Description**	**Date**	**Project:** 2x660 MW Ennore Sez STPP **Owner:** Tamil Nadu Generation & Distribution Corporation Ltd **Consultant:** Desein Pvt Ltd
00	For approval	31.01.2019	

BHEL DOC NO.: PE-V0-412-164-A015			
Clear Water Limited **B- 14/1, Okhla Industrial Area,** **Phase II, New Delhi-110020**	**Data Sheet** **TURBIDITY METER**	**Doc. No**	**DS-01/17-04M(92-TM)**
		Rev	**00**
		Sheet	**2 of 2**

1.	Display	Graphic dot matrix LCD with LED backlighting
2.	Model No.	Single Channel controller Part Description –KTO;TU 5300SC – W/SC 200 1CH
A	**GENERAL**	
3.	Display Resolution	240 x 160 pixels
4.	Power Requirements	100 – 240 V AC ±10%, 50/60 Hz or 24 Vdc -15% + 20%
5.	Operating Temperature	-20 to 60°C ; 0 to 95% RH non-condensing
6.	Storage Temperature	-20 to 70°C (-4 to 158°F); 0 to 95% RH non-condensing
7.	Analog Output Signal	One 0/4 to 20 mA isolated current output, max 500Ω
8.	Security Levels	Two password protected levels
9.	Instrument Enclosure Materials	Polycarbonate,
10.	Mounting Configurations (Wall / Pole / panel)	Sensor pole mounted ; Controller wall mounted
11.	Enclosure Rating	NEMA4X (indoor) / IP66 Controller
12.	Conduit Openings	1/2" NPT Conduit
13.	Current Output and Relays Relays	2 x 4-20 mA out put ; 3 x relays
14	Digital Communication	Network card compatible, MODBUS RS232/RS485, LonWorks Protocol (optional)
D	**MOUNTING ACCESSORIES**	
	Sensor and Controller shall be field mounted.	
1.	Mount Hardware	Provided
2.	Cable between sensor and Transmitter	Provided; special cable as required with flexible conduit ½" NPT.
3	**PERFORMANCE**	
	Accuracy	+/- 2 % (0 to 40 NTU), +/- 10% (40 to 1000 NTU)
	Power supply	240 V , 50 Hz, 1ph,AC
	Cable Termination	Terminal Block to suit 2.5 Sqmm wires
E	**TESTS**	
1.	Calibration Test / Accuracy Test	Factory issued Test Certificates shall be furnished
F	**Catalogues**	
1.	SC 200 ; Hach Part No. 8626500; Hach part description KTO:TU5300SC - W/SC200 1 CH	Turbidity Analyzer Controller ; Single Channel; suitable for 0 to 700 NTU
2.		
G	**PROCESS PHILOSOPHY**	
a.	Sensor shall be connected thru Cable to Panel mounted Controller Transmitter which shall give 4x20 mA output signal to PLC. Supply of Shielded cable from Out Put Terminal of Controller Instrument shall form part of Instrument Control wiring .	
b.	Controller Transmitter Analyzer and Sensor shall be housed in a Weather Proof Housing and shall be field located .	
c.	Self life of Turbidity Standardsand Verification Module is 6 months maximum. Supplied unit shall be supplied with one Standard & Verification Module. If not used within 4 months, then BHEL/TSGENCO at it own cost shall source additional Standard & Verification Module to commission instruments.	
H	Instruments shall be supplied Under Inspection Category -III. i.e thru COC / IP / TC	

00	For approval	31.01.2019	**Project:** 2x660 MW Ennore Sez STPP **Owner:** Tamil Nadu Generation & Distribution Corporation Ltd **Consultant:** Desein Pvt Ltd
Rev	**Description**	**Date**	

ULTRATURB plus sc Sensor

ISO 7027 APPROVED

The Hach ULTRATURB plus sc Sensor is a precisely measures turbidity of ultra-clear to medium turbid media for optimum filtration control in municipal and industrial water processing plants. Data display and processing of measured data is performed by Hach sc Digital Controllers.

Features and Benefits

Wide Measurement Range – 0 to 1000 FNU (NTU)

The Hach ULTRATURB plus sc Sensor measures turbidity from 0 to 1000 FNU (NTU) for a wide variety of low to medium range turbidity applications. Use it to effectively monitor conventional filtered water processes, effluent water, distribution systems, and elevated tanks where small-sized particulates or air entrapment may be an issue.

Self-cleaning Sample Chamber Option

The ULTRATURB sensor is available with an automatically self-cleaning sample chamber that guarantees stable measured values. The silicon wiper blades inside the sample chamber are held in place with a magnetic coupling wheel to further keep the sample chamber intact.

Seawater Version

The new ULTRATURB plus Seawater sc is resistant to salt concentrations up to 65 g/L.

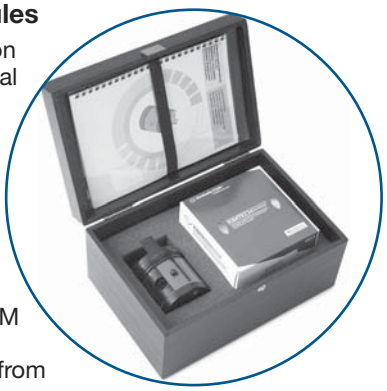
Ratio Methodology Detects Sample Chamber Fouling

The ULTRATURB sensor uses ratio methodology with detection at 90° and 180° to minimize reflections in the measuring cell and on the windows. In this way, fouling of the sample chamber is detected earlier than with a single detection system.

Compatible with Hach Multi-Sensor, Multi-Parameter Digital Controller

The ULTRATURB sensor can be used with Hach's sc Digital Controllers. The sc200 controller accepts up to two sensors. The sc1000 accepts up to eight sensors. Multiple controllers can be networked to accommodate many more sensors and parameters, reducing the cost per measuring point. Just plug in any Hach "plug and play" digital sensor and it's ready to use without software configuration. "Plug and play" connectivity means there's no complicated wiring or set up. Network the ULTRATURB plus sensor with any of Hach's digital sensors for measuring dissolved oxygen, ORP, conductivity, and many other parameters.

Dry Verification Modules



The Calibration/Verification Module (CVM) is an optical standard for rapid and straightforward checking of the ULTRATURB sensor. It facilitates problem-free routine checks and confirmation of measurements without the need to mix liquid calibration standards. CVM modules are available in different turbidity ranges from 0.6 to 25 FNU (NTU).

Complies with ISO 7027

The Hach ULTRATURB plus sc Sensor meets the ISO 7027 turbidity requirements for on-line process turbidity.

Specifications*

Measurement Technique
90° scattered light in accordance with DIN EN ISO 7027 infrared light 860 nm

Range
0.0001 to 1000 FNU, freely programmable (0.0001 to 250 EBC = 2500 ppm SiO_2) (Note: 1 FNU is equivalent to 1 NTU)

Resolution
0.0001 to 0.9999 / 1.000 to 9.999 / 10.00 to 99.99 / 100 to 1000 FNU (NTU)

Precision
±0.008 FNU ±1% of reading (0 to 10 FNU)

Repeatability
±0.003 FNU ±0.5% of reading (0 to 2 FNU)

Variation Coefficient
1% in accordance with DIN 38402

Response Time
1 to 60 seconds (programmable)

Verification
StablCal or dry standard CVM module

Ambient Temperature
Sensor: 36 to 104°F (2 to 40°C)

Display unit: 14 to 104°F (-10 to 40°C)

Sample Temperature
122°F (50°C) maximum

Sample Flow
0.2 to 1 L/min

Sample Pressure
87 PSI at 68°F (6 bar at 20°C)

Sample Connection
13 mm I.D. hose or fixed connection with with G+F system parts

Automatic Cleaning
Wiper

Materials
Window: quartz

Measurement chamber: Noryl, GFN2

Wiper blade: silicon

Wiper shaft: stainless steel 1.4571

Housing: ASA

Enclosure Rating
IP 65

Dimensions
9.9 x 9.4 x 4.3 in. (250 x 240 x 110 mm)

Weight
Approx. 3.3 lbs. (1.5 kg)

Display Unit
Hach sc200 Digital Controller or Hach sc1000 Universal Controller

**Specifications subject to change without notice.*

Engineering Specifications

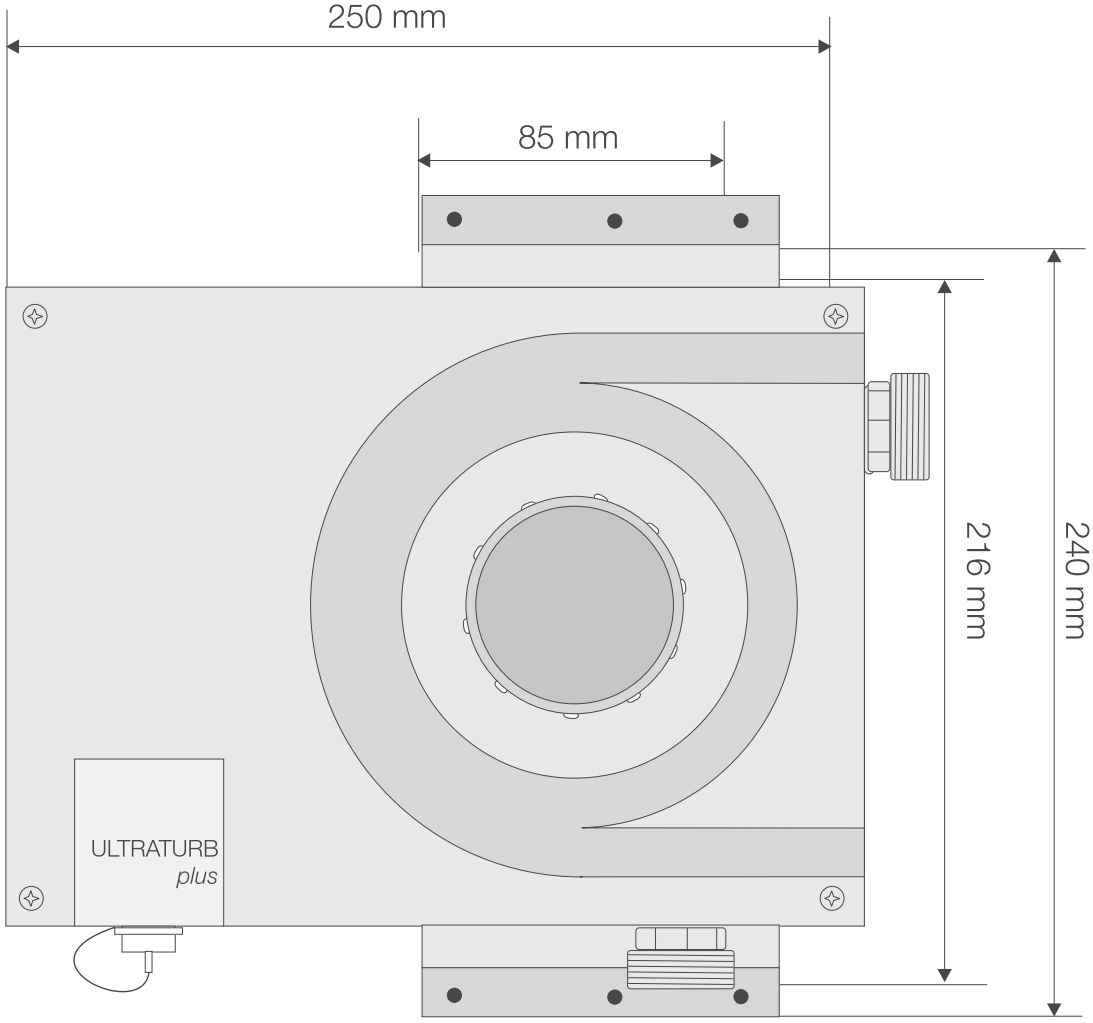
1. The sensor shall continuously measure turbidity in water using detectors at 90 and 180 degrees.
2. The measurement technology shall use infrared pulse scattered light process according DIN EN ISO 7027.
3. The measuring range shall be from 0.0001 to 1000 NTU.
4. The precision shall be ±0.5% or ±0.008 NTU of the measured value.
5. The response time shall be approximately 1 to 60 seconds.
6. The flow rate of sample shall be 0.2 to 1 L/minute.
7. The verification of calibration for the sensor shall be by StablCal or dry standard CVM module.
8. The transmitter enclosure shall be rated at IP 65.
9. The sensor shall be model ULTRATURB plus sc Sensor manufactured by Hach Company.

Optional:

1. The sensor shall be equipped with a self-cleaning sample chamber that uses a silicon wiper that is held in place magnetically.
2. The sensor shall include a calibration/verification module with a factory-certified calibration value for periodic verification of calibration.

Dimensions

The sensor should be installed in an accessible location. It can be mounted on a flat, vertical surface (such as a panel, stand, etc.). It should allow for access for any checking or maintenance. Sample flow should meet the specifications above.



Ordering Information

ULTRATURB plus sc Sensor

LPV415.52.11002	Sensor with 0.35 m cable
LPV415.52.21002	Sensor with 5 m cable
LPV415.52.31002	Sensor with 10 m cable
LPV415.52.41002	Sensor with 15 m cable
LPV415.52.51002	Sensor with 20 m cable
LPV415.52.61002	Sensor with 30 m cable
LPV415.52.71002	Sensor with 50 m cable

ULTRATURB plus sc Sensor with Auto-clean

LPV415.52.10002	Sensor with 0.35 m cable and Auto-clean system
LPV415.52.20002	Sensor with 5 m cable and Auto-clean system
LPV415.52.30002	Sensor with 10 m cable and Auto-clean system
LPV415.52.40002	Sensor with 15 m cable and Auto-clean system
LPV415.52.50002	Sensor with 20 m cable and Auto-clean system
LPV415.52.60002	Sensor with 30 m cable and Auto-clean system
LPV415.52.70002	Sensor with 50 m cable and Auto-clean system
LPV415.99.22002	Sensor Seawater sc with 5 m cable
LPV415.99.32002	Sensor Seawater sc with 10 m cable
LPV415.99.42002	Sensor Seawater sc with 15 m cable
LPV415.99.52002	Sensor Seawater with 20 m cable
LPV415.99.62002	Sensor Seawater sc with 30 m cable
LPV415.99.72002	Sensor Seawater sc with 50 m cable
LPV415.99.82002	Sensor Seawater sc with 1 m cable

sc200 / sc1000 Controller Options

sc200 for Hach Digital Sensors

LXV404.99.00552	sc200 controller, 2 channel, digital
LXV404.99.00502	sc200 controller, 1 channel, digital
LXV404.99.00542	sc200 controller, 2 channel, digital & mA input

sc1000 for Hach Digital Sensors

LXV400.99.1R572	sc1000 Probe Module; 4 sensors - analog
LXV400.99.1B572	sc1000 Probe Module; 4 sensors - RS485
LXV400.99.1F572	sc1000 Probe Module; 4 sensors - PROFIBUS DP
LXV400.99.1R572	sc1000 Probe Module; 6 sensors - analog

Dry/Secondary Verification Modules

LZV414.00.00000	CVM Module; 0.6 NTU
LZV414.00.10000	CVM Module; 1.5 NTU
LZV414.00.20000	CVM Module; 6 NTU
LZV414.00.30000	CVM Module; 15 NTU
LZV414.00.40000	CVM Module; 25 NTU

Spare Parts

LZV275	Wiper blades; set of 4
DOC023.52.03231	User Manual

Calibration Tools

246142	Formazin; 4000 NTU, 500 mL
LZV451	Calibration/Cleaning Kit
LZV325	Filters with Apparatus; for zero calibration (0.2 micron)

Lit. No. 2620 Rev 1
J10 Printed in U.S.A.

At Hach, it's about learning from our customers and providing the right answers. It's more than ensuring the quality of water—it's about ensuring the quality of life. When it comes to the things that touch our lives...

Keep it pure.

Make it simple.

Be right.

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HACH®

Be Right™

BHEL Doc. No. PE-V0-412-164-A015				
Clear Water Limited **B- 14/1, Okhla Industrial Area,** **Phase II, New Delhi-110020**		**Data Sheet** **pH SENSOR AND TRANSMITTER**	**Doc. No**	**DS-01/17-04M(92-PH)**
			Rev	**00**
			Sheet	**1 of 2**

A	**GENERAL**		
1	Sample Location	Raw Water Channel	Filtered Water Distribution Chamber
2	Make	HACH	
3	Installation Type	By Sensor	Immersion Type
4	Model Number	PRO-P3 A1N with PC 1 R1 A; Catalogue enclosed.	
B	**SENSOR**		
1	Operating Principle	Combination Electrode	
2	Ambient Temperature	0 TO 60^{O}C	
3	Ambient Humidity	0 TO 95% (Non Condensing)	
4	Pressure Limitation	>100 psi / Atmospheric ; 6.9 bar at 100 ^{O}C	
5	Temperature Limitation	(-) 20 to 60 ° C	
6	Measure Range	2 to 14 pH	
7	Temperature Compensation	Automatic	
8	Temperature Compensating Range	0 to 100 ºC	
9	Temperature Compensating Element	Pt 1000 ohm RTD	
10	Measuring element	Thoughened	
11	Electrode	Glass	
12	Electrolyte	KCL Gel	
13	Process Connection	N.A.	
14	Sensor Body (Temp)	Polypropelene □ Ryton Body ■	
15	Sensitivity	Less than 0.1 pH	
16	Output Scan	Not applicable	
17	Sample In/Out Connections	Provided	
C	**TRANSMITTER**		
1	Mounting	Panel Mounted	Panel Mounted
2	Type	2 Wire	
3	Accuracy	± 0.1% of Span	
4	Display	Two line by 16 character back lit LCD	
5	Stability / Sensitivity	± 0.05 % of Span per 24 Hrs ; Non -Cumalative	
6	Power Supply	2 wire Hook up – 16-30V DC	
7	Output	4 to 20 mA DC	
8	Over Range Protection	150% of span	
9	Zero Calibration	Required ; Fact. Calibrated	
10	Electrical Connection	Terminal Strip	
11	Enclosure	Poly carbonate	
12	Protection Class	IP 65 □ Exproof □ Nema 4X ■	
13	Dimensions	95x95x60 mm	

00	Submitted for approval	31.01.19	**Project:** 2x660 MW Ennore Sez STPP **Owner:** Tamil Nadu Generation & Distribution Corporation Ltd **Consultant:** Desein Pvt Ltd
Rev	**Description**	**Date**	

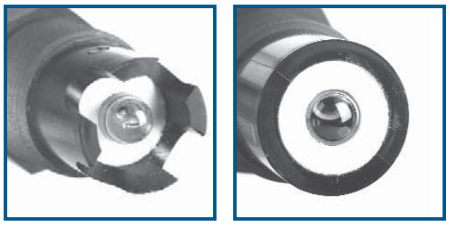
BHEL Doc. No. PE-V0-412-164-A015			
Clear Water Limited **B- 14/1, Okhla Industrial Area,** **Phase II, New Delhi-110020**	**Data Sheet** **pH SENSOR AND TRANSMITTER**	**Doc. No**	**DS-01/17-04M(92-PH)**
		Rev	**00**
		Sheet	**2 of 2**

14	Digital Communication	
D	**MOUNTING ACCESSORIES**	
1.	Sensor and Controller shall be field mounted	
2.	Mount Hardware	Provided
3.	Cable between sensor and Transmitter	Provided; 25m as instrument is Local Control Panel mounted.
4.	Flow thru pipe Assly	Provided
E	**TESTS**	
1.	Calibration Test / Accuracy Test	Factory issued Test Certificates shall be furnished
F	**Inspection Cat.**	III
F.	**CATALOGUE**	
1.	PRO series Transmitter	PRO – P 3 A IN
2.	Convertible pH Sensor	PC 1 R1 A
G.	**PROCESS PHILOSOPHY**	
a.	Sensor shal be connected thru cable to Local Control Panel mounted pH Transmitter which shall give 4x20 mA output signal to PLC. Supply of Shielded cable from Local Control Panel Terminal Strip shall form part of Instrument Control wiring and is in scope of BHEL.	
b.	No reagent is required for operation.	
c.	Power supply to Controller shall be 24 V DC	
d.	Instrument shall be housed inside Local Control panel.	

00	Submitted for approval	31.01.19	**Project:** 2x660 MW Ennore Sez STPP **Owner:** Tamil Nadu Generation & Distribution Corporation Ltd **Consultant:** Desein Pvt Ltd
Rev	**Description**	**Date**	

3/4-inch Combination pH and ORP Sensor Kits

Use the Digital Gateway to make any Hach analog combination pH or ORP sensor compatible with the Hach sc1000 Controller.



Digital combination pH and ORP sensors are available in convertible, insertion, and sanitary mounting styles. Choose from rugged dome electrodes or "easy-to-clean" flat glass electrodes.

Features and Benefits

Low Price—High Performance

These combination sensors are designed for specialty applications for immersion or in-line mounting. The reference cell features a double-junction design for extended service life, and a built-in solution ground. The body is molded from chemically-resistant Ryton® or PVDF, and the reference junction is coaxial porous Teflon®. All sensors are rated 0 to 105ºC up to 100 psig, and have integral 4.5 m (15 ft.) cables with tinned leads. The PC-series (for pH) and RC-series (for ORP) combination sensors are ideal for measuring mild and aggressive media.

Special Electrode Configurations

Sensors with rugged dome electrodes, "easy-to-clean" flat glass electrodes, and even HF (hydrofluoric acid) resistant glass electrodes are available for a wide variety of process solutions.

Temperature Compensation Element Option

The PC-series combination pH sensors are available with or without a Pt 1000 ohm RTD temperature element. The RC-series combination ORP sensors are supplied without a temperature element.

Versatile Mounting Styles

Sensors are available in three mounting styles—convertible, insertion, and sanitary. Please turn to page 3 for more information.

Full-Featured "Plug and Play" Hach sc Digital Controllers

There are no complicated wiring or set up procedures with any Hach sc controller. Just plug in any combination of Hach digital sensors and it's ready to use—it's "plug and play."

One or multiple sensors—The sc controller family allows you to receive data from up to eight Hach digital sensors in any combination using a single controller.

Communications—Multiple alarm/control schemes are available using the relays and PID control outputs. Available communications include analog 4-20 mA, digital MODBUS® (RS485 and RS232) or Profibus DP protocols. (Other digital protocols are available. Contact your Hach representative for details.)

Data logger—A built-in data logger collects measurement data, calibration, verification points, and alarm history.

Specifications*

Most pH applications fall in the 2.5-12.5 pH range. General purpose pH glass electrodes perform well in this range. Some industrial applications require accurate measurements and control at pH values below 2 or above 12. Consult Hach Technical Support for details on these applications.

Combination pH Sensors

Measuring Range
0 to 14 pH

Accuracy
Less than 0.1 pH under reference conditions

Temperature Range
0 to 105ºC (32 to 221ºF)

Flow Rate
0 to 2 m/s (0 to 6.6 ft./s); non-abrasive

Pressure Range
0 to 6.9 bar at 100ºC (0 to 100 psig at 212ºF)

Signal Transmission Distance
100 m (328 ft.) when used with the Hach Digital Gateway and a Hach sc Digital Controller.

1000 m (3280 ft.) when used with the Hach Digital Gateway, Termination Box, and a Hach sc Digital Controller.

Sensor Cable
Integral coaxial cable (plus two conductors for temperature compensator option); 4.5 m (15 ft.) long

Wetted Materials

Convertible style: Ryton® body (glass filled)

Insertion style: PVDF body (Kynar®)

Sanitary style: 316 stainless steel sleeved PVDF body

Common materials for all sensor styles include PTFE Teflon double junction, glass process electrode, and Viton® O-rings

Warranty
90 days

Combination ORP Sensors

Measuring Range
-2000 to +2000 millivolts

Accuracy
Limited to calibration solution accuracy (± 20 mV)

Temperature Range
0 to 105ºC (32 to 221ºF)

Flow Rate
0 to 2 m/s (0 to 6.6 ft./s); non-abrasive

Pressure Range
0 to 6.9 bar at 100ºC (0 to 100 psig at 212ºF)

Signal Transmission Distance
100 m (328 ft.) when used with the Hach Digital Gateway and a Hach sc Digital Controller.

1000 m (3280 ft.) when used with the Hach Digital Gateway, Termination Box, and a Hach sc Digital Controller.

Sensor Cable
Integral coaxial cable; 4.5 m (15 ft.) long; terminated with stripped and tinned wires

Wetted Materials

Convertible style: Ryton® body (glass filled)

Insertion style: PVDF body (Kynar®)

Common materials for all sensor styles include PTFE Teflon double junction, glass with platinum process electrode, and Viton® O-rings

Warranty
90 days

**Specifications subject to change without notice.*

Ryton® is a registered trademark of Phillips 66 Co.; Viton® is a registered trademark of E.I. DuPont de Nemours + Co.; Kynar® is a registered trademark of Pennwalt Corp.

Engineering Specifications

1. The pH sensor shall be available in convertible, insertion or sanitary styles. The ORP sensor shall be available in only convertible or insertion styles.
2. The convertible style sensor shall have a Ryton® body. The insertion style sensor shall have a PVDF body. The sanitary style sensor shall have a 316 stainless steel sleeved PVDF body. Common materials for all sensor styles shall include a PTFE Teflon® double junction, and Viton® O-rings. The pH sensor shall have a glass pH electrode. The ORP sensor shall have a platinum ORP electrode.
3. The convertible style pH sensor shall be available with or without a built-in Pt 1000 ohm RTD temperature element. Insertion and sanitary style pH sensors shall have a built-in Pt 1000 ohm RTD temperature element. Convertible and insertion style ORP sensors shall not have a built-in temperature element.
4. The sensor shall communicate via MODBUS® RS-485 to a Hach sc Digital Controller.
5. The sensor shall be Hach Company Model PC sc or PC-series for pH measurement or Model PC sc or RC-series for ORP measurement.

Dimensions

Convertible Style Sensor

The convertible style sensor has a Ryton® body that features 3/4-inch NPT threads on both ends. The sensor can be directly mounted into a standard 3/4-inch pipe tee for flow-through mounting or fastened onto the end of a pipe for immersion mounting. The convertible style sensor enables inventory consolidation, thereby reducing associated costs. Mounting tees and immersion mounting hardware are offered in a variety of materials to suit application requirements.

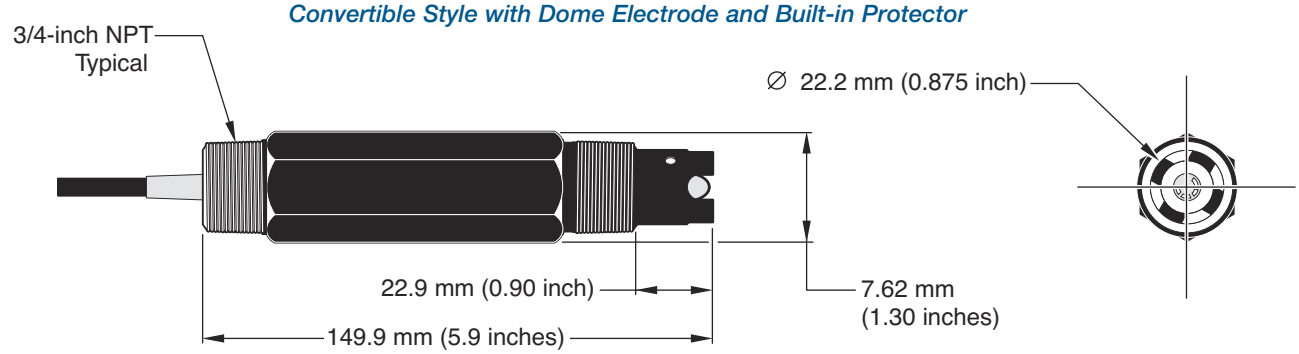
Insertion Style Sensor

Insertion style sensors feature a longer, non-threaded PVDF body with two Viton® O-rings, providing a seal when used with the optional Hach insertion mount hardware assembly. This ball valve hardware enables sensor insertion and retraction from a pipe or vessel without having to stop the process flow.

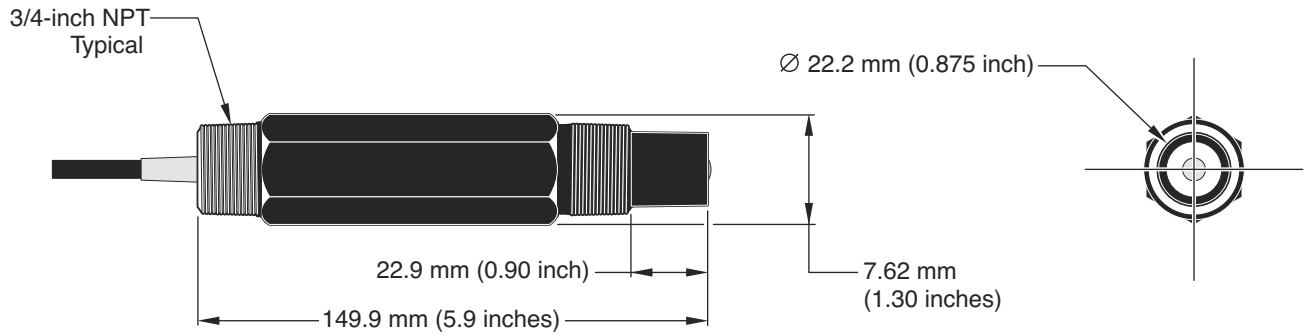
Sanitary Style Sensor

The sanitary style sensor, offered for pH measurement, has a 316 stainless steel-sleeved PVDF body with a 2-inch flange. The sensor mates to a standard 2-inch Tri-Clover fitting. The optional Hach sanitary mounting hardware includes a standard 2-inch sanitary tee, sanitary clamp, and Viton® sanitary gasket.

Convertible Style with Dome Electrode and Built-in Protector

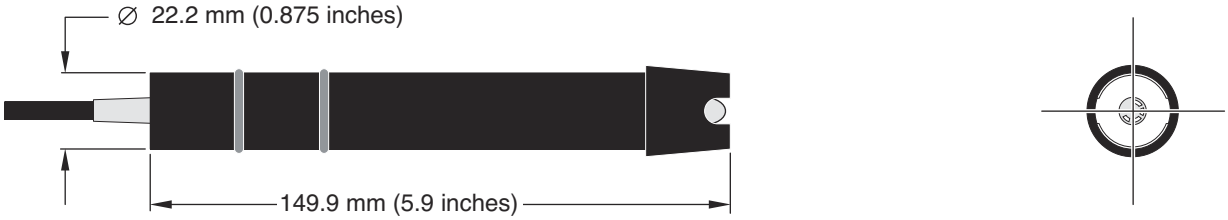


Convertible Style with Flat Electrode

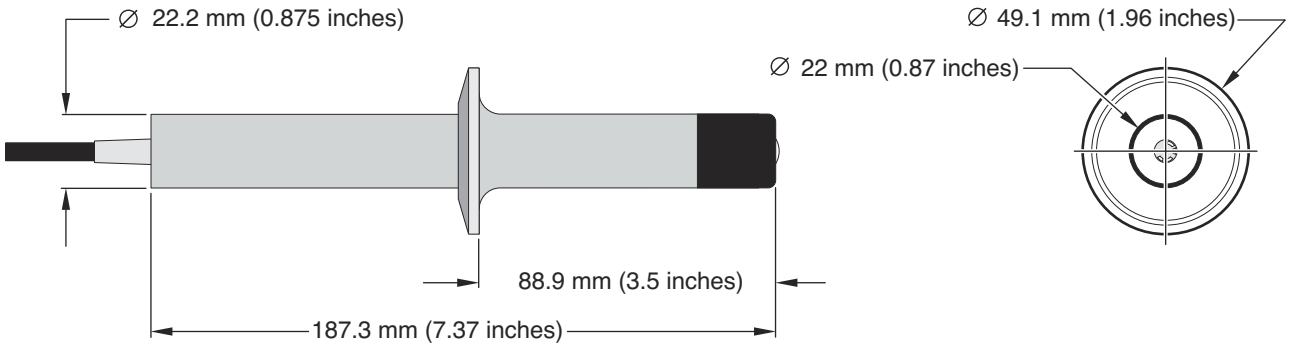


Dimensions continued

Insertion Style with Dome Electrode and Built-In Protector



Sanitary Style



Ordering Information

Digital PC sc and RC sc 3/4-inch Combination pH/ORP Sensors

All PC sc and RC sc 3/4-inch combination sensors come complete with an integral 4.5 m (15 ft.) sensor cable, Digital Gateway, and 1 m (3.3 ft.) digital extension cable.

Product Number	*Measurement*	*Sensor Style*	*Body Material*	*Electrode Type*	*Temp. Comp.*
DPC1R1N	pH	Convertible	Ryton	General purpose glass	None
DPC1R1A	pH	Convertible	Ryton	General purpose glass	Pt 1000 ohm RTD
DPC1R2N	pH	Convertible	Ryton	Flat glass, general purpose	None
DPC1R2A	pH	Convertible	Ryton	Flat glass, general purpose	Pt 1000 ohm RTD
DPC1R3A	pH	Convertible	Ryton	HF-resistant glass (see Note)	Pt 1000 ohm RTD
DPC2K1A	pH	Insertion	PVDF	General purpose glass	Pt 1000 ohm RTD
DPC2K2A	pH	Insertion	PVDF	Flat Glass	Pt 1000 ohm RTD
DPC3K2A	pH	Sanitary	316 SS/PVDF	General purpose glass	Pt 1000 ohm RTD
DRC1R5N	ORP	Convertible	Ryton	Platinum	None
DRC2K5N	ORP	Insertion	PVDF	Platinum	None

NOTE

The HF (hydrofluoric acid) resistant glass electrode reduces the HF dissolution of the complete glass surface to extend the lifetime of the electrode in acid fluoride solutions. The electrode will last longer than conventional glass pH electrodes. How much longer depends on the HF concentration and temperature of the solution.

Replacement Digital Gateway

6120600 Use the Digital Gateway to connect analog PC and RC sensors to a Hach sc Digital Controller.

Ordering Information continued

Analog PC and RC 3/4-inch Combination pH/ORP Sensors

All PC and RC 3/4-inch combination sensors come with an integral 4.5 m (15 ft.) standard length sensor cable.

Product Number	Measurement	Sensor Style	Body Material	Electrode Type	Temp. Comp.
PC1R1N	pH	Convertible	Ryton	General purpose glass	None
PC1R1A	pH	Convertible	Ryton	General purpose glass	Pt 1000 ohm RTD
PC1R2N	pH	Convertible	Ryton	Flat glass, general purpose	None
PC1R2A	pH	Convertible	Ryton	Flat glass, general purpose	Pt 1000 ohm RTD
PC1R3A	pH	Convertible	Ryton	HF-resistant glass	Pt 1000 ohm RTD
PC2K1A	pH	Insertion	PVDF	General purpose glass	Pt 1000 ohm RTD
PC2K2A	pH	Insertion	PVDF	Flat Glass	Pt 1000 ohm RTD
PC3K2A	pH	Sanitary	316 SS/PVDF	General purpose glass	Pt 1000 ohm RTD
RC1R5N	ORP	Convertible	Ryton	Platinum	None
RC2K5N	ORP	Insertion	PVDF	Platinum	None

Accessories for Digital and Analog 3/4-inch combination pH/ORP Sensors

Cables

Digital cables are used only with digital sensors or gateways when connecting to a Hach sc Digital Controller.

