BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET- 632 406.

TECHNICAL SPECIFICATION

FOR

MIXED BED SYSTEM

For Yeramarus Project

00	09.07.13	DBN	P.PALANI	S.KAILASAM	Fresh issue
Rev.No	Date	Prepared	Checked	Approved	Remarks

INDEX

1.0 : SCOPE OF SUPPLY & SERVICES

1.1 The intent of this specification is to cover Design, Engineering, Manufacturing, Shop Testing, Supply, Transportation, Erection and Commissioning and PG (Performance Guarantee) Test. Further, O&M for three months after PG Test (or) based on BHEL notification and handing over of the following systems.

- **DE-GASSER SYSTEM**
- **MIXED BED (MB) SYSTEM**

The scope shall fully cover the requirement of the Design Criteria and Technical requirement of this specification for treating the permeate water from Reverse Osmosis (RO) Desalination Plant to meet the boiler makeup water quality requirement. The scope shall include but not limited to the following

a. 2 x 100% MSRL Degasser tower with internals & accessories (one no. for each RO stream)
b. 4 x 100% (2W + 2S) of Degasser Blower with motor, Air filter box (suction) & accessories, interconnecting piping / ducts and inlet & outlet controls from blowers to degasser tower.
c. 3 x 100% (2W + 1S) MB Unit along with all its accessories & internals.
d. 3 x 100 % (2W+1S) Mixed Bed (MB) feed pumps with drive motors and all accessories.
e. 2 x 100% (1W+1S) MB regeneration Pump with drive motors and all accessories
f. 2 x 100% (1W+1S) MB Blower with drive motors, air connection pipes and all accessories for MB regeneration
g. 2 x 100% Acid Measuring Tank (AMT), 2 x 100% Caustic Dilution Tank (CDT) with agitator, ejector & acc. etc for MB regeneration
h. 3 sets of MB frontal piping along with pneumatic operated diaphragm valves etc.
i. 1 set of interconnecting piping / ducting between all equipment for the system including valves and accessories etc. for auto operation as per P&ID.
j. 1 set of necessary foundation bolts with fasteners for all the equipments.
k. 1 set of Electrical, Controls & Instrumentation as per specification.
l. 1 set of miscellaneous items including fasteners, ladders, common platforms for MB, supports for piping and valves.
m. 1 set of Erection & Commissioning and PG Test (Refer Section 9.0)
n. O&M for three months after PG Test or based on BHEL notification (Refer Section 9.0 : Sl.no. 12)
o. 1 set of Commissioning spares which shall be included in the main supply (refer clause No. 8, 8.1 & 8.2 of specification).

The permeate water from RO 1st stage shall be degasified in the Degasser tower (DGT) and stored in a RCC Degassed water storage tank (DWST). The degassed water shall be pumped by RO 2nd stage feed pump through cartridge filter to the RO-2nd stage RO system and the output from RO Stage-II pumped through mixed bed to meet the **boiler make-up water quality.** Necessary regeneration system shall be included in the MB system package for regeneration of MB resins at specified intervals. **Bulk storage tank & Unloading pumps for chemicals are excluded in the bidder's scope**. P&ID diagram with Legend & Layout for the MB system are enclosed (as referred in secetion-14) for further reference There may be some minor variation in the scope as per the requirement of Smooth & trouble operation of the system / BHEL's customer. System Vendor shall take care of these variations during execution without any additional financial implications to BHEL.

1.1 **Items though not mentioned but needed to make the system complete in all respects as stipulated under these specifications are also to be supplied without any commercial implication unless otherwise specifically excluded.**

1.2 All fasteners are to be of SS 316 only consists of **two washers**, stud/bolt with suitable nut (except foundation bolts).

1.3 It is not the intent to specify all the details of the design & manufacture. However, the equipment shall conform in all respects to high standard of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Engineer / Owner, who will interpret the meaning of drawing & the specification and shall be entitled to reject any work or material, which is not in full accordance herewith.

1.4 General terms & conditions, instructions to the tenderer & other attachments referred to elsewhere are also part of this specification.

1.5 The order of priority of this specification is as follows :
a. Specifications,
b. P&ID drawing and
c. General design requirements

1.6 **Resin supply packing shall be made in drums only**. Resin supply in HDPE bag is not acceptable.

1.7 Bidder shall submit their total shipping list and Quality Plan for BHEL approval well in advance for dispatch clearance. Material should not be dispatched without BHEL clearance.

1.8 Vendor to submit the technical & commercial offer for the complete package with break up as per the following description.

Part-1. Design, Engineering, Manufacturing, shop testing and supply to BHEL stores at site.

Part-2.
i) Collection of materials / equipment from BHEL site stores, transportation to erection spot, erection of the complete Degasser system, MB system, stage clearance, testing, commissioning, trial run & performance guarantee test and handing over.

ii) O&M for three months after PG Test or based on BHEL notification.

Separate order will be released for part – 1 & part – 2 for the successful bidder.

NOTE

1. Successful commissioning means, erection of entire system, trial run / trial operation till achieving the performance both in terms of Quality (including electrical power consumption) and Quantity of output to prove the agreed performance of the system and the system is ready for PG Test. This will be inclusive of regeneration as per the OBR specified, guaranteed consumption of regeneration chemicals, restoration of the system within the time limit as given in the approved data sheet. PG test procedure shall be submitted for BHEL approval after ordering. The PG test will be carried-out as per this procedure only. Once this stage is reached, Vendor will inform to BHEL that they are ready for PG Test. If BHEL Engineer is satisfied in commissioning, PG test can be conducted within 30 days from the date of such notification by Vendor to BHEL and till such time the running of the system to be taken care of by the vendor. Conducting of PG Test shall be the responsibility of the Vendor. Necessary chemicals required for the trial run / trial operation, regeneration till PG Test will be provided by BHEL at free of cost to Vendor. However, the requirement of consumables and chemicals with detailed specification are to be provided well in advance before commissioning by the Vendor to BHEL.

2. *Vendor to quote O&M Charges on monthly basis for O&M of the plant after conducting the PG Test of the system, 30 days notification given by vendor for the readiness to conduct PG test which ever is earlier or based on the notification by BHEL. O&M order will be for a minimum period of 3 months. However, the period of O&M will be extended till the requirement by BHEL. The requirements for O&M viz. Spares, Chemicals and consumable required for the O&M of the system will be provided by BHEL at free of cost to Vendor. However, the requirement of Chemicals & consumable details are to be provided well in advance before commissioning by the Vendor to BHEL.*

2.0: PROJECT INFORMATION

Owner : **Raichur Power Corporation Ltd. Bangalore.**
Project Title : **RPCL- YERAMARUS – 2x800 MW**
Location : **Yeramarus, Raichur District**
(It is situated at about 8 kms from Raichur on the Raichur-Hyderabad State Highway)

Nearest Rly Station : Chicksugar Railway station which is about 2 kms from site

Site office/ Location

Site In charge / PSSR
Bharat Heavy Electricals Ltd,
C/o Yeramarus Thermal Power Station
Raichur Power Corporation Ltd.,
Raichur Industrial Growth Centre, Chiksugar,
Raichur Dist. – 584 134
Karnataka,

3.0 : TECHNICAL REQUIREMENT

3.1 MB PLANT CAPACITY

MB unit shall be capable of producing Boiler Make-up water of required quality using design inlet water quality, specified in this specification, with the **net output capacity of 85 cu.m/hr** per each stream on continuous operation basis. The net output between regeneration (OBR) continuous operation basis shall be **6120 cu. m** in 3 days (72 hrs) for each stream.

a. No of streams of the MB system = 2 Working + 1 stand-by
b. Net output capacity of MB system per Stream = 85 cu.m / hr (Ie. Each mixed bed unit)
c. Net output between regeneration of MB system = 6120 cu.m per stream (Ie. Each mixed bed unit)
d. Net output capacity of MB system with two stream= **170** cu.m / hr

3.2 INLET WATER QUALITY FOR DESIGN OF MB SYSTEM

The inlet water quality to be considered for design is from **2nd** stage (permeate staging) RO system and the analysis is indicated below.

SECOND STAGE RO PERMEATE WATER QUALITY

Sl.No	*Parameters*	*Unit*	*Design*
1	pH		4.8 - 5.2
2	Conductivity	µS./cm	22.0
3	Temperature - Design	deg C	30
	- Min & Max	Deg C	25 & 35
4	Total dissolved Solids	mg/l	12
5	Carbon di Oxide as CO2 - Design	ppm	100 *****
6	Carbon di Oxide as CO2 - Maximum	ppm	120 *****
7	SiO2 as SiO2	ppm	0.4
8	Sodium as Na	ppm	3.0
9	Potassium as K	ppm	0.1
10	Calcium as Ca	ppm	0.6
11	Magnesium as Mg	ppm	0.1
12	Bicarbonate as HCO3	ppm	4.5
13	Chloride as Cl	ppm	3.3
14	Sulphate as SO4	ppm	0.1
15	Nitrate as NO3	ppm	0.2
16	Flouride as F	ppm	0.0

NOTE:

***** The CO2 indicated is at the First stage RO permeate water.
The degasser to strip the CO2 is also included in scope of supply along with Mixed Bed System.

3.3 OUTLET WATER QUALITY:

The plant design should meet the outlet water quality as indicated below.

3.3.1 DEGASSER OUTLET WATER QUALITY

Sl.No	Description	Unit	Values
1	Carbon di Oxide as CO2	ppm	< 5.0 ppm at max flow rate

3.3.2 MIXED BED OUTLET WATER QUALITY

Sl.No	Description	Unit	Values
1	pH		6.8 to 7.2
2	Conductivity at 25 deg C	µS/cm	0.1 max
3	Silica as SiO2	ppm	0.015 max
4	Total Hardness as CaCO3	ppm	Nil
5	Organic matter	ppm	Practically Free (less than 0.2 mg of KmnO4/lt)

4.0: TECHNICAL SPECIFICATION - MECHANICAL

4.1 DESIGN CRITERIA

The Mixed Bed (MB) unit shall be of **automatic operation** (but, incase of regeneration, initiation shall be done manually and sequence of operation shall be automatic). The RO Stage -1 permeate water supplied from Desalination Plant shall be treated in Degasser System comprising of 2 x 100 % Degasser Tower (one no for each steam) and 4(2W+2S) x 100% Degasser Blowers. The degassed water shall be collected in a degassed water storage tank (RCC-200cu.m not in Bidder scope). The degasser tower shall be mounted on the degasser water storage tank.

As the feed water to the degasser will be directly connected from the membrane permeate outlet-having limitations of backpressures (1.0 bar maximum), bidders have to limit the degasser tower **height to less than 3 meters.**

The Degassed water shall be pumped to RO Stage-2 and the RO permeate is collected in RO stage-2 Permeate storage tank (RO stage -2 complete system not in bidder scope). The permeate from RO Stage- 2 Permeate storage tank is to be pumped through MB Feed pumps (2W+1S) to 3- streams of MB Unit. The MB unit shall be sized to meet the guaranteed output quality and quantity as called for in the specification.

A regeneration system shall be included in the design to regenerate the three Mixed Bed units. It shall consist of regeneration pumps (1W+1S) and two Nos. of AMT (1W+1S) & 2 Nos. of CDT (1W+1S) chemical tanks (measuring tanks), ejectors and MB regeneration blowers (1W+1S) along with required accessories and separately CPVC Sch. 80 piping for acid and alkali from bulk storage tank outlet (pipe routing about 85 meter distance : refer attached terminal point detail drawing). The design shall take care to terminate regeneration effluent and all drains of the MB plant at a common trench at outside of building.

Necessary piping, pneumatic and manual operated valves, impulse tubing & accessories, instrument air line distribution for POV's, cabling between junction box to respective instruments / equipment's thro' cable trays, pneumatic operated diaphragm valves, limit switches, instruments, controls & Interlocks shall be provided in the system for auto operation and also as per the preliminary P&ID drawing enclosed along with this specification.

The details of the equipment / system are elaborated in respective section of this specification.

4.2 TERMINAL POINTS:

Scope and terminal point details are indicated in the enclosed drawings, P & ID : No : 1-WT-220-00248 Rev.00 and MB system Layout: 2-WT-220-00064 with this specification.

a. Feed water (RO permeate – 1st stage) will be supplied by the customer (BHEL) at the inlet nozzle flange of degasser tower 200NB flange.

b. One suction nozzle (flooded) with flange (ANSI B 16.5, 150 class) of 250NB will be provided at RO 2nd stage permeate water storage tank (RCC). Further interconnecting piping, valves, fasteners (bolt, nut with two washers), instrumentation, etc., from this flange to MB Feed Pumps system will be in vendor's scope. Vendor shall study the preliminary layout and P&ID drawings and consider sufficient length of piping with reserve (approximate distance: 10 meter) and from pump delivery to MB vessel inlet common header the approximate distance is 100 meter.

c. Outlet DM water piping from MB (3 Nos.)system shall be terminated by the vendor at a common point, with flanged end with dummy flanges and fasteners nearer to the DM water storage tank (at a distance of 25 meter approximately from MB system common outlet header : refer layout terminal details). **The common outlet pipe size shall be of 200 NB (min), schedule 10, SS 316L (after PA BFV as per P&ID) and the required outlet pressure is 2 bar (g).** Further piping to DM water tank is under BHEL's scope**.**

d. The MB regeneration pumps location is away from MB system(suction line 10 meter and delivery line 150 meter approximately). Hence vendor to consider additional 1 bar (g) as extra head over and above the calculated regeneration pump discharge head requirement by considering the above distance. Two suction nozzles (150 NB) with flange & flooded suction at common header pipe will be made available at DM water transfer pump house wall. Necessary interconnection suction / re-circulation & discharge piping of MOC- MSRL from pump delivery flange to respective AMT/CDT & power water for the regeneration system including, valves, instrumentation, piping supports etc to the MB system are in bidder's scope.

e. All drains from MB vessel to be connected to N-pit drain trench outside the building at a distance of 5 meter from the center of the vessel.

f. Required instrument air piping with an isolation valve will be made available by BHEL at one common point near the MB system building boundary. Bidder shall indicate the requirement of the instrument air with quantity and pressure in their offer.

g. The required chemicals (HCl & NaOH) for MB regeneration will be made available at bulk storage tank which is about 115 m distance approximately. Vendor shall verify the actual distance from the drawing and provide necessary reserve for execution. Piping from Bulk storage tank to AMT/CDT and then to the MB system with suitable isolation valves wherever required shall be in the bidder's scope. Technical grade Hydrochloric Acid (HCl) 30 to 33% conc. as per IS-265 and Rayon grade Sodium Hydroxide (NaOH) lye 48% conc. alone will be provided by the purchaser for MB regeneration chemical requirement. Bidder shall indicate the requirement of these chemicals in their offer.

h. Necessary civil works like equipment foundation with pockets, acid resistant tiling in the AMT, CDT area, trenches etc., are excluded from the bidder's scope. However bidder shall provide the details in their offer. All necessary foundation bolts for all equipment, such as MB unit, Degasser towers, blowers, pumps, AMT/CDT, etc., and grouting with suitable grouting mixture for the same will be in the scope of the vendor.

i. Mixed bed regeneration effluent and drain etc. shall be terminated separately by bidder in the acid resistant tiled RCC trenches outside the building. Further disposal will be done by BHEL by gravity.

j. EC&I items shall be as per the ROS:4053 Rev.00 .

k. Electrical power supply from the control panel will be provided by the purchaser at the terminal block of each drive motor. Bidder has to provide the list of drive rating along with the bid. **Terminal blocks with cable gland** are in bidder's scope and the cable gland & lugs shall be dispatched as a separate item in a box with separate packing list. A separate site acknowledgement is to be obtained for the same.

4.3 EQUIPMENT SPECIFICATION - Mechanical

The technical requirements of the equipments are indicated below. In addition, the applicable P&ID and Layout enclosed with this specification shall be referred.

4.3. 1 DEGASSER TOWER

a.	Application	: To reduce CARBON DI OXIDE level. in the RO permeate water.
b.	Quantity	: **2 x 100%**
c.	Operation	: Continuous.
d.	Installation	: Mounted on the top of Degassed water storage tank.
e.	Type	: Vertical tower type & forced draught.
f.	Inlet water flow	: **105** m3/hr (min)
g.	Air to water ratio	: 25 m3/m3 (min)
h.	Specific Velocity of water	: 60 m3/hr/m2 (max)
i.	DGT air vent velocity	: 6 m/sec (max)
j.	Shell thickness & Height	: 6.0 mm & approx. 3.0 m
k.	Packing height	: 2.0 m (min)
l.	Material of Construction- Tower	: IS-2062 Gr-A.
	-Rasching Ring	: Polypropylene.
	- Grid	: FRP
m.	Internal protection	: Rubber lining 4.5 mm thick as per IS 4682 & shore hardness 65 ± 5 Gr.A
n.	Inlet design water quality	: As per section 3.2 for Maximum CO2 level
o.	Guaranteed Outlet water quality	: As per section 3.3
p.	Degasser inlet nozzle Elevation	: **7** meter maximum from Ground Level.
q.	Design Code	: IS 803

4.3.2 DEGASSER BLOWER WITH MOTOR

a.	Application	: To supply air to Degasser Tower
b.	Quantity	: **4x 100 %** (2 Working +2 Standby)
c.	Operation	: Continuous
d.	Type	: Centrifugal,
e.	Installation	: Indoor in MB Building
f.	Flow	: Bidder to Specify
g.	Head	: Bidder to Specify
f.	Accessories	: Air filter box (suction), pressure switch, anti- vibration mountings, ducting piping and flexible discharge connection etc.
h.	MOC - Blower casing & impeller	: MS
i.	- Shaft & Sleeve	: EN 8 /ASTM A 321 & ASTM A276 TP316
j.	Motor	: As per Electrical Spec. eff1 motors.

4.3.3 MIXED BED VESSEL UNIT

a.	Application		: To generate the Boiler make-up water from degassed RO Permeate water.
b.	Quantity		: **3x 100 % (2 W + 1S**)
c.	Type		: Vertical, Cylindrical
d.	Feed water quality		: Degassed water outlet quality in section3.2
e.	MB Outlet quality		: As per Section – 3.3.2
f.	Net guaranteed output,	m3/hr	: **85**
g.	OBR	m3	: **6120** between two successive regeneration
h.	Continuous Operating hours	hrs	: **72** (between two successive regeneration)
i.	Regeneration time	hrs	: 4 (max)
j.	Material		: IS - 2062 Gr. A or equivalent.
k.	Internal protection		: **Rubber lining 4.5 mm** thick (two layers of Thickness -2.2 + 2.3 mm)as per IS 4682 & shore hardness 65 ± 5 Gr. A
l.	Design Code		: IS 2825
m.	Design Pressure		: 6.0 bar (g) minimum.
n.	Test Pressure		: 1.5 times of Design Pressure
o.	Design Temperature		: 65 deg.C
p.	Vessel dia	m	: 2.4 approx(Vendor to specify)
q.	Vessel shell thickness	mm	: as per IS 2825 (or) 10 mm whichever is higher.
r	Vessel dish thickness	mm	: as per IS 2825 (or) 14 mm whichever is higher
s.	Resin bed height		: Minimum **0.5** m for Cation resin, Minimum **1.0** m for Anion resin. However bidder to select increased resin bed height if required to meet the design ionic load.

(For the calculation of resin volume in all ion exchange units, ion exchange vessels sizing etc. 10% (ten percent) deration factor on corrected exchange capacity, as obtained from characteristic curves, shall be considered to provide margin towards ageing of resins). Calculation is to be provided along with offer.

s. Free Board : 100% of bed height

t. Surface flow rate m3/hr/m2 : **> 10 and < 25**

u. Acid available for regeneration : ~ 30% HCl, technical grade as per IS 265

v. Alkali available for regeneration : ~ 48% NaOH rayon grade as per IS 252

w. Resin life : Minimum **3** years for Anion resin &

Minimum **5** years for Cation resin.

x. Attrition loss of resin - Cation : 3% per annum (max)

Anion : 5% per annum (max)

y. Resin type Cation **:** High capacity premium, strongly acidic, sulphonated polystyrene base, Cation exchange resins.

Anion **:** Strongly basic polystyrene base macroporous type-I anion exchange resins. The anion resin shall be able to withstand a Temperature of 60 deg C. **Type –II resin will not be accepted.**

z. Accessories : Necessary Resin traps for normal water outlet and regeneration water outlet, resin removal nozzles (dia 100 NB),distributor nozzles, inlet / outlet / regeneration nozzles, drain, vent, necessary sight glass **(3 nos– MOC of Borosilicate toughened glass**) of clear width not less than 75 mm, for viewing resin level, pneumatic operated valves for automatic operation / regeneration, access ladder with safety cage, handrails at vessel top, two (2 nos) davit type manholes (dia 500 mm size minimum) davit type and an access below the bed plate (ie. strainer on plate) etc.

aa. Support Legs:

Quantity	:	4 Nos
Size	:	Minimum 200 NB pipe, Carbon steel, **Sch 80** pipe with necessary gusset plates for reinforcement.
Base Plate	**:**	~ 350 x 350 x 20 (L x B x thick)

ab. Thinning allowance for dished ends : **2.0 mm**

ac. Corrosion allowance for shell & dish end : **1.5 mm**

ad: All fasteners for vessel internal & sight glass and manholes : **SS 316**

ae. Bottom collector assembly : **Strainer on plate**:
The bottom plate thickness must be minimum of **20 mm** with necessary bottom supports or calculated thickness whichever is higher.

4.3.5 MIXED BED BLOWER WITH MOTOR

a.	Application	: To supply air to MB during regeneration.
b.	Quantity	: **2 x 100 % (1 W + 1S**)
c.	Operation	: Intermittent
d.	Installation	: Indoor near Mixed Bed Building
e.	Type	: Positive displacement -Twin Lobe
g.	Flow	: **540 m3**/hr (min) or higher.
h.	Head	: 0.5 bar (g) (min)
i.	MOC - Blower Casing & Impeller	: CI IS 210 FG 260 or Equivalent
	- Shaft & Sleeve	: EN 8 /ASTM A 321 & ASTM A276 TP316
	- Piping	: MS / MSRL
j.	Motor	: As per Electrical Spec.
k.	Accessories	: Silencers, Non return valve, Pulleys with V belts & guard, Base frame, Pr. Relief valve, Suction filter, pressure gauge, anti-vibration mountings and flexible discharge connection etc.

4.3.6 MIXED BED FEED PUMPS

a.	Application		: To feed water to Mixed Bed units
b.	Quantity		: **3 x 100 %** (2 W + 1S)
c.	Operation		: Continuous
d.	Installation		: Indoor
e.	Type		: Centrifugal, Horizontal
f.	Suction		: From RO Stage-2 Permeate storage tank
g.	Discharge Flow rate ,m3/hr		: Bidder to select with 5% margin minimum.
h.	Discharge head, mWC		: Bidder to select with minimum 10% margin above the requirement. The head requirement to be calculated by considering the losses through resin bed, piping, valves ,orifice etc. in the MB system plus **2 bar (g)** pressure at MB final outlet terminal point.
i.	Speed, rpm		: 1500 (max)
j.	MOC of all wetted parts		:
	Casing		: SS 316
	Impeller		: SS 316
	Shaft		: SS 410 / SS 329
	Shaft sleeve		: SS 316
k.	Shaft Seal		: Mechanical – API plan 11
l.	Coupling		: Flexible coupling (Spacer type) with Guard
m.	Base frame for Pump & Motor mounting	} }	: Carbon steel with epoxy coated.
n.	Bearing		: Anti-friction
o.	All fasteners		: SS316
p.	Motor		: As per Electrical Specification(eff1 motor)

4.3.7 MIXED BED REGENERATION PUMPS

a.	Application	: To supply DM water from DM water storage tank to Mixed Bed system
b.	Quantity	: **2 x 100 %** (1 W + 1S)
c.	Operation	: Intermittent
d.	Installation	: Indoor
e.	Type	: Centrifugal, Horizontal
f.	Suction	: From D.M. Water storage tank
g.	Discharge Flow rate , m3/hr	: Bidder to select with 5% margin
h.	Discharge head, mWC	: Bidder to select with minimum 10 % margin above the head required. The head requirement to be calculated by considering all losses in the MB system plus frictional loss of 150 m pipe segments whichever is higher at MB inlet terminal point.. Bidder to specify the pipe size & pressure rating for all the pipelines & headers.
i.	Speed, rpm	: 3000 (max)
j.	MOC of all wetted parts	:
	Casing	: SS 316
	Impeller	: SS 410 / SS 329
	Shaft	: SS 316
	Shaft sleeve	: SS 316
k.	Shaft Seal	: Mechanical – API plan 11
l.	Coupling	: Flexible coupling (spacer type) with Guard
m.	Base frame for Pump & Motor mounting }	: Carbon steel with epoxy coated.
n.	Bearing	: Anti-friction
o.	All fasteners	: SS 316
p.	Motor	: As per Electrical Spec. eff1 motor

4.3.8 MB REGENERATION SYSTEM: 1 Set consisting of **two Tanks** & accessories

a.	Tanks	:	Acid measuring Tank (AMT) 2nos.	Alakali measuring Tank (CDT)2 nos.
	MOC	:	**IS 2062** with rubber lining	**FRP with PP lining** inside / **MSRL**
	Tank thickness for MS	:	**6.0** mm (min)	-----
	for FRP	:	----	**10** mm (min)
	Fume absorber	:	2 nos.	not applicable

Fume absorber- MOC : FRP /MSRL
(HDPE is not acceptable)

Internal protection : 2 mm thick Vinyl Ester resin for FRP tanks / Rubber lining 4.5 mm thick as per IS 4682, shore hardness 65 ± 5 Gr. A for MSRL tanks.

b. Accessories : Ejectors, piping, valves, mixers & safety showers with eye-wash, Fume absorber for AMT etc.,

Note : **AMT & CDT tank inlet nozzle height is limited to 1.5m due to finalized elevation of Bulk chemical storage tank out let nozzle (Gravity flow).**

4.3.9 PIPING AND VALVES

a. Piping : Refer section 4.5
b. Valves : Refer section 4.6

4.4 GENERAL DESIGN REQUIREMENTS

The common requirements for the system are stated in the general design requirements. However the requirements indicated in the equipment specification section 4.3 shall be strictly complied with.

4.4.1 COMMON REQUIREMENTS FOR ALL SYSTEM:

1. Only latest revision of standard shall be used.

2. The design pressure of pressure vessel shall be minimum 5% higher than the pressure experienced in the system like pump shut-off operation, higher operating pressure at allowable electrical supply variations etc.

3. All the rotating equipments noise level shall be < 85dBA measured at 1 meter distance from the equipment.

4. The tanks coming in contact with corrosive fluids should be rubber lined as indicated in the specification for mechanical equipments.

5. All carbon steel pipelines unless otherwise specified elsewhere-carrying corrosive fluids should be rubber lines inside to a thickness of at least 3.0 mm (2 layers).

6. The design temperature of all vessels shall be taken as minimum **65 deg C**.

7. Sampling connections and air vent at the top most point of piping and vessels shall be provided at all stages of the Unit.

8. The size of the overflow pipes of all storage tanks shall be one size higher than inlet pipe sizes of these tanks.

9. **Motor rating shall be minimum of 116%** of the duty point requirement and also to meet the maximum power requirement over the operating range at 50 Hz frequency.

10. Necessary access to be provided for all manholes & sight glasses.

11. All valves and piping shall be supported suitably & bolted with “U” clamp. The supporting truss must have minimum width of 1.5 time of the pipe diameter and base plate of thick of 12 mm (minimum).

12. Providing of structural supports by supply & fabrication suitably at site for DM water piping from DM water storage tank to MB, regeneration water piping from regeneration pump to MB,AMT/CDT & bulk chemical transfer piping from bulk storage tanks to AMT/CDT are under the scope of bidder.

13. Platforms, walkways & stairways for access to all equipment shall be provided as required.

14. All platforms and stairways shall have minimum clear width of 800 mm. All platforms, stairways, landings etc. shall have railings and guards. Platform for interlinking all vessels with cage-ladders shall be provided for more than one vessel. The ladders & platforms shall have handrails for safe climbing and access.

15. All metallic valves shall be rubber lined

16. All the valves are to be located to facilitate easy accessibility and operation from the ground level.

17. All the pipeline flange fasteners shall be SS316.

18. Vessel Internal supporting cleats shall be of SS316.

19. The direction of Flow shall be indicated by an arrow at regular intervals on all pipelines.

20. All the equipments, valves & other item / component shall be tagged with corresponding KKS number as per PID. KKS number will be informed during execution stage.

21. Name of all vessels, tanks and tank capacity shall be painted on the respective vessel/tank prominently (after erection) with letter size of at least 150 mm tall by means of stencil.

22. Free board shall be provided over resin bed, below the backwash outlet nozzle of vessel to allow for expansion during backwashing.

23. All the ion exchanger vessels shall be provided with additional nozzles with flange for hydraulic transfer of resin as and when necessary arises. The nozzle shall be provided with manual valves of 100 mm NB. Dummy flange, gaskets and fasteners are bidder's scope.

24. **The guaranteed conductivity value must be attained after completion of regeneration and / or during fast rinse of one hour duration maximum.**

4.4.2 Vessels & Tanks

All vessels & tanks except those specified otherwise shall be made of steel. All steel tanks furnished by the bidder shall be designed suitable for operating condition. All pressure vessels shall be designed and tested to withstand **1.5** times of the design pressure. The tank shall be provided with suitable supporting legs, inlet and outlet connections, hand hole, manholes, nozzle connections for level gauges, vents, drains, overflow, access with safety cage ladders, handrails etc. as may be required. They shall be lined with suitable material capable of satisfactorily withstanding respective fluids to be handled by them.

All the tanks including chemical solution shall be provided with drain valves and piping, overflow piping and the same shall be led to a nearest drain sump. All the chemical tanks like AMT & CDT shall be provided with removable top covers in two halves and level indicators of suitable MOC of the respective medium handled, to indicate level.

Design of pressure vessels shall conform to IS 2825 and atmospheric tanks shall conform to IS-803. All the nozzles shall be provided with necessary valves for open / close for regeneration operation.

All the manhole doors shall be provided with davit arrangement.

All the vessels nozzles shall be fitted with leak proof dummy flanges along with gaskets before dispatch.

4.4.3 FRP Tanks design considerations:

Tanks shall be vertical, cylindrical, (tapered bottom wherever needed) with level indication. The top cover shall be flanged type with suitable reinforcing and bracing.

Each tank shall have four support pads with bolt hole & PCD not more than 150 mm beyond the tank diameter.

Nozzles on top, sideways and bottom heads shall have a flanged faces perpendicular to the vertical centerline of the tank and nozzles on sidewalls shall have flanges faces perpendicular to radial centerlines. Tolerance on angle of flange face with respect to tank centerline is ½ degree. All the nozzles with flange shall be molded integrally with tanks.

The tank shall be continuous filament wound type and there shall be no long seam joint in the cylindrical shell. Filament would reinforced tanks shall be considered. The minimum total laminate thickness of the filament wound tank shall not be less than 10 mm all around and minimum 10 mm for tank flange and flanged top cover, tank bottom corners and all nozzle flanges without exception.

Each tank shall have inlet, outlet, drain, overflow, service water inlet, level indication nozzles etc. Drain & overflow lines shall be minimum one size higher than the pump discharge line size.

Each tank shall be equipped with a flanged level indicator / gauge. The gauge shall include two CPVC isolation ball valve, 20 mm dia glass tube and indicator board calibrated in cm.

Resin used for the tanks shall be a commercial-grade corrosion-resistant thermosetting, fully tested and accepted for the severe conditions. All internal surfaces, exposed to chemical, shall be resin rich and the thickness of this inner layer shall be minimum of **2** mm by vinyl ester resin. Isopthalic resin shall be used for rest of the thickness lamination. The glass content of inner layer shall be 25 to 30 % by weight. The glass content of filament wound structural layer shall be 55 to 70 % by weight.

Suitable opening shall also be provided in these tanks to house agitator.

4.4.4 CENTRIFUGAL PUMPS:

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

2. The pumps shall have stable head Vs capacity characteristic continuous rising towards shut-off with an approximate shut-off head of 15% more than the design head for radial flow type pumps.

3. The characteristic curves of set of pumps shall match other for load sharing incase of parallel operation.

4. Pumps shall be provided with non-return valve & shut off valve on discharge side and shut-off valve on suction side.

5. The vibration level must be within the satisfactory zone as per ISO 10816-3:1998(E) for machine group 3 standard for rigid supported base with zone boundary B/C.

6. Tolerance on pump guaranteed efficiency and rated head for the rated flow shall be plus 3% to minus 2%.

7. Pressure gauges shall be provided on discharge side of all pumps individually.

8. Each pump suction and discharge shall be installed with an expansion bellow.

9. The pumps shall be designed for continuous operation at its best efficiency to satisfy the performance requirements.

10. The pumps shall be controlled from remote panel and locally.

4.4.5 MB SYSTEM:

The MB system shall comprise of equipments as listed in equipment specification. However, the design criteria shall be as mentioned below:

1. MB unit shall be rated for a normal flow rate to meet net output between regeneration. The flow rate shall be sized suitably to meet the guarantee requirement.

2. The air blowers shall be designed to supply the required quantity of oil free compressed air at required pressure for mixing the Anion and Cation resins after regeneration. The supply shall also include all necessary piping, valves, fittings, pressure gauges, suction silencer-cum-filter, belt guard, relief valve etc.

3. Necessary Resin traps, distributor, nozzles, manholes, inlet / outlet / regeneration nozzles, drain, vent, necessary sight glasses for viewing resin level, mounting legs, valves for automatic operation / regeneration of the system in the mixed bed units shall be supplied with all necessary piping, valves.

4. Resin selection criteria, calculation for arriving at resin quantities and the resin characteristic curves shall be submitted along with the offer.

5. Bidder to consider regeneration process shall be based on **self-neutralization and** also to furnish chemical calculations for regeneration of resins.

4.4.6 RESIN REGENERATION SYSTEM:

4.4.6.1 CATION & ANION REGENERATION:

1. The Cation exchange resins shall be regenerated with Hydrochloric acid of ~30% concentration as per IS 265 and the Anion exchange resins will be regenerated with Sodium Hydroxide solution of ~48% concentration as per IS 252 technical grade / rayon grade. These chemicals will be drawn from Bulk storage tanks(Bulk storage tanks & chemicals are excluded from bidders scope).

2. The bidder shall include the required regeneration equipments in their scope.

3. Acid measuring / dilution tank for the regeneration of cation resin shall be of sufficient capacity to store the quantity of acid required for atleast one regeneration with **30%** margin. The tank shall be of MSRL with removable top covers with level indicators. Fume absorber shall be provided for this tank.

4. Alkali measuring / dilution tank for the regeneration of anion exchanger shall be of sufficient capacity to store the quantity of alkali required for atleast one regeneration with **30%** margin. The tank shall be of FRP with inside PP lining / MSRL removable top covers with level indicators to indicate the level. Suitable agitator shall be provided to dilute the NaOH solution from 48% to 30 %.

5. Separate hydraulic injector / ejector for anion and cation resins for diluting the alkali / acid to the required level and dosing it to respective resin shall be supplied.

6. Suitable density indicators and flow orifice board / plate shall be provided to determine the exact strength of the acid / alkali injected and flow rate to the exchanger.

7. The dilution ratio of the ejector shall be properly selected such that the bed can be effectively regenerated employing power water at the available pressure. The ejectors and nozzles shall be suitably designed for acid service and high velocity of liquid.

8. Safety showers with eye-wash (2 Nos.,1 at AMT & CDT room & 1 at near MB system) meeting B.I.S specification shall be provided in the acid &, alkali handling area (AMT, CDT & MB area).

4.4.6.2 DRAIN NEUTRALISING SYSTEM:

1. Provision shall be made by the bidder to neutralize wastewater arising out of the regenerating chemicals. The arrangement shall be as follows:

   a. Wastewater from the resin bed shall be led into individual drain sumps near these vessels. Bidder shall provide measuring orifice boards with level marker into these sumps. Wastewater from sump shall be led into a gravity trench suitably lined and leading to neutralizing pit.

   b. Bidder should indicate the neutralizing chemical requirement to keep pH of the waste effluent generated, around **6.5 to 8.5.**

4.5 PIPING

4.5.1 LINE SIZING

a. Sizes of pipelines shall be selected such that the velocity of fluid in pipes does not exceed the following limits under conditions of maximum possible volumetric flow:

Pump Suction	: <1.2 m/sec
Pump Delivery	: <2.5 m/sec
Service water / Potable water	: 1.5 m/sec
Compressed air	: 15 m/s

b. Lower values of velocities than those stated above shall be used to determine line size if dictated by considerations of pressure drop, NPSH, surges, water hammer, etc.

c. The design flows considered in line sizing shall not be less than the rated capacities of equipment to which the piping is connected such as pumps, blowers, compressors, valves, flow limiting orifices, etc., or, the system mass balance diagrams.

d. All high points in piping system shall be provided with vents along with valves. All low points shall be provided with drain along with drain valves.

e. Necessary moisture traps shall be provided in the compressor air line at strategic location.

f. Necessary supports for the considered pipelines are in the scope of bidder. The supporting arrangement shall be rigid and properly designed for the systems where hydraulic shocks and pressure surges may arise in the system during operation.

g. Sufficient upstream and downstream lengths shall be provided for flow measuring device, control valves and other specialties.

h. Bidder shall provide suitable sampling points to take water samples for testing purpose. The water samples shall be through 20 m NB dia pipes of SS 316.

i. Test certificate / Compliance certificate to be furnished by the bidder for all the MSRL, SS, GRP/FRP piping and piping components etc.

