

**TANGEDCO
2x660 MW UDANGUDI STPP STG I**

**TECHNICAL SPECIFICATION
FOR
MISCELLANEOUS PUMPS (VERTICAL)**

Specification No. : PE-TS-435-100-N011 (REV. 0)



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PPEI BUILDING, SECTOR 16 A
NOIDA - 201301**



TITLE: TECHNICAL SPECIFICATION MISCELLANEOUS PUMPS SPECIFIC TECHNICAL REQUIREMENTS	SPEC. NO.: PE-TS-435-100-N011		
	SECTION:		
	SUB-SECTION:		
	REV. NO. 00	DATE	19.10.2019
	SHEET 1	OF	1

INDEX

THIS TECHNICAL SPECIFICATION CONSISTS OF FOLLOWING SECTIONS:

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IIID	Data Sheet – B and Other documents (To be submitted by successful Bidder after award of Contract)

Notes:

1) For detailed list of documents to be submitted by bidder in their technical offer, please refer cl. no. 15.00.00 of Section-IIA.

2) For detailed list of documents to be submitted by vendor after award of contract, please refer Datasheet-C of Section-IIA.

3) In case there is conflict in different clauses of specification, most stringent clause (as decided by BHEL / end customer) shall be followed, if no specific deviation is taken by bidder and accepted by BHEL during tender stage in that regard.



TITLE:
**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-435-100-N011**

SECTION:

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SECTION - I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IA - Specific Technical Requirements (Mech.)

SUB-SECTION IB - Specific Technical Requirements(Electrical) – NOT APPLICABLE

SUB-SECTION IC - Specific Technical Requirements (C & I)

SUB-SECTION ID – Datasheet-A



TITLE:
**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-435-100-N011**

SECTION: **I**

SUB-SECTION: **IA**

REV. NO. **00** DATE 19.10.2019

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SUB-SECTION – IA

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

	TECHNICAL SPECIFICATIONS		Specification No. : PE-TS-435-100-N011, Rev0	
	MISCELLANEOUS PUMPS		SECTION: IA	
	SPECIFIC TECHNICAL REQUIREMENTS		REV. NO. 0	DATE: 19.10.2019

1.0 SCOPE

- 1.1 This enquiry covers the design, manufacture, assembly, inspection and testing at manufacturer's and/or his sub-contractors works, proper packing for delivery and installation checks and PG Test at site for Miscellaneous Pumps (Vertical) along with mandatory spares complete with all accessories and services as per the requirements specified in this specification and any other services, etc. if called for in the succeeding sections of the specification for following project:

A. 2X660 MW UDANGUDI STPP STG I (TANGEDCO)

The above project is referred as '2X660 MW UDANGUDI' elsewhere in the Specification for ease of reference.

NOTE:-

1. The bidder shall include complete supplies for Pumps as covered in this Technical Specification. Part supplies offered for the Pumps shall disqualify the bidder's offer.

2. Pump details shall be as per Data Sheet-A at Section-ID.

- 1.3 The miscellaneous pumps and drives covered under this specification for various projects are as per Annexure-1 of this section. HT drives, wherever applicable and irrespective of motor ratings, shall be issued free of cost by BHEL. The details of pumps with HT drives shall be as per Annexure-2 of this section.
- 1.4 The Capacity, Head, Materials of construction, Mandatory spares and other particulars of these pumps, are detailed in Data Sheet-A at Section-ID of the specification.
- 1.5 For detailed scope of supply & services for Vertical pumps, refer Standard technical Specification for Vertical Centrifugal pumps specified under Section-II of this specification.
- 1.6 DELETED
- 1.7 DELIVERY:
Delivery of miscellaneous pumps shall be as per NIT requirement.
- 1.8 Evaluation and LD criterion w.r.t. Auxiliary Power is defined at clause 4.0 of Section IIA of this specification. In case bidder quotes Aux. power less than Benchmark Auxiliary Power, then quoted Aux. power shall be replaced with Benchmark Auxiliary Power for both evaluation as well as LD purposes.

2.0 Additional requirements for Pumps:

- 2.1 End Customer specific requirements are indicated as Annexure-3 In this section, same are also to be complied. In case of any contradiction with other clauses of Section-IA, the stringentmost requirement is to be complied.

2.2 For Vertical Pmps:

- 2.2.1 All Vertical pump motors shall be designed/capable of withstanding max. run away speed during reverse flow.
- 2.2.2 Thrust block assembly (Thrust pads, attachments) as applicable for transferring the pump thrust to concrete thrust block (concrete thrust block in purchaser scope) to be provided for all Pumps by bidder.
- 2.2.3 Sump Model Study to be conducted for Sea Water Intake Pump House and Outfall Pump House by the Bidder.

Dimensions of pump chamber/ sump in the Pump house shall be fixed up initially by BHEL based on Hydraulic Institute Standard (Preliminary Layout is attached as Annexure-4). The dimensions shall be confirmed by Pump Vendor by conducting a Hydraulic Model Study at a recognised Institute/ hydraulic research laboratory (subject to BHEL/End Customer Acceptance of Sump Model Study/Testing Agency). Scale of the model shall be 1:10. The hydraulic model study shall be conducted to study water level in the pump sump, flow conditions in the pump sump for different discharges & different depths of water, different combinations of pump operations to study velocity distribution in pump bays, etc.

The model shall be based on Froude's law of similitude and shall also be tested for following two more flow conditions, viz.

- At twice the prototype maximum Froude number, i.e., the Froude number of the model is two times that of the prototype.
- At equal velocity criterion, i.e., the velocity is same both in the model and prototype.

The final recommendation shall be based on 2F condition. Based on recommendations of the hydraulic model study, necessary modifications shall be made in the pump sump, forebay & channel, additional structural features required such as flow straighteners, baffle walls, mesh screens, grid walls, guide vanes, floor splitters, anti - swirl cone etc. for elimination of non - uniform velocity distribution, swirls and vortices in the model etc.

Pump Vendor shall furnish procedure for Sump Model Study within One (1) month from LOI. BHEL and/or End Customer shall review/approve the Procedure for Sump Model Study and physical test conductance shall be intimated by the Pump vendor in advance for witness of Sump Model Study by BHEL/End Customer as per Approved Procedure.

- 2.2.4 Non-Reverse Ratchet Mechanism to be provided for all vertical pumps.

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2.2.5 For all HT Motor driven Vertical pumps, following instruments/accessories to be provided:

- All the Pumps with HT Drives only shall be provided with RTDs for each Pump bearing temperature monitoring / tripping. Specification for RTD are attached at Section-1C.
- Reverse rotation Measurement System/Switch Indicator to be provided with all the HT Motor Driven Pumps by bidder. The Technical Specification for Reverse Rotation Monitoring System is attached in Section IC.

3.0 Vibration, Noise and Parallel run test (as applicable) for all pumps shall also be conducted by bidder at site as per approved PG Test Procedure, inline with CI no. 3.04 of Section-IIA of this specification. Mechanical run test along with Performance test shall be carried out on all pumps to determine the vibration levels, noise levels etc. at Vendor works. However, test value at site shall be used for the acceptance of the equipment. Pump vendor shall bring necessary instruments for conductance of site performance test. If the site performance is found not meeting the requirements in any respect as specified, then the equipment shall be rectified or replaced by the vendor, without any commercial implication to BHEL.

4.0 Additional Dispatch Requirements:

MDCC after final inspection shall be provided to vendor on the basis of following:-

- List of items packed in each box with description & quantity.
- Photograph of each box in open & closed condition.
- Bidder to include handling instructions in engineering drg/doc and packing to be done in such a way to avoid damage of items in transit and long storage at site and same shall be approved in Contract stage by BHEL/Customer

5.0 Drawing/Document Submission Schedule:

MISC. PUMPS (VERTICAL)	Primary Documents		
	PE-V6-435-100-N001	TDS AND PERFORMANCE CURVES- MISC. PUMPS	R-0 within 21 days from LOI/PO & subsequent revisions within 10 days of comments received from BHEL.
	PE-V6-435-100-N002	GENERAL ARRANGEMENT AND CROSS SECTIONAL-PUMPS	
	PE-V6-435-100-N004	QP-MISC PUMPS - VERTICAL	
	Secondary Documents		
	PE-V6-435-100-N007	O & M MANUAL -VERTICAL PUMPS	Within 30 days from MDCC
	PE-V6-435-100-N008	PG TEST PROCEDURE -VERT. PUMPS	R-0 within 21 days of Cat-I(or)II approval on pump document.
	PE-V6-435-100-N009	PROCEDURE FOR SUMP MODEL STUDY	Within One (1) month from LOI



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Annexure-1

List of Miscellaneous Pumps and drives for :

A. 2X660 MW UDANGUDI STPP STG I (TANGEDCO)

Sl. No.	Pump Description	Total Qty.	Type of Pumps
	Vertical Pumps		
1	CW MAKEUP PUMPS	3 nos.	Vertical
2	DESALINATION PLANT SUPPLY PUMPS	3 nos.	Vertical
3	OUTFALL PUMPS	3 nos.	Vertical
4	CW BLOWDOWN PUMPS	3 nos.	Vertical
5	ACW PUMPS	4 nos.	Vertical



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Annexure-2

Following HT drives for 2X660 MW UDANGUDI (TANGEDCO), irrespective of Motor ratings shall be issue free, by BHEL:

Vertical Pumps:

- 1 CW MAKEUP PUMPS**
- 2 DESALINATION PLANT SUPPLY PUMPS**
- 3 OUTFALL PUMPS**
- 4 CW BLOWDOWN PUMPS**
- 5 ACW PUMPS**

**ANNEXURE-3****5.3.0 Pumps**

The pump shall be designed to have best efficiency at the specified duty point and shall in no case less than 85%. The pumps shall be capable of continuous operation at any point within the operating range.

The pumps shall have stable head capacity characteristic continuously rising towards shut off conditions. Pump shall operate satisfactorily and continuously at run-out capacity. Pumps shall be capable of operating from 40% to 120% of rated flow.

Both working and standby pump shall have identical performance characteristics. The pump and motor shall be designed for manual as well as automatic start-up facility under standby condition.

The impeller shall be of semi open type and shall be of non overloading characteristic.

The pump shall be directly driven by a constant speed squirrel cage induction motor.

5.3.1 Vertical turbine pumps for ACW and CW Blow down system

The offered pump should be of proven design and Contractor shall provide satisfactory certificate from the end user. Otherwise for the offered pump, Contractor should have carried out the model test in the presence of Owner to predict the performance of the prototype. The specific speed of the model tested shall lie within $\pm 5\%$ of the specific speed of the pump offered. Model test shall include the cavitations test & Net Positive Suction Head Required.

Blow down and ACW Pumps shall be of vertical shaft, submerged suction, self lubrication type (water) design, complete with bowl, column, discharge head and drive assembly, etc. If the water quality is found to be unsuitable for self lubrication, the Contractor shall provide service water as external water for lubrication.

Column Pipes shall be flanged and bolted and shall be complete with bolts, nuts, & gaskets. The standard lengths of the column pipe pieces shall be dictated from considerations of ease of handling and as per IS: 1710.

The pump discharge shall be of above the floor type. Suitable arrangement shall be provided to take care of the discharge hydraulic thrust due to an untied expansion joint. This may be achieved either by sizing pump discharge head and base plate adequately to take care of the discharge hydraulic thrust.

The pump suction bell diameter shall be such as to limit the flow velocity at the maximum flow to within 1.5 m/sec.

The line shaft couplings shall preferably be of flanged type (if applicable).

The type of lubrication shall be self-water or forced water as required. Shaft bearings above minimum water level shall be of self lubricated type and below minimum water level shall be of water lubricated type. During initial filling and normal operation the lubricating water shall be tapped from water filling line/potable/nearest source and fed to overhead tank. The backup

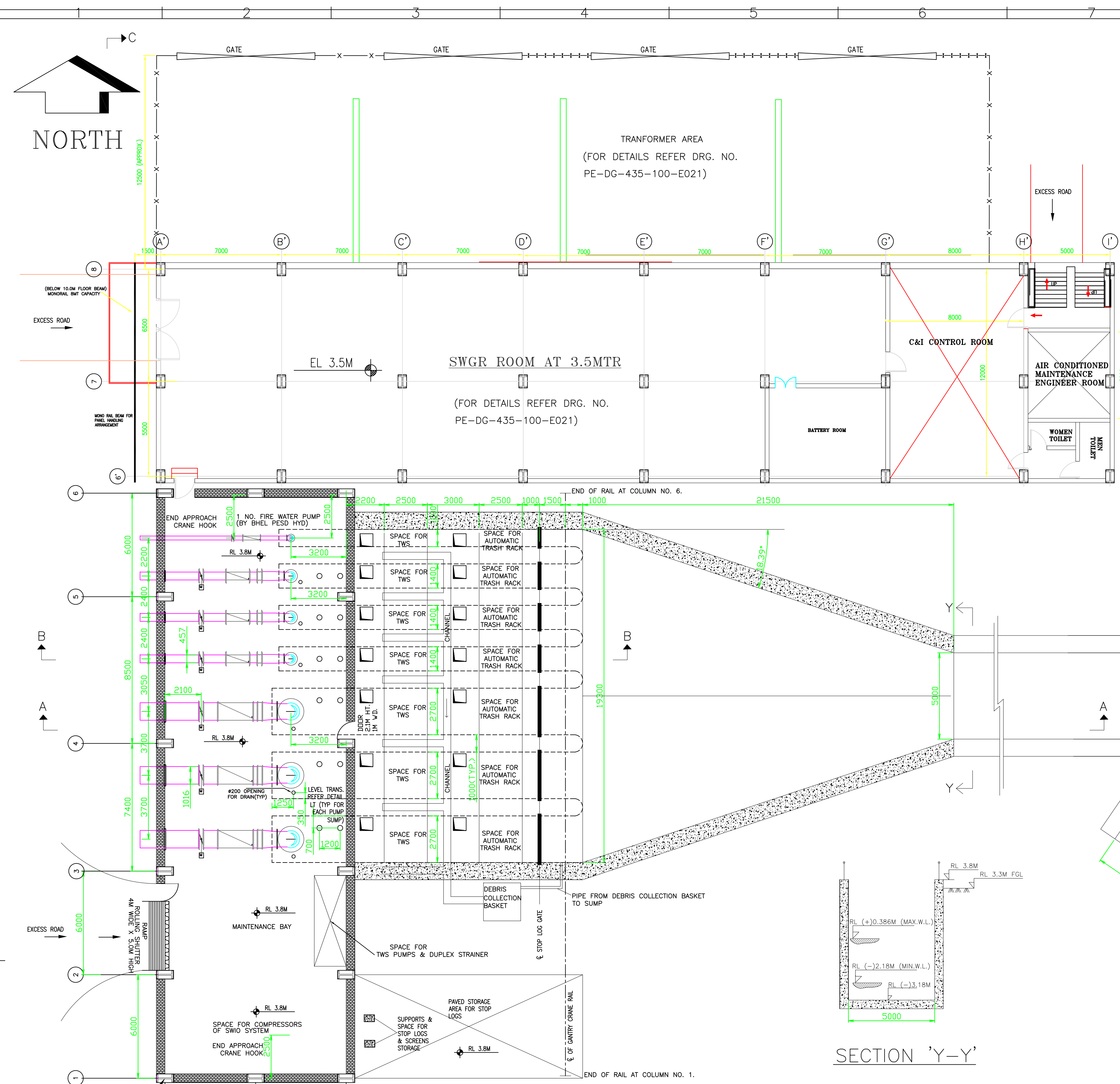


source shall be tapped from a common header formed by taking a tapping from discharge of all ACW pumps and Blow down pumps. This water shall pass through 2 x 100% duplex filters and fed to overhead tank. In case of forced lubrication, lubrication water pump capable of meeting the total lubricating water flow requirement for one ACW pump along with drive shall be provided for each ACW pumps and blow down pumps.

Non – Reverse ratchet mechanism shall be provided for the vertical pumps to prevent the reverse rotation.