6122400 Digital Extension Cable, 1 m (3.3 ft)

5796000 Digital Extension Cable, 7.7 m (25 ft)

5796100 Digital Extension Cable, 15 m (50 ft)

5796200 Digital Extension Cable, 31 m (100 ft)

Analog cables are used only with analog sensors, junction box, and controller.

1W1100 Analog Interconnect Cable (order per foot)

Digital Termination Box

Used with digital extension cables when the desired cable length between the digital sensor/digital gateway and the Hach sc Digital Controller is between 100 m (328 ft) and 1000 m (3280 ft).

5867000 Digital Termination Box

Analog Junction Box

Used with analog interconnect cable when the desired cable length between analog sensor and analog controller is greater than the standard length of sensor cable. Each junction box includes terminal strip and gasket.

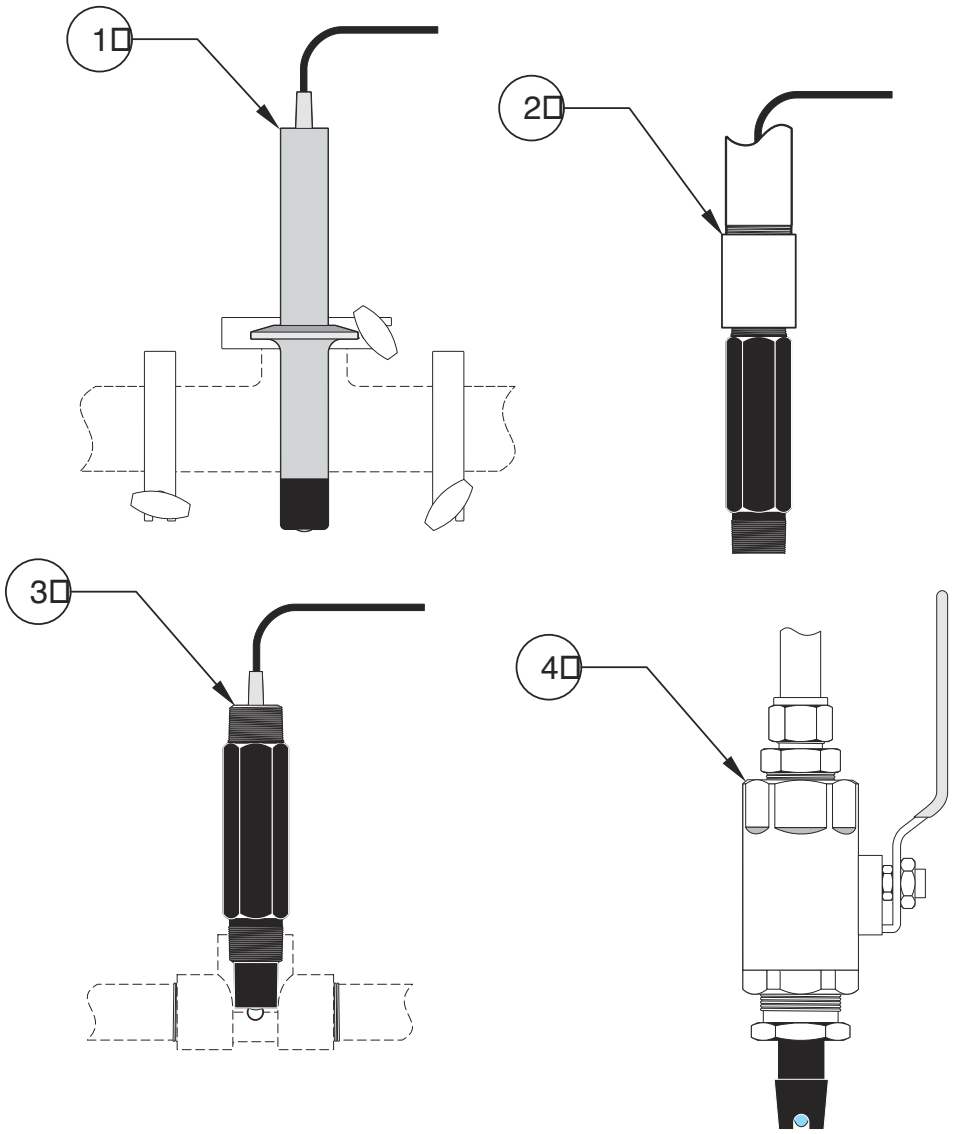
60A2053 Junction Box, Surface-mount, aluminum (includes mounting hardware)

60A9944 Junction Box, Pipe-mount, PVC, for 1/2-inch diameter pipe (includes mounting hardware)

60G2052 Junction Box, Pipe-mount, PVC, for 1-inch diameter pipe (includes mounting hardware)

76A4010-001 Junction Box, NEMA 4X (no mounting hardware included)

Ordering Information *continued*



1. Sanitary Mounting *2. Immersion Mounting* *3. Flow-through Mounting* *4. Insertion Mounting*

Mounting Hardware for PC sc and RC sc Combination Sensors

Sanitary Mount Hardware

9H1310 2-inch Sanitary Tee
9H1132 2-inch Sanitary Clamp
9H1384 2-inch Sanitary Viton Gasket

Immersion Mount Hardware

Each immersion hardware includes a 1/2-inch diameter x 4 foot long pipe, 1/2 x 3/4-inch NPT coupling, and plastic pipe-mount junction box with terminal strip.

MH432G CPVC Pipe

Flow-through Mount Hardware

Each tee is a standard 3/4-inch tee with 3/4-inch NPT threads on all three openings.

MH313N3NZ 316 SS Tee
MH333N3NZ CPVC Tee
MH373N3NZ PVC Tee

Insertion Mount Hardware

The insertion hardware includes a 1-1/2 inch ball valve, 1-1/2 inch NPT close nipple for process connection, sensor connection tube, stainless steel extension pipe, and stainless steel compression fitting with washer and lock nut.

MH116M3MZ 316 SS Hardware

To complete your pH and ORP measurement system, choose from these Hach controllers...

Model sc200 Controller

(see Lit. #2665)

The sc200 controller platform can be configured to operate either 2 Digital Sensor Inputs, or 1 or 2 Analog Sensor Inputs, or a combination of Digital and Analog Sensor Inputs. Customers may choose their communication options from a variety of offerings ranging from MODBUS RTU to Profibus DPV1.

sc200 for Hach Digital Sensors

LXV404.99.00552 sc200 controller, 2 channel, digital
LXV404.99.00502 sc200 controller, 1 channel, digital
LXV404.99.00542 sc200 controller, 2 channel, digital & mA input
LXV404.99.00512 sc200 controller, 2 channel, digital & pH/DO
LXV404.99.00522 sc200 controller, 2 channel, digital & Conductivity
LXV404.99.00532 sc200 controller, 2 channel, digital & Flow

sc200 for Hach Analog Sensors

LXV404.99.00102 sc200 controller, 1 channel, pH/DO
LXV404.99.00112 sc200 controller, 2 channel, pH/DO
LXV404.99.00202 sc200 controller, 1 channel, Conductivity
LXV404.99.00222 sc200 controller, 2 channel, Conductivity
LXV404.99.00212 sc200 controller, 2 channel, pH/DO & Conductivity
LXV404.99.00302 sc200 controller, 1 channel, Flow
LXV404.99.00332 sc200 controller, 2 channel, Flow
LXV404.99.00312 sc200 controller, 2 channel, Flow & pH/DO
LXV404.99.00322 sc200 controller, 2 channel, Flow & Conductivity

Note: Other sensor combinations are available. Please contact Hach Technical Support or your Hach representative.
Note: Communication options (MODBUS and Profibus DPV1) are available.

Model sc1000 Controller

(see Lit. #2403)

Each sc1000 Probe Module provides power to the system and can accept up to 8 digital sensors/expansion boards. Probe Modules can be networked together to accommodate up to 32 digital sensors/expansion boards attached to the same network.

LXV402.99.00002 sc1000 Display Module
LXV400.99.1R572 sc1000 Probe Module, 4 sensors, 4 mA Out, 4 mA In, 4 Relays, 110-230V
LXV400.99.1B572 sc1000 Probe Module, 4 sensors, 4 mA Out, 4 mA In, 4 Relays, RS-485 (MODBUS), 110-230V
LXV400.99.1F572 sc1000 Probe Module, 4 sensors, 4 mA Out, 4 mA In, 4 Relays, PROFIBUS DP, 110-230V
LXV400.99.1R582 sc1000 Probe Module, 6 sensors, 4 mA Out, 4 mA In, 4 Relays, 110-230V

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At Hach, it's about learning from our customers and providing the right answers. It's more than ensuring the quality of water—it's about ensuring the quality of life. When it comes to the things that touch our lives...

Keep it pure.

Make it simple.

Be right.

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www.hach-lange.com

HACH®
Be Right™

PRO-series pH/ORP Transmitter

(Model PRO-P3 measures pH or ORP)

Multiple Measurements

The PRO-P3 transmitter can be selected to measure pH or ORP (oxidation reduction potential). Measured pH and temperature values can be displayed separately or together. The corresponding 4–20 mA analog output can also be shown.

Versatile Hookup Capability

PRO-series transmitters can be wired in a two, three, or four-wire hookup arrangement to meet your application requirement.

Compact Size and NEMA 4X Universal Mounting

The compact PRO-series transmitter can be panel, wall, pipe, or integral sensor mounted.

Electromagnetic Conformance

All PRO-series transmitters exceed U.S. and meet European standards for EMI and RFI emissions and immunity.

Multiple Language Capability

All screens can be selected for display in English or Spanish. Different languages such as French or German may also be substituted.

"Menu-guided" Operation

The simple keypad and logical menu structure make this transmitter easy to use. Menu screens guide you through setup, operation, calibration, and test/maintenance functions.

Passcode-protected Access

For security, use the passcode feature to restrict configuration and calibration settings to only authorized personnel.

Isolated 4-20 mA Output

The isolated 4-20 mA analog output can represent the measured pH or temperature (or ORP). During calibration, the analog output is automatically held at the last measured value and, upon completion, returned to its active state.

Versatile Sensor Capability

The PRO-P3 transmitter can be used with any GLI Differential Technique pH or ORP sensor, or any conventional combination pH or ORP electrode.

Auto/Manual Temperature Compensation

Automatic temperature compensation is provided when using NTC 300 ohm thermistor, Pt 1000 RTD, or Pt 100 RTD temperature elements. For applications requiring fixed temperature compensation, the PRO-P3 can be manually set to a desired temperature.

Simple Interactive Diagnostics

Built-in diagnostics continuously test transmitter and sensor operation.

OEM Versions Available

PRO-series transmitters can be packaged or configured to accommodate OEM-specific needs.

CE

Certified Compliant to European Community Standards

Specifications

Operational

Display . . . . . .Two-line by 16 character backlit LCD

NOTE: *The measured pH (or ORP) and temperature can be displayed separately or together on one screen. Both analog output values are shown together on one screen.*

Measurement	Selectable Ranges
pH	-2.0 to 14.0 pH or -2.00 to 14.00 pH
ORP	-2100 to 2100 mV
Temperature	-4.0 to 392.0˚ F or -20.0 to 200.0˚ C
Analog Outputs (1 and 2)	0.00-20.00 mA or 4.00-20.00 mA

Ambient Conditions . . . . . .Operation: -4 to 140˚ F (-20 to 60˚ C); 0 to 95% relative humidity, non-condensing
Storage: -22 to 158˚ F (-30 to 70˚ C); 0 to 95% relative humidity, non-condensing

Temperature Compensation . . . . . .Automatic from 14.0 to 230.0˚ F (-10.0 to 110.0° C) with selection for NTC 300 ohm thermistor, Pt 1000 ohm RTD, or Pt 100 ohm RTD temperature element, or manually fixed at a user-entered temperature; additional selectable temperature correction factors (ammonia, morpholine, or user-defined pH/°C linear slope) available for pure water automatic compensation from 0.0-50.0° C

Sensor-to-Analyzer Distance

GLI Differential Technique Sensor	3000 ft. (914 m) maximum
Conventional Comb. Electrode w/Preamp	985 ft. (300 m) maximum
Conventional Comb. Electrode w/o Preamp	100 ft. (30 m) maximum with electrode cable capacitance of less than 30 pF/foot

Power Requirements (Class 2 Power Supply)

Two-wire Hookup	16-30 VDC
Three-wire Hookup	14-30 VDC*
Four-wire Hookup	12-30 VDC*

*16 VDC minimum with RS-485 serial communication

Calibration Methods

2-point Buffer (pH only) . . . . . .Automatic calibration and buffer recognition using two buffers from a selected buffer set*

1-point Buffer (pH only) . . . . . .Automatic calibration and buffer recognition using one buffer from a selected buffer set*

**Buffer Sets: 4.00, 7.00, and 10.00 or DIN standard (1.09, 4.65, 6.79, 9.23, and 12.75)*

NOTE: *When using buffers that are not included in either of the analyzer buffers sets, calibrate using only the Sample method (1 or 2)*

2-point Sample (pH only) . . . . . .Enter two known sample values (determined by laboratory analysis or comparison reading) or two known pH buffer values.

1-point Sample (pH and ORP) . . . . . .Enter one known sample value (determined by laboratory analysis or comparison reading), or one known pH buffer value (or, for ORP measurement, one known reference solution value)

Analog Output . . . . . .Isolated 4-20 mA output with 0.004 mA (12-bit) resolution

NOTE: *Each output can represent the measured pH or temperature (or ORP). Parameter values can be entered to define the endpoints at which the 4 mA and 20 mA output values are desired (range expand). During calibration, the analog output is automatically held at the last measured value, and upon completion, returned to its active state.*

Maximum Loop Load . . . . . .Dependent on power supply voltage, transmitter hookup arrangement, and wire resistance:

Maximum Permissible Loads

Transmitter Hookup Arrangement	Power Supply Voltage						
	12 VDC	14 VDC	16 VDC	20 VDC	24 VDC	28 VDC	30 VDC
Two-wire Hookup	———	———	100 ohms	300 ohms	500 ohms	700 ohms	800 ohms
Three-wire Hookup	———	500 ohms	600 ohms	800 ohms	1000 ohms	1200 ohms	1300 ohms
Four-wire Hookup	400 ohms	500 ohms	600 ohms	800 ohms	1000 ohms	1200 ohms	1300 ohms

Memory Backup (non-volatile) . . . . . .All user settings are retained indefinitely without battery backup

EMI/RFI Conformance . . . . . .Exceeds U.S. and meets European standards for conducted and radiated emissions and immunity; certified CE compliant for applications as specified by EN 50081-2 for emissions and EN 50082-2 for immunity

Electrical Certifications

General Purpose (pending) . . . . . .UL, C-UL, FM, and CENELEC
Division 2 (pending) . . . . . .UL, C-UL, and FM: Groups A, B, C, D, F, and G

Analyzer Performance (Electrical, Analog Outputs)

Accuracy** . . . . . .± 0.1% of span
Sensitivity** . . . . . .± 0.05% of span
Repeatability** . . . . . .± 0.05% of span
Temperature Drift** . . . . . .Zero and Span: ± 0.02% of span per ˚C
Response Time . . . . . .1-60 seconds to 90% of value upon step change (with output filter setting of zero)
** These performance specifications are typical at 25˚ C

Mechanical

Enclosure . . . . . .Polycarbonate with NEMA 4X general purpose; choice of included mounting hardware
Mounting Configurations . . . . . .Panel. wall, pipe, or integral sensor mounting
Dimensions . . . . . .With Back Cover: 3.75 in. W x 3.75 in. H x 2.32 in. D (95 mm W x 95 mm H x 60 mm D)
Without Back Cover for Panel Mount: 3.75 in. W x 3.75 in. H x 0.75 in. D (95 mm W x 95 mm H x 19 mm D)
Net Weight . . . . . .10 oz. (280 g) approximately

Ordering Information

Model Number (see Notes 1 and 3)

PRO-P3A	pH/ORP transmitter with wall/pipe/integral sensor mount kit (see Note 2)
PRO-P3B	pH/ORP transmitter with panel mount kit (includes gasket, retainer plate, and four screws)
PRO-P3C	Basic pH/ORP transmitter (without mounting hardware – electronics only)

Reserved Category

Equipment Tagging (specify tag data)
- **N** None
- **P** Paper
- **S** Stainless steel

1 **Product Number**

Choose one from each category.

Ordering Notes:

1. The standard on-screen languages for PRO-series transmitter operation are English and Spanish. A different language (French, German, etc.) may be substituted for Spanish. Please specify the desired language.
2. This mounting kit includes all hardware needed to wall, pipe or integrally sensor mount the transmitter. When integrally mounting the transmitter onto a GLI sensor, please specify the sensor part number with a "PRO1" suffix to ensure a correct sensor cable length and coupling. When the coupling is not required (replacement sensor), please specify the sensor part number with a "PRO2" suffix.
3. Each transmitter is supplied with a CD-ROM containing operating manuals (in PDF-file format) for all of the PRO-series transmitters. Paper manuals are also available (see Accessories).

Accessories (order separately)

Retrofit Wall/Pipe/Integral Sensor Mount Kit (P/N 1000A3457-001)
This hardware kit enables an existing panel-mounted PRO-series transmitter to be wall, pipe, or integral sensor mounted.

Retrofit Panel Mount Kit (P/N 1000A3455-001)
This hardware kit enables an existing wall, pipe, or integral sensor-mounted PRO-series transmitter to be panel mounted.

Operating Manual (P/N PRO-P3)
A paper booklet operating manual for the PRO-P3 pH/ORP transmitter.

pH and ORP Sensors
For various styles of GLI pH and ORP sensors, refer to these data sheets for complete details:

G109 – pHD™ Differential Sensors

G110 – Encapsulated LCP, Ryton, and Epoxy Sensors

G112 – 3/4-inch Combination Sensors

G114 – Manual Positioners for Combination pH Electrode

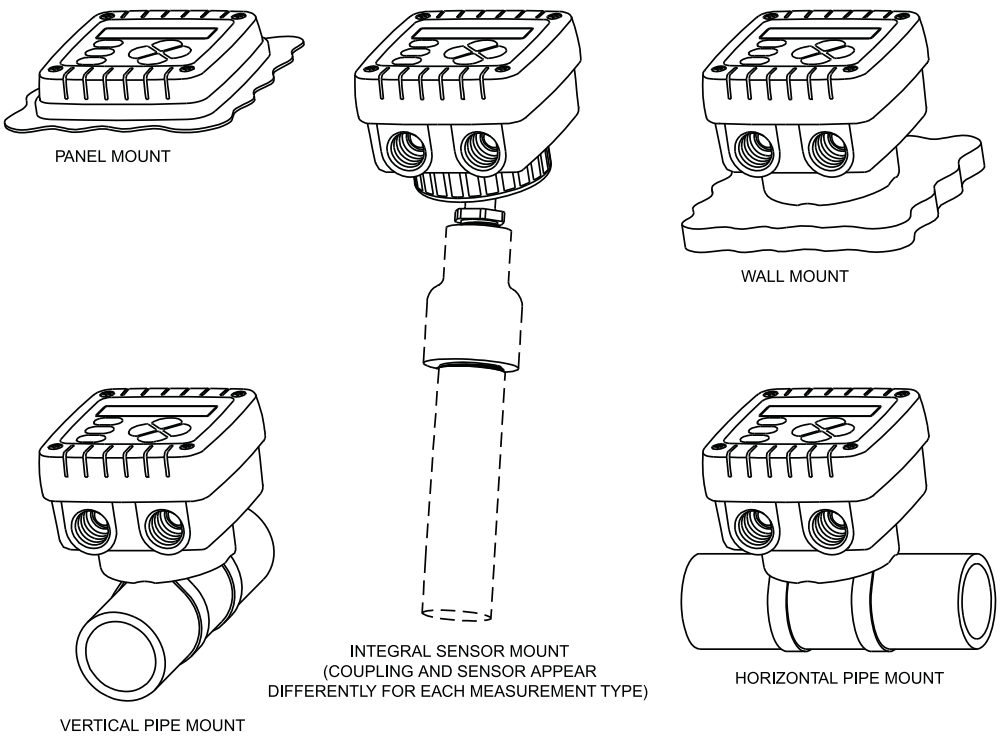
Couplings to Retrofit Transmitter onto Sensor

Installed Sensor	Required Coupling	
	Part Number	Size
pHD™-series:		
Convertible (tee mount)	3P2120-125	1 x 1/2-inch
Convertible (union mount)	None required	------
Sanitary	3P2120-125	1 x 1/2-inch
Insertion	Not available	-----
LCP-series:		
Convertible	3P2120-130	1-1/2 x 1/2-inch
Union mount	3P2120-130	1-1/2 x 1/2-inch
PC-series 3/4-inch Combination	3P2120-122	3/4 x 1/2-inch

Engineering Specifications

1. The microprocessor-based transmitter shall accept any GLI 5-wire Differential Technique pH or ORP sensor, or any conventional combination pH or ORP electrode.
2. The transmitter shall measure pH and process temperature or ORP.
3. The transmitter shall be operable in multiple languages.
4. The transmitter shall have a two-line by 16 character LCD. It shall display measured pH and temperature separately or together on a single screen. The corresponding 4-20 mA analog output value shall also be shown.
5. The transmitter shall have these calibration methods:
   a) 2-point Buffer Method (pH only): Automatic calibration and buffer recognition using two buffers from a selected buffer set.
   b) 1-point Buffer Method (pH only): Automatic calibration and buffer recognition using one buffer from a selected buffer set.
   c) 2-point Sample Method (pH only): Enter two known sample values (determined by laboratory analysis or comparison reading) or two known pH buffer values.
   d) 1-point Sample Method (pH and ORP): Enter one known sample value (determined by laboratory analysis or comparison reading) or one known pH buffer value (or, for ORP measurement, one known reference solution value).
6. The transmitter shall have a passcode to restrict configuration and calibration settings only to authorized personnel.
7. The transmitter shall have two temperature compensation methods:
   a) Automatic: When the pH sensor has an NTC 300 ohm thermistor, Pt 1000 RTD or Pt 100 RTD temperature element, the pH measurement is automatically compensated for process temperature.
   b) Manual: The transmitter can be set to compensate the pH measurement to a fixed, user-entered temperature.
8. The transmitter shall have user-test diagnostics for transmitter and sensor operation without requiring special test equipment.
9. The transmitter shall have an RS-485 data communication port.
10. The transmitter shall have an isolated 4-20 mA analog output that can be assigned to represent the measured pH or temperature (or ORP). Parameter values can be entered to define the endpoints at which the 4 mA and 20 mA analog output values are desired (range expand). During calibration, the analog output is automatically held at the last measured value and, upon completion, returned to its active state.
11. The transmitter shall be Hach Company GLI Model PRO-P3.

Mounting Configurations



GLI pHD™ Differential pH and ORP Sensors

(for use with PRO-P3 Transmitter)
For complete details and specifications, refer to Data Sheet G109.

Hach Worldwide Headquarters
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Loveland, Colorado 80539-0389
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E-mail: orders@hach.com

Represented By:

Be Right™

BHEL DOC NO: PE-V0-412-164-A015			
Clear Water Limited **B-14/1, Okhla Indl. Area, Phase-II,** **New Delhi- 110 020**	**DATA SHEET** **Level Transmitter (Ultrasonic Type)**	**CWL DOC. No.**	**DS-02/17-04(92-LT)**
			Rev-0
		Sheet	**1 of 3**

	Tag No.	Ref Sheet 2 of 2	
	Qty.	Ref Sheet 2 of 2	
	Make	Siemens	
	Measuring Principle	ultrasonic level measurement	
	typical application	Level measurement in effluent sumps / sludge sump / storage vessels and simple Process vessels	
	Model No.	Ref Sheet 2of 2	
	Area Classification	Non Hazardous	
	Tank MOC	Ref Sheet 2of 2	
	Application	Continuous Level Transmission ; local digital indication	
	Signaling	Single	
	Operating Sonic Frequency	54 kHz	
	Beam Angle	10Deg. at - 3 dB boundary	
	Calibration Range	Ref Sheet 2of 2	
	Level Resolution (mm)	<=3mm	
	Blanking Distance (M)	0.25	
	Max. Measuring range (M)	0.25 to 6 M	
	Limit Temp. ºC	-20 to 80	
	Wet side Material	PVDF	
	Housing Material	PBT (Polybutylene Terephthalate) / Cast Aluminum	
	Enclosure	IP-68 PBT	
	Transducer Body Seal	ETFE or PVDF	
	Mounting	Top Mounted	
	Process Connection	2” NPT Threaded ; Two ½-14 NPT for cable glands with Pug and Socket connector	
	Electronics	Microprocessor based	
	Power Supply	24v DC with 550 ohm maximum 12-30 V DC Loop Powered (two Wire)	
	cable Inlet	2 x 1/2"NPT thread	
	Output	4-20mA out put ; +/- 0.02 mA accuracy	
	Accuracy	± the greater of 0.15% of range or 6mm	
	Service	Ref Sheet 2of2	
	Pressure G Nor. I Max	(-)0.25 to 3.0 bar	
	Temp. C-Nor. I Max. (ºC)	35 / 45	
	Temperature Compensation	Built in to compensate over temperature range	
	Related Humidity	0-100%	
	Local Digital Display	Integral Display	
	Hand Held Programmer	Provided 1 no with two spares	
	power	3 V Lithium battery (non -replaceable)	
			Project: 2x660 MW Ennore Sez STPP **Client:** Ennore **Consultant:** Desein Pvt Ltd
00	Submitted for approval	20.12.2018	
REV	**DESCRIPTION**	**DATE**	

BHEL DOC NO: PE-V0-412-164-A015			
Clear Water Limited **B-14/1, Okhla Indl. Area, Phase-II,** **New Delhi- 110 020**	**DATA SHEET** **Level Transmitter (Ultrasonic Type)**	**CWL DOC. No.**	**DS-02/17-04(92-LT)**
			Rev-0
		Sheet	**2 of 3**

	Catalogue	Attached	
	O & M manual	To be provided with Supply	
	Inspection Catalogue	III	
	COC Criteria	i) Review of Factory calibration Certificate ii) Visual ; W & G Certificate	
	Spare	Provided as per Specified BOQ	
			Project: 2x660 MW Ennore Sez STPP **Client:** Ennore **Consultant:** Desein Pvt Ltd
00	Submitted for approval	20.12.2018	
REV	**DESCRIPTION**	**DATE**	

BHEL DOC NO: PE-V0-412-164-A015			
Clear Water Limited **B-14/1, Okhla Indl. Area, Phase-II,** **New Delhi- 110 020**	**DATA SHEET** **Level Transmitter (Ultrasonic Type)**	**CWL DOC. No.**	**DS-02/17-04(92-LT)**
			Rev-0
		Sheet	**3 of 3**

Sl. No.	Location/Sump Tag No.	Level Transmitter Tag No.	Qty	Working Medium/ Process Fluid	Model No.	Remark.
1.	As per P & I Drg. No. 17-04/ A012	As per P & I Drg. 17-04/ A012	17	Dirty Water	Siemens-7ML-5221-2BA-11	
2.						
3.						
4.						
5.						
6.						
7.						
8.						
	Sub Total		17Nos.			
5	Spare		2 Nos.	-		Spare
	Total		19Nos.			

Notes:

1. Sub-vendor product. Cat. Enclosed.
2. Sensor mounting unit with pvc flange shall be of 100 dia with Drill holes conforming to ANSI-16.5 ; Transmitter vender to provide 100mm PVC Flange mounted unit
3. All Level Transmitters are for mounting on atmospheric Tanks
4. All Level Transmitter shall be factory calibrated
5. Canopy for each unit shall be provided by Clear Water.
6. One common hand held Programmer shall be provided

REV	DESCRIPTION	DATE	
00	For approval	20.12.2018	**Project:** 2x660 MW Ennore Sez STPP **Client:** Ennore **Consultant:** Desein Pvt Ltd

SITRANS Probe LU

Overview

SITRANS Probe LU is a 2-wire loop powered ultrasonic transmitter for level, volume and flow monitoring of liquids in open channels, storage vessels and simple process vessels.

Benefits

- Continuous level measurement up to 12 m (40 ft) range
- Easy installation and simple start-up
- Programming using infrared Intrinsically Safe handheld programmer, SIMATIC PDM or HART® Communicator
- Communication using HART or PROFIBUS PA
- ETFE or PVDF transducers for chemical compatibility
- Patented Sonic Intelligence signal processing
- Extremely high signal-to-noise ratio
- Auto False-Echo Suppression for fixed obstruction avoidance
- Level to volume or level to flow conversion

Application

The SITRANS Probe LU is ideal for level monitoring in the water and wastewater industry and chemical storage vessels.

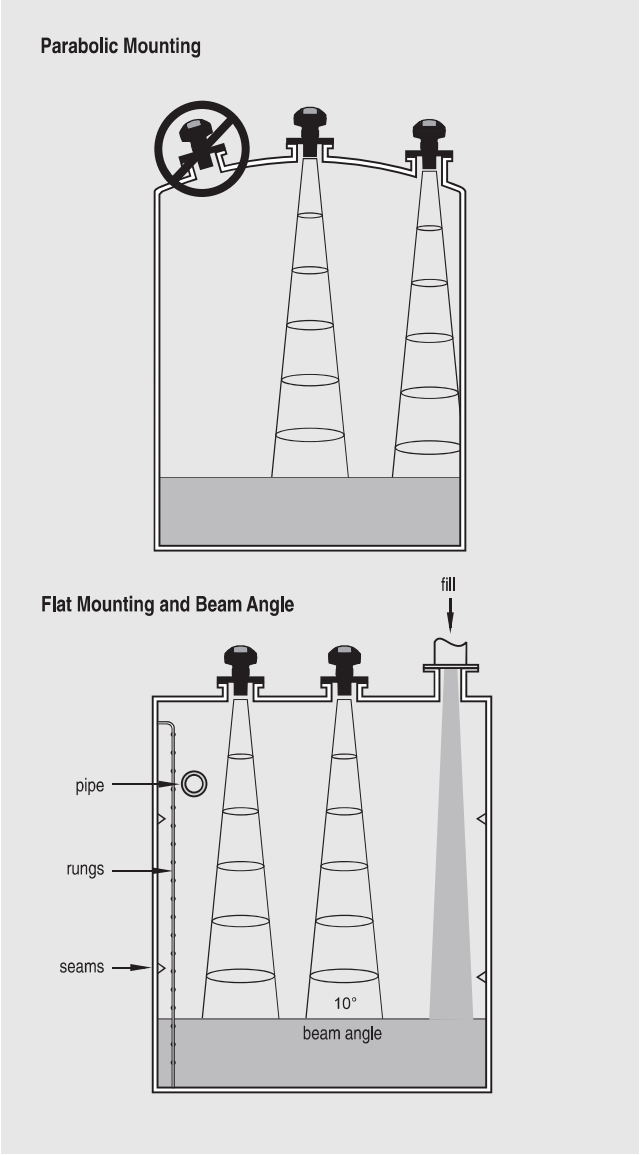
The range of SITRANS Probe LU is 6 or 12 m (20 or 40 ft). Using Auto False-Echo Suppression for fixed obstruction avoidance, as well as an improved signal-to-noise ratio and improved accuracy of 0.15% of range or 6 mm (0.25"), the Probe LU provides unmatched reliability.

SITRANS Probe LU includes Sonic Intelligence® signal processing from the field-proven Probe and incorporates new echo processing features and the latest micro-processor and communications technology. The Probe LU offers two communications options: HART or PROFIBUS PA (Profile version 3.0, Class B).

The transducer on the Probe LU is available as ETFE or PVDF to suit the chemical conditions of your application. As well, for applications with varying material and process temperatures, the Probe LU incorporates an internal temperature sensor to compensate for temperature changes.