4.5.2 MATERIAL OF CONSTRUCTION:

SL. NO.	SERVICE	SIZE	PIPES	FITTINGS	FLANGES	GASKETS	LINE JOINT
1.1	**MB FEED WATER**	**NB 65MM & ABOVE**	**ASTM A53 / IS-1239-Heavy (RUBBER LINED 3 MM THK)**	**ASTM A234 Gr. WPB**	**ASTM A105**	**NEOPRENE RUBBER / EPDM**	**FLANGED**
		NB 50MM & BELOW	**ASTM A312 TP 316 seamless**	**ASTM A403 Gr.WP 316/A 182-F316**	**ASTM A105 (Ref: Note-3)**	**NEOPRENE RUBBER / EPDM**	**SOCKET WELDED**
1.2	**DEMINERA-LISED WATER (MB OUTLET)**	**NB 65MM & ABOVE**	**ASTM A312 TP 316 / CF8M**	**ASTM A403 Gr.WP 316/A 182-F316**	**ASTM A105**	**NEOPRENE RUBBER / EPDM**	**FLANGED**
		NB 50MM & BELOW	**ASTM A312 TP 316 seamless**	**ASTM A403 Gr.WP 316/A 182-F316**	**ASTM A105 (Ref: Note-3)**	**NEOPRENE RUBBER / EPDM**	**SOCKET WELDED**
1.3	**INSTRUMENT AIR SYSEM & POTABLE WATER SYSTEM**	**NB 50MM & BELOW**	**ASTM A53 GALVA-NISED / IS-1239-Heavy**	**ASTM A234 Gr. WPB GALVANI-SED**	**ASTM A105 GALVANI-SED**	**NEOPRENE RUBBER / EPDM**	**SCREWED**
1.4	**CHEMICALS Like HCl, NaOH, NaOCL etc.**	**ALL SIZES**	**CPVC, schedule 80 of ASTM or GRP pressure class-PN 12 & Stiffness class SN-B (124 kpa) as per IS12709**	**CPVC, schedule 80 of ASTM or GRP pressure class-PN 12 & Stiffness class SN-B (124 kpa) as per IS12709**	**CPGF / PP /GRP Flange drilling should be ANSI B16.5, 150 Class**	**EPDM /Viton rubber gasket**	**Flanged / insitu joint**

Notes

1. The material of DM water system Piping from MB outlet to DM water storage tank shall be ASTM A 312 TP 316L. Thickness shall be to suit system requirement. However minimum schedule 10 thick pipes shall be used. Fittings shall be of SS 316L and corresponding pipe thickness.

2. Pipes shall be tested for its material composition and certificate shall be enclosed for the same. Each length of pipe shall be hydro-tested at shop as per the Codes/Standards.

3. Blind flanges on SS Pipe lines shall be to ASTM A 240-TP 316. Stub ends shall be used at flanged connections.

4. Cast steel valves shall be provided for compressed air system.

5. All branch connections shall be wrought or forged steel based on the size and availability based on ASTM Standards.

6. MB System frontal piping shall be trial assembled and tested before despatch.

7. All piping & valves supports shall be of dismantling type for easy maintenance using suitable bolted connections.

9. All non metallic piping shall be FRP (PN 12 & SN 124) / CPVC, industrial grade, Schedule 80, GF or Astral or FIP make including diaphragm valves, where ever called for. For more details refer cl. 4.5.2.

4.5.3 LAYOUT & DETAILING

1. A good engineering practice must be followed in manufacturing the piping weldments like edge preparation, slope, drain & vents by preparation of detailed layout drawing.

2. Overhead piping shall have a minimum vertical clearance of 2.3 metres above walkways and working areas and 7.5 metres above roadways unless otherwise approved by the BHEL-ENGINEER.

3. Provision shall be made while preparing piping layout to accept control valves, flow measurement element and any other on-line specialty or equipment. Sufficient upstream and downstream lengths shall be provided for flow measuring devices, control valves, and other specialties as required by the respective equipment manufacturer.

4. All the screwed valves and screwed connections on equipment shall be provided with unions to facilitate easy assembly / disassembly. Likewise, unions shall also be provided at suitable points on straight length of screwed pipelines.

5. The hangers and supports shall be spaced in accordance with standard engineering practice as outlined in applicable codes and standards.

4.5.4 DIMENSIONAL STANDARDS

1. Uniform dimensional standards for all piping components shall be employed to ensure compatibility with each other.

2. Nominal pipes sizes and pipe outside diameters shall generally be as per ANSI B 36.10.

4.5.5 WELDING AND HEAT TREATMENT

All heat treatment, welding, post and pre weld temperatures shall be as per the applicable ASME code.

4.5.6 INSPECTION

All pipes shall be thoroughly cleaned & hydro-tested at shops for pressures as per standards and all erected piping shall be cleaned & tested at 1.5 times the design pressure.

All hot bent, forge-formed, fabricated and straight pipes shall be chemically cleaned, pickled or wire brush cleaned and purged with air blast or shot/grit blast to remove all sand and scale from the inner surface as applicable during manufacturing.

The Contractor shall carryout the following cleaning after hydro-test.

a. All piping shall be mass flushed, in addition to the specific cleaning operations as described below, as required.
b. Compressed air piping shall be blown by air.

4.5.7 UNDERGROUND PROTECTION

Where pipelines are buried, underground protection shall be provided for the piping system as given below:

With anti-corrosive tape of 4 mm thick conforming to IS-10221 and AWWA C 203-93.

4.6 VALVES

4.6.1 DESIGN AND CONSTRUCTION FEATURES

The following consideration shall be made during the design / selection of valves for the MB System.

1. For the MB system diaphragm type valves shall be used for isolation / regulation purpose.

2. Bidder to select suitable material of construction for the valves based on the system requirement and shall be clearly indicated in the offer.

3. The end connection for the valves shall be of flanged type as per **ANSI B16.5 #150**.

4. Pressure rating of valves shall be of minimum 150 psi.

5. Necessary pneumatic actuated valves shall be provided for auto operation (option for manual opening and closing also provided) & regeneration of the plant as per P&ID.

6. The check valves shall be of wafer type swing check valve suitable for mounting between flanges.

7. The Material of Construction of the body and disc of check valve shall be SS 316

8. Cast steel valve shall be provided for compressed air system.

9. Bidder shall furnish the valves schedule in the attached format. (Annexure-5)

4.6.2 VALVE - MATERIALS

SL NO.	SERVICE	SIZE	BODY/ BONNET	DIAPHRAGM / DISC / BALL	STEM / SHAFT	HAND WHEEL	VALVE ENDS
2.1	DM WATER & DG WATER	≥65NB ≤ 50 NB	IS 210 FG 200 Rubber lined DIAPHRAGM VALVE ASTM A312 TP 316	EPDM		ASTM A47 Gr 32510 ASTM A47 Gr.32510	FLANGED #150PSI SOCKET WELDED
2.2	DM WATER & DG WATER Pumps suction & delivery	≥65NB ≤ 50 NB	IS 210 FG 200 Rubber lined BFV ASTM A312 TP 316	SS 316	SS 410	ASTM A47 Gr 32510 ASTM A47 Gr.32510	FLANGED #150PSI SOCKET WELDED
2.3	INSTRUMENT AIR SYSTEM (BALL VALVES)	≤ 50 NB	ASTM B 62/ IS: 318 Gr 2	ASTM B 62 / IS: 318 Gr2	ASTM B 62 Gr A / IS: 320 HT 2	ASTM A47 Gr 32510	SCREW TYPE
2.4	CHEMICALS	ALL SIZE	CPVC ASTM D1784 PN 16 Pressure rating	EPDM		POLYPROPYLENE	FLANGED / SOCKET

NOTE : 1 Testing of body and seat shall be as per ANSI B16.34
2. For water system with sizes greater than NB200 butterfly valves shall be used and shall conform to AWWA C-504.
3. Flange drilling shall be as per ANSI B16.5, #150 PSI.

4.7 PAINTING

4.7.1 GENERAL

(a) All the Equipment, steel structures and piping etc. shall be protected against external and internal (if any) corrosion by providing suitable painting as described below unless otherwise specified elsewhere. However, the surfaces of stainless steel, Galvanized steel, Gunmetal, brass, bronze, UPVC /CPVC pipes, HDPE pipes and non-metallic components shall not be applied with any painting.

(b) All painting shall be carried out in conformity with the paint manufacturer's recommendation.

(c) Codes and Standards :
Painting of equipment shall be carried out as per the specifications indicated below and shall confirm to the relevant IS specification for the material and workmanship.

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

IS : 5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints.
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

(d) No painting or filler shall be applied until all repairs, hydrostatic test and final shop inspection are completed.

(e) All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks.

(f) **Finish paint coating of DFT 50 microns at site shall be done after completion of erection & Commissioning.**

4.7.2 PREPARATION OF SURFACES

All surfaces to be painted shall be thoroughly cleaned by sand /shot blasted to SA 2$^{1}/_{2}$ finish as per Swedish standard SIS 055900 of all grease, oil, loose mill scale, dust, rust, slag and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations were power tool cleaning cannot be carried out, sand scrapping may be permitted with steel wire brushes and or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only with the approval of the BHEL –Engineer.

4.7.3 PRIMER PAINT

One coat of Epoxy Zinc Phosphate primer shall be applied. After this first coat is dried up completely, second coat shall be applied. Primer shall be applied by brushing / spray to ensure a continuous film without 'holidays'.

No. of coats: 2
The total dry film thickness shall be minimum 100 microns.

4.7.4 FINISH PAINT

First coat of Epoxy finish shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to smooth finish and ensuring that at no place the first coat is completely removed. After allowing the water to get evaporated completely, the second finish coat shall be applied.

No. of coats: 2
The total dry film thickness shall be minimum 100 microns.

(Above Painting procedure described is as per BHEL PRQA : 526 Rev. 01)

4.7.6 SUGGESTED COLOUR CODES FOR PAINTING

Sl No.	ITEM / SERVICE	COLOUR	IS-5 Grade	Colour (Band)	IS-5
1	Vessel & all other proprietary equipment	Light gray	631	-	-
2	Pumps and motors etc.	Light gray	631	-	-
3	Tanks - indoor	Light gray	631	-	-
	Structures, platforms, ladders and handrails	Dark Admiralty Grey	632	–	–
	Control & Relay panels	Light grey	631/ 7078 of IS1650		
4	Piping – DM water	Sea green	217	Light orange	557
	Piping – Soft water, Potable & filtered water	Sea green	217	French blue	166
	Piping – Raw water	Sea green	217	White	
3	Piping – Air System (Station air & Control air)	Sky blue	101	White for Control air	

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 5 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

4.8 VENDOR LIST FOR MECHANICAL ITEMS

Bidder has to considered for bought-out items as per enclosed Customer approved vendor list.

5.0*:* ELECTRICAL, CONTROLS *&* INSTRUMENTATION

Electrical, control & Instrumentation requirements for the MB system is enclosed separately as ROS: 4053 Rev.00 along with this specification.

6: TECHNICAL DETAILS FOR CIVIL WORKS:

Construction of civil building, equipment foundation with pockets and flooring etc for the MB system is not in bidder scope. However the bidder shall provide the equipment layout drawing along with bid.

Detailed construction drawing with foundation requirement like load details, foundation pockets etc, for all the equipments & tanks, flooring requirements, protective coatings, trenches for pipe routing & drains, cable routing etc., shall be furnished to BHEL for further construction immediately after order.

Any special requirement like handling arrangement, floor / trench protection etc. shall also be indicated in the drawings. All the plant drains & trenches are to be connected in a common trench and terminated near MB Plant boundary.

Foundation bolts, nuts & washers for all equipments shall be supplied by the bidder as per their offered equipment requirement. **The final grouting material and grouting equipment are in the scope of bidder.**

The approximate area & location are indicated in the enclosed lay out drawing. Bidder to accommodate the MB system with in the stipulated area only as indicated in the typical layout drawing attached along with this specification.

7.0 : SYSTEM PERFORMANCE

The system performance guarantee are detailed in this section.

7.1 PERFORMANCE GUARANTEE

7.1.1 The bidder shall guarantee all equipments for workmanship, materials and satisfactory performance. The guarantee for performance will cover individual items and systems including electrical for their ratings / outputs as well as for the integrated operation of equipment and its auxiliaries as a whole. On completion of satisfactory commissioning, the supplier shall conduct performance / acceptance tests on the equipment and system as a whole for demonstrating the guaranteed performance parameters specified. All instruments, gauges installed for the normal operation of equipment shall, be made use of during the acceptance test as far as possible. If additional instruments are required for the tests, these shall be brought by supplier free of cost and shall be taken back after performance test.

7.1.2 The Performance guarantee tests shall be conducted & cover the following but not be limited to the rated parameters for smooth operation of complete MB system:

a. Degasser outlet water quality as per annexure-1
b. MB system outlet Water quality as per annexure-1
c MB system net output and gross output between regeneration as per Annexure -1
d. MB regeneration Chemical consumption including neutralizing chemical as per Annexure -1
e. Power consumption for continuous operating equipment as per Annexure-3
f. MB Regeneration time.
g. Guaranteed water consumption for each regeneration of MB including final rinse.
h. Vibration and noise level of rotating equipment.

7.1.2 Minimum 3 performance test run shall be conducted between regenerations for the guaranteed value of treated water quantity and chemical consumption of which 2 consecutive test results shall meet the guaranteed values specified above (a to h)

7.2.0 General

In addition to the guarantees mentioned above, the requirements of specifications on all guarantees as elaborated under relevant clauses of Technical Specifications should be met.

The equipments supplied shall be guaranteed for a minimum period of 12 (twelve) months from the date of successful commissioning of the units (excluding Resins). Resins guarantee shall be as per spec. clause no : 4.3.3-W.

Any part which proves defective either in design, materials / and / or manufacture within the above guarantee period shall be replaced at free of cost to the owner at site and the provision of this clause shall apply to the portions of the plant so replaced or renewed until the expiration of the guarantee period or from the date of replacement which ever is later.

8.0 : COMMISSIONING SPARES :

The bidder shall provide commissioning spares. The commissioning spares shall be delivered along with the main supply well in time before start-up & commissioning of the Plant. The commissioning spares list is indicated in this section. Over and above any additional requirements for trouble free commissioning of the equipment / system shall also be included in the list. Any unutilized commissioning spares shall be handed over to the Owner.

The price for the commissioning spares shall be included in the main supply and the list shall be provided along with the bid, this price will be included for bid evaluation.

8.1 COMMISSIONING SPARES MECHANICAL

Sl. No.	Description of the equipment	Description of spares	Qty	Remarks
01	Mixed Bed Feed pumps Mixed Bed regeneration pumps	'O' rings and gaskets	1 set	For each type of pump
02	Degasser Blowers Mixed Bed Blower	V Belts Filter elements Seals	1 set 2 set 1 set	For each blower
03	Lubricants and grease (for initial fill)		1 lot	
04	Valves	Gland packing	01 set per valve for each size and type	
		Bonnet / Cover gasket	01 set for every set of 4 valve of each size and type	
		Valve assembly	3% of total quantity or 1 no (which ever is high) for each size and type	
05	Butterfly / diaphragm valves	Bearing Body seat / Disc seal ring Seal retaining ring Diaphragm	1 set 1 set 1set 1 set	
05	MB System	Strainers for collector, distributer & nozzles	10 %	
		Ejector for Acid & Alkali injection	1 set	
		Sight Glass (toughened)	3 Nos.	

8.2 ELECTRICAL, CONTROLS & INSTRUMENTATION COMMISSIONG SPARES

Please refer clause 2.8 (Annexure – ECI 11 page 56 of 56) of Specification 4053 Rev.00.

9.0 : ERECTION , COMMISSIONING, PG TEST & HANDING OVER:

Erection, commissioning, trial operation, Performance Guarantee (PG) test and handing over of the MB system is attached separately as **Section-9** along with this specification.

10.0 : DOCUMENTATION :

The documentation during bid and post order stage shall meet the following requirements.

1. All documents and drawings shall be submitted in English
2. Hard copies of all documents and drawings during bid stage to be submitted in **duplicate.**
3. Hard copies of all documents for approval shall be submitted in **triplicate.**
4. Hard copies of all final documents, drawings, erection and O&M manual etc., shall be submitted in bound folder in **duplicate.**
5. Soft copies of all final documents in MS word / MS office in the form of CD – 1 set
6. Soft copies of all final calculations in MS excel /MS officer in the form of CD – 1set
7. Soft copies of all final drawings in Auto Cad, latest version in the form of CD – 1set

11.0 : DOCUMENTS TO BE SUBMITTED ALONG WITH BID:

The following drawings / documents are to be enclosed along with the bid for scrutiny.

1. Complete confirmation to our specifications by signing in each page with seal.
2. Duly filled up Data sheets enclosed **- Annexure – 1 to 5**
3. Resin quantity calculations along with resin literature and characteristic curves.
4. Resin regeneration calculations (chemical consumption).
5. Resin regeneration sequence with flow rate, duration, effluent details etc.,
6. Confirmation of BHEL P& I diagram
7. Confirmation of BHEL equipment layout drawing
8. Typical Pump performance curves with marked duty point.
9. Typical Quality Plan.
10. Un-priced commercial offer on the scope of supply

Note:

1. In case of any deviation, the Bidder shall indicate the deviation, clause by clause in the deviation format attached in **Annexure - 5.** If there is no deviation "NIL" statement shall be furnished. In the absence of the non attachment of this **Annexure-5,** it will be construed that the bid confirms strictly to the specification. Acceptance or rejection of the offer with or without deviations (either fully or partially) is sole discretion of the purchaser without seeking further clarification from the bidder.

2. Bidder to note that failing to submit the above, the bid shall be considered as incomplete and offers are liable for rejection.

12.0 : DOCUMENTS TO BE SUBMITTED AFTER ORDER:

12.1 The following documents / Drawings and data to be furnished for BHEL / customer approval.

Phase – 1 with in 2 weeks from the date of purchase order receipt.

1. P and I Diagram including pipe sizes, MOC and terminal points.
2. Generated regeneration water quantity / quality (TDS & pH and major constituents) of each regeneration
3. Equipment layout showing equipment details, headroom, size.
4. Duly filled Data sheets enclosed – Annexure 1 to 2
5. GA Drawing of MB vessel, Degasser tower, AMTD & CDT tanks .
6. Design calculation and thickness calculations for all major vessels and tanks as per code.
7. Resin quantity calculations along with resin literature and characteristic curves.
8. Resin regeneration calculations (chemical consumption) and resin regeneration sequence with flow rate, duration, effluent details etc.,
9. Technical Write-up and design basis
10. MB system "Control Description" write-up including sequential operation, controls, interlocks, protection, annunciation etc.
11. Quality Plan and field quality checks, stage inspection etc. for the above equipment & system
12. Activity chart / Bar Chart and schedules for drawing submission, manufacturing, erection and commissioning

Phase – 2 with in 4 weeks from the date of purchase order receipt.

13. Detailed construction and cross- sectional drawings for the following:
    a. Vessel fabrication & assembly with Bill of material (BOM)
    b. Nozzle and Orientation
    c. Internals (Collector & distributers)
    d. Resin depth, filling details and preservation details
    e. Any other accessories with bill of materials.

14. Duly filled Data sheets enclosed – Annexure 3 to 5

15. Foundation drawings indicating foundation design, load data, anchor bolt location, pocket details, floor & trenches etc.

16. Performance curves for pumps & blowers
    a. Flow Vs Head
    b. Flow Vs efficiency
    c. Flow Vs Power
    d. Flow Vs NPSH

17. Detailed assembly & cross sectional drawings with bill of material for pump & motor.

18. Detailed assembly & cross sectional drawings with bill of material for blower, motor, V-belt, pulley, base frame, valves, silencers etc., with lifting arrangement for blower and motor.

19. Detailed assembly & cross sectional drawing of valves.

20. Instrument schedule.

21. PLC I/O list

22. Utility requirements like instrument air, service air and service water for Regeneration and rinse etc.

Phase – 3 With in 8 weeks from the date of purchase order receipt for information.

23. Isometric drawing of pipe segments.
24. Erection Manual indicating
    a. Erection / installation instruction of equipments.
    b. Log sheet containing Stage check parameters & clearance
    c. Log sheet for Alignment Check of pump & motor
    d. Field quality checks
25. Performance Test procedure
26. As-built manufacturing drawing of the equipment and total system with bill of materials (BOM)
27. All the documents called in Electrical specification.
28. PG Test Procedure

12.2 The following documents/Drawings are to be furnished for BHEL / customer review for information and before dispatch.

Phase – 4

1. Pump & Blower performance test reports
2. Pump & blower performance guarantee certificates
3. Necessary material test certificates, hydraulic test certificates for all major items.
4. Operation and maintenance manual indicating, Operating procedure for start-up, normal operation, shut down and emergency shut down. Maintenance instruction & assembly
5. Lubrication chart
6. Electrical equipment layout, Cable trench layout, cable routing, cable schedules and cable termination details.
7. MB System Logic diagram & Sequential Flow Chart (SFC) for PLC
8. Cable interconnection diagram for cables up to junction box & cable schedule.
9. PLC I/O list.
10. Test Certificates for all the supplied instruments.
11. List of alarm, interlock & trip set points
12. Installation drawings for instruments
13. Wiring drawings & GA drawings for Local Panels, junction boxes.
14. As built drawings
15. All other details called in electrical specification.

Note: Bidder to confirm in their offer that these details called in 13.1 & 13.2. will be provided.

13.0: ATTACHMENTS:

1. P & ID No. : 1-WT-220-00248 Rev. 00 (with Terminal Points).
2. MB & Degasser System equipment layout Drawing No. : 2-WT-220-00064 Rev.00
3. SECTION: 9 Specification (ROS -6095 Rev.00)
4. Specification for Electrical, Control & Instrumentation (ROS - 4053 Rev. 00)
5. BOQ for EC &I items of MB System (3-WT-310-00228 Rev.00)
6. Customer approved vendor list .

BHEL Enquiry / P.O. Reference No. & Date:

ANNEXURE-1

GUARANTEE DATA SHEET

I DEGASSER OUTLET WATER QUALITY

Sl.No.	*Description*	*Unit*	*Values*
1	**Carbon di Oxide as CO2**	**ppm**	
2	**Conductivity**	**µS/cm**	
3	**pH**		

II MIXED BED OUTLET WATER QUALITY

Sl.No.	*Description*	*Unit*	*Values*
1	**pH**		
2	**Conductivity**	**µS/cm**	
3	**SiO2 as SiO2**	**ppm**	
4	**Sodium as Na**	**ppm**	
5	**Total Hardness as CaCO3**	**ppm**	
6	**Organic matter as KMnO4 value**	**ppm**	
7	**Carbon Di Oxide**	**ppm**	

III MB OUTPUT BETWEEN EACH REGENERATION

Sl.No.	*Description*	*Unit*	*Values*
1	**NET**	**Cu.M**	
2	**GROSS**	**Cu.M**	

IV CHEMICAL REQUIREMENT PER REGENERATION INCLUDING NEUTRALIZATION

Sl.No.	*Description*	*Unit*	*Values*
1	**HCl - 30%**	**kg/regen**	
2	**NaOH - 48%**	**Kg/regen**	

V MIXED BED RESIN

Sl.No.	*Description*	*Unit*	*Cation / Anion*
1	**Quantity per vessel**	**Ltrs**	***I***
2	**Life**	**Years**	***I***

ANNEXURE –2

BHEL Enquiry / P.O. Reference No. & Date:

ELECTRICAL POWER CONSUMPTION

Sl. No.	Eqpt.. Description	Qty		Drive rating KW	Conn load. Load KW	Power consumption KW**	Voltage, Phase
		W	SB				
A	FOR CONTINUOUS OPERATING EQPT.						
1	**MB Feed Pump**						
2	**DG BLOWER**						
3							
	Sub total of A						
B	FOR INTERMITTENT OPERATING EQPTS.						
1	**M.B Regeneration Pump**						
2	**Mixed Bed Blower**						
3	**CDT Agitator of MB**						
4							
5							
6							
7							
	Grand Total						

Note:1. Power consumption for continuous operating equipment will be considered for bid evaluation and Guarantee purpose

W – Working SB – Standby

ANNEXURE - 3

BHEL Enquiry / P.O. Reference No. & Date:

EQUIPMENT DATA SHEET

1.0 EQUIPMENT : DEGASSER TOWER & ACCS.

2.0 Application : To reduce CO2 level in the permeate
: water from R.O stage-1 Desalination Plant.

3.0 Quantity : TWO (2) set

4.0 Tower particulars

a. Type :

c. Make :

d. Model :

e. Flow rate in M3/hr - design/Max :

f. Design Code :

g. Corrosion allowance Shell mm :

h. Material of Construction :

i. Dia x Height mm :

j Thickness Shell/Ends mm :

k.. Surface Flow rate in m/sec-Design/Max:

l. **Velocity :**

m. **Air to water ratio :**

n. Internal Protection :

o. External protection :

p. Design Pressure :

q. Packing material of tower :

r. Quantity of packing materials :

s. Packing height :

t. Inlet Nozzle size, type, rating :

u. Outlet nozzle size, type, rating :

v. Level switches :

w. MOC of Rasching Ring :

6.0 DEGASSER BLOWER

a. Qty. offered :

b. Capacity in m3/hr :

c. Head in mm WC :

d. Efficiency :

e. Make :

f. Type

g. Power rating of motor in KW :

h. Speed RPM :

g. MOC of Blower - Casing :

Impeller :

Shaft :

i. Total weight of DGT assembly :

j. Noise level measured at 1 m distance :

7.0 MIXED BED UNIT

a. Quantity :

b. Type :

c. Net output, m3/hr :

d. Gross output between regeneration in M3 } :

excluding regeneration hrs. }

e. **Productive output between each regeneration } :**

excluding regeneration hrs. in M3 }

f. Operating cycle excluding regen.hrs :

g. Duration of regeneration hrs :

Regeneration type for Cation :

Regeneration type for Anion :

h. Material of Construction of Vessel :

i. Diameter -shell mm :

j Thickness -shell & Dish Ends mm :

k. Design Flow Velocity m3/hr/m2 :

l. Maximum velocity permitted m/s :

m. Internal protection :

n. Shore hardness :

- Lining Material :

o. External protection :

p. Design Code :

q. Corrosion allowance-Shell/DE mm :

r. Thinning allowance-DE mm :

s. Design Pressure :

t. Test Pressure :

u. Vessel dia x st. height x tot. ht mm :

v. Resin bed ht. Anion/Cation mm :

w. Free Board % :

x. Nozzles size & rating :

-

-

y. No.of sight glasses & size :

z. No of manholes & size :

aa. Details about distributor nozzles :

7.1 MIXED BED UNIT RESIN

		: CATION	ANION
a. Resin make & Model No.		:	
b. Resin quantity, M3		:	
c. Resin Type		:	
d. Bed Depth , M		:	
e. Resin Life, years		:	
f. Ionic load as CaCO3	mg/l	:	
g. Regeneration level,	kg/m3	:	
h. Operating Exchange Capacity} As CaCO3, }	kg/m3	:	
i. Derated Exchange Capacity , kg/m3		:	
j. Qty of Acid 30% & NaOH 48%		:	
k. Time required / duration for Complete Regeneration		:	
l. Head loss through exchanger,	m	:	
m. Resin Trap provided		:	
n. Attrition loss of resin per annum			
o. Quantity of DM water required per Regeneration with break up cycle		:	
p. Time required to complete one regeneration		: Bidder to provide (max. 4 hrs)	

7.2 MIXED BED BLOWER WITH MOTOR

a. Qty. offered		:
b. Type & make		:
c. Capcity	M3/hr	:
d. Head	mWC	:
e. Efficiency		:

f. Power rating of Motor :

g. Guard :

h. Noise level :

i. Blower speed :

j. BHP KW :

K. Material of Construction

- Rotor
- shaft
- Gears
- Main casing & side plates
- Base frame

m. Lubrication

n. flow orientation

o. discharge line size

p. sealing

7.3	REGENERATION CHEMICAL	:	CATION	ANION
	a. Type & Specification	:		
	b. Chemical Concentration	:		
	c. Grade	:		
	d. Quantity required for each Regeneration on % basis	:		
	e. Protection from outside if any	:		

7.4	Measuring Tanks	:	Acid measuring Tank	Alakali measuring Tank
1	Quantity	:		
2	Type	:		
3	Capacity lts	:		
4	Dimensions (dia x ht)	:		
5	MOC	:		
6.	Thickness bottom, top circumference	:		
6	Internal protection, if any	:		
7	Thickness of lining	:		
8	Lining Material	:		
9	Agitator quantity	:		
10	Agitator M.O.C	:		
11.	Resin used for inner layer	:		
12.	Resin used for outer layer	:		
13.	The glass content of inner layer % by weight.	:		
14.	The glass content of filament wound } structural layer % by weight }	:		
16.	Level Indicator make and details	:		

8.0 DATA SHEET FOR MB FEED / MB REGENERATION CENTRIFUGAL PUMP

				: MB FEED	MB REGEN.
I.	**TECHNICAL PARAMETERS**				
a.	Make			:	
b.	Model			:	
c.	Fluid details				
-	Medium handled			:	
-	PH range			:	
-	Specific Gravity			:	
-	TDS/Chloride range		ppm	:	
-	Temperature range		Deg.C	:	
d.	Design flow at rated speed		cu.m/hr	:	
e.	Mini. & Max continuous flow		M3/Hr	:	
f.	Total Head developed @design flow		mWC	:	
g.	**Selected Motor**		**KW**	**:**	
h.	Shut-off head		mWC	:	
i.	NPSH required (minimum)		mWC	:	
j.	Design Pressure		kg/cm2	:	
k.	Hydraulic test pressure		kg/cm2	:	
l.	Pump efficiency at duty point		%	:	
m.	Pump efficiency at maximum flow		%	:	
n.	Pump shaft power reqd. at duty point		KW	:	
o.	Maximum shaft power required		KW	:	
p.	Rated speed & Critical speed		rpm	:	
q.	GD2 of the pump		kg-m2	:	
r.	Pump performance curve ref. Nos			:	
s.	Upward / Downward thrust			:	
t.	Operating flow range from duty point		%	:	
u.	Noise level at duty range		dbA	:	

v. Vibration level

- Displacement microns (peak to peak)mm:
- Velocity (peak) mm/sec:

w. Balancing quality as per ISO 1940 STD :

x. Rotation of shaft viewing from drive end :

y. Tolerance on guaranteed efficiency & head at rated flow and speed :

II. CONSTRUCTION DETAILS			**MB FEED**	**MB REGEN**
a. Orientation		:	Horizontal	Horizontal
b. Suction / Discharge nozzle				
- Size	mm	:	/	/
- Rating	psi	:	/	/
- Flange drilling standard		:	/	/
- Nozzle Orientation looking from drive end		:	/	/
- Material		:	/	/
c. Material of Construction / Make				
- Pump Casing		:		
- Impeller		:		
- Shaft		:		
- Shaft Sleeve		:		
- Wear rings		:		
- Diffuser		:		
- Mechanical Seal		:		
- Bearing housing		:		
- Fasteners		:		
- Others if any		:		
d. No. of stages		:		

e. Impeller type :

f. Impeller diameter Trimmed / Untrimmed :

g. BEARINGS

- Type :
- Make :
- Lubrication oil spec. :
- Lubricaion oil qty / pump :

h. Mechanical seal :

- Type :
- Make :
- Model :
- Drawing No. :

i. Pump dimension L x W x H :

j. Pump Weight :

III. COUPLING

a. Type :

b. Make & Model No. :

c. Coupling guard material :

d. Dimension detail with BOM enclosed :

e. Weight :

IV. BASE FRAME AND ACCESSORIES

a. Material :

b. Dimension detail mm :

c. Weight kg :

d. Foundation Bolt - Size & Qty mm & Nos. :

- MOC :

V. **GENERAL**

a. Shipping package dimension mm :

b. Total Assembly / Shipment weight kg :

c. List of Special tools :

d. Accessories details :

ANNEXURE- 4

VALVES SCHEDULE - DATA SHEET

Sl. No.	Application	Type	Size	Pr. Rating Bar	Qty.	MOC of wetted Parts				ACTUATOR DETAILS
						Body	Disc / Diaphragm	Stem/shaft	Lining	
I	**MANUAL VALVES**									
II	**PNEUMATIC VALVES**									

ANNEXURE - 5

TECHNICAL DEVIATIONS

Sl. No	*Section no.*	*Clause No.*	*Page / No.*	*Specification*	*Statement of Deviations/variations*	*Reason for Deviation*	*cost of withdrawal*

SECTION – 9

ERECTION, COMMISSIONING, PG TEST AND O&M FOR THREE MONTHS AND HANDING OVER

1.0 SCOPE OF SERVICES

The scope of Erection and Commissioning of systems {De-Gasser System and Mixed Bed (MB) System} comprises of collection of materials and equipment from site stores, transportation to erection spot, erection of complete system including site fabrication if any, stage clearance, testing, commissioning and PG (Performance Guarantee) Test. Further, O&M for three months after PG Test or based on BHEL notification and handing over of these systems. Please refer the Note to Clause No. 1.0 Scope of Supply and Services in the main specification (Page No. 4 of 55).

The equipment after inspection at manufacturer's works shall be transported to BHEL site and shall be delivered to the BHEL stores as in supply specification. Unloading of the materials at Site stores & storing of the materials is in BHEL-PSSR's scope. The applicable materials shall be drawn from BHEL stores as per the relevant procedure. The equipment shall be erected sequentially and shall be interconnected with the applicable piping and valve system. Necessary Hydro testing of piping shall also be carried out. All the dummy flanges etc. required for it are under the scope of bidder.

1.1 **The following are the scope of major equipment for the erection & commissioning of the mixed bed system at site.**

a. 2 x 100% MSRL Degasser tower with accessories (one no. for each RO stream)
b. 4 x 100% (2W + 2S) of Degasser Blower with motor, Air filter box (suction) & accessories, interconnecting piping / ducts and inlet & outlet controls from blower to degasser tower.
c. 3 x 100% (2W + 1S) MB Unit along with all accessories & internals.
d. 3 x 100 % (2W+1S) Mixed Bed (MB) feed pumps with drive motors and all accessories.
e. 2 x 100% (1W+1S) MB regeneration Pump with drive motors and all accessories
f. 2 x 100% (1W+1S) MB Blower with drive motors, air piping and all accessories for MB regeneration
g. 2 x 100% Acid Measuring Tank (AMT), 2 x 100% Caustic Dilution Tank (CDT) with agitator, ejector & acc. etc for MB regeneration
h. 3 sets of MB frontal piping along with pneumatic operated diaphragm valves etc.
i. 1 set of interconnecting piping to system equipment including valves and accessories etc. for auto operation through PLC system.

j. 1 set of necessary foundation bolts with fasteners for all the equipments.
k. 1 set of Electrical, Controls & Instrumentation as per specification.
l. 1 set of miscellaneous items including fasteners, gaskets, common platform for MB, supports for piping and valves etc.,
m. Providing of structural supports by fabrication suitably at site for DM water transfer line from MB to DM water storage tank terminal point. Regeneration water piping from regeneration pump to MB, AMT/CDT. Bulk chemical transfer piping from bulk storage tanks to AMT/CDT are under the scope of bidder as per the P&ID.
n. 1 set of Erection & Commissioning and PG Test
o. O&M for three months after PG Test or based on BHEL notification.
p. 1 set of Commissioning spares included in the main scope of supply.

The above quantity and the details given are only indicative. However the bidder shall supply required quantity and carry out the erection of all the items to meet the system requirement as complete without any commercial implication to BHEL.

2.0 The Intent of this specification is to provide erection, commissioning , trial run, PG Test , O&M for three months and handing over of MB for execution of projects according to most modern and proven techniques and codes. It is not the intent to specify completely herein, all aspects of the entire system. Nevertheless, the entire system shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation. The contract services towards installation of the Plant shall not relieve the contractor of the responsibility of providing such services, facilities to complete the project of portion of project awarded to him. The quoted rate shall deem to be inclusive of all such contingencies.

3.0 The Contractor shall carry out the work in accordance with instructions/ drawings/ specification/ standard practices supplied / approved by BHEL from time to time.

4.0 Modification / Rectification / repair / replacement of defective components if any shall be under bidder’s scope within specified time without any commercial implication to BHEL.

5.0 Bidder to submit the erection schedule along with stage checks data sheets. Each and every stage the bidder to get clearance from the BHEL Engineer / Customer Engineer.

6.0 Bidder to establish the site co-ordination for identification of materials, withdrawal of material from BHEL Site stores, taking delivery, co-ordination for the movement from store to erection site, stage clearance for erection & commissioning.

7.0 All the equipments and materials would be issued only at BHEL stores and it shall be the responsibility of the contractor to take delivery from BHEL stores and transport the same to site

8.0 Bidder has to keep all equipments/materials under their safe custody till the completion of erection, commissioning, trial run and handing over of the System to BHEL. Bidder should ensure deployment of adequate security personal. Necessary security arrangement around the clock is under the scope of the bidder. If any theft, pilferage or any damages are to be replaced by the bidder at their expenses (without financial implication to BHEL).