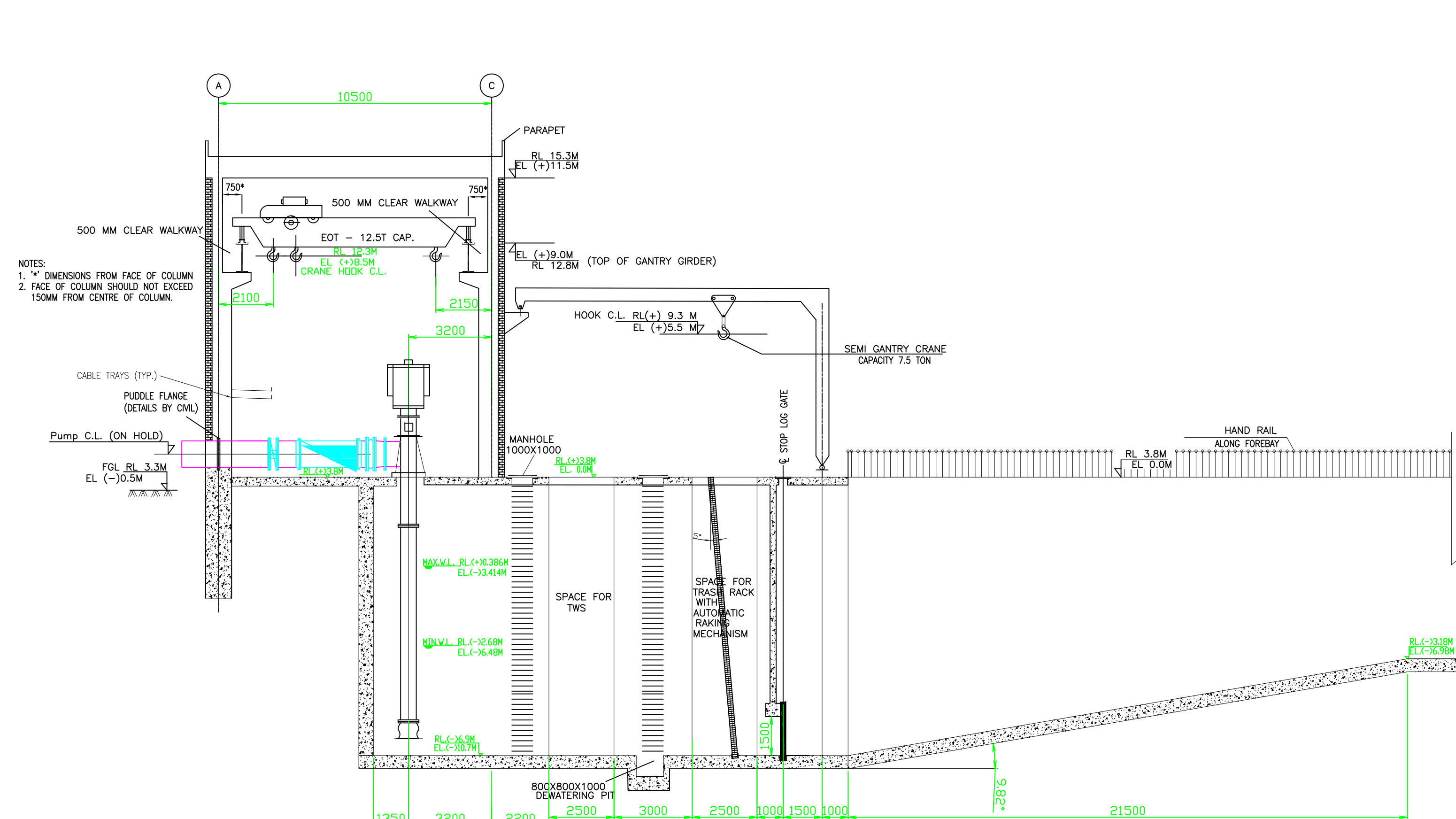
The pump and motor (complete assembly) should be designed for withstanding the run away speed attained with reverse rotation caused by reverse flow continuously even when all the remaining pumps are in operation. Necessary speed switches to detect reverse rotation shall be provided to prevent motor switching on while rotating in reverse direction. The indication shall also be provided for this purpose.

ANNEXURE-4



85.80E
1290.2N

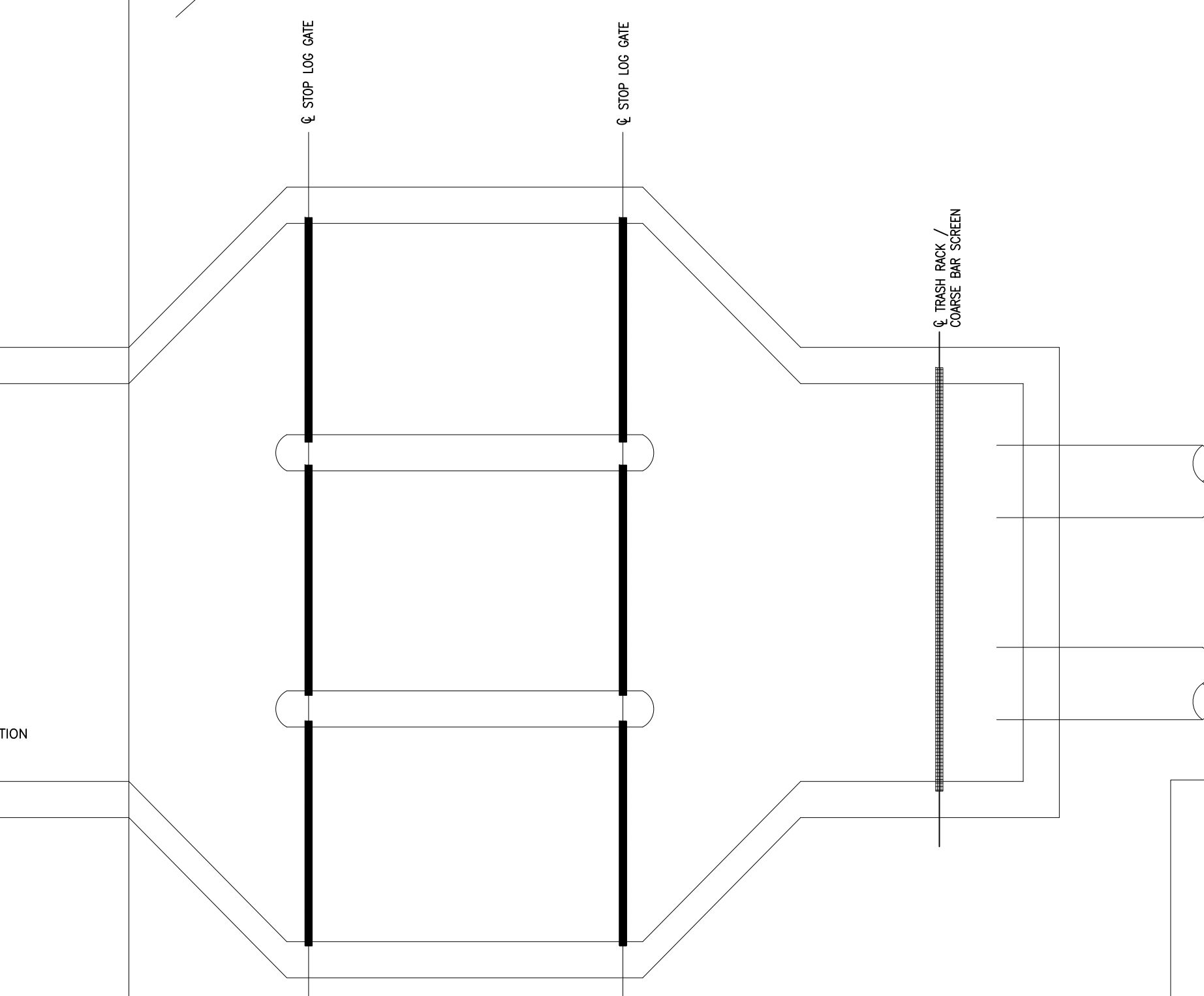
PLAN OF SWI PUMP HOUSE & FOREBAY
SCALE 1:160



SEA WATER INTAKE PUMP FOR CW MAKEUP
SECTIONAL VIEW -A-A'
SCALE 1:160

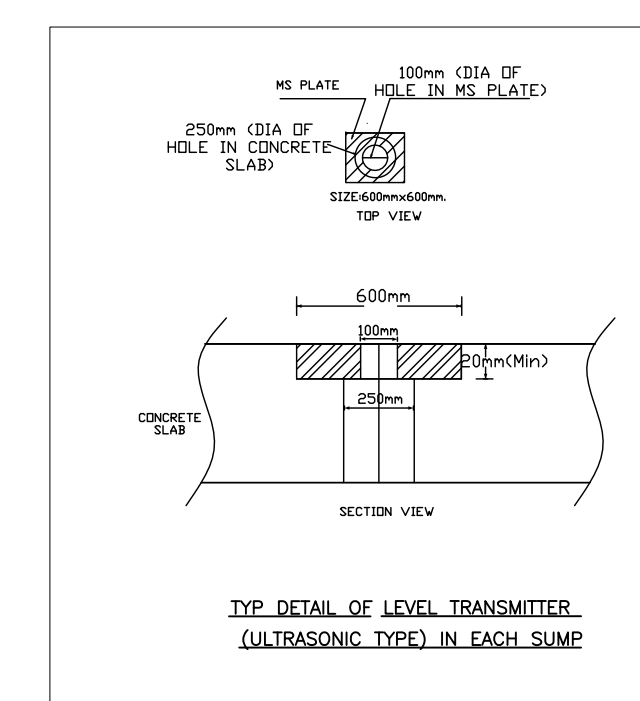
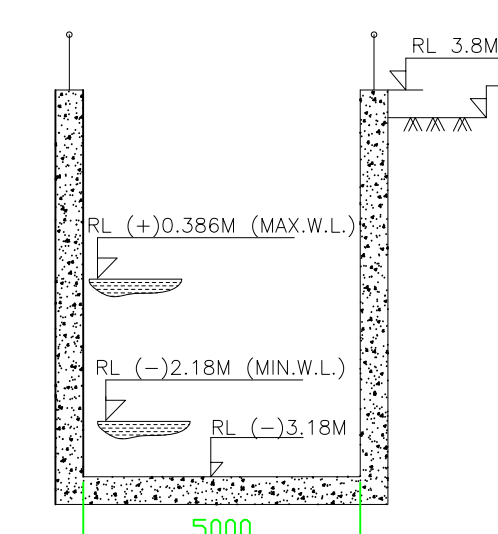
LEVELS CONSIDERED FOR DESIGNING (AS PER INFORMATION FURNISHED BY TANGEDCO)			
	ELEVATIONS W.R.T. CD	RL	EL. (M)
PLANT FGL	3.940	+3.300	(-)0.500
HIGHEST HIGH WATER LEVEL	1.026	+0.386	(-)3.414
MEAN SEA LEVEL	0.640	0.000	(-)3.800
LOWEST LOW WATER LEVEL	0.110	(-)0.530	(-)4.330

BHEL VENDOR
(SWI SYSTEM
VENDOR)



PLAN VIEW OF DESILTING BASIN & CHANNEL
NOT TO SCALE

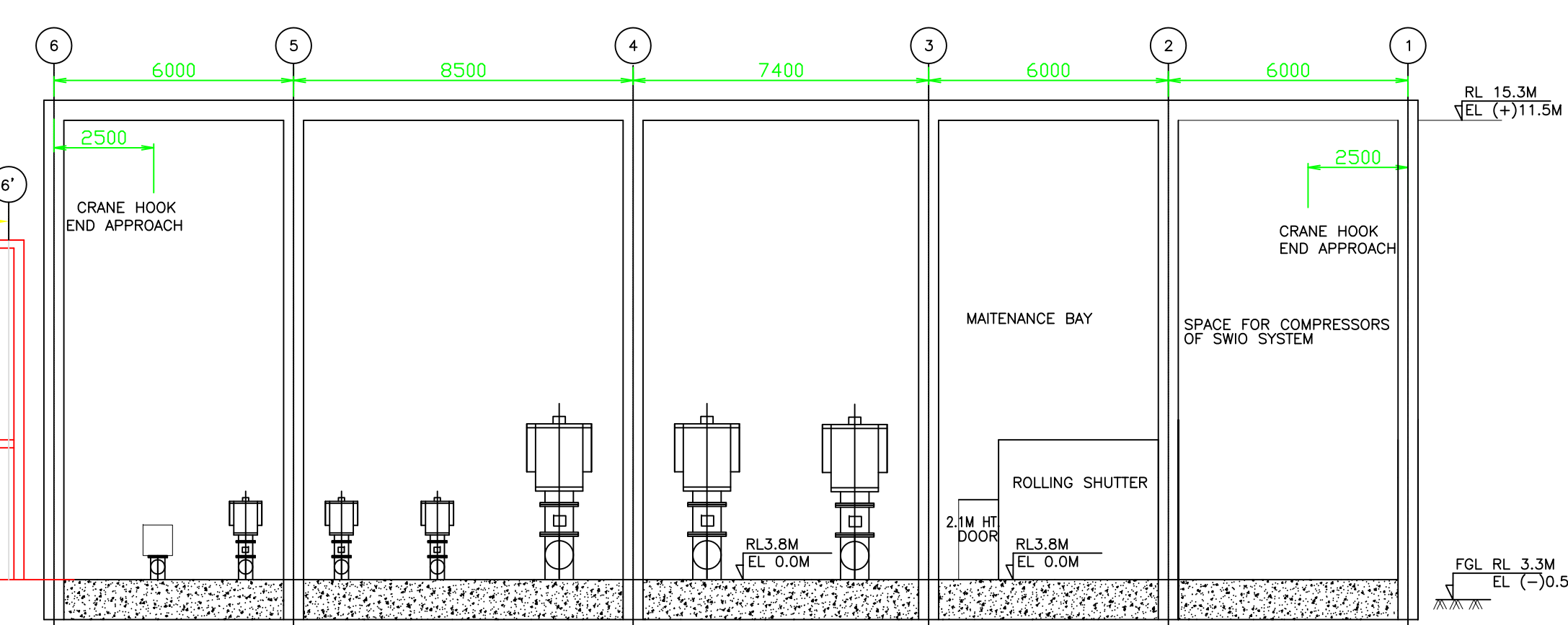
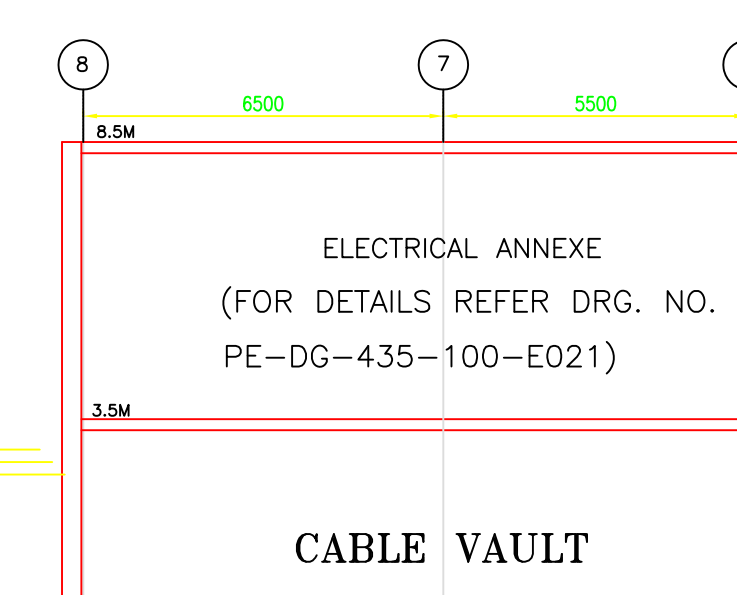
SECTION 'Y-Y'



EL 0.00M CORRESPOND TO RL 3.8M, WHICH IS FFL
OF TG BUILDING. ALL ELEVATIONS ARE MARKED WITH
RESPECT TO THIS LEVEL.

NOTES :

- ALL DIMENSIONS ARE IN MM AND ALL ELEVATIONS ARE IN METRES UNLESS OTHERWISE STATED
- SS316L GATES (TOTAL 3 NOS. i.e. 1NO. FOR SWIP FOR CW MAKEUP, 1 NO. FOR SWIP FOR DESALINATION PLANT, & 1 NO. FOR FIRE WATER PUMP) & SS316L GUIDE TO BE FABRICATED AND SUPPLIED BY CIVIL CONTRACTOR.
- 1 NO. TRASH RACK FOR EACH PUMP SUMP SHALL BE PROVIDED ALONG WITH 1 NO. COMMON AUTOMATIC MOBILE TRASH CLEANING MECHANISM BY BHEL-PEM TWS VENDOR.
- SUMP MODEL STUDY SHALL BE CARRIED OUT BY BHEL PEM PUMP VENDOR FOR SEA WATER INTAKE SUMP & FOREBAY AND REQUISITE HYDRAULIC ELEMENTS SHALL BE INCORPORATED IN CIVIL WORKS, IF REQUIRED, AS PER STUDIES
- OPENINGS, INSERTS ETC. REQUIRED FOR C&I ITEMS, PIPE/VALVE SUPPORTS ETC. SHALL BE AS PER RESPECTIVE INSTRUMENTS, PIPING LAYOUT ETC.
- ACCESS TO ROOF FOR PUMP HOUSE SHALL BE PROVIDED BY CAGE LADDER.
- STOP LOG GATE HEIGHT SHALL BE DESIGNED FOR SUMP OPENING HEIGHT AS SHOWN IN DRAWING.
- TRASH RACK (COARSE BAR SCREEN) HEIGHT SHALL BE UP TO PUMP FLOOR LEVEL (RL 3.8M)
- REFERENCE ENGINEERING DRAWINGS:
 - PLANT WATER P&ID: PE-DG-435-172-N001
 - GA OF PUMPS
 - ELECTRICAL EQUIPMENT LAYOUT & CABLING IN SEA WATER INTAKE P/H AREA: PE-DG-435-100-E021.
 - ELECTRO-CHLORINATION DRAWINGS BY BHEL BAP RANIPET
 - GA DRAWING FOR SWI PH EOT CRANE: PE-V0-435-501-A105
 - INTAKE PIPING OUTSIDE PUMP HOUSE: PE-DG-435-100-M049
- VENTILATION DETAILS SHALL BE AS PER HVAC DOCUMENTS.
- SERVICE & POTABLE WATER OVER HEAD TANK ON ROOF OF P/H TO BE PROVIDED BY CIVIL CONTRACTOR.