- Key Applications: chemical storage vessels, filter beds, liquid storage vessels

Configuration



SITRANS Probe LU mounting

Technical specifications

Mode of operation	
Measuring principle	Ultrasonic level measurement
Typical application	Level measurement in storage vessels and simple process vessels
Inputs	
Measuring range	
• 6 m (20 ft) model	0.25 to 6 m (10" to 20 ft)
• 12 m (40 ft) model	0.25 to 12 m (10" to 40 ft)
Frequency	54 kHz
Outputs	
mA/HART®	
• Range	4 to 20 mA
• Accuracy	± 0.02 mA
PROFIBUS PA	Profile 3, Class B
Performance	
Resolution	≤ 3 mm (0.12")
Accuracy	± the greater of 0.15 % of range or 6 mm (0.24")
Repeatability	≤3 mm (0.12")
Blanking distance	0.25 m (10")
Update time	≤ 5 seconds
• 4/20 mA/HART version	≤ 5 seconds at 4 mA
• PROFIBUS version	≤ 4 seconds at 15 mA current loop
Temperature compensation	Built-in to compensate over temperature range
Beam angle	10°
Rated operating conditions	
• Ambient conditions	
- Location	Indoor/outdoor
- Ambient temperature	-40 to +80 °C (-40 to +176 °F)
- Relative humidity/ingress protection	Suitable for outdoor
- Installation category	I
- Pollution degree	4
• Medium conditions	
- Temperature at flange or threads	-40 to +85 °C (-40 to +185 °F)
- Pressure (vessel)	0.5 bar g (7.25 psi g)
Design	
Material (enclosure)	PBT (Polybutylene Terephthalate)
Degree of protection	Type 4X/NEMA 4X, Type 6/ NEMA 6/IP67/IP68 enclosure
Weight	2.1 kg (4.6 lbs)
Cable inlet	2 x M20x1.5 cable gland or 2 x ½" NPT thread
Material (transducer)	ETFE (Ethylene Tetrafluoroethylene) or PVDF (Polyvinylidene Fluoride)

Process connection	
• Threaded connection	2" NPT [(Taper), ANSI/ASME B1.20.1] R 2" [(BSPT), EN 10226] or G 2" [(BSPP), EN ISO 228-1]
• Flange connection	3" (80 mm) universal flange
• Other connection	FMS 200 mounting bracket (see page 5/189) or customer supplied mount
Display and Controls	
Interface	Local: LCD display with bar graph Remote: Available via HART or PROFIBUS PA
Configuration	Using Siemens SIMATIC PDM (PC) or HART handheld communicator or Siemens infra-red handheld programmer
Memory	Non-volatile EEPROM
Power supply	
4 to 20 mA/HART	Nominal 24 V DC with 550 Ω maximum; maximum 30 V DC 4 to 20 mA
PROFIBUS PA	12, 13, 15, or 20 mA depending on programming (General Purpose or Intrinsically Safe version) per IEC 61158-2
Certificates and Approvals	
General	$CSA_{US/C}$, FM, CE, C-TICK
Marine (only applies to HART communication option)	• Lloyd's Register of Shipping • ABS Type Approval
Hazardous	
• Intrinsically Safe (Europe)	ATEX II 1G EEx ia IIC T4
• Intrinsically Safe (USA/Canada)	CSA/FM (barrier required) T4, Class I, Div. 1, Groups A, B, C, D; Class II, Div. 1, Groups E, F, G; Class III
• Intrinsically Safe (Australia/New Zealand)	ANZEx Ex ia IIC T4, Tamb = -40 to +80 °C (-40 to +176 °F) IP67, IP68
• Intrinsically Safe (International)	IECEx TSA 04.0020X Ex ia IIC T4
• Intrinsically Safe (Brazil)	INMETRO Br-Ex ia IIC T4
• Non-incendive (USA)	FM (no barrier required) T5: Class I, Div. 2, Groups A,B,C, D
Handheld Programmer	
• Intrinsically Safe Siemens handheld programmer	Infrared receiver
- Approvals for handheld programmer	IS model with ATEX EEx ia IIC T4 CSA/FM Class I, Div. 1, Groups A, B, C, D
• Ambient temperature	-20 to +40 °C (-5 to +104 °F)
• Interface	Proprietary infrared pulse signal
• Power	3 V lithium battery (non-replaceable)

SITRANS Probe LU

Selection and Ordering data		Order No.
SITRANS Probe LU	C)	**7ML5221 -**
2-wire, loop powered ultrasonic transmitter for level, volume and flow monitoring of liquids in open channels, storage vessels and simple process vessels.		
Enclosure/Cable Inlet		
Plastic (PBT), 2 x M20x1.5 (check Approvals for cable gland details)		**1**
Plastic (PBT), 2 x ½" NPT (no cable glands supplied)		**2**
Range/Transducer material		
6 meter (20 ft), ETFE		**A**
6 meter (20 ft), PVDF Copolymer		**B**
12 meter (40 ft), ETFE		**C**
12 meter (40 ft), PVDF Copolymer		**D**
Process connection		
2" NPT [(Taper), ANSI/ASME B1.20.1]		**A**
R 2" [(BSPT), EN 10226]		**B**
G 2" [(BSPP), EN ISO 228-1]		**C**
Communication/Output		
4 to 20 mA, HART®		**1**
PROFIBUS PA		**2**
Approvals		
General Purpose, FM, CSA, CE, C-TICK		**1**
FM, Class I, Div. 2[1]		**4**
Intrinsically Safe, CSA/FM Class I, Div. 1, Groups A, B, C, D (barrier required); Class II, Div. 1, Groups E, F, G; Class III[2]		**5**
Intrinsically Safe, ATEX II 1G EEx ia IIC T4[2]		**6**
Intrinsically safe, ATEX II 1 G EEx ia IIC T4, ANZEx, IECEx, INMETRO, CE, C-TICK [3]		**7**
Intrinsically safe, CSA/FM Class I, Div. 1, Groups A, B, C, D; Class II, Div. 1 Group E, F, G; Class III T4[3]		**8**
Further designs		Order code
Please add "**-Z**" to Order No. and specify Order code(s).		
Stainless steel tag [69 x 50 mm (2.71 x 1.97")]: Measuring-point number/identification (max. 16 characters) specify in plain text		**Y15**
Operating Instructions for HART/mA device		Order No.
English	C)	**7ML1998-5HT02**
French	C)	**7ML1998-5HT11**
German	C)	**7ML1998-5HT32**
Note: The Operating Instructions should be ordered as a separate item on the order.		
Additional Multi-language Quick Start manual	C)	**7ML1998-5QR81**
This device is shipped with the Siemens Milltronics manual CD containing the complete ATEX Quick Start and Operating Instructions library.		
Operating Instructions for PROFIBUS PA device		
English	C)	**7ML1998-5JB02**
German	C)	**7ML1998-5JB32**
Note: The Operating Instructions should be ordered as a separate item on the order.		
Additional Multi-language Quick Start manual	C)	**7ML1998-5QV81**
This device is shipped with the Siemens Milltronics manual CD containing the complete ATEX Quick Start and Operating Instructions library.		

Selection and Ordering data		Order No.
SITRANS Probe LU	C)	**7ML5221 -**
2-wire, loop powered ultrasonic transmitter for level, volume and flow monitoring of liquids in open channels, storage vessels and simple process vessels.		
Optional equipment		
Handheld programmer, Intrinsically Safe, EEx ia		**7ML5830-2AH**
Handheld programmer, General Purpose approvals		**7ML1830-2AN**
Handheld programmer, Infrared, Intrinsically Safe, PROFIBUS PA		**7ML5830-2AJ**
HART modem/RS-232 (for use with PC and SIMATIC PDM)	D)	**7MF4997-1DA**
HART modem/USB (for use with a PC and SIMATIC PDM)	D)	**7MF4997-1DB**
2" NPT locknut, plastic		**7ML1830-1DT**
2" BSPT locknut, plastic		**7ML1830-1DQ**
3" ASME, DN 65 PN 10, JIS 10K 3B ETFE Flange adapter for 2" NPT		**7ML1830-1BT**
3" ASME, DN 65 PN 10, JIS 10K 3B ETFE Flange adapter for 2" BSPT		**7ML1830-1BU**
One General Purpose polymeric cable gland M20x1.5, rated for -20 to +80 °C (-4 to +176 °F)		**7ML1930-1AM**
One metallic cable gland M20x1.5, rated -40 to +80 °C (-40 to +176 °F) for General Purpose or ATEX EEx e installations (available for HART only)		**7ML1930-1AP**
One metallic cable gland M20x1.5, rated -40 to +80 °C (-40 to +176 °F) with integrated shield connection (available for PROFIBUS PA)		**7ML1930-1AQ**
SITRANS RD100 Remote display - see RD100 on page 5/312		
SITRANS RD200 Remote display - see RD200 on page 5/314		
SITRANS RD500 Remote display - see RD500 on page 5/318		
Spare Parts		
Plastic lid		**7ML1830-1KB**

1) Available with Enclosure/Cable Inlet option 2 only.
2) Available with communication option 2 only.
3) Available with communication option 1 only.

C) Subject to export regulations AL: N, ECCN: EAR99

D) Subject to export regulations AL: N, ECCN: EAR99H

2X660 MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NNTPS, CHENNAI
CUSTOMER: TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD. (TANGEDCO)
MINUTES OF MEETING FOR MAUX PACKAGES DURING ERM DATED 03-04 Oct 2019 AT PSSR HQ CHENNAI

Drawing/Document No PE-V0-412-164-A008
Title: PROCESS DESIGN AND SIZING CALCULATION INCLUDING PRESSURE DROP CALCULATIONS (ETP) rev-0

S.No.	TANGEDCO COMMENTS	BHEL reply	resolution
1	Indicate standard Title block applicable for the project.	This will be updated in revised document.	Noted.
2.	Sheet 1 – Influent Flow Please indicate RO Stage II reject flow.	This will be indicated in revised document.	Noted.
3.	The operation philosophy indicated for CMB Transfer pumps for supplying water to CHP & Guard pond is very complex. The flexibility should be available to supply water to either areas without any opening & closing of valves. Revise the philosophy in this context.	Common pumps have been envisaged for transferring effluent from CMB to CHP area and excess water to Guard pond as per approved P&ID for ETP.	Noted.
4.	Sheet 3 – Wording "Flow to be pumped to CHP system is not indicated in the spec" is not understood. Please clarify and revise the statement.	This will be updated in revised document.	Noted.
5	Sheet 3 & 4 – Please indicated basis for selecting C Value as 120.	C value have been selected as per standard practice used for PU coated pipes.	TANGEDCO insisted BHEL to provide internally Glass flakes coated pipes for sea water application instead of PU coated pipes. BHEL will review and revert.
6	Sheet 3 & 4 – Head calculation of CMB Pump 1. Static lift shall be summation of minimum water level + maximum water level + highest point to where water has to be lifted. Please verify the same. 2. Pump internal losses shall also be included in head calculation. 3. Please calculate frictional drop accurately and remove word "assumed"	1. Already considered. 2. Pump internal losses are negligible. 3. Shall be corrected.	Noted.
7.	Sheet 5 – Delivery pipe shall be glass flake coated instead of PU. Revise the same. Indicate thickness of coating.	Inside PU coated pipe has been provided as per approved P&ID and it is suited for site modifications.	TANGEDCO insisted BHEL to provide internally Glass flakes coated pipes for sea water application instead of PU coated pipes. BHEL will review and revert.
8	Sheet 5 – Static height shall be considered from minimum water level to top of pipe rack. Please confirm the same.	1. Pipe rack height has been considered while calculating the discharge head of pumps .	Noted.
9	Submit all reference drawings indicated in the calculations.	Will be indicated.	Noted.

04/10/19 (BHEL) (DESEIN) 4/10/19 (TANGEDCO)

2X660 MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NNTPS, CHENNAI
CUSTOMER: TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD. (TANGEDCO)
MINUTES OF MEETING FOR MAUX PACKAGES DURING ERM DATED 03-04 Oct 2019 AT PSSR HQ CHENNAI

S.No.	TANGEDCO COMMENTS	BHEL reply	resolution
10	Remove all reference to BHEL discussions as these are internal matter to which owner is not party to.	Will be removed.	Noted.
11	Remove all wording about "not indicated in spec."	Will be removed.	
12	Please give a detailed operation and control philosophy of Guard Pond pumps.	Separate document PE-V0-412-164-A040 control write up for ETP has been submitted for customer approval.	Noted.
13	The head selection of guard pond pumps shall be detailed out. The pump should be able to pump water to ash water sump and pump water to sea parellely. The pumps should also be able to pump water upto sea even when blowdown pumps are not working. Please rework the head calculation highlighting each condition separately.	BHEL will revise the document..	Noted.
14	Sheet 8 – "Please delete "BHEL to review".	Will be removed.	Noted.
15	Sheet 8 – The philosophy of "Header shall generally be closed mode-----" is not acceptable.	Will be removed.	Noted.
16	Sheet – Please indicate basis for injection pressure of 21Value. m.	Calculations shall be submitted for basis.	Noted.
17	Guard Pond transfer pump shall be capable of pumping water independently to sea even when blowdown pumps are not working.	BHEL will revise the document..	Noted.
18	Sheet 8 – Delete "During table discussion in early Feb 19 ---------"	Will be removed.	Noted.
19	Sheet 8 – replace PU coating with glass flake coating.	Inside PU coated pipe has been provided as per approved P&ID and it is suited for site modifications.	TANGEDCO insisted BHEL to provide internally Glass flakes coated pipes for sea water application instead of PU coated pipes. BHEL will review and revert.
20	Sheet 8 – Please furnish basis for selection of C	C value have been selected as per standard practice used for PU coated pipes.	TANGEDCO insisted BHEL to provide internally Glass flakes coated pipes for sea water application instead of PU coated pipes. BHEL will review and revert.
21	Sheet 8 & 9 - Include pump internal losses in head calculation	Pump internal losses are negligible.	Noted.
22	Sheet 9 – Please add static head (minimum water level to highest point(pipe rack height)) to the bowl delivery head for getting total head of pump.	Pipe rack height has been considered while calculating the discharge head of pumps .	Noted.

(BHEL) (DESEIN) (TANGEDCO)

2X660 MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NNTPS, CHENNAI
CUSTOMER: TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD. (TANGEDCO)
MINUTES OF MEETING FOR MAUX PACKAGES DURING ERM DATED 03-04 Oct 2019 AT PSSR HQ CHENNAI

S.No.	TANGEDCO COMMENTS	BHEL reply	resolution
23	Sheet 18 – Add static of minimum water level to maximum water level to FFL in the head calculation and revise the calc.	Will be included.	noted
24	Other comments marked on drawing.	Will be revised.	noted

Based on the above BHEL will submit the revised document.

04/11/19
(BHEL)

(DESEIN)

RRBS 4/11/19
(TANGEDCO)

S.No.	TANGEDCO COMMENTS
1	Indicate standard Title block applicable for the project.
2.	Sheet 1 – Influent Flow Please indicate RO Stage II reject flow.
3.	The operation philosophy indicated for CMB Transfer pumps for supplying water to CHP & Guard pond is very complex. The flexibility should be available to supply water to either areas without any opening & closing of valves. Revise the philosophy in this context.
4.	Sheet 3 – Wording "Flow to be pumped to CHP system is not indicated in the spec" is not understood. Please clarify and revise the statement.
5	Sheet 3 & 4 – Please indicated basis for selecting C Value as 120.
6	Sheet 3 & 4 – Head calculation of CMB Pump 1. Static lift shall be summation of minimum water level + maximum water level + highest point to where water has to be lifted. Please verify the same. 2. Pump internal losses shall also be included in head calculation. 3. Please calculate frictional drop accurately and remove word "assumed"
7.	Sheet 5 – Delivery pipe shall be glass flake coated instead of PU. Revise the same. Indicate thickness of coating.
8	Sheet 5 – Static height shall be considered from minimum water level to top of pipe rack. Please confirm the same.
9	Submit all reference drawings indicated in the calculations.
10	Remove all reference to BHEL discussions as these are internal matter to which owner is not party to.
11	Remove all wording about "not indicated in spec."
12	Please give a detailed operation and control philosophy of Guard Pond pumps.
13	The head selection of guard pond pumps shall be detailed out. The pump should be able to pump water to ash water sump and pump water to sea parellely. The pumps should also be able to pump water upto sea even when blowdown pumps are not working. Please rework the head calculation highlighting each condition separately.
14	Sheet 8 – "Please delete "BHEL to review".
15	Sheet 8 – The philosophy of "Header shall generally be closed mode-----" is not acceptable.
16	Sheet – Please indicate basis for injection pressure of 21Value. m.
17	Guard Pond transfer pump shall be capable of pumping water independently to sea even when blowdown pumps are not working.
18	Sheet 8 – Delete "During table discussion in early Feb 19 ---------"
19	Sheet 8 – replace PU coating with glass flake coating.
20	Sheet 8 – Please furnish basis for selection of C
21	Sheet 8 & 9 - Include pump internal losses in head calculation
22	Sheet 9 – Please add static head (minimum water level to highest point(pipe rack height)) to the bowl delivery head for getting total head of pump.
23	Sheet 18 – Add static of minimum water level to maximum water level to FFL in the head calculation and revise the calc.
24	Other comments marked on drawing.

APPROVED WITH COMMENTS

REV	DATE	ALTERED	CHECKED	DOC. TITLE :
				PROCESS DESIGN AND SIZING CALCULATION INCLUDING PRESSURE DROP CALCULATIONS (ETP)
				STATUS : CONTRACT
				JOB NO.: 17-04

1. Document have numbers of the reference of drawings / documents etc (17-02/A011, 17-02/A081, 085-27A, etc) which are not submitted. Please attached them for review of the document.
2. BHEL to submit the GA Drawings to review the mentioned elevation levels.
3. BHEL to include the Oil & Water Separator Calculation.

BHARAT HEAVY ELECTRICALS LTD
PRO ECT ENGINEERING MANAGEMENT.
This approval status shall be interpreted as laid down in the contract and it shall not relieve the contractor from the contractual obligation.
APPROVAL CATEGORY AWARDED II
CAT I - Approved
CAT II - Approved With Comments as Noted
CAT III - Not Approved
CAT IV - Reference Drawing
DEPARTMENT MECHANICAL AU ILIARY
NAME FALGUNI SAHA

FALGUNI SAHA 2020.11.06 09:28:25 +05'30'

CUSTOMER: **TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD.**
2x660 MW Ennore Sez STPP

PACKAGE: EFFLUENT TREATMENT PLANT

ORGINATOR	TURNKEY CONTRACTOR:-	**CWL. DOC. NO.**
	CLEAR WATER LTD. B-14/1, OKHLA INDUSTRIAL AREA PHASE-II, NEW DELHI-110020 PHONE: 011 26386095 EMAIL: clearwater@bol.net.in	**17-04 D (11) PH rev 01A** **Dtd. 14-02-2019**

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT, NEW DELHI

REV.	NAME	SIGN	DATE	BHEL DOCUMENT NO.	REV
0	R. R. BAGARI		14/02/2019	**PE-V0-412-164-A008**	0

NO. OF SHEETS	30	EXCLUDING COVER PAGE

CMB Pond (Twin Section)		
Specified aggregate Volumetric Capacity of two compartments	*Cum*	1000
No. of compartment	*Nr*	2
Volumetric capacity of each compartment	*Cum*	1000/2 = 500
Assumed SWD of Tank	*M*	3.5
Tank Area Required	*Sqm*	500/ 3.5 = 143
Tank Size Provided	*MxM*	12 x12 ; 144 sq.mt ; hence O.K
Specified Free Board	*mm*	500
Influent Flow		
Flow From CPU & DM Plant (150 NB)	*Cum/hr*	80 ; intermittent [1]
Return Flow (Max); 300 NB pipe	*Cum/hr*	1000 (assumed)
Aggregate total flow (Max) assuming equivalent to defined Pump Transfer capacity	*Cum/hr*	1000
For ETP –Water Balance refer to Water Balance annexure attached		
Inlet Sump		
Specified Inflow	*Cu.m/hr*	1000
Consider volumetric capacity (minimum) equivalent to	*Mt*	1 (one)
Volume required	*Cu.m*	(1000/ 60) x 1=16.7
Inlet sump size provided	*M x M x M*	3 x 4 x 3.5= 42 > 16.7 ; hence Ok.
Higher volume/ larger size sump provided as inflow is thru Pump Headers ; return recirculation pipe . Higher sump volume will kill turbulence in sump and flow thru isolating Shutter shall be quiescent .		
TWL considered in Inlet sump	*M*	2.00
Please refer to Layout Drg No 17-02/A011 and Guard Pond GA Drg. No. 17-02/A081 for typical		

CMB. Please revise

details. Provision of 100 dia holes on Inlet Launder Slab has been envisaged to ensure better pond capacity utilization; to distribute flow over maximum length of Pond so as to prevent short circuiting of flow to over flow sump. This is important as influent is to be neutralized by adding chemicals in Inlet sump. To isolate each compartment , isolating Channel shutter provision has been envisaged .		
Provided shutter width	mm	800
Lip level of shutter	M	1.565; Ref. Sec. 085-27A
Water Way area	Sq.m	0.8 x (2.0- 1.565) = 0.348
Velocity thru shutter	mps	1000/ (3600x0.348) = 0.798 <1.5 ;hence OK.
FLOW DISTRIBUTION LAUNDER		
Flow thru channel shall keep reducing over the length due to provision of orifices in launder slab as it flows from one end to other end. However, channel width has been considered as 800mm throughout to allow Maintenance personnel's to walk thru the channel for attending to maintenance problems		
Flow	Cu.m/hr	1000
Assumed width	mm	800
Velocity thru channel at the up Stream end		1000/ (3600 x 92.0-1.5=0.5) =0.555 < 0.75; hence O.k
Velocity being very very low in channel, no head loss has been envisaged and therefore TWL in Pond has been kept same as that in Inlet Channel. Larger channel size shall also reduce bending moment to wall and help reduce wall structural thickness.		
TWL in Pond	*M*	2.00
Invert level of Tank	*M*	2.00 –3.5 = (-) 1.5
Considering settlement of sediments present in Inflow ; we have considered Minimum water level in sump as (-) 1.15 considering the impracticality of cleaning tanks frequently (Even once in a year) Local Dewatering Sump; one in each section , has been provided . 1: 200 Floor slope has be rds Dewatering sump / Overflow sump. 4 Nrs. Rung Ladders have been provided in pond for maintenance access.		
Penstock at Guard Pond overflow sump		
Specified Transfer Pump flow	*m3/hr*	1000

Please check the value.

CMB. Please revise

Velocity assumed thru Penstock	*Mps*	2
Flow thru area Reqd	*Sqm*	1000/ (3600 x 2)= 0.139 = 375 x 375
Provide Penstock	*mmxmm*	400 x 400
Revised velocity thru Penstock water way	*Mps*	1.736 < 2 ; hence OK.
Penstock is provided with Manual Gear operation.		

CMB Transfer Pumps : Pump selection philosophy

Specification calls for Vertical Pumps (1 W + 1 SB) to transfer neutralized effluent to Guard Pond Sump and to CHP Dust suppression system thru 350 NB pipe . Flow discharge to Guard Pump shall be atmospheric pressure and to CHP Suppression shall be also at atmospheric pressure . Flow shall be diverted to these locations as per operational requirement . CMB Pump delivery head required is not indicated and is to be worked out .

From envisaged P & I , it is observed that while a substantial delivery head is required to deliver water to CHP sump , very little head is required to deliver CMB flow to Guard Pond .

Flow to be pumped to CHP system is not indicated in Spec.

To over come the problem and after long discussions with Pump Vender , we have envisaged to provide two Orifice plates to increase the head loss thru pipe line to Guard Pond to some extent so that selected pump could meet both operational requirement . System has been designed to deliver 1000 Cu.m/hr flow to Guard Pond .

When water is to be discharged to CHP system , then Operator would have to close the valve to Guard Pond . In such case the pump shall deliver the water to CHP system but at reduced capacity as head shall increase .

In view of this Pump selected shall meet Head required to transfer 1000cu.m/hr flow to Guard Pond . Same pump shall approx. deliver 500 cu.m /hr flow to CHP Dust Separation sump . Please refer to Data Sheet Doc. for further details.

Deliver Head Determination while pumping water to Guard Pond

Maximum water level (TWL)	*M*	(-) 1.5
Minimum water level (MWL)	*M*	(+) 2.00
Specified static lift to be considered for pipe Rack from FGL	*M*	Nil as the pipe line is routed inside the ETP area
Specified max velocity as per cl.13.13 of Chapter 13 for pipe >200 mm ; “C “as 120	*Mps*	2.1-2.4
Pump delivery port size as per Pump Data Sheet	*mm*	350

Please check the levels.

Total delivery Length of pipe to Guard Pond (Max)	*Rmt*	<30
Ref. Hazen & Williams formula; page 599; Manual 3rd edition		
Hydraulic Loss for 1000 M considering C value as 120; flow as 1000cu.m/hr;pipe dia as 400 NB	*M*	14
Expected Head loss thru pipe length assumed to be maxmm. as 40 m considering equivalent length for specials ; Generally such losses are considered as 10% of pipe friction losses ; how ever higher losses considered as several Bends and Tees are involved in short length (assumed)	*M*	(14 x 40) / 1000 = 0.56; say 1.5
Static Suction lift (Max)	*M*	(2.5 (+) (-) 1.15) = 3.65
Total delivery head	*M*	1.5 + 3.65= 5.15
Head loss thru provision of Non Measuring Orifice plate is envisaged to be provided in pump delivery header at down stream of branch connection to CHP Dust Suppression line to increase total Head loss so that selected pump could operate at two heads determined .		
Assumed Total Pump Head required to deliver 1000 cu.m/hr to Guard Pond as per pump curve	*M*	11
Orifice shall be procured of such size to increase pump delivery head from 5 to 11 M		
For Pump details please refer to Data Sheet Doc. No. DS-01/ 17-04 M (82)		
Pump Delivery Header to CHP Suppression System Please refer to Drg. No. 17-04/ A-081.		
Specified pipe header size	*mm*	350
Velocity assumed thru common Pipe header	*Mps*	2.2 as maximum allowed in 350 da pipe as per spec.
Approximate expected Flow thru pipe at maximum assumed velocity to transfer flow to CHP	*Cu.m/hr*	(0.785 x 0.35^2) x 2.2 x 3600 =520
Please refer to Pump Data Sheet Doc. No. DS-01 / 17-04M (82). Delivery of pump selected shall give approx. 500 cu.m /hr flow to CHP Dust Separation against derived head.		
Determination of delivery Head to CHP Dust Separation System		
Specified length of pipe	*Rmt*	780; say 800

Please check the sign.

Delivery pipe size	*mm*	350; MS PU coated
Assume - Ç		'130
Flow	*Cu./hr*	500
Assumed velocity	*mps*	2.2
Head loss thru pipe ; ref. Hazen & Williams formula; page 599; Manual 3rd edition	*M*	7/1000mt
Friction loss	*M*	(7/1000)x800= 5.6
Modified Friction loss due to C - 130	*M*	5.6 / 1.3 = 4.31
Consider losses thru Pipe specials and valves , etc as 10 % to be very conservative side losses	*M*	4.31 x 1.10 = 4.71; say 5
Pipe shall be routed thru Pipe rack ; specified Pipe rack height	*M*	8
Static Head has not been considered as the sump top water elevation is much below Rack height		
Total Delivery Head	*M*	{ 2.5 (+) (-) 1.5] + 8 + 5 =17
Guard Pond (Twin Section)		
Specified aggregate Volumetric Capacity of two compartments	*Cum*	5000
No. of compartment	*Nr*	2
Volumetric capacity of each compartment	*Cum*	5000/2 = 2500
Assume SWD of Tank	*M*	3.5
Tank Area Required	*Sqm*	2500/ 3.5 = 715
Tank Size Provided	*MxM*	27 x 27 ; 729 sq.mt; hence O.K
Specified Free Board	*mm*	500
Influent Flow		

Please check the sign.

Please refer to ETP – Water Balance attached		
Aggregate total flow (Max) assuming equivalent to defined Pump Transfer capacity	*Cum/hr*	1200
Inlet Sump		
Specified Inflow	*Cu.m/hr*	1200
Consider volumetric capacity (minimum) equivalent to	*mt*	1 (one)
Volume required	*Cu.m*	(1200/ 60) x 1=20
Inlet sump size provided	*M x M x M*	3 x 4 x 3.5= 42 > 20 ; hence Ok.
Higher volume/ larger size sump provided as inflow is thru Pump Headers and higher sump volume will kill turbulence in sump and flow thru isolating Shutter shall be quiescent .		
TWL considered in Inlet sump	*M*	2.00
Please refer to Layout Drg No 17-02/A011 and Guard Pond GA Drg. No. 17-02/A085 for typical details. Provision of 100 dia holes on Inlet Launder Slab has been envisaged to ensure better Pond capacity utilization ; to distribute flow over maximum length of Pond so as to prevent short circuiting of flow to Over flow sump . This is important as influent is to be neutralized by adding chemicals in Inlet sump. To isolate each compartment , isolating Channel shutter provision has been envisaged .		
Channel Shutter		
Provided shutter width	mm	800
Lip level of shutter	M	1.565; Ref . Sec. 085-27A; Drg. No. 17-04/A085 (Sh.1 & 2 of 2)
Water Way area	Sq.m	0.8 x (2.0- 1.565) = 0.348
Velocity thru shutter	mps	1200/ (3600x0.348) = 0.958 <1.5 ;hence OK.
FLOW DISTRIBUTION LAUNDER		
Flow thru channel shall keep reducing over the length due to provision of orifices in launder slab as it flows from one end to other end. However, channel width has been considered as 800mm throughout to allow Maintenance personnel's to walk thru the channel for attending to maintenance problems		

Flow	Cu.m/hr	1200
Assumed width	mm	800
Velocity thru channel at the upper end		1200/ (3600 x 92.0-1.5=0.5) =0.666 0.75; hence o.k
Velocity being very very low in channel, no head loss has been envisaged and therefore TWL in Pond has been kept same as that in Inlet Channel. Larger channel size shall also reduce bending moment to wall and help reduce wall structural thickness.		
TWL in Pond	*M*	(+)2.00
Invert level of Tank	*M*	2.00 –3.5 = (-) 1.5
Considering settlement of sediments present in Inflow ; we have considered Minimum water level in sump as (-) 1.15 considering the impracticality of cleaning tanks frequently (Even once in a year) Local Dewatering Sump; one in each section , has been provided . 1: 200 Floor slope has been envisaged to wards Dewatering sump / Overflow sump. 4 Nos. Rung ladders have been provided in Pond for maintenance access.		
Penstock at Guard Pond overflow sump		
Specified Transfer Pump flow	*m3/hr*	1200
Velocity assumed thru Penstock	*Mps*	2
Flow thru area Required	*Sqm*	1200/ (3600 x 2)= 0.166 = 408 x 408
Provide Penstock	*mmxmm*	400 x 400
Revised velocity thru Penstock water Way	*mps*	2.08; hence O.k
Penstock is provided with Manual Gear operation.		
Guard Pond Transfer Pumps		
Specification calls for Vertical Pumps (1 W + 1 SB) to transfer neutralized effluent to deliver to Ash Water Sump thru 350 dia pipe and to CW Blow Down thru 450 dia pipe . From discussion, we understand that flow discharge to Ash Water Sump shall be at atmospheric pressure and to CW Blow Down Header it shall be thru injection to header having maximum pump head as 20 MWC at point of Injection as advised by BHEL during discussions in Feb.2019 .Water shall be diverted to these locations as per operational requirement . CW Pump Header delivery head was not indicated in Spec. Injection point was also not specified in Spec.		

check

As per Flow sheet , CW Blow Down header is discharging into sea. This header has a branch connection to feed waste water to Ash Water Sump . It is further advised that the Ash water Header from ETP required to be connected to branch Header shall normally be in closed mode and is to be opened only when operationally required to meet water requirement .

In view of this Pump Head has been designed to meet Back pressure requirement of CW Header at point of Injection . As advised by BHEL during Document approval , pump injection head has been considered as 21M . BHEL is to review .

Maximum water level (TWL)	*M*	(-) 1.5
Minimum water level (MWL)	*M*	(+) 2.00
Specified static lift to be considered for pipe Rack from FGL	*M*	8
Specified max velocity as per cl.13.13 of Chapter 13 for pipe >200 mm ; "C "as 130	*Mps*	2.1-2.4
Specified Pump delivery Header size in Spec.	*mm*	450 ; revised to 500 NB as per BHEL advise during Doc. approval

Please check the level.

To limit the Motor size to LT , BHEL advised to to consider delivery header of 500 dia wit C value as 130 as Pipes are internally PU coated up to ETP area and thereafter pipe and pipe specials are glass lined . Calculations have accordingly been revised .

During table discussion held in early Feb. 2019 , BHEL has further advised that Pump delivery pipe length is now to be considered as 1050 M in place of earlier advised length of 800 rmt . Further , It was also clarified that Guard pump delivery header is to be connected to CW delivery header running buried under the Ground level having BOP of 1500dia pipe as (-)3.3 M . CW delivery header shall run for considerable length below Ground level up stream as well down stream before running on Rack .

Total specified delivery Length of CW Blow Down header up to point of injection (Max)	*Rmt*	1050
Max. flow thru header	*Cu.m/hr*	1200
Ref. Hazen & Williams formula;page 599;Manual3rd edition		
Hydraulic losses (Hf) as per Hazzen William ., considering 500 nb pipe	*M*	3.8 per 1000
Expected Head loss thru 500 NB pipe with C as 100	*M*	(3.8 x 1050) / 1000 = 3.99; say 4.0
C "value to be considered as per BHEL advise		130
Revised Friction loss	*M*	4.00

Actual friction loss thru 1040 rmt pipe length		4.00/1.3 = 3.08; say 3.1
ses say 10% of hf as most of the run is straight	*M*	0 .31
Suction lift	*M*	[(2.5 +(- 1.15) = 3.65]
Rack Elevation	*M*	8
Static Head	*M*	It is negative
Total delivery Bowl head	*M*	8+3.5 +0.31 + 3.10= 14.91 Reqd.
BHEL advised Injection head required	*M*	21
Total Bowl delivery Head required to be considered	*M*	(Injection +pipe Hf) =21+3.1+0.31 say 24.41
Consider Bowl Head	*M*	25
For Pump details please refer to Guard Pond Data Sheet Doc. No. DS-01/ 17-04 M (82) Please note that if delivery head / Injection Head increases or decreases due to any reason , the pump delivery flow shall decrease or increase ,		
Pump Delivery Header Please refer to Drg. No. 17-04/ A-085.		
Designed Pump flow	*m3/hr*	1200
Specified (Modified) pipe size	*mm*	500 NB (0.785x0.5 x0.5= 0.19625 sq.m)
Velocity thru common Pipe header	*Mps*	1200/3600x 0.196 = 1.7
Provide 500 mm NB; 6 thk M.S. common delivery header Pipe as per IS:3589; Internally 1500 micron PU coated as pump delivery header up to battery limit of this package . Further piping shall be laid by BHEL		
Power required as per Pump Data Sheet Doc. No. DS-01/17-04 M (82) ; BKW -Water	BKW	105.09
Specific Gravity considered as advised		1.03
BKW required for liquid		108.25

1050. Please check.

Total bowl head required shall be calculated after adding the injection head + all head loss, static etc. Please also consider the pump internal losses if any

Recommended Motor	Kw / RPM	125 / 4 Pole
For typical details of Pump , please refer to Data Sheet Doc. No. DS-01/17-04 M (82)		
For typical details of Motor , please refer to Data Sheet Doc. No. EMS-01/17-04 M (72)		

TUBE SETTLER

Process Data, Influent Characteristics and Treated water quality

Tube Media provides effective settling of chemically treated water in potable and Industrial water Treatment Plants.

Individual Tubes are continuous and smooth to minimize any mixing currents within the tubes. The configuration and shape of each tube is designed to give a low “Reynolds Number“ and laminar flow conditions. This enables rapid accumulation and settlement of solids through the tubes.

Individual tubes are continuous and imperforate and prevent any transfer of liquid between each tube. This eliminates any mixing currents within the tubes. Mixing currents adversely affect the settlement of solids and re-suspend the settled solids within each tube. The high surface area of tubes, combined with these features, enables substantial expansion of of settling capacity at high “Rise Rates“. The tube settling modules are assembled to give multiple tubes of approximately hexagonal –chevron shape. Tube settlers can be placed adjacent to each other, to snugly fit and cover as much area as is required in the clarifiers and sedimentation basins.

A module of standard size block is placed in one corner of the tank along with the centre channel. Care should be taken that the module is placed right side up, with the tongue and groove system underneath. The slope of the module is inclined to the side wall of the tank and slight pressure is then applied on the module to push it into the corner, so that is touches the two wall sides. The space underneath the slope at the end of the module and the wall can stay empty.

The next standard module has to be placed alongside the first one. The two modules have to touch each other so that the grooves of the second module lie upon the tongues of the first.

The step has to be repeated until the last standard module is installed. Care must be taken that each module is supported by at least two beams symmetrically. If a module is not supported symmetrically, it has to be lengthened or shortened to achieve the necessary support symmetry.

1.	Application		To remove settle able solids from Power Plant waste water flow to Effluent Treatment Plant
2	System Requirement		1 (One)
3.	Influent flow to system	Cu.m /hr	125

4.	Total Suspended solids (Turbidity max.)	ppm	500
5.	Total oil; max.	mg./l	50
6.	Free oil; max.	mg./l	50
7.	Sp. Gravity of liquid		1
9	Viscosity of effluent	cp	1.0
10	Design Temp.	ºC	50
11	Ambient Temp.	ºC	33
B	**Treated Effluent characteristics**		
1	Free oil (ppm)	mg./l	<10
2	Suspended solids (TSS)	ppm	<10
C	**Unit Specification**		
1.	Design		Clear Water Ltd. using PVC Tube Pac modules
2	No. of Unit	No.	1
3	Design Flow Rate	Cu.m/hr	125;
4	Nature of flow		Assumed Continuous at steady rate; Oil water Separator at up stream; Flocculator provided up stream of Tube Settler
5	Tank MOC		RCC designed as per IS:3370
6	Flow direction (counter/cross/co-current)		Bottom to top; Counter current
	Determination of Unknown Values		
	Specified settling rate	m/hr	1.5 to 2
	Sedimentation velocity has to be determined by Sedimentation Tests. As application is to treat the Plant waste water , we have adopted lower range of specified Settling rate i.e 1 based upon our experience		
7	Factor of Safety ; Consideration of Safety Factor is necessary to account for Uneven flow; uneven distribution etc.		0.5 for bad Settle able solids ; 0.6 -0.7 for med. settle able solids ; 0.7 to 0.8 for good settle able solids; Although liquid is being flocculated but nature of solids is un known and flow shall also be uneven and distribution shall also be uneven .