9.0 Necessary clearance for stage check, hydraulic test, leak check from the customer engineer & pre – commissioning tests shall be carried out by the bidder.

10.0 Commissioning and putting into satisfactory operation of all the equipment at site including successful completion of trial run, PG Test and handing over of the system to the end user are the responsibility of the bidder.

11.0 Bidder shall arrange to carryout the repair paint and Finish coat (final coat) of painting of DFT as per the spec. for all of the equipment before hand over of the system to BHEL/Customer. This is required to cover up the possible damage for the external surface of all equipment during erection/handling.

12.0 O& M for 3 months after PG Test or based on BHEL notification (Required man power, normal consumables, tools and tackles, instruments, etc., will be under the scope of the vendor. However, necessary chemicals as per the requirement will be provided by BHEL, However the required chemical details shall be furnished by the vendor.

13.0 EXCLUSIONS

The following are excluded from the scope of supplier and will be arranged by BHEL

13.1 All civil works pertaining to DM Plant are excluded from the scope of the bidder.

13.2 Service water at one point near RO-DM Plant will be provided by BHEL on free of charge. Subsequent piping within and outside the plant are under the scope of the bidder.

13.3 Electricity (3 phase) will be available to the bidder at one point near RO-DM Plant on free of charge for erection purpose.

13.4 Service / instrument air will be made available at one point to the bidder within the plant boundary. Subsequent piping within and outside the plant are under the scope of the bidder.

13.5 Chemicals for commissioning and trial operation of the plant will be supplied by BHEL.

13.6 Storage of shipped items / container at BHEL store as of received condition will be taken care by BHEL.

14.0 Specification, Standards & Codes:

All equipment shall be designed, tested and supplied as per the specification, relevant national / international standards & statutory codes.

15.0 Name plates, labels and directional marks:

Each equipment shall be provided with nameplate details designating the tag no., service of the item etc. Necessary directional arrow marks shall be provided. Equipment name shall be painted legibly with minimum 150mm size for the vessels.

16.0 Tools and Tackles:

All the Tools & tackles required for the complete erection of components shall be arranged by the contractor at his cost. The bidder shall have & own a complete set of special tools and tackles required for erection, assembly, disassembly, maintenance and testing. The bidder shall also supply any special tools and tackles that may be required additionally during commissioning. All tools & tackles shall be reputed make with validity test certificates. One set of operation & maintenance tools for O&M for the system has to be supplied during the erection & commissioning and it will be retained by BHEL.

17.0 Commissioning Spares:

The bidder shall supply all consumables like lubricating oil, Teflon tape, m-seal, cotton waste, tissue paper roll, sampling bottles, mugs, buckets etc required for commissioning of the equipment shall be in bidder's scope.

The bidder shall consider sufficient quantity of the commissioning spares so that the commissioning of the system will not be delayed. The bidder shall also supply any spare components that may be required additionally during commissioning. These commissioning spares shall be included in the basic scope of main supply.

18.0 Inspection & Testing:

All the stage checks & materials for erection shall be offered as per the Quality plan wherever applicable to BHEL / Customer for inspection. During erection, the internal inspection reports shall be submitted to BHEL / customer for information.

19.0 Additional requirements

19.1 After completion of all erection and commissioning works, the left out items shall be handed over to BHEL site stores.

19.2 During commissioning at site some smaller equipment may get added or Logics may have to be changed. The bidder shall carryout these changes at site without any commercial implications to BHEL.

20.0 GENERAL INSTRUCTIONS TO THE BIDDER

20.1 Bidder shall contact BHEL and obtain additional details/data if any required to submit proper quotation.

20.2 The Bidder shall include all necessary commissioning spares in his basic main scope of supply.

20.3 Adequate lighting facilities such as low volt hand lamps shall be arranged by the contractor at the construction site, etc. at his cost.

20.4 All the lifting tackles including wire ropes, slings, shackles and electrically operated equipment shall be got test certificate & statutory authority approved before they are actually put on use. Test certificates & statutory authority approved certificate should be submitted to BHEL before their usage.

20.5 All equipment so used by contractor shall be of proven quality and safe in operation .

20.6 At periodic / intervals of work, complete and detailed account of the equipment so for erected shall be submitted to the BHEL Engineer.

20.7 All equipment's shall be handled very carefully to prevent any damage and loss. No bare wire ropes, slings etc.., shall be used for unloading and / or handling for equipments. The equipments from the storage yard shall be moved to the actual site of erection / location at the appropriate time as per the direction of BHEL Engineer so as to avoid damage for such equipments at site.

20.8 The work covered under this scope of work is of highly sophisticated nature requiring best quality / precision workmanship engineering and construction management. He should also ensure successful and timely commercial operation of equipment installed. The contractor must have adequate quantity of precision tools, construction aids in possession. Contractor must also have adequate trained qualified and experienced supervisory staff and skilled personnel.

20.9 All the necessary certificates & licenses and statutory clearance required to carry out his scope of work are to be arranged by the contractor then and there at no extra cost.

20.10 When the work is temporarily suspended he shall protect all construction materials equipments and facilities from causing damage to existing property interfering with the operations of the station when it goes into services. The contractor shall comply with all applicable provisions of the safety regulations

clean – up programme and other precautionary measures which the BHEL has in effect at the site .

20.11 It will be the responsibility of the contractor to ensure the safe lifting of the equipment taking due precautions to avoid any accidents and damage to other equipments and personnel.

20.12 All piping shall be adequately supported and protected to prevent damage during handling and erection.

20.13 Sometimes it may become necessary for the contractor to handle certain un-required components in order to take out the required materials. The contractor has to take this contingency also into account. No extra payment is payable for such contingencies.

20.14 Due to atmospheric conditions erected materials are likely to get rusted more frequently. It is the responsibility of the contractor to preserve the erection materials drawn from stores for erection till these are commissioned and handed over to customer. The required paint, thinner all other consumables like painting brush, emery paper, cotton waste, cloth etc.., have to be arranged by the contractor at his cost. The quoted rates shall be inclusive of above work. The contractor should ensure that the materials are not rusted on any account till they are handed over to customer.

20.15 All dilution / service / flushing for initial startup of the MB system required DM water shall be provided by BHEL, However further requirement can be taken care by providing suitable transfer line.

21.0 SITE CLEANLINESS AND SAFETY REQUIRMENTS:

21.1 Contractor shall strictly follow all safety regulations / conditions as per general conditions of contract.

21.2 Providing of safety equipments like Helmet, safety goggle, hand glows etc. under the scope of bidder. Non – conformity of safety rules and safety appliances will be viewed seriously and the BHEL has right to impose fines on the contractor as under.

21.3 Contractors shall ensure that the quality is maintained in all the works connected with this contract at all stages of the requirement of BHEL.

21.4 Contractor shall ensure that all Inspection, Measuring and Testing equipment that are used, whether owned by the contractor or used on loan, are calibrated by the authorized agencies and the valid calibration certificate will be available with them for verification by BHEL. A list of such instruments possessed by contractor at site with its calibration status is to be submitted to BHEL Engineer for control.

21.5 Contractors shall arrange for the inspection of the works at various stages as required by BHEL. Immediate corrective action shall be taken by the contractor for the non-conformances if any, observed and pointed out by BHEL.

22.0 All payments due to the contractor shall be made only through “e-Payment” . The Bidder has to furnish details of his Bank account as certified by the concerned Banker in the format attached to enable e-payment.

Applicable payment shall be made after the certification of completion by the site BHEL Engineer.

23.0 PROVIDENT FUND & MINIMUM WAGES

23.1 The contractor is required to extend the benefit of provident fund to the labour employed by them in connection with this contract as per the Employees Provident Fund Act 1952. For due implementation of the same, the bidder is hereby required to get themselves registered with the Provident Fund authorities for the purpose of reconciliation of PF dues and furnish us the code number allotted to them by the Provident Fund authorities with in one month from the date of issue of this letter of intent. In case any exemption from such remittance, an attested copy of authority for such exemption is to be furnished. Please note that in the event of failure to comply with the provisions of said Act, if recoveries there fore are enforced from payments due to BHEL by the customer or paid to statutory authorities by BHEL, such amount will be recovered from payments due to the contractor. Success full bidder before execution of work has to submit PF Regn. No. Labour License No. & Workmen Insurance Policy No.

23.2 The contractor shall ensure the payment of minimum labour wages to the workmen under him as per the rules applicable from time to time in the state.

24.0 OTHER STATUATORY REQUIREMENTS:

24.1 The contractor shall submit a copy of labour licence obtained from the licencing Officer (Form VI) u/r 25 read with u/s 12 of contract labour (R&A) Act 1970 & rules and valid WC Insurance copy or ESI Code (if applicable) and PF code no along with the bill.

24.2 The contractor shall submit bills along with the copies of monthly wages (of the preceding month) u/r 78 (1) (a) (1) of contract labour rules, copies of monthly return of PF contribution with remittance challans under EPF Act 1952 and copy of renewed WC insurance policy or copies of monthly return of ESI contribution with challans under ESI Act 1948 (if applicable) in respect of the workmen engaged by them.

24.3 The contractor should ensure compliance of Sec 21 of Contract Labour (R&A) act 1970 regarding responsibility of payment of wages. In case of "Non compliance of sec21 or non-payment of wages" to the workmen before the expiry of wage period by the contractor, BHEL will reserve its right to pay the workmen under the orders of appropriate authority at the risk and cost of the contractor.

25.0 TIME OF COMPLETION

25.1 The time schedule as prescribed in the contract is the essence of the contract. The time for completion shall always be reckoned from the date of commencement of work as certified by the BHEL Engineers.

25.2 The entire work shall be completed by the contractor with in the time schedule or within the such extended time as may be allowed under relevant clause.

26.0 ENGAGEMENT OF L ABOUR

26.1 The contractor will be directly responsible for provision of health and sanitary arrangements more particularly described in contract labour (regulations & Abolition) Act, safety precautions etc., as may be required for safe and satisfactory execution of the contract.

26.2 The contractor shall be responsible for proper accommodation including adequate medical facilities & transportation to the work spot and back for the personnel employed by him.

27.0 COMPLIANCES WITH LABOUR LAWS & RULES

27.1 The contractor shall comply with all state and central Laws, statutory rules, regulation etc.., relating to labour in respect of following acts and also as amended by the Government during the tenure of the contract and having in force or jurisdiction at site.

a. Payment of wages act, 1936
b. Minimum wages act, 1948
c. Workmen's Compensation act, 1923
d. Industrial dispute act, 1947
e. Employees Provident fund scheme, 1952
f. Payment of Bonus act, 1965
g. Payment of Gratuity act, 1972
h. Contract Labour (Regulation & Abollition) Act, 1970

28.0 TAXES & DUTIES:

The contractor shall pay all taxes, VT, licence fee, deposits, duties, royalty, commissions or other charges, other than such taxes specifically mentioned in the special conditions of contract, which may be leviable on account of any of his operations in executing the contract. In case BHEL is forced to pay any of such taxes, BHEL shall have the right to recover the same from the contractor either from his bills or other wise as deemed fit.

BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET- 632 406.

TECHNICAL SPECIFICATION

FOR

MIXED BED SYSTEM

ELECTRICALS, CONTROL & INSTRUMENTATION PORTION

00	11.07.13	RPS/MKV	DNB	SK	Fresh issue
Rev.No	Date	Prepared	Checked	Approved	Remarks

THIS DOCUMENT CONSISTS OF THE FOLLOWING SPECIFICATIONS:

1.0 GENERAL SPECIFICATION FOR ELECTRICAL, CONTROLS & INSTRUMENTATION:

1) ELECTRICAL, CONTROL & INSTRUMENTATION (E,C&I) scope of work by System bidder, scope of work between BHEL & BIDDER, Scope of supply for the system between BHEL and Bidder shall be as per ANNEXURE– ECI-1, ECI-2 & ECI-3 to this specification.

2) The bidder shall provide all necessary inputs to enable the Customer (BHEL) to design & procure the LT MCC, for the system.

3) All E,C&I equipment shall be suitable for the power supplies, fault levels and other climatic conditions indicated in "Project Information" mentioned elsewhere in this enquiry

4) The system bidder shall provide necessary Electrical, Control & Instrumentation equipments, Pneumatic Operated Valves (POVs), Control Valve etc. in this plant to facilitate auto operation.

5) The system bidder should furnish a "Write up on Control Description" explaining the controls, interlocks etc., for the auto operation of the system for information/review. Necessary Sequence Flow Charts, Logic Diagram etc., have to be furnished during detailed engineering to facilitate implementation of the system controls & interlocks in the PLC/DCS system.

6) Based on the inputs, the PLC/DCS Vendor will prepare the engineering software in the form of ladder diagrams for the system. The system bidder shall review and approve the ladder diagram for implementation. Once the system requirements are implemented in the PLC/DCS system after bidder's review & approval, the responsibility for proper functioning of the entire system in Auto & Manual mode shall rest with the bidder.

7) All field initiating devices like Pressure / Temperature / Flow / Level switches shall have the terminal block inside the switch enclosure to which external cables shall be wired. The terminals shall be suitable for 2.5 sq mm copper stranded conductor. Necessary plug in socket shall also be provided for electrical connection. The terminals of the field initiating devices shall be wired to junction boxes by cables with necessary cable trays & supports by bidder.

8) Junction Boxes being supplied by bidder shall comply with junction box requirements given in ANNEXURE-ECI -6.

9) Analytical instruments for pH / ORP / Conductivity / Silica / Turbidity etc. shall consist of sensor & microprocessor based analyser which shall be located in the

field. Only 4 - 20mA Single / Dual output signals from the analysers shall be brought to the PLC/DCS system where these parameters will be displayed on the PC screens using HMI software. Necessary calibration solutions / buffer powders / reagents etc. required for calibration & commissioning of analytical instruments shall be included by the bidder in his scope. The offer should include rates for such calibration solution / buffer powder / reagents and the periodicity and quantity requirement.

10) To facilitate Auto operation of the system, valve operation shall be pneumatically operated. Accordingly bidder to indicate the Instrument air requirement taking into consideration the maximum number of pneumatic valves that can operate simultaneously at any point of time.

11) Tanks shall be provided with float operated level indicators, level gauges, level transmitters and level switches, as required, with complete assembly. Suitable flanged pads for level switch mounting shall also be provided. The level indicator can be top or side mounted as the case may be.

12) All drive motors for the plant shall be supplied as per Annexure ECI-5 and Motor Data sheet enclosed. The complete data for all motors shall be furnished in the Data sheet format enclosed to motor specification, during detailed engineering.

13) Cable glands shall be of tinned brass (double compression type) conforming to BS 6121. Cable lugs shall be of heavy duty, crimping type, tinned copper / Aluminium conforming to IS.

14) Make of various equipments / items in the scope of bidder shall be as per Vendor list enclosed with the enquiry. The bidder must indicate make of various equipments clearly in the offer. The words equivalent / reputed make are not acceptable.

15) Bidder shall furnish Electrical Power Consumption for various drives in the format enclosed, along with the offer to enable the customer to design the MCC for feeding the System loads. Based on this input, starters & controls will be provided by BHEL in the UF-RO-MB Plant LT MCC. Once the system requirements are implemented in the LT MCC system, the responsibility for proper functioning of the entire system in Auto & Manual mode shall rest with the bidder.

16) Bidder shall furnish schedule of Analytical Instrument Power, control & screened cables, Indicating Quantity of cables required, within 2(two) weeks after award of contract. However, bidder shall furnish tentative quantity of power, control & screened control cables with the offer also.()

17) Any equipment, fitting and instrument though not specifically mentioned in the specification, PID and BOQ, but considered essential, necessary for the efficient and safe operation of the system shall be included in this supply by the bidder. All instruments shall be calibrated in metric units.

18) The detailed specification of various electrical / control equipments and supply system are given in the respective sections of this specification.

19) The instruments offered shall be of reputed make and shall have accuracy and Tolerances suitable for the purpose. Complete bill of material for control & instrumentation indicating make, type, range, quantity and location, number of signalling contacts, their rating, shall be provided by the bidder and any item of equipment instrument even though not included in bill of material but required as per scheme or otherwise for the completion and efficient functioning of the system shall be deemed to be included in the bill of material at no extra cost. The bidder shall provide detailed schematics for the controls and protections along with flow diagram clearly indicating all local control panel instruments. The instruments shall be of approved make as per the approval of Customer.

20) The instruments offered shall be complete with all accessories like isolating valves, automatic temperature compensation, monitoring accessories etc.. All instruments shall have a degree of protection as given in detailed technical specification.

21) Instruments / relay contacts shall conform to the relevant C&I sections of this Specification and shall be adequately rated to suit interlock / alarm circuitry requirements.

22) All auto valves shall be pneumatic operated type. Limit switches shall be provided on all the auto valves. Facility for adjusting speed of opening / closing of the valve shall be provided for each valve to prevent system upsets by quick opening / closing. Bidder shall furnish complete details of pneumatic actuator along with the offer.

23) All instruments shall be subjected to Routine & Type test as per relevant applicable latest standards. If Type tests are performed already on identical model, valid type test certificates are acceptable. Necessary Routine & Type test certificates shall be furnished by the bidder for all instruments.

24) We have enclosed a set of typical drawings for the frame works (for installation of instruments). Bidder may choose GI steel pipes for the fabrication of the frame instead of angles & channels wherever required. **Necessary SS fasteners and U Clamps are to be provided by the bidder for fixing the instruments.**

25) Bidder shall submit the detailed installation drawing for each instrument, showing the various components such as connector, SS tubing, valves, 2 / 3 / 5 valve manifolds etc. for the approval of BHEL. This is to ensure proper erection at site.

24) Junction Boxes / Field Termination Cabinets shall be provided for

(a) Termination of all sensors and transmitters located area wise
(b) Termination of transmitters to JB which is mounted on the transmitter racks.
(c) Termination of both the contacts of switches and duplex elements of Temperature measurement.

The arrangement of terminals in the field junction boxes and the system cabinets in the control room shall match 1:1 to avoid any field marshalling issues.

25) INSTRUMENTATION & CONTROL CABLES:

These shall be supplied to:

Connect field instruments to Field Junction Boxes/ Field Termination Cabinets.

Connect limit switches, torque switches and position transmitters to Field Junction Boxes / Solenoid valve Boxes.

26) Pneumatic Operated Valve / Control Valve :

26.1 Pneumatic Actuators shall be used for operating actuated valves, wherever required. All pneumatic actuators included in the scope of bidder for ON/OFF and regulating services shall be complete with all accessories including the following:
Valve Actuators Accessories
All pneumatic actuators (for valves) included in the scope of BIDDER for ON/OFF and regulating services shall be complete with all accessories including the following:

26.2 Air Filters Regulators shall be provided in the following:
Air supply line to valve positioners
Air supply line to Electro pneumatic converters
Air supply line to each Solenoid Valve Box

27) Additional requirements

a) All mounting accessories for various instruments shall be supplied as a part of basic scope of this package.

b) Erection hardware like root valves, impulse lines, 2 / 3 / 5 valve Manifolds shall also be supplied as a part of basic scope of this package.

c) Electrical equipments and instruments shall be provided with suitable earthing terminals as per relevant IS standard.

d) Instrument air will be made available at one point. Further distribution shall be taken care of by System bidder.

e) KKS tag numbering philosophy would be uniform for the entire plant. There would be a single, unique tag for a given equipment / signal.

f) After completion of all erection and commissioning works, the left out items/ spares / tools & tackles / calibration instruments etc. shall be handed over to BHEL site office.

28) The following drawings shall be referred.

a) PID drawing:	Enclosed with purchase Enquiry
b) Equipment Layout drawing:	Enclosed with purchase Enquiry
c) BOQ for EC&I ITEMS	
d) Installation Instructions	- 4-WT-310-00017
e) Instruments Mounting frame Arrangement (Typical)	- 3-WT-310-00012 To 3-WT-310-00025
f)Instrument Hook up Diagram	- 3-WT-310-00026 To 3-WT-310-00035

1.1 ELECTRICAL AND C&I SCOPE OF WORK

ANNEXURE – ECI- 1

SL. NO	ELECTRICAL, C&I SYSTEM ACTIVITY
1	Manufacture / procurement, testing at manufacturer's works, packing delivery of instruments, Instrument cables, Cable Trays & Junction Box to site
2	Supply, Receipt of supplied materials at site stores, fabrication of supports for junction box, panels, instruments, Erection & Commissioning of instruments, Junction Boxes (JB's) & Solenoid Valve enclosure Boxes(SVEB), laying & termination of Cables, erection of Cable Trays (from Equipment to JB) , Pneumatic Operated Valves (POV's), Control Valve (CV), SVEB at site
3	Laying & termination of cables between JB & Equipments, Laying & termination of copper tube thro' Air filter regulator for Pneumatic Operated Valves (POV's / SVEB), SS impulse tube for Instruments in GI perforated trays with supporting structure etc. at site
4	Calibration of all instruments at site with standard calibration solutions & standard instruments
5	Supply of tools required for erection & commissioning of instrumentation system
6	Carrying out pre commissioning Checks & test at site
7	Commissioning and putting into satisfactory operation of all instruments at site including successful of trial operation and handing over the system to end user (Customer)
8	Providing training to BHEL & End user (BHEL Customer) at site
9	Furnishing the Valve Operating sequence Chart / Control philosophy / Logic Diagram for the system
10	Furnishing all the drawings, data sheets and documents as per this specification
11	Extending support by furnishing the required drawings/documents for obtaining approvals from customer for the specification, makes, model numbers of the instruments, GA drawing, if required.
12.	Preparation of Instrument hook up & installation drawings, Cable schedule and Cable Interconnection diagrams
13	Supply of all applicable drawings as Soft copies in CD.

1.2 ELECTRICAL AND C&I SCOPE OF SUPPLY

ANNEXURE – ECI- 2

SL. NO	ELECTRICAL, C&I SYSTEM
1	Supply of Instruments as per enclosed specification / PID / E,C&I Bill Of Quantity (BOQ).
2	Supply of required erection materials (Mounting skid) for mounting the instruments, Junction Boxes, Cables, Perforated Cable trays, Steel support material & Accessories (From Equipment to Junction Box)
3	Supply of required Digital & Analog signal cables (2 /4/ 6 / 8 /12 / 24 pair) (From Equipment to Junction Box)
4	Supply of required Digital & Analog Junction Boxes (12 / 24 / 48 way) (From Equipment to Junction Box)
5	Supply of required Perforated Cable Trays to lay the Digital & Analog signal cables (From Equipment to Junction Box)
6	Supply of required erection materials for Instruments impulse line (Root valves, 2 / 3 / 5 Way manifold for instruments, Drain valves, ½" SS316 SS Tube, SS Fittings, Perforated trays for impulse tube,steel supporting structure etc)
7	Supply of required erection materials for instrument Air line from Solenoid valve enclosure box to POV's / SVEB (¼" OD PVC insulated copper tube, Brass Fittings, Air filter regulator, Perforated trays for impulse tube, steel supporting materials etc)
8	Supply of Instrument air line header (GI Rigid pipe, bends, tees, isolation / Drain valves etc.) for distribution from BHEL Supplied terminal point at one end.
9	Supply of required Solenoid valve enclosure Box (SVEB) for grouping of Pneumatic Operated Valves and supply of solenoid valve for individual POV
10	Supply of Commissioning spares as per Annexure ECI-11

1.3 ELECTRICAL AND C&I SCOPE OF WORK BETWEEN BHEL & BIDDER

ANNEXURE – ECI- 3

SL. NO	ELECTRICAL SYSTEM	ACTIVITY	AGENCY
1.	415V MCC PANEL	SUPPLY ERECTION	BHEL BHEL
2.	LT POWER & CONTROL CABLES	SUPPLY ERECTION	BHEL BHEL
3	CONTROL CABLES AND INSTRUMENTATION CABLES BEYOND JUNCTION BOX (JB), JUNCTION BOX TO PLC/DCS, PLC/DCS TO LTMCC / VFD	SUPPLY ERECTION	BHEL BHEL
4.	CABLING MATERIAL (CABLE TRAYS, SUPPORT MATERIAL ACCESSORIES AND CONDUITS ETC.) BEYOND JBS,JB TO PLC,PLC TO VFD/LTMCC	SUPPLY ERECTION	BHEL BHEL
5.	LOCAL PUSH BUTTON STATION	SUPPLY ERECTION	BHEL BHEL
6.	EQUIPMENT EARTHING	SUPPLY ERECTION	BHEL BHEL
7.	JUNCTION BOXES / SOLENOID VALVE BOXES	SUPPLY ERECTION COMMG CHECK	BIDDER BIDDER BIDDER
8	ALL CABLES BETWEEN BIDDER SUPPLIED EQUIPMENT(INSTRUMENTS, POV'S & JUNCTION BOXES / SOLENOID VALVE BOXES)	SUPPLY ERECTION COMMG CHECK	BIDDER BIDDER BIDDER
9	CABLING MATERIAL (CABLE TRAYS & STEEL SUPPORT & ACCESSORIES) BETWEEN SUPPLIED EQUIPMENT & JUNCTION BOX / SOLENOID VALVE BOX	SUPPLY ERECTION	BIDDER BIDDER
10	CABLE SCHEDULE & CABLE INTERCONNECTION DRG.	PREPARATION ERECTION VETTING	BIDDER BIDDER BHEL
11	BELOW GROUND EARTHING, LIGHTING, A/C AND VENTILATION	SUPPLY ERECTION	BHEL BHEL
12	CONTROLS AND INSTRUMENTATION (AS PER PID ENCLOSED)	SUPPLY ERECTION COMMG.	BIDDER BIDDER BIDDER
13	PLC/DCS SYSTEM	SUPPLY ERECTION COMMNG.	BHEL BHEL BHEL
14	INSTRUMENT AIR LINE DISTRIBUTION FROM BHEL	SUPPLY ERECTION	BIDDER BIDDER

	SUPPLIED TERMINAL POINT AT ONE END.	COMMG.	BIDDER
15	SS IMPULSE PIPING AND FITTINGS FOR INSTRUMENTS	SUPPLY ERECTION COMMG.	BIDDER BIDDER BIDDER
16	CALIBRATION OF INSTRUMENTS AT SITE WITH BUFFER SOLUTION.	SUPPLY SITE CALIBRATION	BIDDER BIDDER
17	IMPULSE PIPING AND BRASS FITTINGS FOR POV'S	SUPPLY ERECTION COMMNG.	BIDDER BIDDER BIDDER
18	PANELS/JB/SVEB/INSTRUMENTS MOUNTING FRAMES	SUPPLY FABRICATION ERECTION	BIDDER BIDDER BIDDER

NOTES:

1. Plug & socket type shall be provided by Bidder for equipment supplied by Bidder.
2. Cable gland & Lugs shall be provided by bidder for equipment supplied by bidder.
3. Cable glands shall be matching to cable sizes where cables are supplied by customer. Cable sizes shall be furnished to the bidder at detailed Engineering stage.
4. Cables other than Power, Control & Screened control cables are special cables.
5. Termination of cables at Bidder supplied equipments by bidder.
6. A separate packing list shall be provided along with the supply for the total no of cable glands & cable lugs. These items shall be packed in a separate wooden box and supplied.

1.4 List of drawings / documents to be submitted along with offer .

The bidder shall submit the following documents along with the offer:

a) Schedule of Makes of Instruments.
b) List of Electrical loads indicating KW etc.

1.5 List of drawings / data sheet to be submitted to be submitted within 2 weeks from the date of LOI, for the approval of the Purchaser, for all items under the scope of supply:

a) Detailed I/O list
b) Instruments Schedule in BHEL format
c) List of Electrical loads
d) Datasheet for LT Motors in BHEL format
e) Data Sheet for Instrument Cables
f) Data sheets for all items / instruments in BHEL format

g) Cable schedule and Cable Interconnection drawings (For cables in supply and erection scope of Bidder)
h) Maintenance instructions for trouble shooting, routine adjustments, assembly & disassembly instructions, off-line testing
i) Test certificates for Instruments & LT motors
j) Instruments Installation drawings for all items
k) Control Philosophy of MB plant along with Valve Operating Sequence Chart.
l) Instrument Hookup Drawings

2.0 E,C&I SPECIFICATION

ANNEXURE – ECI-4

2.1 SPECIFICATION FOR LT MOTORS

1.0 INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors. Maximum rating of the LV motor shall be 160 KW. Motors rated 0.20 KW and below shall be 240v,1Ph,50Hz motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325 Three phase Induction motors
IS : 900 Code of practice for installation and maintenance of induction motors
IS: 996 Single phase small AC and universal motors
IS: 4722 Rotating Electrical machines
IS: 4691 Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728 Terminal marking and direction of rotation rotating electrical machines
IS: 1231 Dimensions of three phase foot mounted induction motors
IS: 8789 Values of performance characteristics for three phase induction motors
IS: 13555 Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148 Flame proof enclosures for electrical appliance
IS: 5571 Guide for selection of electrical equipment for hazardous areas
IS: 12824 Type of duty and classes of rating assigned
IS: 12802 Temperature rise measurement of rotating electrical machines
IS: 12065 Permissible limits of noise level for rotating electrical machines
IS: 12075 Mechanical vibration of rotation of electrical machines
IS: 12615 Energy Efficient Squirrel Cage Induction Motors

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 All LV motors will be suitable for 415V, 3 Phase, 50 Hz power supply. System fault level shall be 50kA for 1 Sec. Design Ambient Temperature of 50˚C shall be considered.

3.2 All Motors shall be energy efficient type.

3.3 Motors shall be continuously rated at the design ambient temperature of 50˚C and other site conditions specified under Project Information indicated in main equipment specification. Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.4 Starting Requirements

3.4.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.4.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature. The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be as 80% of rated voltage during the starting period of motors.

3.4.3.The motor shall be designed for direct on line starting at full voltage. Starting current shall not exceed 6 times full load current for all auxiliaries, subject to IS tolerance.

3.4.4 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

3.4.5 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

3.5 Running Requirements

3.5.1 Minimum voltage required for starting the motors shall be 80% of rated voltage

3.5.2. Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.5.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage up to 70% of the rated voltage for duration of 2 secs.

3.6 Stress During bus Transfer

3.6.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.6.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.7 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.8 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

3.9 Locked rotor withstand time

3.9.1 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time at minimum permissible voltage specified below by at least 3 seconds or 15% of the accelerating time whichever is greater. Provision of speed switch shall be avoided to the extent possible.

3.9.2 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.

3.9.3 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

4.0 CONSTRUCTIONAL FEATURES

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors up to 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362. Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10 deg C.

4.7 (iii) Winding and insulation

All insulated winding shall be of copper.

Windings shall be impregnated to make them non hygroscopic and oil resistant.

4.8 Noise and vibration

Maximum noise level measured at a distance of 1 metre from the outer surface of the motor shall not exceed 85 dB(A)

The peak amplitude of the vibration shall be within IS specified limits.

4.9 Grounding

The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

The grounding connection shall be suitable for accommodation of ground conductors as follows:

LT Motors	
a. Fractional HP	8 SWG GI wire
b. Up to 40 KW	25 x 3 mm flat
c. 41 to 70 KW	25 x 6 mm flat
d. 71 KW and above	50 x 10 mm flat
Control Desks, Control/relay panels, LDBs, PDBs, Lighting Panels, Power receptacles, Lighting Masts, Lighting Poles	25 x 6 mm flat
LPB stations, Limit/Pressure switches, Starters, CT/PT terminal Boxes	08 SWG GI wires
Columns, Fence, Gates, Cable trays etc	25 x 6mm flat

The cable terminal box shall have a separate grounding pad.

4.10 Terminals and Terminal Boxes

4.10.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified below

Unless otherwise stated, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current Short time rating for terminal boxes below 110 kW (Contactor controlled) shall be 50 KA protected by fuse for 0.25 sec

4.10.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.10.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or V W & V respectively.

4.10.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.10.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable.

4.10.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.10.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.10.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.10.9 Suitable Double Compression type Cable glands and cable lugs shall be provided. Cable lugs shall be of tinned Copper, crimping type. The cable sizes will be informed during detail engineering.

4.10.10 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size suitable for solidly grounded system shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.11 General

4.11.1 Motors provided for similar drives shall be interchangeable.

4.11.2 Suitable foundation bolts are to be supplied along with the motors.

4.11.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.11.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956

.

4.11.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.11.6 Name plate with all particulars as per IS: 325 shall be provided

4.11.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

4.11.8 Necessary cable glands & cable lugs for the motors shall be supplied by the bidder

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the Approved quality plan

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325
Noise level measurement and vibration test as per standards shall be conducted on all motors.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.

iii) Torque vs. speed at rated voltage and minimum voltage.

For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.

iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

DATA SHEET
LT MOTORS (A.C.)

01. Application	:
02. Type	:Energy Efficient IE2
03. Frame size	:
04. Manufacturer	:
05. Rated output in KW	:
06. Duty cycle	: Continuous, S1
07. Rated voltage, no. of phases and frequency	: 415 V, 3 Ph, 50 Hz
08. Allowed voltage variation	: ±10%.
09. Allowed frequency variation	: ±5 %
10. Combined voltage and Frequency variation	: 10 % (Absolute sum)
11. At rated Voltage and frequency	
a) Full load current (Amps)	:
b) Rated speed	:
c) Full load efficiency	:
d) Full load power factor	:
e) Starting torque in % of FLT	:
12. Method of starting	: DOL
13. Degree of protection	: IP 55
14. Method of ventilation	: TEFC

15. Class of insulation : "F" (temp.rise limited to cl.B)
16. Stator winding connection : (For continuous run) (Delta / Star)
17. Full load torque :
18. Breakdown torque in % of FLT :
19. Pull up torque in % of FLT :
20. Locked rotor current in Amps : 600% with tolerance of 20%
21. Motor efficiency and P.F. at 100 % full load :
22. Locked rotor withstand time under hot/cold condition at 110 % Voltage :
23. Maximum permissible starting time :
24. No load current in Amps. :
25. Starting time in seconds with driven equipment coupled at 80 % voltage :
26. Actual temperature rise over an ambient of 50°C when motor is delivering rated output
    a) By thermometer method :
    b) By resistance method :
27. Number of successive starts with driven equipment coupled and motor initially at rated load temperature :
28. Minimum voltage required by the motor to bring the driven equipment to rated speed : To be 80% of RV.
29. Resistance per phase in ohms

at 20 degree :

30. Direction of rotation viewed from driving end :

31. Make, type and size of bearing
    a) At drive end :
    b) At Non drive end :

32. Type of mounting and shaft Orientation :

33. Location of terminal box viewed from driving end :

34. Type and number of terminals brought out :

35. Type and size of cable gland (size will be given during Detail engg)

36. Cable gland entry (Top / Bottom) :

37. Tropical & fungicidal treatment :

38. GD2 of the motor :

39. Weight of the motor :

40. Drawings To Be Submitted:
    a) OGA drawing showing the position of terminal boxes, earthing connections etc.
    b) Arrangement drawing of terminal boxes.
    c) Characteristic curves:
        i) Current vs. time at rated voltage and minimum starting voltage.
        ii) Speed vs. time at rated voltage and minimum starting voltage.
        iii) Torque vs. speed at rated voltage and minimum voltage.
        For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
        iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

ANNEXURE – ECI – 5

2.2 SPECIFICATION FOR INSTRUMENTATION CABLE

1.0.0 SCOPE :

The scope of supply of INSTRUMENT CABLE includes design, manufacture, inspection, testing, packing and delivery.

2.0.0 APPLICATION :

The cable to be supplied under this specification is intended to be used for carrying the following signals in RO-DM Plant.

1. 4 – 20 mA DC analogue signals from Transmitters, Analysers, to the PLC Panel.
2. Digital Input / Digital Output signals between PLC Panel & field instruments.

3.0.0 APPLICABLE STANDARDS :

3.1.0 The INSTRUMENT cable shall be manufactured, tested and packed as per the following standards with their latest amendment. In case of any conflict between these standards and this technical specification, the most onerous shall prevail to the extent of such difference.

IS 1554 PART 1, IS 3975, IS 3961, IS 8130, IS 5831, IS 9938, IS 10418, IS 10810, IS 8784, VDE-0815, VDE 0207 Part - 4, Part – 5, VDE 0816, VDE 0472, ANSI – MC 96.1,

3.2.0 Following standards are additionally applicable for FRLS cable, if FRLS cables are asked for in the Enquiry / Purchase order.

IEEE 3833, IEC 60322-1, ASTMD 2843-7, ASTM 2863-77, IEC 60754 – I, SS 4241475 Clause F3, DIN 53387

4.0.0 SITE ENVIRONMENT :

4.1.0 Ambient temperature : 1 ° C to 50 ° C.
4.2.0 Relative humidity : 95% at 45 ° C.

5.0.0 CONSTRUCTION OF INSTRUMENT CABLE :

The conductors shall be formed by multi-strands and insulated with PVC. Two such cores shall be twisted, and shall be taped with MELINEX and then screened with Aluminium Mylar tape. A drain wire shall be provided for individual pair screen touching the Aluminium. Then a MELINEX TAPE shall be provided on

such screened pair for screen isolation. No of screened pair as per enquiry shall be laid up, collectively screened with Aluminium Mylar tape. . A drain wire shall be provided for overall screen touching the Aluminium. Such laid – up cables shall be provided with inner sheath, armuored and outer sheath. Cables shall be suitable for continuous operation at 70 Deg.C.