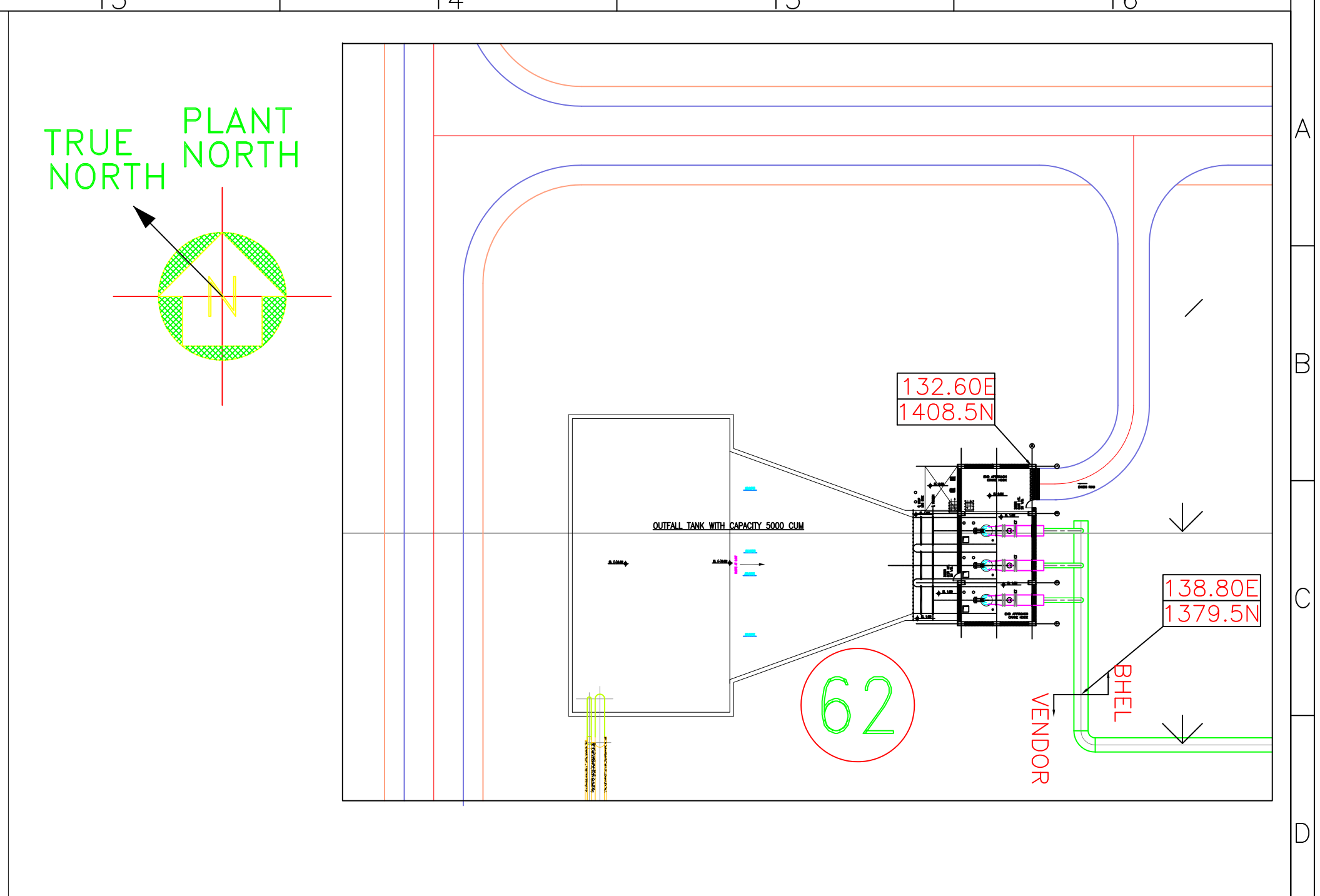
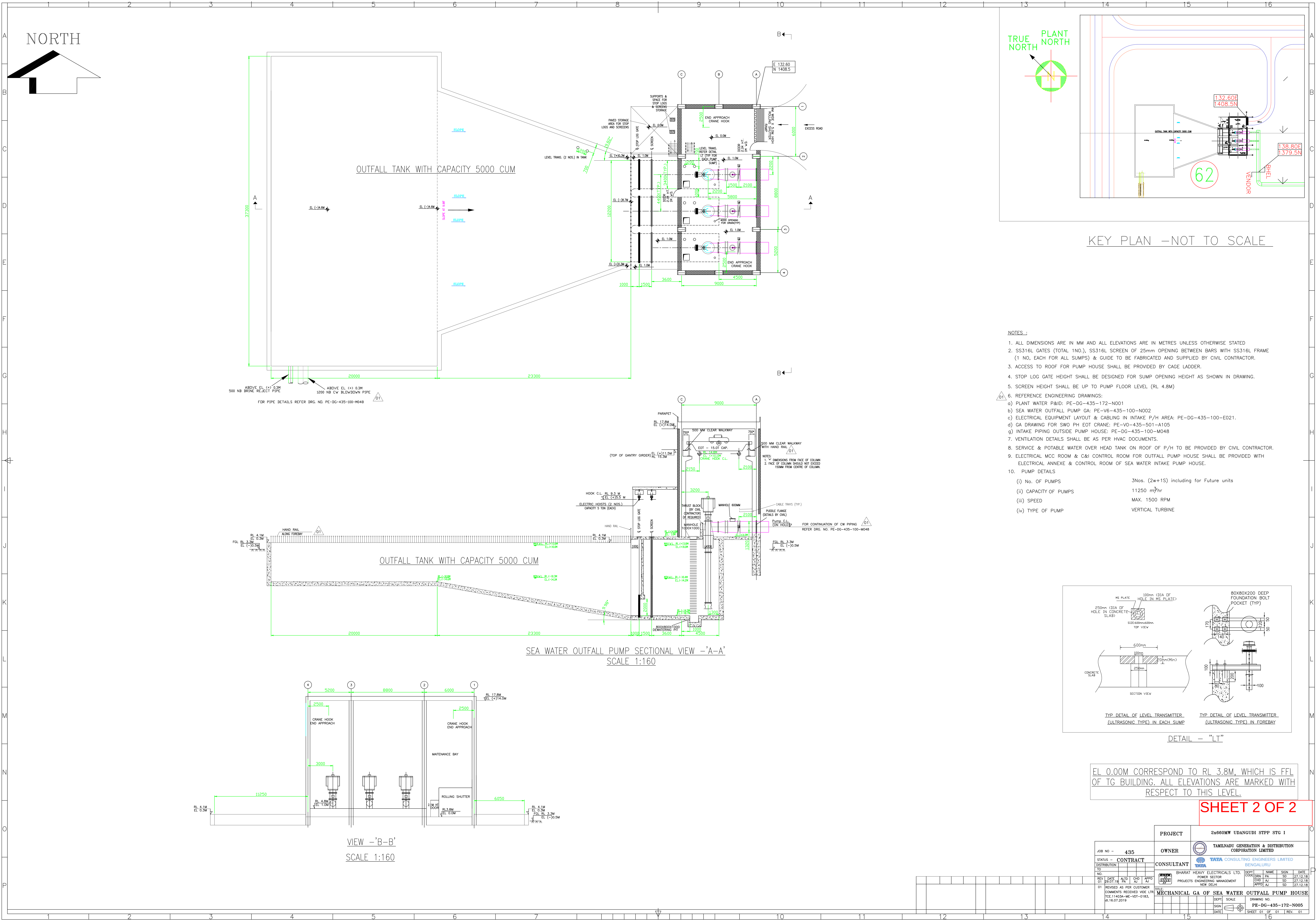
VIEW -C-C'
SCALE 1:160

IMPORTANT NOTE:
THIS PUMP HOUSE IS BASED ON MINIMUM WATER LEVEL AS PER CALCULATION
IN PLANT WATER EQUIPMENT SIZING (DOC. NO. PE-DC-435-172-N007). ANY
CHANGE IN FINAL WATER LEVELS FROM SEA WATER INTAKE SYSTEM AT
DOWNSTREAM OF DESILTING CHAMBER MAY HAVE BEARING ON PUMP HOUSE.

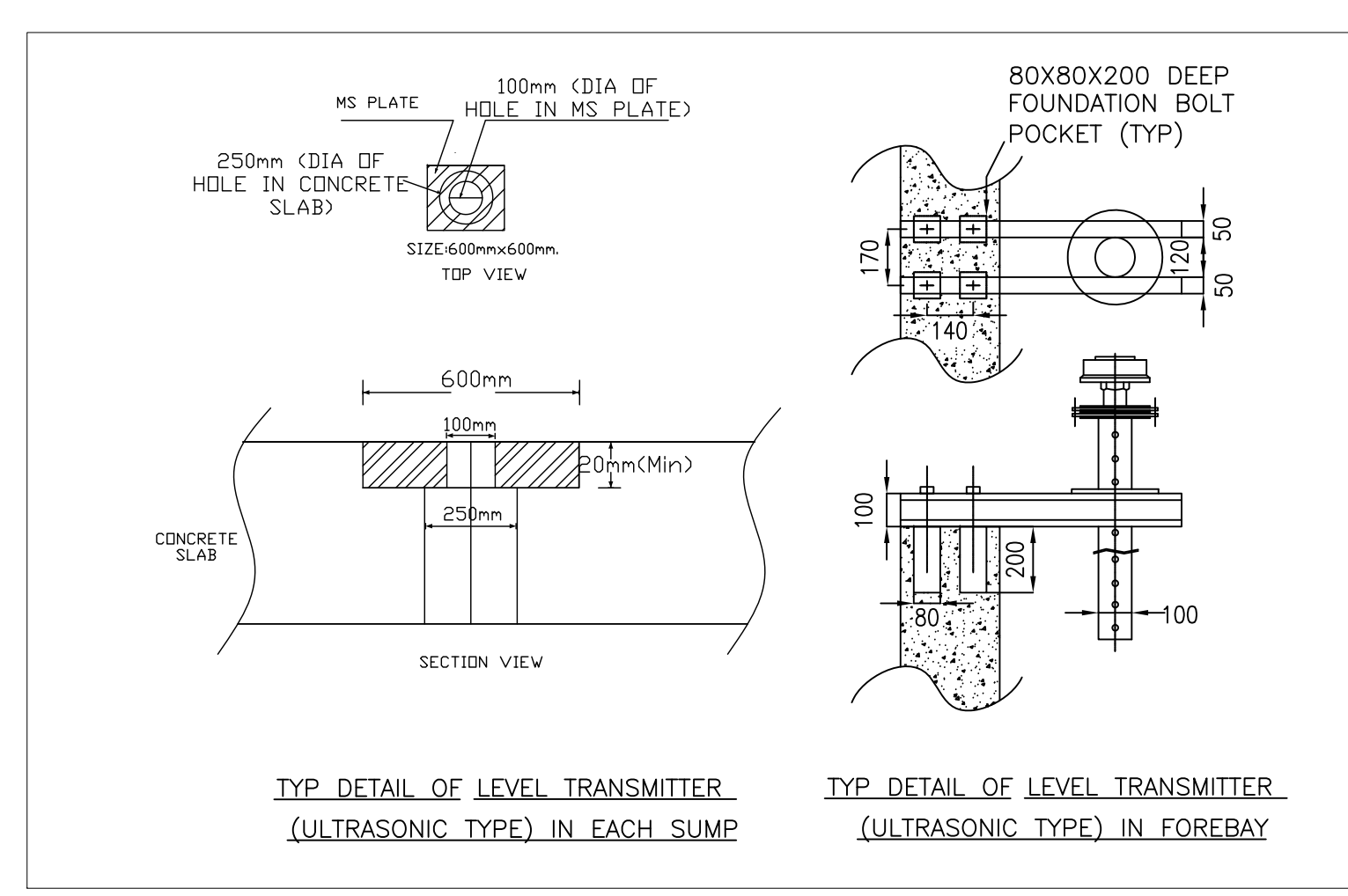
SHEET 1 OF 2

SEA WATER INTAKE PUMP FOR DESALINATION PLANT
& FIRE WATER PUMP SECTIONAL VIEW -B-B'
SCALE 1:160

PROJECT		TANGEDCO TRANSCUT STP STG 1	
OWNER		TANGEDCO TRANSCUT STP STG 1	
CONSULTANT		BHEL PRIVATE LIMITED	
DATE		10/01/2024	
DRAWN		S. S. S.	
CHECKED		S. S. S.	
APPROVED		S. S. S.	
PROJECT		SEA WATER INTAKE PUMP HOUSE	
SCALE		1:160	
DRAWING NO.		PE-DG-435-100-E021	
SHEET NO.		1 OF 2	



- KEY PLAN -NOT TO SCALE
- NOTES :
1. ALL DIMENSIONS ARE IN MM AND ALL ELEVATIONS ARE IN METRES UNLESS OTHERWISE STATED.
 2. SS316L GATES (TOTAL 1NO.), SS316L SCREEN OF 25mm OPENING BETWEEN BARS WITH SS316L FRAME (1 NO, EACH FOR ALL SUMPS) & GUIDE TO BE FABRICATED AND SUPPLIED BY CIVIL CONTRACTOR.
 3. ACCESS TO ROOF FOR PUMP HOUSE SHALL BE PROVIDED BY CAGE LADDER.
 4. STOP LOG GATE HEIGHT SHALL BE DESIGNED FOR SUMP OPENING HEIGHT AS SHOWN IN DRAWING.
 5. SCREEN HEIGHT SHALL BE UP TO PUMP FLOOR LEVEL (RL 4.8M)
 6. REFERENCE ENGINEERING DRAWINGS:
 - a) PLANT WATER P&ID: PE-DG-435-172-N001
 - b) SEA WATER OUTFALL PUMP GA: PE-V6-435-100-N002
 - c) ELECTRICAL EQUIPMENT LAYOUT & CABLING IN INTAKE P/H AREA: PE-DG-435-100-E021.
 - d) GA DRAWING FOR SWO PH EOT CRANE: PE-V0-435-501-A105
 - e) INTAKE PIPING OUTSIDE PUMP HOUSE: PE-DG-435-100-M048
 - f) VENTILATION DETAILS SHALL BE AS PER HVAC DOCUMENTS.
 - g) SERVICE & POTABLE WATER OVER HEAD TANK ON ROOF OF P/H TO BE PROVIDED BY CIVIL CONTRACTOR.
 - h) ELECTRICAL MCC ROOM & C&I CONTROL ROOM FOR OUTFALL PUMP HOUSE SHALL BE PROVIDED WITH ELECTRICAL ANNEXE & CONTROL ROOM OF SEA WATER INTAKE PUMP HOUSE.
 - i) PUMP DETAILS
 - (i) No. OF PUMPS 3Nos. (2w+1S) including for Future units
 - (ii) CAPACITY OF PUMPS 11250 m³/hr
 - (iii) SPEED MAX. 1500 RPM
 - (iv) TYPE OF PUMP VERTICAL TURBINE



EL 0.00M CORRESPOND TO RL 3.8M, WHICH IS FFL OF TG BUILDING. ALL ELEVATIONS ARE MARKED WITH RESPECT TO THIS LEVEL.

SHEET 2 OF 2

PROJECT		2x660MW UDANGUDI STPP STG 1	
OWNER		TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED	
CONSULTANT		TATA CONSULTING ENGINEERS LIMITED BENGALURU	
DESIGNER		BHARAT HEAVY ELECTRICALS LTD.	
CHECKED		POWER SECTOR PROJECTS ENGINEERING MANAGEMENT NEW DELHI	
APPROVED		TATA CONSULTING ENGINEERS LIMITED BENGALURU	
TITLE		MECHANICAL GA OF SEA WATER OUTFALL PUMP HOUSE	
DEPT.		SCALE	
SIGN.		DRAWING NO. PE-DG-435-172-N005	
DATE		SHEET 01 OF 01 REV. 01	



TITLE:
**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-435-100-N011**

SECTION: **I**

SUB-SECTION: **IB**

REV. NO. **00** DATE **19.10.2019**

SHEET **1** OF **1**

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

(NOT APPLICABLE)



TITLE:
**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-435-100-N011**

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SUB-SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C&I)

**2. Resistance Temperature Detector**

- | | | |
|------------------------|---|---|
| 01. Type | : | Platinum (Duplex), ungrounded class 'A' |
| 02. Resistance | : | 100 ohm at 0 °C |
| 03. Base | : | Wound on ceramic (anti-inductive) |
| 04. Wiring | : | 3 Wire |
| 05. Protecting Tube :- | | |
| i) O.D. | : | 8 mm (approx). |
| ii) Material | : | SS-316, Seamless |
| iii) Filling | : | Magnesium oxide (Purity above 99.4%). |
| iv) Length | : | As per application |
| 06. Response time | : | a) 1 to 2 seconds |
| 07. Head: | | |
| i) Type | : | IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area) |
| ii) Material | : | Die cast aluminum or better |
| iii) Terminal blocks | : | Nickel plated Brass-screw type / silver plated |
| iv) Cable connection | : | 3/4" ET gland and grommet. |
| v) Others | : | Terminal head cover with SS chain and suitable gasket |
| 08. Accessories | : | a) Adjustable nipple-union-nipple with thermowell connection
b) Compression fittings/unions
c) Flanges etc. (for flanged connections only)
d) SS 316 forged thermowell as per ASME PTC code. |
| 09. Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 10. Standard | : | Standard DIN 43760 |
| 11. Limit of error | : | @ 0 Deg C ± 0.06 Ohm
@ 100 Deg C + 0.13 Ohm
@ 200 Deg C ± 0.20 Ohm
@ 300 Deg C ± 0.27 Ohm |

3. Field Mounted Temperature Transmitters

- | | | |
|---------------------------------|---|--|
| 01. Working Principle | : | Smart |
| 02. Type | : | Two wire |
| 03. Input | : | Universal (T/C of different types, PT 100 RTD and other RTDs) |
| 03. Output Signal | : | Simultaneous transmission of digital and 4-20 mA DC signal with HART. |
| 04. Signal Processing Circuitry | : | Microprocessor based Solid State Electronic |
| 05. Span and Zero | : | Adjustable in field, Non-interacting facility for elevation and suppression of zero. |
| 06. Enclosure Class | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 07. Output Indicator | : | LCD type |



- | | | | |
|-----|---------------------------------|---|--|
| 08. | Span Adjustability | : | Yes |
| 09. | Nameplate | : | Tag number to be engraved on metallic tag plate rigidly fixed to the body. |
| 10. | Body | : | Die Cast aluminum |
| 11. | Operating Voltage | : | 18-36 V DC |
| 12. | Load | : | 600 Ohms at 24V DC (Min.) |
| 13. | Performance | : | |
| | i) Accuracy | : | 0.2% of span |
| | ii) Repeatability | : | ±0.05% of span |
| | iii) Cold Junction Compensation | : | Built-in |
| | iv) Calibration | : | As per N.I.S.T Monograph 125 for T/C and European Curve Alpha = 0.00385 for RTD |
| 14. | Accessories | : | a) Universal mounting bracket suitable for pipe and surface mounting.
b) Hi-tensile Carbon Steel U-bolts. |

4. Thermo Well

Thermo wells Pipe/equipment mounted temperature test wells of 316 SS with a process connection of M33x2 thread or 150 RF flanged and instrument connection of 1/2" NPT (F) in general or 150 RF flanged.. Accessories like name plate, plug with chain, etc. shall be provided. Material of accessories shall be SS. Thermowell shall be hex head of barstock assembly. In case flanged wells are required for any specific application, the same shall be supplied as required. The thermo well construction shall meet the ANSI 19.3 (latest) requirements. Thermo well shall be designed such that the resonant frequency is above the exciting frequencies generated by vortex shedding in the process fluid. All Test thermo well shall have the plug of SS316.

For measurement of pulveriser outlet temperature tungsten carbide block thermowells abrasion resistant not tungsten carbide coated thermowell shall be used. Also the terminals of Thermocouple shall not be at the top of Mills itself. The thermocouple wires are to be laid up to JB through SS tubing of required diameter and the head shall be placed nearer to the JB. Compensating cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of Mill.

For measurement of sea water temperature SS with titanium sleeve thermo wells or better, shall be used.

5. Temperature Switch

- | | | | |
|-----|--------------------------|---|--|
| 01. | Type | : | Mercury filled-in |
| 02. | Sensing Element Material | : | Bellow / Bourdon AISI SS-316 |
| 03. | Bulb Material | : | AISI SS-316 |
| 04. | Capillary | : | Stainless steel armored |
| 05. | Movement Material | : | AISI SS-304 |
| 06. | Case material | : | Epoxy coated steel plate or die-cast aluminum alloy with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area). |
| 07. | Scale | : | Black lettering on white background |
| 08. | Over range Protection | : | 120 % |
| 09. | Instrument connection | : | Bottom |
| 10. | Switch configuration | : | Two SPDT |
- Lead wires (3+3 Nos.) are to be brought externally to the male connector wherein the female pug connector will be inserted to connect the control room cables for easy removal & re - calibration



- | | | | |
|-----|--------------------|---|---|
| 11. | Switch rating | : | 240V, 5A AC/220V, 0.5A DC |
| 12. | Switch type | : | Snap acting, shock and vibration-proof. |
| 13. | Adjustability | : | a) Internal Set point adjustable over span range
b) Differential adjustable by 10% of span (minimum) |
| 14. | Cable connection | : | 3/4" ET compression gland. |
| 15. | Compensation | : | a) Capillary compensation with invar wire throughout the capillary length.
b) Case compensation |
| 16. | Performance: | | |
| | i) Scale Accuracy | : | ±1.0 % of full scale |
| | ii) Repeatability | : | < 0.5 % of full range |
| | iii) Response time | : | Less than 40 seconds with thermowell |
| 17. | Capillary length | : | 5 meters (minimum) for local mounting/15 meters for local panel mounting. |
| 18. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 19. | Accessories | : | Mounting accessories, 3/4"ET cable gland |

6. Temperature Gauge

- | | | | |
|-----|--------------------------|---|--|
| 01. | Type | : | Mercury filled-in remote mounting system
Capillary armoured / rigid system type (backward entry / bottom entry) |
| 02. | Sensing Element Material | : | Bourdon - AISI-316 SS |
| 03. | Capillary Armoring | : | Stainless steel flexible |
| 04. | Movement Material | : | AISI 304 SS / Direct Bourdon tip connection to pointer spindle |
| 05. | Bulb Diameter and Length | : | As required |
| 06. | Bulb Material | : | AISI 316 |
| 07. | Capillary | : | Stainless Steel |
| 08. | Thermometer | : | M 20 x 1.5 Male adjustable gland on stem to suit associated Thermowell |
| 09. | Case Material | : | Stainless steel bayonet type with clear glass cover conforming to IP-65. |
| 10. | Dial Size | : | 150 mm in general (100 mm for SWAS gauges) |
| 11. | Scale | : | Black lettering on white background in 270 Deg. arc. |
| 12. | Mounting | : | Surface/Panel |
| 13. | Over range Protection | : | 125 % of range or more |
| 14. | Instrument connection | : | Bottom connection for local mounting and back connection for panel mounting. |
| 15. | Range | : | 50% ~ 70% range of operating temperature of application approximately. |
| 16. | Compensation | : | Case compensation |
| 17. | Zero adjuster | : | Micrometer screw adjustable from front. |
| 18. | Window | : | Shatterproof toughened glass. |
| 19. | Performance | : | Accuracy of ± 1 % of full-scale deflection or better. |
| 20. | Enclosure Class | : | IP-65 |
| 21. | Capillary | : | 5 meters (local)/15.0 meters (local panel) - armored stainless steel |
| 22. | Preferred Feature | : | Capillary Compensation |
| 23. | Accessories | : | a) Forged SS 316 thermowell weldable or screwed as per ASME PTC code
b) Installation accessories as required. |
| 24. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 25. | Immersion length | : | Adjustable up to 300 mm including bulb length or as per application |



1.1.2 Temperature Instrumentation

- a) For temperature up to 300°C 3-wire RTD duplex type, PT 100 type shall be used. For temperature beyond 300°C thermocouples shall be used. Thermocouples shall be manufactured in accordance with the ISA Standard MC96.1, Temperature Measurement Thermocouples. All thermocouples shall be Chromel Alumel (Type K) for $300^{\circ}\text{C} \leq T < 850^{\circ}\text{C}$. R or S type for $T > 850^{\circ}\text{C}$.



- b) The Mv signal of thermocouple shall be used as input to the DCS. Cold junction compensation shall be achieved in the DCS
- c) Thermocouples shall have duplex elements and ungrounded measuring junction.
- d) An extension nipple / union / nipple of sufficient length to extend beyond lagging and connection head shall be furnished for each thermocouple assembly. Terminal blocks shall be marked with polarity and connectors shall be resistant to heat, vibration and galling. The cap shall provide a weather tight enclosure and a chain shall be provided to prevent loss of cap. The cap shall be made of cast aluminium.
- e) RTDs of Duplex type furnished by the Supplier shall be of the three-wire type made with 100 ohm platinum resistance elements. They shall be certified to meet the requirements of the International Temperature Scale, calibrated to the IEC-751 standard ($\alpha = 0.00385 \text{ Ohms/Ohm/}^\circ\text{C}$). The RTDs shall be contained in an insulated material and a sheath or sleeve of stainless steel SS-316 and shall be so mounted that they can withstand the greatest shocks and vibrations that can be imposed upon them in the system piping without deterioration. Specific information shall be furnished concerning type and accuracy of bridge circuits to be used with the RTDs. RTDs shall be directly connected to DCS without any transmitters
- f) Unless specified otherwise, each temperature element and thermometer shall be provided with a 1" socket weld type, 316 stainless steel tapered thermowell suitable for the requirements of the given application. Temperature element process connection shall be $\frac{1}{2}$ NPTM.
- g) Temperature transmitters of SMART type are to be provided for all temperature measurements that are used in any CLCS. For thermocouple, cold junction compensation shall be implemented within the transmitter.
- h) Thermocouples will be of duplex MI type in ISA, K(chromel-Alumel), Platinum-Rhodium/Platinum with sheath OD 6 mm. RTD will be Duplex, Pt 100 ohm, 3 wire type as per DIN standard 43760 or equivalent. Thermo wells will be ASME PTC 19.3 latest revision with process connection M 33x2 for threaded connection and flanged connection for Air and Gas system & tanks.
- i) Thermowell immersion length will generally be between $\frac{1}{3}$ and $\frac{1}{2}$ the distance to the center of the pipe. Where thermo wells are installed in lines smaller than 4 inches, the piping shall be expanded to 4 inch size to accommodate the thermo well. Thermowell shall be drilled from solid bar stock.
- j) All thermo well in a high velocity line or duct shall have an ASME PTC 19.3 calculation for determination of the wells resonant frequency. Thermo wells that do not meet the acceptance criteria shall be resized or relocated as necessary.
- k) Thermocouple extension wire is to be solid, shielded, twisted pairs.
- l) If intermediate terminal blocks are required in a thermocouple measuring circuit, they need not be the same material as the thermocouple.
- m) Dial thermometers shall be bimetallic, minimum 150mm dial, every angle form, hermetically sealed with external recalibration adjustment, $\frac{1}{4}$ " OD SS stem, $\frac{1}{2}$ " NPT connection and SS case.
- n) Temperature switches shall be actuated by filled bulb-type elements equipped with standard-length armored capillary tubing. All the switches are internally connected and brought to the surface with Amphenol male/female connection.
- o) Temperature gauges shall have $\pm 1\%$ accuracy and overage protection of 125%.

2X 660 MW UDANGUDI STPP STG I

Specifications of Reverse Rotation Monitoring System		
A) Specifications for Indicator		
1	Service	Reverse Rotation Monitor
2	Speed Range	0 – 1500 RPM
3	Indicator Electronics	The Indicator will have cards like signal conditioner cards power supply cards, microprocessor cards using latest state of the art microcontroller technology and will be replaceable individually by the user at site.
4	Power Supply	240 V AC
5	Front Plate Indication	Digital Indication of the rotation speed, Digital Indication of Normal, Reverse and Power On
6	No. of Contacts	4 NO + 4 NC
7	Rating Contacts	5 Amps at 240 V AC 50 Hz
8	Outputs	4-20mA corresponding to the speed of the rotation range
9	Casing	Metallic Panel Mounting Type
10	Dimensions	Casing : 192 mm x 96 mm x 160 mm Cutout : 188 mm x 92 mm x 160 mm
	Vendor will provide a complete user and troubleshooting Manual of the indicator containing brief write up about the system features and working principle along with details of the cards	
B) Specification for Probes		
1	No. of Probes	3 Nos. (For each Reverse Rotation Monitor)
2	Type of Probe	Non contact type probes which can sense the reverse rotation Within 30 degrees of motion
3	Probe dia	M 30 x 1.5 with optional accessories of mounting arrangements
4	Probe length	65 mm
5	Power Supply	Each Probe is powered from the remotely mounted indicator with +12V DC
6	Sensitivity of the Probes	The probes will be capable of sensing the shaft rotation in a gap of 2 or 8 mm
7	Extension Cable	Cable of 3 meters will be supplied with each probe for Connection of the probe with the local Junction Box
8	Junction Box	A local Junction Box suitable for installation in harsh coastal environment will be provided by vendor. The Junction will have terminals suitable for connection of the Cable from remotely mounted indicator and the cables from the Proximity Sensors. Necessary glands, sealing will be provided to prevent entry of insects, dust, ash, etc.
9	Probe Construction	The probe will be suitable for working in harsh coastal environment
10	Mounting of the Probe	The probe will be mounted suitably using locknuts suitable for the probe
11	Target hole / key projection	Pump supplier should provide hole / slot/ projection on the shaft for Proximeter sensing and size of the hole / projection should be informed to vendor



TITLE:
**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-435-100-N011**

SECTION: **I**

SUB-SECTION: **ID**

REV. NO. **00** DATE 19.10.2019

SHEET **2** OF **1**

SUB-SECTION – ID

DATASHEET-A

	DATA SHEET - A				SPECIFICATION NO.:	PE-TS-435-100-N011
	MISCELLANEOUS PUMPS (Vertical Pumps) - (TYPE II)				REV. NO.: 00	DATE : 19/10/2019
	2 X 660 MW UDANGUDI STPP STG I				SECTION:	I D
Sl. No.	DESCRIPTION	CW MAKEUP PUMPS	DESALINATION PLANT SUPPLY PUMPS	OUTFALL PUMPS	CW BLOWDOWN PUMPS	ACW PUMPS
1.0	SERVICE					
1.1	Total no. of pumps for Project	3	3	3	3	4
1.2	No. of working & standby pumps	(2W+1S) for station	(2W+1S) for station	(2W+1S) for station	(2W+1S) for station	(1W+1S) per unit
1.3	Liquid Handled (ref. water analysis enclosed herein)	Sea Water	Sea Water	Sea Water	Sea Water	Sea Water
1.4	Location	Sea Water Intake P/H		Outfall P/H	CW P/H	
1.4.1	Indoor / Outdoor	Indoor	Indoor	Indoor	Indoor	Indoor
1.5	Duty	Continuous	Continuous	Continuous	Continuous	Continuous
1.6	Specific gravity	1.03	1.03	1.03	1.03	1.03
1.7	No. of pumps working in parallel	2	2	2	2	-
1.8	System design pressure (kg/sqcm), g	3	5	6	5	8
2.0	DESIGN PARAMETERS					
2.1	Design capacity each, M ³ /hr	6500	2000	11250	5000	4150
2.2	Total dynamic head (MWC) (At Bowl, excluding Pumps Internal frictional losses upto discharge)	16.5	30	19.5	10	40
2.3	• Suction Pressure(MWC)	Submerged Suction	Submerged Suction	Submerged Suction	Submerged Suction	Submerged Suction
	• Floor Level- for Pump Mounting	RL (+) 3.8 M	RL (+) 3.8 M	RL (+) 4.8 M	RL (+) 4.693 M	RL (+) 4.693 M
	• Min. W.L	RL (-) 5.18 M	RL (-) 5.18 M	RL (-) 0.4 M	RL (+) 2.5 M	RL (+) 2.5 M
	• Max. W.L.	RL (+) 0.386 M	RL (+) 0.386 M	RL (+) 3.8 M	RL (+) 3.5 M	RL (+) 3.5 M
	• Sump Invert Level	RL (-) 9.4 M	RL (-) 9.4 M	RL (-) 4.9 M	RL (-) 1.5 M	RL (-) 1.5 M
	• Crane Hook Level	RL (+) 12.3 M	RL (+) 12.3 M	RL (+) 14.8 M	RL (+) 13.252 M	RL (+) 13.252 M
	• Crane Capacity Available (Maximum Weight of Single Assembly at Pump Erection shall not exceed 80% of Crane Capacity)	12.5 Ton	12.5 Ton	15 Ton	65 Ton	65 Ton
2.4	Design Temperature (°C)	50	50	50	60	60
2.5	Maximum permissible speed of pump (RPM)	1000	1500	1500	1500	1500
2.6	Max. limit on shut off head Corresponding to pump TDH (MWC) at 51.5 Hz	Not to exceed 28 MWC	Not to exceed 47 MWC	Not to exceed 54 MWC	Not to exceed 45 MWC	Not to exceed 72 MWC
2.7	Pump Discharge - above floor / below floor	Above Floor				
2.8	Discharge pipe (ODXTHK),(mmxmm)	1016 X 12	610 X 10	1320 X 12	914 x 10	813 x 10
2.9	Operating range	-----40-120% of design duty point flow-----				
2.10	Motor rating	Drive Motor shall be rated, at an ambient temp. of 50 Deg C from Maximum of following conditions: a. Margin of at least 15 % over the shaft requirement at the duty condition including voltage and frequency variation. b. 10 % above the maximum load demand in the operating range including voltage and frequency variation. c. Pump shaft input power required considering the overloading of the pump assuming single pump operation in the event of tripping of one or more of the pumps operating in parallel.				
2.11	Permissible tolerance in rated capacity & TDH	no negative tolerance				
2.12	Permissible tolerance in efficiency at rated capacity(%)	no negative tolerance				
2.13	Performance/Design Standard	HIS				
3.0	CONSTRUCTION FEATURES					
3.1	Pump type	Vertical Turbine Type	Vertical Turbine Type	Vertical Turbine Type	Vertical Turbine Type	Vertical Turbine Type
3.2	Impeller type	Closed	Closed	Closed	Semi Open mixed flow	Semi Open mixed flow
3.3	Casing type	Vertical Turbine Type				
3.4	Coupling type	Flexible	Flexible	Flexible	Flexible	Flexible
3.5	Sealing arrangement	Self Water/Gland packing	Self Water/Gland packing	Self Water/Gland packing	Self Water/Gland packing	Self Water/Gland packing
3.6	Type of Lubrication	Oil / Grease / Self Water	Oil / Grease / Self Water	Oil / Grease / Self Water	Oil / Grease / Self Water	Oil / Grease / Self Water
3.7	Pump characteristics	Non Overloading type & stable	Non Overloading type & stable	Non Overloading type & stable	Non Overloading type & stable	Non Overloading type & stable
3.8	Drain Plugs, vent with valve, lifting lugs, etc.	To be Provided				
4.0	MATERIALS OF CONSTRUCTION					
4.1	Casing & Suction Bell	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)
4.2	Column Pipe & Discharge Head	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)
4.3	Minimum column pipe thickness, mm	10 mm	10 mm	10 mm	10 mm	10 mm
4.4	Impeller	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)
4.5	Shaft/ Line Shaft	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)
4.6	Shaft Sleeves	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)
4.7	Shaft Coupling (Muff Type)	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)
4.8	Wearing rings	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)
4.9	Wetted fasteners	Duplex SS	Duplex SS	Duplex SS	Duplex SS	Duplex SS
4.10	Fasteners (others)	Alloy steel (IS-1367 Gr.8.8 or equivalent)	Alloy steel (IS-1367 Gr.8.8 or equivalent)	Alloy steel (IS-1367 Gr.8.8 or equivalent)	Alloy steel (IS-1367 Gr.8.8 or equivalent)	Alloy steel (IS-1367 Gr.8.8 or equivalent)
4.11	Gland plate & Stuffing Box	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)	Duplex ST ASTMA 890/890M-CD3MN Type 4A (PREN>38)
4.12	Lantern Ring	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)	Duplex SS (PREN>38)
4.13	Intermediate stage bearings	- Cutless rubber with ST SHELL (for below minimum water level) - Self Lubricated Type (for above minimum water level)	- Cutless rubber with ST SHELL (for below minimum water level) - Self Lubricated Type (for above minimum water level)	- Cutless rubber with ST SHELL (for below minimum water level) - Self Lubricated Type (for above minimum water level)	- Cutless rubber with ST SHELL (for below minimum water level) - Self Lubricated Type (for above minimum water level)	- Cutless rubber with ST SHELL (for below minimum water level) - Self Lubricated Type (for above minimum water level)
4.14	Mech. seal	N/A	N/A	N/A	N/A	N/A
4.15	Gland Packing	Braided Impregnated Teflon (Asbestos Free)	Braided Impregnated Teflon (Asbestos Free)	Braided Impregnated Teflon (Asbestos Free)	PTFE (Asbestos Free)	PTFE (Asbestos Free)
4.16	Base/ Sole Plate	Carbon steel (IS:2062) with Epoxy Coating				
4.17	Thrust pad (if applicable)	Carbon Steel with White Metal Lining	Carbon Steel with White Metal Lining	Carbon Steel with White Metal Lining	Carbon Steel with White Metal Lining	Carbon Steel with White Metal Lining
4.18	Connecting Pipe material (for deciding counterflange material)	Piping shall be Carbon Steel (IS:2062), rolled and welded conforming to IS:3589 (internally coated with Corrocoat/Glass Flake).				
5.0	MANDATORY SPARES FOR PUMP SET					
5.1	BEARINGS FOR PUMP	NA	NA	NA	2 sets	2 sets
5.2	THRUST PADS FOR PUMP	NA	NA	NA	1 set	1 set
5.3	SHAFT SLEEVES FOR PUMP	NA	NA	NA	1 set	1 set
5.4	FASTNERS FOR PUMP	NA	NA	NA	1 set	1 set
	Mandatory Spare Note: 1. 1 Set is equivalent to spare required for assembling one pump. 2. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed as above.					
6.0	Bid Evaluation					
6.1	Bid evaluation rate	Rs.3.56 Lacs/KW	Rs.3.56 Lacs/KW	Rs.3.56 Lacs/KW	Rs.3.56 Lacs/KW	Rs.3.56 Lacs/KW
6.2	Maximum permissible efficiency for Bid evaluation					
6.2.1	Pump Efficiency	87	85	87	87	86
6.2.2	Motor Efficiency	95	95	95	95	95
Notes :						
1	Material of construction for other components not specified above shall be similarly selected in line with the above for the duty intended and subject to approval. Material which is not specified above and is coming in Direct Contact with Sea Water shall be Duplex SS (with PREN > 38).					
2	For items stated as not applicable by bidder, shall have to be supplied without any cost implication to BHEL in the event they are found to be applicable during detail engineering stage.					
3	For all HT motor driven pumps (wherever applicable), bidder shall provide flat surface with dimensions 60 MM x60 MM on bearing Housing for mounting vibration measuring block and a key slots of dimensions 30MM (L) X 15 MM (W) X 3 MM (D) on each pump shaft or some other suitable location which shall be confirmed during detail engineering by BHEL for Phase Marker.					
4	Wherever SS/ DSS material is coming in contact with non SS / DSS material, suitable isolation (rubber etc.) shall be provided to avoid galvanic corrosion.					

ANNEXURE II

TYPICAL SEA WATER ANALYSIS (FOR 2X660 MW UDANGUDI)

SAMPLE IDENTIFIED AS : SEA WATER

SAMPLING METHOD	N.A.
SAMPLE DESCRIPTION	SEA WATER
SAMPLE QTY.	20L
SAMPLE CODE	N.08+24,001,E-78+04,088/09.09.06
MARK	TOP LAYER
COLLECTED ON	09/09/2006
TEST START DATE	13/09/2006
TEST END DATE	27/09/2006

S.NO	Parameter	Protocol	Result
1	pH	ASTM D1292-99	7.98
2	Conductivity	ASTM D1125-99	53700µS/cm
3	Temperature	ASTM method	34°C
4	Turbidity	ASTM D1889-00	12.5 NTU
5	Salinity	ASTM method	35.5
6	Total Suspended Solids	ASTM D1888	6 mg/l
7	Total Organic Carbon	ASTM D4129-98	Less than 5 mg/l
8	Calcium as Ca	ASTM D511-98	400 mg/l
9	Magnesium as Mg	ASTM D511-98	1274 mg/l
10	Sodium as Na	ASTM D1428	12600 mg/l
11	Potassium as K	ASTM D1428	380 mg/l
12	Ammonia as NH3	ASTM D1426-98	BDL (DL : 0.01 mg/l)
13	Strontium as Sr	ASTM D5673-02	1.57 mg/l
14	Barium as Ba	ASTM D5673-02	BDL (DL : 0.41 mg/l)
15	Total Aluminium as Al	ASTM D5673-02	BDL (DL : 0.03 mg/l)
16	Dissolved Aluminium as Al	ASTM D5673-02	BDL (DL : 0.03 mg/l)
17	Total Manganese as Mn	ASTM D5673-02	BDL (DL : 0.02 mg/l)
18	Dissolved Manganese as Mn	ASTM D5673-02	BDL (DL : 0.02 mg/l)
19	Total iron as Fe	ASTM D1068-03	0.30 mg/l
20	Dissolved iron as Fe	ASTM D1068-03	0.16 mg/l
21	Chloride as Cl	ASTM D512-99	21088 mg/l
22	Sulfate as SO4	ASTM D516-02	3189 mg/l
23	Nitrate as NO3	ASTM 3867-99	0.87 mg/l
24	Nitrite as NO2	ASTM D3867-99	0.008 mg/l
25	Bicarbonate as HCO3	ASTM D1067-02	140 mg/l
26	Carbonates as CO3	ASTM D1067-02	NIL

27	Fluoride as F	ASTM D1179-99	1.4 mg/l
28	Boron as B	ASTM D3082-03	1.29 mg/l
29	Phosphate as PO ₄	ASTM D515-97	0.08 mg/l
30	Sulfide as H ₂ S	ASTM D4658-03	BDL (DL : 0.01 mg/l)
31	Total Silica as SiO ₂	ASTM D859-00	0.31 mg/l
32	Dissolved Silica as SiO ₂	ASTM D859-00	0.18 mg/l
33	Dissolved Oxygen	ASTM D888-96	5.5 mg/l
34	BOD @ 27°C for 3 days.	ASTM method	10 mg/l
35	Phenols	ASTM D1783-01	BDL (DL : 0.001 mg/l)
36	COD	ASTM D1252-00	62 mg/l
37	Oil & Grease	ASTM D4281-01	Less than 1 mg/l
38	Zinc as Zn	ASTM D5673-02	BDL (DL : 0.003 mg/l)
39	Copper as Cu	ASTM D5673-02	BDL (DL : 0.006 mg/l)
40	Nickel as Ni	ASTM D5673-02	BDL (DL : 0.008 mg/l)
41	Cadmium as Cd	ASTM D5673-02	BDL (DL : 0.003 mg/l)
42	Lead as Pb	ASTM D5673-02	BDL (DL : 0.01 mg/l)
43	Mercury as Hg	ASTM D5673-02	BDL (DL : 0.001 mg/l)

NOTE: BDL: Below Detection Limit.

DL : Detection Limit

COC of 1.5 to be considered for MOC Selection of
ACW Pumps and CW Blowdown Pumps



TITLE: TECHNICAL SPECIFICATION MISCELLANEOUS PUMPS SPECIFIC TECHNICAL REQUIREMENTS	SPEC. NO.: PE-TS-435-100-N011		
	SECTION: II		
	SUB-SECTION: IIA		
	REV. NO. 00	DATE	19.10.2019
	SHEET 1	OF	1

SUB-SECTION - IIA

STANDARD TECHNICAL SPECIFICATION (MECHANICAL)

- **STANDARD TECHNICAL SPECIFICATION FOR MISC. PUMPS (VERTICAL) INCLUDING DATASHEET-C**
- **STANDARD QUALITY PLANS**

	TITLE: STANDARD TECHNICAL SPECIFICATION VERTICAL PUMPS	SPECIFICATION NO. PES-179-07	
		VOLUME:	
		SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 1 of 18	

1.00.00	GENERAL INFORMATION
1.01.0	The general guidelines as illustrated in the subsequent clauses of this section shall be applicable for vertical pumps to be procured under the scope of this package.
1.02.0	It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship, and shall be capable of performing the required duties in a manner acceptable to Engineer/Owner who will interpret the meaning of drawings and specifications and shall be entitled to reject any component or material, which in his judgement is not in full accordance herewith.
1.03.0	The omission of specific reference to any component/accessory necessary for the proper performance of Miscellaneous Pumps and drives shall not relieve the bidder of the responsibility of providing such facilities to complete the supply of equipment at quoted prices.
1.04.0	BHEL's / Customer's representative shall be given full access to the shop in which the equipment are being manufactured or tested and all test records shall be made available to him.
1.05.0	The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and shipping release issued by BHEL/Customer.
2.00.00	CODES AND STANDARDS
2.01.00	In addition to the requirements spelt out elsewhere in the specification, the equipment to be provided under this section shall specifically conform to the following codes, standards, specifications and regulations, as applicable, including all the latest amendments subsequent to the year of publication as mentioned below.
2.01.01	IS-1710/1989: Vertical Turbine Pumps for Clear, Cold and Fresh Water.
2.01.02	IS-5120/1977: Technical requirements for Rotodynamic special purpose pumps.
2.01.03	IS-5639/1970: Pumps for handling chemicals & corrosive liquids.
2.01.04	IS-5659/1970: Pumps for process water.
2.01.05	IS-6536/1972: Pumps for handling volatile liquids.
2.01.06	IS-9137/1978: Code for acceptance tests for centrifugal, mixed flow and axial flow pumps- Class 'C'.

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2.01.07	BS 5316	Acceptance tests for Centrifugal, mixed flow Part-I/1976 and axial flow pumps - Class 'C' Tests (ISO 2548/1973)		
2.01.08	BS 5316	Acceptance tests for Centrifugal, mixed flow Part-II/1977 and axial flow pumps - Class 'B' Tests (ISO 3555/1977)		
2.01.09	ANSI B 73.2M 1984	Vertical inline centrifugal pumps for chemical process		
2.01.10	API-610/1989:	Centrifugal pumps for general refinery services.		
2.01.11	HIS	Hydraulic Institute Standards, USA		
2.01.12	PTC 8.2/1965:	Power Test Codes - Centrifugal pumps.		
2.01.13	ASTM-1-165-55	Standard Methods for Liquid Penetration Inspection.		
2.02.00	In case of any contradiction with the above standards and annexure, the stipulations in the annexure shall prevail and shall be binding on the bidder.			
3.00.00	SCOPE OF SUPPLY & SERVICES:			
3.01.00	The miscellaneous pumps and drives scope shall be as specified in Data Sheet-A /Section IA.			
3.02.00	The Capacity, Head, Materials of construction and other particulars of pumps are detailed in Data Sheet-A of the specification.			
3.03.00	Accessories:			
	All the pumps under this specification shall be complete with following standard/special accessories.			
3.03.01	Standard accessories:			
	a)	LT Electric drives/motors (as applicable) with cable gland and lugs at motor end. (The bare HT drive motors and LT motors not in bidder's scope of supply, wherever required supplied as free issue by BHEL refer Cl. 5.08.00).		
	b)	Pump motor coupling along with coupling guard.		
	c)	Common base/sole plate for pumps and motor.		
	d)	Thrust block assembly (Thrust pads, attachments) for transferring the pump thrust to concrete thrust block (concrete thrust block in purchaser scope), as per clause 5.23.00.		

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e) Thrust bearing temperature measurement devise to be provided. f) Self contained lubrication system along with all internal piping, valves, fittings, specialties etc. as required. g) Counter flanges for suction/ discharge nozzles along with fixing nuts, bolts and gaskets. h) Anchor bolts, nuts, seating steel works, shims etc. as necessary for mounting the pump-motor unit on Civil foundations. i) Suitable vent (with valves)/ lifting/ handling attachments for the pump/ motor/ accessories. j) Suitable drain connections with isolating valves as applicable. k) Supply of first fill of lubricants with toping requirements for one year of operation after commissioning and handing over of equipment. l) Set of "Special" Tools & Tackles for Pumps and motors, if any. m) Erection and commissioning spares, "on as required" basis. n) Bidder shall provide various drawings, data, calculations, test reports/ certificates, operation and maintenance manuals, As-built drawings, etc. as specified and as necessary. o) Mandatory spares as specified in respective Data Sheet-A of this section. 3.04.00 Services included in Bidder's Scope: 3.04.01 The pumps shall be guaranteed to meet the performance requirements specified vide Data Sheet -A and also for trouble free operation after commissioning. Schedule of performance guarantees (Section-IIIA) duly filled and signed shall be furnished with the bid. 3.04.02 The pumps erected by the purchaser shall be checked by the bidder for correctness of their installation, alignment, etc. at site prior to their commissioning. 3.04.03 After commissioning of pumps at site, site performance test for Noise, vibration and parallel running of pumps of all pumps for each unit/project shall be conducted by pump vendor at project site to ensure that the pumps meet the specified requirements. Pump vendor shall bring necessary instruments for conductance of site performance test. If the site performance is found not meeting the requirements in any respect as specified, then the equipment shall be rectified or replaced by the vendor, without any commercial implication to BHEL.			



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Note: Applicability of conducting PG test at site by vendor as per above clause shall be applicable if indicated in Section-1A.

If conductance of PG test of pumps at site for Noise, vibration and parallel running of pumps of all pumps for each unit/project is not in bidders scope and same is conducted by BHEL/ customer. In such cases also, if the site performance is found not meeting the requirements in any respect as specified, then the equipment shall be rectified or replaced by the vendor, without any commercial implication to BHEL.

3.04.04 Performance Guarantees for pumps shall stand valid till the satisfactory completion of performance testing by BHEL and its acceptance by purchaser / customer.

3.05.00 Works excluded from Bidder's Scope:

- a) All HT motors and those LT Motors which are specifically excluded
- b) Civil foundation
- c) Suction/ discharge pipe works
- d) MCC/ Switchgear/Power supply
- e) Power and Control Cables, unless specifically specified in Electrical/ Systems portion of the specification.
- f) Erection of equipments.

4.00.00 BID EVALUATION CRITERIA & LIQUIDATED DAMAGES FOR SHORTFALL:

4.01.00 The bids received shall be evaluated for power consumption at inlet to the motors, in respect of pumps specified in Data Sheet-A (working pump only viz. not the standby), for the purpose of price comparisons as briefed below:

The bid evaluation shall be done at the rate as specified in Data Sheet A per one (1) KW Power consumption, per working pump as follows.

$$\text{KW} = \frac{Q \times H \times S}{P \times M \times 367.2}$$

Where Q = Rated capacity M³/hr
H = Rated TDH, MWC
P = Pump Efficiency
M = Motor Efficiency.
S = Specific Gravity of fluid handled

4.02.00 The efficiencies for pumps and motors for arriving at benchmark power for Bid Evaluation shall be as indicated in Data Sheet A for various pumps.

No advantage shall be given to the bidder for Aux. Power quoted lower than the Bench mark values calculated with KW calculation formula at Cl. 4.01.00 above, *considering the bid evaluation efficiencies for pump and motor as indicated in Data Sheet-A.* However the



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bids shall be evaluated as above if the Aux. Power quoted are higher than Bench mark values.

NOTE:

1. Efficiencies for HT motors and LT motors not in bidder's scope, for bid evaluation purpose shall be taken based on the maximum value as furnished in Data Sheet A.
2. During contract stage the Guaranteed power consumption of Pumps with BHEL supplied drives (HT/LT) for successful bidder shall be reworked by BHEL as below:

Revised guarantee power consumption shall be as per KW calculation formula at Cl. 4.01.00 above, where P = pump efficiency guaranteed by bidder and M = motor efficiency as per approved datasheet of the supplied HT/LT motor.

4.03.00 Liquidated damages for shortfall in Guaranteed KW

The above guaranteed power consumption shall be demonstrated by the successful bidder during performance testing at works/ site.

For pumps with BHEL supplied drives, the power consumption shall be compared with the reworked guarantee power consumption, defined as per note no. 2 of Cl. 4.02.00 above for the purpose of shortfall.

The liquidated damages @ twice the bid evaluation rate as above per KW per working pump shall be levied in the event of failure of bidder to demonstrate the guaranteed power consumption.

5.00.00 TECHNICAL REQUIREMENTS:

5.01.00 The pumps shall meet the technical requirements of Section-I as well as Section-II. In the event of any contradiction of Section-II with Section-I, the Section-I will prevail.

5.02.00 The pumps shall be Electric motor driven.

5.03.00 The Pumps shall conform to HIS. It is bare minimum requirement, however, any other equivalent or stringent standard is also acceptable, if, all the requirements of HIS are also met.

5.04.00 The type of Vertical pumps shall be as follows (if specifically not indicated otherwise in Data Sheet-A):

- a) Vertical turbine type pumps with 1500rpm. (if no. of stages ≤ 5) shall be preferred.
- b) If stages of vertical turbine pumps are more than 5, then sump pump construction shall be preferred with 1500 rpm speeds.
- c) For pumps with maximum speed 3000rpm, sump pump construction is also acceptable.

5.05.00 No negative tolerance shall be permitted in rated capacity & TDH.

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5.06.00	No negative tolerance shall be permitted in efficiency at rated capacity.		
5.07.00	The shut off head of pumps shall be more than pump rated TDH and percentage variation may vary depending on the specific speed of the pump as under: i. 10-15% for pumps of specific speed up to 1000 US units, ii. 15-20% for pumps of specific speed in the range of 1000 to 2000 US units, iii. 20-40% for pumps of specific speed in the range of 2000 to 4000 US units, iv. Above 50% for pumps of specific speed in the range of 4000 to 7000 US units.		
5.08.00	All HT motors and those LT motors which are not in bidder's scope of supply: bare motors only, shall be supplied as free issue by BHEL through BHEL, based on ratings and TS (Torque - Speed) curve selected and furnished by the bidders along with their un-priced bid. The responsibility for satisfactory operation for combined performance of pumps & motors shall rest with the bidder only as if, the drive motors also have been supplied by the bidder. Couplings, base plate, foundation bolts, any other fittings, etc. as required shall be supplied by the bidders only. BHEL shall supply one number of each type of drive motors (where drive motor is not in bidder's scope of supply) for shop testing of pumps with job motors. All other motors shall be dispatched by BHEL directly to project sites.		
5.09.00	For all HT motor driven pumps, BHEL has envisaged vibration-monitoring system in their own scope. The bidder shall make provisions for mounting following on the pump/ pump shaft: • Purchaser's probes in both DE/NDE bearings of pumps • Key slots on pump shaft and flat surface on bearing housing for mounting vibration measuring block with dimensions as specified in Data Sheet A. • Other components as finalized during detailing. • For mounting of above on the HT motors & specifically excluded LT motors, same shall be taken care by BHEL.		
5.10.00	The pumps shall be capable of developing the required total head at rated capacity for continuous operation. The pumps shall operate satisfactorily at any point on the Q-H characteristic curve over a range of 0% to 130% capacity and shall be suitable for continuous operation between 30% to 130% capacity.		
5.11.00	Selection of the pumps shall be such that the design point shall be met even with negative manufacturing tolerance.		
5.12.00	The total head capacity curve shall be continuously rising towards the shut off, the pumps shall preferably be non-overloading type and stable.		
5.13.00	The pumps shall be capable of running over the entire range of submergence/ NPSH requirement conditions required without any noise, vibration or cavitations.		

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	The prevailing suction pressures for various pumps are indicated in Data Sheet-A for suitable mechanical design of pumps.		
5.14.00	The pumps shall be of stiff shaft design. The minimum internal clearances should be sufficiently more than the max. static deflection of the shaft. Shaft size selected must take into consideration the critical speed as specified in API-610.		
5.15.00	Pumps and motors shall run smooth without undue noise and vibration.		
	The vibration shall be within vibration norms for testing as per American National Standard for 'Rotodynamics Pump' for Vibration Measurement and allowable values, Doc. ANSI/ HIS 9.6.4-2009. The applicable vibration limits for each pump, shall be indicated in the Technical Data sheet to be furnished by the successful bidder after award of LOI/ PO.		
	The noise level shall be limited to 85 dB at distance of 1.0M.		
5.16.00	Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. Components of identical pumps shall be interchangeable.		
5.17.00	After installation, the guaranteed values of noise, vibration and parallel operation of pumps shall be tested and verified. If the site performance is found not meeting the requirements in any respect as specified, then the equipment shall be rectified or replaced by the vendor, at his own cost.		
5.18.00	High reliability of the pumps is an essential requirement and therefore it gets weightage over its efficiency. It is therefore essential that the bidder choose a standard proven model from the range of pumps manufactured.		
5.19.00	The offered pumps shall be of proven design meeting the experience-qualifying requirement of their operation at two sites for a minimum period of one year or as specified in technical PQR. Any deviation to this criterion shall be suitably highlighted in the deviations schedule.		
5.20.00	The bearings shall be self-water lubricated, no external water supply shall be available. The cooling/ lubrication water for bearings, etc. shall be tapped from the pump discharge and supplied thru' bidder's integral pipe work.		
5.21.00	<u>If water handled by pump is sea water/ dirty/ not suitable for lubrication/ cooling:</u>		
5.21.01	The bearing lubrication/cooling may be specifically reviewed by bidders for the suitability with water analysis enclosed with Data Sheet-A of this section.		
	These pumps shall necessarily be provided with Thordan type line shaft bearings even if the other type of bearings are claimed suitable by the manufacturers.		

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The bidder's shall satisfactorily establish the adequacy of self water lubrication if provided, for similar rating pumps installed for the duty condition in the event of order. In absence of adequate documentary evidence to the satisfaction level of BHEL, the bidder shall provide force water lubrication as per clause 5.21.02 below without any cost implication.

5.21.02

In the event, the forced water lubrication is envisaged by the bidder, the following minimum requirements shall be complied with further details subject to Purchaser's approval during detailed engineering after the award of order.

One set of common water lubrication system shall be provided separately for each type of pumps. The lubricating system shall provide continuous lubrication to all the pumps during operation and the minimum requirements shall be as follows:

- 2X100 % duty self cleaning strainers of suitable size and mesh opening shall be installed on the common pump discharge and outlet shall be led to 1 no. 6 hrs. storage or min. 10 M3 capacity tank of carbon steel MOC, to be placed on roof of pump house .
- 2X100 % duty horizontal centrifugal lubricating pumps with TDH more than the shut off head of the subject pumps shall be provided. The capacity of each pump shall be sufficient to lubricate all of the subject pumps including 10% margin on capacity and head to suit requirement with 10 % margin with head.
- These horizontal pumps shall take suction from the overhead Sintex tank as explained above.
- Associated piping, fittings, Tank inlet motor operated valve, lubricating pumps suction & discharge isolating valves, motorised/ solenoid valves (as per purchaser's approval), lubricating pumps discharge check valves and lubricating pipe isolating valve at inlet to each of subject pump, etc. as required shall be provided.
- Instrumentation – Level Gauge, high level & low level switches for tank, pressure gauges at suction & discharge of each lubricating water pumps, low pressure switch on lubricating pipe at inlet to each of subject pump for subject pump start interlock, pressure switch on lubricating pipe at common discharge of subject pump for start up of stand by pump etc., as required subject to purchaser's approval shall be provided.



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- Bidder shall supply any other equipment/ instrument required for proper functioning of the lubricating system, as deemed necessary during contract without any price implication to BHEL.
- Bidder shall also provide a relay based local control panel for proper functioning of the above system. The system shall be suitable for fully automatic operation as per approved write-up during detailed stage.
- Subject pumps shall be provided with shaft enclosing tube in the event above Lubrication system is envisaged by bidder. MOC for shaft enclosing tube shall be equivalent/ superior to MOC for column pipe for subject pump.

The complete forced water lubrication as above – if applicable, shall be in bidder's scope. Bidder to inform in schedule of deviation at bid submission stage, if fresh water is required for forced water lubrication system.

5.22.00 For Vertical pumps no thrust block is being provided except for pumps of projects, specified in Sec-IA of this specification. Bidder to design the pump foundation system (base plate/ sole plate, discharge head, foundation bolts etc.) capable of transferring the pump thrust to the concrete pump foundation itself.

5.23.00 If specified in Sec-IA of specification, thrust block assembly (Thrust pads, attachments) for transferring the pump thrust to concrete thrust block (concrete thrust block in purchaser scope) to be provided by bidder.

6.00.00 MANDATORY SPARES:

6.01.00 Bidder to provide the Mandatory spares listed vide Data Sheet-A. Unit price of mandatory spares shall be furnished in price Schedule.

6.02.00 Bidder shall include the cost of Mandatory Spares, unless specified otherwise in Sec-IA of the specification or NIT.

7.00.00 OTHER REQUIREMENTS:

7.01.00 The quality of water handled by various pumps shall be as per Data Sheet-A.

7.02.00 The materials of construction for various components specified are the minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty.

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7.03.00	The makes of various bought out items of bidder (i.e. motor, bearings etc.) shall be subject to purchaser’s approval in the event of order.		
7.04.00	Painting for Pumps		
	a) The surface of SS, Gun metal, brass, bronze and non-metallic component shall not be applied with any painting.		
	b) The Steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shop blasting etc. as per the agreed procedure.		
	c) For all the steel surfaces inside the (indoor installation) building, a coat of red oxide primes of min. thickness DFT of 50 microns followed up with under coat of Synthetic Enamel paint of min. thickness DFT of 50 microns shall be applied. The top coat shall consist of two coats each of min. thickness DFT of 50 microns of synthetic enamel paint and thus total DFT shall be min. 200 microns.		
	d) For all the steel surfaces exposed to (outdoor installation) atmosphere, a coat of chlorinated rubber based zinc phosphate primer of min. thickness DFT of 50 microns followed up with under coat of chlorinated rubber paint of min. thickness DFT of 50 microns shall be applied. Then, intermediate coat consisting of one coat of chlorinated rubber based paint pigmented with Titanium di-oxide with min. thickness DFT of 50 microns and top coat shall consist of two coats each of min. thickness DFT of 50 microns of chlorinated rubber paint shall be provided. Total DFT of paint system shall be min. 200 microns.		
7.05.00	It is mandatory for the bidder to submit along with the bid, the deviations if any – whether major or minor in the schedule of deviations only. In the absence of deviations listed in the “Schedule of deviations, the offer shall be deemed to be full conformity with the specification, “not-withstanding” anything else stated elsewhere in bidder’s offer. The implied/indirect deviations shall not be binding on the purchaser.		
8.00.00	PERFORMANCE REQUIREMENTS		
8.01.00	Performance requirements for the pumps shall be as guided in Data sheet - A enclosed with Section-I.		
8.02.00	Pump(s) shall preferably be designed to have the best efficiency at flow within ± 10% of the specified duty point flow. The pumps shall be suitable for continuous operation at any point within the “Range of Operation” as stipulated in the Data Sheet - A attached with Section-I.		

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8.03.00	Pump(s) shall preferably have a continuously rising head-capacity characteristics from the specified duty point towards shut-off point, the maximum being at shut-off to enable parallel operation. Under all circumstances, the 'range of operation' of the pumps shall exclude any unstable operating zone of the head-capacity curve.		
8.04.00	Wherever specified in the Data Sheet - A, pumps of each category shall be suitable for parallel operation. The head vs. capacity, the BHP vs. capacity characteristics etc. shall be identical to ensure equal load sharing and trouble-free operation of any pump when the other pump(s) working in parallel with it trip.		
8.05.00	The pump set along with drive motor shall run smooth without undue noise and vibration. Acceptable vibration limits shall be guided by the HIS of USA. Refer clause 5.15.00 above for permissible limits.		
9.00.00	DESIGN AND CONSTRUCTION Pumps shall be of vertical shaft, complete with bowl, column pipe, discharge head and base plate with all accessories. General design and constructional features of the pumps shall be as follows:		
9.01.00	Bowl Assembly		
9.01.01	This will be either a single or multi-stage centrifugal, mixed flow or axial flow type with discharge co-axial with shaft. Type of impeller shall be chosen on the basis of the pump specific speed and the characteristics of handling fluid.		
9.01.02	Pumps (s) shall have provision for adjustment of impellers in vertical direction from an accessible location, preferably at the housing (where separate thrust bearing for the pump is provided). The adjustment mechanism must take into consideration the extension of the line shaft due to hydraulic down thrust, weight of the shaft and impeller.		
9.02.00	Discharge Head		
9.02.01	Pump (s) shall have above/below floor discharge, as specified in the Data Sheet-A, attached to this section.		
9.03.00	Column pipe		
9.03.01	Column pipe shall be flanged and of bolted connection. Column pipes shall be designed for full internal vacuum.		
9.03.02	In case of multi-piece column pipe and shaft assembly, the design shall permit raising/lowering of the pump assembly piece by piece without any difficulty. Any fixtures, clamps, etc. necessary for such purpose shall be supplied by the Bidder under this section.		



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The bidder shall also submit a write-up describing clearly the procedure of handling the pump.

9.04.00 Impeller shaft, line shaft and head shaft

9.04.01 Shaft size shall be selected on the basis of maximum torque to be applied on the pump shaft.

The critical speed shall be at least 30% higher than the rated speed.

9.04.02 Impeller shaft shall be guided by bearings provided in each bowl or above and below the impeller shaft assembly. The butting faces of the shaft shall be machined square to the assembly and the shaft shall chamfered at the edges.

9.04.03 Line shaft may be single or multiple pieces as required. In case of multiple pieces, line shaft shall be coupled as per the standard practice of the manufacture. For screwed coupling, directions shall permit tightening of the joint during pump operation.

9.04.04 Replaceable shaft sleeves shall be furnished at applicable location, particularly under stuffing box and at other locations, as considered necessary.

9.05.00 Shaft enclosing tube

Shaft enclosing tube shall be required, unless self lubricated (and cooled) type of shaft bearings are asked for. Length of the shaft enclosing tube shall be in conformity with the shaft piece lengths.

9.06.00 Seal rings

Replaceable seal/wear rings both on impeller and on casing shall be provided in case it is asked for in this specification.

9.07.00 Bearings

9.07.01 Shaft bearings

Adequate number of properly designed bearings shall be provided for smooth and trouble free operation of the pump. Number of bearings shall consider the number of shaft pieces used and the critical speed of the shaft. Bearings shall be either lubricated by external clear water/oil/grease or self lubricated as specified in the Data Sheet-A of this section.

In case of external water/oil lubrication, complete lubrication arrangement shall be furnished with the pump. In case of forced water lubrication of the shaft bearings, the system and other accessories shall be in the scope of supply of Bidder as per clause 5.21.02.

9.07.02 Thrust Bearing



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Thrust bearing of adequate size and capacity shall be provided to take the vertical thrust of the impeller arising out of the pump operation and dead weight of the rotating components. Life of the thrust bearing shall be guided by the design standard of the pump. Thrust bearing shall be capable of running continuously at maximum load.

Thrust bearing shall be either grease or oil lubricated. Lubrication arrangement shall be such that the lubricant does not contaminate the handling fluid. The arrangement shall also be adequate to protect the bearing, while the pump coast down to stop in case of power failure of the station. Pre-lubrication of the thrust bearing, if recommended by the pump manufacturer, shall be taken care of in designing the lubrication system.

For thrust bearing, provision for temperature measurement shall be provided.

Cooling of the thrust bearing, if necessary, shall be done by the handling fluid/external water, depending on the fluid handled.

Location of the thrust bearing may be at the pump body or at the driver, or at both depending on the requirement indicated in this specifications or as per the recommendation of the pump manufacturer (and approved by Purchaser).

9.07.03 Bearings of reputed makes are to be provided, same shall be indicated in Technical Data sheet to be furnished by the successful bidder after award of LOI/ PO, subject to acceptance of BHEL/ end customer, without any price implication to BHEL.

9.08.00 **Reverse Rotation**

9.08.01 If indicated at Section-IA of the specification, the pump impeller and other rotating components shall be designed for reverse rotation, when subject to reverse flow at rated pump discharge head.

9.09.00 **Drive Unit**

9.09.01 The pumps shall be driven by electric motor directly coupled as specified in the Data Sheet-A of this section. A heavy duty coupling along with coupling guard shall be provided between the pump and drive unit.

9.09.02 Unless otherwise specified in Data Sheet-A of this section, drive unit power rating shall be the maximum of the following requirements.

- a) 16% margin over the pump shaft input power at the rated duty point.
- b) 10% margin over the maximum pump shaft input power required within the 'Range of Operation'.
- c) Pump shaft input power required considering the overloading of the pump assuming



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single pump operation in the event of tripping of one or more of the pumps operating in parallel.

9.09.03 All Vertical pump motors shall be designed/capable of withstanding max. run away speed during reverse flow through pump.

10.00.00 INSPECTION AND TESTING

10.01.00 The Quality Plans enclosed in the specification are for bidder's guidance only. The bidder shall comply with these and other minimum requirements specified in the specification and shall furnish his own quality plan in the event of order based on the guidance given as above, for approval by BHEL/Customer.

10.02.00 The Bidder shall carry out the following specific tests inspections to ensure that the equipment furnished lies in strict conformance with the specification and also in accordance with applicable codes/standards and good engineering practice.

a) Identification and Testing

i) All materials used for pump construction shall be of tested quality. Material shall be tested as per the relevant standard and test certificates shall be made available to the Owner. Material identification and testing shall include, but shall not be limited to the following components:

- Bowls and suction bells
- Impeller and wearing rings
- Shafts and shaft sleeves
- Couplings
- Bearings
- Column pipes
- Discharge heads
- Bowl Assembly

ii) 100% PMI (Process Material Identification) inspection for material grade of pump casing, shaft and impeller shall be done by vendor & certification shall be submitted for review of BHEL. Further BHEL reserves the right to conduct random & independent PMI inspection on pump casing, shaft and impeller to ascertain the grade of material during inspection at vendor works.

iii) Tests for each pump included under this section shall include but not be limited to the following:

- The entire surface of the impeller / casing / diffuser castings shall be subjected to Dye Penetration Test as per ASTM Specification no.:1-165-65.

**TITLE:****STANDARD TECHNICAL SPECIFICATION
VERTICAL PUMPS****SPECIFICATION NO.** PES-179-07**VOLUME:****SECTION:** IIA**REV. NO.** 04**DATE:** 01/07/2016**SHEET** 15 of 18

- Shaft coupling & other active components shall be subjected to Dye Penetration and Ultrasonic Tests.
- Wearing rings, shaft sleeves shall be subjected to Dye Penetration Test.
- Fabricated components of pumps shall be subjected to Dye Penetration test on weld.
- Verification of material, witnessing of pouring, casting and inspection of finished fabricated/castings.
- Inspection of finished castings for impeller and verification of materials.
- Inspection of pump shaft and verification of material.
- Witnessing of NDT/review of NDT reports.
- Static balancing test for impeller and dynamic balancing of complete rotating parts as per ISO- 1940 to grade 6.3 or better.
- Complete Inspection of assembled pump.

b) Hydraulic Testing

Bowls/ Suction bells, Columns pipe, Discharge head and any other applicable pressure parts shall be hydrostatically tested at maximum of the following:

- i. 2 times the TDH (Total Dynamic Head) at rated capacity (or)
- ii. 1.5 times the shut-off pressure
- iii. System Design pressure indicated in Data Sheet-A of Section-I.

The HT pressure shall be maintained for a period of not less than 30 minutes. During testing there should not be any pressure drop & leakage.

c) Performance Test at Shop

- i) Each pump shall have to be tested to determine the performance curves of the pumps. These tests are to be conducted in presence of Owner's representative as per the requirements of the Standards of Hydraulic Institute of USA (ASME-Power Test Code PTC 8.2/BS-599) or any other equivalent standard.
- ii) Performance tests are to be conducted to cover the entire range of operation of the pumps at rated speed. These shall be carried out to span 130% of rated capacity up to pump shut-off condition. A minimum of five combinations of head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point, shut-off point and the two extremities of the range of operation as specified in the annexure. After

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		VOLUME:	
		SECTION: IIA	
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completion of performance test, all pumps shall be stripped down for inspection of internals. iii) Tests shall be conducted with actual drive motors being furnished. iv) Minimum submergence/ NPSH required tests are to be conducted for each type at 3% head drop conditions, if specified in the pump approved QP. v) All rotating components of the pumps shall be subjected to static and dynamic balancing tests. The assembled rotor will be subjected to dynamic balancing tests. vi) Mechanical run test shall be carried out on all pumps to determine the vibration levels, noise levels etc. This test shall be conducted at site also. However, test value at site shall be used for the acceptance of the equipment.			
10.03.00	Inspection of Mandatory/ Recommended spares shall be in line with approved QP for main supply.		
11.00.00	DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE		
11.01.00	After award of LOI, the successful bidder shall submit drawings/documents as per Data Sheet-C.		
11.02.00	The no. of drawings/documents to be submitted shall be as per Data Sheet-C.		
12.00.00	The various Sections-I's & II's along with Data Sheets attached in this specification together with the specification for Miscellaneous Pumps shall be complied with by the bidders.		
13.00.00	Bidder to submit all drawing/ documents in soft as well as hard copy in the event of order as per schedule indicated in section-IA.		
	Within one (1) week of receipt of BHEL comments a technical representative from Bidder's works shall come for meeting with BHEL along with revised documents to resolve all issues and incorporate all comments in the soft copy for further submission to customer. Further on receipt of customer's comments on the documents a technical representative from Bidder's works shall come for meeting with Customer to resolve all issues and incorporate all comments in the soft copy and further resubmission of same to Customer. The representative shall be available here till category I approval of all the drawings and documents.		
14.00.00	Guarantee for all pumps shall at least remain valid for 18 months from the Unit commissioning date or as specified in NIT.		



TITLE:

**STANDARD TECHNICAL SPECIFICATION
VERTICAL PUMPS**

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15.00.00 The following documents only shall be furnished by the bidder with his offer:

- a) Compliance certificate duly signed and stamped (enclosed at Section-IIIB).
- b) GA drawings of pumps and motors with following: (shall be only for reference purpose, same shall not be reviewed/commented by purchaser at this stage and shall be subject to approval only during contract).
 - Civil static & dynamic loads.
 - Foundation details.
 - Minimum Submergence required.
 - Clearances - Side, Back & Bottom
 - Min. Recommended crane capacity
- c) Guarantee Schedule duly signed and stamped (enclosed at Section-IIIA).
- d) Technical deviation schedule (if reqd.) (enclosed at Section-IIIC).
- e) Data for drive Motor (HT/LT- which is not in bidder's scope of supply - as applicable):
Load torque speed curves of the pumps, selected motor rating, rpm, GD^2 of driven equipment.
- f) Unpriced copy of the price bid shall be furnished along with the technical bid.

Apart from above no other Drgs./Docs./Data sheets etc. are required to be submitted at bid stage and even if furnished shall not be taken cognizance of.

In case of any deviation from this technical specification, the same shall be indicated in the schedule of deviations as per Section-IIIC or NIT. In the absence of duly filled schedules it will be assumed that the bid strictly conforms to the specification.



TITLE:

**STANDARD TECHNICAL SPECIFICATION
VERTICAL PUMPS**

SPECIFICATION NO. PES-179-07

VOLUME:

SECTION: IIA

REV. NO. 04

DATE: 01/07/2016

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DATA SHEET – C

Drawings / documents distribution schedule to be followed by successful Bidder:

1.0 Drawings/documents submission schedule, shall be as per Section-IA.

The successful bidder shall submit at least following drawings/ documents:

1.1 Fully dimensioned outline general arrangement drawings of the pump and motor assembly. This drawing should include foundation base plate/sole plate details as applicable, civil foundation, anchor bolt details, loading data (Static and Dynamic), points of connections of external piping, cables and mounting of devices furnished by the supplier and details for Gap between Coupling Shafts, Float & details for axial/radial tolerance allowed etc. which are required for erecting agency during erection of pump.

1.2 Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction with standard applicable codes.

1.3 Technical datasheet as per Datasheet-B (Section-IIID) including characteristic curves of pumps showing the following:

- a) Flow Vs Head
- b) Flow Vs Power
- c) Flow Vs Efficiency
- d) Flow Vs NPSHR/ minimum submergence

1.4 QAP for pump and QAP for motors (if applicable).

1.5 GA, Datasheet, Curves etc. for drive motor (as applicable).

1.6 Operation and maintenance manual.

1.7 Lubrication arrangement drawings for external lubrication (if applicable).

1.8 PG test procedure as per clause 3.04.03 (if applicable).

1.9 Motor type test document (if applicable).

1.10 Test Procedure for Sump Model Study (if applicable).

2.0 Within the stipulated time period as per vendor's drawings/ documents schedule as per NIT, the O&M Manual comprising of minimum following shall be submitted:

- a) Drawings of components & details as deemed necessary.
- b) Instruction manual for erection, operation & maintenance.
- c) Storage instruction.

3.0 Before dispatch of the equipment the bidder shall furnish the following.

- a) Material test certificates.
- b) Shop test reports & certificates.
- c) Fulfilment of packing instructions as indicated in Section-IA of this specification.

4.0 Distribution of drawings / documents for all projects:

The no. of copies of drawing/ documents to be submitted by the successful bidder, after the award of the contract shall be as per Section-IA or as specified in NIT.



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QUALITY PLAN FOR MISCELLANEOUS PUMPS				CUSTOMER		PROJECT TITLE						
				BIDDER/VENDOR		QUALITY PLAN NUMBER		PE-QP-999-100-N004 (For Hor. Pumps) PE-QP-999-100-N004 (For Ver. Pumps)				
SHEET 1 OF 6				SYSTEM		ITEM - CENTRIFUGAL PUMPS (HORIZONTAL / VERTICAL)						
S. No.	COMPONENT / OPERATION	CHARACTERISTIC CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1	MATERIALS CONTROL											
1.1	CASINGS (INCLUDING BOWLS, DIFFUSERS, STAGE BODIES, DISCH HEAD (IF CAST)), ETC. - (AS APPLICABLE) AND IMPELLER	MECHANICAL AND CHEMICAL PROPS	CR	MECHANICAL AND CHEM. ANALYSIS	ONE/HEAT/BATCH	APPROVED CS DRAWING/DATA SHEET	RELEVANT MATERIAL SPECN.	LAB REPORT/ MTC	3/2.		2,1	
1.2	STUFFING BOX, SUCTION BELL, WEARING RINGS, NECK RINGS, SHAFT SLEEVES	DO-	MA	MECHANICAL AND CHEM. ANALYSIS	ONE/HEAT/BATCH	APPROVED CS DRAWING/DATA SHEET	RELEVANT MATERIAL SPECN.	LAB REPORT/ MTC	3/2.		2,1	
		HARDNESS DIFFERENCE BETWEEN CASING / IMPELLER AND WEARING RING	MA	LAB. TEST	100%	APPROVED CS DRAWING/DATA SHEET	50 BHN MIN.	LAB. REPORT	3/2.		2,1	
1.3	BARS/FORGINGS FOR SHAFTS, LINE SHAFTS	1. PHYSICAL & CHEMICAL PROPS	CR	1. MECHANICAL & CHEMICAL ANALYSIS.	1/CAST OR 1/BARS	APPROVED CS DRAWING/DATA SHEET	RELEVANT MATERIAL SPECN.	MILL T.C. OR LAB. REPORT	3/2.		2,1	CORRELATION REQUIRED, IDENTIFICATION AS PER TC
		2. DIMENSIONS	CR	2. MEASUREMENT	100%	MFR. DRAWING	MFR. DRAWING	INSP. REPORT	3/2.		2,1	
		3. INTERNAL DEFECTS FOR 40MM & ABOVE DIA SHAFTS.	CR	3. ULTRA SONIC TEST	100%	ASTMA388 BACK WALL ECHO 100%	DEFECT ECHO MAX 20% OF B.W.E. LOSS OF BACK WALL ECHO 20% MAX	NDT CERTIFICATE	3/2.		2,1	
1.4	STRESS RELIEVING/ HEAT TREATMENT OF CASTING OF ALL ABOVE (IF APPLICABLE) / SOLUTION ANNEALING OF SS CASTING	1. VERIFICATION OF HT CHART	MA	VERIFICATION OF SR/HT CHART	ALL BATCHES	RELEVANT MATERIAL SPECN.	DO-	CORRELATED SR/HT. CHARTS	3/2.		2,1	
		2. IGC TEST FOR SS CASTING	MA	LAB. TEST	ONE SAMPLE/ HT BATCH	ASTM A 262	ASTM A 262 Gr A	LAB. REPORT	3/2.		2,1	
1.5	SHAFT ENCLOSING TUBES, COLUMN PIPES & DISCHARGE ELBOW	1. MECHANICAL & CHEMICAL PROPS. 2. DIMENSIONS. 3. SURFACE FINISH	MA	1. MECH & CHEM TEST 2. MEASUREMENT 3. VISUAL EXAM	1/BATCH 100% 100%	APPROVED GA DRG./DATA SHEET	RELEVANT MATERIAL SPECN./MAFG./ APPROVED DOCS	MFR T.C OR LAB. REPORT	3/2.		2,1	
BHEL				PARTICULARS			BIDDER / VENDOR					
				NAME								
				SIGNATURE								
				DATE						BIDDER/VENDOR SEAL		

NAME SIGN. DATE	Prepared By AJAY JAIN <i>Ajay</i> 23-07-2012	Reviewed By ASHWANI KHANNA <i>Ashwani</i> 23-07-2012	Approved By I. J. SINGH <i>I. J. Singh</i> 23-07-2012
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BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
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Rev-01

QUALITY PLAN FOR MISCELLANEOUS PUMPS				CUSTOMER		PROJECT TITLE						
				BIDDER/VENDOR		QUALITY PLAN NUMBER						
SHEET 2 OF 6				SYSTEM		ITEM - CENTRIFUGAL PUMPS (HORIZONTAL / VERTICAL)						
S. No.	COMPONENT / OPERATION	CHARACTERISTIC CHECKED	CATEGORY	TYPE/METHOD OF CHECKED	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.6	PLATE FLANGE, C/FLANGE	1. MECHANICAL & CHEMICAL PROS. 2. DIMENSIONS. 3. SURFACE FINISH	MA	1. MECH & CHEM TEST 2. MEASUREMENT 3. VISUAL EXAM	1/CAST 100% 100%	APPROVED GA DRG./DATA SHEET	RELEVANT MATERIAL SPECN./ MFR. DRG./ APPROVED DOC	MILL TC/ LAB REPORT	3/2.		2,1	CORRELATION REQ. FOR MAT OTHER THAN IS 2062
1.7	SUCTION STRAINER (IF APPLICABLE)	MECHANICAL & CHEMICAL PROS.	MI	MECH. & CHEMICAL TEST	1/HEAT	APPROVED GA DRG./DATA SHEET	RELEVANT MATERIAL SPECN./ MFR. DRG./ APPROVED DOC	MILL TC/ LAB REPORT	3/2.		2,1	
1.8	MECHANICAL SEAL (IF APPLICABLE)	TYPE, SIZE, MFRS, NO., MAKE	MA	VISUAL EXAM	100%	APPROVED DATASHEET / GA MECH. SEAL	APPROVED DATASHEET		3/2.		2,1	COMPLIANCE TC FOR APPROVED MAKE
1.9	PUMP BEARINGS	TYPE, SIZE, MFRS, NO., MAKE	MA	VISUAL EXAM	100%	APPROVED DATASHEET	APPROVED DATASHEET		3/2.		2,1	COMPLIANCE TC FOR APPROVED MAKE
2.0 IN PROCESS CONTROL												
2.1	ALL COMPONENTS UNDER 1.00 ABOVE	VISUAL DEFECTS, DIMENSIONS	MA	VISUAL EXAM, MEASUREMENT	100%	MFG. DRAWING	MFG. DRAWING	COMPLIANCE TC	3/2.		2,1	
2.2	IMPELLER	CLEANING AND DEBURRING	MA	VISUAL	100%	MFG. DRAWING	MFG. DRAWING		3/2.		2,1	
	IMPELLER	DYNAMIC BALANCING	CR	DYNAMIC BALANCING	100%	ISO 1940	ISO1940 Gr 6.3	BALANCING CERTIFICATE	3/2.	2,1		WITNESSING ONLY FOR SIZE GREATER THAN 10KW
2.3	IMPELLER-ALL ACCESSIBLE SURFACES, DIFFUSERS	DP TEST	MA	DP TEST ON M/CED AREA	100%	APPENDIX 8 OF ASME SEC. VIII DIV. 1		NDT CERTIFICATE	3/2.	2,1		WITNESS BY BHEL & VERIFICATION BY CUSTOMER
2.4	WEARING RING, SHAFT SLEEVES, CASING	DP TEST	MA	DP TEST ON M/CED AREA	100%	APPENDIX 8 OF ASME SEC. VIII DIV. 1		NDT CERTIFICATE	3/2.		2,1	
2.5	SHAFT	DP TEST	MA	DP TEST ON M/CED AREA	100%	ASTM E 165	NO RELEVANT INDICATION ALLOWED	NDT CERTIFICATE	3/2.	2,1		WITNESS BY BHEL & VERIFICATION BY CUSTOMER
2.6	CASINGS/ BOWLS, STAGE BODIES, DISCHARGE HEAD (IF CAST), SUCTION HOUSING, COLUMN PIPE DISCHARGE PIPE ETC	LEAK TIGHTNESS	CR	VISUAL	100%	TECHNICAL DATA SHEET AND NOTE 2	NO LEAKAGE FOR TEST DURATION OF 30 MIN.	HT CERTIFICATE	3/2.	2,1		HAMMERING OF CASTINGS WITH WOODEN/ RUBBER MALLET BEFORE HYDRO TEST
BHEL				PARTICULARS		BIDDER / VENDOR						
				NAME								
				SIGNATURE								
				DATE					BIDDER/VENDOR SEAL			

NAME SIGN. DATE	Prepared By AJAY JAIN 23-07-2012	Reviewed By ASHWANI KHANNA 23-07-2012
	Approved By I. J. SINGH 23-07-2012	



BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
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QUALITY PLAN FOR MISCELLANEOUS PUMPS				CUSTOMER		PROJECT TITLE						
				BIDDER/VENDOR		QUALITY PLAN NUMBER						
SHEET 3 OF 6				SYSTEM		ITEM - CENTRIFUGAL PUMPS (HORIZONTAL / VERTICAL)						
S. No.	COMPONENT / OPERATION	CHARACTERISTIC CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.7	FABRICATED COMPONENTS											WELDING PROCEDURE APPROVAL BY BHEL ALT. 3RD PARTY (LLYODS, BVQI OR EQ.) IS ACCEPTABLE.
2.7.1	WELDING PROCEDURE SPECIFICATION	CORRECTNESS	MA	EXAM.	100%	ASME SEC.IX	ASME SEC.IX	QW 482 OF ASME SEC.IX	3/2.		2,1	
2.7.2	WELDING PROCEDURE QUALIFICATION	WELD SOUNDNESS	MA	VISUAL,PHYS. TESTS RT (AS APPLICABLE)	100%	ASME SEC.IX	ASME SEC.IX	QW 483 OF ASME SEC.IX	3/2.		2,1	
2.7.3	WELDER PERFORMANCE QUALIFICATION	WELD SOUNDNESS	MA	VISUAL,PHYS. TESTS RT (AS APPLICABLE)	100%	ASME SEC.IX	ASME SEC.IX	QW 484 OF ASME SEC.IX	3/2.		2,1	
2.7.4	WELD FIT-UPS	DIMENSION & ALIGNMENT	MA	MEAS.VISUAL EXAM	100%	WPS, MFG . DRAWING	WPS, MFG . DRAWING	IR/LOGBOOK	3/2.			
2.7.5	ROOT RUNS	SURFACE DEFECTS	MA	PENETRANT TEST	100%	ASTM E 165	NO SURFACE DEFECT	DO.	3/2.		2, 1	
2.7.6	WELDMENTS	SURFACE DEFECTS	MA	PENETRANT TEST	100%	ASTM E 165	ASME-VIII,DIV I	INSPN REPORT	3/2.		2,1	
BHEL				PARTICULARS		BIDDER / VENDOR						
				NAME								
				SIGNATURE								
				DATE								

NAME	Prepared By AJAY JAIN <i>Ajay</i>	Reviewed By ASHWANI KHANNA <i>Ashwani</i>	Approved By I. J. SINGH <i>I. J. Singh</i>
SIGN.			
DATE	23-07-2012	23-07-2012	23-07-2012



BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
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QUALITY PLAN FOR MISCELLANEOUS PUMPS				CUSTOMER		PROJECT TITLE						
				BIDDER/VENDOR		QUALITY PLAN NUMBER						
SHEET 4 OF 6				SYSTEM		ITEM - CENTRIFUGAL PUMPS (HORIZONTAL / VERTICAL)						
S. No.	COMPONENT / OPERATION	CHARACTERISTIC CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.7.7	BUTT WELDS	INTERNAL DEFECT	MA	UT/RT	100%			IR	3/2.		2.1	
2.7.8	DICHARGE HEAD, COLUMN PIPE, DISCHARGE PIPE, ETC.	1. LEAK TIGHTNESS 2. DIMENSION	CR	1. HYDROTEST 2. MEASUREMENT	100%	TECHNICAL SPEC/ DATA SHEET, MFR DRAWING	1. NO LEAKAGE 2. MFR. DRAWING	IR	3/2.	2.1		
3.0	SUB-ASSEMBLY CONTROL											
3.1	ROTOR ASSEMBLY	ECCENTRICITY	MA	MEASUREMENT	100%	MFR.DRAWING	MFR.DRAWING	IR/LOG BOOK	3/2.		1	
3.2	ROTOR ASSEMBLY RESIDUAL UNBALANCE	STATIC & DYNAMIC	CR	STATIC & DYNAMIC BALANCING	100%	ISO 1940	ISO1940 Gr 6.3	BALANCING CERTIFICATE	3/2.	2.1		WTNESSING ONLY FOR SIZE GREATER THAN 10KW
3.3	COMPLETE PUMP ASSEMBLY	COMPLETENESS, CORRECTNESS, CLEANLINESS, CLEARANCES, FREENESS, ALIGNMENT	MA	VISUAL EXAM MEASUREMENT	100%	APPROVED DRG & MFG STANDARDS	APPROVED DRG & MFG STANDARDS	I.R. & CHECK LISTS	3/2.		2.1	
BHEL				PARTICULARS		BIDDER / VENDOR						
				NAME								
				SIGNATURE								
				DATE					BIDDER/VENDOR SEAL			

NAME	Prepared By AJAY JAIN	Reviewed By ASHWANI KHANNA	Approved By I. J. SINGH
SIGN.			
DATE	23-07-2012	23-07-2012	23-07-2012



BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
STANDARD QUALITY PLAN

Rev-01

QUALITY PLAN FOR MISCELLANEOUS PUMPS				CUSTOMER		PROJECT TITLE						
				BIDDER/VENDOR		QUALITY PLAN NUMBER						
SHEET 5 OF 6				SYSTEM		ITEM - CENTRIFUGAL PUMPS (HORIZONTAL / VERTICAL)						
S. No.	COMPONENT / OPERATION	CHARACTERISTIC CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
4	FINAL INSPECTION, TESTS & PACKING DESPATCH CONTROL											
4.1	PUMP WITH JOB/SHOP MOTOR ASSEMBLED ON INDIVIDUAL BASE FRAME	1. Q V/S HEAD, 2. Q V/S POWER, 3. Q V/S PUMP EFF. 4. VIBRATION 5. NOISE 6. BEARING TEMP. 7. LEAKAGES	CR	PERFORMANCE TEST	100%	APPD. PERFORMANCE TEST PROCEDURE/ APPD. DATA SHEET/APPD. CURVES FOR VIBRATIONS - AS PER ANSI/HIS 9.6.4-2009 (VALUES AS PER APPROVED DATA SHEET) FOR BEARING TEMP - BEARING HOUSING SHOULD NOT BE UNTOUCHABLY HOT. FOR LEAKAGE - MINOR LEAKAGE (DROP BY DROP) IN CASE OF GLAND PACKING ARRANGEMENT.	I.R., PERF. TEST RECORD, PLOTTED CURVES	3/2.	2,1.			* MINIMUM 7 POINTS FROM SHUT-OFF TO MAX. OPERATING FLOW COVERING ENTIRE OPERATION RANGE OF PUMP SHALL BE TAKEN.
		NPSH/ MIN. SUBMERGENCE REQUIRED	CR	NPSH TEST	1/MODEL	DO.	IR. NPSH/MIN. SUBMERGENCE TEST RECORD, PLOTTED CURVES	3/2.	2,1.			IF SPECIFIED or INSISTED BY CUSTOMER.
4.2	STRIP DOWN AFTER PERFORMANCE TEST	1. UNDUE WEAR TEAR AND RUBBING	MA	VISUAL EXAM AFTER STRIPPING	1/MODEL	NO UNDUE WEAR TEAR & RUBBING ON IMPELLER & WEAR RING	INSP. REPORT	3/2.	1			WITNESS REQUIRED ONLY WHEN ABNORMAL SOUND OBSERVED DURING PERFORMING TEST.
4.3	COMPLETE PUMP WITH UNIT MOTOR BASE FRAME, COUNTER FLANGES ETC. INCLUDING ALL ACCESSORIES AS PER SECTION C OF SPECN.	COMPLETENESS, CLEANLINESS, OVERALL DIMENSIONS ORIENTATION, WORKMANSHIP AND FINISH	MA	VISUAL EXAM MEASUREMENT	100%	APPD. G.A DRAWING	APPD. G.A DRAWING	INSP. REPORT	3/2.	1		
BHEL				PARTICULARS		BIDDER / VENDOR						
				NAME								
				SIGNATURE								
				DATE					BIDDER/VENDOR SEAL			

NAME	Prepared By	Reviewed By
SIGN.	AJAY JAIN	ASHWANI KHANNA
DATE	23-07-2012	23-07-2012
		Approved By
		I. J. SINGH
		23-07-2012



BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
STANDARD QUALITY PLAN

Rev-01

QUALITY PLAN FOR MISCELLANEOUS PUMPS

CUSTOMER

PROJECT TITLE

BIDDER/VENDOR

QUALITY PLAN NUMBER

SHEET 6 OF 6

SYSTEM

ITEM - CENTRIFUGAL PUMPS (HORIZONTAL / VERTICAL)

S. No.	COMPONENT / OPERATION	CHARACTERISTIC CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
4.4	COMPLETION OF ALL STAGES	1.COMPLETION	MA	VERIFICATION OF IR/T.C.ETC.	100%	MFG. DRG./TECHNICAL DOCS.	APPD. MFG. DRG./TECHNICAL DOCS	IR.	3/2.	2,1		WITNESSING ONLY BY BHEL, CUSTOMER VERIFICATION ONLY BUT CHP
4.5	PAINTING	1.SURFACE FINISH, DFT, MARKINGS ETC.	MA	VISUAL EXAM MEASUREMENT AESTHETIC	100%	APPD.DRG.	APPD.DOCS	IR.	3/2.		2	
4.6	PACKING, MARKING	SOUNDNESS OF PACKING	MI	VISUAL AESTHETIC	100%	MFG. STANDARD	MFG. STANDARD		3/2.		2	

MTC -Mill Test Certificate, MA-Major, MI-Minor, TC-Test Certificate, CR-Critical, IGC- Inter Granular Corrosion

- 1.AS CAST HEAT MARKS SHALL BE PROVIDED ON CI CASTING LIKE TOP & BOTTOM CASING.
2. HYDRO TEST PRESSURE SHALL BE AT LEAST 2(TWO) TIMES THE DUTY POINT (OR) 1.5 TIMES OF SHUT OFF HEAD (OR) SYSTEM DESIGN PRESSURE, WHICHEVER IS HIGHER.
3. THIS QAP IS ALSO APPLICABLE FOR SPARES.
4. NO WELD REPAIRS PERMISSIBLE ON CI CASTING.
5. MATERIAL SHALL BE AS PER APPROVED CROSS SECTION DRG./ DATA SHEET.
6. STRIP TEST- INCASE OF ABNORMAL NOISE OBSERVED DURING PERF. TEST, THOSE PUMP WILL BE STRIPPED DOWN FOR VISUAL INSPECTION OF IMPELLER & WEAR SHALL BE OFFERED FOR VISUAL INSPECTION FOR WEAR /RUBBING MARKS.
7. PUMPS WITH MECHANICAL SEAL ARRANGEMENT TO BE TESTED AND SUPPLIED WITH GLAND PACKING ARRANGEMENT. HOWEVER MANUFACTURER TO ENSURE DIMENTIONAL MATCHING OF MECHANICAL SEAL WITH PUMP GA DRAWING.

LEGEND : 1- BHEL OR BHEL NOMINATED THIRD PARTY /END CUSTOMER OF BHEL,
2- VENDOR,
3-SUB-VENDOR

P- PERFORM, W- WITNESS, V-VERIFICATION

BHEL	PARTICULARS	BIDDER / VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER/VENDOR SEAL

NAME	Prepared By	Reviewed By	Approved By
SIGN.	AJAY JAIN	ASHWANI KHANNA	I. J. SINGH
DATE	23-07-2012	23-07-2012	23-07-2012



TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-435-100-N011**

SECTION: **II**

SUB-SECTION: **IIB**

REV. NO. **00** DATE 19.10.2019

SHEET **1** OF **1**

SUB-SECTION - IIB

STANDARD TECHNICAL SPECIFICATION (ELECTRICAL)

(NOT APPLICABLE)



TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-435-100-N011**

SECTION: **III**

SUB-SECTION:

REV. NO. **00** DATE 19.10.2019

SHEET **1** OF **1**

SECTION III

DOCUMENTS TO BE SUBMITTED BY BIDDER



TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-435-100-N011**

SECTION: **IIIA**

SUB-SECTION:

REV. NO. **00** DATE 19.10.2019

SHEET **1** OF **1**

SECTION IIIA

**GUARANTEE SCHEDULE
(TO BE SUBMITTED ALONG WITH THE BID BY ALL BIDDERS)**

**SCHEDULE OF PERFORMANCE GUARANTEES****2X660 MW UDANGUDI (TANGEDCO)**

SPECN. NO.:

PE-TS-435-100-N011, Rev-00

VOLUME:

--

SECTION: IIIA Sheet 1 of 1

REV. NO.

00

DATE:

19.10.2019

Following parameters are guaranteed for following pumps

Sl. No.	Pump Description	Guaranteed Capacity	Guaranteed TDH	Guaranteed Pump Eff.	Guaranteed Motor Eff.	Guaranteed Power consumption at inlet to motor terminals	Pump model	Motor Rating	Pump GD ² Value for HT motor only	Pump RPM	T/S Curve attached for HT motor
		(M3/Hr)	(MWC)	%	%	(KW)		(KW)			
	Vertical Pumps										
1	#CW MAKEUP PUMPS	6500	16.5		95						
2	#DESALINATION PLANT SUPPLY PUMPS	2000	30		95						
3	#OUTFALL PUMPS	11250	19.5		95						
4	#CW BLOWDOWN PUMPS	5000	10		95						
5	#ACW PUMPS	4150	40		95						

Note: 1 # Bid evaluation and LD is applicable for these pumps only as per clause 4.00.00 of Section-IIA & Data Sheet-A of Section-ID of Technical Specification for pumps.

We the undersigned hereby undertake to meet the performance guarantees as listed in the table above on the conditions as elsewhere specified. Any variation of the specified conditions during official tests will be taken in account by the customer

PARTICULARS OF BIDDER/ AUTHORISED REPRESENTATIVE

NAME

DESIGNATION

SIGNATURE

DATE

COMPANY SEAL



TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-435-100-N011**

SECTION: **IIIB**

SUB-SECTION:

REV. NO. **00** DATE 19.10.2019

SHEET **1** OF **1**

SECTION IIIB

**COMPLIANCE CERTIFICATE
(TO BE SUBMITTED ALONG WITH THE BID BY ALL BIDDERS)**

	TECHNICAL SPECIFICATIONS	SPECN. NO.: PE-TS-435-100-N011, Rev.0		
	MISCELLANEOUS PUMPS COMPLIANCE CERTIFICATE	VOLUME:	--	SECTION: IIIB
		REV. NO.	0	DATE: 27.09.2019

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

- The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.
- QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.

QP will be subject to BHEL/ CONSULTANT/ CUSTOMER approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.
- All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/ CONSULTANT/ CUSTOMER approval.
- There are no other deviation with respect to specification other than those furnished in the 'Schedule of Deviations'.
- Bidder shall include the cost of Mandatory Spares, unless specified otherwise in Sec-IA of the specification or NIT.

Any mandatory spares stated as not applicable, shall have to be supplied without any cost implication to BHEL in the event they are found to be applicable during detail engineering stage.
- The offered materials should be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty. All materials shall be subject to approval in the event of order.
- Prices for recommended spares (if any) for 3 years operation shall be furnished separately & not included in the base price.
- The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).
- All sub vendors shall be as per BHEL/CONSULTANT/CUSTOMER approved list.
- Tests for noise, vibration, parallel running etc. for pumps shall be conducted at site by Pump Vendor/BHEL as per cl. no. 3.04.00 of Section-IIA and if the site performance is found not meeting the requirements in any respect as specified, than the equipment shall be rectified or replaced by the vendor, at his own cost.
- Any special tools & tackles, if required, shall be in bidder's scope.
- All models offered have been supplied by bidder in the past and are meeting the experience qualifying criteria of BHEL/CONSULTANT/CUSTOMER (viz. offered model is successfully operating in two separate stations for at least one year or as specified in technical PQR). Any deviation to this criteria shall be suitably highlighted in deviation schedule.
- All selected motor ratings have minimum margins as per Datasheet A, Section ID.

We the undersigned hereby undertake to meet the compliance requirements as listed above on the conditions as elsewhere specified.

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



TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-426 -100-N001**

SECTION: **IIIC**

SUB-SECTION:

REV. NO. **00** DATE 19.10.2019

SHEET **1** OF **1**

SECTION IIIC

**DEVIATION SCHEDULE – AS PER NIT FORMAT
(TO BE SUBMITTED ALONG WITH THE BID BY ALL BIDDERS)**



TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-435-100-N011**

SECTION: **IIID**

SUB-SECTION:

REV. NO. **00** DATE 19.10.2019

SHEET **1** OF **1**

SECTION IIID

DATA SHEET – B FOR PUMPS

**(TO BE SUBMITTED BY SUCCESSFUL BIDDER AFTER AWARD OF
CONTRACT)**

		PROJECT: MISCELLANEOUS PUMPS DATASHEET - B	
SL.	DESCRIPTION	UOM	PUMP DATA
1.0	GENERAL		
1.1	Designation of the Pump		
1.2	Manufacturer		
1.3	Model No.		
1.4	No. of pumps	Nos.	
1.5	System Design Pressure	Kg/cm ²	
1.6	Specific Gravity of fluid to be handled	-	
2.0	PERFORMANCE PARAMETERS		
2.1	Performance standard		
2.2	Rated capacity. (No negative tolerance)	M ³ /hr	
2.3	Total Dynamic Head (TDH) at rated capacity (No negative tolerance)	MWC	
2.4	Shut off head	MWC	
2.5	Range of Operation of the Pump		
	a) Min.Flow	M ³ /hr	
	b) Max.Flow	M ³ /hr	
2.6	The pumps offered have continuously rising head capacity curves from the duty point towards shut off point.		
2.7	The pumps offered have stable rising H-Q curves within the "Range of Operation"		
2.8	Pump rated speed	RPM	
2.9	Vibration measurements (2.9.2 is applicable in addition to 2.9.1 for Pumps with speed less than 600 RPM)		
2.9.1	Max.value of vibration on any pump /motor bearing w.r.t. velocity (Vrms) as per ANSI/ HIS 9.6.4 for speed > 600 RPM		
	a) Guaranteed at manufacturer's works	mm/s	
	b) Guaranteed at site	mm/s	
2.9.2	Max.value of vibration on any pump /motor bearing w.r.t. peak to peak amplitude as per ANSI/ HIS 9.6.4 for speed <= 600 RPM		
	a) Guaranteed at manufacturer's works	microns	
	b) Guaranteed at site	microns	
2.10	Max. noise Level (Guaranteed at site)	dB	
2.11	Guaranteed Pump efficiency at rated head & rated capacity without -ve tolerance	%	
2.12	Power consumption		
	a) Guaranteed pump input power at duty point	KW	
	b) Guaranteed max. Pump input power within range of operation.	KW	
	c) Max. pump input power at shut off	KW	
	d) Guranteed power at motor input	KW	
2.13	NPSH required at rated capacity	MWC	
3.0	DESIGN & CONSTRUCTION FEATURES		
3.1	Type of pump casing		
3.2	Pump duty		
3.3	Type of Impeller		
3.4	Location		
3.5	Pump suitable for parallel operation		
3.6	Torque speed curve of the pump & drive motor furnished for pumps with drive motor rating of 100 KW and above.		
3.7	Pump number of stages		

		PROJECT: MISCELLANEOUS PUMPS DATASHEET - B	
SL.	DESCRIPTION	UOM	PUMP DATA
3.8	Specific speed $N = \frac{\text{RPM} \times (\text{Flow in USGPM})^{1/2}}{(\text{Head in Ft.})^{3/4}}$		
3.9	Minimum suction head required in MLC for pump operation at maximum discharge point within the 'Range of Operation' specified (NPSHR at max. flow).		
3.10	Whether pump is suitable/ designed so that pump internals can be attended without disturbing suction and discharge piping.		
3.11	Type of coupling between pump & motor		
3.12	Bearing (DE & NDE)		
	a) Type and manufacturer		
	b) Bearing no.		
	c) Type of lubrication		
	d) Design life (Hrs.)		
3.13	Shaft Sealing arrangement		
	a) Type and manufacturer		
	b) Sealing liquid		
	c) Requirement of external water if any		
	i) Quality		
	ii) Quantity/ Pump	M ³ /hr	
3.14	In case separate oil/grease/water pump or any such equipment required for bearing lubrication/stuffing box gland sealing, furnish full technical details of these equipment and their drive.		
4.0	MATERIAL OF CONSTRUCTION (Indicate applicable code/ standard)		
4.1	Casing		
4.2	Impeller		
4.3	Shaft		
4.4	Shaft sleeves		
4.5	Wear ring		
4.6	fasteners		
4.7	Gland		
4.8	Lantern ring		
4.9	Mechanical seals (faces)/		
	Gland packing		
4.10	Base plate		
5.0	CONNECTIONS AND OTHER DIMENSIONAL DETAILS		
5.1	Impeller diameter	mm	
6.0	DRIVE DATA		
6.1	Drive unit output at 50°C ambient condition	KW/ P	
7.0	INSPECTION & TESTING		
7.1	Material test		
7.2	Hydrostatic test pressure	Kg/cm ²	
7.3	Hydrostatic test duration	Min.	
7.4	Performance test on pump at shop		
7.5	Dyanamic balance test		
8.0	WEIGHT AND LOADING DATA		
8.1	Weight of the pump & drive assembly	Kg	
8.2	Weight of the heaviest piece to be handled	Kg	

		PROJECT: MISCELLANEOUS PUMPS DATASHEET - B		
SL.	DESCRIPTION	UOM	PUMP DATA	
8.3	Size of base plate (length x width)	mm		
9.0	ADDITIONAL INFORMATION FOR VERTICAL PUMPS			
9.1	Type of pump			
9.2	No. of stages for Vertical Turbine Pump	Nos.		
9.3	Bowl Head	MLC		
9.4	Bowl Efficiency	%		
9.5	Setting Length	m		
9.6	Column pipe OD X Thickness	mm X mm		
9.7	No of column pieces	Nos.		
9.8	No of intermediate shafts	Nos.		
9.9	No of bearings	Nos.		
9.10	Type & make of Bearing			
9.11	Sealing/lubrication arrangement of bearings			
9.12	Capacity of overhead forced lubrication tank	m ³		
9.13	Nos of forced lubrication pumps	Nos.		
9.14	Capacity of forced lubrication pumps	m ³ /Hr		
9.15	TDH of forced lubrication pumps	MLC		