8.	Safety Factor considered		0.5; Adopt 0.5 for bad settle able solids as nature of solids is un-known
	Height of Tube Settler		
	For Settle able solid	ppm	➢ 100 adopt 0.5M ; <10 adopt 1.0M
	Adopted 0.6 M height of Media Pac as solid load shall vary and no pattern can be predicted .		
	Media		
	Angle of Inclination	degree	60
9.	Hydraulic Radius of Tube Pac as per Mfr's IN Put data	mm	65
10	Media type		Hexagonal – Chevron
11	Cross Sectional area (single tube)of Pac	mm	75x50
	Specified straight height of Tube	Mm	Not specified ;
12	Depth of Pack / straight height of media	mm	750
12	Plan Settling area available of module media placed at 60^{o} inclination; as per Tube Pac Manufacturer's Input Data	m^2/m^3	12 (at 60^0 slope); 13 (at 55 ^{0} slope) ;
D	**Unit Dimensional Design**		
1	Flow	Cu.m/hr	125
2	Operating hours /day		1-2 ;
	Restricted operating hours shall adversely effect functioning of unit .		
	Nature of flow		Intermittent at steady rate assumed
3	Type of settling		Primary
4	Settling Velocity (considered)	m/hr	1 as against specified settling velocity is 1.5 to 2 m/hr
5	Factor of safety considered for Flocculated liquid		0.50
6	Straight height of Media	mm	750
7	Angle correction for 60 ^{0}slope for 750 high pack	mm	870
8	Required Settling Area	Sq.m	125 / (1 x 0.5) =250;
9	Specified . Settling area of Tube for 750 straight height media	M2/m3	12

10	Volume of Media required	M3	(250 / 12) = 20.83 ; say 21
	Required Plan surface area of Media	M2	21 / 0.75 = 28
	Surface loading rate (SLR)	$M^3/m^2/hr$	Q / A = 125 / 28 = 4.46;
	Ref. to Tube Settler Drg.		
	Provided Tube Plan area	M2	4 (2+4 + 2 =8) = 32 > 28 required
5	Dimension of tube settler tank	Sq.m	32+ 0.8 x 4 = 35.2
	required by Collecting Launder		
	Provided tank dimension	M x M	9.6 x4 = 38.4 > 35.2 required ; hence o.k
6	Considered Tank Hydraulic Retention Time	mts	60
7	SWD of tank assumed considering Media depth plus Sludge consolidation depth	m	4.5 (700mm above media + 1500mm depth of Media +2300mm below media)
8	Tank Volumetric capacity required considering 60 mts detention period	Cu.m	(125/60) x 60 =125
9	Tank volume capacity provided	Cu.m	9.6x4 x4.5 =172.8 > 125 ;Hence O.K
	INTERNAL LAUNDER		
	To collect settled water, a two Launders have been envisaged. Please refer to Cleawat Drg No.A031 .As envisaged provision is to draw settled water evenly and not to measure the flow, orifice holes have been envisaged @ 500 c/c.		
	ORIFICE HOLE SPACING :		
	To provide free flow condition at Down Stream of Clarifier and to make hydraulic independent of upstream of clarifier and downstream structure such as Reservoir, we have considered provision of 75 dia. Orifice Holes at 500c/c with 75 mm free fall in Launder. For conceptual detail, please refer to Drg. No.A032;		
	Length of launder	m	2 x 4=8
	To allow free flow thru orifice, consider a free fall of	mm	75
	To reduce surface current action over discharge orifice, consider 50mm head over center line of orifice holes.		
	Flow thru each submerged hole may be expressed as		Q=Cd A ($\sqrt{2gh}$

	Where Q= discharge in cu.m per sec cd = Average discharge co-efficient (consider 0.61 being most conservative) A = Area of orifice hole in sqm. H = head in M on centre of orifice = 0.05 M	M^3/sec	Q= 0.61(0.785 x 0.05^2) ($\sqrt{2x9.81x0.06}$) = 0.00116
	No. orifice holes required to handle Qmax	No.	= (125) / (0.00116 x 3600) = 26.9 (Provided 28)
	Spacing of orifice holes reqd.	m	500
	i)Provide 50 mm O.D. Orifice holes at @ 500 c/c to allow free fall of Qmax without heading up in Clarifier ii) Allow free fall of 75 mm in to settled water Launder to make hydraulics independent		
F	**Material Specification of Tube Media**		
1	Tank MOC		R.C.C
2	Tube		P.V.C-UV stabilized in profile; Profiles to be assembled to form module at site.
3	Shape of Tube		Hexagonal Chevron shaped
4	Tube Fitting		Tongue and Groove
5	Hydraulic radius of Tube Pac	mm	65
6	Cross sectional area (single tube) of pac	mm	75 x 60
7	Depth of Pack	mm	750
8	Plan Settling area available of module media placed at 60° inclination	m^2/m^3	12(at 60 Deg slope) 13 (at 55 deg slope)
9	Thickness	mm	1.1 (+/-0.1)
10	Dry / working Module Weight (kg / m^3)		~ 70 / 150 approx
11	Storage		Media should be stored in a covered place with adequate ventilation
12	Color		Black
13	Maximum Continuous working Temp ^0C		~ 55 approx.

Please check the hole dia & head considered & taken in calculation

14	Hot water Stability		Can withstand a temperature of 55º C added to the QAP
15	Load test after Gluing		It is not significant as there is no external load on Tube Settler modules in the tank.

G	**Chemical / Physical Characteristics**			
1.	Characteristics Test	**Type of Check**	**Acceptance Norm**	**Acceptance Range**
2	Density	Physical	ASTM-D-792	Min 1.4 Gm/cc
3	Tensile Strength	Physical	ASTM-D-638	Min 420 kg/cm2
4	Tensile Modules	Physical	ASTM-D-882	MIN 22000 kg/cm2
5.	Impact Strength (IZOD)	Physical	ASTM-D-256	MIN 35.6 J/m
6	Vicat Softening Temp	Physical	ASTM-D-1525 DIN 53460 A/50	80º C Min.
7	Fire Ret ardency	Physical	ASTM-D-635	Time of Burning 5 Seconds Extent of Burning 8-15 cm
8	Tensile elongation	Physical	ASTM-D-638	Min 7%

SLUDGE DISPOSAL ;- (Refer P & I Drg. No. A012; A390)		
Sump Sizing = Sludge from Lamella Clarifier / TPI Shall flow under gravity to Sludge sump		
Location Specification specified required capacity	*CuM*	20
Provided Sump plan size	*MxMxM*	3X3
Effective water depth required	*M*	20 / 9 = 2.23
With passage of time , the sludge accumulation at bottom level shall take place , hence consider a minimum 200 mm dead storage		
Water depth required	*M*	2.23 +0.2 = 2.43 ; say 2.5
Provided Sump size	*MxMxM*	(3X3X2.5 = 22.5 Sq.M) + 1.0 M Free Board
TWL considered	*M*	(-) 1.20
Invert Level	*M*	(-) 3.00
Minimum Water Level considered	*M*	(-) 2.80
PUMP :-		
Specification Specified Pump flow	*CuM/hr.*	10
Pipe Velocity considered	*mps*	1.5
Conduit pipe size required	*Sq.m*	10/3600) / 1.5 =0.00185 ; 48 mm
Delivery Header provided	*mm*	65NB ; MS Hvy cl. Pipe to IS 1239
Delivery Head Determination		
Specification specified delivery header Length	*Mt*	400
Velocity considered	*mps*	1.5
Length of pipe as well as flow being very small; hf loss shall be extremely less; However , Pipe rack is located very close to ETP area. Pipe length is not to exceed 100 M before pipe is raised to Rack height		
Consider hf ; C = 100	*M*	Hf may be considered as 1 to be

		on conservative side
Static Head (minimum TWL in sump to Ash Slurry Sump wall top + 0.5M	*M*	(-) 2.80 + 2.00 (assumed) = 4.80 Say 5
Specified Static lift to be considered for pipe rack from FGL ; Pipe rack is located very close to ETP area. And hence 5 M static lift required being less than rack elevation is of no consideration	*M*	8 > 5.0 M
Total delivery Head envisaged	*M*	1 + 8 = 9
Consider Pump Delivery Head to account for any unforeseen losses and pipe ageing; infrequent operation leading to pipe clogging etc etc	*M*	15
For typ. Detail of Pump , please refer to Pump Data Sheet Doc. No. DS-01 / 17-04 M (83)		
AIR SCOURING OF SLUDGE SUMP		
BLOWER:-		
Air Scour rate	Lpm/sqm	500
Liquid depth above air delivery header	M	(-)0.5 – (-)2.3 = 2.8
Design Pressure adopted	Kg/cm^2	0.4 ;
Area under Air Scour at a time	Sq.mt	3x 3 =9
Air Flow reqd.	LPM	9 x 500=4500 lpm =270 Cu.m/hr
Air Application		Intermittent
No. of Blowers	No.	2 (1W +1S)
Recommended Air Velocity in Air pipe line	Mps	25 to 30
Adopted Design Velocity	Mps	25
Pipe size reqd.	mm	(270/3600) / 25 = 0.003
Conduit size reqd.	mm	60
Provide 65 NB dia MS Hvy, cl, Pipe to IS : 1239 as Main Header with 50 NB dia Branch connection to each section; For configuration detail refer to Drg. A 390		
For typ. Detail of Blower , please refer to Blower Data Sheet Doc. No. DS-01 / 17-04 M (10 B)		

Ultrasonic type level transmitter has been provided as capacitance type Level Transmitter do not perform after some time due to coating of sludge on probes. This happens faster if Lime is being used in Clarifier.

LT in field shall be so adjusted that pump shall auto start when water level rises to (-)0.5 M level and close when minimum water level reaches at (-) 2.80 M

When TWL reaches defined maximum level LT shall give alarm

CHEMICAL HOUSE

As per Specification specified conceptual provisions Alum, Lime and PE are to be dosed to Tube Settler and Acid & Alkali to CMB/Guard Ponds.

Design Parameter

S. No.	Application	Dose rate (ppm)	Design flow (m^3/hr)	No. of tanks/ cap. (M^3)	Sol. Strength (%)	Dose Period per Tank	Method of Dosing	Tank MOC	Agitator MOC
A	**Tube Settler**								
1.	Alum Sol. Tank	40	125	1W / 5	10	12	Dosing pumps	MSRL	SS 316
2.	Lime Sol. Tank	70	125	1W / 5	6	12	Screw Pumps	MS	MS 2062
3.	Pol. Sol. Tank (clarifier)	1	125	1W / 5	0.5	12	Dosing Pumps	MSRL	SS 316
B	**CMB & Guard Pond: Hydrochloric Acid**								
1	Guard Pond	10	1200	1 /1	30 to 32 %	24	Dosing Pumps	MSRL	NR
2	CMB	10	1000				Dosing Pumps		
C	**CMB & Guard Pond: Alkali (NaOH – Liquid)**								
1	Guard Pond	10	1200	1 /1	10	24	Dosing Pumps	MSRL	SS316
2	CMB	10	1000				Dosing Pumps		

Separate set of Dosing Pumps have been provided for each application	
Recommended Chemical Storage Area for large size plant as this	- 15 days; Provide 20 % area in addition as movement area.

ALUM SOLUTION PREPARATION TANK(for Lamella Clarifier):-		
Design Flow (Qm)	cum/hr	125
Conceptual specified design dose rate	Ppm	40
As per ETP water balance , flow is 40 cu.m/hr maximum. How ever Specification stated capacity of Lamella Clarifier is 125 cu.m/hr and hence unit has been designed for 125cu.m/hr. This may lead to operational problem .		
Flow rate to Lamella Clarifier shall be intermittent and very occasional. From discussion it is understood that Flow to Lamella Clarifier shall be very very intermittent and never more than two to three hours at a time In view of this chemical dose rate has been conceptually considered high. Even then operational problem may arise such as clogging of drains , floor deposition etc. How ever , system has been designed to treat 125 cu.m /hr flow as specified in Spec.		
No of Tanks envisaged as per Specification	No	1
Dosing Capacity of each Tank	hr.	24
Solution Strength	%	10
Alum Reqd./hr	kg/d	125x40x24) / 1000 = 120
Nature of Alum		Ferric Alum (15 -18 % ; Powder Form
Alum Tank Volumetric Capacity Reqd. to prepare 10% solution Strength;		(120 x 100/10= 1200
Specification Specified capacity of Tank	lts.	5000
Provided MS R/L cylindrical flat bottom Tank capacity	lts	5000
Solution dosing period per batch	Hrs.	5000/1200= 4.17 days = 100 hrs
Alum solution has self life and even 5 % solution strength solution shall loose its characteristic / reactive strength if solution is stored for undue long duration . This long duration storage may cause undue deposition in Solution preparation tank requiring frequent maintenance. In view of this , we suggest either to opt for smaller capacity Tank and or prepare solution volume as required . This shall have to be monitored by Plant Operator.		
SIZING OF DISSOLVING BASKET		
Volume of broken filter Alum	m^3/ton	0.93
(Ref Annex. 2; Chemicals used in water Treatment, Operation & Control of Water Treatment Process by Charles R. Cox published by World Health Organization		

Alum reqd./charge	Kg	120
Basket volume required;	cum	0.93 x 120 = 0.116 ~ 1.2 1000
Basket Area required; considering Basket depth as 500 mm	Sq. m	1.2 / 0.5 = 2.4
ALUM TANK SIZING		
Capacity	lts	5000
Consider SWD	M	1.8
Free Board	mm	300
Area Required	Sq.m	5/1.8 = 2.78
Dia required	M	1.9
Provide Drain line	mm	25
Over flow line	mm	25
For typical details of Alum Solution Preparation Tank , please refer to P & I Drg. No. 17-04/ A012 (sh 2 0f 4)		
Alum Dosing pump Capacity & Delivery Header		
Dosing volume (considering 10% Sol. Strength)	lt/hr	1200 / 24 =50
Electronic Pump provided with operating range	LPH	0.6 to 90 (0.000025 cu.m/sec) >50 required
Velocity in delivery header, assumed max	mps	1.5
Conduit area required at max. delivery out put	Sq.m	0.000025/1.5=.000017
Conduit size required	mm	5
Pipe size (HDPE) provided	mm	25; Cl . 10 kgf/cm2
As pump is to discharge to atmospheric pressure , Dampener provision is not required as Fill and Draw pulsating effect is only possible and takes place when there is a back pressure to pump		
Alum STORAGE AREA REQUIRED		
Alum required /day	Kg	120
Storage period	day	30
Total qty to be stored	kg	120 x 30
volume required / ton	m^3 /T	0.93
Stacking Height	m	2
Area Required to store Alum	m^2	(3.6 x 0.93) /2 = 1.674
From practical consideration of storage of alum , a effective area of 4 Sq.m provision has been envisaged		

Effective Alum storage area provided	m^2	4
LIME SOLUTION PREPARATION TANK for Lamella Clarifier :- For conceptual observations , please refer to Alum Solution Preparation Tank write up		
Nature of Lime envisaged t be used		Slaked Hydrated Lime ; Powder ; 80-90 %$Ca(OH)_2$;
Flow	cum/hr	125
Conceptual designed annual average dose rate	ppm.	70
Spec. specified No. of Tank to be provided	No	1
Dosing Capacity of each battery of Tanks	hr.	24
Spec. Specified Solu. Strength	%	6 ; considered as 5 % as lime is not highly soluble
Lime required / day	Kg/d	125 x 70 / (1000) = 210
Lime Tank Volumetric Capacity required for dosing 24 hrs	Lts	[210 x 100 / 5] = 4200
Specification specified tank capacity	Lts	5000
Provided MS cylindrical flat bottom Tank capacity	lts	5000
Solution dosing period per batch	Hrs.	5000/4200= 1.19 days = 28.57 hrs
Free Board	mm	300
Ref. Drg. No. A012 for Tank Configuration and other details etc. envisaged.		
BASKET VOLUME:-		
Provide Strainer basket		
Volume of broken Lime lumps	m^3/T	1.15
Basket Volume required	m^3	210 kg/d x 1.15 / (1000) =0.25
Slacked lime shall be procured , Powder shall have lime granules of 10 to 20 mm size		
Lime solution dosing Pump		
Dosing volume (considering 5 % Sol. Strength)	lt/hr	4200/24 =175
Pump provided with operational range (maximum)	LPH	600 (.00017 Cu.m/sec)
Velocity in delivery heade , assumed max	mps	1.5
Conduit area required	Sq.m	0.00017/1.5=.00011
Conduit size required	mm	12
Pipe size (HDPE) provided	mm	40; considering that pipe shall be subjected to classification and in due course the conduit area shall reduce
The losses depends upon velocity, pipe length, pipe co-efficient. All these factors are very very		

negligible in present case.

Screw pumps performance curve (delivery Vs head) is practically flat.

Pump selected with 20 mwc delivery head is on very very conservative side.

Solution dosing rate being very low , such small capacity screw pumps are not available . Smallest screw pump available is of 500 LPH . In view of this , a recirculation line with isolating valve has been provided . Please refer to P & I Drg.

LIME STORAGE AREA		
Quantity of lime required per day	kg	120
Envisaged storage	days	30
Lime required to be stored	kg	120 x 30 =3600
Stacking height	m	2
Volume required to store Lime	m^3/T	1.15
Area Required for Lime storage	m^2	(3.6 x 1.15) / 2 =2.07
From practical consideration of storage of lime powder , an effective area of 4 Sq.m provision has been envisaged		
Effective Lime Alum storage area provided	m^2	4

Non Toxic PE Dosing Tank (for lamella Clarifier)

i) Specification specified PE Dosing for improvement of Solid settlement is 1ppm maxm.

ii) Advocated storage period of Solution is 4 hrs. PE solution has short self life. It is our experience that solution starts forming lye after approximately 4 hrs of solution preparation with 1% concentration. PE solution has self life Even 0. 5 % solution strength solution shall loose its characteristic / reactive strength if solution is stored for undue long duration. This long duration solution storage will result in solution turning into “lye “ and shall not only cause pumping problem but will also be ineffective in application . This long duration storage may cause undue deposition in Solution preparation tank requiring frequent maintenance .

Considering the huge specification specified capacity of tank , we propose 2 % solution strength to increase self life of solution.

In view of this , we suggest to either opt for smaller capacity Tank and or prepare solution volume as required . This shall have to be monitored by Plant Operator.

Flow	cu.m/hr	125
Conceptual design dose rate specified	ppm	1
Type		Liquid Coagulant
INDFLOC or equivalent make Polymers may be unloaded manually directly into the solution Tank		

from the container. Feed solution is prepared by diluting the stock solution with water directly.		
No. of Tank (Spec. Specified)	Nr	1
Spec. Specified Dosing solution strength	%	0.5; adopted 0.2%
Spec. Specified Dosing period per tank	hr	Not specified ; assumed 24
pHof solution varies between 1.5 to 5.5. It depends upon prepared sol. strength: for 0.5 % sol. strength expected pH may be approx 3.30.		
PE qty required	Kg / d	(125 x1 x24) /1000 = 3.

Tank Volumetric capacity required to prepare 0.2 % solution strength solution	lt	[3.0 x100] / 0.2 =1500
Specification specified Volumetric capacity of tank	lt	5000
Provide MS vertical cylindrical flat bottom rubber lined Tank (effective dia = ID – 2x4.5 thk rubber lining)	-	2.00 ID. x 1. 8 SWD + 300 mm Free Board
Effective solution capacity provided	m^3	0.785x $(1.81)^2$ x 1.8 =5154 >5000 ;
METERING PUMP DOSING PIPE SIZE		
Dosing volume (considering 0.5 % Sol. Strength)	lt/hr	1500/24= 62.5
Pump provided with operating range	LPH	0.6 to 90 (0.000025 cu.m/sec)
Velocity in delivery header, assumed max	mps	1.5
Conduit area required at max. delivery out put	Sq.m	0.000025/1.5=.000017
Conduit size required	mm	5
Pipe size (HDPE) provided	mm	25; Cl . 10 kgf/cm2

PE STORAGE AREA REQUIRED		
PE required /day	Kg	3
Storage period	day	30
Total qty to be stored	kg	3 x 30 = 90
Area Required to store PE pouches	m^2	negligible
From practical consideration of storage of PE pouches on Shelves , an effective area of 2 Sq.m provision has been envisaged		
Effective PE storage area provided	m^2	2

Total chemical storage area required for 30 days chemical storage for Lamella Clarifier stream	*Sq.m*	4 (Alum) + 4 (Lime) +2 (PE) =10

Neutralization of influent to CMB and Guard Pond :

As per envisaged dosing philosophy of Acid to neutralize the flow , separate pumps have been envisaged to dose to CMB and Guard Pond . Further neutralized effluent of CMB shall be pumped to Guard Pond of 1200 Cu.m/hr flow capacity.

What dose rates are required to neutralize the influent water has not been specified . It is not practically feasible to derive the dose required to a complex liquid such as this as neutralization reaction shall be subject to temp; shape of tanks; dose rates ; pollutant parameters etc.

We have therefore, conservatively considered 10 ppm dose of acid and alkali to each unit which in our considered opinion is more than adequate

Hydrochloric Acid

As per specification specified, one tank of adequate capacity has to be provide with provision of separate set of pumps to dose acid to CMB and Guard Pond

CMB Flow to be treated	*M3/hr*	1000
Guard Pond Flow to be treated	*M3/hr*	1200
Total flow to be treated	*M3/hr*	1000+1200= 2200
Specified dose rate	*ppm*	Not specified; Assumed 10
Acid required	*Kg/hr*	2200 x 10 / 1000= 22
Packing of acid		As per cl. 5 of IS:265: 1993;4th revision
Relative Density at 15^{0}C		1.085
Percent by mass	%	38
Specification specified storage Tank capacity (nett) Minimum	m3	1
Sol. Strength	%	32-33% Tech. Grade; Minimum 30%
Relative density at 25^{o}C for 30% strength Sol.		1

HCL is dosed in commercially available strength as further diluting is not practiced .

Spec. Specified Minimum capacity of tank	lts	1000
Provided MS Cylindrical dished bottom tank	lts	1000
METERING PUMP & DOSING PIPE SIZE		
Dosing volume considering 24 hrs dosing capacity	lt/hr	1000 /24 = 41.66; say 42
Pump provided with operating range	LPH	0.6 to 90 (0.000025 cu.m/sec)
Velocity in delivery header, assumed max	mps	1.5
Conduit area required at max. delivery out put	Sq.m	0.000025/1.5=.000017
Conduit size required	mm	5
Pipe size (HDPE) provided	mm	25 ; Cl . 10 kgf/cm2
Alkali Dosing (Sodium Hydroxide (solution) As per specification specified, one tank of adequate capacity has to be provide with provision of separate set of pumps to dose acid to CMB and Guard Pond		
CMB Flow to be treated	*M3/hr*	1000
Guard Pond Flow to be treated	*M3/hr*	1200
Total flow to be treated	*M3/hr*	1000+1200= 2200
Specified dose rate	*ppm*	Not specified; Assumed 10
Alkali required	*Kg/hr*	2200 x 10 / 1000= 22
Packing of Alkali		As per cl. 5 of IS:265: 1993;4th revision
Specification specified storage Tank capacity (nett) Minimum	m3	1
Sol. Strength	%	10-40% NaOH;Tech. Grade; Minimum 10%
NaOH is dosed in commercially available strength as further diluting is not practiced .		
Spec. Specified Minimum capacity of tank	lts	1000
Provided MS Cylindrical dished bottom tank	lts	1000
METERING PUMP & DOSING PIPE SIZE		

Dosing volume considering 24 hrs dosing capacity	lt/hr	1000 /24 = 41.66; say 42
Pump provided with operating range	LPH	0.6 to 90 (0.000025 cu.m/sec)
Velocity in delivery header, assumed max	mps	1.5
Conduit area required at max. delivery out put	Sq.m	0.000025/1.5=.000017
Conduit size required (PVC)	mm	5
Pipe size (PVC) provided	mm	25 ; Cl . 10 kgf/cm2
FIELD SUMPS		
Pre-settling Tank		
Specification does not give any design parameter. For design, Feed flow to sump has been considered same as pump Transfer capacity; Detention period as 60 mts; configuration as Hopper Bottom; Inlet TSS < 50 ppm.		
Feed Flow (max)	*m3/hr*	15
Sedimentation Tank Area Provided	*m2*	2.5 x 2.5 = 6.25
Detention volume required	*m3*	15 x 1 = 15
Side water depth	*m*	15 ÷ 6.25 = 2.4
For Typical details of the pump GA please ref. to Drg. No. A061		
Provide 2 Nos. (1W + 1 SB) Pumps for Transferring flow from each sump to common Collection Sump located in ETP area		

EFFLUENT TRANSFER SUMPS

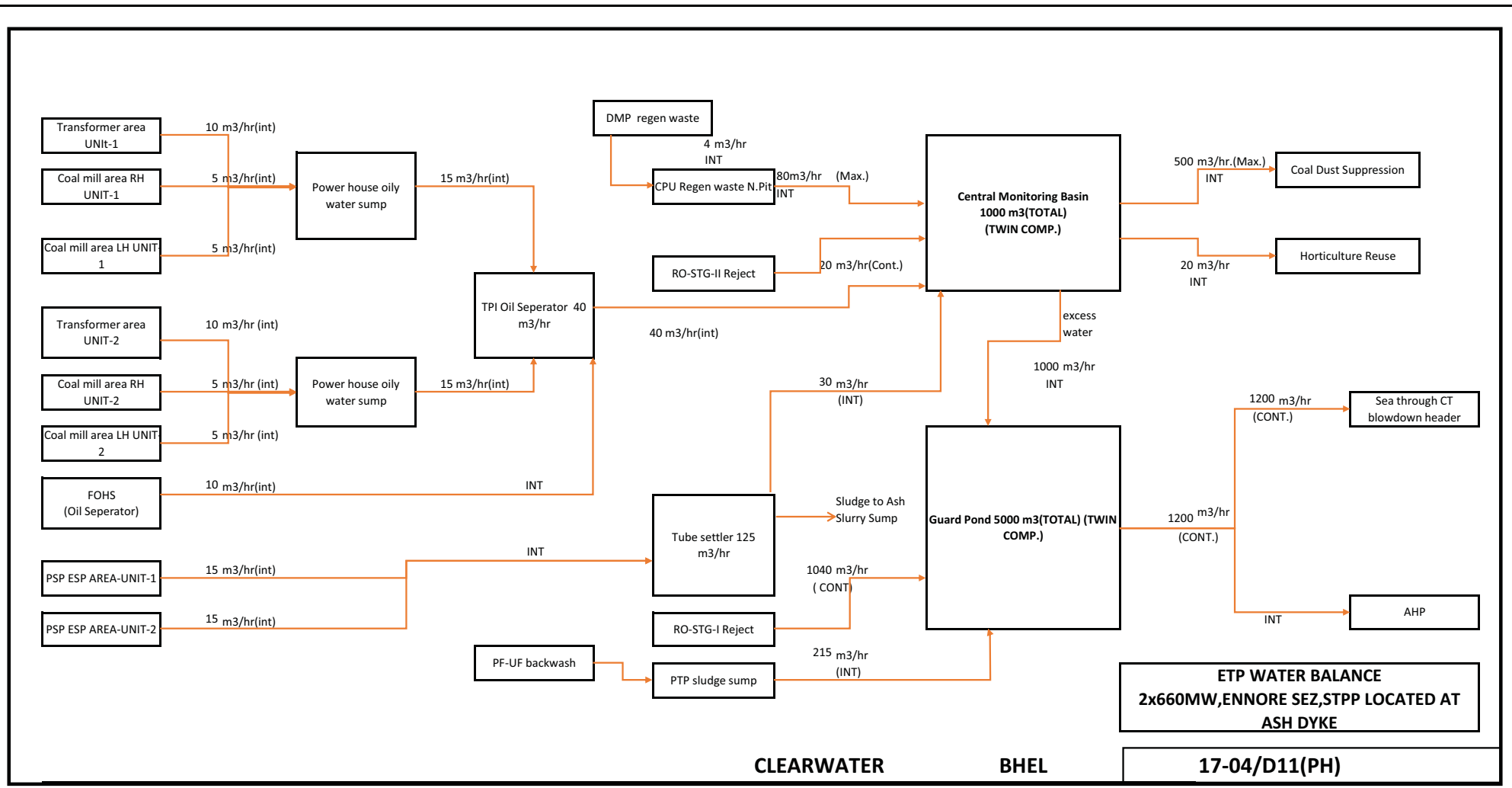
For Typical provisions, please refer to P & I Drg. No. 17-04 ? A012 (sh 1 of 3)

BHEL Spec. has indicated the delivery length of header pipes to recipient sumps. The maximum length of header pipes are as under

Sl No.	Sump Tag No.	Pump Cap. M^3/hr	Header line size (mm)	Minimum TWL	Wall top of Recipient sump (M)	Header length (Rmt)	Selected head	Remarks
1	E-1	10	50	-4.40	+0.5	115	15	
2	E-2	5	50	-2.00	+0.5	160	15	
3	E-3	5	50	-2.00	+0.5	270	15	
4	E-4	10	50	-4.40	+0.5	250	15	
5	E-5	5	50	-2.00	+0.5	160	15	
6	E-6	5	50	-2.00	+0.5	60	15	
7	E-7	15	63	-2.40	+0.5	530	15	
8	E-8	15	63	-2.40	+0.5	670	15	
9	E-9	15	63	-2.40	+0.5	515	15	
10	E10	15	63	-2.40	+0.5	725	15	
11	TPI to Lamella Clarifier	40					15	
12								

		Case-1	Case-2	Case-3	Case-4
Flow	M3/hr	5	10	15	
Spec. Specified pipe size	mm	50 NB (0.00186)	50 NB (0.00186)	63 NB (0.0031)	
Velocity	Mps	1.494	1.494	1.34	
Max delivery header length for a particular flow	M	270	250	725	
Ref Hazen & Williams chart ; consider C=100 ; Max hf	M	6/1000	6/1000	6/1000	
Fiction loss thru pipe	M	6/250 = 0.24	6/250 = 0.24	6/250 = 0.24	
From practical consideration ; consider (hf)	M	1	1	1	
Spec. Specified height of pipe rack to be considered en route to CMB ;	M	8	8	8	
Max suction lift (Ref GA Drg) Minimum water level + wall top of recipient Tank	M	+0.5 (-) 4.4 + (0.5+0.5) = 5.4	+0.5 (-) 4.4 + (0.5+0.5) = 5.4	+0.5 (-) 4.4 + (0.5+0.5) = 5.4	
Total pump delivery head required	M	8+5.4+1 = 14.4	8+5.4+1 = 14.4	8+5.4+1 = 14.4	
Pump delivery head considered to overcome any unforeseen losses	MWC	15	15	15	

CLEAR WATER LTD


Transformer area UNIt-1
10 m3/hr(int)
Coal mill area RH UNIT-1
5 m3/hr(int)
Coal mill area LH UNIT-1
5 m3/hr(int)
Power house oily water sump
15 m3/hr(int)
DMP regen waste
4 m3/hr INT
CPU Regen waste N.Pit
80m3/hr (Max.) INT
Central Monitoring Basin 1000 m3(TOTAL) (TWIN COMP.)
500 m3/hr.(Max.) INT
Coal Dust Suppression
Horticulture Reuse
20 m3/hr INT
RO-STG-II Reject
20 m3/hr(Cont.)
TPI Oil Seperator 40 m3/hr
40 m3/hr(int)
Transformer area UNIT-2
10 m3/hr (int)
Coal mill area RH UNIT-2
5 m3/hr (int)
Coal mill area LH UNIT-2
5 m3/hr (int)
Power house oily water sump
15 m3/hr(int)
excess water
1000 m3/hr INT
30 m3/hr (INT)
1200 m3/hr (CONT.)
Sea through CT blowdown header
FOHS (Oil Seperator)
10 m3/hr(int)
INT
Tube settler 125 m3/hr
Sludge to Ash Slurry Sump
Guard Pond 5000 m3(TOTAL) (TWIN COMP.)
1200 m3/hr (CONT.)
PSP ESP AREA-UNIT-1
15 m3/hr(int)
INT
1040 m3/hr (CONT)
PSP ESP AREA-UNIT-2
15 m3/hr(int)
RO-STG-I Reject
INT
AHP
PF-UF backwash
PTP sludge sump
215 m3/hr (INT)
ETP WATER BALANCE
2x660MW,ENNORE SEZ,STPP LOCATED AT ASH DYKE
CLEARWATER
BHEL
17-04/D11(PH)

TANGEDCO comments on Drg.No: PE-V0-412-164-A005

S.No.	TANGEDCO Comments	BHEL Reply	Resolution during MOM Dated 30-31 July 2019	TANGEDCO Comments	BHEL/CWL REPLY dtd 05/10/20	TANGEDCO Response
1	All the points are closed except the following points.					
2.	Please submit head calculations for all pumps.	Please refer to Process Design folder. Head Calculation is indicated .	Noted	Please refer our comments on process calculations and revise pump parameters accordingly.	Please note that the comments marked in process sizing calculation is very minor type and the same shall be revised and submitted soon. We checked and found there is no change in pump parameters (like head of pump) w.r.t revision in process sizing calculation. Also we confirm that if any modification/changes required the same shall be taken care by BHEL/CWL. Please accept and furnish your approval on pump data sheet.	Not acceptable. Please submit the revised process calculation for review of this document
4	Mark FFL on pump GA drawings.	Maximum FSL in Guard and CMB pumps is (+) 2.0 M and is marked	Noted	**GA CMB disposal Pump** • FFL is indicated as EL (+) 2.7 m as against EL (+2.5) M indicated in mech	**Noted and corrected in revised document.**	**GA CMB disposal Pump** • Not revised • Max water level not marked • Sump depth not corrected in line with mech GA of CMB,

S.No.	TANGEDCO Comments	BHEL Reply	Resolution during MOM Dated 30-31 July 2019	TANGEDCO Comments	BHEL/CWL REPLY dtd 05/10/20	TANGEDCO Response
				GA of CMB. Please correlate and correct. • Please mark the max & min water levels. • The sump depthe is indicated as 5843 mm as against 5750 mm indicated in the Mech GA of CMB. Please correct the drawing accordingly. • The pump arrangment shall be corrected in Mech GA of CMB in line with pump drawing. **GA Guard**	**Noted and corrected in revised document.**	**GA Guard Pond Pump** • FFL not matching with GA of Guard Pond • Please mark max water level • Sump deoth not matching with mech GA of Guard pond. • Drg not fully revisd in line with mech GA of Guard Pond.