6.1.0 CONDUCTOR :

6.1.1 Material : High conductivity Annealed tinned copper of electrolytic grade

6.1.2 Cross section area of conductor : 0.5 sq.mm.

6.1.3 Construction : Multi stranded.

6.1.4 Number of strands & Dia : 7 / 0.3

6.1.5 Shape : True circular before stranding, uniform quality free from defects.

6.2.0 INSULATION :

6.2.1 Voltage grade : 1100 V

6.2.2 Material : PVC Compound Type Y 13

6.2.3 Standard applicable : VDE 0207 Part -4

6.2.4 Method of application : Extrusion.

6.2.5 Thickness : 0.4 mm.(Nom.)

6.2.6 Colour : Identification of the cores and pairs shall be done with Suitable colour coding &band marking as well as by Numbering of cores / pairs as per VDE- 0815. The Details of colour coding etc., shall be as approved By the end customer during detailed engg stage.

6.2.6 Shade of colour : As per IS 9938.

6.2.7 Lay length of twin cores. : Max. 50 mm. (min. 20 twists per meter)

6.2.8 Sequence of twisting of twin cores : Right hand.

6.3.0 TAPING ON TWISTED PAIR :

6.3.1 Material : MELINEX

6.3.2 Thickness : 0.015mm(min)

6.3.3 Coverage : 100%.

6.3.4 Overlap : Min 20%

6.4.0 INDIVIDUAL PAIR SCREENING :

6.4.1 Material : ALUMINIUM MYLAR TAPE.

6.4.2 Coverage : 100%.

6.4.3 Overlap : 25% (min).

6.4.4 Thickness : 0.055 mm (min).

6.5.0 DRAIN WIRE FOR INDIVIDUAL SCREENING :

6.5.1 Material : Annealed tinned copper.

6.5.2 Area of cross section : 0.51 sq mm nominal.

6.5.3 No of strands : 7.

6.6.0 SCREEN ISOLATIONS (INDIVIDUAL PAIR SCREEN).

6.6.1 Material : MELINEX.

6.6.2 Coverage : 100%.

6.6.3 Overlap : 20%.

6.6.4 Thickness : 0.015mm(min).

6.7.0 OVERALLSCREEN :

6.7.1 Material : ALUMINIUM MYLAR TAPE

6.7.2 Coverage : 100%.

6.7.3 Overlap : 25% (min).

6.7.4 Thickness : 0.055mm(min).

6.8.0 DRAIN WIRE (OVERALL SCREEEN) :

6.8.1 Material : Annealed tinned copper.

6.8.2 Area of cross section : 0.51 sq. mm (nominal).

6.8.3 No.of strands : 7.

6.9.0 FILLERS (IF PROVIDED) :

6.9.1 Material : Non – hygroscopic, fire retardant, suitable for the operating temp of cable.

6.10.0 INNER SHEATH :

6.10.1 Material : PVC Type YM -1 with FRLS properties

6.10.2 Method of application : Extrusion.

6.10.3 Applicable standard : VDE 0207 PART - 5

6.10.4 Minimum thickness : 0.3mm

6.10.5 Colour : Black.

6.11.0 ARMOURING : Steel (galvanized) wire armouring as per IS-3975 shall be provided. Strip type of armour is not acceptable.

6.12.0 OUTER SHEATH :

6.12.1 Material : PVC Type YM -1 with FRLS properties

6.12.2 Method of application : Extrusion.

6.12.3 Applicable standard : VDE 0207 PART - 5

6.12.4 Minimum thickness : 1.8mm (VDE – 0816)

6.12.5 Colour : Black

6.12.6 Tolerance on Outer Dia : ± 2mm (max)

6.13.0 ADDITIONAL REQUIREMENT OF OUTER SHEATH:

6.13.1 Oxygen index : Minimum 29 when tested at 27 +/- 2 Deg.C as per ASTMD 2863-77.

6.13.2 Temperature index : Min.250°C at oxygen index 21(when tested as per ASTMD 2863-77.

6.13.3 Max . Acid gas generation : Not more than 20%. by weight when tested as per IEC 60754 – 1

6.13.4 Light transmission : Minimum 40% when tested as per ASTMD 2843-7. (Smoke density rating shall be max.60%. This is average value and not instantaneous value).

6.13.5 Flammability : The finished cables shall pass the flammability test as per IEC 60322-1 and IEEE 3833.

6.13.6 Flame resistance : The finished cables shall pass the flame resistance requirement as per category F3 of SS4241475

6.13.7 Hydraulic Stability and Ultraviolet test:

The cables shall pass Hydraulic Stability & Ultra-violet tests as per DIN 53387.

a. If the test is already conducted on similar size and type of cables, then valid type test certificate of not older than 5 years shall be submitted.

b. If the test is not already conducted, then the vendor has to conduct the above mentioned tests without financial and commercial implication.

6.14.0 SPECIAL REQUIREMENT OF INSTRUMENT CABLE AT 20°C :

6.14.1 Characteristic impedance @1KHz : 320 (max.)

6.14.2 Mutual capacitance between Conductors at 0.8 KHz : 120 nf / km (max.).

6.14.3 Noise interference : Better than 60 DB.

6.14.4 Attenuation at 1 KHz (max) : 1.2 dB/KM.

6.14.5 Cross talk at 0.8 KHz : Better than 60dB

6.14.6 Max.Conductor resistance at 20 deg.C : 73.4 Ohm/Km (loop

6.14.7 Insulation Resistance : 100 M Ohm / Km (min)

7.0.0 GENERAL REQUIRMENTS :

7.1.0 The cable shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operation conditions.

7.2.0 A distinct inner sheath shall be provided in all twin and multi-core armoured / unarmoured cables.

7.3.0 Repaired cables and cut bit cables will not be accepted.

7.4.0 Progressive automatic on line sequential marking including manufacturer's Name, insulation material, conductor size, no. of pairs, voltage rating, type of the cable etc., progressive marking on the length of the cable at every one metre shall be provided by printing or embossing, on the outer sheath of the cable.

7.5.0 Progressive markings to read "FRLS" at every 5 metres shall be provided by printing or embossing, on the outer sheath of the cables.

7.6.0 Allowable tolerance on overall diameter of the cable shall be $\pm$ 2 mm. Variation In diameter and the ovality at any cross section shall not be more than 1.0 mm.

7.7.0 The cables size (No. of cores and conductor cross section) shall be marked on the outer sheath of cable at every 5 metre by printing or embossing.

7.8.0 Other details as called for in IS 1554 part 1 shall also be marked on the outer sheath of the cable by printing or embossing.

7.9.0 The Inner and Outer sheath shall be resistant to Water, UV radiation , fungus, termite and rodent attack.

8.0.0 PACKING AND MARKING :

8.1.0 The cable shall be wound on a non – returnable drum of suitable size and packed.

8.2.0 Cables shall be supplied in wooden or steel drums as per IS 10418. Wooden drums shall be of seasoned wood and shall be free from defects. Wood preservative coating shall be applied on the wood. A layer of non hygroscopic PVC / polyethylene sheet shall be provided on the axial surface of the drums on the outermost layer of the cable.

8.3.0 The ends of the cable shall be sealed by means of non – hygroscopic sealing material.

8.4.0 The information as detailed in clause 18.2 of IS 1554 (Part – I) shall be stenciled on each drum.

8.5.0 The cables shall be supplied in lengths of 1000metres.

8.6.0 Tolerance on length of cable in each drum shall be ± 5%.

8.7.0 However if the enquiry / order quantity is less than or equals to 1000m, the entire quantity shall be supplied in a single length.

8.8.0 After winding the cables in 1000metres in each drum the remaining quantity shall be supplied in single length.

8.9.0 Cut bit cables will not be accepted.

8.10.0 The overall quantity tolerance on each cable size will be – 2%, + 0 %.

9.0.0 INSPECTION AND TESTING :

The cable shall be inspected and tested based on the following documents.

1. BHEL Technical Specification.
2. BHEL Purchase order.
3. BHEL Approved supplier's data sheet
4. BHEL Approved QP

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ANNEXURE – ECI-6

2.3 SPECIFICATION FOR JUNCTION BOXES &SOLENOID VALVE ENCLOSURE BOXES

2.3.1 JUNCTION BOX

1.0 SCOPE OF SUPPLY:

The scope of supply of Junction box includes manufacturing, inspection, testing, packing and delivery of junction Boxes (painted) as per this specification

2.0 APPLICATION:

The Junction boxes are used in to interconnect various field-mounted electrical equipment pertaining to RODM plant.

3.0 APPLICABLE STANDARDS:

The Junction boxes shall be manufactured and tested as per the following standards.

IS 13947 - Low voltage Switchgear and Control Gear specification.
IS 6005 - Code for Practice for Phosphate Coatings of Iron & Steel.
IS 694 - PVC insulated Cables for working voltages upto and including 1100V - specification.

4.0 SITE CONDITIONS:

4.1 Ambient temperature : 1 Deg.C to 50 Deg.C
4.2 Relative humidity : 100% RH
4.3 Atmospheric condition : Highly dusty, abrasive and polluted, conducive to fungus growth, climate is tropical. Environment is as prevalent in a coal fired thermal power station.
4.4 Design temperature : 50 Deg.C
4.5 Location : Out door

5.0 GENERAL REQUIREMENTS:

5.1 Enclosure material : 3 mm Cold rolled sheet steel
5.2 Material of Removable gland plate : 3mm Cold rolled sheet steel
5.3 Material of continuous hinge pin, rider clamp, rider spring, washers & rider bolt. : SS 316
5.4 Pre Treatment of sheet steel : Seven tank process as per IS 6005.
5.5 General construction : As per drawings forming part of this specification
5.6 Enclosure protection : IP 55 as per IS 13947
5.7 Terminal block type & arrangement : ELMEX CST 2.5 or equivalent type of BHEL approved make mounted on DIN rail
5.8 Terminal block insulating material : Melamine
5.9 Terminal block voltage grade : 650 V (Minimum)

5.10 Door Gasketing : Neoprene gasket 6 mm thick of shore hardness 20 to 30 & density 0.4 gm/cc shall be provided on all mating surfaces.

5.11 Gland plate Gasketing : Neoprene gasket 3 mm thick of shore hardness 30 to 40 & density 0.4 gm/cc shall be provided on all mating surfaces.

5.12 Door Opening : Suitable for 180 ° opening.

5.13 Lug type : Annealed tinned solder less crimping type copper lugs shall be provided for all the terminals on both sides. Lug type shall be Dowell's CP-19 pin type (insulated) or equivalent type of BHEL approved make.

5.14 Cable Gland type : Nickel chromium plated Brass Double Compression type cable glands fixed on the gland plate, with dummy plugs.

5.15 Cable Gland size & quantity : As required

5.16 Number of earthing terminals : Two.

5.17 Size & location of earthing terminals : As required

5.18 Location of earthing symbol : Just above the earthing terminal. Symbol to be black lines on yellow background.

5.19 Rated voltage grade of junction box : 415V.

5.20 Mounting fasteners : 4 sets of chromium plated bolts, nuts and spring washers for mounting the JB shall be supplied.

5.21 All seams are to be continuously welded. There shall be no holes or sockets on top and sides.

5.22 Suitable DIN rails along with clamps and screws shall be provided for terminal block mounting .All terminals are to be numbered serially by suitable identification label of PVC material in white background with black numbers. Terminal blocks shall be fixed to T.B supporting DIN rail by means of suitable end plates with screws.

Stickers have to be fixed over the cable glands to indicate the cable size.

5.24 Rolled lip shall be provided around three sides of door and around all sides of enclosure opening. This lip is to increase the strength and to keep dirt and liquid from dropping into the enclosure when the door is opened.

5.25 Name plate of 2 ply lamicoid in white colour with the inscription in black letters shall be fixed to the name plate mounting bracket on top of the junction box with plated screws.

5.26 The untoleranced dimensions shall be as per IS 2102.

6.0 MAKE OF COMPONENTS

6.1 Terminal block : ELMEX / CONNECTWELL / TOSHA CONTROLS & SWITCHGEAR / WAGO

6.2 Crimping type lug : DOWELLS / JAINSON / LOTUS

6.3 Cable glands : COMET / BRACCO / ANUP ENGG./ QUALITY PRECISION/ SUNIL & Co. / SIEMENS / CONTROLS & SWITCHGEAR / SCHNEIDER

7.0 PAINTING

The JB shall be painted with two coats of epoxy based Zinc Chromium primer and finally finished with two coats of epoxy paint as follows.

Exterior & Interior : Light grey shade 631 as per IS 5.
Finish : Semi Glossy
Paint thickness : 50 microns.

8.0 PACKING

Each JB shall be fully wrapped in a polythene cover to avoid water entry and then packed separately in cardboard box. Finally all such boxes shall be packed in a wooden crate.

9.0 DRAWING

JB Manufacturing drawings such as General Arrangement, Mounting Arrangement, Terminal Block Details in AUTO CAD/PDF shall be submitted for approval by BHEL, (prior to start of manufacture) within 10 days from the date of purchase order.

2.3.2 SOLENOID VALVE ENCLOSURE BOX (SVEB)

1.0 The solenoid valves shall be provided suitably as per the process requirement with corresponding SVEBs. . The bidder shall locate the required no. of solenoid valves inside the enclosure box and do the tubing and wiring. The solenoid valve coil wires shall be terminated in a terminal block located inside the enclosure box. The inlet ports of the solenoid valves shall be connected to a common inlet manifold to which the air supply will be connected at site using a Air Filter Regulator (AFR). The outlet / vent connections of the solenoid valve shall also be connected to respective manifolds in each SVEB using SS 316 compression type tube fittings. The external tubing & wiring connections from the SVEB to the respective POV shall be taken care of by Bidder at site. The Terminal blocks for wiring the POV limit switches shall be located inside the respective SVEB.

2.0 CONSTRUCTION:

The Solenoid Valve Enclosure Box (SVEB) shall be made from Cold rolled Sheet Steel Min 3 mm. The doors shall be hinged type. The enclosure shall be suitable for IP 55. Single piece Neoprene gasket of suitable thickness shall be provided on all mating surfaces to ensure watertight seal. Enclosure box shall have 4 fixing lugs & shall be suitable for wall mounting or angle iron frame mounting.

2.1 SOLENOID VALVE:

a) Quantity	: 01 No. for each POV actuator.
b) Type	: Single coil solenoid valve suitable for the diaphragm actuator with needle type flow control valve to adjust valve closing / opening speed.
c) Body	: Bronze
d) Plunger	: SS316
e) Pressure range	: 5 to 8 Kg/sq. cm
f) Duty	: Continuous
g) Coil Voltage	: 24 V DC.
h) Air Connection	: ¼" NPT(F)
i) Protection	: Weather proof IP65.
j) Class of insulation	: " F "
k)Manual override for solenoid valve	: Required.
l) Shut off class	: Class IV
m) Make	: As per vendor list enclosed with the enquiry.

3.0 Painting:

a) Exterior : Epoxy based paint. Light grey (Shade : 631) as per IS-5. Paint thickness 100 microns. Finish – Semi Glossy

b) Interior : Epoxy based white paint. Paint thickness 50 microns. Finish – Glossy

C) The following items are to be located in each SOV enclosure box and the box shall be sized to accommodate the same.

a) Solenoid valves – as required POVs for a filter.
b) Terminal Block (required No. of ways) – 1 Set.,
c) Cable Entry ; Bottom only
d) Double compression cable gland suitable for 2 pair x 0.5 sq. mm PVCA cable– As required for limit switch outgoing cables.
e) Double compression cable gland suitable for 8 pair x 0.5 sq. mm PVCA cable – As required for limit switch/Solenoid valve incoming cable.

Necessary SS316 tubing and compression fittings are to be supplied and mounted inside the enclosure Box for connection of the SOVs located inside.

The solenoid valve coils are to be wired to the terminal block by using 650V grade PVC insulated, 2.5 sq. mm stranded Copper flexible wire.

One No. ATC crimp type lug shall be provided on both sides of each TB.

Earthing bolts & nuts with lug shall be provided at opposite points on outside of the junction box with earth symbol.

Name plate with suitable inscription shall be provided for each box. The inscription details will be informed after ordering.

Incoming line size & common header : ½" SS316 Tube
Outgoing line size (To POVs) : ¼" OD PVC Insulated Copper Tube
Exhaust line size & Common header : ½" SS316 Tube

Terminal Block Make : ELMEX, TOSHA OR CONNECTWELL
Cable Gland : Make: COMET, SIEMENS, SUNIL
Cable Lugs : Make: DOWELLS, JAINSON, LOTUS
Wires : Make: RELIANCE, RPG, NICCO, UNIVERSAL, FORT GLOSTER, DELTON, CCI,

8.0 PACKING

Each SVEB shall be fully wrapped in a polythene cover to avoid water entry and then packed separately in cardboard box. Finally all such boxes shall be packed in a wooden crate.

9.0 DRAWING

SVEB Manufacturing drawings such as General Arrangement, Mounting Arrangement, Terminal Block Details in AUTO CAD/PDF shall be submitted for approval by BHEL, (prior to start of manufacture) within 10 days from the date of purchase order.

ANNEXURE – ECI- 7

2.4GENERAL REQUIREMENTS

1.01.00 Instruments for sensing, transmission and measuring system shall be of electronic type with signal transmission in current mode of 4-20 mA DC. For interrogation of potential free Contacts, 48V DC power supply shall be employed.

1.02.00 Tripping contact for unit as well as for equipment shall be separate from interlock and alarm contacts. Also the tripping contact for equipment and unit shall be separate. The protection system shall conform to the relevant standard as indicated in clause

1.03.00 Indicating type process switches deriving contact from pointer shall not be acceptable wherever blind switches are provided, separate gauges for local indication shall be provided to facilitate easy operation / maintenance.

1.04.00 The contacts of switch devices (process switches, limit switches) etc. unless higher rating is required for specific application, shall be rated continuously for 5A at 240 V AC, 50 Hz (breaking inductive circuits) and 0.25 A at 220V DC. Each switching element including the contacts from limit and torque switches of valve actuators shall be provided with two contacts. All spare contacts of the switch devices, shall be wired to the nearest junction box/ terminal box.

1.05.00 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.

1.06.00 All equipment/systems located in the field shall be suitable for continuous operation without loss of function, departure from specifications or damage, at the ambient temperature of 50 deg.C and relative Humidity 95%.

All electrical & electronic equipments located in hazardous areas shall be provided with explosion proof enclosures safety barriers manufactured according to internationally accepted codes NEC, BASEEFA, CENELEC, JIS, VDE, CEL, UTI etc. Applicable protection certificates (explosion proof, intrinsic safe etc.) shall be furnished for equipment to be installed in areas classified as hazardous.

Bidder must clearly bring out in his proposal the hazardous area classification for the entire plant in accordance with International codes.

1.07.00 All equipment/systems located in air conditioned areas shall also be designed and constructed to operate for short periods of plant operation when air-conditioning equipment malfunctions (without loss of function, departure from specifications requirements or damage) at the maximum ambient temperature of 50 deg. C and relative humidity of 95%. RH.

ANNEXURE – ECI- 8

2.5 MEASURING INSTRUMENTS GENERAL

1.1 Measuring instruments / equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance. They shall comply with the acceptable international standards and shall be subject to Employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, makes / numbers as approved by the Employer during detailed engineering.

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

1.3 All local gauges as well as transmitters, sensors, and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided. The Bidder shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering.

1.4 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors; switches etc. for external connection including spare contacts shall be wired out in flexible/ rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose.

1.5 **SELECTION OF RANGES FOR INSTRUMENTS**

The ranges of the instruments shall be selected based on the following Philosophy Indicated below:

For pressure measurements, the maximum operating pressure will be Within 70 to 80% of the maximum scale range. All pump suction measurements will cover the negative pressure range also.

For temperature measurement, the maximum operating temperature will be within 80 to 90% of the maximum scale range.

For pressure switches and temperature switches, the set points shall fall within 40% to 70% of the scale range selected.

For level measurement, the maximum of the range will cover the overflow point orsix inches from the top of the vessel and the minimum of the range will be six inches above the bottom of the vessel. Also, the gauge glasses will be stacked with overlap to cover permissive, alarm and trip levels.

For flow measurement, the maximum range shall be fixed at about 10 to 15% above the maximum operating flow.

For electro-chemical measurements (conductivity, pH, Silica etc.), the maximum Range will be around 10 to 15% higher than the recommended alarm settings.

2.00 TRANSMITTERS

2.01 SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, D.P., FLOW AND LEVEL ELECTRONIC TRANSMITTERS

Sr. No.	Features	Essential/Minimum Requirements
1.	Type of Transmitter	Microprocessor based 2 wire type, Hart protocol compatible.
2.	Accuracy	± 0.1% of calibrated span (minimum)
3.	Output signal Range	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)
4.	Turn down ratio	10:1 for vacuum/very low pressure applications.30:1 for other applications.
5.	Stability	± 0.1% of calibrated span for six months for Ranges up to and including70 Kg/cm².

		± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm²(g).
6.	Zero and span	+/- 0.015% per deg.C at max span. +/-0.11% per drift deg.C at min. span.
7.	Load impedance	500 ohm (min.)
8.	Housing	Weather proof as per IP-55 with durable corrosion resistant coating.
9.	Over Pressure	150% of max. Operating pressure
10.	Connection (Electrical)	Plug and socket type
11.	Process Connection	1/2 inch NPT (F)
12.	Span and Zero adjustability	Continuous, tamper proof, Remote as well as manual from instrument with Zero suppression and elevation facility.
13.	Accessories	-Diaphragm seal, pulsation dampeners, Siphon etc. as required by service and operating condition. -2 valve manifold for absolute pressure Transmitters (3-valve manifold for gauge / vacuum pressure transmitters) and 5 valve manifold for DP/level/flow transmitters. -For hazardous area, explosions proof enclosure as described in NEC article 500.
14.	Diagnostics	Self Indicating feature
15.	Power supply	24V DC ± 10%.
16.	Adjustment /calibration/ maintenance	Centralised PC based system. In addition total two (2) nos. of hand- held type universal calibrators per module, compatible with HART protocol , shall be provided.

Notes :

In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold. LVDT type is not acceptable.

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

4.00 SPECIFICATION FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.

Sl. No	FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
	Gauge/	Pr. Gauge/ DP Gauge Draught gauges	Temperature	Level Gauge*
1	Sensing Element and material	Bourdon for high pressure, Diaphragm/ Bellow for low Pr. of 316 SS	Mercury in steel for below 450°C and inert gas actuated for above 450°C of SS bulb and capillary.	Tempered, toughened Borosilicate gauge glass steel armoured Reflex or Transparent type
2.	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon.steel / 304 SS
3	Dial size	150mm	150 mm entire range	Tubular covering
4	End connection	1/2 inch NPT (F)	3/4" NPT (F)	Process connection as per ASME PTC and Drain / vent 15 NB
5	Accuracy	±1% of span	± 1% of span	± 2%

6	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
7	Range selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale
8	Over range test	Test pr. for the assembly shall be1.5 to the max. Design pr. at 38°C.		
9	Housing dust proof as	Weather and dust proof as per IP-55	Weather and leak proof per IP-55	CS/304 SS
10	Zero/span adjustment	Provided	Provided	–
11	Identification name plate	Engraved with service legend or laminated phenolic		
12	Accessories siphon, snubber, for transparent	Blow out disc, dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell KEL-F shield	Gasket for all pulsation type vent and drain, valves of Steel/SS as per CS/Alloy process Requirement.
13	Material of Bourdon/ movement	316 SS / 304 SS		316 SS / 304 SS

Notes:-

* Bicolour type level gauges will be provided for application involving steam and water except for condensate and feed water services

Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.
Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

5.00 BYPASS ROTAMETERS

Sl. No.	Features	Essential / minimum requirements
1.	Type	Orifice plate bypass type
2.	Fluid media	Water
3.	Tube body	SS316
4.	Material of float	316 SS
5.	Indicator	Linear scale
6.	Accessories	Flange, orifice in case of bypass Rota meter (for line size above 100 mm)
7.	Housing protection class	IP-55
8.	Accuracy	+ 2% of measured value.
9.	Repeatability	+/- 0.5% of full scale.
10.	Flow rangeability	Greater than 3
11	Packing	Teflon

6.00 PROCESS ACTUATED SWITCHES

FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
	Pressure/ Draft Switches/ DP Switches	**Temperature switches**	**Level switches**
Sensing	Piston actuated types Element and diaphragm or bellows for low pr. / Vacuum	Vapour pressure for high pressure filled bellow type With SS bulb and capillary (10M minimum)	Float type switches for sensing, liquid medium, Condensate application.
Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS

End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard
Over range proof	150% of max. design pr.	- Pressure	150% of max. design Pressure
Repeatability	+ 0.5% of full range		
No. of contacts	2 No.+2NC. SPDT snap action dry contact		
Rating of contacts	60 V DC, 6 VA- (or more if required by DDCMIS		
Elect. Connection	Plug in socket		
Set point/ dead band adjustment	Provided over full range		
Enclosure	Weather and dust proof as per IP-55		
Accessories	Siphon, snubber, Chemical seal pulsation dampeners as required by process	Thermo well of 316 SS and packing glands	All mounting accessories
Mounting	Suitable for enclosure/ rack mounting or	Suitable for rack mounting or direct mounting direct mounting	-
Power Supply Required)	24 V DC to be arranged by Bidder except for Ash level Switches where the same shall be as per Bidder's (wherever Standard practice		

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

6.01 FLOW SWITCHES

Flow Switches shall be with paddle & bellows sensors with paddle MOC of SS316 & Bellows MOC SS 316L. Wetted parts shall be SS316. Enclosure shall be Die Cast Aluminuim with weather proof to IP66 and suitable for ambient temp of 50 deg C. Mounting shall be vertical/direct on line. Electrical connection shall be through 7 pin plug-in connector. Suitable process connection shall be selected. Range shall be suitable for process requirement with repeatability of ±2% of Full Scale Reading. The switches shall be SNAP acting Micro Switches suitable for 240V AC, 15A with 2 NO + 2 NC SPDT Dry Contact. The set point adjustability should be over the full range.

7.00 SPECIFICATION FOR FLOW ELEMENTS

7.01 Orifice Plate

Features	**Essential/Minimum Requirements**
Type	Concentric as per ASME PTC-19.5 (Part-II), SA RP-3.2, 1960 or BS-1042
Material	316 SS
Thickness	3mm for main pipe diameter upto 300mm and 6mm for main pipe dia above 300 mm.
Material of branch pipe	Same as main pipe
Root valve type	Globe / Needle
Root valve material	316 SS
Root valve size	1 inch
Impulse pipe of same material up to root valve	Required
Tappings	Flanged weld neck. 3 pairs. of tapping.
Beta Ratio	0.34 to 0.7
Beta Ratio calculation to be submitted	Yes

Assembly drg. and flow Vs DP Curves	Yes
Accessories	Root valves, flanges, Vent/drain hole (As required)

Bidder shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of commutated flow calculations.

Each flow element shall have the name plate engraved on the element. This name plate shall have details of tag no, make, serial no, body material, beta ratio, line size, thickness, flow direction etc. as minimum. All these details shall also be put on the additional tag plate attached to the flow element, which shall be easily visible from outside of the insulation.

Air Filter Regulator (AFR)

Constant bleed type AFR with an accuracy of +0.1%, inlet pressure range of 5-8 kg/ cm2 and suitable spring ranges (AFR) for use with positioners in control valves, control damper, E/P convertors and shut off valves for phosphor bronze filter element; Filtering particles above five microns.
Weather and water proof enclosure. Material of accessories will be SS.

Air filter regulators shall be provided in the :

(a) Air supply line to valve positioners / power cylinders
(b) Air supply line to electric to pneumatic converters.
(c) Air supply line to pneumatic interlocked block valves.
(d) For each instrument rack, field instruments enclosure for purging.

SPECIFICATION FOR SILICA ANALYSER

01. Item : Silica Analyser

02. Application / Medium : To suit the system requirement.

03. Ambient Temperature : 50 Deg.C.

04. Surrounding Atmosphere : Dusty, humid & corrosive atmosphere .

Relative humidity - 100%.

05. Design Condition : To suit the system requirement.

06. Scope of Supply : Analyser is to be offered as a complete working system along with the necessary sample conditioning system, if any, reagent chemicals, Indicator etc. housed in an enclosure.

07. **Analyser:**

a) Type : Solid State / Microprocessor based
b) Make : As per Approved Vendor's list
c) Range : 0.00 to 5000 ppb as SiO2, Auto ranging.
d) Accuracy : ± 2 ppb
e) Minimum Detection Limit : 0.5 ppb
f) Number of sample streams : 6 (Six)
g) Response Time : Better than 12 min. for 90% change.
h) Calibration : Auto & Manual calibration, Programmable on front key board.
i) Features : Auto Zero & span calibration, Ambient temperature Compensation.
j) Indicator : Integral
k) Display : LCD display with backlit.
l) Recorder Outputs : Single / Dual 4-20mA DC isolated linear signal.
m) Alarms (Self Diagnostic feature) : a) No reagent
b) Calibration Fault
c) Silica Concentration High
d) Analyser system shutdown.
n) Power Supply : 240V, 50Hz, 1ph, AC
o) Housing : Corrosion proof plastic enclosure, weather water proof.
p) Mounting : To suit Bench top / Wall / Panel mounted type.
q) Cable Termination : Terminal block to suit 2.5 sqmm wires.

08. **Calibration Solutions** :

Calibration solutions, if any, required during commissioning of the system should be offered as part of the Silica Analyser. Offer for the same should also be given for periodic calibration.

09. **Reagent Chemicals**:

Bidder to supply the Analyser with 1 set of reagent chemicals in Standard package. Bidder to submit offer for reagent chemicals

mentioning the periodicity of replacement. Bidder to supply reagents as commissioning spares in addition to supply made for silica analyser in standard package.

10. **Reagent Chemical Guarantee**:
Bidder to submit guarantee for reagent consumption . If the Quantity Consumption exceeds the guaranteed quantity, Bidder shall supply the additional quantity of reagent free of cost. This guarantee shall be valid for the guarantee period.

SPECIFICATION FOR pH ANALYSER

01. Item	: pH Analyser
02. Application / Medium	: To suit the system requirement.
03. Ambient Temperature	: 50 Deg.C.
04. Surrounding Atmosphere	: Dusty, humid & corrosive atmosphere . Relative humidity - 100%.
05. Design Condition	: To suit the system requirement.

06. **Sensor** :

a) Installation	: Mounted on bypass line. Flow through chamber or Tee to be offered for bypass line installation.
b) Measuring Electrode	: Double junction, combined electrode housed in tough, corrosion proof body.
c) Accessories	: i) Pre-Amplifier if required ii) Screened junction box for electrodes.
d) Temperature Compensation	: Automatic (integral) upto 0-100 ° C.
e) Wetted Parts	: Bidder to select suitable for the medium.
f) Sensor Connection	: Suitable for threading to flow thro' chamber mounted on bypass line.
g) Sensor to Indicator Cable Length	:10 Mtrs. (Per mtr. Rate to be offered for ordering additional length, if required).

07. **Analyser :**

a) Type	: Solid State / Microprocessor based
b) Scale Range	: 0-14 pH
c) Mounting	: Wall / Panel / Pipe mounted type

d) Protection Class : NEMA 4X, IP 65, weather & water proof
e) Display : Digital.
f) Temperature Compensation : Automatic (-15 to 100 Deg. C)
g) Calibration : Calibration with standard
m) Features : a) Zero & span adjustableAuto zero check
b) Manual zero and span calibration.
n)Output : Single / Dual 4-20 mA Isolated
o) Alarms : pH High/Low

08. **Performance**:
a) Accuracy : ± 0.02 pH
b) Power Supply : 240V, 50Hz, 1ph, AC
c) Cable Termination : Terminal block to suit 2.5 sqmm wires.
d) Stability : +/- 0.01 pH / Month, non cumulative

SPECIFICATION FOR CONDUCTIVITY ANALYSER

01. Item : Conductivity Analyser

02. Application / Medium : Demineralised Water.

03. Ambient Temperature : 50 Deg.C.

04. Surrounding Atmosphere : Dusty, humid & corrosive atmosphere .
Relative humidity - 100%.
05. Design Condition : To suit the system requirement.

06. **Sensor :**
a) Installation : Mounted on bypass line. Flow through chamber or Tee to be offered for bypass line installation.
b) Measuring Electrode : Unbreakable electrode housed in tough, corrosion proof body.
c) Preamplifier (if required) : Integral with the sensor.
d) Temperature Compensation : Automatic (integral) upto 0-100 ° C.
e) Wetted Parts : Bidder to select suitable for the medium.
f) Sensor Connection : Suitable for threading to flow thro' chamber mounted on bypass line.

g) Sensor to Indicator Cable Length : 10 Mtrs. (Per mtr. Rate to be offered for ordering additional length, if required).

07. **Analyser** :

a) Type	: Solid State / Microprocessor based
b) Scale Range	: To suit the system requirement.
c) Mounting	: Wall / Panel / Pipe mounted type
d) Protection Class	: IP 55, weather & water proof
e) Display	: LCD / LED with alarm status and Indications.
f) Temperature Compensation	: Automatic (0-100 Deg. C)
g) Calibration	: Calibration with standard buffer solution.
h) Alarms	: High
i) Accessories	: 2 Adjustable set points
j) Output Signal	: Single / Dual Isolated 4-20 mA DC linear signal.
k) Enclosure	: Corrosion proof plastic enclosure.
l) Auto Calibration	: To be provided.
m) Features	: Zero Check.

08. **Performance**:

a) Accuracy % FSD	: $\pm$ 1
b) Power Supply	: 240V, 50Hz, 1ph, AC
c) Cable Termination	: Terminal block to suit 2.5 sqmm wires.
d) Stability	: 0.5% of reading / month.

(ANNEXURE – ECI -9)

2.6 SPECIFICATION FOR PNEUMATIC ACTUATOR

01 ACTUATOR:

a) Quantity	: 01 No. for each Pneumatic Operated Valve (POV)
b) Type	: Pneumatic Diaphragm Actuator, Double / single acting (as per process requirement)
c) Action	: Air to Open & Air to Close
d) Pressure	: 5 to 8 Kg /sq. cm
e) Air Connection	: ¼" NPT(F) copper tube.
f) Local Position Indicator	: To be provided.
g) Hand wheel for manual operation	: Required
h) Speed adjustment for Actuator operation	: To be provided to facilitate speed : adjustments both during opening & : closing by means of flow control valve.
i) Action of driving equipment on air failure, power supply failure	: : Stay put :
j) Type of operation	: I) Solenoid Valve Energised for valve to open & Solenoid Valve De-energised for valve to close OR II) Solenoid Valve De-energised for valve to open & Solenoid Valve Energised for valve to close The above requirement shall be informed during order Execution stage for each POV. Bidder to supply accordingly.
k) Actuator Make	: As per vendor list enclosed with the enquiry.

02 LIMIT SWITCHES:

a) Quantity	: One for Open & one for Close position for each POV.
b) No. of Contacts	: Two normally open & two normally closed potential free contacts in each limit switch corresponding to open & close positions of the valve.
c) Contact Rating	: 5A,240V AC , 0.5A, 220 V DC
d) Protection	: Weather proof IP 55.
e) Cable Gland	: Suitable for 2P x 0.5 sq mm PVCA cable.
f) Limit Switch Box	: Limit Switch terminals shall be brought out to a Terminal Box

NOTE:

All the analysers / cells shall have open corrosion resistant SS drain channel to waste header.

All chemicals reagents required for 12 months operation is to be supplied in phased manner depending on shelf life in addition to that indicated under mandatory spares. Availability of chemical reagents for future use shall be ensured from indigenous source.

Two years consumable kits for each analyser shall be supplied with each analyser. This shall be over and above the standard consumable kit supplied by OEM for commissioning of analyser.

ANNEXURE- ECI – 10

2.7 IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS

1.01 All impulse pipe shall be of seamless type SS316 material.

1.02 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/erection of the local instruments shall be furnished, even if not specifically asked for, on as required basis. The instrument fittings shall be of forged SS. Instrument piping shall be designed for maximum design pressure & temperature of the process. Pressure instrument connection shall be ½" or 12 mm pipe connection. The contacts of equipment mounted instruments, sensors, switches etc for external connection including spare contacts shall be wired out to the LCP.

1.03 The valve manifolds shall be of 316 stainless steel with pressure rating suitable for intended application. 2-valve manifold and 3-valve manifold shall be used for pressure measurements using pressure transmitters/ pressure switches and differential pressure transmitter/ switches respectively. 5-valve manifold shall be used for remaining applications like DP, flow and level measurements.

1.04 For Pr. / D.P gauges in fluid application two-way globe valve on each impulse line to the instrument and in Air / Flue gas application two-way gate valve on each impulse line to the instrument shall be provided near the instrument. These shall be in addition to the three ways gauge cock provided along with the pr./D.P gauges.

1.05 All the threaded tube fittings used in the plant shall be of the NPT type threading. All the tapping points and pipe to tube joints shall also be using the NPT type threading. Any deviation from the NPT type threading shall be Notified to the Customer specifically for the ease of the maintenance.

1.06 Tube Fittings:

1.06.1 All the threaded tube fittings used in the plant shall be of Stainless Steel double compression type.

1.06.2 All fittings used in the impulse tubing / piping except the last fitting connecting the instrument shall be socket welded.

2.00 AIR SUPPLY PIPING

2.01. All pneumatic piping, fittings, valves, air filter cum regulator, purge rotameter and other accessories required for instrument air for the various pneumatic devices/instruments shall be provided.