S.No.	TANGEDCO Comments	BHEL Reply	Resolution during MOM Dated 30-31 July 2019	TANGEDCO Comments	BHEL/CWL REPLY dtd 05/10/20	TANGEDCO Response
				Pond Pump • Please indicate FFL. • Please mark the max & min water levels. • The sump depth is indicated as 6300 mm as against 5750 mm indicated in the Mech GA of Guard Pond Pease correct the drawing accordingly. • The pump arrangment shall be corrected in Mech GA of Guard Pond in line with pump drawing.		

S.No.	TANGEDCO Comments	BHEL Reply	Resolution during MOM Dated 30-31 July 2019	TANGEDCO Comments	BHEL/CWL REPLY dtd 05/10/20	TANGEDCO Response
6	Coating inside pumps for MS parts in all sea water applications shall be glass flake only. Revise accordingly.	Noted	Noted	**Please remove reference of PU coating**	**Noted and corrected in revised document.**	**MS parts shall also be coated inside with glass flake coating. Please indicate the same. Inside coating has been deleted in this revision.**
10	As per spec Vol III Cl 3.3, P393, MOC of Guard pond pumps are to be fabricated DSS. But in this drawing MOC of guard pond pumps are mentioned as Cast DSS. Hence BHEL to provide MOC of guard pond pumps as Fabricated DSS or else to pass on the commercial benefit to TANGEDCO for not providing	BHEL informed that for CMB disposal pumps and Guard pond pumps, Gardening pumps, MOC of Bowl/ Suction bell and impeller shall be duplex stainless steel (as per ASTM A 890 as per UNS J92205 applicable for casting DSS The forged products may be limited in shape and is possible for the flat surface or simple objects. Cast grade as provided for casing/ impeller is equivalent to the forged grade and is as per industries practice, as there is no vendor available to provide the forged	TANGEDCO informed to provide commercial implication for providing cast grade in place of forged grade. BHEL informed that cast grade as provided for casing/ impeller is equivalent to forged grade and is as per the industry prevalent practice. Cost difference between			Noted. But M/s BHEL is not accepting to pass on commercial benefit to TANGEDCO vide its reply under Sl.No:14, which is not acceptable to TANGEDCO.

S.No.	TANGEDCO Comments	BHEL Reply	Resolution during MOM Dated 30-31 July 2019	TANGEDCO Comments	BHEL/CWL REPLY dtd 05/10/20	TANGEDCO Response
	MOC of Guard pond pumps as per spec requirement.	casing/ impeller for pumps. In addition to that, if the part is too complex for forging then that casting will be the better choice as molten metal flows into small ant section in the molten cavity. Particularly, in case of pumps where the internal structure and hydraulic geometry are so complicated that these cannot be made forged casting is the only option for the same.	equivalent cast and forged grades cannot be arrived, as there are no vendors available to provide forged casing/ impeller for our pumps. It is therefore requested that any commercial implication cannot be ascertained in this regard. TANGEDCO still insisted for commercial implication. BHEL informed that same may be settled suitably commerciall y at later stage.			

S.No.	TANGEDCO Comments	BHEL Reply	Resolution during MOM Dated 30-31 July 2019	TANGEDCO Comments	BHEL/CWL REPLY dtd 05/10/20	TANGEDCO Response
			TANGEDCO noted.			
11				In line with comments at S. No. 2 & 4 above please submit the process calculations and correlate the sump GA with the pump setting drawing prior to resubmission.	Please note that the comments marked in process sizing calculation is very minor type and the same shall be revised and submitted soon. We checked and found there is no change in pump parameters (like head of pump) w.r.t revision in process sizing calculation. Also we confirm that if any modification/changes required the same shall be taken care by BHEL/CWL. Please accept and furnish your approval on pump data sheet.	Please submit the revised process calculations prior to resubmission of this document.
12.				The motor data shall be revised, if needed, in line with comments on process calculation.	Noted. Motor rating remain same. However, make of motor changed from CGL to ABB due to uncertainty of supply from CGL. Please accept.	Refer comments in S. No. 11 above.
13				Please furnish pump	Noted and	• FFL is indicated as EL (+) 2.7 m as against EL (+2.5) M indicated in mech GA of CMB.

S.No.	TANGEDCO Comments	BHEL Reply	Resolution during MOM Dated 30-31 July 2019	TANGEDCO Comments	BHEL/CWL REPLY dtd 05/10/20	TANGEDCO Response
				GA drawing, Cross section drawing for Gardenning Pump. Please submit the sump details also for verifying the pump setting length.	incorporated.	Please correlate and correct. • Please mark the max & min water levels. • The sump depth is indicated as 5700 mm as against 5750 mm indicated in the Mech GA of CMB. Please correct the drawing accordingly. • The pump arrangment shall be corrected in Mech GA of CMB in line with pump drawing.
14.				MOC of Guard Pond Pump & Gardening Pump mentioned as DSS 2205 UNS31803 within brackets is not acceptable. MOC is to be mentioned as DSS 2205 UNS31803 without mentioning any other alternate MOC otherwise M/s BHEL is to pass on commercial benefit to TANGEDCO	Provide MOC of Guard Pond Pump & Gardening Pump are not different MOC. The grade mentioned in tender is for plate material, but the grade used for these pumps are forging grade. From Plate it is not possible to manufacture the pump. Please accept and furnish your approval. Refer below appended picture (Ref. https://pmfirst.com/materials/duplex-stainless-steel/).	Not acceptable. M/s BHEL had agreed to pass on commercial benefit to TANGEDCO vide its reply under point no:10. But now it is not accepting to pass on commercial benefit to TANGEDCO. The drawing will be approved after getting consent from M/s BHEL to pass on commercial benefit to TANGEDCO.

S.No.	TANGEDCO Comments	BHEL Reply	Resolution during MOM Dated 30-31 July 2019	TANGEDCO Comments	BHEL/CWL REPLY dtd 05/10/20	TANGEDCO Response
				on par with MOC of similar pumps in earlier cases. Location of Gardening Pump is to be mentioned.		
15.				Details of Motors are to be removed from this document and shall be submitted as a separate document for approval.	Noted and incorporated.	Noted
16.				Sub-vendor approval from TANGEDCO is to be enclosed.	Noted and enclosed as Annexure-AA.	Noted. But in Flowmore drawings, client is mentioned as Clear water limited.

REV	DATE	ALTERED	CHECKED	DOC. TITLE :
				DATA SHEET FOR VERTICAL / HORIZONTAL PUMPS
				STATUS : CONTRACT
				JOB NO.: 17-04

APPROVED WITH COMMENTS

CUSTOMER: TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD.
2x660 MW Ennore Sez STPP

PACKAGE: EFFLUENT TREATMENT PLANT

ORGINATOR	TURNKEY CONTRACTOR:-	CWL. DOC. NO.
	CLEAR WATER LTD. B-14/1, OKHLA INDUSTRIAL AREA PHASE-II, NEW DELHI-110020 PHONE: 011 26386095 EMAIL: clearwater@bol.net.in	FALGUNI SAHA 2020.12.23 15:14:12 +05'30'

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT, NEW DELHI

REV.	NAME	SIGN	DATE	BHEL DOCUMENT NO.	REV
				PE-V0-412-164-A005	05
				NO. OF SHEETS	EXCLUDING COVER PAGE

	TECHNICAL DATA SHEET	Doc. No.: SALE-19023985 - 30	Rev. 01
FLOWMORE PUMPS	Project : TANGEDCO-ENNORE STPP Client : Clear Water Limited. Order No. : 142/17-04M(82)		Dated: 23-Feb-2019

S. No	Description	
General Information:		
1.	Application	CMB DISPOSAL PUMP
2.	Duty	Continuous
3.	Quantity	2 Nos.
4.	Liquid	Processed sea water
5.	Specific Gravity of Liquid	1.03
6.	Temperature (Deg. C)	Ambient
7.	Pump Design & Testing Standard	IS 1710 / IS 9137
Specifications:		
8.	Pump Make	FLOWMORE
9.	Pump Type	Propeller Pump
10.	Pump Model / Size	6310 / 14"/ OIL
11.	No. of Stage	(2) Two Stage
12.	Full Load Speed of Motor	1482 rpm
13.	Capacity (M^3/Hr.)	1000 M^3/Hr.
14.	Bowl Head (Mtr.)	11.24 M
15.	Shut Off Head (Mtr.)	15 Mtr.
16.	Bowl Efficiency (%)	82.5 %
17.	Bowl Input (BKW)	38.22 KW
18.	Motor Rating (KW)	55 KW /415 V/4P
19.	Motor Type	VSS, Sq. Cage induction Motor/IE-3
20.	Sump Depth (MM)	5950 MM
21.	Discharge Size (mm)	350 mm
22.	Type of Bearing Lubrication	Oil
23.	Type of Impeller	Enclosed
24.	Type of Pump Motor Coupling	Flexible
25.	Flange Drilling Standard	ANSI B 16.5 , CL-150 (350 NB)
26.	Noise Level	85 dBA at 1.5 M
27.	Vibration Level	75 Microns
28.	Bearing Type / Make	Antifriction (SKF / FAG)
29.	Min. Submergence Required.	900 mm
Material of Construction		
30.	Bowl/Suction Bell	DUPLEX S.S –ASTM-A890,GR.4A(UNS-J92205)
31.	Impeller	DUPLEX S.S –ASTM-A890,GR.4A(UNS-J92205)

32.	Column Pipe	DUPLEX S.S-ASTM-A790/A240 (UNS-S31803)
33.	Pump Shaft	DUPLEX S.S-ASTM-A276 (UNS-S31803)
34.	Line Shaft /Top Shaft	DUPLEX S.S-ASTM-A276 (UNS-S31803)
35.	Line Shaft Bearing	THORDON/FEROFORM
36.	Line Shaft Coupling	DUPLEX S.S-ASTM-A790/A240 (UNS-S31803)
37.	BOWL WEARING RING	DUPLEX S.S –ASTM-A890,GR.4A(UNS-J92205)
38.	ENCL. TUBE	DUPLEX S.S-ASTM-A789 (UNS-S31803)
39.	SURFACE DISCHARGE HEAD	DUPLEX S.S –ASTM-A240/A790 (UNS S31803)(DISCHARGE ELBOW) & OTHER M.S (IS-2062)WITH EPOXY COATING OUTSIDE & GLASS COATING
40.	Type of Sealing	Gland Packing
41.	Gland Packing Pcs.	IMPREGNATED TEFLON
42.	Gland	DUPLEX S.S –ASTM-A890,GR.4A(UNS-J92205)
43.	Strainer	DUPLEX S.S-ASTM-A276 (UNS-S31803) (BASKET TYPE)
44.	Fasteners	S.S-316L
45.	Sole Plate	MS (IS – 2062) (EPOXY COATED)
46.	Bearings	Antifriction (SKF/FAG)

NOTE:

1) **Inspection & Testing shall be as per approved QAP.**

CALCULATION FOR BOWL HEAD

3. Pump Model-6310/14" -2Stage/1480 RPM

Flow at Duty Point = 1000 M^3/Hr.

Total Head = 11 Meters

Column Pipe Diameter / Discharge size = 350 MM

Column length = 4.496 Meters

Suction Bell diameter =533 MM

Shaft Diameter = 36.51 MM

Speed =1480 RPM

No of Stage =2 Stage

Bowl Effieciency= 82.5%

A) Entry Losses

Velocity at Bell Mouth = Q/A = (1000/3600) x (4/(π x 0.533^2))

= 1.245 m/sec.

Velocity Head = $V^2/2g$ = 1.245^2/ (2 x 9.81) = 0.0790 Meters

Entry Loss = 10% of Velocity Head (As per our standard Practice)

= 0.00790 Meters

B) Column Pipe Losses

As per Column friction loss chart (F_c) = 3.2 Mtr. / 100 Mtr. of pipe

Column loss at duty point = F_c x Column length/100

= (3.2 x 4.496/100)

= 0.1439 Meters

C) Discharge Elbow Losses

As per HIS table 33 (First Edition) Resistance Coefficient for Bend (k) = 0.21

Velocity at Discharge point = Q/A = (1000/3600) x (4/(π x 0.350^2)

= 2.8872 m/sec.

Velocity Head = $V^2/2g = 2.8872^2/(2 \times 9.81)$ = 0.4249 Meter

Discharge Elbow Loss = k x velocity head

= 0.21 x 0.4249

= 0.0892 Meters

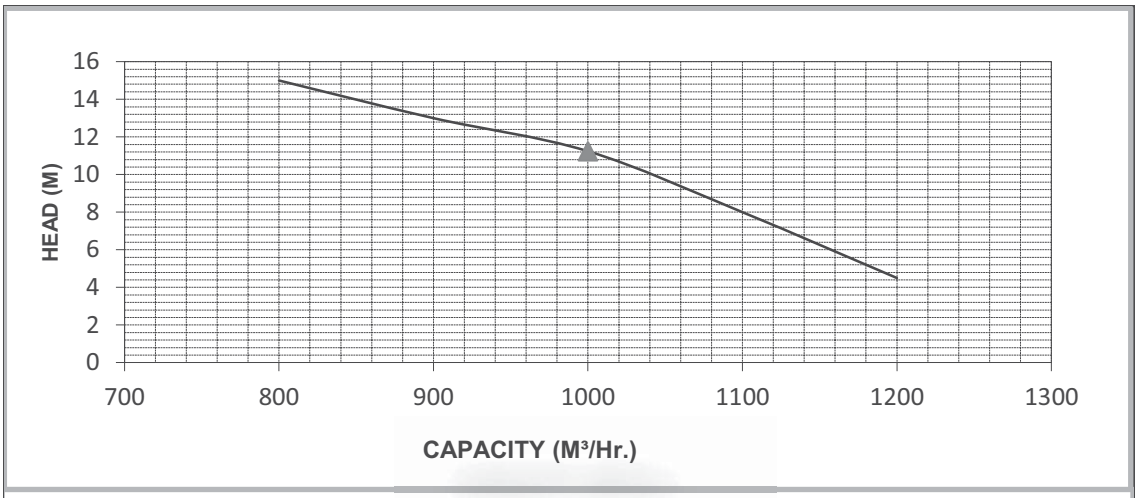
Total Losses = A + B + C = 0.00790 + 0.1439 + 0.0892 = 0.241 Meters

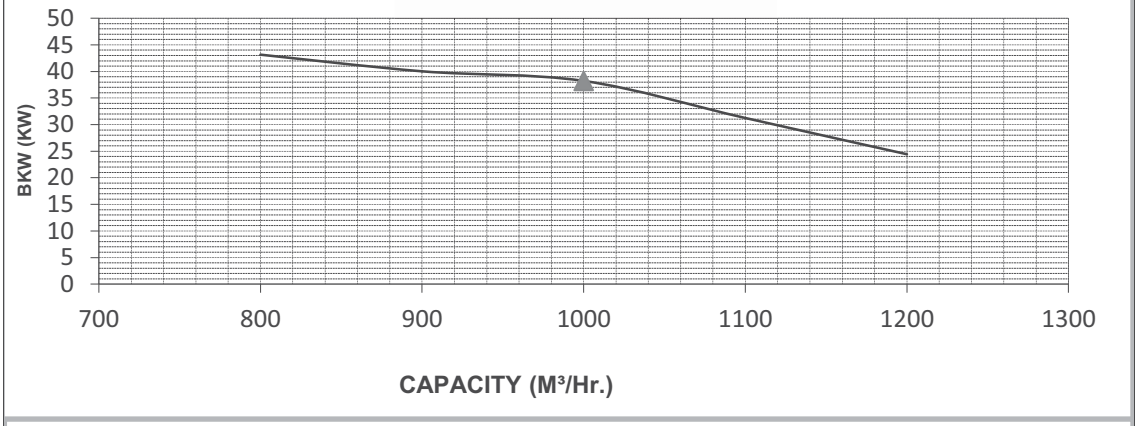
Bowl Head = Total Head + Total Losses

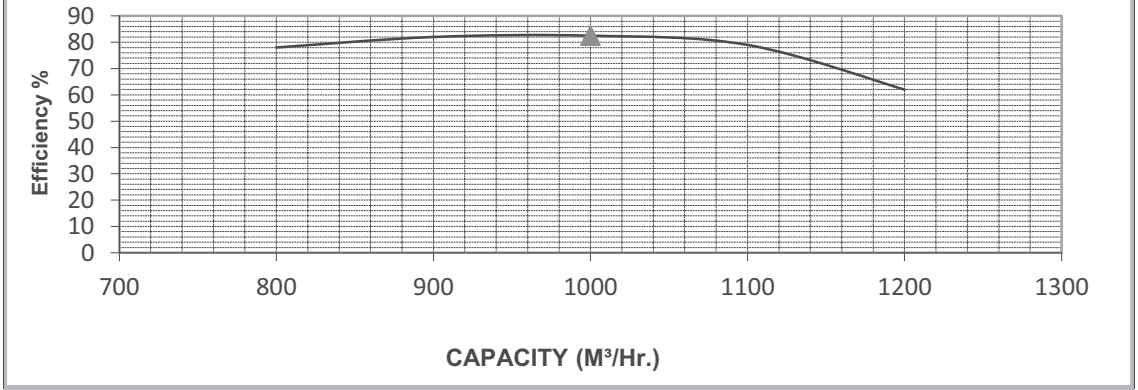
= 11 + 0.241

= 11.241 Meters ≈ **11.24 Meters**

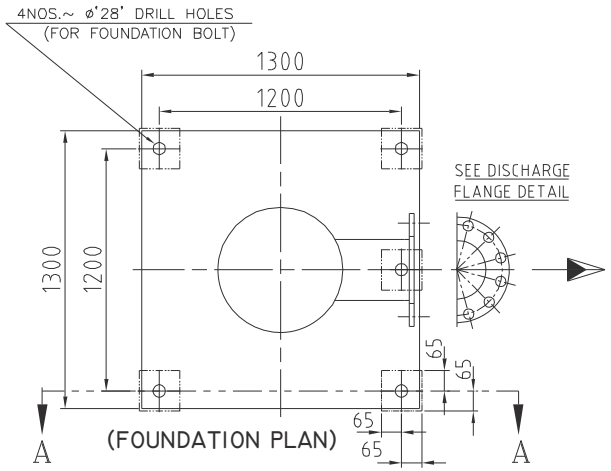
PERFORMANCE CURVE

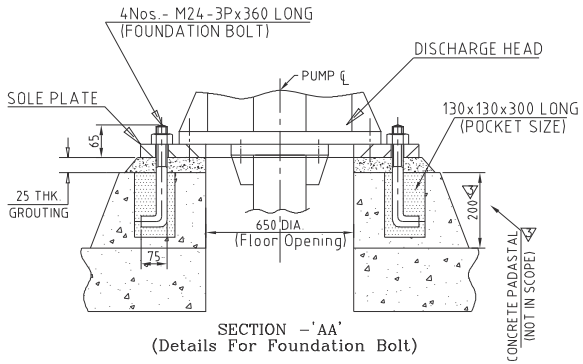






CUSTOMER : Clear Water Limited.				CMB DISPOSAL PUMP			
PROJECT - TANGEDCO-ENNORE STPP				Work order	SALE19023895-30		
CAPACITY	1000	M³/Hr.		Model	6310 / 2 STG. / OIL/14"		
HEAD	11.24	Mtrs		Pump Input	38.22 KW	Sp Gr	1.03
SOH	15	Mtrs		Speed	1482 rpm		
Efficiency	82.5	%		RATING	55 KW / 4 P /VSS		





SECTION –'AA'
(Details For Foundation Bolt)

THE CIVIL DETAILS SHOWN HERE ARE ONLY FOR GUIDELINE & SHOULD BE FINALIZED AT CUSTOMER END.

GROUTING PRECAUTIONS

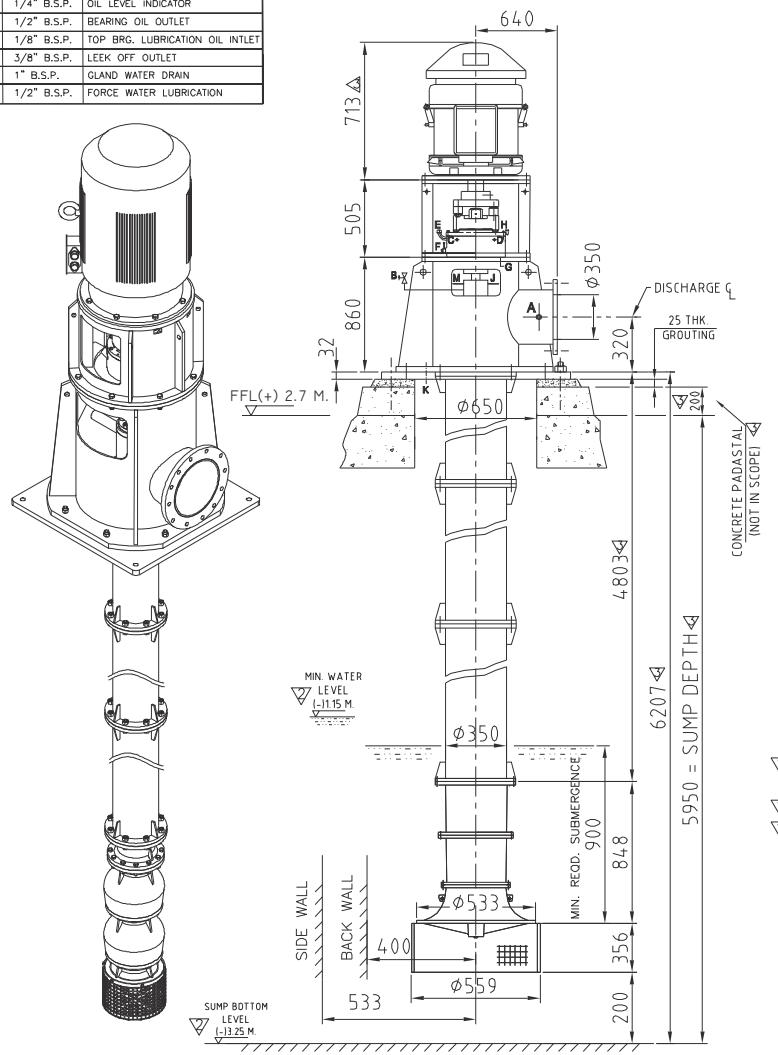
1. WHILE PREPARING POCKET TAKE CARE THAT MOTHER CONCRETE DOES NOT ENTER INTO THE FOUNDATION BOLT CAVITY.
2. BEFORE FINAL GROUTING PREPARE SURFACE BY CHIPPING MOTHER CONCRETE.
3. ENSURE THAT SOLE PLATE IS LEVELED TO REQUIRED ACCURACY BEFORE POURING THE FINAL GROUT.
4. GIVE PROPER SUPPORT WITH HELP OF TAPER WEDGES, SO THAT THE ALIGNMENT IS NOT DISTURBED DUE TO CONCRETE WEIGHT WHILE POURING.
5. ENSURE THAT NO AIR POCKETS ARE FORMED UNDER THE SOLE PLATE WHILE POURING THE FINAL GROUT.
6. BEFORE POURING GROUT, TAKE CARE THAT THE CHIPPED SURFACE DOES NOT COME IN CONTACT WITH OIL OR GREASE.
7. TOP MACHINE FACE OF FOUNDATION PLATE OF PUMP SHALL BE LEVELLED 0.05 MM / METER BEFORE CONCRETING.
8. CEMENT GRADE SHALL BE GP2

SCHEDULE OF CONNECTIONS:-

NO.	SIZE IN	DESCRIPTION
A	3/8" B.S.P.	DELIVERY PRESSURE GAUGE
B	2" B.S.P.	AIR VENT
C	1/2" B.S.P.	BEARING TEMP. INDICATOR
D	1/2" B.S.P.	BEARING RTD INDICATOR
E	1/2" B.S.P.	BRG. LUBRICATION OIL INTLET
F	1/4" B.S.P.	OIL LEVEL INDICATOR
G	1/2" B.S.P.	BEARING OIL OUTLET
H	1/8" B.S.P.	TOP BRG. LUBRICATION OIL INTLET
J	3/8" B.S.P.	LEEK OFF OUTLET
K	1" B.S.P.	GLAND WATER DRAIN
M	1/2" B.S.P.	FORCE WATER LUBRICATION

DIRECTION OF ROTATION COUNTER CLOCKWISE WHEN LOOKING FROM TOP.

(CHECK DIRECTION OF ROTATION IN DECOUPLED CONDITION)



PUMP PARTICULARS		MOTOR PARTICULARS	
PUMP Q.TY.	TWO	RATING	55 KW
FIGURE	6310	SPEED	1482 RPM (FLS) ◁
PUMP MODEL	14"	MAKE	A.B.B. ◁
STAGE	TWO	FRAME	M2BAX250SMA4 ◁
PUMP SPEED	1482 RPM ◁	PHASE	THREE
DISCHARGE	1000 M^3/HR.	VOLTAGE	415 V
BOWL HEAD	11.24 MTRS. ◁	FREQUENCY	50 Hz.
BOWL EFF.	82.5%	TYPE	VERTICAL-SOLID SHAFT
BOWL INPUT.	38.22 K.W. ◁		
SP. GRAVITY	1.03		
LUBRICATION	OIL		

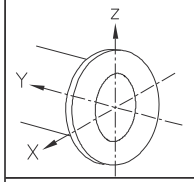
LOAD DETAIL:-

1. PUMP WEIGHT :– 2600 KGS. (APPROX.)
2. MOTOR WEIGHT :– 358 KGS. (APPROX.) ◁
3. DYNAMIC LOAD PUMP WITH MOTOR :– 3900 KGS. (APPROX.)

DETAILS OF DISCH. FLANGE:–
(AS PER ANSI–B–16.5) 150 LBS. (350 NB)

OUTER DIA.	533.4
PITCH CIRCLE DIA.	476
NO. OF HOLES	12
DIA. OF HOLES	28.5
THICKNESS	35

MAX. ALLOWABLE
DISCH. NOZZLE LOADS



FORCES N		
FX	FY	FZ
7759	8650	6980
MOMENTS N–M.		
MX	MY	MZ
7178	4950	5792

NOTE:–

1. DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. PUMP TO BE STARTED WITH DEL. VALVE IN CLOSED CONDITION.
3. ENSURE THAT AIR IS VENTED OUT FROM PUMP COLUMN IMMEDIATELY AFTER STARTING.
4. ''EL 0.00 M CORRESPONDS TO RL 10.00 WHICH IS FFL OF TG BUILDING.
5. OIL LUBRICATION TANK CAPACITY :– 1.75 LTR.
6. ELECTRICAL CONNECTION B/W MOTOR SOLENOID VALVE.

▽DRAWING NO. :- PE-V0-412-164-A005

FLOWMORE PUMPS **FLOWMORE LIMITED**

JOB NAME :- CMB DISPOSAL PUMP

CLIENT :- M/s. CLEAR WATER LIMITED

PROJECT :- 2 X 660 MW ENNORE SEZ STPP

CLIENT ORDER NO.:- 142/17-04M(82), DT:- 23-Feb-2019

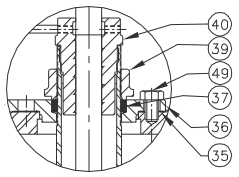
	NAME	SIGN	DATE
DRAWN	PRITAM		13.03.2019
CHECKED	RAKESH		13.03.2019
APPROVED	P.K.S.		13.03.2019

TITLE: GENERAL ARRANGEMENT DRG. FOR VERTICAL PROPELLER PUMP

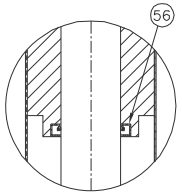
SCALE N.T.S. | SHEET 1 OF 1

DRG. No. GA-SALE190239850 30 | SIZE A4 | REV. 03

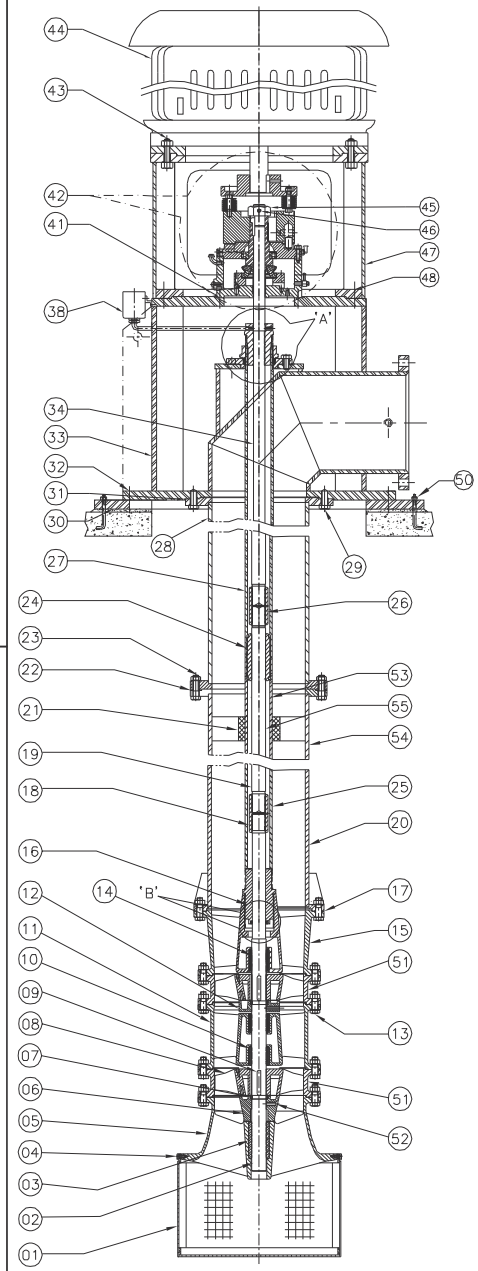
REV.	DATE	PREPARED	CHKD.	APPROVED	REVISIONS
3	05.09.2020	MANOJ	RAKESH	P.K.S.	ADDED & CHANGES AS MARKED
2	14.09.2019	PRITAM	RAKESH	P.K.S.	ADDED & CHANGES AS MARKED
1	07.05.2019	PRITAM	RAKESH	P.K.S.	DETAILS ADDED.
0	13.03.2019	PRITAM	RAKESH	P.K.S.	FIRST SUBMISSION



DETAIL–'A'
(BRG. & CAP Assy. Details)



DETAIL–'B'



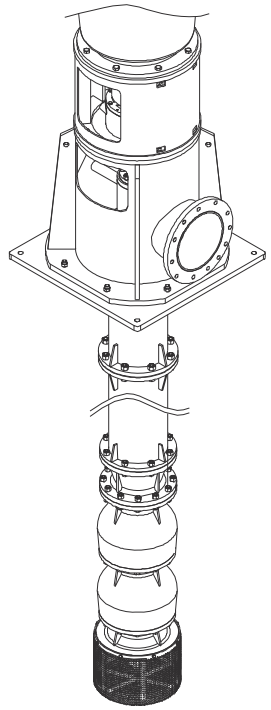
NOTE:–
* DULPLEX S.S.–ASTM–A240/A790 (UNS S31803) (DISCHARGE ELBOW) & OTHER M.S. (IS–2062) WITH EPOXY COATING PAINTING OUTSIDE & GLASS COATING/ PU COATING INSIDE

S.NO.	DESCRIPTION	QTY.	MATL.
56.	OIL SEAL	01	NITRILE RUBBER
55.	LINE SHAFT	02	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
54.	FLGD. COL. PIPE	02	DUPLEX S.S.–ASTM–A790/A240 (UNS–S31803)
53.	ENCL. TUBE	02	DUPLEX S.S.–ASTM–A789 (UNS–S31803)
52.	ALLEN SET SCREW	04	S.S.–316L ▽
51.	IMTERMEDIATE/DISCH. BOWL (PART–II)	02	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
50.	FOUNDATION BOLT WITH NUT L–TYPE	04	MILD STEEL
49.	HX. HD. CAP SCREW	06	S.S.–316L ▽
48.	HX. HD. BOLT WITH NUT	08	S.S.–316L ▽
47.	MOTOR STOOL	01	M.S. (IS–2062)
46.	ALLEN SET SCREW	01	S.S.–316L ▽
45.	TOP ADJUSTING NUT	01	S.S.–316–ASTM–A276
44.	MOTOR	01	A.B.B.–MAKE ▽
43.	HX. HD. BOLT WITH NUT	08	S.S.–316L ▽
42.	T.S. ASSY.	01	SEE DRG.No.TSA–SALE19023985–30
41.	HX. HD. CAP SCREW	04	S.S.–316L ▽
40.	BRG. & CAP	01	BRONZE (IS–318, LTB–V)
39.	T.T. NUT	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
38.	OIL TANK	01	ALUMINIUM
37.	PACKING PCS	02	IMPREGNATED TEFLON
36	ENCL. TUBE HEAD ADOPTER	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
35.	GASKET	01	WIRE REINFORCED RUBBER
34.	TOP SHAFT	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
33.	SURFACE DISCHARGE HED	01	SEE NOTE *
32.	STUD BOLT WITH NUT	08	S.S.–316L ▽
31.	GASKET	01	WIRE REINFORCED RUBBER
30.	SOLE PLATE	01	M.S. (IS–2062) EPOXY COATED
29.	HX. HD. CAP SCREW	12	S.S.–316L ▽
28.	TOP COL. PIPE	01	DUPLEX S.S.–ASTM–A790/A240 (UNS–S31803)
27.	TOP ENCL. TUBE	01	DUPLEX S.S.–ASTM–A789 (UNS–S31803)
26.	LINE SHAFT COUPLING	03	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
25.	ENCL. TUBE (BOTTOM)	01	DUPLEX S.S.–ASTM–A789 (UNS–S31803)
24.	CONNECTOR BEARING	03	BRONZE (IS–318, LTB–V)
23.	HX. HD BOLT WITH NUT	36	S.S.–316L ▽
22.	GASKET	03	WIRE REINFORCED RUBBER
21.	SPIDER	03	NITRILE RUBBER
20.	FLGD. COL. PIPE (BOTTIM)	01	DUPLEX S.S.–ASTM–A790/A240 (UNS–S31803)
19.	LINE SHAFT (BOTTOM)	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
18.	PUMP SHAFT COUPLING	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
17.	GASKET	01	WIRE REINFORCED RUBBER
16.	STEP BRG	01	BRONZE (IS–318, LTB–V)
15.	DISCHARGE BOWL (PART–I)	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
14.	LOWER BRG. FOR DISCH. BOWL	01	BRONZE (IS–318, LTB–V)
13.	HX. HD. BOLT WITH NUT	48	S.S.–316L ▽
12.	GUARD RING	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
11.	IMTERMEDIATE BOWL (PART–I)	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
10.	INTERMEDIATE BOWL BRG. (Lower & Upper)	02	BRONZE (IS–318, LTB–V)
09.	IMPELLER KEY	02	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
08.	IMPELLER	02	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
07.	THRUST COLLAR HALF	4Halves	S.S.–AISI–316
06.	PROTECTING RING	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
05.	SUCTION BOWL	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
04.	HX. HD. CAP SCREW	06	S.S.–316L ▽
03.	SUCTION BRG.	01	BRONZE (IS–318, LTB–V)
02.	PUMP SHAFT	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
01.	STRAINER (BASKET TYPE)	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)

REV.	DATE	PREPARED	CHKD.	APPROVED	REVISIONS
2	05.09.2020	MANOJ	RAKESH	P.K.S.	ADDED & CHANGES AS MARKED
1	07.05.2019	PRITAM	RAKESH	P.K.S.	FASTENERS MATL. CHANGED.
0	13.03.2019	PRITAM	RAKESH	P.K.S.	FIRST SUBMISSION

PUMP PARTICULARS

NO. OF PUMP	TWO
FIGURE	6310
MODEL	14"
STAGE	TWO
LUBRICATION	OIL



▽ DRAWING NO. :- PE-V0-412-164-A005

FLOWMORE PUMPS — FLOWMORE LIMITED

JOB NAME :- CMB DISPOSAL PUMP
CLIENT :- M/s. CLEAR WATER LIMITED
PROJECT :- 2 X 660 MW ENNORE SEZ STPP
CLIENT ORDER NO.:- 142/17-04M(82), DT:- 23-Feb-2019

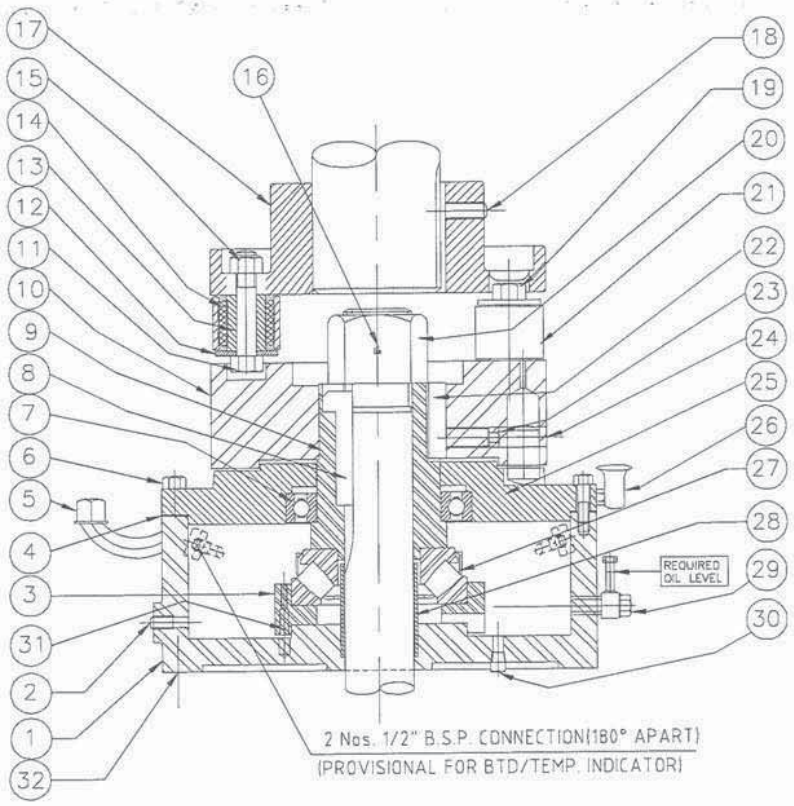
	NAME	SIGN	DATE
DRAWN	PRITAM		13.03.2019
CHECKED	RAKESH		13.03.2019
APPROVED	P.K.S.		13.03.2019

TITLE : CROSS–SECTIONAL AND AND PARTS LIST FOR VERTICAL MIX FLOW PUMP

SCALE N.T.S. | SHEET 1 OF 1

DRG. No. CSD-SALE19023985-30 | SIZE A4 | REV. 02

S. ON.	DESCRIPTION	QTY.	MATL.
32	HX. HD. CAP SCREW	04	S.S.-316L ▽
31	DOWEL PIN	02	STEEL
30	PLUG	01	MAL. IRON
29	L.B.T. OIL INDICATOR	01	STEEL & GLASS
28	OIL RETAINER SLEEVE	01	C. STEEL
27	SPH. ROLLER THRUST BRG.	01	BRG. STEEL (SKF/FAG)
26	OIL CUP WITH WICK	01	STEEL
25	MOUNTING COVER (RATCHET PLATE)	01	CAST STEEL(IS-1030)
24	RATCHET PIN	04	C.S. (CASE HARDENED)
23	ALLEN SET SCREW	01	S.S.-316L ▽
22	STRAIGHT KEY	01	M.S.
21	LINK	04	MAL. IRON
20	ADJUSTING NUT	01	S.S.-316-ASTM-A276
19	HX. HD. BOLT	04	EN-8(H.T. STEEL)
18	ALLEN SET SCREW	02	S.S.-316L ▽
17	UPPER COUPLING HALF	01	CAST STEEL(IS-1030)
16	ALLEN SET SCREW	01	S.S.-316L ▽
15	NYLOCK NUT	04	MILD STEEL
14	RUBBER BUSH	08	RUBBER
13	PIN BLOCK	08	ALUMINIUM
12	RETAINING WASHER	08	MILD STEEL
11	HX. HD. BOLT	04	EN-8(H.T. STEEL)
10	LOWER COUPLING HALF	01	CAST STEEL(IS-1030)
09	THRUST HUB	01	CAST STEEL(IS-1030)
08	GIB KEY	01	EN-8
07	RADIAL BALL BEARING	01	BRG. STEEL (SKF/FAG)
06	HEX. HD. CAP SCREW	08	S.S.-316L ▽
05	OIL FILL PORT	01	GAL. IRON
04	GASKET	01	OIL PROOF PAPER
03	THRUST BEARING SEAT	01	C.I. (IS-210, FG.-260)
02	PLUG	02	MAL. IRON
01	THRUST BEARING HOUSING	01	C.I. (IS-210, FG.-260)



▽ DRAWING NO. :- PE-V0-412-164-A005

NOTE:-
1. PLEASE READ THIS DRG. WITH DRG. NO. CSD-SALE19023985 30.

REV.	DATE	PREPARED	CHKD	APPROVED	REVISION
1	07.05.19	PRITAM	RAKESH	P.K.S.	FASTENERS MATL. CHANGED.
0	13.03.19	PRITAM	RAKESH	P.K.S.	FIRST SUBMISSION

FLOWMORE PUMPS

FLOWMORE LIMITED
NEW DELHI

JOB NAME :- CMB DISPOSAL PUMP
CLIENT :- M/s. CLEAR WATER LIMITED
PROJECT :- 2 X 660 MW ENNORE SEZ STPP
CLIENT ORDER NO.:- 142/17-04M(82), DT:- 23-Feb-2019

	NAME	SIGN	DATE
DRAWN	PRITAM		13.03.2019
CHECKED	RAKESH		13.03.2019
APPROVED	P.K.S.		13.03.2019

TITLE: THRUST STAND ASSY. & PART LIST (FOR VERTICAL TURBINE PUMP)

SCALE N.T.S. | SHEET 1 OF 1

DRG. No. TSA-SALE19023985-30 | SIZE A4 | REV. 01

	TECHNICAL DATA SHEET	Doc. No.: SALE-19023985 - 20	Rev. 01
FLOWMORE PUMPS	Project : TANGEDCO-ENNORE STPP Client : Clear Water Limited. Order No. : 142/17-04M(82)		Dated: 23-Feb-2019

S. No	Description	
General Information:		
1.	Application	GUARD POND PUMP
2.	Duty	Continuous
3.	Quantity	2 Nos.
4.	Liquid	Processed sea water
5.	Specific Gravity of Liquid	1.03
6.	Temperature (Deg. C)	Ambient
7.	Pump Design & Testing Standard	IS 1710 / IS 9137
Specifications:		
8.	Pump Make	FLOWMORE
9.	Pump Type	Vertical Turbine Pump
10.	Pump Model / Size	7000 / 20 H/ OIL
11.	No. of Stage	(1)Single Stage
12.	Full Load Speed of Motor	1488 rpm
13.	Capacity (M^3/Hr.)	1200 M^3/Hr.
14.	Bowl Head (Mtr.)	27.2 M
15.	Shut Off Head (Mtr.)	38 Mtr.
16.	Bowl Efficiency (%)	84.5 %
17.	Bowl Input (BKW)	108.35 KW
18.	Motor Rating (KW)	125 KW /415 V/4P
19.	Motor Type	VSS, Sq Cage induction Motor/IE-3
20.	Sump Depth (MM)	5950 MM
21.	Discharge Size (mm)	400 mm
22.	Type of Bearing Lubrication	Oil
23.	Type of Impeller	Enclosed
24.	Type of Pump Motor Coupling	Flexible
25.	Flange Drilling Standard	ANSI B 16.5 , CL-150 (400 NB)
26.	Noise Level	85 dBA at 1.5 M
27.	Vibration Level	75 Microns
28.	Bearing Type / Make	Antifriction (SKF / FAG)
29.	Min. Submergence Required.	1100 mm
Material of Construction		
30.	Bowl/Suction Bell	DUPLEX S.S –ASTM-A890,GR.4A(UNS-J92205)
31.	Impeller	DUPLEX S.S –ASTM-A890,GR.4A(UNS-J92205)

32.	Column Pipe	DUPLEX S.S-ASTM-A790/A240 (UNS-S31803)
33.	Pump Shaft	DUPLEX S.S-ASTM-A276 (UNS-S31803)
34.	Line Shaft /Top Shaft	DUPLEX S.S-ASTM-A276 (UNS-S31803)
35.	Line Shaft Bearing	THORDON/FEROFORM
36.	Line Shaft Coupling	DUPLEX S.S-ASTM-A790/A240 (UNS-S31803)
37.	BOWL WEARING RING	DUPLEX S.S –ASTM-A890,GR.4A(UNS-J92205)
38.	ENCL. TUBE	DUPLEX S.S-ASTM-A789 (UNS-S31803)
39.	SURFACE DISCHARGE HEAD	DUPLEX S.S –ASTM-A240/A790 (UNS S31803)(DISCHARGE ELBOW) & OTHER M.S (IS-2062)WITH EPOXY COATING OUTSIDE & GLASS COATING
40.	Type of Sealing	Gland Packing
41.	Gland Packing Pcs.	IMPREGNATED TEFLON
42.	Gland	DUPLEX S.S –ASTM-A890,GR.4A(UNS-J92205)
43.	Strainer	DUPLEX S.S-ASTM-A276 (UNS-S31803) (BASKET TYPE)
44.	Fasteners	S.S-316L
45.	Sole Plate	MS (IS – 2062) (EPOXY COATED)
46.	Bearings	Antifriction (SKF/FAG)

NOTE:

1) **Inspection & Testing shall be as per approved QAP.**

CALCULATION FOR BOWL HEAD

2. Pump Model-7000/20H-1Stage/1488 RPM

Flow at Duty Point = 1200 M^3/Hr.

Total Head = 27 Meters

Column Pipe Diameter / Discharge size = 400 MM

Column length = 4.891 Meters

Suction Bell diameter =490 MM

Shaft Diameter = 42.86 MM

Speed =1488 RPM

No of Stage =1 Stage

Bowl Effieciency= 84.5%

A) Entry Losses

Velocity at Bell Mouth = Q/A = (1200/3600) x (4/(π x 0.490^2))

= 1.768 m/sec.

Velocity Head = $V^2/2g$ = 0.223^2/ (2 x 9.81) = 0.1593 Meters

Entry Loss = 10% of Velocity Head (As per our standard Practice)

= 0.01593 Meters

B) Column Pipe Losses

As per Column friction loss chart (F_c) = 2.26 Mtr. / 100 Mtr. of pipe

Column loss at duty point = F_c x Column length/100

= (2.26 x 4.891/100)

= 0.1105 Meters

C) Discharge Elbow Losses

As per HIS table 33 (First Edition) Resistance Coefficient for Bend (k) = 0.21

Velocity at Discharge point = Q/A = (1200/3600) x (4/(π x 0.400^2)

= 2.572 m/sec.

Velocity Head = $V^2/2g = 2.572^2/(2 \times 9.81)$ = 0.3372Meter

Discharge Elbow Loss = k x velocity head

= 0.21 x 0.3372

= 0.070812 Meters

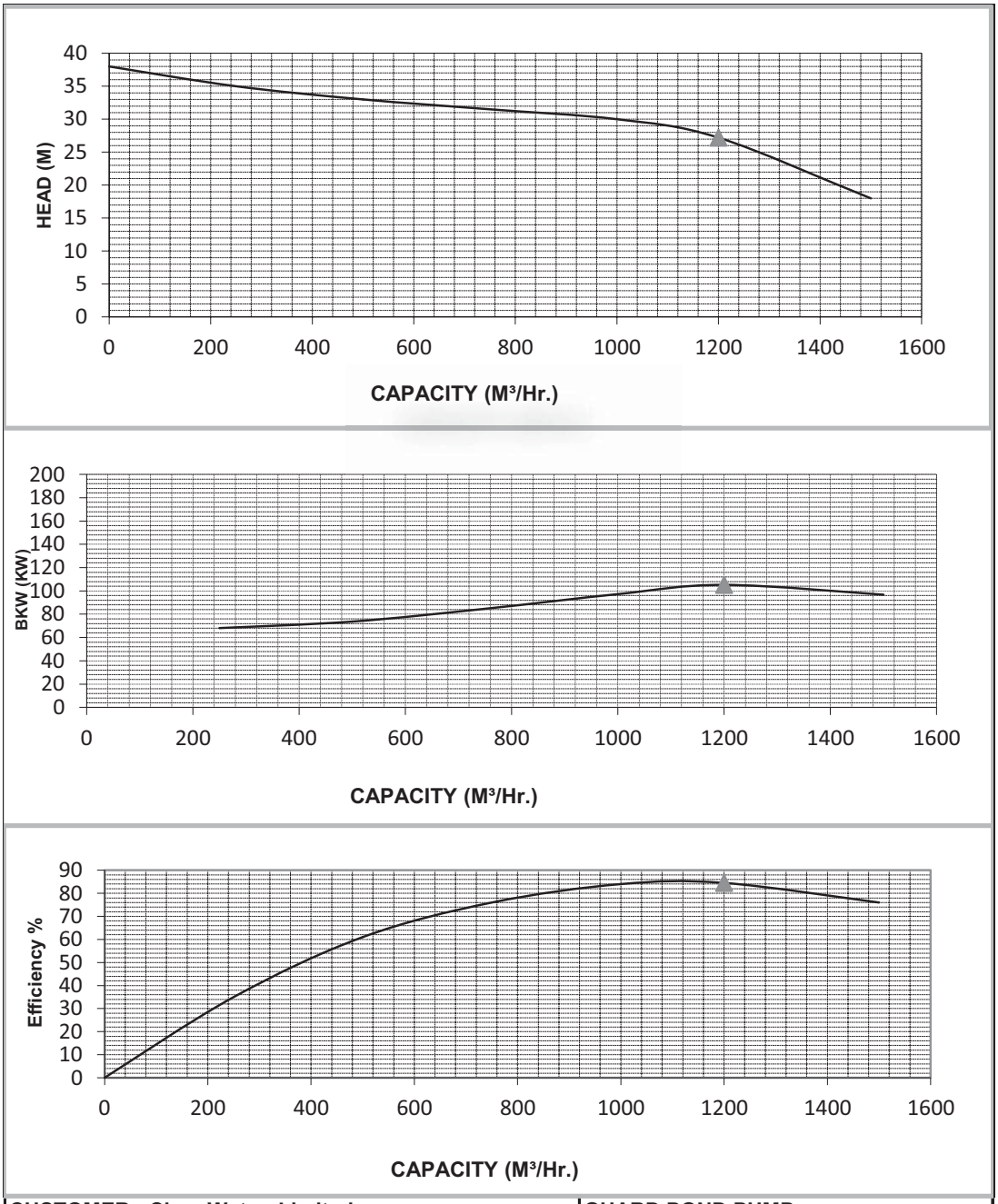
Total Losses = A + B + C = 0.01593 +0.1105 + 0.070812= 0.197 Meters

Bowl Head = Total Head + Total Losses

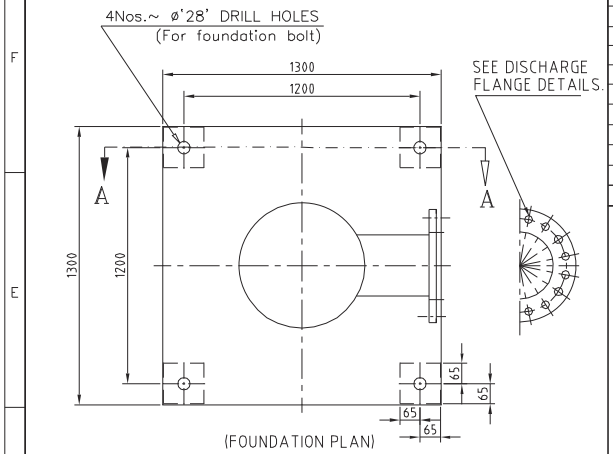
= 27 + 0.197

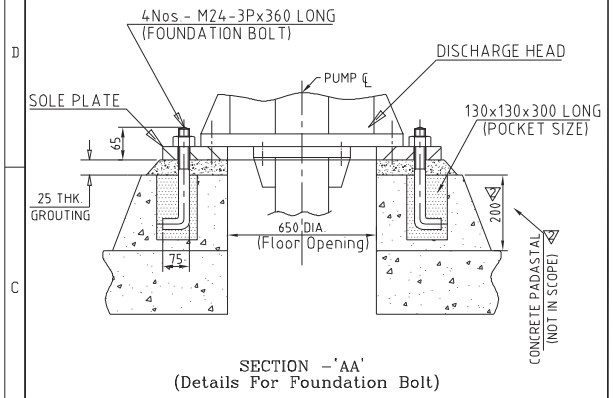
= 27.197 Meters ≈ 27.2 Meters

PERFORMANCE CURVE



CUSTOMER : Clear Water Limited.				**GUARD POND PUMP**			
PROJECT - TANGEDCO-ENNORE STPP				**Work order**	**SALE19023985-20**		
CAPACITY	**1200**	**M³/Hr.**		**Model**	**20 H / 1 STG. / OIL**		
HEAD	**27.2**	**Mtrs**		**Pump Input**	**108.35 KW**	**Sp Gr**	**1.03**
SOH	**38**	**Mtrs**		**Speed**	**1488 rpm**		
Efficiency	**84.5**	**%**		**RATING**	**125 KW / 4 P /VSS**		





SECTION –'AA'
(Details For Foundation Bolt)

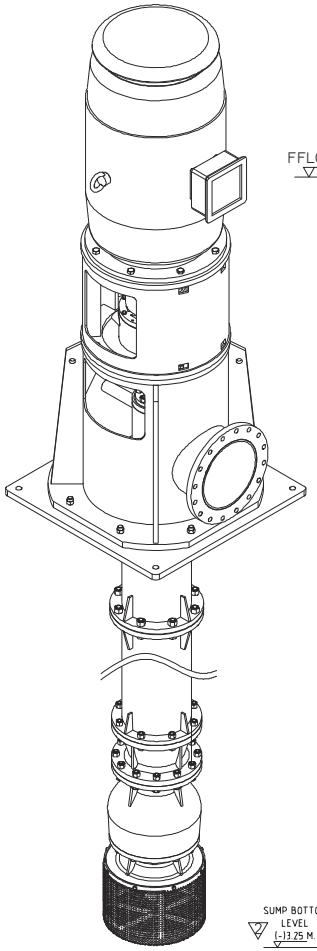
THE CIVIL DETAILS SHOWN HERE ARE ONLY FOR GUIDELINE & SHOULD BE FINALIZED AT CUSTOMER END.

GROUTING PRECAUTIONS

1. WHILE PREPARING POCKET TAKE CARE THAT MOTHER CONCRETE DOES NOT ENTER INTO THE FOUNDATION BOLT CAVITY.
2. BEFORE FINAL GROUTING PREPARE SURFACE BY CHIPPING MOTHER CONCRETE.
3. ENSURE THAT SOLE PLATE IS LEVELED TO REQUIRED ACCURACY BEFORE POURING THE FINAL GROUT.
4. GIVE PROPER SUPPORT WITH HELP OF TAPER WEDGES, SO THAT THE ALIGNMENT IS NOT DISTURBED DUE TO CONCRETE WEIGHT WHILE POURING.
5. ENSURE THAT NO AIR POCKETS ARE FORMED UNDER THE SOLE PLATE WHILE POURING THE FINAL GROUT.
6. BEFORE POURING GROUT, TAKE CARE THAT THE CHIPPED SURFACE DOES NOT COME IN CONTACT WITH OIL OR GREASE.
7. TOP MACHINE FACE OF FOUNDATION PLATE OF PUMP SHALL BE LEVELLED 0.05 MM / METER BEFORE CONCRETING.
   CEMENT GRADE SHALL BE GP2

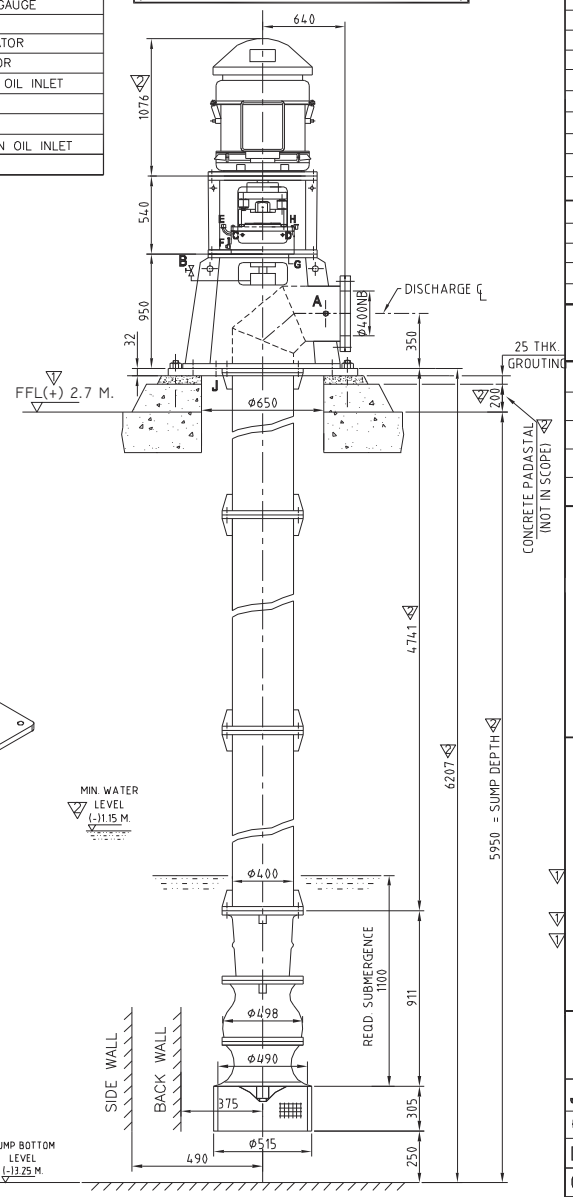
SCHEDULE OF CONNECTIONS:-

NO.	SIZE IN	DESCRIPTION
A	3/8" B.S.P.	DELIVERY PRESSURE GAUGE
B	2" B.S.P.	AIR VENT
C	1/2" B.S.P.	BEARING TEMP. INDICATOR
D	1/2" B.S.P.	BEARING RTD INDICATOR
E	1/2" B.S.P.	BEARING LUBRICATION OIL INLET
F	1/4" B.S.P.	OIL LEVEL INDICATOR
G	1/2" B.S.P.	BEARING OIL OUTLET
H	1/8" B.S.P.	TOP BRG. LUBRICATION OIL INLET
J	1" B.S.P.	GLAND WATER DRAIN



DIRECTION OF ROTATION COUNTER CLOCKWISE WHEN LOOKING FROM TOP.

(CHECK DIRECTION OF ROTATION IN DECOUPLED CONDITION)



PUMP PARTICULARS		MOTOR PARTICULARS	
PUMP Q.TY.	TWO	RATING	125 K.W.
FIGURE	7000	SPEED	1488 RPM (FLS)
PUMP SIZE	20H	MAKE	A.B.B. ▽
STAGE	ONE	FRAME	M2BAX315SC4 ▽
PUMP SPEED	1488 RPM	PHASE	THREE
DISCHARGE	1200 M³/HR.	VOLTAGE	415
BOWL HEAD	27.2 MTRS.	FREQUENCY	50 Hz.
BOWL EFF.	84.5 %	TYPE	VERTICAL-SOLID SHAFT
BOWL INPUT.	108.35 K.W.		
SP. GRAVITY	1.03		
LUBRICATION	OIL		

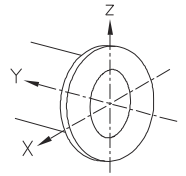
LOAD DETAIL:-

1. PUMP WEIGHT :– 3200 KGS. (APPROX.)
2. WEIGHT OF MOTOR :– 955 KGS. (APPROX.) ▽
3. DYNAMIC LOAD PUMP WITH MOTOR :– 5200 KGS.(APPROX.)

DETAILS OF DISCHARGE FLANGE:–
(AS PER ANSI–B–16.5), 150 LBS. (400 NB)

OUTER DIA.	597
PITCH CIRCLE DIA.	539.8
NO. OF HOLES	16
DIA. OF HOLES	28.5
THICKNESS	37

MAX. ALLOWABLE DISCH. NOZZLE LOADS



FORCES N		
FX	FY	FZ
7600	7210	6000
MOMENTS N–M.		
MX	MY	MZ
6590	3300	4880

NOTE:–

1. DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. PUMP TO BE STARTED WITH DEL. VALVE IN CLOSED CONDITION.
3. ENSURE THAT AIR IS VENTED OUT FROM PUMP COLUMN IMMEDIATELY AFTER STARTING.
4. ''EL 0.00 M CORRESPONDS TO RL 10.00 WHICH IS FFL OF TG BUILDING.
5. OIL LUBRICATION TANK CAPACITY :– 1.75 LTR.
6. ELECTRICAL CONNECTION B/W MOTOR SOLENOID VALVE.

▽DRAWING NO. :- PE-V0-412-164-A005

FLOWMORE PUMPS **FLOWMORE LIMITED.**

JOB NAME :- GUARD POND PUMP

CLIENT :- M/s. CLEAR WATER LIMITED

PROJECT :- 2 X 660 MW ENNORE SEZ STPP

CLIENT ORDER NO.:- 142/17-04M(82), DT:- 23-Feb-2019

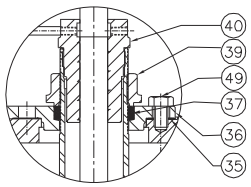
	NAME	SIGN	DATE
DRAWN	PRITAM		13.03.2019
CHECKED	RAKESH		13.03.2019
APPROVED	P.K.S.		13.03.2019

TITLE: GENERAL ARRANGEMENT DRG. FOR VERTICAL TURBINE PUMP

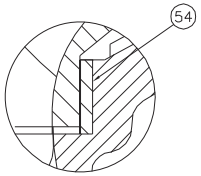
SCALE N.T.S. | SHEET 1 OF 1

DRG. No. GA-SALE190239852 0 | SIZE A4 | REV. 02

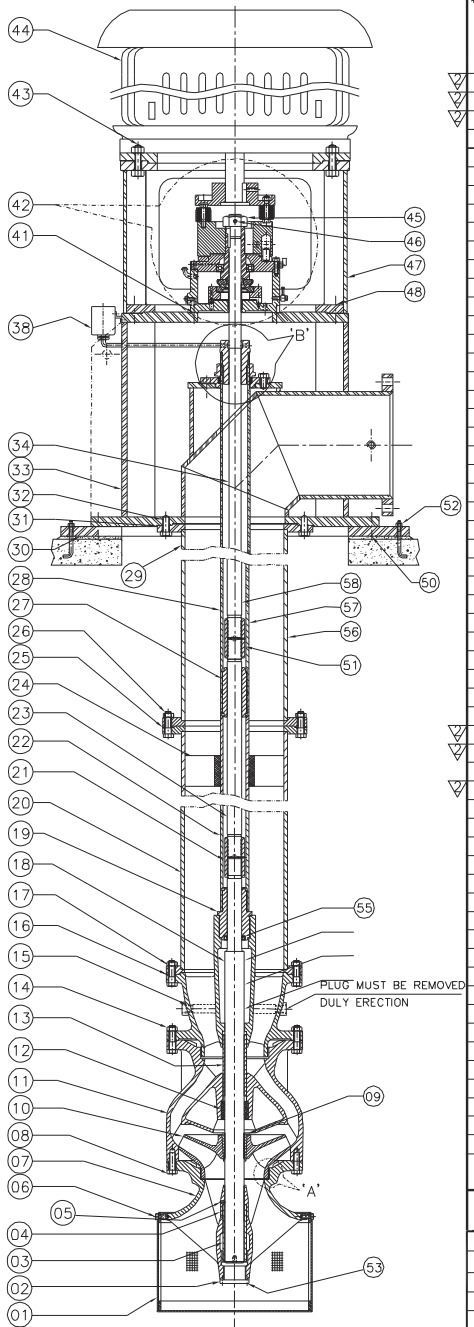
REV.	DATE	PREPARED	CHKD.	APPROVED	REVISIONS
2	05.09.2020	MANOJ	RAKESH	P.K.S.	ADDED & CHANGES AS MARKED
1	07.05.2019	PRITAM	RAKESH	P.K.S.	DETAILS ADDED.
0	13.03.2019	PRITAM	RAKESH	P.K.S.	FIRST SUBMISSION



DETAIL–'B'
(BRG. & CAP Assy. Details)



DETAIL–'A'



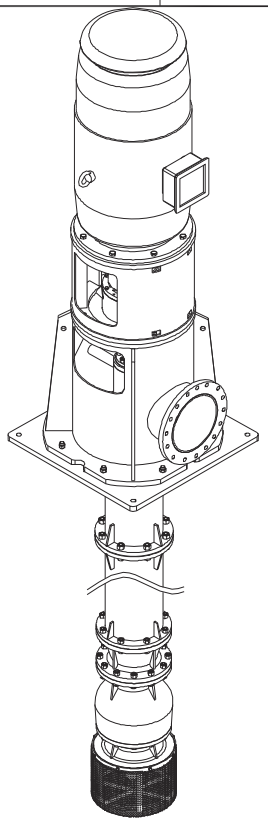
NOTE:–
* DULPLEX S.S.–ASTM–A240/A790 (UNS S31803) (DISCHARGE ELBOW) & OTHER M.S. (IS–2062) WITH EPOXY COATING PAINTING OUTSIDE & GLASS COATING/ PU COATING INSIDE

S.NO.	DESCRIPTION	QTY.	MATL.
58	LINE SHAFT	02	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
57	ENCL. TUBE	02	DUPLEX S.S.–ASTM–A789 (UNS–S31803)
56	FLGD. COL. PIPE	02	DUPLEX S.S.–ASTM–A790/A240 (UNS–S31803)
55	OIL SEAL	01	NITRILE RUBBER
54	BOWL WEARING RING	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
53	HX. HD. CAP SCREW	06	S.S.–316L ▽
52	FOUNDATION BOLT WITH NUT L–TYPE	04	MILD STEEL
51	LINE SHAFT COUPLING	03	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
50	STUD BOLT WITH NUT	08	S.S.–316L ▽
49	HX. HD. CAP SCREW	06	S.S.–316L ▽
48	HX. HD. BOLT WITH NUT	08	S.S.–316L ▽
47	MOTOR STOOL	01	M.S.(IS–2062)
46	ALLEN SET SCREW	01	S.S.–316L ▽
45	TOP ADJUSTING NUT	01	S.S.–316–ASTM–A276
44	MOTOR	01	A.B.B.–MAKE ▽
43	HX. HD. BOLT WITH NUT	08	S.S.–316L ▽
42	T.S. ASSY.	01	SEE DRG.No.TSA–SALE19023985–20
41	HX. HD. CAP SCREW	04	S.S.–316–ASTM–A193, GR. B8M
40	BRG. & CAP	01	BRONZE (IS–318, LTB–V)
39	T. T. NUT	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
38	OIL TANK	01	ALUMINIUM
37	PACKING PCS.	02	IMPREGNATED TEFLON
36	ENCL. TUBE HEAD ADOPTER	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
35	GASKET	01	WIRE REINFORCED RUBBER
34	TOP SHAFT	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
33	SURFACE DISCHARGE HEAD	01	SEE NOTE *
32	HX. HD. CAP SCREW	16	S.S.–316L ▽
31	GASKET	01	WIRE REINFORCED RUBBER
30	SOLE PLATE	01	M.S. (IS–2062) EPOXY COATED
29	FLGD. TOP COL. PIPE	01	DUPLEX S.S.–ASTM–A790/A240 (UNS–S31803)
28	TOP ENCL. TUBE	01	DUPLEX S.S.–ASTM–A789 (UNS–S31803)
27	CONNECTOR BEARING	11	BRONZE (IS–318, LTB–V)
26	HX. HD. BOLT WITH NUT	48	S.S.–316L ▽
25	GASKET	03	WIRE REINFORCED RUBBER
24	SPIDER	03	NITRILE RUBBER
23	BOTTOM LINE SHAFT	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
22	BOTTOM ENCL. TUBE	01	DUPLEX S.S.–ASTM–A789 (UNS–S31803)
21	PUMP SHAFT COUPLING	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
20	FLGD. BOTTOM COL. PIPE	01	DUPLEX S.S.–ASTM–A790/A240 (UNS–S31803)
19	STEP BEARING	01	BRONZE (IS–318, LTB–V)
18	PUMP SHAFT	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
17	HX. HD. BOLT WITH NUT	16	S.S.–316L ▽
16	GASKET	01	WIRE REINFORCED RUBBER
15	DISCHARGE CASE	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
14	HX. HD. BOLT WITH NUT	12	S.S.–316L ▽
13	BEARING TOP INTERBOWL	01	BRONZE (IS–318, LTB–V)
12	BOWL BUSH	01	NITRILE RUBBER
11	INTER BOWL	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
10	IMPELLER	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
09	IMPELLER LOCK COLLET	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
08	HX. HD. CAP SCREW	12	S.S.–316L ▽
07	SUCTION BELL	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
06	HX. HD. CAP SCREW	08	S.S.–316L ▽
05	ALLEN SET SCREW	02	S.S.–316L ▽
04	SAND CAP	01	S.S.–AISI–316
03	BRG. SUCTION	01	BRONZE (IS–318, LTB–V)
02	COVER PLATE FOR BELL	01	DUPLEX S.S.–ASTM–A240(UNS S31803)
01	STRAINER (BASKET TYPE)	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)

REV.	DATE	PREPARED	CHKD.	APPROVED	REVISIONS
2	05.09.2020	MANOJ	RAKESH	P.KS.	ADDED & CHANGES AS MARKED
1	07.05.2019	PRITAM	RAKESH	P.KS.	FASTENERS MATL. CHANGED.
0	13.03.2019	PRITAM	RAKESH	P.KS.	FIRST SUBMISSION DRG.