2.02 This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements etc.

2.03. For individual supply line and control signal line to control valve, 1/4-inch size light drawn tempered copper tubing conforming to ASTM B75 shall be used. The thickness of cu-tubing shall not be less than 0.065 inch and shall be PVC coated. The fittings to be used with copper tubes shall be of cast brass, screwed type.

2.04 All other air supply lines of 1/2 inch to 2 inch shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty with threaded ends. The threads shall be as per ASA B.2.1. Fittings material shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1.Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs.

2.05. All instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply. The filter regulators shall be suitable for 10-kg/ sq.cm max. inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge and built in filter housing blowdown valve. The end connection shall be 1/4 inch / 1/2 inch/ 3/4 inch NPT as per the requirement to be finalised during detailed engineering.

2.06 All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.

3.00 INSTALLATION AND ROUTING

3.01. All instrument piping, tubing and its accessories shall be supported in a safe manner to prevent excessive vibrations and anchored sufficiently to prevent undue strain on connected equipment. Instrument piping & tubing shall not be routed across equipment removal areas, above or below monorails, cranes, removable gratings, cable trays.

3.02. Instrument Air & Service Air Piping/ Tubing System

3.02.01 The air supply headers, sub-headers and branch pipes shall be supported properly by clamps or supports to be provided and fabricated by the Bidder. Air supply piping shall be installed with a slope of over 1/100 to prevent accumulation of condensed water within the pipe. Signal/control air tubings shall run with the minimum number of changes in direction. Suitable

identification tags shall be provided for easy link up and checking of proper connections. Single and multi tubes shall run with the minimum number of changes in direction. Suitable identification tags shall be provided for easy check-up and for connections.

4.00. PIPING/ TUBING SUPPORT

4.01. Impulse piping and sample piping shall be supported at an interval not exceeding 1.5 meters. Each pipe shall be supported individually using slotted angle mounted clamps with necessary fixtures. Tubing shall run in proper perforated trays with proper cover. Tubing shall be supported inside the trays by aluminium supports. Hangers and other fixtures required for support of piping and trays shall be provided, either by welding or by bolting on walls, ceilings and structures. Hanger clamps and other fastening hardware shall be of corrosion resistant metals and hot-dip galvanized.

5.00 **Cable trays, support systems and pipes**

5.01 Support system

Cable trays/junction box/SVEB supports shall be made of MS angles/channels cut to size and welded at site to suit the requirement.

5.02 Type of cable trays

Material of cable tray Shall be Rolled mild steel, min. 2.5 mm thick for trays and 3mm thick for coupler plate. Finish of cable trays Shall be hot dip galvanised Trays. Length of the cable trays shall be 2.5 metres.

5.03. The cable sub-trays and the supporting system, to be generally used between Local/ Group JBs and the main cable trays and the same shall be furnished and installed by the Bidder. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure up to the main cable trays (trunk route).

5.04 The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. & shall be electrically continuous and solidly grounded. The cable trays shall not have sharp edges, burrs or projections injurious to the insulation or outer sheath of the cables.

5.05 The supporting arrangement of cable tray system shall be able to withstandthe weight of the cable and cable tray system. The supporting interval shall not be more than the recommended span for the above loading for the type of cable tray selected. The tray shall not overhang by more than one meter from the support at the dead end. As far as practicable the cable sub-tray system shall be supported from one side only, in order to facilitate installation and maintenance of cables.

5.06 Pipe size & type

Shall be Suitable with 40% fill criteria.GI conduits shall be of heavy duty confirming to IS: 9537.

5.07 Cable lugs and ferrules

Lugs and ferrules for aluminium Bidder cables shall be aluminium solder less crimping type. Copper cable lug/ ferrule shall be solder less tinned copper crimping type.

5.08 Cable clamping

All cables laid on trays shall be neatly dressed up & suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided.

ANNEXURE – ECI- 11

2.8 COMMISSIONING SPARES (To be supplied in addition to the sensor/reagent supplied along with instrument)

The following items shall be considered as commissioning spares.

a) pH Sensor - 1 No

b) Silica Reagents – 1 set

DRAWING NO. 1-WT-220-00248

ALL DIMENSIONS ARE IN MILLIMETRES

BHEL SCOPE / VENDOR SCOPE

INSTRUMENT AIR LINE — MOC : HEAVY GRADE GI — INSTRUMENT AIR LINE

FEED INLET · BACKWASH OUTLET · ALKALI INTLET · DOWN FLOW INLET · POWER WATER INTLET · MIDDLE COLLECTOR FLUSHING INLET · MIDDLE COLLECTOR FLUSHING OUTLET · AIR INLET · BACKWASH INLET · ACID INLET · UP FLOW INLET · TO SIO2 · PRODUCT OUTLET · RINSE OUTLET · COND · TO NEUTRALISING PIT

MIXED BED - 1 | MIXED BED - 2 | MIXED BED - 3

8" NB MOC : MSRL — MB FEED I/L — MB OUTLET — FROM MB-1 / FROM MB-2 / FROM MB-3 — SIO2

MB FEED I/L — ALKALI MOC : CPVC — ACID MOC : CPVC — POWER WATER — AIR — INSTRUMENT AIR LINE

MOC : HEAVY GRADE GI — MOC : SS316 — TP-4 — TO DMWST-2 / TO DMWST-3

MOC : MS/MSRL — MOC : CPVC — MOC : MSRL

NC-SA — 8"NB MSRL — 6"NB MSRL — 10" NB MSRL

LA · LL · L · H · LI · LS · PI · PIT · PS · M

TP-3 — VENDOR SCOPE — BHEL SCOPE

RO STAGE-II PERM. WATER STORAGE TANK
1 NO.
(RCC-200 M³)

MB FEED PUMPS (1,2&3)
(2W+1S)
FLOW : 87 M³/Hr min/
VENDOR TO CONFIRM
HEAD : VENDOR TO SPECIFY

FUME ABSORBER · TANK-1 · TANK-2 · EJECTOR

ACID MEAS. TANK (1&2)
(1W+1S)

CUST. DIL. TANK (1&2)
(1W+1S)

TO NEUTRALISING PIT

MB BLOWERS
(1W+1S)
FLOW-540m³/hr (min.)/
VENDOR TO CONFIRM
HEAD : VENDOR TO SPECIFY

TP-6 — BULK ACID STORAGE TANKS

TP-7 — BULK CAUSTIC STORAGE TANKS

BY-PASS · DMWST-1

DM REGEN. PUMPS (1&2)
(1W+1S)
FLOW : VENDOR TO SPECIFY
HEAD : VENDOR TO SPECIFY
TP-5

DM WATER STORAGE TANKS
QTY: 3 NOS
FLOW : 800 m³ STEEL TANK.

FROM RO STAGE-1 STREAM 1 · FROM RO STAGE-1 STREAM 2 · DUCT (MS) · TP-1 · TP-2 · PS · M · DRAIN · TO RO STAGE-2 FEED PUMP

DEGASSER TOWER
TYPE : VERTICAL
FLOW RATE : 105 M³/Hr EACH
MOC : MSRL
QTY : 2W

DEGASSER BLOWERS (1,2,3&4)
TYPE : CENTRIFUGAL
CAPACITY : VENDOR TO SPECIFY
STATIC HEAD : VENDOR TO SPECIFY
MOC : MS FABRICATED
QTY : 2W+2S

DEGASSED WATER STORAGE TANK
CAPACITY : 200 CUM.

DEGASSER SYSTEM

LEGEND :

- PUMP
- AIR BLOWER
- BUTTERFLY VALVE (MANUAL)
- NON RETURN VALVE
- DIAPHRAGM VALVE (MANUAL)
- BUTTERFLY VALVE WITH LIMIT SWITCH (MANUAL)
- DIAPHRAGM VALVE (AUTO-NORMALLY CLOSE) NC-SA
- DIAPHRAGM VALVE (AUTO-NORMALLY OPEN) NO-SA
- PR. RELIEF VALVE
- DAMPER VALVE
- BALL VALVE
- CONC. REDUCER
- ECCEN. REDUCER
- FLEXIBLE CONNECTOR
- RESIN TRAP
- DUMP/DRAIN
- SAMPLE
- INTERLOCK
- 3-WAY MANIFOLD

L – LOW · LL – LOW LOW · H – HIGH · DPS – DIFF. PR. SWITCH · DPI – DIFF. PR. INDICATOR

PI – PR. INDICATOR · PS – PR. SWITCH · PIT – PR. TRANSMITTER · LS – LEVEL SWITCH · LI – LEVEL INDICATOR · LIT – LEVEL TRANSMITTER · COND – CONDUCTIVITY · pH – pH MEASUREMENT · FE – FLOW ELEMENT · FS – FLOW SWITCH · FIT – FLOW TRANSMITTER · SiO_2 – SILICA ANALYSER · DI – DENSITY INDICATOR

- PROCESS LINE
- PROCESS LINE (BHEL SCOPE)
- AIR LINE
- INSTRUMENT AIR LINE
- ACID LINE
- ALKALI LINE
- DRAIN LINE

TERMINAL POINT DETAILS

MARK	DESCRIPTION	PIPE SIZE NB	FLANGE CONN DETAIL	LOCATION
TP-1	DEGASSER I/L	200 NB	FLANGE DRILLING SHALL BE AS PER IS 1538 SHALL BE FIXED OFF CMS	AS PER EQPT. LAYOUT DRG. NO: 2-WT-220-00064
TP-2	DEGASSER O/L	200 NB		
TP-3	MB FEED PUMP SUCTION HDR.	250 NB		
TP-4	MB OUTLET HDR.	200 NB		
TP-5	MB REGEN PUMP SUCTION	VENDOR TO SPECIFY		
TP-6	BULK ACID TANK O/L	65 NB		
TP-7	BULK CUSTIC TANK O/L	65 NB		
TP-8	INST. AIR LINE	50 NB		

NOTES:

1. VENDOR TO SPECIFY THE PIPE LINE SIZE AND MOC IN THE DRAWING FOR APPROVAL. THIS SHALL BE IN LINE WITH THE SPECIFICATION.
2. TP – TERMINAL POINT

FOR TENDER PURPOSE ONLY

REV	DATE	ALTERED : CHECKED :

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: UF-RO-MB PLANT
RPCL-YERAMARUS -2X800MW

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

	NAME	SIGN	DATE	NO.OF VAR.
DRN	DBN/BBS		04.07.13	
CHD	PALANI		04.07.13	
APPD	SK		04.07.13	

DEPT NP	GRADE OF UNTOL.DIM	SCALE	WEIGHT (KG).	REF. TO ASSY/OLD DRG.	ITEM NO.	NO. OF ITEMS
CODE 976	PR:QA-500	---	---	1-BW-220-00047 REV.01		

TITLE: P & ID OF MB AND DEGASER SYSTEM

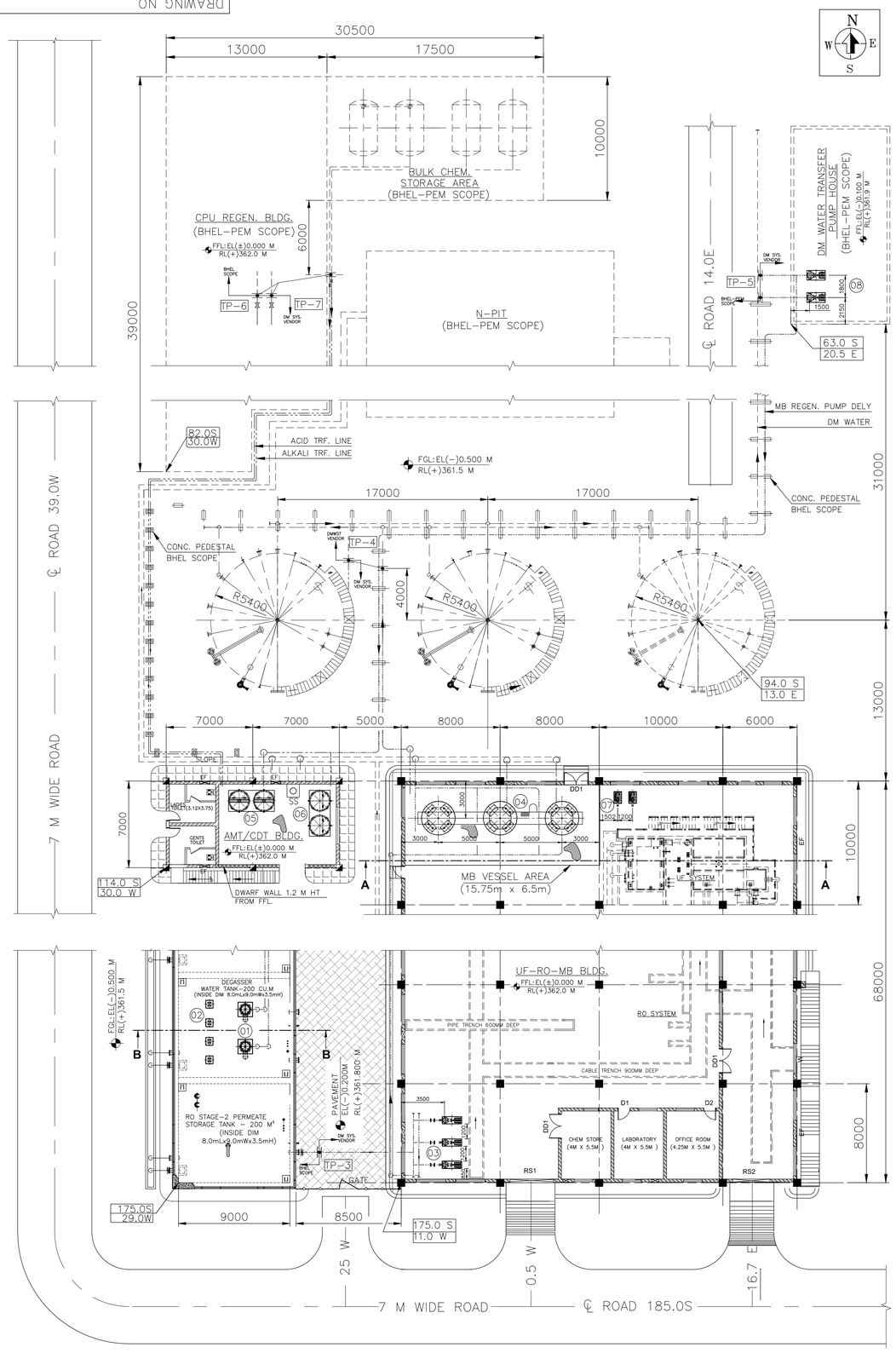
CARD CODE: U 01

DRAWING NO.: 1-WT-220-00248

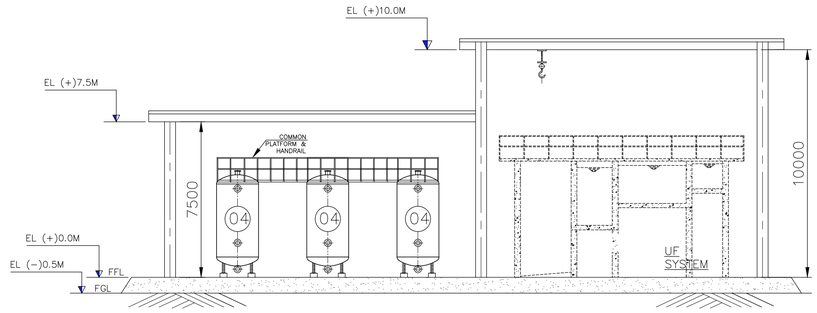
REV: 00

Size A1

DRAWING NO. **2-WT-220-00064**

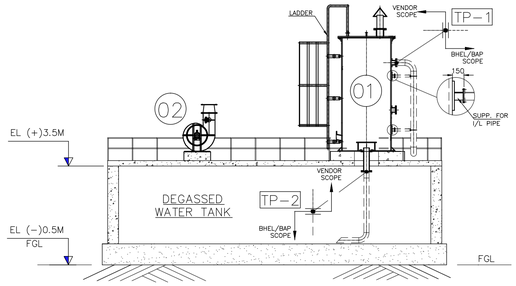


MB & DEGASSER SYSTEM PLAN



SECTION - AA

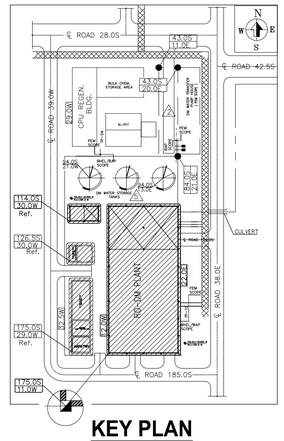
(D–2)



SECTION-BB

(E–1)

ALL DIMENSIONS ARE IN METRES



KEY PLAN

EQUIPMENT LIST:-

EQPT. NO	DESCRIPTION	QUANTITY	EQPT. SIZE (LxBxH)	WORKING WT. (In Kg.)	ZONE	REMARKS
01	DEGASSER TOWER	2W	VENDOR TO SPECIFY	VENDOR TO SPECIFY	E–2	
02	DEGASSER AIR BLOWER	4(2W+2S)			E–1	
03	MB FEED PUMP	3(2W+1S)			E–3	
04	MIXED BED UNIT	3(2W+1S)			D–3	
05	ACID MEASURING TANK	2(1W+1S)			D–2	
06	ALKALI MEASURING TANK	2(1W+1S)			D–2	
07	MB AIR BLOWERS	2(1W+1S)			D–3	
08	MB REGENERATION PUMPS	2(1W+1S)			B–4	

TP DETAILS

MARK	DESCRIPTION	PIPE SIZE NB	FLANGE CONN DETAIL	LOCATION
TP–1	DEGASSER I/L	200 NB	FLANGE DRILLING SHALL BE AS PER ANSI B 16.5#150 AND SHALL BE FIXED OFF C'RS	DEGASSER TOWER WATER I/L NOZZLE. EL. ––
TP–2	DEGASSER O/L	200 NB		DEGASSER TOWER WATER O/L NOZZLE. EL.+3.3M
TP–3	MB FEED PUMP SUCTION HDR.	250 NB		RO–2 PER. TANK O/L NOZZLE EL. ~(+)0.2M
TP–4	MB OUTLET HDR.	200 NB		90.0 S/12.5 W / BOP EL. ~(+)0.0M
TP–5	MB REGEN PUMP SUCTION	VENDOR TO SPECIFY		61.5 S/18.0E / BOP EL. ~(+)0.3M
TP–6	BULK ACID TANK O/L	65 NB		59.0 S/17.5 W / BOP EL. ~(+)0.35M
TP–7	BULK CUSTIC TANK O/L	65 NB		59.0 S/17.5 W / BOP EL. ~(+)0.35M
TP–8	INST. AIR LINE	50 NB		NEAR MB VESSEL AREA

NOTES :

1. POWER HOUSE (TG HALL) FINISHED FLOOR LEVEL IS EL.(±)0.00M WHICH CORRESPONDS TO RL(+)362.0M.
2. RO–DM PLANT FINISHED FLOOR LEVEL (FFL) IS EL.(±)0.00M WHICH CORRESPONDS TO RL(+)362.0M.
3. RO–DM PLANT FINISHED GRADED LEVEL (FGL) IS EL(–)0.5M WHICH CORRESPOUNDS RL(+)361.5.
4. EQPT. LOCATION DIMENSIONS AND PIPE LINE ROUTING ARE SUGGESTIVEE. IT MAY BE MODIFIED DURING DETAILED ENGG. AND TO SUIT SITE CONDITION.
5. ACID AND ALKALI SHALL BE TRANSFERED FROM THE BULK STORAGE TANKS TO THE AMT/CDT BY GRAVITY. BULK STORAGE TANKS O/L NOZZLE EL. SHALL BE APROX. +3.0M

LEGEND:

—— – – —— VENDOR SCOPE PIPE LINES

– – – – – – – – BHEL SCOPE PIPE LINES / EQUIPMENTS

REF. DRAWING:

1. P&ID OF MB AND DEGASSER SYSTEM : 1–WT–220–00248 REV.00

FOR TENDER PURPOSE ONLY

REV	DATE	ALTD	
		CHD	

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: **UF-RO-MB PLANT**
RPCL-YERAMARUS -2X800MW

EPC CONTRACTOR
BHARAT HEAVY ELECTRICALS LTD.
UNIT: BOILER AUXILIARIES PLANT, RANIPET – 632 406.

	NAME	SIGN	DATE	NO.OF VAR.
DRN	BBS		04.07.13	
DESN	BBS		04.07.13	
CHD	PPALANI		04.07.13	
APPD	SK		04.07.13	

DEPT	GRADE OF	SCALE	WEIGHT (KG).	REF. TO ASSY/OLD DRG.	ITEM NO.	NO. OF ITEMS
NP/DES	UNTOL.DIM			1–WT–220–00109 REV.00		
CODE	PR: QA: 500			2–WT–220–00020 REV.00		

TITLE: **MB & DEGASSER SYS. EQPT. LAYOUT**

CARD CODE: U 01

DRAWING NO.: **2-WT-220-00064**

REV: 00

Size A2

DRAWING NO. 3-WT-310-00228

ALL DIMENSIONS ARE IN MILLIMETRES

1.2.1 **Schedule of E,C&I (Supply Scope) Bill Of Materials**

Sl. No.	Description	Qty.	Unit
1	Pressure Indicator (PI)	qty.shall following AS per P&ID	No.
2	Pressure Switch (PS)		No.
3	Density Indicator (DI)		No.
4	Differential Pressure Switch (DPS)		No.
5	Flow switch		
6	Flow Indicating Transmitter (FIT) & orifice plates		No.
7	Bypass Rotameter & orifice plates		No.
8	Level Switch (LS)		No.
9	Level Indicator (LI)		No.
10	Silica (SiO2) Analyser		No.
11	Conductivity Analyser		No.
12	PH Analyser		No.
13	SS 316 Tube & Fittings	As per hookup dra.No	No
14	SS 316 Tube		Mtr
15	SS 316 Fitting		No
16	Ball valve (Isolation Valve)	AS required	No.
17	Copper Tube & Fittings	AS required	
18	¼ OD PVC insulated copper tube	AS required	Mtr
19	Brass Fittings	AS required	No.
20	Digital / Analog Junction box (JB) 12/24/48 way	AS required	No.
21	Electrical Junction box (JB) 12/24/48 way	AS required	No
22	Soleniod Valve Enclosure Box (SVB)	AS required	No
23	Perforated tray for laying instrument cables, Impulse line & copper tube 100/50 mm L=2.5 mtr tk=2.5 mm	AS required	Mtr
24	Digital signal PVC Arm cable 2 pairx0.5sqmm (over all shield)	AS required	Mtrs
25	Analog signal PVC Arm cable 2 pairx0.5sqmm (Individual pair shield & over all shield)	AS required	Mtrs
26	3C x 2.5 sqmm PVC Arm Cable	AS required	Mtrs
27	Double Compression Cable Glands for PVC Armoured cable	AS required	No.
28	2/8/12 pair x 0.5 sqmm (pair overall shield Copper Conductor)**	AS required	No.
29	4/8/12 pair x 0.5 sqmm (incividual pair & overall pair shield Copper Conductor)**	AS required	No.
30	3 core x 2.5 sqmm Copper Conductor	AS required	No.
31	7 core x 2.5 sqmm Copper Conductor **	AS required	No.
32	Cable Glands for motor & Instruments	AS required	No.
33	Cable Lugs for motor AL/ATC Lugs	AS required	No
34	Cable Lugs 0.5 & 2.5 mm ATC lugs	AS required	No
35	2" Pipe	AS required	No

NOTE:

1. PLEASE REFER TO SPECIFICATION ROS–4053 REV. 00 FOR DETAILED SPECIFICATION
2. PID REF: DRG NO. 1–WT–220–000248 REV 00
3. ** SIZE & QTY WILL BE INFORMED DURING DETAILED ENGG.
4. FLANGED/THREADED TAPPING POINTS WILL BE PROVIDED IN THE PIPE LINE FOR MOUNTING INSTRUMENTS. VENDOR TO SUITABLY SELECT INSTRUMENT FITTINGS FOR ERECTING THE REQUIRED INSTRUMENTS. VENDOR SHALL SUBMIT THE INSTRUMENT HOOKUP DRAWINGS FOR OUR REVIEW AFTER ORDER.
5. THE FOLLOWING SHALL BE TAKEN CARE:
   a) PRESSURE GAUGE/PRESSURE SWITCH SHALL BE CONNECTED WITH ISOLATION VALVE AND TWO VALVE MANIFOLD
   b) DPI/DPS SHALL BE CONNECTED WITH ISOLATION VALVE AND THREE VALVE MANIFOLDS
   c) DPIT/FIT SHALL BE CONNECTED WITH ISOLATION VALVE AND FIVE VALVE MANIFOLDS
   d) PH, CONDUCTIVITY ANALYSER ALONG WITH ISOLATION VALVE, FLOW THROUGH CHAMBER AND SUITABLE DRAIN LINE
6. JB/SVEB DRAWINGS TO BE SUBMITTED FOR REVIEW/APPROVAL
7. THE QUANTITY INDICATED IN THIS BOQ IS TENTATIVE AND THE BIDDER SHALL QUOTE FOR ADDITIONAL INSTRUMENTS,VALVES ETC. WHICH ARE ESSENTIAL AND REQUIRED FOR THE SAFE AND EFFICIENT OPERATION OF THE SYSTEM

REV	DATE	ALTERED : CHECKED :
01		
Zone		

RAICHUR POWER CORPORATION LTD. BANGLORE

STEAG ENERGY SERVICES (India) Pvt.Ltd

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: **UF-RO-MB PLANT RPCL-YERAMARUS -2X800MW**

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

	NAME	SIGN	DATE	NO.OF VAR.
DESN	RS		08.07.13	
CHD	MKV/RPS		08.07.13	
APPD	DNB		08.07.13	

DEPT NP	GRADE OF UNTOL.DIM	SCALE	WEIGHT (KG).	REF.	TO ASSY/OLD DRG.	ITEM NO.	NO. OF ITEMS
CODE 976	PR: QA: 500	---	---				

TITLE	CARD CODE	DRAWING NO.	REV
BOQ FOR EC&I ITEMS OF MB SYSTEM	U 01	3-WT-310-00228	00

Size A3

ALL DIMENSIONS ARE IN MILLIMETRES

FOR PRODUCTION
REF.-PR:QA:590 FOR PAINTING
REF.-PR:QA:500 FOR UNTOL. DIMNS.

INSTALLATION INSTRUCTIONS

1. IDENTIFY EACH INSTRUMENT IN THE UF- RO- DM PLANT WITH "P & ID DIAGRAM"
2. FOR INSTRUMENTS TO BE LOCATED DIRECTLY ON THE PIPE LINE OR VESSEL/TANK REFER THE RELEVANT PIPING/TANK ASSY. DRAWING.
3. FOR INSTRUMENTS LOCATED AWAY FROM THE PIPE LINE/TANK (ie. NOT DIRECT MOUNTED) REFER TO INSTALLATION SCHEME DRAWINGS.
4. THE IMPULSE LINE SHALL BE ROUTED THROUGH PERFORATED CABLE TRAY WITH SUITABLE SUPPORTS.
5. DRAIN LINE ARE TO BE CONNECTED IN THE DRAIN TRENCH

REV	DATE	ALTERED	IRS
01	04.12.12	CHECKED	RPS
ZONE	NOTE 4 & 5 ADDED		

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: BOILER AUXILIARIES PLANT.
RANIPET - 632 406.

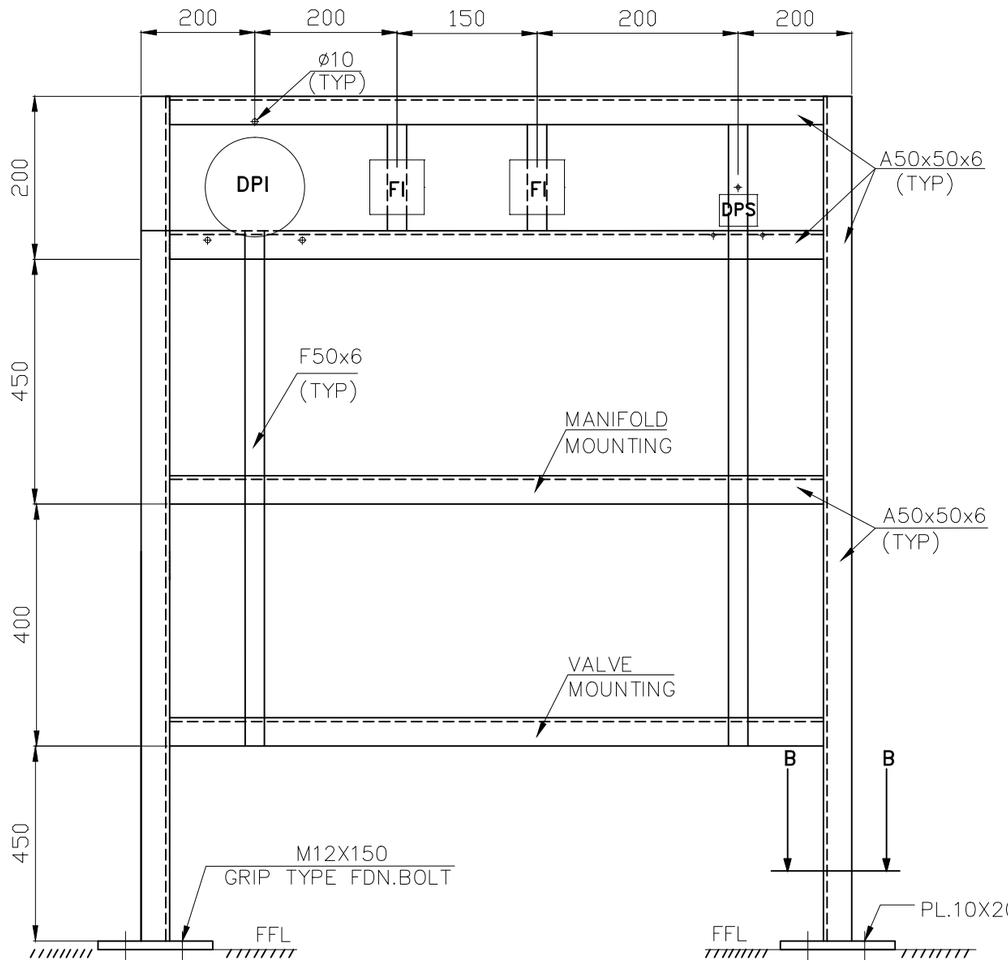
	NAME	SIGN	DATE	NO.OF VAR
DRN	ACK			
CHD	RPS			
APPD	DNB			

DEPT	GRADE OF UNTOL.DIM	SCALE	WEIGHT (KG).	REF. TO ASSY./OLD DRG.	ITEM NO.	NO. OF ITEMS
DCI	PR:QA:500					
CODE						

TITLE	CARD CODE	DRAWING NO.	REV
INSTALLATION INSTRUCTIONS (TYPICAL)	U 01	4-WT-310-00017	01

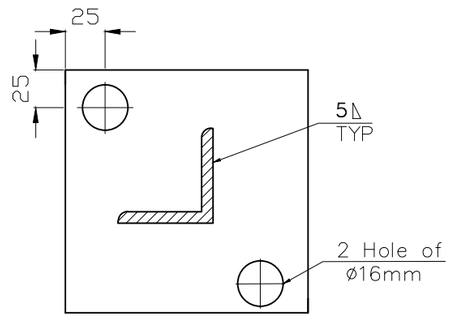
Size A4

ALL DIMENSIONS ARE IN MILLIMETRES



NOTE: –

1. THE FRAME SHALL BE FABRICATED AT SITE.
2. INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BE ø10.



SECTION–BB

REV	DATE	ALTERED	
01		CHECKED	
ZONE			

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET–632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

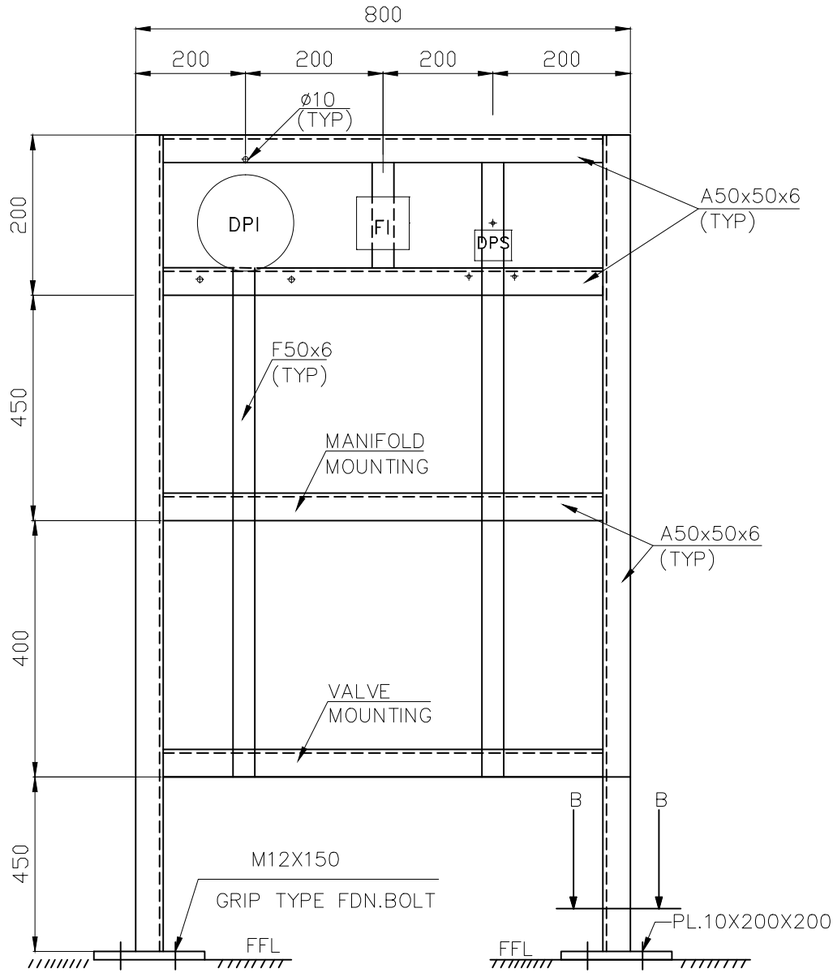
TITLE

INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

DEPT.
SIGN
DATE
SCALE NTS
DRAWING NO. 3–WT–310–00012
SHEET 1 OF 1
REV. 00

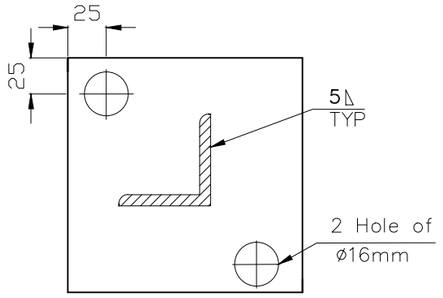
Size A3

ALL DIMENSIONS ARE IN MILLIMETRES



NOTE: –

1. THE FRAME SHALL BE FABRICATED AT SITE.
2. INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BE ø10.



SECTION–BB

REV	DATE	ALTERED	
01		CHECKED	
ZONE			

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET–632 406

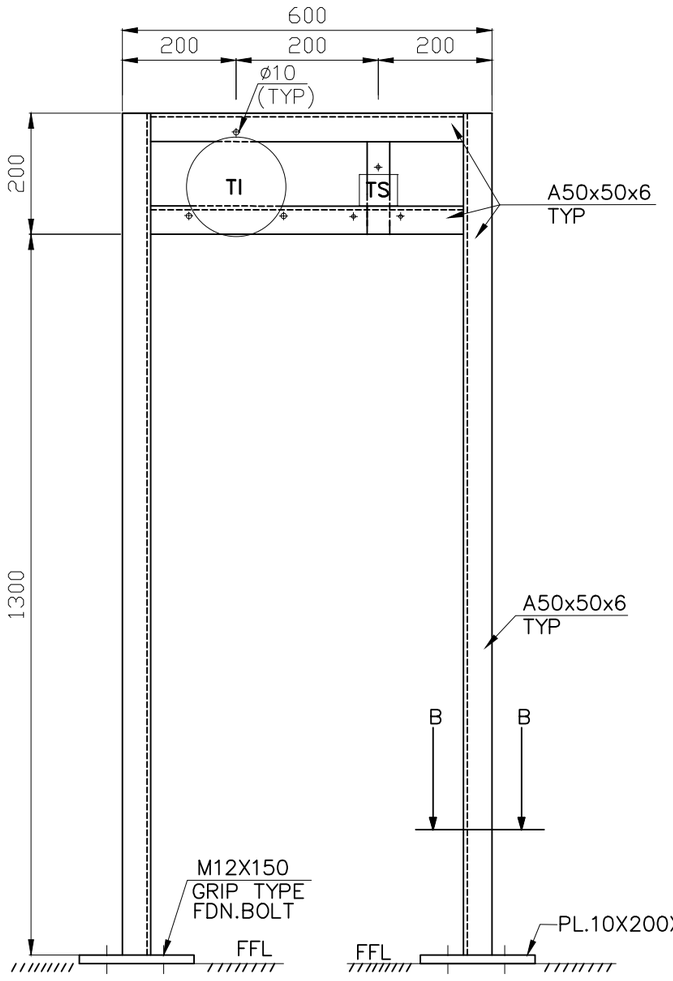
DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE
INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

DEPT.	SCALE NTS	DRAWING NO. 3–WT–310–00013	
SIGN			
DATE		SHEET 1 OF 1	REV. 00

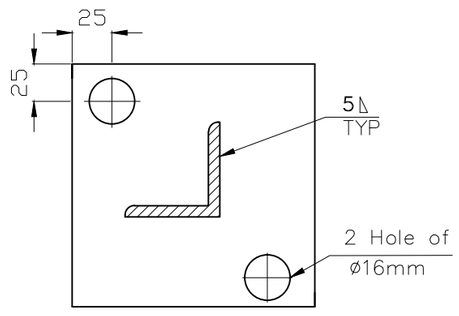
Size A3

ALL DIMENSIONS ARE IN MILLIMETRES



NOTE: –

1. THE FRAME SHALL BE FABRICATED AT SITE.
2. INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BE ø10.



SECTION–BB

REV	DATE	ALTERED	
01		CHECKED	
ZONE			

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET–632 406

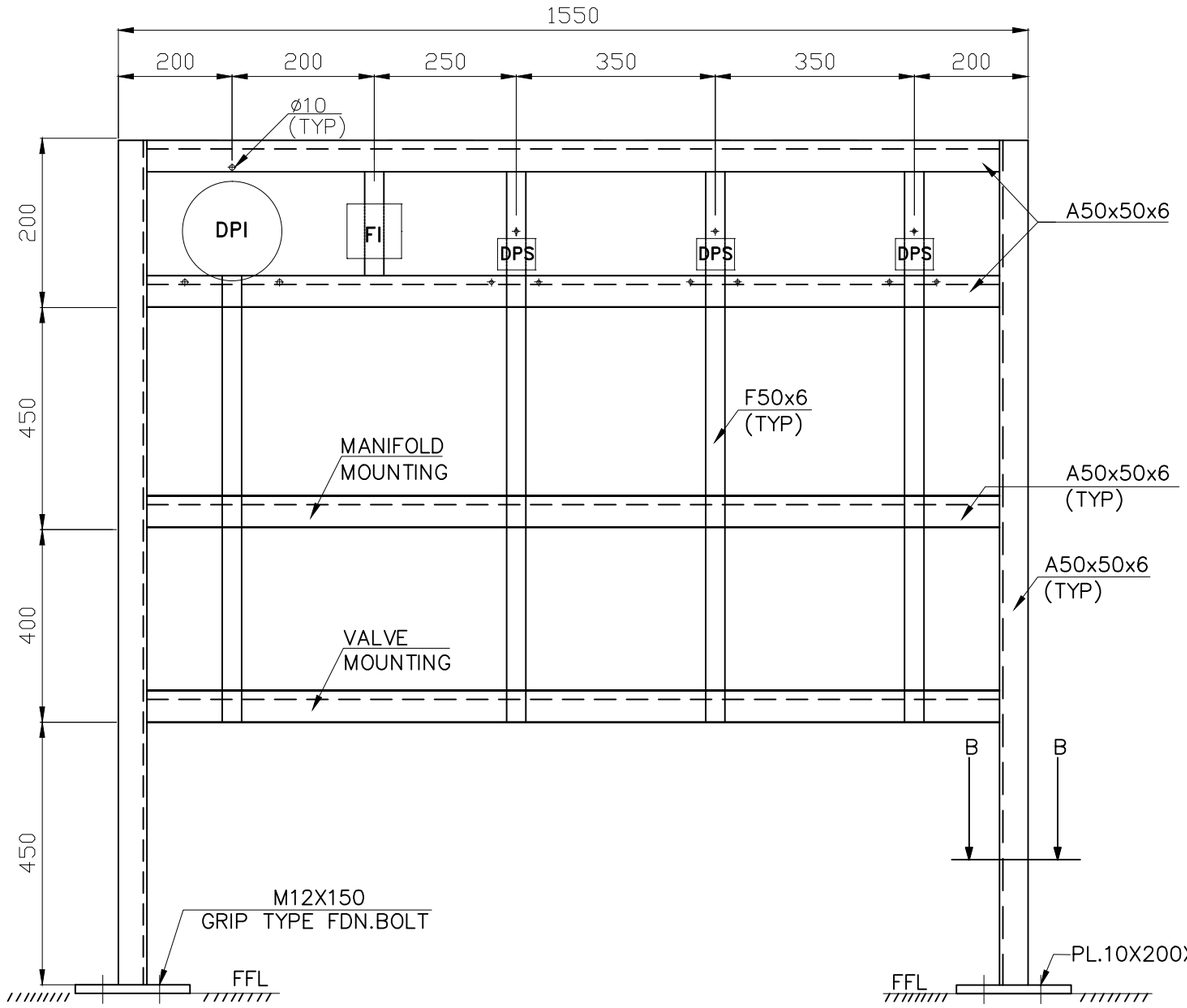
DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

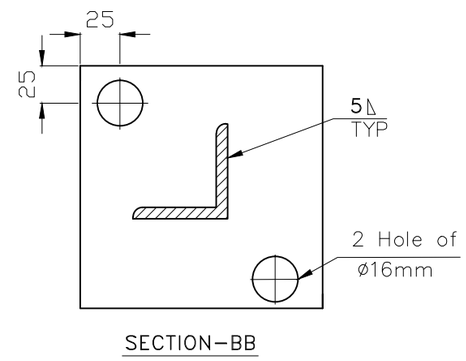
TITLE
INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

DEPT. | SCALE NTS | DRAWING NO. 3–WT–310–00014
SIGN
DATE
SHEET 1 OF 1 | REV. 00

Size A3

ALL DIMENSIONS ARE IN MILLIMETRES





SECTION–BB

NOTE: –

1. THE FRAME SHALL BE FABRICATED AT SITE.
2. INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BE ø10.

REV	DATE	ALTERED	
01		CHECKED	
ZONE			

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET–632 406

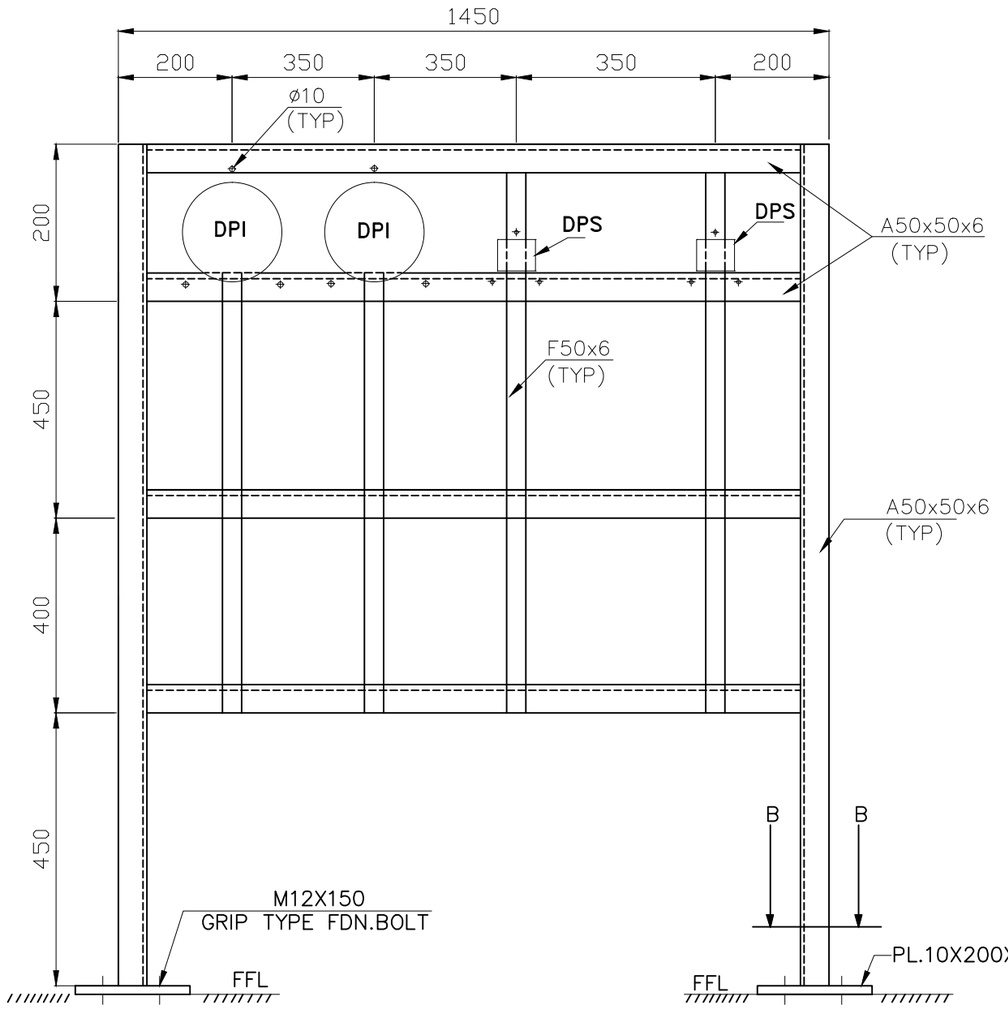
DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE
INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

DEPT.	SCALE NTS	DRAWING NO. 3–WT–310–00015	
SIGN			
DATE		SHEET 1 OF 1	REV. 00

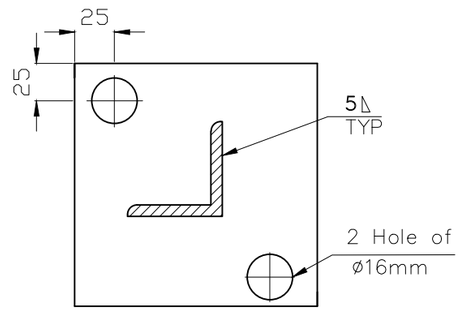
Size A3

ALL DIMENSIONS ARE IN MILLIMETRES



NOTE: –

1. THE FRAME SHALL BE FABRICATED AT SITE.
2. INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BE ø10.



SECTION–BB

REV	DATE	ALTERED
01		CHECKED
ZONE		

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET–632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE
INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

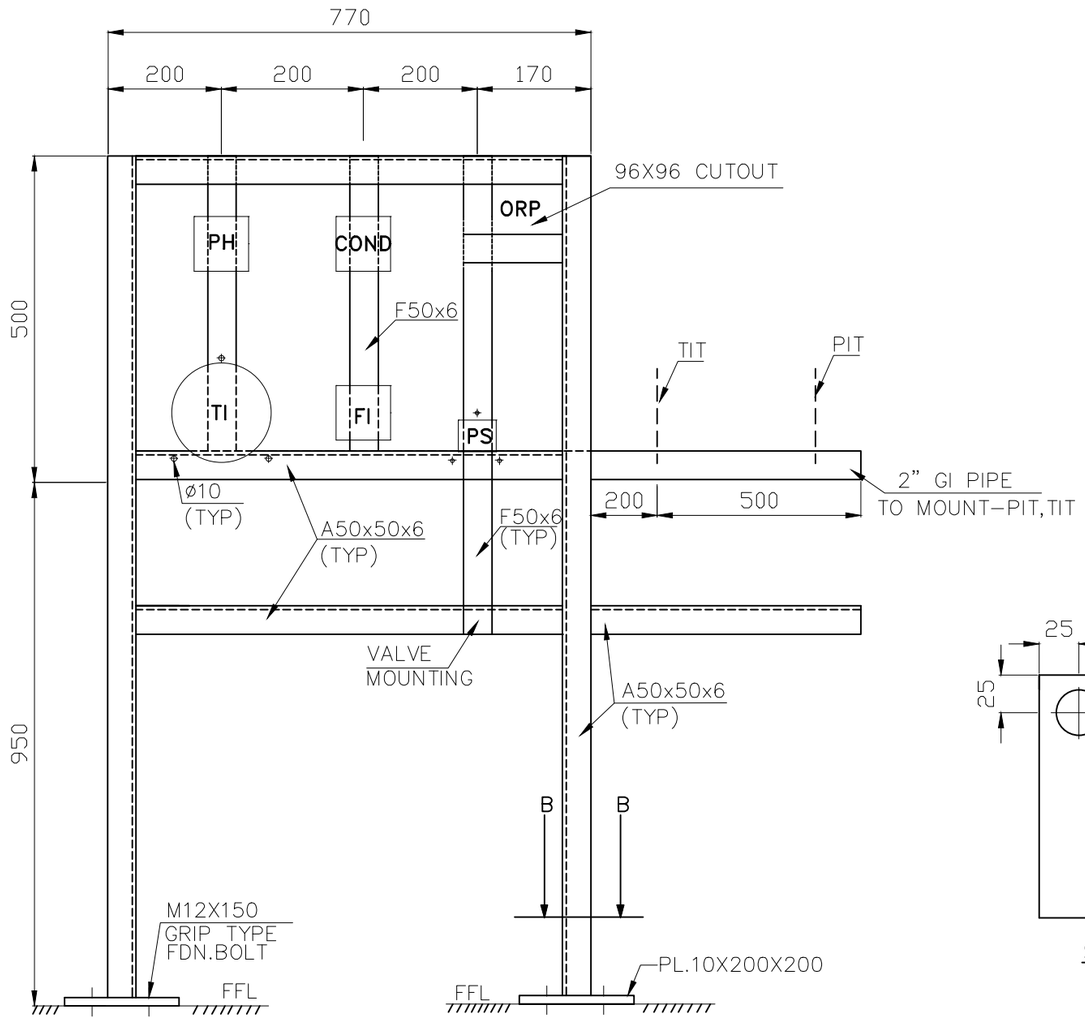
						DEPT.	SCALE NTS
						SIGN	
						DATE	

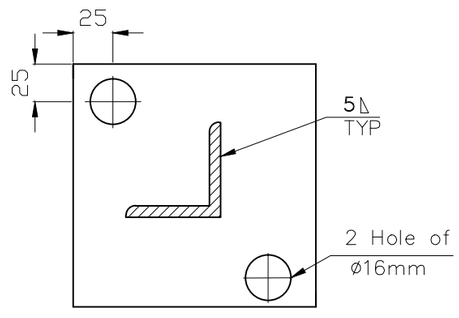
DRAWING NO.
3–WT–310–00016

SHEET 1 OF 1 | REV. 00

Size A3

ALL DIMENSIONS ARE IN MILLIMETRES





SECTION-BB

NOTE: -

1. THE FRAME SHALL BE FABRICATED AT SITE.
2. INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BE ø10.

REV	DATE	ALTERED	
01		CHECKED	
ZONE			

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET-632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE
INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

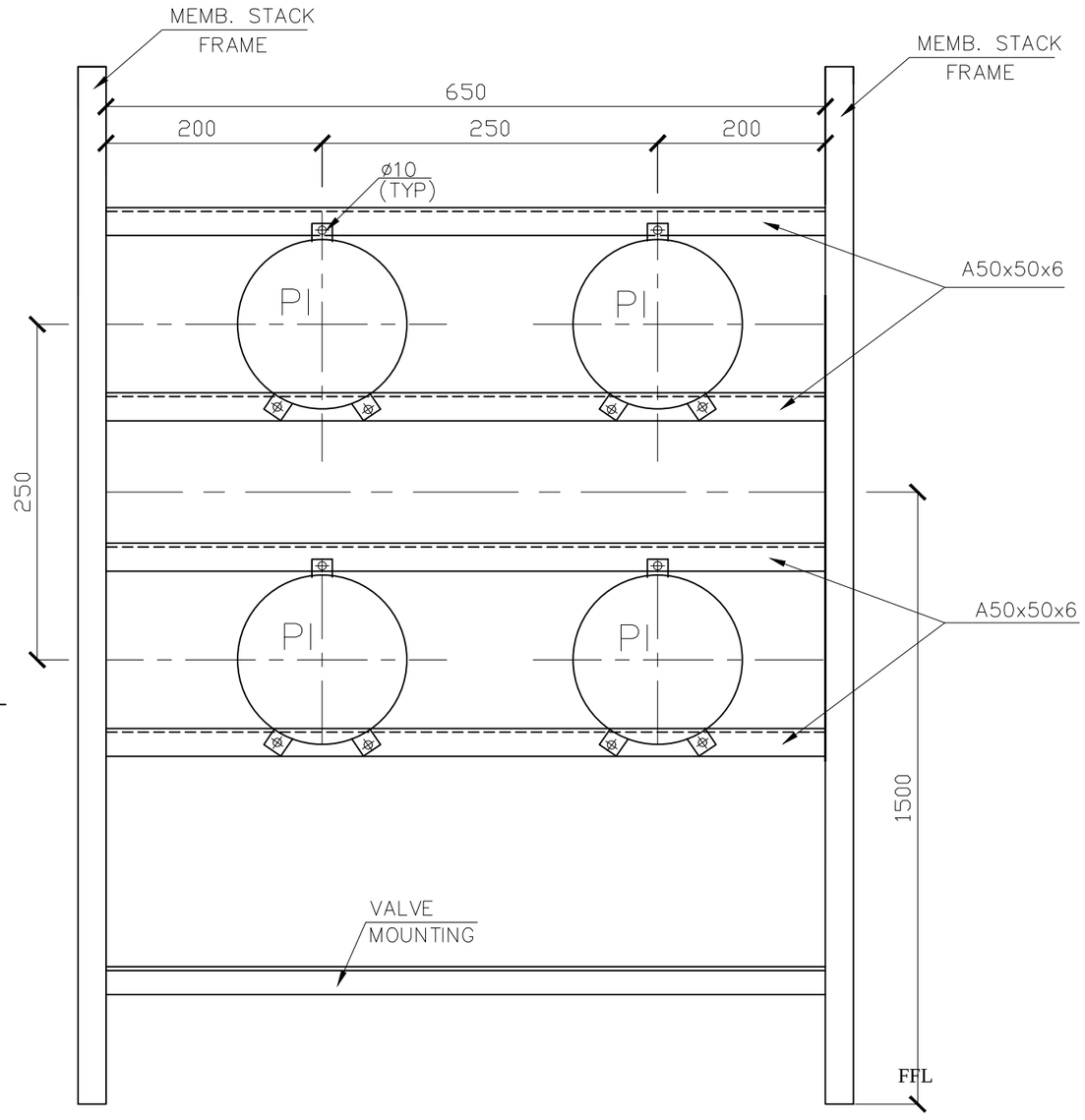
DEPT.
SIGN
DATE
SCALE NTS

DRAWING NO.
3-WT-310-00017

SHEET 1 OF 1 REV. 00

Size A3

ALL DIMENSIONS ARE IN MILLIMETRES



NOTE: –

1. THE FRAME SHALL BE FABRICATED AT SITE.
2. INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BE ø10.

REV	DATE	ALTERED	
01		CHECKED	
ZONE			

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET–632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE
INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

DEPT.
SIGN
DATE

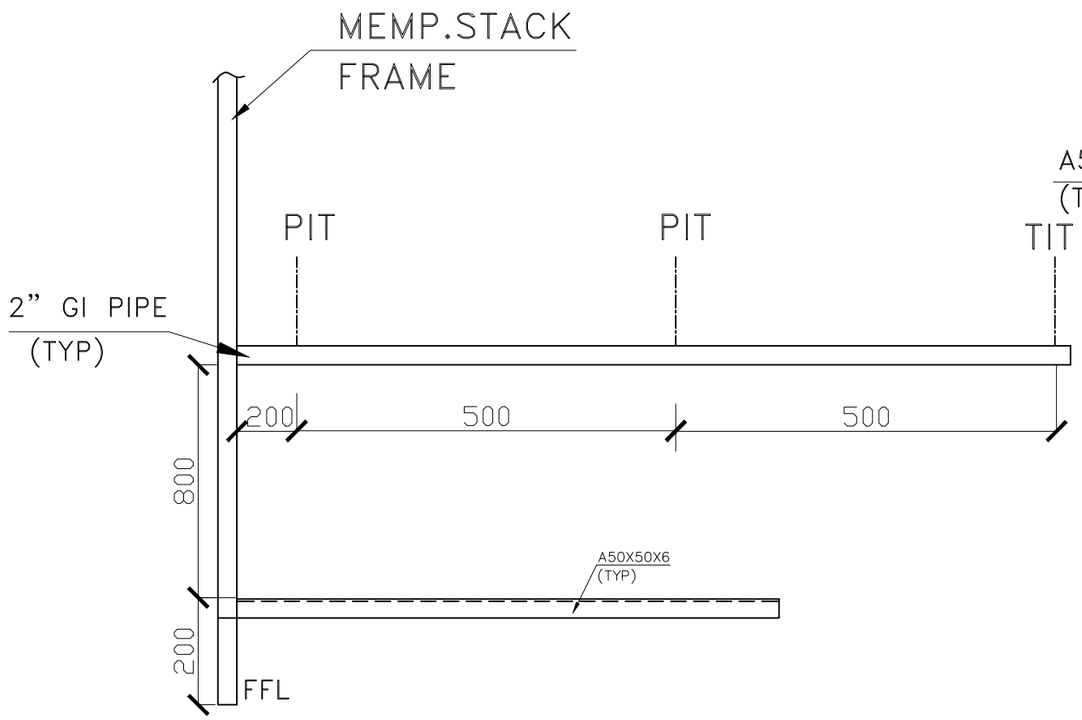
SCALE NTS

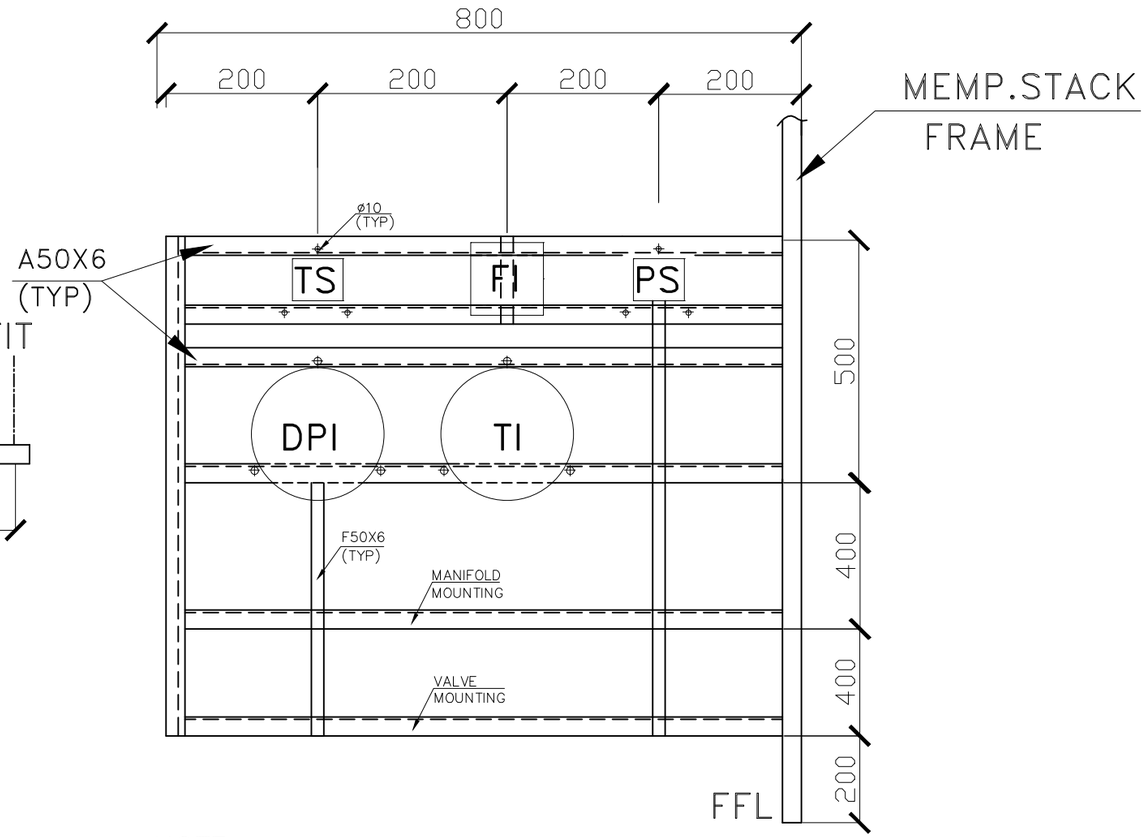
DRAWING NO.
3–WT–310–00018

SHEET 1 OF 1 REV. 00

Size A3

ALL DIMENSIONS ARE IN MILLIMETRES





NOTE: –

1. THE FRAME SHALL BE FABRICATED AT SITE.
2. INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BEø10.

REV	DATE	ALTERED	
01		CHECKED	
ZONE			

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET–632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE
INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

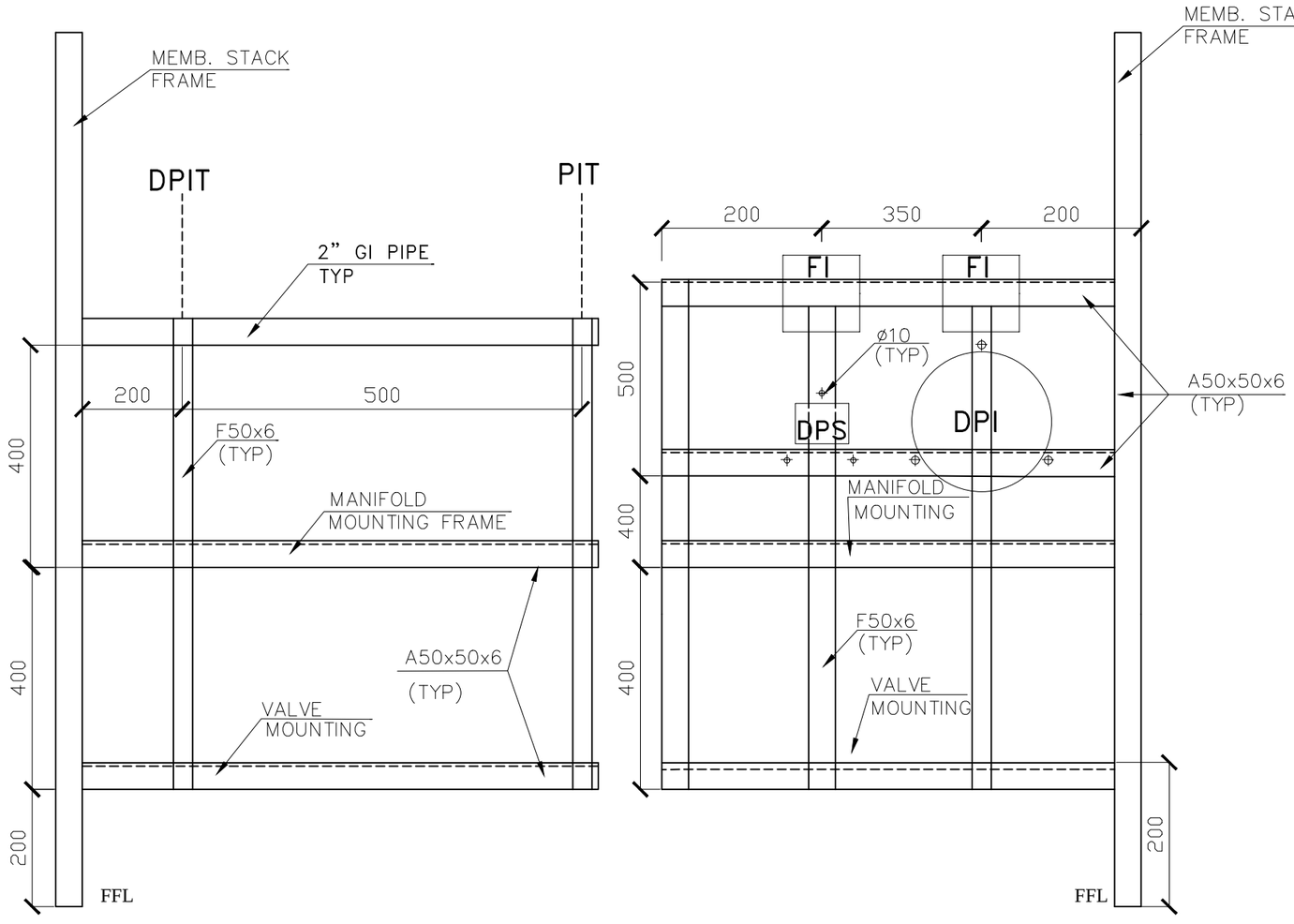
DEPT. SIGN DATE | SCALE **NTS**

DRAWING NO. **3–WT–310–00019**

SHEET 1 OF 1 | REV. 00

Size A3

ALL DIMENSIONS ARE IN MILLIMETRES



NOTE:–

1. THE FRAME SHALL BE FABRICATED AT SITE.
2. INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BE ø10.
3. THE FRAME SHALL BE MOUNTED IN THE RO MEMB STACK FRAME.

REV	DATE	ALTERED	
01		CHECKED	
ZONE			

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET–632 406

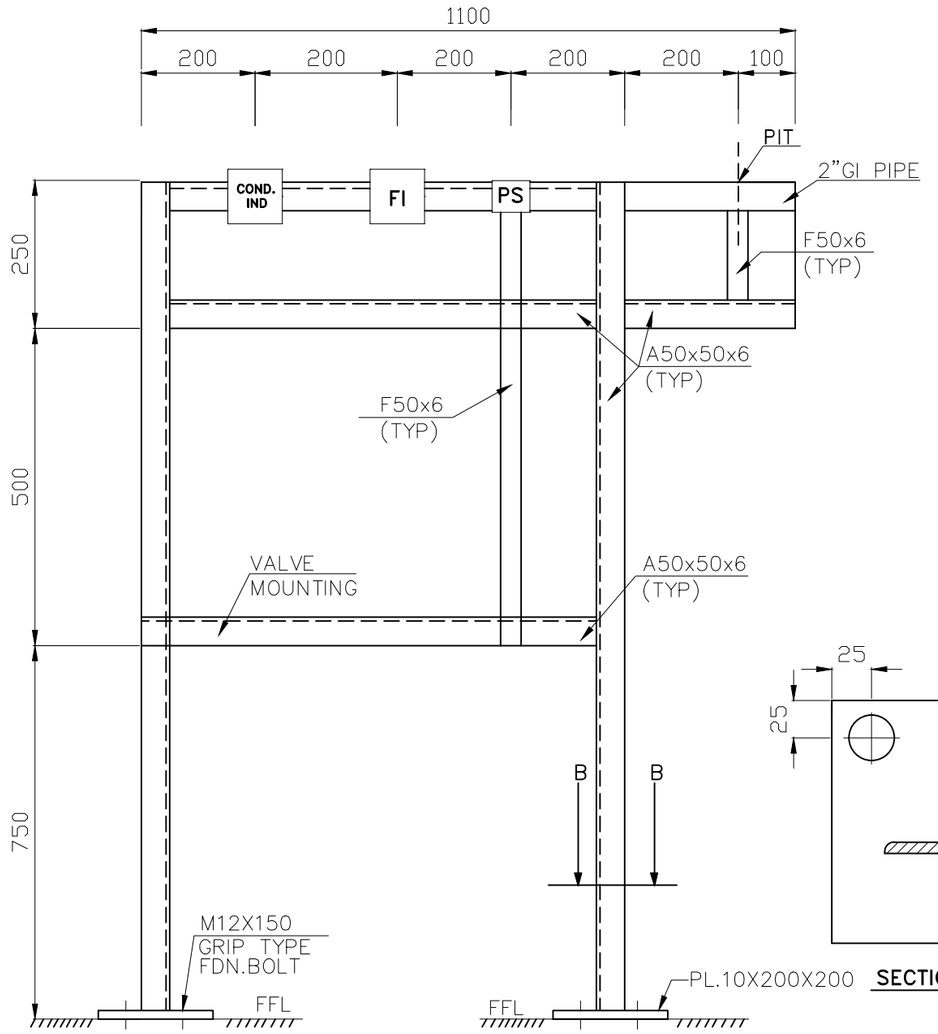
DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

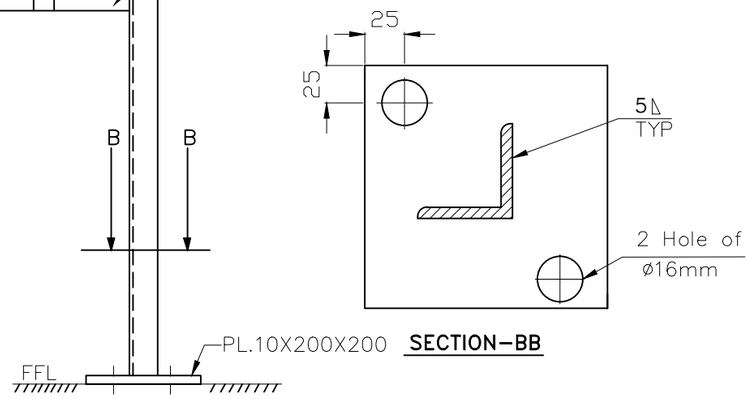
TITLE
INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

DEPT.	SCALE NTS	DRAWING NO. 3–WT–310–00020
SIGN		
DATE		SHEET 1 OF 1 REV. 00

Size A3

ALL DIMENSIONS ARE IN MILLIMETRES





SECTION–BB

NOTE: –

1. THE FRAME SHALL BE FABRICATED AT SITE.
2. INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BE ø10.

REV	DATE	ALTERED	
01		CHECKED	
ZONE			

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET–632 406

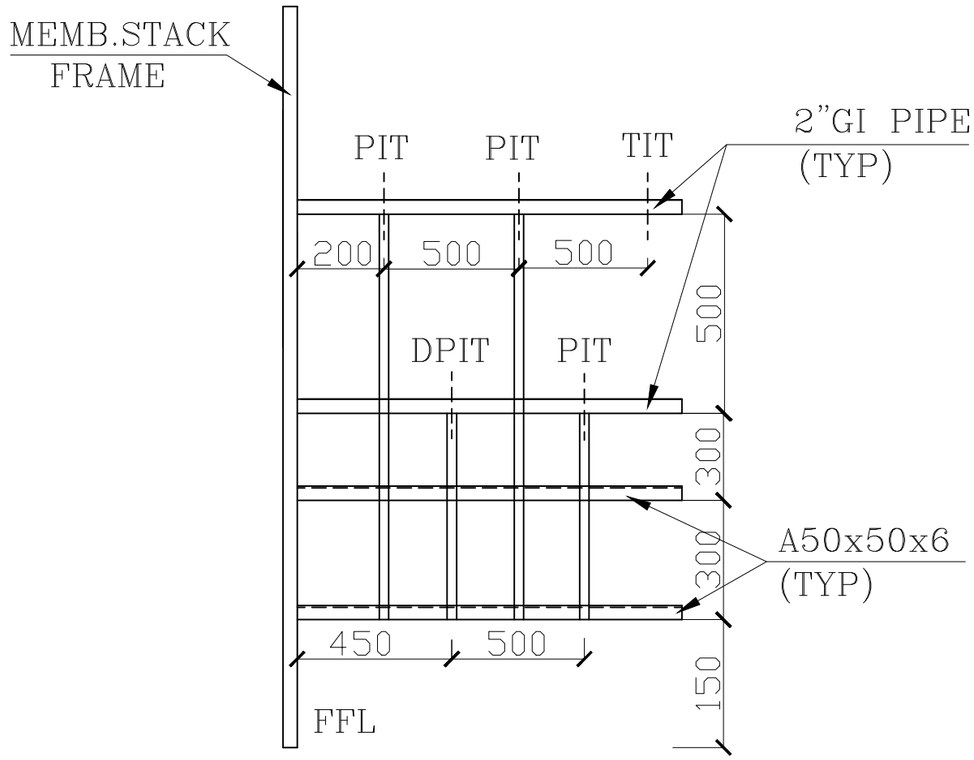
DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

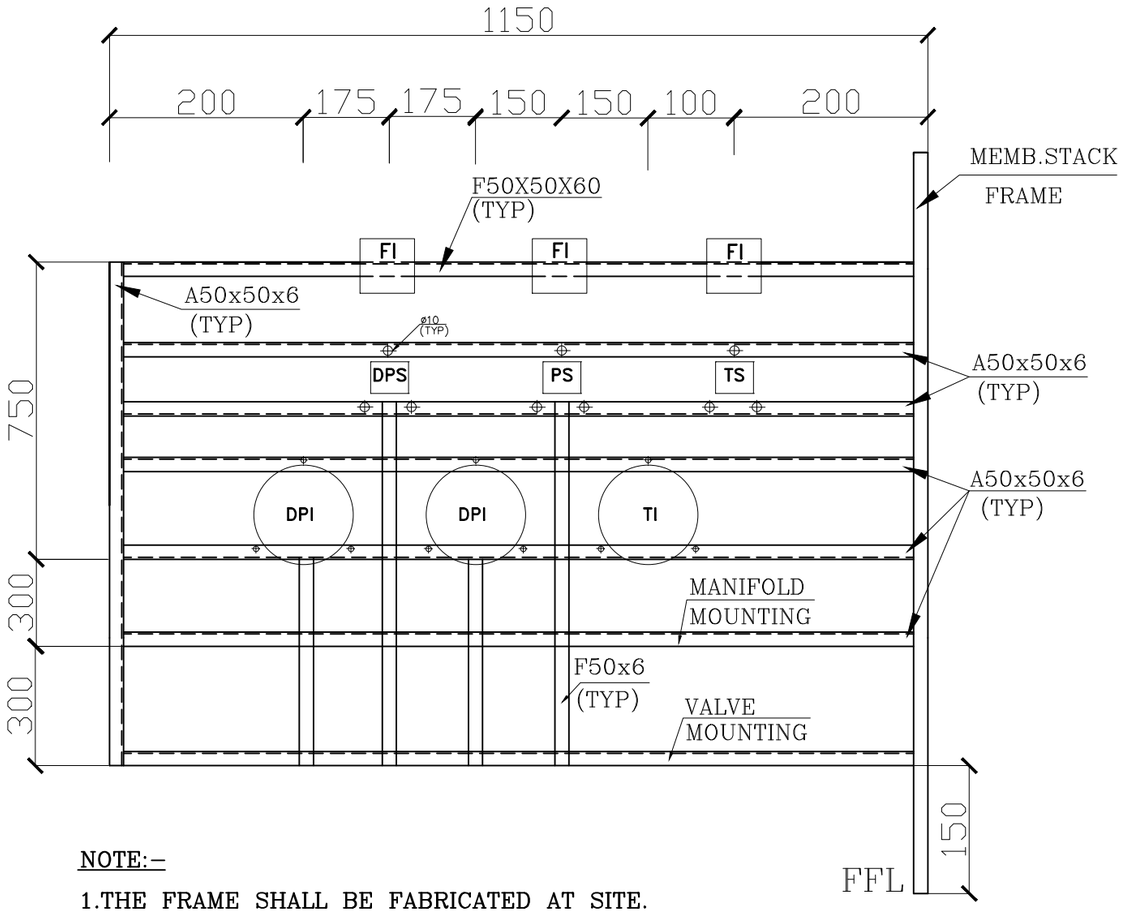
TITLE
INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

DEPT.	SCALE NTS	DRAWING NO. 3–WT–310–00021
SIGN		
DATE		SHEET 1 OF 1 REV. 00

Size A3

ALL DIMENSIONS ARE IN MILLIMETRES





NOTE:–

1.THE FRAME SHALL BE FABRICATED AT SITE.

2.INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BE ø10.

3.THE FRAME SHALL BE MOUNTED IN THE RO MEMB STACK FRAME.

REV	DATE	ALTERED
01		CHECKED
ZONE		

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET–632 406

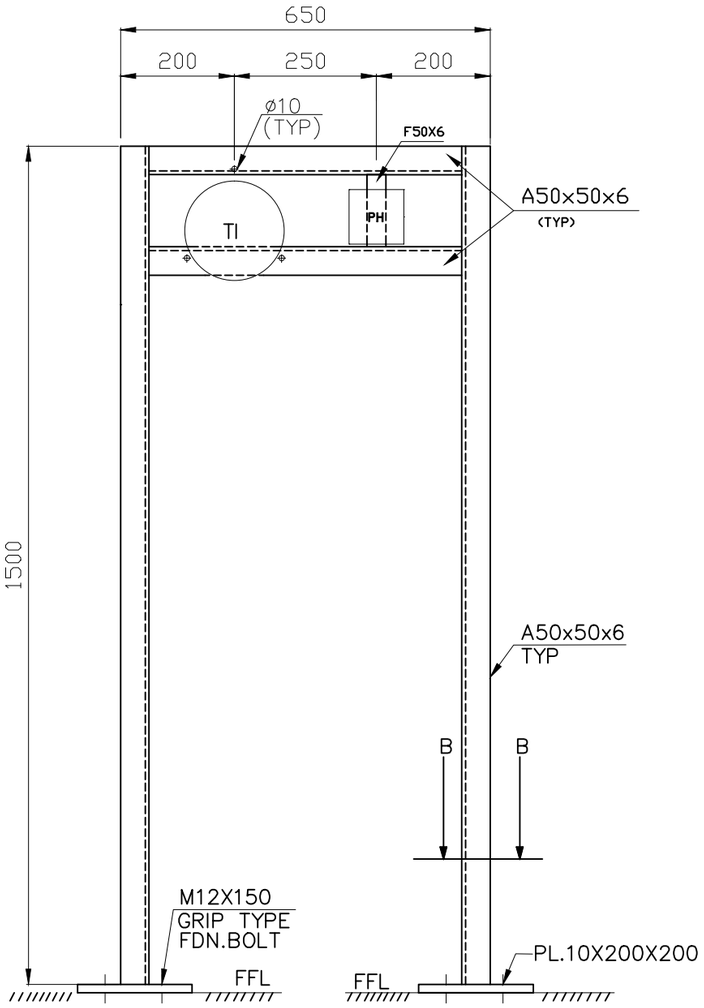
DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE
INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

DEPT.
SIGN
DATE
SCALE NTS
DRAWING NO. 3–WT–310–00022
SHEET 1 OF 1
REV. 00

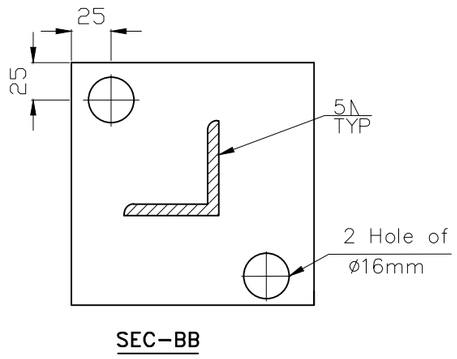
Size A3

ALL DIMENSIONS ARE IN MILLIMETRES



NOTE: –

1. THE FRAME SHALL BE FABRICATED AT SITE.
2. INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BE ø10.



SEC–BB

REV	DATE	ALTERED	
01		CHECKED	
ZONE			

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET–632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE
INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

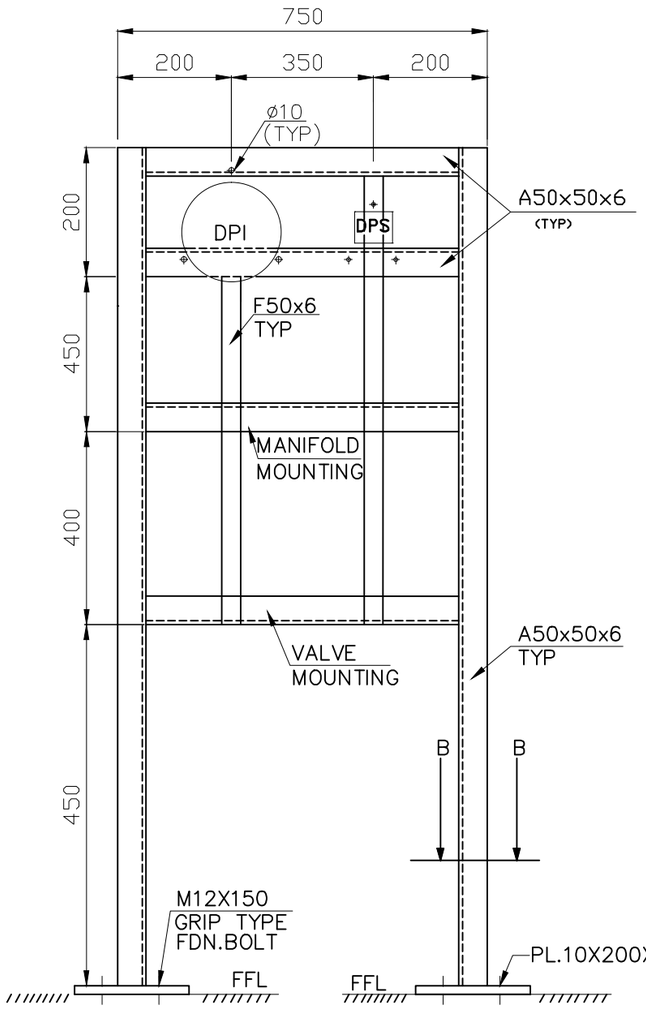
DEPT.
SIGN
DATE
SCALE NTS

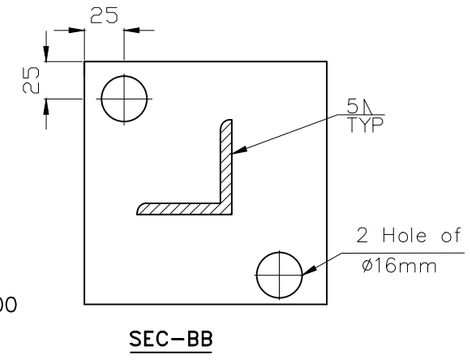
DRAWING NO.
3–WT–310–00023

SHEET 1 OF 1 REV. 00

Size A3

ALL DIMENSIONS ARE IN MILLIMETRES





SEC-BB

NOTE: –

1. THE FRAME SHALL BE FABRICATED AT SITE.
2. INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BE ø10.

REV	DATE	ALTERED	
01		CHECKED	
ZONE			

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET–632 406

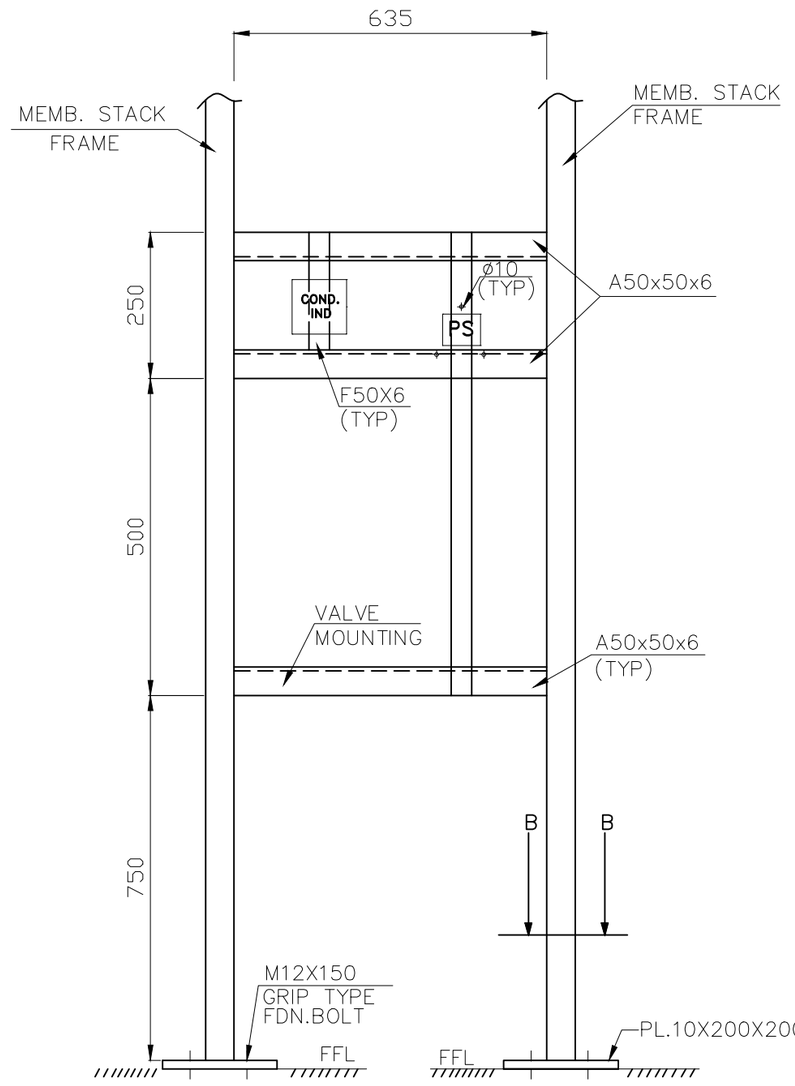
DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE
INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

DEPT.	SCALE NTS	DRAWING NO. 3–WT–310–00024
SIGN		
DATE		SHEET 1 OF 1 REV. 00

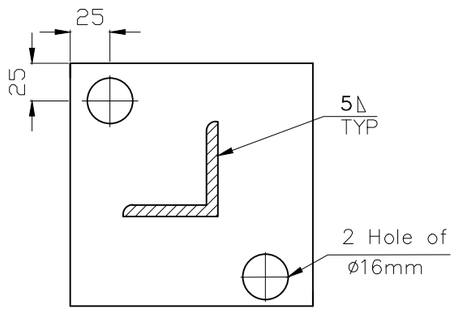
Size A3

ALL DIMENSIONS ARE IN MILLIMETRES



NOTE: –

1. THE FRAME SHALL BE FABRICATED AT SITE.
2. INSTRUMENT MOUNTING HOLE DIA IN THE FRAME SHALL BE ø10.
3. THE FRAME SHALL BE MOUNTED IN THE RO MEMB STACK FRAME.



SECTION–BB

REV	DATE	ALTERED	
01		CHECKED	
ZONE			

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET–632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE
INSTRUMENT MOUNTING FRAME ARRANGEMENT (TYPICAL)

DEPT.	SCALE NTS	DRAWING NO. 3–WT–310–00025
SIGN		SHEET 1 OF 1 REV. 00
DATE		

Size A3

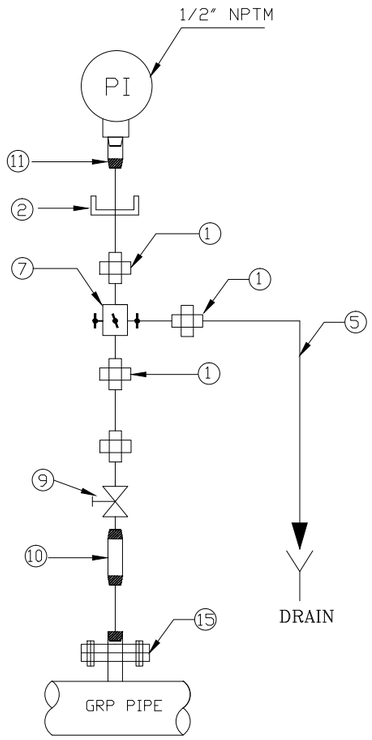
DRAWING NO. 3-WT-310-00026

ALL DIMENSIONS ARE IN MILLIMETRES

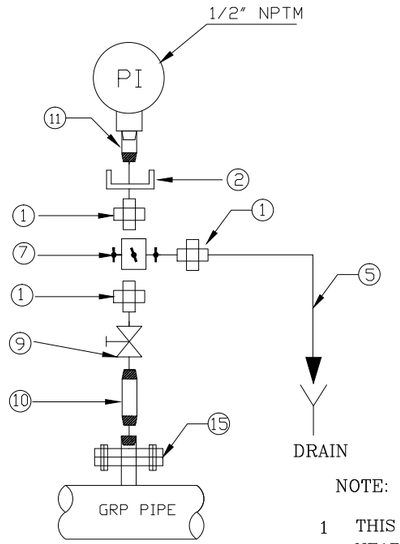
FOR PRODUCTION

REF. PR:QA:590 FOR PAINTING
REF. PR:QA:500 FOR UNTOL. DIMNS.
REF. APPLICABLE GMS FOR MATCODE&SPEC.

PI-REMOTE MOUNTING



PI-DIRECT MOUNTING



SI. NO	ITEM. NO.	ITEM DESCRIPTION	QUANTITY IN NOS
1	1	1/2"NPT SS316,double compression ferrule type male connector	3
2	2	1/2" NPT SS316,double compression ferrule type female connector	1
5	5	1/2" OD SS tube-5metres	1
6	7	3 valve manifold	1
9	9	1/2" NB SS316 Ball Valve,2 way with 1/2" NPT internal thread at both ends	1
10	10	1/2" NB pipe nipple	1
11	11	1/2" female NPT to male NPT adaptor	1
12	15	1/2" NB Threaded flange with internal thread 1/2" NPT as per ANSI B16.5, 150 class with suitable gasket & fassteness	1

NOTE:

1 THIS INSTRUMENT SHALL BE MOUNTED ON A STEEL FRAME FABRICATED AT SITE AND MOUNTED NEAR BY STRUCTURE OR FIXED ON AN ANGLE IRON FRAME AT A SUITABLE LOCATION ON THE GROUND TO ENABLE EASY FRAME HAS TO BE EPOXY PAINTED IN LIGHT GREY COLOUR.WORK GROUTED TO THE FLOOR. THE

2 THIS INSTRUMENT SHALL BE ACCESS TO THE OPERATOR FOR TAKING READINGS. THE TUBING IS TO BE SUITABLY ROUTED TO THE INSTRUMENT.

3 REFER TO INSTALLATION INSTRUCTIONS DRG. NO: 4-WT-310-00017

4 THE IMPULSE LINE SHALL BE ROUTED THROUGH PERFORATED CABLE TRAY WITH SUITABLE SUPPORTS.

5 DRAIN LINE ARE TO BE CONNECTED IN THE DRAIN TRENCH

SI. NO	ITEM. NO.	ITEM DESCRIPTION	QUANTITY IN NOS
1	1	1/2" NPT SS316,double compression ferrule type male connector	4
2	2	1/2" NPT SS316,double compression ferrule type female connector	1
3	5	1/2" OD SS tube-10metres	1
4	7	3 valve manifold	1
5	9	1/2" NB SS316 Ball Valve,2 way with 1/2" NPT internal thread at both ends	1
6	10	1/2" NB pipe nipple	1
7	11	1/2" female NPT to male NPT adaptor	1
8	15	1/2" NB Threaded flange with internal thread 1/2" NPT as per ANSI B16.5, 150 class with suitable gasket & fassteness	1

REV	DATE	ALTERED	IRS
01	04.12.12	CHECKED	RPS
ZONE	NOTE 4 & 5 ADDED.		

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET-632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE

PRESSURE INDICATOR INSTALLATION IN GRP LINE (TYPICAL)

DEPT. | SCALE NTS | DRAWING NO. 3-WT-310-00026
SIGN
DATE
SHEET 1 OF 1 | REV. 01

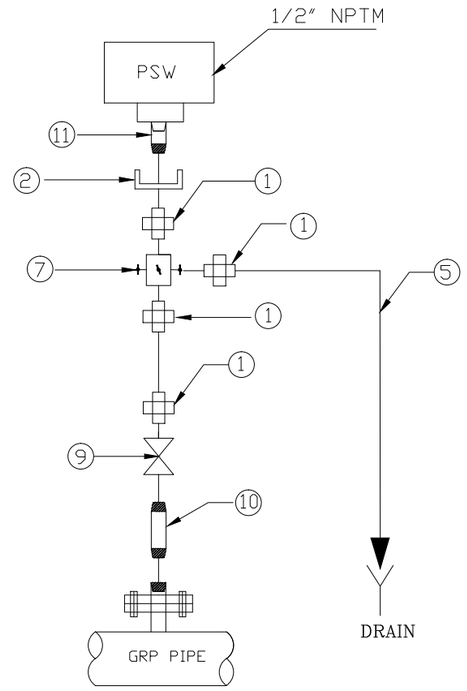
Size A3

DRAWING NO. 3-WT-310-00027

ALL DIMENSIONS ARE IN MILLIMETRES

FOR PRODUCTION

REF. PR:QA:590 FOR PAINTING
REF. PR:QA:500 FOR UNTOL. DIMNS.
REF. APPLICABLE GMS FOR MATCODE&SPEC.



NOTE:

1 THIS INSTRUMENT SHALL BE MOUNTED ON A 2.5MM THICK MS SHEET WHICH SHALL BE WELDED TO A NEAR BY STRUCTURE OR FIXED ON AN ANGLE IRON FRAMEWORK GROUTED TO THE FLOOR. THE MS SHEET HAS TO BE EPOXY PAINTED IN LIGHT GREY COLOUR.

2 THIS INSTRUMENT SHALL BE LOCATED AT A SUITABLE LOCATION ON THE GROUND TO ENABLE EASY ACCESS TO THE OPERATOR FOR TAKING READINGS. THE TUBING IS TO BE SUITABLY ROUTED TO THE INSTRUMENT.

3 REFER TO INSTALLATION INSTRUCTIONS DRG. NO: 4-WT-310-00017

4 THE IMPULSE LINE SHALL BE ROUTED THROUGH PERFORATED CABLE TRAY WITH SUITABLE SUPPORTS.

5 DRAIN LINE ARE TO BE CONNECTED IN THE DRAIN TRENCH

SI. NO	ITEM. NO.	ITEM DESCRIPTION	QUANTITY IN NOS
1	1	1/2" NPT SS316,double compression ferrule type male connector	4
2	2	1/2" NPT SS316,double compression ferrule type female connector	1
3	5	1/2" OD SS tube-10metres	1
4	7	3 valve manifold	1
5	9	1/2" NB SS316 Ball Valve,2 way with 1/2" NPT internal thread at both ends	1
6	10	1/2" NB pipe nipple	1
7	11	1/2" female NPT to male NPT adaptor	1

REV	DATE	ALTERED	IRS
01	04.12.12	CHECKED	RPS
ZONE	NOTE 4 & 5 ADDED		

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET-632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE: PRESSURE INDICATING TRANSMITTER / PRESSURE SWITCH INSTALLATION IN GRP LINE (TYPICAL)

DEPT. | SCALE NTS | SIGN | DATE

DRAWING NO. 3-WT-310-00027

SHEET 1 OF 1 | REV. 01

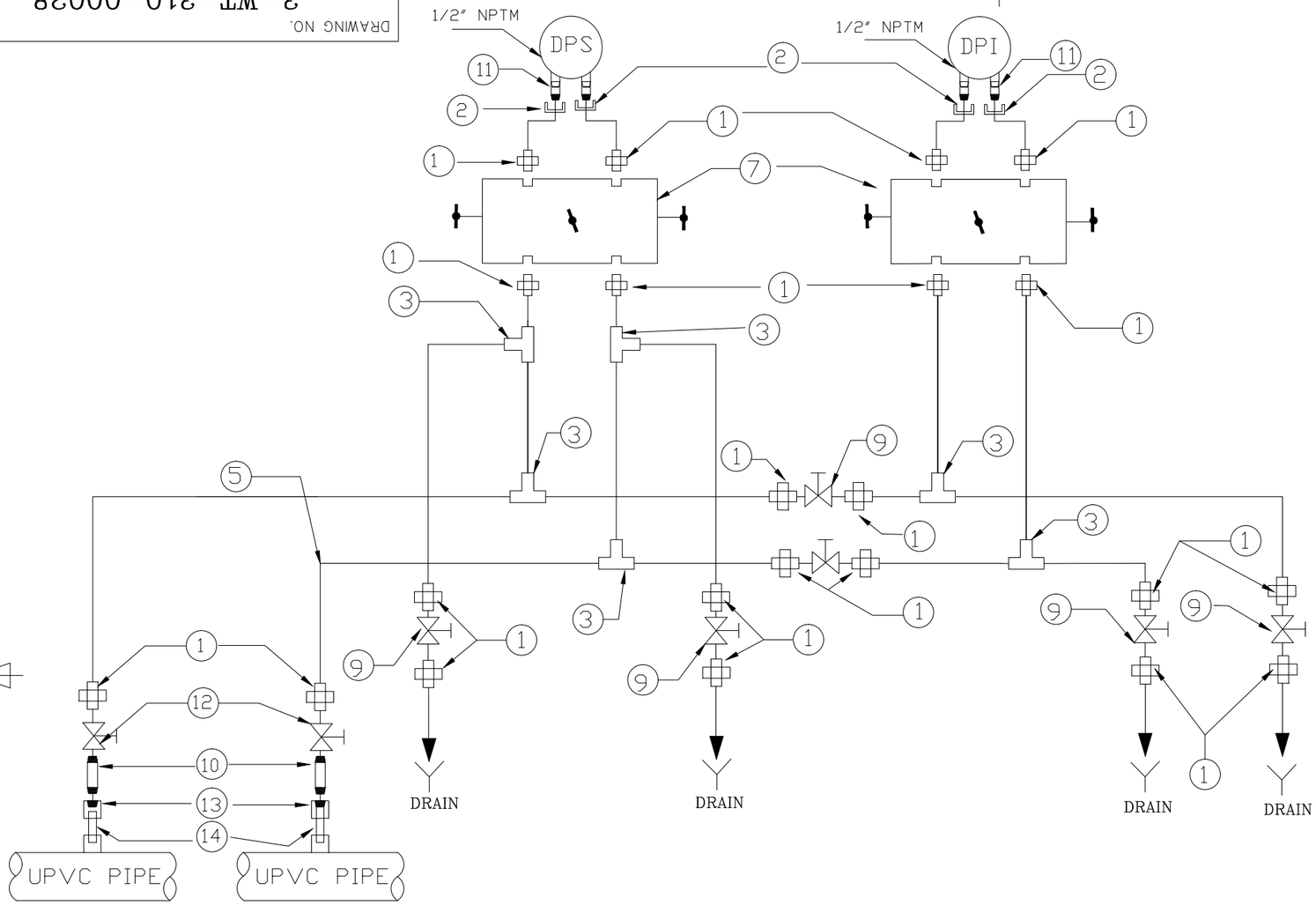
Size A3

DRAWING NO. 3-WT-310-00028

ALL DIMENSIONS ARE IN MILLIMETRES

FOR PRODUCTION

REF. PR:QA:590 FOR PAINTING
REF. PR:QA:500 FOR UNTOL. DIMNS.
REF. APPLICABLE GMS FOR MATCODE&SPEC.



Sl. NO	ITEM. NO.	ITEM DESCRIPTION	QUANTITY IN NOS
1	1	1/2" NPT SS316,double compression ferrule type male connector	22
2	2	1/2" NPT SS316,double ompression ferrule type female connector	4
3	3	Equal Tee	6
4	5	1/2" OD SS tube-20metres	1
5	7	3 valve manifold	2
6	9	1/2" NB SS316 Ball Valve,2 way with 1/2" NPT internal thread at both ends	6
7	10	1/2" NB pipe nipple	2
8	11	1/2" female NPT to male NPT adaptor	4
9	12	1/2" UPVC 2 way ball valve	2
10	13	1/2" OD UPVC PIPE-70mm	2
11	14	1/2" NPT Female Socket Adaptor	2

NOTE:

1 THIS INSTRUMENT SHALL BE MOUNTED ON A FRAME WHICH SHALL BE WELDED TO A NEAR BY STRUCTURE OR FIXED ON AN ANGLE IRON FRAMEWORK GROUTED TO THE FLOOR. THE FRAME HAS TO BE EPOXY PAINTED IN LIGHT GREY COLOUR.

2 THIS INSTRUMENT & 3 VALVE MANIFOLD SHALL BE LOCATED AT A SUITABLE LOCATION ON THE GROUND TO ENABLE EASY ACCESS TO THE OPERATOR FOR TAKING READINGS. THE TUBING IS TO BE SUITABLY ROUTED TO THE INSTRUMENT.

3 REFER TO INSTALLATION INSTRUCTIONS DRG. NO: 4-WT-310-00017

4 THE IMPULSE LINE SHALL BE ROUTED THROUGH PERFORATED CABLE TRAY WITH SUITABLE SUPPORTS.

5 DRAIN LINE ARE TO BE CONNECTED IN THE DRAIN TRENCH

REV	DATE	ALTERED	IRS
01	04.12.12	CHECKED	RPS
ZONE	NOTE 4 & 5 ADDED		

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET-632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE: DIFFERENT PRESSURE GAUGE / SWITCH INSTALLATION IN LOW PRESSURE LINE (LP) (TYPICAL)

DEPT. | SCALE NTS | DRAWING NO. 3-WT-310-00028

SIGN | DATE

SHEET 1 OF 1 | REV. 01

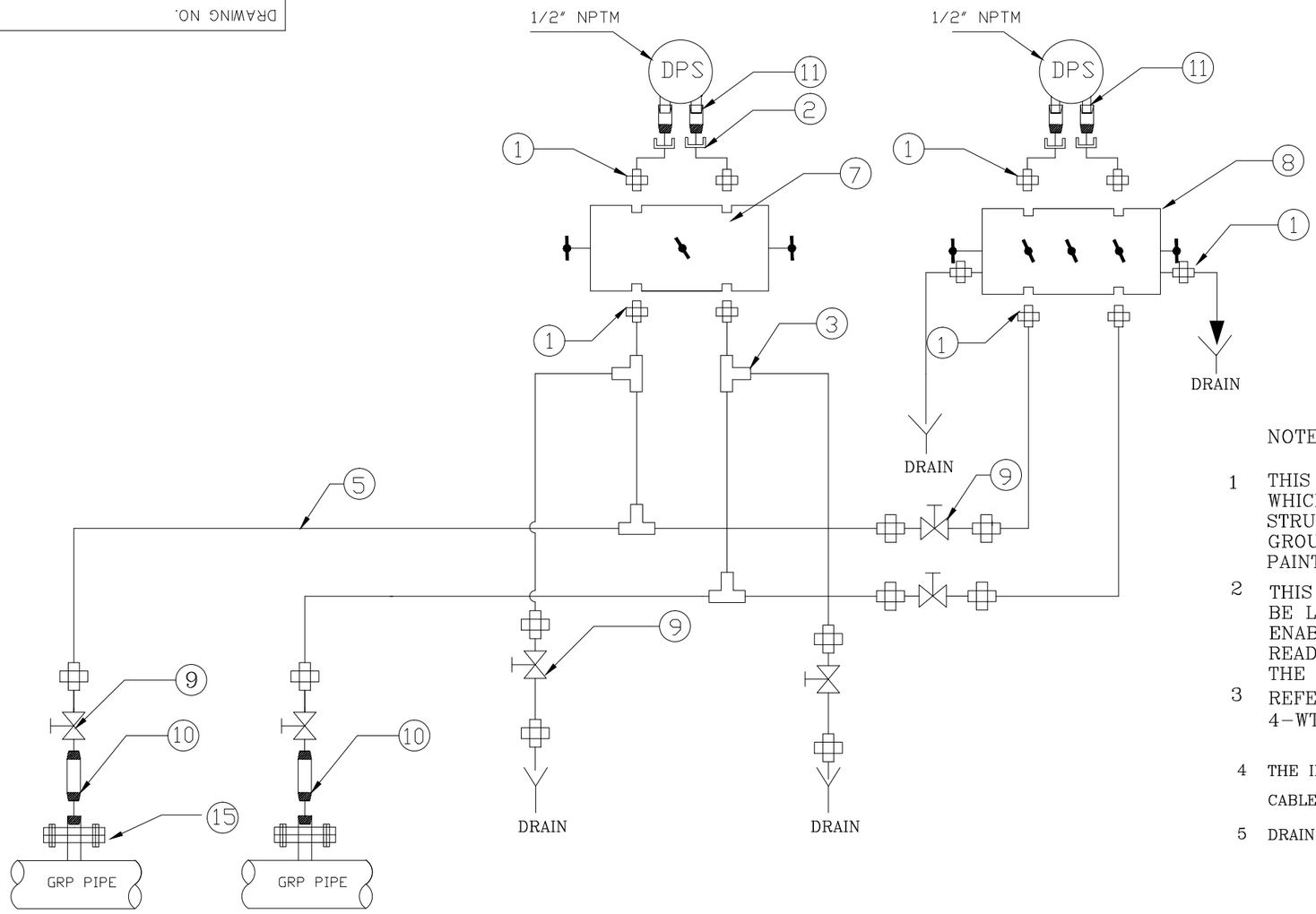
Size A3

DRAWING NO. 3-WT-310-00029

ALL DIMENSIONS ARE IN MILLIMETRES

FOR PRODUCTION

REF. PR:QA:590 FOR PAINTING
REF. PR:QA:500 FOR UNTOL. DIMNS.
REF. APPLICABLE GMS FOR MATCODE&SPEC.



NOTE:

1 THIS INSTRUMENT SHALL BE MOUNTED ON A FRAME WHICH SHALL BE WELDED TO A NEAR BY STRUCTURE OR FIXED ON AN ANGLE IRON FRAMEWORK GROUTED TO THE FLOOR. THE FRAME HAS TO BE EPOXY PAINTED IN LIGHT GREY COLOUR.

2 THIS INSTRUMENT & 3 VALVE/ 5 VALVE MANIFOLD SHALL BE LOCATED AT A SUITABLE LOCATION IN THE GROUND TO ENABLE EASY ACCESS TO THE OPERATOR FOR TAKING READINGS. THE TUBING IS TO BE SUITABLY ROUTED TO THE INSTRUMENT.

3 REFER TO INSTALLATION INSTRUCTIONS DRG. NO: 4-WT-310-00017

4 THE IMPULSE LINE SHALL BE ROUTED THROUGH PERFORATED CABLE TRAY WITH SUITABLE SUPPORTS.

5 DRAIN LINE ARE TO BE CONNECTED IN THE DRAIN TRENCH

SI. NO	ITEM. NO.	ITEM DESCRIPTION	QUANTITY IN NOS
1	1	1/2" NPT SS316,double compression ferrule type male connector	20
2	2	1/2" NPT SS316,double ompression ferrule type female connector	4
3	3	Equal Tee	4
5	5	1/2" OD SS tube-20metres	1
7	7	3 valve manifold	1
8	8	5 valve manifold	1
9	9	1/2" NB SS316 Ball Valve,2 way with 1/2" NPT internal thread at both ends	6
10	10	1/2" NB pipe nipple	2
11	11	1/2" female NPT to male NPT adaptor	4
12	15	1/2" NB Threaded flange with internal thread 1/2" NPT as per ANSI B16.5, 150 class with suitable gasket & fassteness	1

REV	DATE	ALTERED	IRS
01	04.12.12	CHECKED	RPS
ZONE	NOTE 4 & 5 ADDED		

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET-632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE: DP INDICATING TRANSMITTER/ DP SWITCH INSTALLATION IN GRP LINE (TYPICAL)

DEPT. SIGN DATE

SCALE NTS

DRAWING NO. 3-WT-310-00029

SHEET 1 OF 1 REV. 01

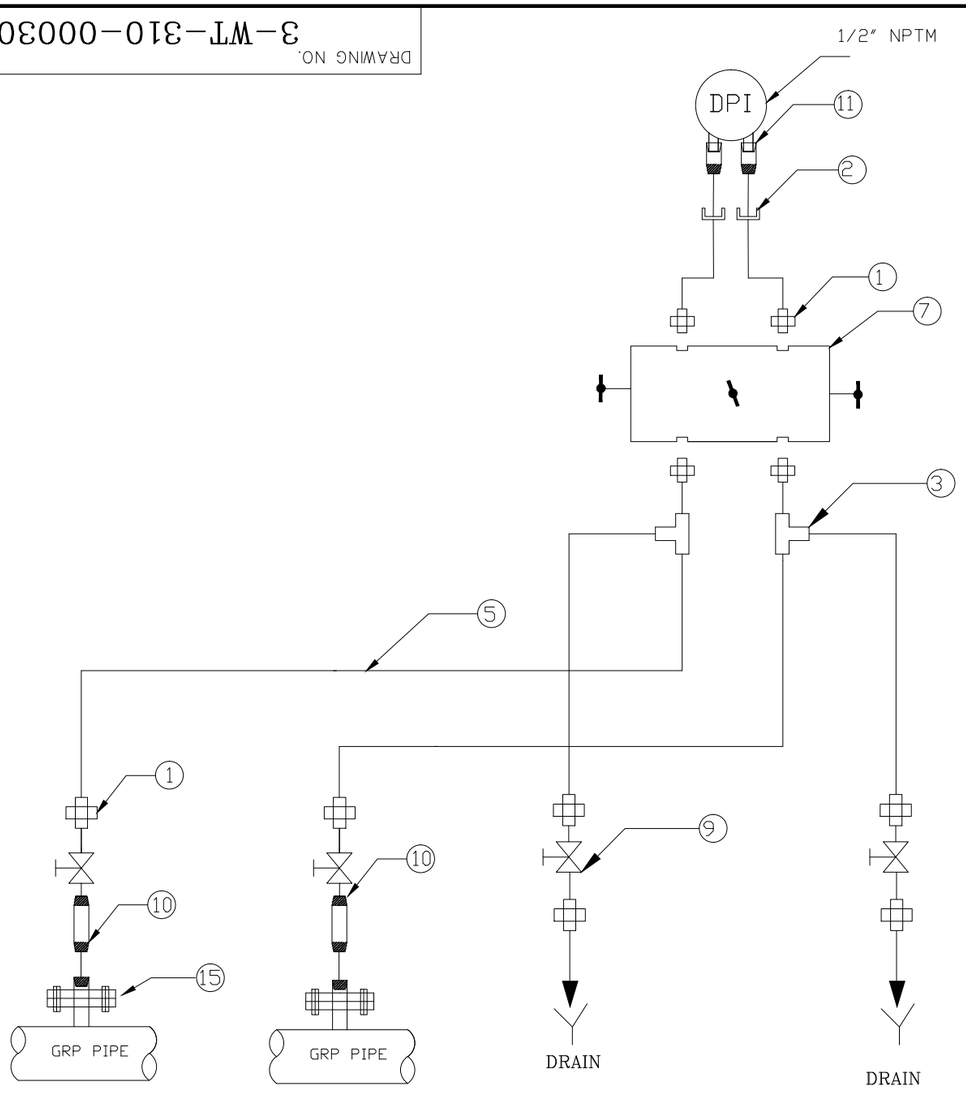
Size A3

DRAWING NO. 3-WT-310-00030

ALL DIMENSIONS ARE IN MILLIMETRES

FOR PRODUCTION

REF. PR:QA:590 FOR PAINTING
REF. PR:QA:500 FOR UNTOL. DIMNS.
REF. APPLICABLE GMS FOR MATCODE&SPEC.



NOTES:

1 THIS INSTRUMENT SHALL BE MOUNTED ON A FRAME WHICH SHALL BE WELDED TO A NEAR BY STRUCTURE OR FIXED ON AN ANGLE IRON FRAME WORK GROUTED TO THE FLOOR. THE FRAME HAS TO BE EPOXY PAINTED IN LIGHT GREY COLOUR.

2 THIS INSTRUMENT & 3 VALVE MANIFOLD SHALL BE LOCATED AT A SUITABLE LOCATION ON THE GROUND TO ENABLE EASY ACCESS TO THE OPERATOR FOR TAKING READINGS. THE TUBING IS TO BE SUITABLY ROUTED TO THE INSTRUMENT.

3 REFER TO INSTALLATION INSTRUCTIONS DRG. NO: 4-WT-310-00017

4 THE IMPULSE LINE SHALL BE ROUTED THROUGH PERFORATED CABLE TRAY WITH SUITABLE SUPPORTS.

5 DRAIN LINE ARE TO BE CONNECTED IN THE DRAIN TRENCH

SI. NO	ITEM .NO.	ITEM DESCRIPTION	QUANTITY IN NOS
1	1	1/2" NPT SS316,double compression ferrule type male connector	10
2	2	1/2" NPT SS316,double ompression ferrule type female connector	2
3	3	Equal Tee	2
4	5	1/2" OD SS tube-10metres	1
5	7	3 valve manifold	1
6	9	1/2" NB SS316 Ball Valve,2 way with 1/2" NPT internal thread at both ends	4
7	10	1/2" NB pipe nipple	2
8	11	1/2" female NPT to male NPT adaptor	2
9	15	1/2" NB Threaded flange with internal thread 1/2" NPT as per ANSI B16.5, 150 class with suitable gasket & fassteness	1

REV	DATE	ALTERED	IRS
01	04.12.12	CHECKED	RPS
ZONE	ZONE	NOTE 4 & 5 ADDED	

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET-632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE: DIFFERENT PRESSURE GAUGE INSTALLATION IN GRP LINE (TYPICAL)

DEPT.
SCALE NTS
SIGN
DATE

DRAWING NO. 3-WT-310-00030

SHEET 1 OF 1 REV. 01

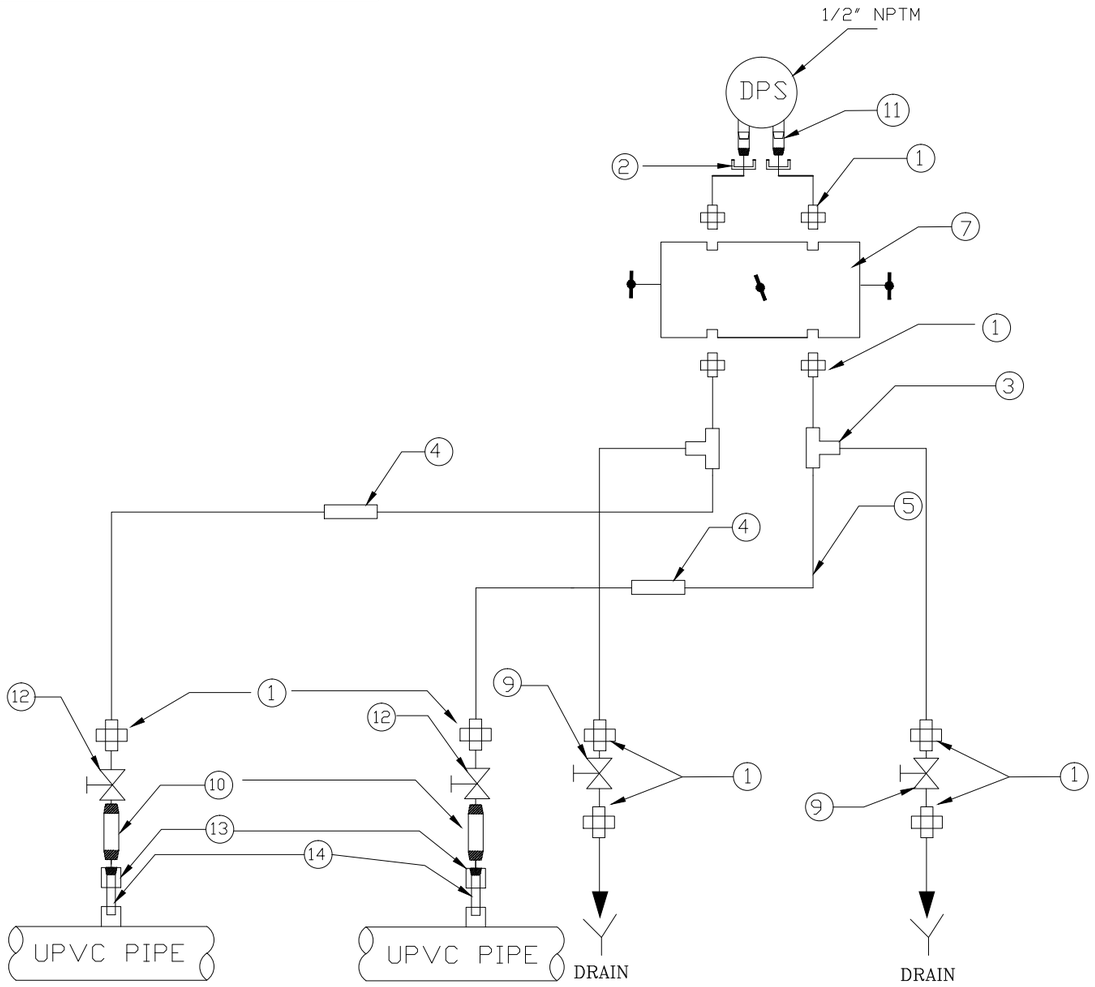
Size A3

DRAWING NO. 3-WT-310-00031

ALL DIMENSIONS ARE IN MILLIMETRES

FOR PRODUCTION

REF. PR:QA:590 FOR PAINTING
REF. PR:QA:500 FOR UNTOL. DIMNS.
REF. APPLICABLE GMS FOR MATCODE&SPEC.



NOTE:

1 THIS INSTRUMENT SHALL BE MOUNTED ON A FRAME WHICH SHALL BE WELDED TO A NEAR BY STRUCTURE OR FIXED ON AN ANGLE IRON FRAME WORK GROUTED TO THE FLOOR. THE FRAME HAS TO BE EPOXY PAINTED IN LIGHT GREY COLOUR.

2 THIS INSTRUMENT & 3 VALVE MANIFOLD SHALL BE LOCATED AT A SUITABLE LOCATION ON THE GROUND TO ENABLE EASY ACCESS TO THE OPERATOR FOR TAKING READINGS. THE TUBING IS TO BE SUITABLY ROUTED TO THE INSTRUMENT.

3 REFER TO INSTALLATION INSTRUCTIONS DRG. NO: 4-WT-310-00017

4 THE IMPULSE LINE SHALL BE ROUTED THROUGH PERFORATED CABLE TRAY WITH SUITABLE SUPPORTS.

5 DRAIN LINE ARE TO BE CONNECTED IN THE DRAIN TRENCH

SI. NO	ITEM.NO.	ITEM DESCRIPTION	QUANTITY IN NOS
1	1	1/2" NPT SS316,double compression ferrule type male connector	10
2	2	1/2" NPT SS316,double compression ferrule type female connector	2
3	3	Equal Tee	2
4	4	Male Union	2
5	5	1/2" OD SS tube-10metres	1
6	7	3 valve manifold	1
7	9	1/2" NB SS316 Ball Valve,2 way with 1/2" NPT internal thread at both ends	2
8	10	1/2" NB pipe nipple	2
9	11	1/2" female NPT to male NPT adaptor	2

REV	DATE	ALTERED	IRS
01	04.12.12	CHECKED	RPS
ZONE	NOTE 4 & 5 ADDED		

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET-632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE: DIFFERENT PRESSURE SWITCH INSTALLATION IN LOW PRESSURE LINE (LP) (TYPICAL)

DEPT.
SIGN
DATE
SCALE NTS

DRAWING NO. 3-WT-310-00031

SHEET 1 OF 1 REV. 01

Size A3

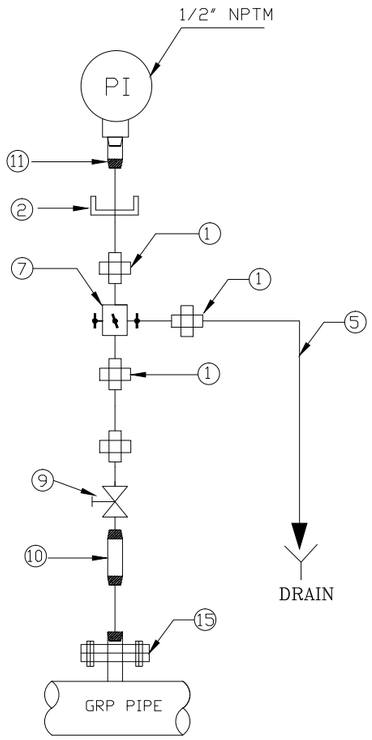
DRAWING NO. 3-WT-310-00032

ALL DIMENSIONS ARE IN MILLIMETRES

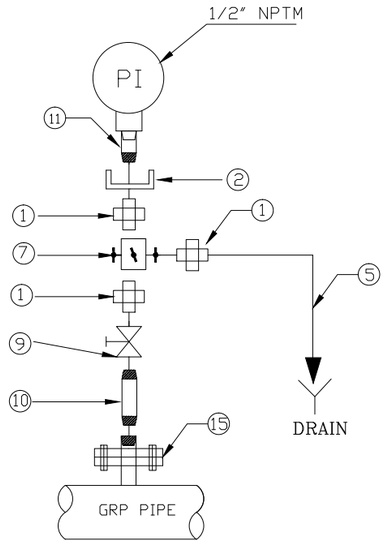
FOR PRODUCTION

REF. PR:QA:590 FOR PAINTING
REF. PR:QA:500 FOR UNTOL. DIMNS.
REF. APPLICABLE GMS FOR MATCODE&SPEC.

PI-REMOTE MOUNTING



PI-DIRECT MOUNTING



SI. NO	ITEM. NO.	ITEM DESCRIPTION	QUANTITY IN NOS
1	1	1/2"NPT SS316,double compression ferrule type male connector	3
2	2	1/2" NPT SS316,double compression ferrule type female connector	1
5	5	1/2" OD SS tube-5metres	1
6	7	3 valve manifold	1
9	9	1/2" NB SS316 Ball Valve,2 way with 1/2" NPT internal thread at both ends	1
10	10	1/2" NB pipe nipple	1
11	11	1/2" female NPT to male NPT adaptor	1
12	15	1/2" NB Threaded flange with internal thread 1/2" NPT as per ANSI B16.5, 150 class with suitable gasket & fassteness	1

NOTE:

1 THIS INSTRUMENT SHALL BE MOUNTED ON A STEEL FRAME FABRICATED AT SITE AND MOUNTED NEAR BY STRUCTURE OR FIXED ON AN ANGLE IRON FRAME WORK GROUTED TO THE FLOOR. THE FRAME HAS TO BE EPOXY PAINTED IN LIGHT GREY COLOUR.

2 THIS INSTRUMENT SHALL BE LOCATED AT A SUITABLE LOCATION ON THE GROUND TO ENABLE EASY ACCESS TO THE OPERATOR FOR TAKING READINGS. THE TUBING IS TO BE SUITABLY ROUTED TO THE INSTRUMENT.

3 REFER TO INSTALLATION INSTRUCTIONS DRG. NO: 4-WT-310-00017

4 THE IMPULSE LINE SHALL BE ROUTED THROUGH PERFORATED CABLE TRAY WITH SUITABLE SUPPORTS.

5 DRAIN LINE ARE TO BE CONNECTED IN THE DRAIN TRENCH

SI. NO	ITEM. NO.	ITEM DESCRIPTION	QUANTITY IN NOS
1	1	1/2" NPT SS316,double compression ferrule type male connector	4
2	2	1/2" NPT SS316,double compression ferrule type female connector	1
3	5	1/2" OD SS tube-10metres	1
4	7	3 valve manifold	1
5	9	1/2" NB SS316 Ball Valve,2 way with 1/2" NPT internal thread at both ends	1
6	10	1/2" NB pipe nipple	1
7	11	1/2" female NPT to male NPT adaptor	1
8	15	1/2" NB Threaded flange with internal thread 1/2" NPT as per ANSI B16.5, 150 class with suitable gasket & fassteness	1

REV	DATE	ALTERED	IRS
01	04.12.12	CHECKED	RPS
ZONE	NOTE 4 & 5 ADDED		

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET-632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE

PRESSURE INDICATOR INSTALLATION IN GRP LINE (TYPICAL)

DEPT. | SCALE NTS | DRAWING NO. 3-WT-310-00032
SIGN
DATE
SHEET 1 OF 1 | REV. 01

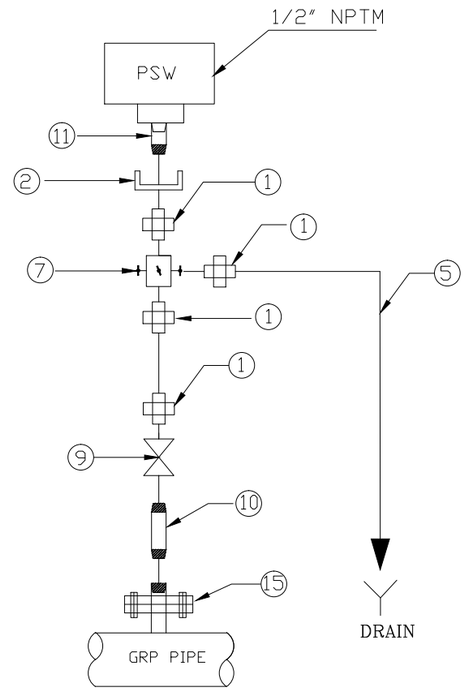
Size A3

DRAWING NO. 3-WT-310-00033

ALL DIMENSIONS ARE IN MILLIMETRES

FOR PRODUCTION

REF. PR:QA:590 FOR PAINTING
REF. PR:QA:500 FOR UNTOL. DIMNS.
REF. APPLICABLE GMS FOR MATCODE&SPEC.



NOTE:

1 THIS INSTRUMENT SHALL BE MOUNTED ON A 2.5MM THICK MS SHEET WHICH SHALL BE WELDED TO A NEAR BY STRUCTURE OR FIXED ON AN ANGLE IRON FRAMEWORK GROUTED TO THE FLOOR. THE MS SHEET HAS TO BE EPOXY PAINTED IN LIGHT GREY COLOUR.

2 THIS INSTRUMENT SHALL BE LOCATED AT A SUITABLE LOCATION ON THE GROUND TO ENABLE EASY ACCESS TO THE OPERATOR FOR TAKING READINGS. THE TUBING IS TO BE SUITABLY ROUTED TO THE INSTRUMENT.

3 REFER TO INSTALLATION INSTRUCTIONS DRG. NO: 4-WT-310-00017

4 THE IMPULSE LINE SHALL BE ROUTED THROUGH PERFORATED CABLE TRAY WITH SUITABLE SUPPORTS.

5 DRAIN LINE ARE TO BE CONNECTED IN THE DRAIN TRENCH

SI. NO	ITEM. NO.	ITEM DESCRIPTION	QUANTITY IN NOS
1	1	1/2" NPT SS316,double compression ferrule type male connector	4
2	2	1/2" NPT SS316,double compression ferrule type female connector	1
3	5	1/2" OD SS tube-10metres	1
4	7	3 valve manifold	1
5	9	1/2" NB SS316 Ball Valve,2 way with 1/2" NPT internal thread at both ends	1
6	10	1/2" NB pipe nipple	1
7	11	1/2" female NPT to male NPT adaptor	1
8	15	1/2" NB Threaded flange with internal thread 1/2" NPT as per ANSI B16.5, 150 class with suitable gasket & fasteners	1

REV	DATE	ALTERED	IRS
01	04.12.12	CHECKED	RPS
ZONE	NOTE 4 & 5 ADDED		

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET-632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE: PRESSURE INDICATING TRANSMITTER / PRESSURE SWITCH INSTALLATION IN GRP LINE (TYPICAL)

DEPT. | SCALE NTS | DRAWING NO. 3-WT-310-00033
SIGN
DATE
SHEET 1 OF 1 | REV. 01

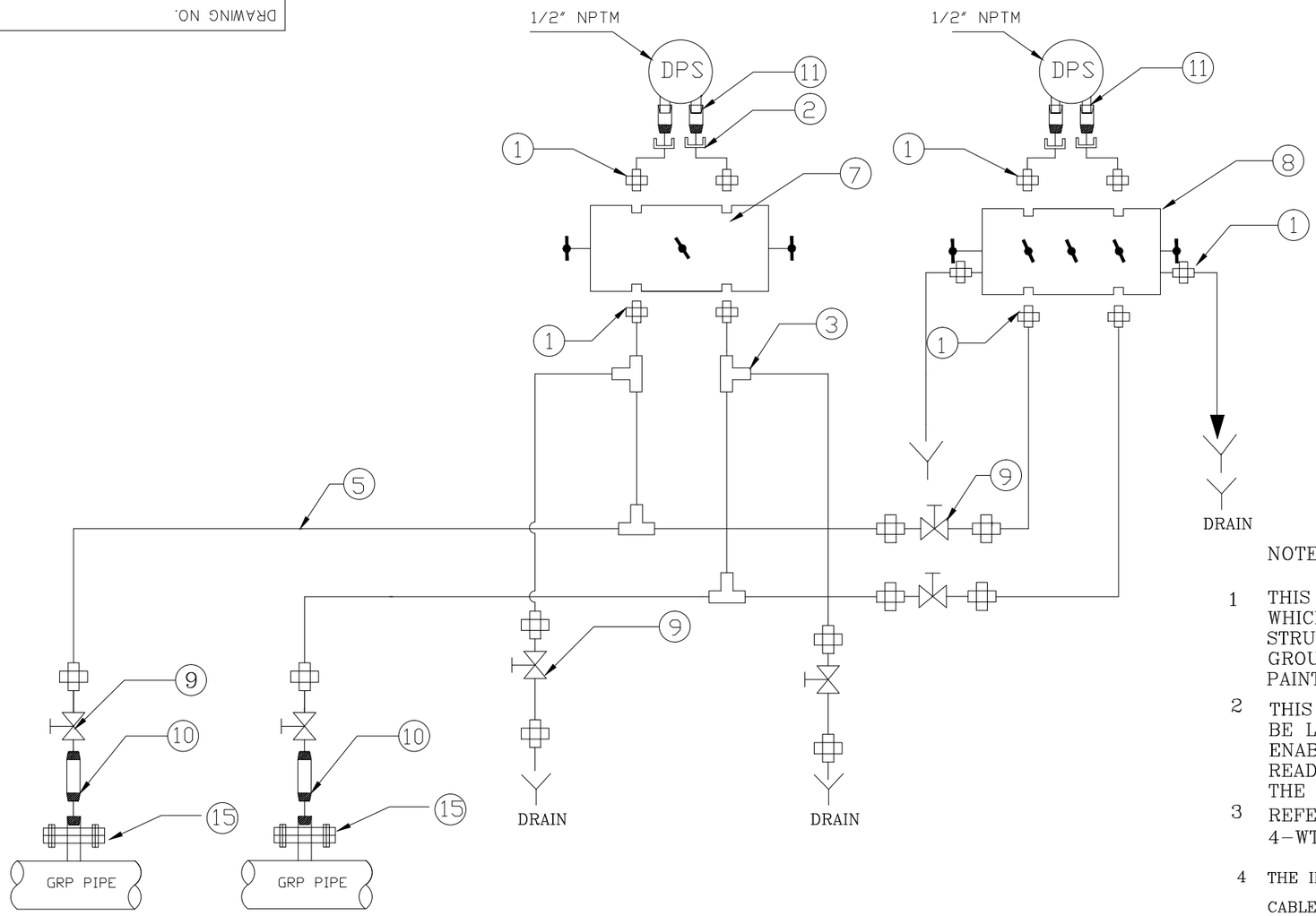
Size A3

DRAWING NO. 3-WT-310-00034

ALL DIMENSIONS ARE IN MILLIMETRES

FOR PRODUCTION

REF. PR:QA:590 FOR PAINTING
REF. PR:QA:500 FOR UNTOL. DIMNS.
REF. APPLICABLE GMS FOR MATCODE&SPEC.



SI. NO	ITEM. NO.	ITEM DESCRIPTION	QUANTITY IN NOS
1	1	1/2" NPT SS316,double compression ferrule type male connector	20
2	2	1/2" NPT SS316,double ompression ferrule type female connector	4
3	3	Equal Tee	4
5	5	1/2" OD SS tube-20metres	1
7	7	3 valve manifold	1
8	8	5 valve manifold	1
9	9	1/2" NB SS316 Ball Valve,2 way with 1/2" NPT internal thread at both ends	6
10	10	1/2" NB pipe nipple	2
11	11	1/2" female NPT to male NPT adaptor	4
12	15	1/2" NB Threaded flange with internal thread 1/2" NPT as per ANSI B16.5, 150 class with suitable gasket & fasteners	2

NOTE:

1 THIS INSTRUMENT SHALL BE MOUNTED ON A FRAME WHICH SHALL BE WELDED TO A NEAR BY STRUCTURE OR FIXED ON AN ANGLE IRON FRAMEWORK GROUTED TO THE FLOOR. THE FRAME HAS TO BE EPOXY PAINTED IN LIGHT GREY COLOUR.

2 THIS INSTRUMENT & 3 VALVE/ 5 VALVE MANIFOLD SHALL BE LOCATED AT A SUITABLE LOCATION IN THE GROUND TO ENABLE EASY ACCESS TO THE OPERATOR FOR TAKING READINGS. THE TUBING IS TO BE SUITABLY ROUTED TO THE INSTRUMENT.

3 REFER TO INSTALLATION INSTRUCTIONS DRG. NO: 4-WT-310-00017

4 THE IMPULSE LINE SHALL BE ROUTED THROUGH PERFORATED CABLE TRAY WITH SUITABLE SUPPORTS.

5 DRAIN LINE ARE TO BE CONNECTED IN THE DRAIN TRENCH

REV	DATE	ALTERED	IRS
01	04.12.12	CHECKED	RPS
ZONE	NOTE 4 & 5 ADDED		

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET-632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE: DP INDICATING TRANSMITTER/ DP SWITCH INSTALLATION IN GRP LINE (TYPICAL)

DEPT. | SCALE NTS | DRAWING NO. 3-WT-310-00034

SIGN | DATE

SHEET 1 OF 1 | REV. 01

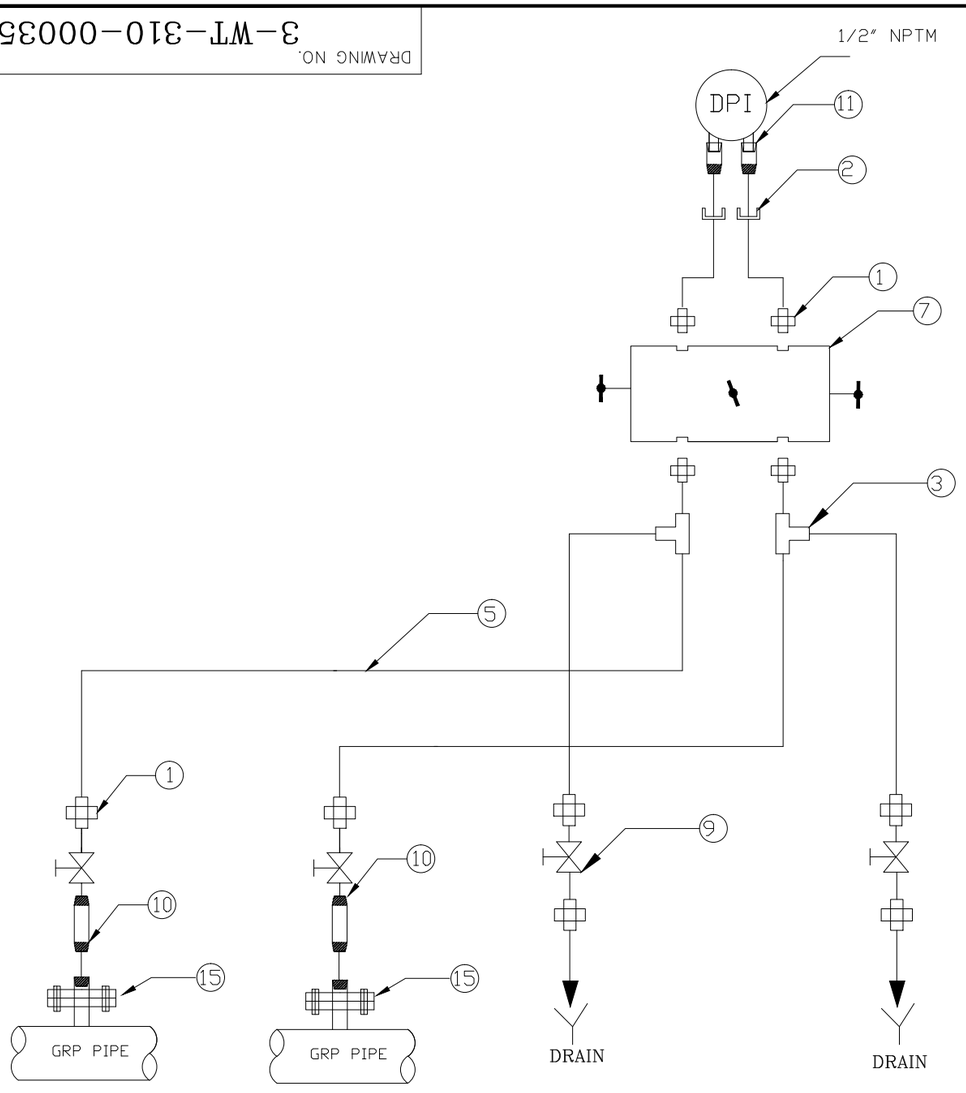
Size A3

DRAWING NO. 3-WT-310-00035

ALL DIMENSIONS ARE IN MILLIMETRES

FOR PRODUCTION

REF. PR:QA:590 FOR PAINTING
REF. PR:QA:500 FOR UNTOL. DIMNS.
REF. APPLICABLE GMS FOR MATCODE&SPEC.



NOTES:

1 THIS INSTRUMENT SHALL BE MOUNTED ON A FRAME WHICH SHALL BE WELDED TO A NEAR BY STRUCTURE OR FIXED ON AN ANGLE IRON FRAME WORK GROUTED TO THE FLOOR. THE FRAME HAS TO BE EPOXY PAINTED IN LIGHT GREY COLOUR.

2 THIS INSTRUMENT & 3 VALVE MANIFOLD SHALL BE LOCATED AT A SUITABLE LOCATION ON THE GROUND TO ENABLE EASY ACCESS TO THE OPERATOR FOR TAKING READINGS. THE TUBING IS TO BE SUITABLY ROUTED TO THE INSTRUMENT.

3 REFER TO INSTALLATION INSTRUCTIONS DRG. NO: 4-WT-310-00017

4 THE IMPULSE LINE SHALL BE ROUTED THROUGH PERFORATED CABLE TRAY WITH SUITABLE SUPPORTS.

5 DRAIN LINE ARE TO BE CONNECTED IN THE DRAIN TRENCH

SI. NO	ITEM .NO.	ITEM DESCRIPTION	QUANTITY IN NOS
1	1	1/2" NPT SS316,double compression ferrule type male connector	10
2	2	1/2" NPT SS316,double ompression ferrule type female connector	2
3	3	Equal Tee	2
4	5	1/2" OD SS tube-10metres	1
5	7	3 valve manifold	1
6	9	1/2" NB SS316 Ball Valve,2 way with 1/2" NPT internal thread at both ends	4
7	10	1/2" NB pipe nipple	2
8	11	1/2" female NPT to male NPT adaptor	2
9	15	1/2" NB Threaded flange with internal thread 1/2" NPT as per ANSI B16.5, 150 class with suitable gasket & fasteners	2

REV	DATE	ALTERED	IRS
01	04.12.12	CHECKED	RPS
ZONE	NOTE 4 & 5 ADDED		

BHARAT HEAVY ELECTRICALS LTD
UNIT : BOILER AUXILIARIES PLANT
RANIPET-632 406

DEPT CODE		NAME	SIGN	DATE
876	DRN	ACK		
	DESN	ACK		
	CHD	RPS		
	APPD	DNB		

TITLE: DIFFERENT PRESSURE GAUGE INSTALLATION IN GRP LINE (TYPICAL)

DEPT.
SCALE NTS
SIGN
DATE

DRAWING NO. 3-WT-310-00035

SHEET 1 OF 1 REV. 01

Size A3

VENDORS LIST FOR MB

		09.07.2013
Cust. No.: R804		
PROJECT : M/S.RPCL, YERAMARUS TPS		
		MECHANICAL
SL. No	**Description of Items**	**Vendors Proposed**
1	LP CENTRIFUGAL PUMPS	KIRLOSKAR
		FLOWSERVE
		SULZER
		MATHER&PLATT
		GRUNDFOS
		BEST & CROMPTON
		WIPL LTD
		KSB
2	GLOBE VALVES	FOURESS, BANGALORE
		KIRLOSKAR
		KSB, CHENNAI
		WEIR BDK, CHENNAI
3	BALL VALVES	WEIR BDK, CHENNAI
		KIRLOSKAR
		KSB, CHENNAI
		VIRGO ENGINEERS LIMITD
		MICROFINISH VALVES , HUBLI
4	BUTTERFLY VALVES	KIRLOSKAR
		L&T, Chennai
		FOURESS, BANGALORE
		WEIR BDK, CHENNAI
		CRANE PROCESS - ALFA LAVAL(Saunders) *
		INTER VALVE (POONAWALLA)
5	DIAPHRAGM VALVES	FISHER XOMOX
	(FOR MB SYSTEM)	FOURESS, BANGALORE
		PROCON ENGINEERS LTD
		CRANE PROCESS - Alfa Laval (Saunders)
		WEIR BDK, CHENNAI

6	PUMP MECH. SEALS	JOHN CRANE
		DURAMETALLIC
		EAGLE BURGMANN
		FLOWSERVE SCANMAR
7	PUMP BEARING	SKF
		FAG
8	MB BLOWERS	EVEREST
		KAY INTERNATIONAL
		RKR
		HICK HARGRIVERS
9	RESIN	DOW
		THERMAX
		ION EXCHANGE
		ROHM & HASS
10	DEGASSER BLOWER	VISWAKARMA
		CASCADE AIRTECH
11	UPVC/CPVC piping & valves	GF
		FIP
		ASTRAL

Cust. No.: R804

PROJECT : M/S.RPCL, YERAMARUS TPS

		MB : ELECTRICAL & C&I
SL. NO	DESCRIPTION OF ITEMS	VENDORS PROPOSED
12	POWER CABLES	INDUSTRIAL CABLES RAJPURA, CHENNAI,KOLKATA.
		KEI INDUSTRIES, NEW DELHI
		NICCO CORP. PVT. LTD, CHENNAI / KOLKATTA
		DELTON CABLES, NEW DELHI
		KEC INTERNATIONAL LTD,
		PARAMOUNT COMMUNICATION LTD
		POLYCAB WIRES PVT LTD
		CORDS CABLE INDUSTRIES LIMITED
		RADIANT CORPORATION PRIVATE LIMITED
		GOYOLENE FIBRE (I) PVT LTD
		KRISHNA ELECTRICAL INDUSTRIES LIMITED
		TORRENT CABLES LTD
		RAVIN CABLES LTD
		THERMO CABLES LIMITED

13	INSTRUMENTATION CABLES	INDUSTRIAL CABLES RAJPURA, CHENNAI,KOLKATA.
		KEI INDUSTRIES, NEW DELHI
		NICCO CORP. PVT. LTD, CHENNAI / KOLKATTA
		DELTON CABLES, NEW DELHI
		C M I LTD.,
		PARAMOUNT COMMUNICATION LTD
		POLYCAB WIRES PVT LTD
		CORDS CABLE INDUSTRIES LIMITED
		RADIANT CORPORATION PRIVATE LIMITED
		ELKAY TELELINKS LTD
		TORRENT CABLES LTD
		SUYOG ELECTRICALS LTD
		THERMO CABLES LIMITED
14	LT MOTORS	BHARAT BIJILEE LTD
		CROMPTON GREAVES LTD
		SIEMENS LTD
		ABB
		KIRLOSKAR ELECTRIC CO. LTD
		NGEF (HUBLI) LTD
	INSTRUMENTS	
15	CONDUCTIVITY, PH ANALYSER	ABB
		POLYMETRON
		HONEYWELL
		HACH
		YOKOGAWA
		ENDRESS+ HAUSER
		EMERSON PROCESS MANAGEMENT(INDIA) PVT LTD
16	DIFFERENTIAL PRESSURE SWITCHES / PRESSURE SWITCHES	SWITZER INSTRUMENTS LTD.
		INDFOSS (INDIA) LTD
		AN INSTRUMENTS
		BELLS CONTROLS LTD
		VARMA TRAFAG
		GIC
17	PRESSURE / FLOW/ LEVEL DIFFERENTIAL PRESSURE TRANSMITTER	HONEYWELL
		YOKOGAWA
		EMERSON PROCESS MANAGEMENT(INDIA) PVT LTD
		ABB
		E & H

18	SOLENOID VALVES	ASCO
		AVCON
		ROTEX
		NUCON
19	SILICA MEASUREMENT	HACH
		EMERSON
20	PNEUMATIC ACTUATOR FOR DIAPHRAGM VALVE	ELOMATIC INDIA LTD
		VIRGO ENGINEERS LTD
		FISCHER XOMOX LTD
		CRANE PROCESS FLOW TECHNOLOGIES (REVO MAKE)
21	PNEUMATIC ACTUATOR FOR BUTTERFLY VALVE	ELOMATIC INDIA LTD
		VIRGO ENGINEERS LTD
		FISCHER XOMOX LTD
		CRANE PROCESS FLOW TECHNOLOGIES (REVO MAKE)
		ROTEX
22	FLOW SWITCH	Switzer Instrument Co
		Levcon
		TRAC
		DK Instruments
		Krohne Marshall
		GIC
23	PRESSURE GAUGES	AN INSTRUMENTS
		HGURU INSTRUMENTS(SI)
		MANOMETER(I) LTD)
		Goa Thermostatic instruments
		GLUCK(INDIA) MFG .CO.
		PRECISION INDS
		GIC
24	Level Switches (Magnetic Float Type	LEVCON
		PUNE TECHTROL
		V.Automat
		Nivo
		SBEM
		Chemtrols
25	LEVEL GAUGES	CHEMTROLS
		PUNE TECHTROL
		SBEM
		V.Automat & Instruments Pvt ltd
		LEVCON
26	ROTAMETERS	EUREKA
		IEPL
		Placka
		Trac
		FLUIDYNE INSTRUMENTS
27	Orifice Plate Assembly	Micro Precision
		Star Mech
		Baliga
		Wellwin Industries
		Instrumentation Ltd
		Placka
		GIC
28	Impulse lines, valves & Compression Fittings	Parker
		Precision engg industries
		HP Valves & Fittings
		Swagelock
		Hy Lock
		Fluid Controls/Hydair
		Excel Hydro - Pneumatics P Ltd

29	Valve Manifolds	Excell Hydro - Pneumatics P Ltd
		Astec Valves & Fittings P Ltd
		HP Valves & Fittings
		Precision
		Hydair Engg. Works
30	AIR FILTER REGULATOR	SHAVO NORGREN
		VELJAN HYDAIR
		PLACKA
31	Cable Glands	Sunil & Co.
		Bracco
		QPIE
		Arup Engg.
		Comet
		SMI
32	Cable Lugs	Dowells
		Chetna
		Electro Billets
33	JUNCTION BOXES	SHIBSHA INSTRUMENT INDIA P LTD , CHENNAI
		WIN POWER , KOLKATA
		CHEMIN CONTROLS AND INSTRUMENTATION PVT. LTD , PONIDICHERRY
		PYROTECH ELECTRONICS PVT LTD , UDAIPUR
		SAHYADRI ELECTRO CONTROLS (INDIA) PRIVATE LTD., , BANGALORE
		SRI VISHNU INDUSTRIES , HOSUR
		KEAS CONTROL SYSTEMS INDIA PRIVATE LIMITED , COIMBATORE
		HAROLD INDUSTRIES PVT LTD., , CHENNAI
		K.S.INSTRUMENTS PVT. LTD., , BANGLORE
		PRAMMEN INDUSTRIES , PUDUKOTTAI
		SAJAS ELECTRICALS , TRICHY
34	PERFORATED CABLE TRAYS	M METAPRINT INDUSTRIES ,CHENNAI
		PATNY SYSTEMS (P) LTD., ,SECUNDARABAD
		PRAMMEN INDUSTRIES ,PUDUKOTTAI
		AM-TECH ENGINEERING SERVICES ,PUNE
		JAMNA METAL COMPANY ,DELHI
		JAMUNA METAL COMPANY ,SONEPAT (DT)
		KANADE ANAND UDYOG PVT. LTD ,MUMBAI
		INAR PROFILES PVT. LIMITED ,ANAKAPALLE
		INDUSTRIAL PERFORATION (INDIA) PVT. LTD ,KOLKATA
		PREMIER POWER PRODUCTS (CALCUTTA) PVT. LTD ,KOLKATA
		PARMAR METALS PVT LTD ,RAJKOT
		RATAN PROJECTS & ENGINEERING CO PVT. LTD ,KOLKATA
		RUKMANI ELECTRICAL & COMPONENTS PRIVATE LTD ,KOLKATA