PUMP PARTICULARS

NO. OF PUMP	TWO
FIGURE	7000
MODEL	20H
STAGE	ONE
LUBRICATION	OIL



▽DRAWING NO. :- PE-V0-412-164-A005

FLOWMORE PUMPS **FLOWMORE LIMITED.**

JOB NAME :- GUARD POND PUMP
CLIENT :- M/s. CLEAR WATER LIMITED
PROJECT :- 2 X 660 MW ENNORE SEZ STPP
CLIENT ORDER NO.:- 142/17-04M(82), DT:- 23-Feb-2019

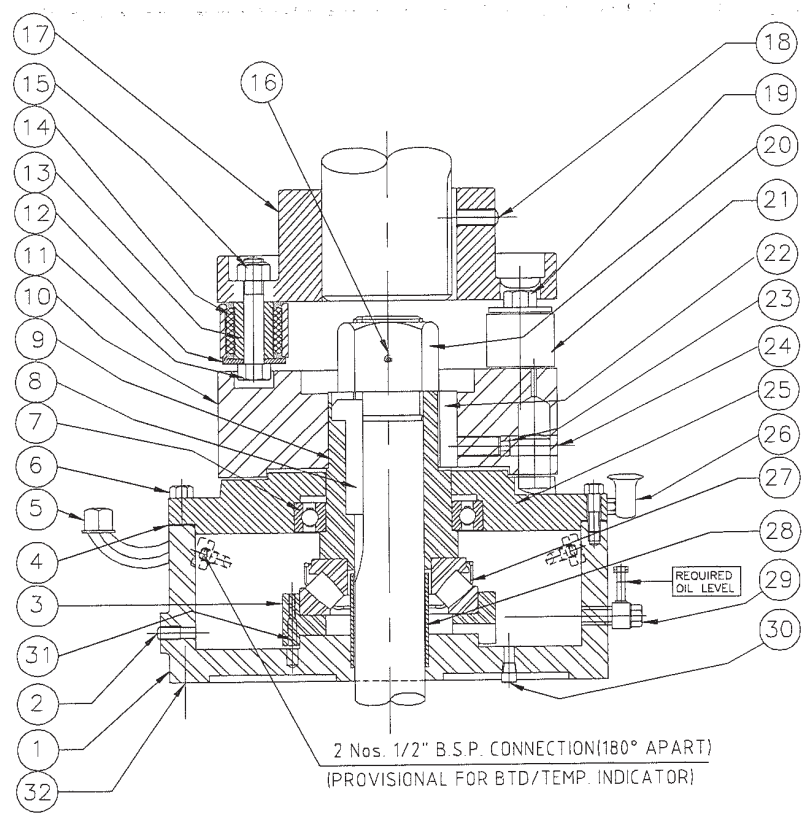
	NAME	SIGN	DATE
DRAWN	PRITAM		13.03.2019
CHECKED	RAKESH		13.03.2019
APPROVED	P.K.S.		13.03.2019

TITLE: CROSS–SECTIONAL AND PART LIST VERTICAL TURBINE PUMP

SCALE N.T.S. | SHEET 1 OF 1

DRG. No. CSD-SALE19023985-20 | SIZE A4 | REV. 02

S. ON.	DESCRIPTION	QTY.	MATL.
32	HX. HD. CAP SCREW	04	S.S.–316L ▽
31	DOWEL PIN	02	STEEL
30	PLUG	01	MAL. IRON
29	L.B.T. OIL INDICATOR	01	STEEL & GLASS
28	OIL RETAINER SLEEVE	01	C. STEEL
27	SPH. ROLLER THRUST BRG.	01	BRG. STEEL (SKF/FAG)
26	OIL CUP WITH WICK	01	STEEL
25	MOUNTING COVER (RATCHET PLATE)	01	CAST STEEL(IS–1030)
24	RATCHET PIN	04	C.S. (CASE HARDENED)
23	ALLEN SET SCREW	01	S.S.–316L ▽
22	STRAIGHT KEY	01	M.S.
21	LINK	04	MAL. IRON
20	ADJUSTING NUT	01	S.S.–316–ASTM–A276
19	HX. HD. BOLT	04	EN–8(H.T. STEEL)
18	ALLEN SET SCREW	02	S.S.–316L ▽
17	UPPER COUPLING HALF	01	CAST STEEL(IS–1030)
16	ALLEN SET SCREW	01	S.S.–316L ▽
15	NYLOCK NUT	04	MILD STEEL
14	RUBBER BUSH	08	RUBBER
13	PIN BLOCK	08	ALUMINIUM
12	RETAINING WASHER	08	MILD STEEL
11	HX. HD. BOLT	04	EN–8(H.T. STEEL)
10	LOWER COUPLING HALF	01	CAST STEEL(IS–1030)
09	THRUST HUB	01	CAST STEEL(IS–1030)
08	GIB KEY	01	EN–8
07	RADIAL BALL BEARING	01	BRG. STEEL (SKF/FAG)
06	HEX. HD. CAP SCREW	08	S.S.–316L ▽
05	OIL FILL PORT	01	GAL. IRON
04	GASKET	01	OIL PROOF PAPER
03	THRUST BEARING SEAT	01	C.I. (IS–210, FG.–260)
02	PLUG	02	MAL. IRON
01	THRUST BEARING HOUSING	01	C.I. (IS–210, FG.–260)



▽ **DRAWING NO. :- PE-V0-412-164-A005**

NOTE:–
1. PLEASE READ THIS DRG. WITH DRG. NO. CSD–SALE19023985 20.

REV.	DATE	PREPARED	CHKD	APPROVED	REVISION
1	07.05.19	PRITAM	RAKESH	P.K.S.	FASTENERS MATL. CHANGED.
0	13.03.19	PRITAM	RAKESH	P.K.S.	FIRST SUBMISSION

FLOWMORE

FLOWMORE LIMITED
NEW DELHI

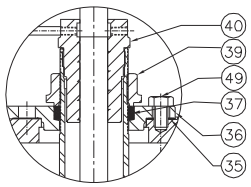
JOB NAME :- GUARD POND PUMP
CLIENT :- M/s. CLEAR WATER LIMITED
PROJECT :- 2 X 660 MW ENNORE SEZ STPP
CLIENT ORDER NO.:- 142/17-04M(82), DT:- 23-Feb-2019

	NAME	SIGN	DATE
DRAWN	PRITAM		13.03.2019
CHECKED	RAKESH		13.03.2019
APPROVED	P.K.S.		13.03.2019

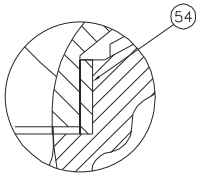
TITLE: THRUST STAND ASSY. & PART LIST (FOR VERTICAL TURBINE PUMP)

SCALE N.T.S. | SHEET 1 OF 1

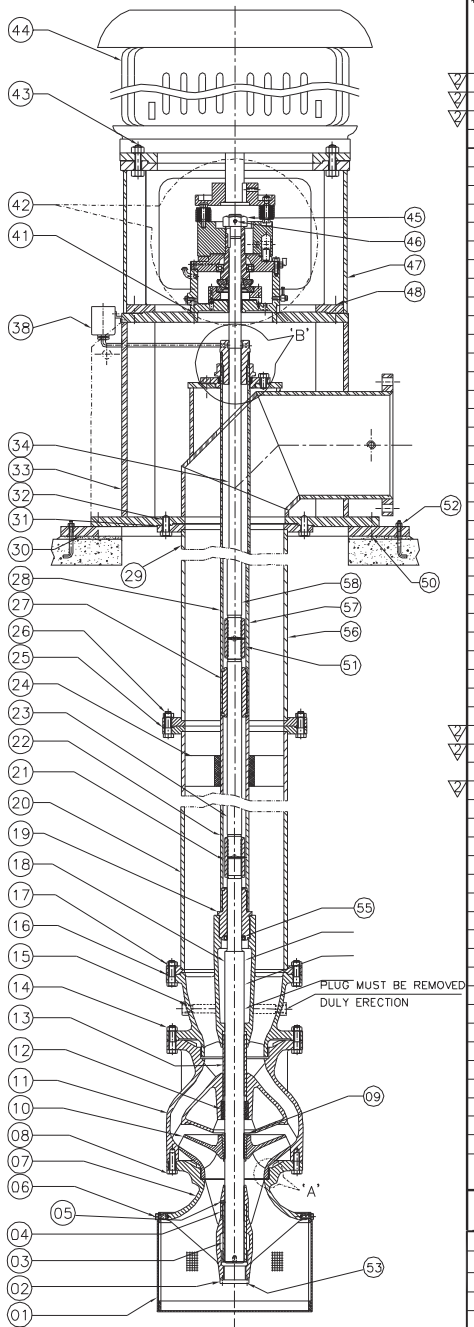
DRG. No. TSA-SALE19023985-20 | SIZE A4 | REV. 01



DETAIL–'B'
(BRG. & CAP Assy. Details)



DETAIL–'A'



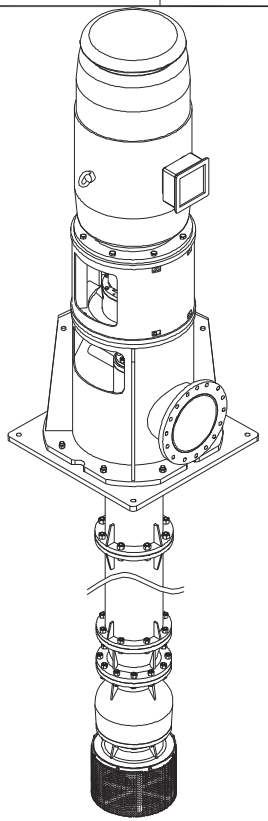
NOTE:–
* DULPLEX S.S.–ASTM–A240/A790 (UNS S31803) (DISCHARGE ELBOW) & OTHER M.S. (IS–2062) WITH EPOXY COATING PAINTING OUTSIDE & GLASS COATING/ PU COATING INSIDE

S.NO.	DESCRIPTION	QTY.	MATL.
▽ 58	LINE SHAFT	02	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
▽ 57	ENCL. TUBE	02	DUPLEX S.S.–ASTM–A789 (UNS–S31803)
▽ 56	FLGD. COL. PIPE	02	DUPLEX S.S.–ASTM–A790/A240 (UNS–S31803)
55	OIL SEAL	01	NITRILE RUBBER
54	BOWL WEARING RING	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
53	HX. HD. CAP SCREW	06	S.S.–316L ▽
52	FOUNDATION BOLT WITH NUT L–TYPE	04	MILD STEEL
51	LINE SHAFT COUPLING	03	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
50	STUD BOLT WITH NUT	08	S.S.–316L ▽
49	HX. HD. CAP SCREW	06	S.S.–316L ▽
48	HX. HD. BOLT WITH NUT	08	S.S.–316L ▽
47	MOTOR STOOL	01	M.S.(IS–2062)
46	ALLEN SET SCREW	01	S.S.–316L ▽
45	TOP ADJUSTING NUT	01	S.S.–316–ASTM–A276
44	MOTOR	01	A.B.B.–MAKE ▽
43	HX. HD. BOLT WITH NUT	08	S.S.–316L ▽
42	T.S. ASSY.	01	SEE DRG.No.TSA–SALE19023985–20
41	HX. HD. CAP SCREW	04	S.S.–316–ASTM–A193, GR. B8M
40	BRG. & CAP	01	BRONZE (IS–318, LTB–V)
39	T. T. NUT	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
38	OIL TANK	01	ALUMINIUM
37	PACKING PCS.	02	IMPREGNATED TEFLON
36	ENCL. TUBE HEAD ADOPTER	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
35	GASKET	01	WIRE REINFORCED RUBBER
34	TOP SHAFT	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
33	SURFACE DISCHARGE HEAD	01	SEE NOTE *
32	HX. HD. CAP SCREW	16	S.S.–316L ▽
31	GASKET	01	WIRE REINFORCED RUBBER
30	SOLE PLATE	01	M.S. (IS–2062) EPOXY COATED
29	FLGD. TOP COL. PIPE	01	DUPLEX S.S.–ASTM–A790/A240 (UNS–S31803)
28	TOP ENCL. TUBE	01	DUPLEX S.S.–ASTM–A789 (UNS–S31803)
27	CONNECTOR BEARING	11	BRONZE (IS–318, LTB–V)
26	HX. HD. BOLT WITH NUT	48	S.S.–316L ▽
25	GASKET	03	WIRE REINFORCED RUBBER
24	SPIDER	03	NITRILE RUBBER
▽ 23	BOTTOM LINE SHAFT	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
▽ 22	BOTTOM ENCL. TUBE	01	DUPLEX S.S.–ASTM–A789 (UNS–S31803)
21	PUMP SHAFT COUPLING	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
▽ 20	FLGD. BOTTOM COL. PIPE	01	DUPLEX S.S.–ASTM–A790/A240 (UNS–S31803)
19	STEP BEARING	01	BRONZE (IS–318, LTB–V)
18	PUMP SHAFT	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
17	HX. HD. BOLT WITH NUT	16	S.S.–316L ▽
16	GASKET	01	WIRE REINFORCED RUBBER
15	DISCHARGE CASE	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
14	HX. HD. BOLT WITH NUT	12	S.S.–316L ▽
13	BEARING TOP INTERBOWL	01	BRONZE (IS–318, LTB–V)
12	BOWL BUSH	01	NITRILE RUBBER
11	INTER BOWL	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
10	IMPELLER	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
09	IMPELLER LOCK COLLET	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
08	HX. HD. CAP SCREW	12	S.S.–316L ▽
07	SUCTION BELL	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
06	HX. HD. CAP SCREW	08	S.S.–316L ▽
05	ALLEN SET SCREW	02	S.S.–316L ▽
04	SAND CAP	01	S.S.–AISI–316
03	BRG. SUCTION	01	BRONZE (IS–318, LTB–V)
02	COVER PLATE FOR BELL	01	DUPLEX S.S.–ASTM–A240(UNS S31803)
01	STRAINER (BASKET TYPE)	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)

REV.	DATE	PREPARED	CHKD.	APPROVED	REVISIONS
2	05.09.2020	MANOJ	RAKESH	P.K.S.	ADDED & CHANGES AS MARKED
1	07.05.2019	PRITAM	RAKESH	P.K.S.	FASTENERS MATL. CHANGED.
0	13.03.2019	PRITAM	RAKESH	P.K.S.	FIRST SUBMISSION DRG.

PUMP PARTICULARS

NO. OF PUMP	TWO
FIGURE	7000
MODEL	20H
STAGE	ONE
LUBRICATION	OIL



▽ DRAWING NO. :- PE-V0-412-164-A005

FLOWMORE PUMPS

FLOWMORE LIMITED.

JOB NAME :- GUARD POND PUMP

CLIENT :- M/s. CLEAR WATER LIMITED

PROJECT :- 2 X 660 MW ENNORE SEZ STPP

CLIENT ORDER NO.:- 142/17-04M(82), DT:- 23-Feb-2019

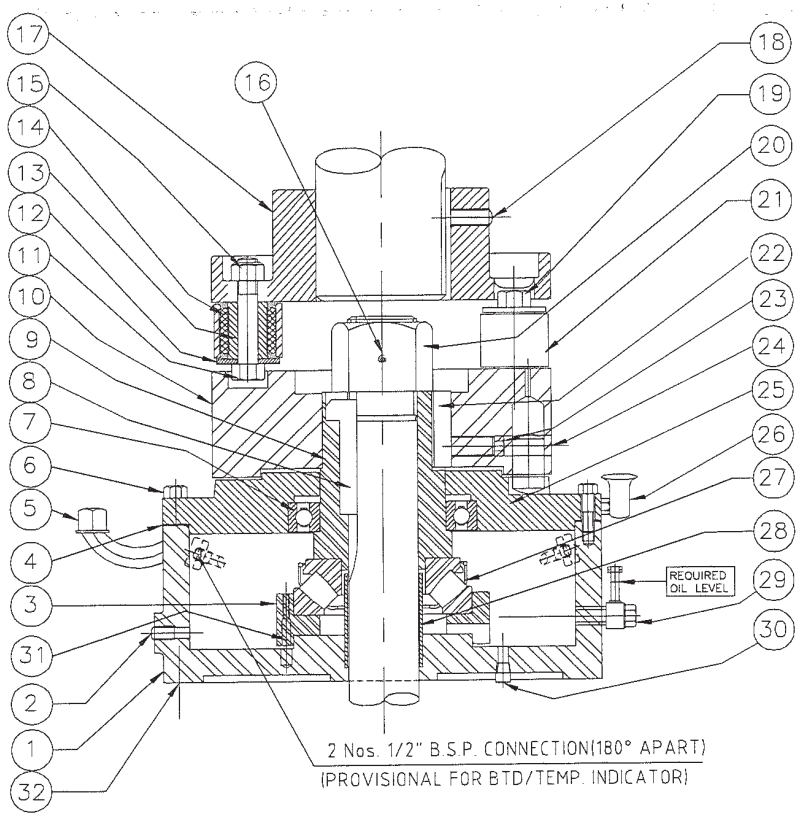
	NAME	SIGN	DATE
DRAWN	PRITAM		13.03.2019
CHECKED	RAKESH		13.03.2019
APPROVED	P.K.S.		13.03.2019

TITLE : CROSS–SECTIONAL AND PART LIST VERTICAL TURBINE PUMP

SCALE N.T.S. | SHEET 1 OF 1

DRG. No. CSD-SALE19023985-20 | SIZE A4 | REV. 02

S. ON.	DESCRIPTION	QTY.	MATL.
32	HX. HD. CAP SCREW	04	S.S.–316L ▽
31	DOWEL PIN	02	STEEL
30	PLUG	01	MAL. IRON
29	L.B.T. OIL INDICATOR	01	STEEL & GLASS
28	OIL RETAINER SLEEVE	01	C. STEEL
27	SPH. ROLLER THRUST BRG.	01	BRG. STEEL (SKF/FAG)
26	OIL CUP WITH WICK	01	STEEL
25	MOUNTING COVER (RATCHET PLATE)	01	CAST STEEL(IS–1030)
24	RATCHET PIN	04	C.S. (CASE HARDENED)
23	ALLEN SET SCREW	01	S.S.–316L ▽
22	STRAIGHT KEY	01	M.S.
21	LINK	04	MAL. IRON
20	ADJUSTING NUT	01	S.S.–316–ASTM–A276
19	HX. HD. BOLT	04	EN–8(H.T. STEEL)
18	ALLEN SET SCREW	02	S.S.–316L ▽
17	UPPER COUPLING HALF	01	CAST STEEL(IS–1030)
16	ALLEN SET SCREW	01	S.S.–316L ▽
15	NYLOCK NUT	04	MILD STEEL
14	RUBBER BUSH	08	RUBBER
13	PIN BLOCK	08	ALUMINIUM
12	RETAINING WASHER	08	MILD STEEL
11	HX. HD. BOLT	04	EN–8(H.T. STEEL)
10	LOWER COUPLING HALF	01	CAST STEEL(IS–1030)
09	THRUST HUB	01	CAST STEEL(IS–1030)
08	GIB KEY	01	EN–8
07	RADIAL BALL BEARING	01	BRG. STEEL (SKF/FAG)
06	HEX. HD. CAP SCREW	08	S.S.–316L ▽
05	OIL FILL PORT	01	GAL. IRON
04	GASKET	01	OIL PROOF PAPER
03	THRUST BEARING SEAT	01	C.I. (IS–210, FG.–260)
02	PLUG	02	MAL. IRON
01	THRUST BEARING HOUSING	01	C.I. (IS–210, FG.–260)



▽ **DRAWING NO. :- PE-V0-412-164-A005**

NOTE:–
1. PLEASE READ THIS DRG. WITH DRG. NO. CSD–SALE19023985 20.

REV.	DATE	PREPARED	CHKD	APPROVED	REVISION
1	07.05.19	PRITAM	RAKESH	P.K.S.	FASTENERS MATL. CHANGED.
0	13.03.19	PRITAM	RAKESH	P.K.S.	FIRST SUBMISSION

FLOWMORE

FLOWMORE LIMITED
NEW DELHI

JOB NAME :- GUARD POND PUMP
CLIENT :- M/s. CLEAR WATER LIMITED
PROJECT :- 2 X 660 MW ENNORE SEZ STPP
CLIENT ORDER NO.:- 142/17-04M(82), DT:- 23-Feb-2019

	NAME	SIGN	DATE
DRAWN	PRITAM		13.03.2019
CHECKED	RAKESH		13.03.2019
APPROVED	P.K.S.		13.03.2019

TITLE: THRUST STAND ASSY. & PART LIST (FOR VERTICAL TURBINE PUMP)

SCALE N.T.S. | SHEET 1 OF 1

DRG. No. TSA-SALE19023985-20 | SIZE A4 | REV. 01

	TECHNICAL DATA SHEET	Doc. No.: SALE-19023985 - 10	Rev. 01
FLOWMORE PUMPS	Project : TANGEDCO-ENNORE STPP Client : Clear Water Limited. Order No. : 142/17-04M(82)		Dated: 23-Feb-2019
S. No	Description		
General Information:			
1.	Application	GUARDENING PUMP	
2.	Duty	Continuous	
3.	Quantity	2 Nos.	
4.	Liquid	Processed sea water	
5.	Specific Gravity of Liquid	1.03	
6.	Temperature (Deg. C)	Ambient	
7.	Pump Design & Testing Standard	IS 1710 / IS 9137	
Specifications:			
8.	Pump Make	FLOWMORE	
9.	Pump Type	Vertical Turbine Pump	
10.	Pump Model / Size	7000 / 7 M/ OIL	
11.	No. of Stage	(4) Four Stage	
12.	Full Load Speed of Motor	1435 rpm	
13.	Capacity (M^3/Hr.)	20 M^3/Hr.	
14.	Bowl Head (Mtr.)	20.2 M	
15.	Shut Off Head (Mtr.)	22.4 Mtr.	
16.	Bowl Efficiency (%)	70 %	
17.	Bowl Input (BKW)	1.62 KW	
18.	Motor Rating (KW)	2.2 KW /415 V/4P	
19.	Motor Type	VSS, Sq. Cage induction Motor/IE-2	
20.	Sump Depth (MM)	5700 MM	
21.	Discharge Size (mm)	100 mm	
22.	Type of Bearing Lubrication	Oil	
23.	Type of Impeller	Enclosed	
24.	Type of Pump Motor Coupling	Flexible	
25.	Flange Drilling Standard	ANSI B 16.5 , CL-150 (100 NB)	
26.	Noise Level	85 dBA at 1.5 M	
27.	Vibration Level	75 Microns	
28.	Bearing Type / Make	Antifriction (SKF / FAG)	
29.	Min. Submergence Required.	762 mm	
Material of Construction			
30.	Bowl/Suction Bell	DUPLEX S.S –ASTM-A890,GR.4A(UNS-J92205)	
31.	Impeller	DUPLEX S.S –ASTM-A890,GR.4A(UNS-J92205)	

32.	Column Pipe	DUPLEX S.S-ASTM-A790/A240 (UNS-S31803)
33.	Pump Shaft	DUPLEX S.S-ASTM-A276 (UNS-S31803)
34.	Line Shaft /Top Shaft	DUPLEX S.S-ASTM-A276 (UNS-S31803)
35.	Line Shaft Bearing	THORDON/FEROFORM
36.	Line Shaft Coupling	DUPLEX S.S-ASTM-A790/A240 (UNS-S31803)
37.	BOWL WEARING RING	DUPLEX S.S –ASTM-A890,GR.4A(UNS-J92205)
38.	ENCL. TUBE	DUPLEX S.S-ASTM-A789 (UNS-S31803)
39.	SURFACE DISCHARGE HEAD	DUPLEX S.S –ASTM-A240/A790 (UNS S31803)(DISCHARGE ELBOW) & OTHER M.S (IS-2062)WITH EPOXY COATING OUTSIDE & GLASS COATING /
40.	Type of Sealing	Gland Packing
41.	Gland Packing Pcs.	IMPREGNATED TEFLON
42.	Gland	DUPLEX S.S –ASTM-A890,GR.4A(UNS-J92205)
43.	Strainer	DUPLEX S.S-ASTM-A276 (UNS-S31803) (BASKET TYPE)
44.	Fasteners	SS-316L
45.	Sole Plate	MS (IS – 2062) (EPOXY COATED)
46.	Bearings	Antifriction (SKF/FAG)

NOTE:

1) **Inspection & Testing shall be as per approved QAP.**

CALCULATION FOR BOWL HEAD

1. Pump Model-7000/7M-4Stage/1445 RPM

Flow at Duty Point = 20 M^3/Hr.

Total Head = 20 Meters

Column Pipe Diameter / Discharge size = 100 MM

Column length = 4.677 Meters

Suction Bell diameter =178 MM

Shaft Diameter = 25.4 MM

Speed =1445 RPM

No of Stage =4 Stage

Bowl Effieciency= 70%

A) Entry Losses

Velocity at Bell Mouth = Q/A = (20/3600) x (4/(π x 0.178^2))

= 0.223 m/sec.

Velocity Head = $V^2/2g = 0.223^2/ (2 \times 9.81)$ = 0.00253 Meters

Entry Loss = 10% of Velocity Head (As per our standard Practice)

= 0.000253 Meters

B) Column Pipe Losses

As per Column friction loss chart (F_c) = 3.3 Mtr. / 100 Mtr. of pipe

Column loss at duty point = F_c x Column length/100

= (3.3 x 4.677/100)

= 0.1543 Meters

C) Discharge Elbow Losses

As per HIS table 33 (First Edition) Resistance Coefficient for Bend (k) = 0.27

Velocity at Discharge point = Q/A = (20/3600) x (4/(π x 0.100^2)

= 0.707 m/sec.

Velocity Head = $V^2/2g = 0.707^2/(2 \times 9.81)$ = 0.0255Meter

Discharge Elbow Loss = k x velocity head

= 0.27 x 0.0255

= 0.006885 Meters

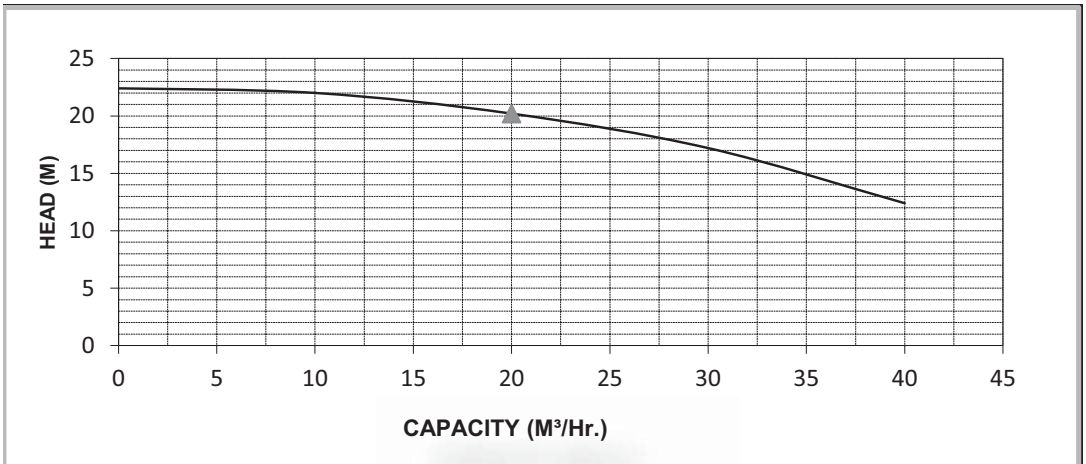
Total Losses = A + B + C = 0.000253 + 0.1543 + 0.006885 = 0.161 Meters

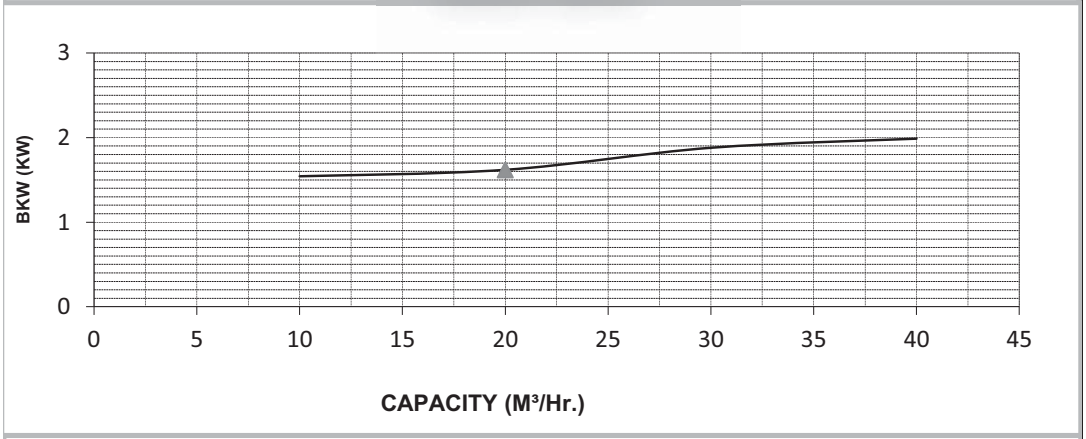
Bowl Head = Total Head + Total Losses

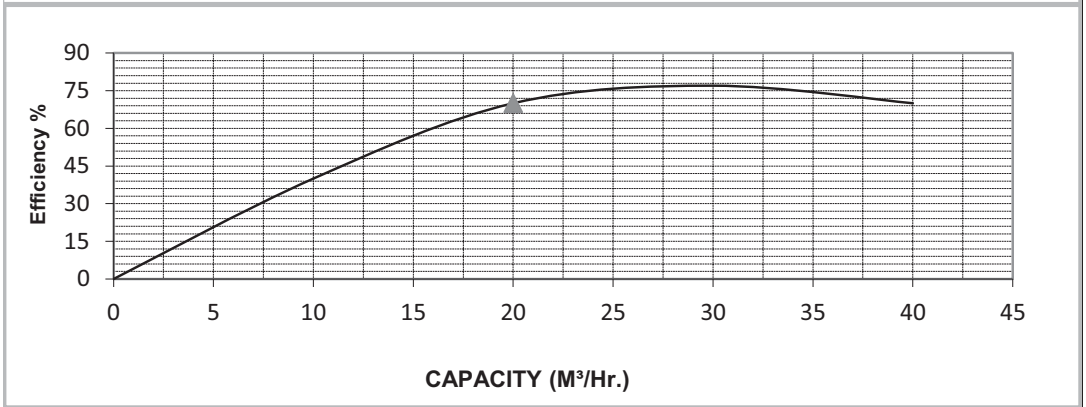
= 20 + 0.161

= 20.161 Meters ≈ **20.2 Meters**

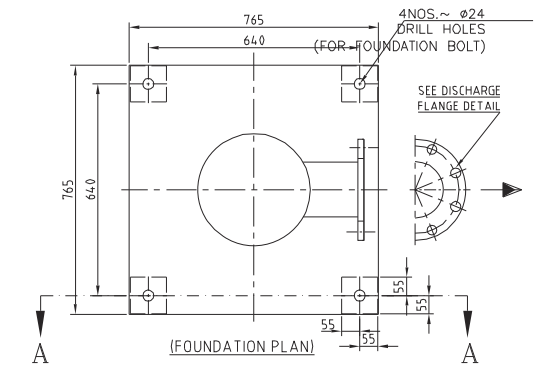
PERFORMANCE CURVE

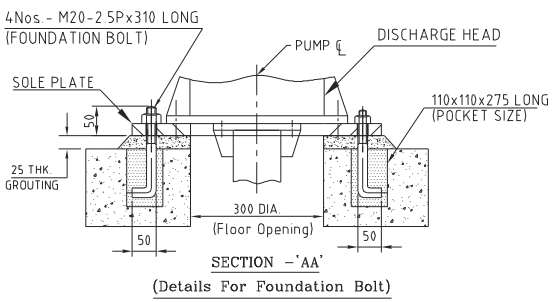






CUSTOMER : Clear Water Limited.				**GUARDENING PUMP**	
PROJECT - TANGEDCO-ENNORE STPP				**Work order**	**SALE19023985-10**
CAPACITY	**20**	**M³/Hr.**		**Model**	**7 M / 4 STG. / OIL**
HEAD	**20.2**	**Mtrs**		**Pump Input**	**1.62 KW**
SOH	**22.4**	**Mtrs**		**Speed**	**1435 rpm**
Efficiency	**70**	**%**		**RATING**	**2.2 KW / 4 P /VSS**





THE CIVIL DETAILS SHOWN HERE ARE ONLY FOR GUIDELINE & SHOULD BE FINALIZED AT CUSTOMER END.

GROUTING PRECAUTIONS

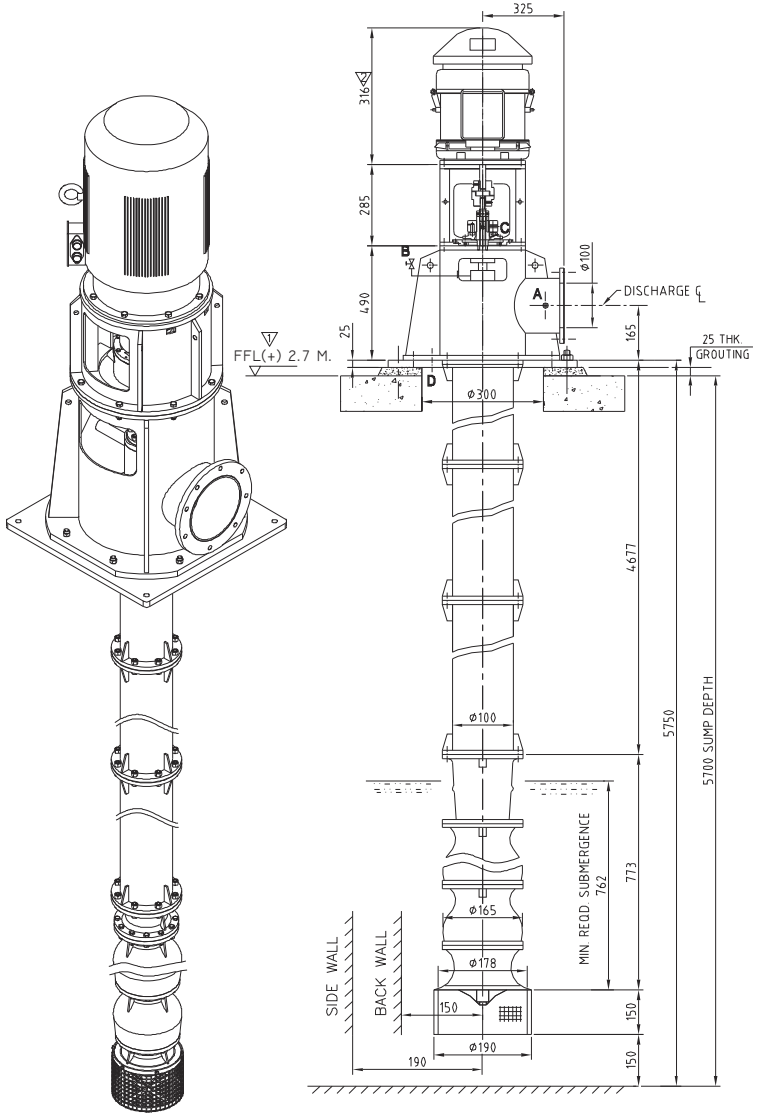
1. WHILE PREPARING POCKET TAKE CARE THAT MOTHER CONCRETE DOES NOT ENTER INTO THE FOUNDATION BOLT CAVITY.
2. BEFORE FINAL GROUTING PREPARE SURFACE BY CHIPPING MOTHER CONCRETE.
3. ENSURE THAT SOLE PLATE IS LEVELED TO REQUIRED ACCURACY BEFORE POURING THE FINAL GROUT.
4. GIVE PROPER SUPPORT WITH HELP OF TAPER WEDGES, SO THAT THE ALIGNMENT IS NOT DISTURBED DUE TO CONCRETE WEIGHT WHILE POURING.
5. ENSURE THAT NO AIR POCKETS ARE FORMED UNDER THE SOLE PLATE WHILE POURING THE FINAL GROUT.
6. BEFORE POURING GROUT, TAKE CARE THAT THE CHIPPED SURFACE DOES NOT COME IN CONTACT WITH OIL OR GREASE.
7. TOP MACHINE FACE OF FOUNDATION PLATE OF PUMP SHALL BE LEVELLED 0.05 MM / METER BEFORE CONCRETING.
8. CEMENT GRADE SHALL BE GP2

SCHEDULE OF CONNECTIONS:-

NO.	SIZE IN	DESCRIPTION
A	3/8" B.S.P.	DELIVERY PRESSURE GAUGE
B	1" B.S.P.	AIR VENT
C	1/8" B.S.P.	GREASE NIPPLE CONNECTION
D	1" B.S.P.	GLAND WATER DRAIN

DIRECTION OF ROTATION COUNTER CLOCKWISE WHEN LOOKING FROM TOP.

(CHECK DIRECTION OF ROTATION IN DECOUPLED CONDITION)



PUMP PARTICULARS		MOTOR PARTICULARS	
PUMP Q.TY.	TWO	RATING	2.2 KW
FIGURE	7000	SPEED	1435 RPM (FLS) ▽
PUMP SIZE	7M	MAKE	A.B.B. ▽
STAGE	FOUR	FRAME	M2BAX100LA4 ▽
PUMP SPEED	1435 RPM ▽	PHASE	THREE
DISCHARGE	20 M^3/HR.	VOLTAGE	415
BOWL HEAD	20.2 MTRS.	FREQUENCY	50 Hz.
BOWL EFF.	70%	TYPE	VERTICAL-SOLID SHAFT
BOWL INPUT.	1.62 KW		
SP. GRAVITY	1.03		
LUBRICATION	OIL		

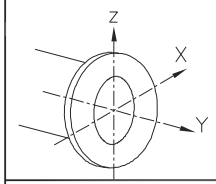
LOAD DETAIL:-

1. PUMP WEIGHT :– 1200 Kgs.(Approx)
2. WEIGHT OF MOTOR :– 31 Kgs.(Approx)
3. DYNAMIC LOAD OF PUMP & MOTOR SET :– 1600 Kgs.(Approx)

DETAILS OF DISCHARGE FLANGE:–
(AS PER IS–ANSI–B–16.5, 150 LBS) (100 NB)

OUTER DIA.	228.6
PITCH CIRCLE DIA.	190.5
NO. OF HOLES	08
DIA. OF HOLES	19
THICKNESS	25

MAX. ALLOWABLE DISCH. NOZZLE LOADS



FORCES N		
FX	FY	FZ
2228	2487	2005
MOMENTS N–M.		
MX	MY	MZ
1238	743	941

NOTE:–

1. DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. PUMP TO BE STARTED WITH DEL. VALVE IN CLOSED CONDITION.
3. ENSURE THAT AIR IS VENTED OUT FROM PUMP COLUMN IMMEDIATELY AFTER STARTING.
4. ▽ ''EL 0.00 M CORRESPONDS TO RL 10.00 WHICH IS FFL OF TG BUILDING.
5. ▽ OIL LUBRICATION TANK CAPACITY :– 1.75 LTR.
6. ▽ ELECTRICAL CONNECTION B/W MOTOR SOLENOID VALVE.

▽ DRAWING NO. :- PE-V0-412-164-A005

FLOWMORE PUMPS **FLOWMORE LIMITED.**

JOB NAME :- GUARDENING PUMP

CLIENT :- M/s. CLEAR WATER LIMITED

PROJECT :- 2 X 660 MW ENNORE SEZ STPP

CLIENT ORDER NO.:- 142/17-04M(82), DT:- 23-Feb-2019

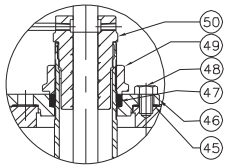
	NAME	SIGN	DATE
DRAWN	PRITAM		15.03.2019
CHECKED	RAKESH		15.03.2019
APPROVED	P.K.S.		15.03.2019

TITLE: GENERAL ARRANGEMENT DRG. FOR VERTICAL TURBINE PUMP

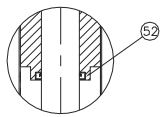
SCALE N.T.S. | SHEET 1 OF 1

DRG. No. GA-SALE19023985 10 | SIZE A4 | REV. 02

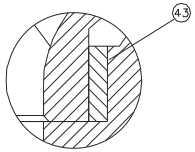
REV.	DATE	PREPARED	CHKD.	APPROVED	REVISIONS
2	05.09.2020	MANOJ	RAKESH	P.K.S.	MOTOR MAKE CHANGED
1	07.05.2019	PRITAM	RAKESH	P.K.S.	DETAILS ADDED.
0	15.03.2019	PRITAM	RAKESH	P.K.S.	FIRST SUBMISSION



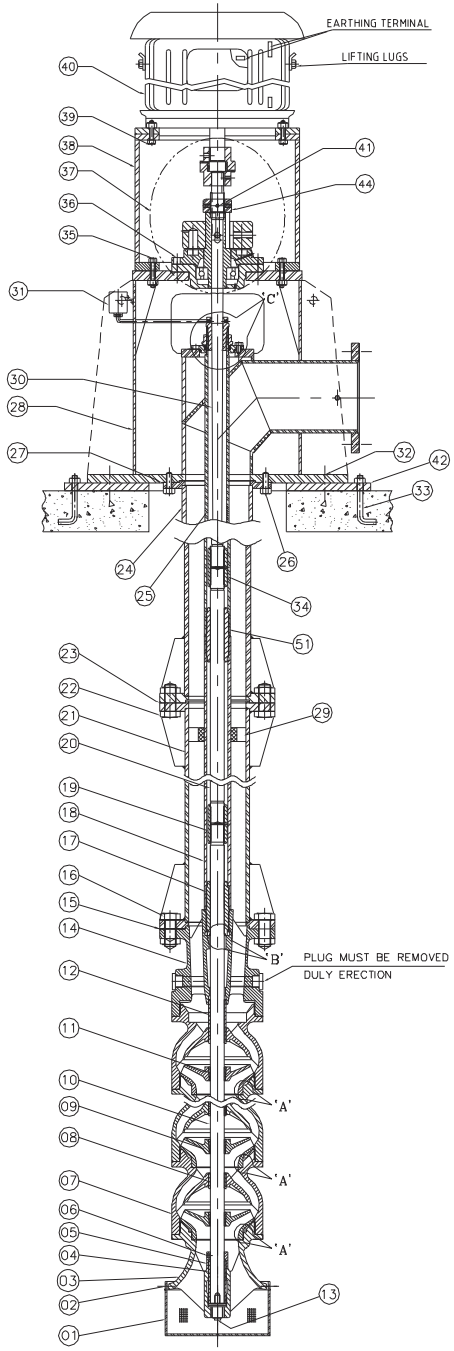
DETAIL–'C'
(BRG. & CAP Assy. Details)



DETAIL–'B'



DETAIL–'A'



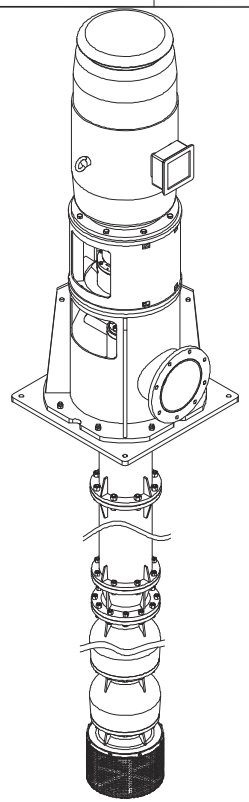
NOTE:–
* DULPLEX S.S.–ASTM–A240/A790 (UNS S31803) (DISCHARGE ELBOW) & OTHER M.S. (IS–2062) WITH EPOXY COATING PAINTING OUTSIDE & GLASS COATING/ PU COATING INSIDE

S.NO.	DESCRIPTION	QTY.	MATL.
52	OIL SEAL	01	NITRILE RUBBER
51	CONNECTOR BEARING	03	BRONZE (IS–318, LTB–V)
50	BRG. & CAP	01	BRONZE (IS–318, LTB–V)
49	T.T. NUT	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
48	HX. HD. CAP SCREW	06	S.S.–316L ▽
47	PACKING PCS.	01	IMPREGNATED TEFLON
46	ENCL. TUBE HEAD ADOPTER	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
45	GASKET	01	WIRE REINFORCED RUBBER
44	ADJUSTING NUT	01	S.S.–316–ASTM–A276
43	BOWL WEARING RING	04	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
42	SOLE PLATE	01	M.S. (IS–2062) EPOXY COATED
41	ALLEN SET SCREW	01	S.S.–316L ▽
40	MOTOR	01	A.B.B.–MAKE ▽
39	HX. HD. BOLT WITH NUT	04	S.S.–316L ▽
38	MOTOR STOOL	01	M.S. (IS–2062)
37	THRUST STAND ASSY.	01	SEE DRG. NO. TSA–SALE19023985 10
36	HX. HD. BOLT WITH NUT	08	S.S.–316L ▽
35	HX. HD. BOLT WITH NUT	04	S.S.–316L ▽
34	LINE SHAFT COUPLING	03	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
33	FOUNDATION BOLT WITH NUT (L–TYPE)	04	MILD STEEL
32	STUD BOLT WITH NUT	04	S.S.–316L ▽
31	OIL TANK	01	ALUMINIUM
30	TOP SHAFT	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
29	SPIDER	03	NITRILE RUBBER
28	SURFACE DISCH. HEAD	01	SEE NOTE *
27	GASKET	01	WIRE REINFORCED RUBBER
26	HX. HD. CAP SCREW	08	S.S.–316L ▽
25	TOP ENCL. TUBE	01	DUPLEX S.S.–ASTM–A789 (UNS–S31803)
24	FLGD. TOP COL. PIPE	01	DUPLEX S.S.–ASTM–A790/A240 (UNS–S31803)
23	GASKET	01	WIRE REINFORCED RUBBER
22	HX. HD. BOLT WITH NUT	24	S.S.–316L ▽
21	FLANGE COL. PIPE	03	DUPLEX S.S.–ASTM–A790/A240 (UNS–S31803)
20	LINE SHAFT	03	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
19	PUMP SHAFT COUPLING	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
18	ENCL. TUBE	03	DUPLEX S.S.–ASTM–A789 (UNS–S31803)
17	STEP BEARING/CONNECTOR BRG.	01	BRONZE (IS–318, LTB–V)
16	HX. HD. BOLT WITH NUT	08	S.S.–316L ▽
15	GASKET	01	WIRE REINFORCED RUBBER
14	FLGD. DISCH. CASE	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
13	PLUG For Disch. Case	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
12	TOP INTER BOWL BEARING	01	BRONZE (IS–318, LTB–V)
11	IMPELLER LOCK COLLET	04	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
10	PUMP SHAFT	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)
09	IMPELLER	04	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
08	INTER BOWL BEARING	03	BRONZE (IS–318, LTB–V)
07	INTER BOWL	04	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
06	ALLEN SET SCREW	02	S.S.–316L ▽
05	SAND CAP	01	S.S.–AISI–316
04	BEARING SUCTION	01	BRONZE (IS–318, LTB–V)
03	SUCTION BELL	01	DUPLEX S.S.–ASTM–A890,GR.4A(UNS–J92205)
02	HX. HD. CAP SCREW	06	S.S.–316L ▽
01	STRAINER (BASKET TYPE)	01	DUPLEX S.S.–ASTM–A276–(UNS–S31803)

REV. NO.	REVISION	DRN. BY	CHD. BY	APPD. BY	DATE
2	MOTOR MAKE CHANGED	MANOJ	RAKESH	P.K.S	05.09.2020
1	FASTENERS MATL. CHANGED	PRITAM	RAKESH	P.K.S	07.05.2019
0	FIRST SUBMISSION	PRITAM	RAKESH	P.K.S	15.03.2019

PUMP PARTICULARS

NO. OF PUMP	TWO
FIGURE	7000
MODEL	7M
STAGE	FOUR
LUBRICATION	OIL



▽ DRAWING NO.:- PE-V0-412-164-A005

FLOWMORE PUMPS **FLOWMORE LIMITED.**

JOB NAME :- GUARDENING PUMP

CLIENT :- M/s. CLEAR WATER LIMITED

PROJECT :- 2 X 660 MW ENNORE SEZ STPP

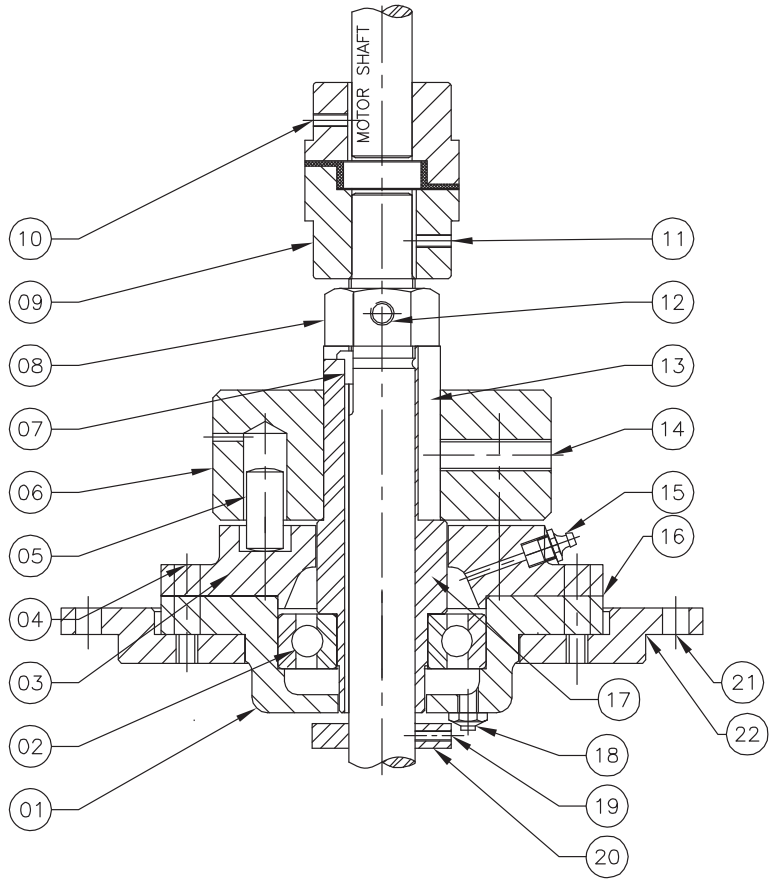
CLIENT ORDER NO.:- 142/17-04M(82), DT:- 23-Feb-2019

	NAME	SIGN	DATE
DRAWN	PRITAM		15.03.2019
CHECKED	RAKESH		15.03.2019
APPROVED	P.K.S.		15.03.2019

TITLE: CROSS–SECTIONAL AND PART LIST VERTICAL TURBINE PUMP

SCALE N.T.S. | SHEET 1 OF 1

DRG. No. CSD-SALE19023985-10 | SIZE A4 | REV. 02



S. NO.	DESCRIPTION	QTY.	MATERIAL
22	ADOPTER PLATE	1	M.S.(IS-2062)
21	HEX. HD. BOLT WITH NUT	4	S.S.-316-ASTM-A193/A194,GR. B8M
20	SHAFT COLLAR	1	BRONZE(IS-318,LTB-V)
19	ALLEN SET SCREW	2	S.S.-316-ASTM-A193, GR. B8M
18	DRAIN PLUG	1	STEEL
17	THRUST HUB	1	CAST STEEL(IS-1030)
19	ALLEN SET SCREW	2	S.S.-316-ASTM-A193, GR. B8M
18	GREASE RELIEF FITTING	1	STEEL
17	THRUST HUB	1	CAST STEEL(IS-1030)
16	GASKET (For Mounting Cover to Hsg.)	1	OIL PROOF PAPER
15	GREASE RELEASE FITTING	1	STEEL
14	ALLEN SET SCREW	2	S.S.-316-ASTM-A193, GR. B8M
13	STRAIGHT KEY	1	M.S.
12	ALLEN SET SCREW	1	S.S.-316-ASTM-A193, GR. B8M
11	ALLEN SET SCREW	2	S.S.-316-ASTM-A193, GR. B8M
10	ALLEN SET SCREW	2	S.S.-316-ASTM-A193, GR. B8M
9	FLEXIBLE JAW TYPE COUPLING	1	C.I. (IS-210,FG-260)
8	ADJUSTING NUT	1	S.S.-316-ASTM-A276
7	GIB KEY	1	EN-8
6	LOWER COUPLING HALF	1	CAST STEEL(IS-1030)
5	RATCHET PIN	3	C.S. (H)
4	HEX. HD. CAP SCREW	8	S.S.-316-ASTM-A193, GR. B8M
3	MOUNTING COVER (RATCHET PLATE)	1	CAST STEEL (IS-1030)
2	ANTI-FRICTION BEARING	1	BRG. STEEL (SKG/FAG)
1	THRUST BEARING HOUSING	1	C.I. (IS-210,FG-260)

NOTE:-

- SHAFT COLLAR TO BE FITTED ON SHAFT JUST BELOW THE BRG. HOUSING AT A RUNNING CLEARANCE OF 0.30 TO 0.50 mm.
- SHAFT COLLAR TO BE LOCKED AFTER ADJUSTING AXIAL CLEARANCE OF IMPELLER.
- PUT SOME GREASE BETWEEN BRG. HOUSING TO COLLAR.

PLEASE READ THIS DRG. WITH DRG. NO. CSD/SALE19023985 10

REV. NO.	REVISION	DRN. BY	CHD. BY	APPD. BY	DATE
0	FIRST SUBMISSION	PRITAM	RAKESH	P.K.S	15.03.2018

FLOWMORE PUMPS

FLOWMORE LIMITED.
NEW DELHI.

JOB NAME :- GUARDENING PUMP

CLIENT :- M/s. CLEAR WATER LIMITED

PROJECT :- 2 X 660 MW ENNORE SEZ STPP

CLIENT ORDER NO.:- 142/17-04M(82), DT:- 23-Feb-2019

	NAME	SIGN	DATE
DRAWN	PRITAM		15.03.2019
CHECKED	RAKESH		15.03.2019
APPROVED	P.K.S.		15.03.2019

TITLE: THRUST STAND ASSY. & PART LIST FOR VERTICAL TURBINE PUMP

SCALE N.T.S.

SHEET 1 OF 1

DRG. No. TSA-SALE19023985-10

SIZE A4

REV. 00

PAINTING PROCEDURE
(ANNEXURE-C)

CHAPTER - 6

PAINTING

1.0 SCOPE

This section defines the technical requirements for surface preparation, selection and application of paints on equipment, vessels, machinery, piping, ducts etc. However, manufacturers shall follow their standard procedures for painting their equipment. The bidder shall submit a detailed painting procedure for approval of owner/ owner's representative after the award of contract.

The following surface and material shall require painting:

a. All un-insulated carbon steel and alloy steel equipment like columns, vessels, storage tanks, pumps, heat exchangers etc.
b. All un-insulated carbon steel and low alloy piping, fitting and valves (including painting of identification marks).
c. All pipe structural steel supports, walkways, platforms, handrails, ladders etc.

The following surfaces and materials shall not require painting :

a. Non-ferrous materials
b. Austentic stainless steel
c. Plastic and / or plastic coated materials
d. Insulated surface of equipment and pipes except color coating wherever required.
e. Painted equipment like blowers, pumps, valves etc. with finishing coats in good condition and with matching color code.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job :

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)

IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:158	:	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS:2932	:	Enamel Synthetic exterior (a) Undercoating (b) finishing
IS:4682	:	Code of practice for lining of vessels & equipment
SIS 559000	:	Swedish standard for blasting
ISO 8504-2	:	Preparation of steel substrates before application of paints and related products. Surface preparation methods Part 2 Abrasive blast cleaning
ISO 8501-1	:	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1 : Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
SIS 05 5800	:	Surface preparation by acid pickling
SSPC SP08	:	Surface preparation by acid pickling
IS 2629	:	Recommended practice for hot dip galvanizing of iron and steel
ASTM A780	:	Standard practice for repair of damaged galvanized coatings
SSPC	:	Steel structures painting council
NACE	:	National association of Corrosion Engineers
DIN	:	Deutsehes Institute for Normung
BS	:	British Standard
ASTM	:	American Society for Testing material
AWWA	:	American Water works association

3.0 SURFACE PREPARATION

The surface shall be prepared in a manner suitable for coatings. Chemical derusters or rust converters shall not be applied. Acid cleaning is subject to approval of Purchaser/ Purchaser's representative.

3.1 BLASTING

The surface of the part/ component shall be blasted before the coating material is applied.

Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air above 1100C. Blasting activity shall be performed at temperatures 30C above due point and substrata temperature between 50C & 500C and relative humidity not exceeding 85% shall be maintained during painting. Necessary safety precautions for equipment and operator shall be adhered to and shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work.

Abrasive used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives are chilled iron grit, shot steel, malleable iron grit and shots of non metallic abrasive (aluminum oxide, copper slag, garnet etc.).
The grade of blasting shall be performed in line with the approved painting scheme.
The nature, quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the required surface profile depth and cleanliness.
Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and commencement pf painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

The grades of surface finish

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial Blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting
(a) Blasting according to SIS 055900, Grade Sa 2½

Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer coat shall be 15-25 µm.

3.2 Manual Rust Removal

Manual rust removal shall be allowed for welded zones and for touching up installed components.

3.3 Cleaning

Removal of impurity

	Impurity	Removal
a)	Dust, Loose deposits	Vacuum cleaning, brushing
b)	Adhesive deposits	Power brushing
c)	Oils, greasy impurities	Wet Blasting, Use of Detergent Additives by agreement
d)	Salt deposits	Rinsing
e)	Markings (eg felt up pen)	Organic solvents to manufacturer's specifications eg Trichloro trifluoro ethane and solvents containing acetone (renew solvent and rag frequently)

3.4 Acid Pickling

Prior to galvanizing the surface preparation shall be done by acid pickling as per SSPC-SP-08.

4.0 PROCESSING

4.1 General
Application Conditions

The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature shall be + 5^0C and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3^0C above dew point.

4.2 Application Procedure

The primer shall be applied by means of brush or by spary. The top coats shall be applied by means of brush, roller or spray.

At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed.

4.3 Touching Up

Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning according coating manufacturers specification. The final top shall be reapplies completely.

4.4 Uncoated Surfaces

Moving parts of machines (e.g stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating upto a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.

4.5 Bond Strength

The pill off stress determined using the pull off test method for adhesion shall not be less than 1.5 N/mm2, according to ISO 4624.

5.0 SURFACE CONDITIONS OF COATING SURFACES

The coating surface shall have a uniform film thickness, shade and gloss and shall be free from inclusions, sags and wrinkles.

6.0 COATING SYSTEMS

6.1 General Requirements for Coating Systems

Coating materials according to SSPC, BS 5493 or DIN 55 928 shall be used. Intermediate coats are to be pigmented with micaceous iron oxide. The materials shall be matched with each other so that they are compatible. Coatings deviating this

specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.

The colour and gloss of top coats shall be in accordance with sub clause suggested colour codes for painting (Sub Clause 6.8)

6.2 Standard Coating System (External Coatings)

(a) Steel Surfaces

(i) All steel structures shall receive two primer coats and two sandwich coat of MIO Epoxy paint and one finish coat of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two intermediate coats and one finished coat shall also be applied after erection.

(ii) Steel surface which is to be painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted as explained in clause 3.1 to Sa 2½ finish as per SIS05-5900. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer shall be 60 microns.

(iii) Two intermediate MIO Epoxy paint, and one top polyurethane coating of approved brand shall be applied. Dry film thickness of each intermediate coat shall be 90 microns and top polyurethane coating shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 330 microns. All paints shall be of approved brand and shade as per owner's requirement.

(iv) Joints to be site welded shall have weldable primer applied within 100 mm of welding zone. Similarly where friction grip fasteners are to be used removable anti corrosive coating shall be provided. On completion of the joint the surfaces shall receive the paint as specified.

(v) Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams, supporting gratings or chequered plate shall receive one additional coat of finish paint over the above number of coats specified before erection. Portion of steel member embedded/ to be encased in concrete shall not be painted.

(b) Gratings and Step Threads

(i) Surface Preparation

Gratings and step threads shall be cleared by acid pickling as per SSPC-SP-08

(ii) Hot Dip galvanizing

The hot dip galvanizing shall be done as per IS 2629. The average mass of coating shall be 610 gm/m2.

(iii) Post Treatment

Immediately after galvanizing post treatment such as chromating shall be applied to retard white rust attack.

(iv) Touch up mechanical damages

The repair of damages coatings shall be done as per the recommended practice ASTM A780.

6.3 Painting of Indoor components such as valves, pumps, motors, electrical parts, tanks etc.

At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry fim thickness 75µm.

At Site

Thorough cleaning to remove oil, grease, dirt and any other contaminants. Derusting of all mechanical damages according to SIS 055900 Grade ST3. Touch up with dry film thickness 50 µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 30-40 microns DFT each coat in approved shades.

Remarks

Equipment coated with a standard application system can be accepted if the quality of this application system is corresponding with the quality of the above mentioned system.

6.4 Painting of Outdoor equipment (external surfaces) such as piping, valves, pumps, motors, electrical parts, tanks etc.

Weather exposure, weather resistance, temperature upto 120^0C as per clause 6.1 & 6.3. However

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry fim thickness 75µm.

Intermediate Coat

One (1) layer 2 pack high build epoxy polyamide MIO, DFT 100µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 50 microns DFT each coat in approved shades.

6.5 Special Coating

(a) Parts exposed to temperatures above 120^0C, upto 200^0C, not insulated

(i) At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½ and ISO 8501-1:1958. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry fim thickness 75µm.

(ii) At Site

Pretreatment

Dersuting of all mechanical damages, according to ISO 8501-1:1989, grade St 3 touch up with 1 pack inorganic ethyl zinc silicate, dry film thickness 50µm.

Intermediate Coat

I pack silicon acrylic dry film thickness 35 µm.

Final Coat

1 pack silicon acrylic, dry film thickness as 35µm.
Total system dry film thickness 145µm.
Final coat according to colour code.

(b) **Parts exposed to temperatures above 200^{0}C, upto 400^{0}C, not insulated**

(i) At Works

Surface Preparation

Blasting according to ISO 8501-1:1958 grade Sa-2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm.

(ii) At Site

Pretreatment

Derusting of all mechanical damages, according to standard Sa 2½ to ISO 8501-1:1988. Touch up with coating system according to manufacturer's recommendations.

(c) **Insulated parts continuously exposed to condensing water or parts exposed to temperatures**

For parts that are provided with insulation on site.

(i) **Insulated parts exposed to condensing water**

At Works

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm

(ii) **Insulated parts exposed to temperatures**

Parts exposed to temperatures upto < 400^{0}C

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.

Parts exposed to temperature above 400^0C at works (Steam pipes, pressure tubes and parts for the HRSG, such as heating surfaces, heaters and superheaters, reheaters etc)

Temporary Primer

Varnish

(d) **Intermittent exposure due to condensing water/ chemicals (Indoors)**

(i) At Works

Surface Preparation

Blasting according to Sa 2½ and ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two layers of Zinc phosphate primer, total dry fim thickness 75µm.

(ii) At Site

Pretreatment

Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 50µm.

Total system dry film thickness 205µm.

When exposed o weathering, weather resistance finish coat shall be applied.

(e) **Water Exposure**

(i) At Site/ Works

Pretreatment

Removal of all welding pearls.

Blasting according to Sa 3 to ISO 8501-1:1988

Coat
4 coats 2 pack coal tar epoxy, dry film thickness 125 µm each.

Total system dry film thickness 500µm
Touch up after erection as required.

6.6 Painting of Pipes

6.6.1 Buried Piping

Internal surfaces

(i) Surface cleaning by sand blasting.

(ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.

(iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note : All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

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

External surfaces

(i) Surface cleaning by Sand Blasting.

(ii) Coal tar primer compatible with coal tar enamel grade. The number of coats shall be two with a DFT of 35 microns each.

(iii) Coal tar enamel shall be applied. A single spiral inner wrap of glass fibre tissues shall be applied overlapping at least 25 mm ensuring impregnation of glass fibre tissues in the first coat. The second coat of enamel and second outer wrap of glass fibre felt, Type – I to IS: 7193-1974 will be applied in the same way confirming to Table – 10 of IS – 10221 – 1982.

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

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

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

6.6.2 Overground Piping

Internal surfaces

(i) Surface cleaning by sand blasting.

(ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.

(iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note : All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

External surfaces

(i) Surface cleaning by Sand Blasting.

(ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.

(iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

6.7 Internal Coatings

6.7.1 Tanks (Internal surfaces) as specified in relevant sections of specification

Industrial deionised, demineralised and potable water upto 60^0C pH range 4.5-9.5

Blasting according to Sa 2½ and ISO 8501-1:1988.

Prime Coat

Two layers of Zinc phosphate epoxy primer, total dry fim thickness >75µm.

Pretreatment

Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 150µm per coat.

In case of service or potable water tanks, the coating material selected shall not taint the water. The paint system shall confirm to regulations issued by Food & drug administration/ National Public Health service/ AWWA/ OSHA and comply with applicable laws, regulations, ordinances etc. of the local authority, state or the nation pertains to work.

QA/ QC Procedure including pinhole inspection, shall be submitted for approval by Owner/ Owner's representative.

6.6.2 Rubber Lining of Pipes, Valves and Tanks for DM Water

Pretreatment

Blasting according to Sa 2½ and ISO 8501-1:1988

Rubber Lining

Hard rubber 5 mm for DM water applications as IS – 4682

6.7 **Painting for Electrical items**

6.7.1 All the steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and swarf by pickling, emulsion cleaning etc. The sheet steel shall be phosphate/ oven dried and then painted with two coats of zinc rich primer paint. After application of the primer, two coats of finishing epoxy paint shall be applied. The colour of the finishing coats inside shall be glossy white and exterior of the treated sheet steel shall be shade 631 of IS-5/ RAL 7032 for all switchboard/ MCC/ Distribution boards, control panels etc.

6.7.2 All electrical equipment shall be given tropical and fungicidal treatment and outdoor equipment shall be provided with rain hood to prevent entry of rain water into the equipment.

6.7.3 Painting of I & C equipment : Epoxy coating required for all I & C equipment.

6.8 SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
1.	Structures, platforms, galleries, ladders and handrails	Dark Admirality Grey	632	-	-
2.	Boiler casing, ducting	Nut Brown	413	-	-

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
3.	Crane				
3.1	Crane structure	Golden Yellow	356	Black	-
3.2	Trolley & hook	Crimson	540	-	-
4.	Fans, pumps, motors, compressors	Light Grey	631	-	-
5.	Tanks (without insulation and cladding)				
5.1	Outdoor	Aluminium	-	-	-
5.2	Indoor	Light grey	631	-	-
6.	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
7.	Switchgear	Light grey (Powder coated)		-	-
8.	Control & relay panels	Light grey (Powder coated)	631/70 78 of IS 1650	-	-
9.	Turbines	Light Grey	631	-	-
10.	Generators & Exciter	Light Grey	631	-	-
11.	Transformers	Aluminum	-	-	-
12.	Machinery guards	Signal red	537	-	-
13.	Piping (without insulation and cladding)				
13.1	Water System				
a	Boiler feed	Sea Green	217	-	-

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
b	Condenstae	Sea Green	217	Light Brown	410
c	DM Water	Sea Green	217	Light Orange	557
d	Soft Water	Sea Green	217	French Blue	166
e	Bearing Cooling Water	Sea Green	217	French Blue	166
f	Potable & filtered Water	Sea Green	217	French Blue	166
g	Service and clarified water	Sea Green	217	French Blue	166
h	Cooling water	Sea Green	217	French Blue	166
I	Sea Water	Sea Green	217	White	-
14.	Ash Transmitting Vessels and pipe lines	Aluminium	-	-	
15.	**Air System**				
15.1	Station air	Sky blue	101	-	-
15.2	Control air	Sky blue	101	White	-
16.	**Oil system**				
16.1	Fuel oil	Light brown	410	French	166
16.2	Light oil (HSD)	Light Brown	410	Brilliant green	221
16.3	Lubricating oil	Light brown	410	Light grey	631
16.4	Transformer oil	Light brown	410	Light orange	557
17.	Gas System				
17.1	Carbon dioxide	Canary yellow	309	Light grey	631
17.2	Hydrogen	Canary yellow	309	Signal red	537
18.	Fire services	Fire red	536	-	-
19.	Effluent pipes	Black	-	-	-
20.	Vacuum pipes	Sky blue	101	Black	-

Notes :

1. This colour code basically refers to IS:2379 for piping with necessary modifications

2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

Bidder shall furnish his painting specification to suit corrosive atmosphere of coastal area along with the bid. The specification shall in general be in line with the above requirements.

LIST OF SCHEDULES

SCHEDULE OF PRE-BID CLARIFICATION

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

COMPLIANCE CUM CONFIRMATION SCHEDULE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

a.) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.

b.) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.
QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.
The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder

c.) All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.

d.) The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.

e.) The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).

f.) All sub vendors shall be subject to BHEL/CUSTOMER approval

g.) Any special tools & tackles, if required, shall be in bidder's scope.

h.) Demonstration parameters shall stand valid till the satisfactory completion of demonstration test and its acceptance by BHEL/Customer.

	TITLE *** SCHEDULE OF DECLARATIONS**	**BHEL DOCUMENTS NO.: PE-TS-412-164-A002** VOL III SHEET…….. OF……

*** Bidder shall include this schedule both in technical and Price offers**

DECLARATION

I ……..……certify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated …….. and there is no deviation to the specification.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Biders Company Name …….

Authorised representative's
Signature ……..

Name …….

Bider's Name

The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL