COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

TECHNICAL SPECIFICATION FOR BOILER FEED PUMP

	Prepared by :	Checked by :	Approved by :	Date :
Revisions:00 Refer to record of revisions	GIRISH	M.S.P.B	M.S.P.B	08.04.17

Please refer specification, Doc. No. PY-AS-4-M095-8360-01 & annexures for details on Boiler Feed Pump (Main & Mandatory Spares) with drives.

Variant No.	Item	Material Code	Job Specification	Project
01	Boiler Feed Pump Assembly-Main Supply	PY9751272017	PY-AS-4-M095-8360-01	RFCL
02	Boiler Feed Pump Assembly-Mandatory Supply	PY9751272025	PY-AS-4-M095-8360-01	RFCL

RECORD OF REVISIONS				
Rev. No.	**Date**	**Revision Details**	**Revised By**	**Approved By**
00	04.08.17	First Issue	----------	M SIVA PRASAD BABU

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

TECHNICAL SPECIFICATION

FOR

BOILER FEED PUMPS - MOTOR DRIVEN

PROJECT	**STEAM AND POWER GENERATION PACKAGE FOR REVIVAL OF RAMAGUNDAM FERTILIZER COMPLEX (1X32.5 GTG + 1X125 TPH HRSG + 1X85 TPH UB)**
CUSTOMER	**RAMAGUNDAM FERTILIZERS AND CHEMICALS LIMITED**
CONSULTANT	**ENGINEERS INDIA LIMITED (EIL), NEW DELHI**

DOCUMENTS TO BE SUBMITTED WITH THE BID:
The bidder must submit the following documents along with their bid to enable BHEL to evaluate their offer.

a) Duly filled in Pump datasheet
b) ~~Duly filled in motor datasheet~~
c) Tentative GAD / P&ID for Pump
d) Performance curves for pump
e) Un-priced copy of attached BHEL price bid formats indicating quoted/ not quoted against each row & column.
f) Equipment qualification criteria / PTR / Reference Lists
g) Checklist as per annexure-5
h) Deviation list [if any] as per annexure-11

In case the above mentioned documents are not submitted with the offer, the offer of the bidder may be liable for technical rejection

1.0.0 INTENT OF SPECIFICATION:

This specification specifies the requirement of Design, Engineering, Manufacturing, Assembling, Inspection, Testing at manufacturer's works and Delivery of properly packed and painted Boiler Feed Pump excluding Drive Motor but including Gear box & hydraulic coupling with all accessories as specified in the scope of work and as required for the safe and trouble-free operation of equipment to be installed at site.

2.0.0 SPECIAL NOTES TO BIDDERS:

2.0.1 This specification shall read in conjunction with its enclosures. In case of any discrepancy arising between this specification & its enclosures, the most stringent of all shall be followed and shall over-ride others. Further, if a requirement in this specification or its enclosures, calls for decision of BHEL, it shall be bidder's sole responsibility to clearly bring out the same distinctively in his technical tender offer, to enable BHEL to furnish their decision. If such a requirement is not duly addressed by bidder during tender stage and same comes out during order execution stage, it shall be binding on the bidder to comply with the decision furnished by BHEL then, without any cost, delivery, or any other commercial implications.

a) Bidders shall comply with various requirements of this specification. Bidders can bring out only those deviations, which are impractical to meet, for BHEL review.
b) Bidders may please note that unless the deviations are specifically brought out under deviations clause, it will be considered that no deviations are taken, even if they are mentioned elsewhere directly/indirectly in the offer.

2.0.2 Any additional equipment, material, etc., which are not specifically mentioned here, but are required to make the supplied equipment complete in all respect, in accordance with the intent of this technical specification, contractual agreement, statutory requirements, relevant/applicable codes/standards, good engineering practices, and for safe and trouble-free operation, shall be deemed to be covered under the scope of this specification.

2.0.3 The Bidder shall accept full responsibility for the completeness and for the faultless working of all the equipments. These shall be executed on the basis of proven design principle and in accordance with the latest state of the art in such a manner that the purpose to be served by the Pump unit is fulfilled in every respect and a maximum of operational dependability and efficiency are assured. Standardization of equipment, materials etc. shall be employed in the design. Care shall be taken to ensure safe operation as well as simplicity of assembling and dismantling of all parts of the plant.

2.0.4 Bidder shall quote strictly as per the scope of supply and requirements of this specification. Unsolicited or Alternate offers from the bidders will not be entertained.

2.0.6 In case bidder feels that it is necessary to exclude some components of scope of supply or some of the features of specification requirements due to any technical constraints, bidder shall bring the same to the notice of purchaser during pre-bid stage and take their prior approval before submission of their bid.

2.0.7 Incase Bidder is unable to offer due to any specific requirement of specification, Bidder shall bring out the same in their regret letter. Otherwise, it will be considered that non-participation by the bidder is attributable to reasons other than any specification requirements.

3.0.0 APPLICATION OF SYSTEM:

Total 3 numbers of BFP's (2 Working + 1 Stand-by) are envisaged to transfer feed water from De-aerator to HRSG and UB. Location of all Pumps & Motor assembly shall be: Outdoor

4.0.0 SCOPE OF SUPPLY:

The scope of supply for this enquiry is as given below:

Please refer to the enclosed P&ID (Annexure-1) for general clarity on scope of supply. The system shall be provided as per annexure-1 taking into all requirements including for testing, painting, documentation, sub vendor list, equipment specifications etc., specified in this specification and enclosures.

No. of Pump & Drive Assembly: 3 Nos.

4.0.1 Pump:

Horizontal, Centrifugal, Multistage, Barrel casing design pump complete with all accessories as per specification. The design standard of pump shall be API 610 10th Edition , EIL std. Spec. 6-41-0006 & other EIL specifications. (Refer Annexure-2, 6 &13 for details)

4.0.2 Motor:

Motor is excluded from scope of supply. Motor shall be a free issue to pump supplier.
AOP motor for LO skid shall be as per annexure-13 H & J. Refer clause no 15.0.0.

4.0.3 Hydraulic coupling: If applicable [For applicability refer clause no 5.1.0]

If applicable, Hydraulic coupling shall be as per manufacturer's standard. Refer annexure-1 &14 for details. Applicability of Hydraulic coupling, pl refer clause no 5.1.0.

4.0.4 Gear Box: If applicable

If applicable, Gear Box shall be provided between pump & Hydraulic coupling. The design standard of Gear box shall be API 613 5th Edition. All instrumentation shall be as per annexure-6.

4.0.5 LO skid:

(a) Forced oil lubrication system shall be as per chapter-3 of API-614 including all instrumentation.
(b) The interconnection piping between the equipment & Lube oil system.
(c) LO skid shall cater for the LO requirement of Pump, Motor & Gearbox.
Pl refer clause no 10.4.6 of Annexure-13F & 13N. All instrumentation shall be as per annexure-6.

4.0.6 Coupling:

All interconnecting coupling between Pump, Gearbox, Hydraulic coupling & Motor shall comply with the following:

a) Design standard of coupling shall be as per API 671.
b) Couplings shall be of metallic, non-lubricated, flexible element type (i.e. either diaphragm or discs) with spacer, for all equipment. All coupling models shall be selected for a minimum service factor of 1.5 over driver rating.
c) Removable coupling guard shall be provided which shall be fabricated from nonsparking material, and shall be open at the bottom to permit manual shaft rotation. The guard shall be sufficiently rigid to withstand deflections as a result of bodily contact of nominally 100 kgs. DBSE shall be more than the seal cartridge length.

4.0.7 ARC Valve:

a) Modulating type Automatic Recirculation Control valve with flanged ends for minimum flow control.
b) The ARC valve size shall be as per pump supplier's recommendation, however not less than Pump discharge nozzle size.
c) ARC valve shall be selected based on required minimum re-circulation flow of the pump
d) ARC Valves to be selected in such a way that the increase in pressure drop through the ARC Valve from rated flow of the pump to approx. 130% of the rated flow shall be limited to 1.0 kg/cm^2 only. This is to ensure flexibility of operating system at marginally higher flows as per site conditions if any.
e) Material of construction: Body: CS, Internals: SS
f) Additional requirements: IBR certification is required for ARC valve

4.0.8 Strainer:

Conical type suction strainer with flanged ends, with

a) Strainer size & rating shall be same as BHEL suction pipe size (Refer Annexure-1)
b) MOC of the strainer: Body: CS & Internals:SS
c) Suction strainer Mesh size: 40 mesh **
d) Free Flow Area: Minimum 4 times that of BHEL inlet pipe size.

e) Strainer pressure drop: 0.15 Kg/cm2 in 50% clogged conditions @ rated condition & 0.11 Kg/cm2 in 50% clogged conditions @ condition-2
f) Additional requirements: IBR certification is required for Strainer

*** Bidder to note that Mesh size of 40 mesh of screen mentioned in the specification is for indicative purpose only. Bidder is to select the suitable mesh size of the screen for strainer based on the actual pump clearances.*

4.0.9 MECHANICAL SEAL:
Mechanical seal as per API 682 3rd Edition to be provided. Seal Qualification tests (SQT) shall have been conducted on the proposed mechanical seal model(s) for standard API 682 seals as per annexure-13-F.

For Seal flushing plans & auxiliary Pump Process piping (Casing Vent, Casing Drain and Balance line), the piping material shall be of SS 316 as a minimum.

4.0.10 Local Gauge board:
Local gauge board [as required for Pump, Gearbox (if applicable)] for mounting instruments shall be included in pump supplier scope. Provision shall be available on the gauge board for mounting all instruments supplied by both BHEL & Bidder. *For mounting instruments for Hydraulic coupling, dedicated gauge board [part of hydraulic coupling skid] shall be provided.
** For mounting instruments for LO skid, dedicated gauge board [part of LO skid] shall be provided.
All the gauge boards shall be box type, weatherproof construction suitable for outdoor mounting with front side glass for readability for local gauges.
- Gauge board shall be constructed from 3 mm stainless steel sheet with other necessary SS supporting structure.

4.0.11 Common base frame with fixing bolts, necessary foundation bolts, nuts, shims/grouting pads etc. for Pump, Hydraulic coupling, Gearbox, Motor.

4.0.12 Inter connecting Piping & Instrumentation:
All instrumentation for Pump, Gearbox, LO skid & Hydraulic coupling shall be as per as per enclosed Annexure-1 & C&I specification, Annexure-6.

4.0.12.1 Suitable IBR certified suction, discharge, recirculation and BLO line spool pieces, reducers/expanders, Flanges & Companion flanges with necessary gaskets & bolts at all terminal points matching with BHEL pipe sizes as indicated in the P& I D [Annexure-1]

4.0.12.2 Minimum instrumentation as shown in P & ID [Annexure-1]. Additional instruments as mentioned below:

i) Pressure Gauges at each individual cooling water inlet & outlet lines as per annexure-6
ii) Temperature Gauges at each individual cooling water inlet & outlet lines as per annexure-6
Note: All temperature instruments shall be provided with thermo -well.
iii) 2 nos of Pressure Safety relief valve at Balance leak off line. PSV shall be as per annexure-13-N.
iv) Sight flow indicator shall have ball or flag for easy verification of water flowing through pipes. Same shall be provided on each individual cooling water return lines.
v) Thermal relief valve (in each isolatable cooling water circuit) shall be provided upstream of globe valve on each individual cooling water outlet lines. TRV shall be as per annexure-13-N.

4.0.12.3 Provision for Instruments: Applicable for Instruments mounted on BFP Suction, Discharge, Recirculation & Balance leak off line
A) For all pressure measuring instruments [Pressure gauge, Pressure Transmitters, Differential Pressure Gauge, Differential Pressure Transmitters] pump supplier to provide stub with root valves and hook up arrangement including manifold up to local gauge board as per enclosed schemes. Refer Annexure-6. Only instruments shall be supplied by BHEL and rest of the items up to gauge board shall be in bidder scope of supply. Based on the pressure rating & as per annexure-1, pump supplier to provide single / double root valves.

Following are the instruments for which bidder to provide provisions along with hook up arrangements including manifold:
i) Pressure Gauges at:
- pump suction
- pump discharge
- Re-circulation line
- Balance leak off line

ii) Differential Pressure Gauge across Suction strainer
iii)Differential Pressure Transmitter across Suction strainer

iv) Pressure Transmitter at:
- pump suction
- pump discharge
- Balance leak off

B) For all temperature instruments temperature stub of 1 ½" Flanged connection up to #600 & 2" flanged connections beyond #600 be provided by the bidder. Refer annexure-6 for stub length.

Following are the instruments for which pump suppliers to provide provisions with Flanged connections as mentioned above:
i) Temperature Gauges at:
- pump suction
- pump discharge

ii) Thermocouple with Temperature Transmitter at:
- pump suction
- pump discharge

Note:
1) Bidder to provide provision for mounting the above mentioned BHEL supplied instruments.
2) Referring to clause no 4.0.11.5, The Pressure & temperature instruments along with JB & cabling shall be in BHEL scope of supply. However bidder to supply structural support for mounting JBs on Base plate. However, all other instruments for Pump, Gearbox, LO skid & Hydraulic coupling along with all accessories such as hook up arrangements, cabling, Cabl trays, JBs etc shall be in bidder scope of supply.
3) Only Thermocouple with temperature transmitter to be used for process application. RTD is not applicable for process applications.
4) Process switches are not applicable.
5) Cable trays & installation of the cable trays for all the instruments [both BHEL & bidder supplied] shall be in bidder scope of supply.

4.0.13 Provision for Vibration Monitoring System items:
Only provision for mounting probes shall be made available on Pump, Hydraulic coupling, Gear Box. Provision for mounting Key Phasor to be provided for each speed change of the shaft system. Pump supplier to furnish type of probes [accelerometers or proximity probes] based on the type of bearings so that suitable probes can be supplied by BHEL. Based on the probe details, Notch dimensions and vibration pad details (Dimension, tapping details) shall be provided during detail engineering stage.

4.0.14 Bearing & Winding instruments & JB for Pumps & Motors:
4.0.14.1 All instrumentation shall be as per enclosed C&I specification, Annexure-6.

4.0.14.2 Pump:
1) 2 nos Duplex RTD for radial bearing of pump DE
2) 2 nos Duplex RTD for radial bearing of pump NDE
3) 4 nos [2 nos for active & 2 nos for inactive side] Duplex RTD for thrust bearing of pump
4) TGs for each bearing

~~**4.0.14.3 Motor:**~~
~~1) RTD for radial bearing of motor DE~~
~~2) RTD for radial bearing of motor NDE~~
~~3) DTT for Motor bearings~~

~~**4.0.14.4 Motor Winding RTD's:**~~
~~RTD's for winding temperature detection -12 nos. of simplex RTD's~~

4.0.14.5 Hydraulic Coupling: Refer Annexure-1 & 14

4.0.14.6 Gear Box:
1) 2 nos Duplex RTD for radial bearing of HSS DE
2) 2 nos Duplex RTD for radial bearing of HSS NDE
3) 2 nos Duplex RTD for radial bearing of LSS DE
4) 2 nos Duplex RTD for radial bearing of LSS NDE
5) TGs for each bearing

Note: Required Temp Transmitters for the RTDs as per clause no 4.0.14.2 to 4.0.14.6 only shall be supplied by BHEL.

4.0.14.7 Casing skin temperature monitoring system:

BFPs shall be provided with pump casing skin temperature monitoring system consisting of the following:
- Four thermocouples along-with yoke mounted temperature transmitters with integral indicator for each thermocouple.
- One Junction Box (JB) to be mounted on the pump base-plate.
- Cables between the thermocouples and transmitters.
- Cables between transmitters and junction box.

4.0.15 No. of Junction Boxes: Refer Annexure-1

Each Pump & Drive assembly skid shall be provided with following No. of Junction Boxes.:
1) For Pump – Bidder to recommend as per no of instruments & spare philosophy
2) For Hydraulic coupling – Refer Annexure- 1 &14. ~~Bidder to recommend as per no of instruments & spare philosophy~~
3) For Gearbox - Bidder to recommend as per no of instruments & spare philosophy
4) For LO skid - Bidder to recommend as per no of instruments & spare philosophy
5) ~~For Motor Winding & Bearing RTDs -1 No. (Generally this is provided by motor manufacturer, it is the integral part of motor~~)

4.0.16 Lateral Analysis / Torsional Analysis:

A) Following information shall be furnished during detailed engineering for review:
- Dry Critical Speed
- 1st wet Critical Speed at 100 % design clearances.
- 1st wet Critical Speed at 200 % design clearances.

B) Lateral analysis shall be performed as per the requirement of Clause 8.2.4.1 & Appendix-I of API 610, 10th edn.
C) The pump vendor shall conduct a train torsional analysis of the complete pump package in case the pump package includes a Gear-box.

4.0.17 Complete Unit Test:

Complete unit test is to be included in Pump vendor scope of supply.
All machinery equipment shall be unitized with respective drivers at the manufacturer's works before dispatch to check fit-up of equipment, alignment, location of bolt holes, interface locations / dimensions etc

4.0.18 First Fill of Lubricant: Excluded from Pump vendor scope of supply

4.0.19 All other items necessary for safe and smooth running of Pump & accessories required to make the supplied equipment complete in all respect.

4.0.20 Commissioning Spares:

3 sets [1 set for each Pump & drive assembly] of commissioning spares BFPs shall be quoted as per manufacturer's recommendation.
One set stands for requirement for one no. of each pump and drive assembly. Minimum 1 Set of O rings & gaskets for each pump & drive assembly, and 1 set of spare Strainer Elements for each pump.
Pump Vendor to furnish the list along with the offer reg requirement of commissioning spares for entire skid consisting Pump, Hydraulic coupling & Gearbox.

Any commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor.

Any leftover (unused) spares after commissioning, out of those included by vendor, shall be handed over to the owner.

4.0.21 Mandatory Spares:

4.0.22 For Pump

A) 1 set of pump element assembly including dynamically balanced rotor
B) 1 set of mechanical seals (complete cartridge assembly)
C) 1 set of bearings
Notes:
1) Element consists of assembled rotor plus stationary hydraulic parts [diffuser(s) or volute(s)].
2) The word "set" means the quantity required for full replacement of that part in one machine.
3) Spare rotors shall be boxed in a metal container for vertical storage with nitrogen purging.

4.0.23 ~~For Motor: BHEL Bhopal scope.~~

4.0.24 For Gearbox: 1 set of Bearings

4.0.25 For Hydraulic coupling: 1 set of Bearings

4.0.26 For Shell & Tube Heat Exchangers for Hydraulic coupling & LO skid:
A) Gaskets: 400% of total installed qualtity [for all the 3 skids part of vendor scope of supply]
B) Bolting (stud & nuts): 20% (Minimum 4 sets) of total installed qualtity [for all the 3 skids part of vendor scope of supply]
C) Lamiflex sealing strips: 100% of total installed qualtity [for all the 3 skids part of vendor scope of supply]
D) Ferrules: 20% of total installed qualtity [for all the 3 skids part of vendor scope of supply]

4.0.26 For Coupling: 1 set of Coupling Shim Membranes of each type.

4.0.27 For Instrumentation:
A) Higher of 10% or minimum one of each type (range, type, material and rating) of complete instruments [for all the 3 skids part of vendor scope of supply] such as Pressure Gauges, Differential pressure gauges, Temperature Gauges, Draft Gauge, Field Indicators, Thermocouple (with Thermowell), Thermowells, speed probes/transmitters, Machine monitoring probes/ transmitters/extension cables etc.

B) Higher of 10% or minimum one of each type (range, type, material and rating) of complete instruments [for all the 3 skids part of vendor scope of supply] such as Transmitters for Pressure, Level (DP type), Flow (DP type), Temperature & Differential Pressure and Field Indicators etc.

C) Pressure safety Valves [for all the 3 skid part of vendor scope of supply]: 10% of quantity subject to minimum 1 No. of each type for the following items:
i) Gasket , ii) O-ring, iii) Seal-ring, iv) Packings

Special notes for Mandatory spares:
1) All Mandatory spares should be supplied separately with green color painted box.
2) Loose items sent by Vendor to sites shall be quantified/numbered/tagged and not merely mentioned as ONE lot of loose items.
3) A packing list covering items having shelf life are to be intimated to site. Also, shelf life items shall be packed separately in black color painted box for easy identification at site.

4.0.28 Special Tools and Tackles: 1 set for Pump & drive assembly.
The bidder shall furnish a complete 1 sets of all special tools, wrenches etc. with necessary tools boxes as required for operation and maintenance [disassemble, assemble, or maintaining the unit] of the BFP packages) supplied, as a part of scope of supply. **Bidder shall furnish a list of such tools along with offer for the system.** Prices for the special tools and tackles shall be part of main scope of supply. No separate price shall be offered for the same.

4.0.29 LOGIC DIAGRAM & WRITE UP:
Interlocks & Protections realized in PLC, DCS (BHEL scope). However, vendor shall provide the necessary write-up & logic diagram.

4.0.30 CONFLICTS IN SPECIFICATION REQUIREMENTS:
In case of any conflict between this specification and Annexures, stringent of the requirement will govern.

4.0.31 TECHNICAL PARAMETERS:

SL No.	Description	Unit	Rated Condition	Condition-4	Condition-1	Condition-2
1	Suction Temp	Deg. C	132			
2	Design Temp	Deg. C	150			
3	Capacity of each pump	m^3/hr	148	134	126	116
4	Pump Differential Head	mlc	1675	1769	1502	1575
5	Available Pressure at Pump suction flange	$Kg/cm^2(a)$	3.84	3.84	3.88	3.93
6	NPSHA at pump suction flange	mlc	10.05	10.05	10.52	10.99
7	Margin between NPSH A & NPSHR		1 m at rated condition & NPSHR shall be less than NPSHA till end of the curve condition.			

Note: Please note that the Pump Curve shall be selected to satisfy Condition 1,2 &4 also. Accordingly, the actual rated head lying on the curve can be higher than the rated head mentioned here. The Pump shall be selected as mentioned here and shall be cross-checked to satisfy all the conditions as indicated above. Accordingly, actual heads at condition 1 &2 can be higher than the head indicated in clause no 4.0.31.

5.0.0 COOLING WATER PARAMETERS:

BHEL shall provide cooling water at one location for each BFP skid. Further distribution [Pump, Motor, Hydraulic coupling, Gearbox etc] shall be in Pump supplier scope of supply & all return line shall be terminated at BHEL provided return header at each skid.

All pump bridle cooling water lines (for bearing cooling, gland cooling, seal cooling) shall be minimum 11/2"NB. The return lines will be connected to bearing cooling water return header. Return lines to be connected to cooling water return header with a drain to grade near pump skid for flushing purpose.

The parameters are as follows:

- Working pressure (Max Allowable): 4 kg/cm2 (g)
- Mech design Pressure : 8.5 kg/cm2 (g)
- Max. Allowable pr drop in the system: 0.7 kg/cm2
- Inlet Temp. : 35 Deg C (Normal)
- Mechanical design Temp. : 65 Deg C (Max.)
- Max. Temp. Rise in the system: 9 Deg. C

5.1.0 SPECIAL FEATURES:

Motor rating shall be limited within 1600 kW. Motor rating more than 1600 kW is not acceptable.

Auxiliary power [Input power to Motor] shall be limited to 820 kW [inclusive of all losses such as Gear Box loss, Hydraulic coupling loss, loss due to motor in efficiency etc] at guaranteed condition ie 116 m3/hr @ 1438 mlc. **Auxiliary power above 820 kW @ guaranteed condition is not acceptable.** If bidder can meet aux power without speed reduction, then hydraulic coupling is not mandatory.

5.2.0 WARM UP ARRANGEMENT:

Bidder shall provide suitable hardware (i.e. piping, valves & fittings) & as part of the operating manual a suitable startup procedure shall be provided as per EIL specification, Annexure-13

6.0.0 OPTIONAL PRICES:

Please Refer to Attached Price Bid Format.

Bidder to furnish the following as optional prices:

1) 2 year recommended spares as per each equipment manufacturer's recommendations
2) Supervision charges for erection & commissioning of the supplied package

7.0.0 EQUIPMENT QUALIFICATION CRITERIA (EQC)

The following criteria shall be applicable for acceptance of the offered Centrifugal Pump model and EQC requirements specified in “Standard Specification for Centrifugal Pumps (Special Purpose Process) (Doc. # 6-41-0006 Rev. 2).

1. a) The vendor shall be an established manufacturer of API-610 centrifugal pumps having adequate design, engineering, manufacturing, packaging and testing facilities for pumps and shall be the single point responsibility vendor for the complete centrifugal pump package.

1. b) The vendor shall have designed, engineered, packaged, tested and supplied, in the last TEN (10) years, from the proposed manufacturing plant, at least ONE (1) centrifugal pump package with same type of driver having similar driver power. As a minimum, this package shall have completed ONE Year of satisfactory operation at site, as on the bid due date.

2. a) The pump model offered shall be from the existing pump model series and shall be from the regular manufacturing range of the vendor. The mechanical as well as the hydraulic performance (including NPSHR) for the complete range of operation of the offered model shall have been established in the shop test.

The offered pump model shall meet the minimum service and manufacturing experience requirements specified in clause# 2.b).

2. b) Pumps shall be identical in terms of Hydraulics and similar in terms of Power Rating, Inlet flow, Differential Head, Operating Pressure & Temperature, Pumping Liquid, Speed, Number & Type of Impellers, Mechanical Design, Materials, Bearing span (applicable for between bearing pumps) etc. as compared to at least ONE (1) unit of the proposed model designed, manufactured, tested and supplied from the proposed manufacturing plant in the last TEN (10) years and the reference unit shall have completed ONE year of satisfactory operation at site, as on the bid due date.

In case all the above parameters are not available from single past reference, more than one reference can be cited/considered to satisfy the above qualification requirement, but not exceeding 3 references.

3. In case the vendor is a licensee / member of a group company (As defined in clause# 5) and does not meet on his own, the experience criteria of clause# 2.b), the vendor can substitute the references of his Collaborator (licensor) / another member of the group company, who shall also be a regular manufacturer of the proposed pump model, provided the following conditions are met by the vendor:

3. a) The vendor shall be a regular & established manufacturer of API 610 centrifugal pumps and shall have supplied smaller & larger sizes of pump models of the same series, from the proposed manufacturing plant and proves to the satisfaction of the purchaser that the vendor does possess the manufacturing & testing facilities for the offered pump model.

3. b) The vendor's collaborator (licensor) / the member of group company whose references are being used to establish proven track record of the proposed pump model, meets the criteria as per clause# 2.a & 2.b).

3. c) The vendor's license agreement is valid and continues to remain valid till, at least TWO years after the delivery of the pumps.

3. d) The vendor imports as a minimum the following critical components (including components required for spare parts) from his Collaborator (licensor)/Group Company or their sub-vendors:
- Impellers/Diffusers (fully machined)
- Complete Rotor Assembly (dynamically balanced) for multi-stage pumps
- Casing (proof machined, hydrostatically tested)
- Bearing Bracket.

The vendor need not import the components defined above, if the same have been designed, manufactured, assembled, tested & supplied by the vendor, in the past from the vendor's proposed manufacturing plant and such references have completed ONE year of satisfactory operation at site as on the bid due date.

3. e) The vendor shall have adequate testing facilities and shall carry out all the inspection and tests as specified in the inquiry/order at the proposed manufacturing plant (except for tests specified in 3.d) above, i.e. dynamic balancing & hydrostatic test) from where the vendor intends to supply the proposed pump model.

3. f) The vendor shall indicate the details of such arrangement in the proposal.

4. In case the vendor is a licensee / member of a group company (As defined in clause# 5) and does not possess the manufacturing experience of the proposed pump models at his own manufacturing plant as per Clause# 2 & 3 , the vendor may propose to supply the complete package with duly performance tested bare shaft pump sourced from the vendor's licensor / another member of the group company, who shall be a regular manufacturer of the proposed pump model, provided the following requirements are met:

4. a) The vendor shall be a regular & established manufacturer of API 610 centrifugal pumps and shall be a licensee / member of group company (As defined in clause# 5) from where the bare shaft pump is proposed to be sourced.

4. b) The vendor's license agreement is valid and continues to remain valid till, at least TWO years after the delivery of the pumps. Necessary documents to establish that vendor has requisite facilities and has been authorised to package the proposed pump model shall be furnished in the proposal.

In case of member of group company also, vendor to furnish requisite documents from group company to establish that vendor has requisite facilities and has been authorised to package the proposed pump model.

4. c) The vendor's collaborator (licensor) / the member of group company whose references are being used to establish proven track record of the proposed pump model, meets the criteria as per clause# 2 above.

4. d) The vendor shall have adequate equipment handling and testing facilities and shall carry out the Unitization/Complete Unit Test (As applicable) of the complete pump package at his shop.

Hydrostatic test, Performance Test, Mechanical Run Test, Sound & Vibration Level Test, NPSH Test, dismantle inspection and reassembly after the running test of the bare shaft pump shall be carried out at the pump manufacturer's shop i.e. the shop from where the pump is proposed to be sourced. All the above tests at pump manufacturer's shop shall be duly witnessed as specified/required in Inquiry document. The vendor shall furnish the test certificates for tests carried out at pump manufacturer's shop at the time of final inspection.

4. e) The vendor shall indicate details of such arrangement in the proposal.

5. Group Company shall mean one of the following:
a) Wholly owned subsidiary of the bidder.
b) Principal of whom the bidder is a wholly owned subsidiary.
c) Another wholly owned subsidiary of the Principal of whom the bidder is a wholly owned subsidiary.
Necessary documents to justify above shall be furnished in the proposal.

6. The vendor shall also furnish documentary evidence like copies of Purchase Order and Inspection Release Note (IRN) as an evidence of meeting the PTR requirement, based on which the qualification is sought. The vendor may also furnish additional documentation to justify meeting the PTR. Vendor to furnish duly fill in EXPERIENCE RECORD PROFORMA as per Annexure-8.

8.0.0 QUALITY PLAN & INSPECTION AGENCY & TESTING:

8.1.0 QUALITY PLAN:

Quality plan will be reviewed during detailed Engineering stage with respect to inspection, standard Engineering practices & specification requirements and various tests and stages of inspection and appropriate agencies for Inspection will be Intimated. Bidder to abide by the same.

Pl refer Annexure-7 for guidelines & QAP format. For details refer EIL specifications, Annexure-13.

8.2.0 INSPECTION AGENCY:

BHEL/Third Party appointed by BHEL.
The various review/witness/observation stages by individual agencies (or) Group of Agencies as above will be in line with approved quality plan**.** Pl refer Annexure-7 for guidelines & QAP format. For details refer EIL specifications, Annexure-13.

8.3.0 TESTING:

Testing shall be as per API 610 10th Edn & Standard Specification for Centrifugal Pumps (Special Purpose Process) (Doc. # 6-41-0006 Rev. 2).
However, Performance tolerance shall be as mentioned below:
i) Rated head : Zero negative tolerance @ rated flow rate & rated speed
ii) Shut-off head: Following criteria shall apply:
a) Positive tolerance permitted as long as maximum shutoff pressure corresponding to shut-off head (as observed during the shop performance test) and the maximum suction pressure (as specified on pump data sheet), does not exceed the downstream design pressure (as specified on pump data sheet).
b) Negative tolerance (as per Table 4-2 of API Std. 610, 8th edition) may be permitted only if test curve still shows rising characteristics.
c) Negative tolerance is not permitted for pumps required for pumps under parallel operation. [Note: Generally, shutoff head should be limited within 120% of rated head.]"
iii) Guaranteed case [116 m3/hr @ 1438 mlc] & Rated point BkW: Zero positive tolerance.

9.0.0 PAINTING:

For details pl refer Annexure-13-M.

10.0.0 PACKING AND FORWARDING:

The equipment shall be protected for a storage of 12 months at site. If any extra precaution is to be taken by the purchaser for storage beyond 12 months, the same shall be explicitly indicated in the O&M manual.

For other details, please refer clause no 8.2.8 of API 610 10th Edn. The words `if specified' stand deleted in clause no 8.2.8.2, 8.2.8.3, 8.2.8.3 & 8.2.8.4.

11.0.0 SUB VENDORS:

Bidder shall follow approved sub vendors list as per Annexure-9. In case of any specific practical difficulty, bidder is requested to bring out the same with proper reason for not following vendor list [Annexure-9 A or B]. For other items for which sub vendors are not specified, bidder can follow their standard vendors. However, they have to ensure the Proven Track record of the sub vendors and Bidder to take prior approval of BHEL for the same.

Note: EOT crane vendor shall not source any items from his sub vendors who are part of EIL holiday list of vendors.

12.0.0 DOCUMENTATION:

12.1.0 MASTER DOCUMENT LIST: Refer Annexure-10

12.2.0 A master documentation shall be prepared during kick off meeting identifying all the DOCUMENTS / DRAWINGS to be submitted by the bidder as part of documentation. Bidder shall ensure submission of all documentation as per approved Master Document List**.**

12.1.2 Bidder to note that the dates of submission of all the documents shall be finalized based on PO date. It shall be solely bidder's responsibility to get approval on the entire document from purchaser to meet project schedule.

12.3.0 DRAWING APPROVAL / REVIEW CATEGORY:

The master document list shall clearly identify the class of review to be performed against each document.
Following classes of review shall be followed for all the documents engineered by the bidder

- APPROVAL (A): Approval is mandatory and bidder cannot proceed without obtaining Purchaser's approval.
- INFORMATION / RECORDS (I): This type of documents shall be submitted to Purchaser for his information. Bidder can proceed if Purchaser's comments are not received within 14 working days of receipt in Purchaser's office.

12.4.0 DRAWINGS REVIEW & APPROVALS:

12.4.1 Each drawing submitted by the bidder shall be with a title bock furnished by BHEL during detailed engg stage.

12.4.2 All drawings / documents shall be thoroughly checked, duly signed, and stamped by the vendor including drawing /documents of sub-vendor, before submission to BHEL. Documents, which are unchecked, unsigned, and without revisions marked clearly, shall be returned without review. Any delay on account of this shall be to the vendor's account. After first review of documents, vendor to submit all the further revisions of documents along with comment resolution sheet. Successive documents submitted without comment resolution sheet shall be returned without review

12.4.3 The approval and /or review by BHEL /End customer shall not be construed by the bidder as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and drawings.

12.4.4 Documents once reviewed in Code-1 shall not be submitted (incorporating some changes) again for review, however if some change is really necessary, the same shall be brought to the notice of BHEL separately through design change note for review / information. Finally As –built drawings, duly updated, shall be submitted.

12.4.5 During detailed engg stage, BHEL shall furnish check list reg minimum contents in GA drawing. Bidder to submit GAD [duly incorporating all requirements as per the check list] along with signed checklist. GAD shall not be reviewed without duly filled in checklist signed by the bidder.

12.5.0 NO. OF COPIES OF EACH DOCUMENT TO BE FURNISHED:

All the documents shall be submitted as given below:

SL NO.	DESCRIPTION	NO. OF COPIES / PIECES TO BE SUBMITTED	WHEN TO SUBMIT
1)	Initial drawings/documents under approval and information category.	Soft copy only	Within 2 weeks of placement of order
2)	BHEL shall furnish their observation on submitted documents	Soft copy only	Within 2 weeks of document submission
3)	*Revised drawings/documents along with compliance sheet incorporating all BHEL comments. ***Vendor to incorporate all BHEL comments so that further revisions can be minimized.**	Soft copy only	Within 1 weeks of receipt of commented Drawings from BHEL

SL NO.	DESCRIPTION	NO. OF COPIES / PIECES TO BE SUBMITTED	WHEN TO SUBMIT
4)	BHEL shall furnish their observation on submitted documents	Soft copy only	Within 2 weeks of document submission
5)	Final Drawings/documents	12	Within 2 months of placement of order.
6)	Erection Documentation	5	1 month before dispatch of equipment. The list of documents identified under master document list for erection to be furnished in 5 no's of folders
7)	Draft O & M Manuals for BHEL review. Note: Bidder to furnish final hard copy of O&M only after getting concurrence on soft copy.	Soft copy	At least 2 months before the delivery date of equipment
8)	Revised O & M Manuals with Test Certificates to be submitted to BHEL (Hyderabad)	12	Within one month before the delivery date of equipment
9)	Final O&M manuals in a CD	4	Within one month after dispatch of equipment after BHEL concurrence on soft copy.

NOTE: The O&M manuals shall contain the following as minimum:

1) The identification details of the equipment like BHEL P.O. No., Vendor's Job Identification No., full contact address with telephone, fax, & e-mail details.
2) Brief description of the system.
3) All approved documents [Drawings, documents & test procedures as per MDL]
4) Bill of material, BBU, LO schedule, sub vendor list, Mandatory & commissioning spares list etc.
5) Operation, Instruction & maintenance manuals of all equipments / items fo the complete package
6) System unloading, storage erection, start up, commissioning, shut down requirements.
7) Operational & environmental safety instructions.
8) Test reports and certificates.
9) Catalogues of the equipment & instrumentation.

13.0.0 PRICE BID FORMAT:

Bidder to indicate his offer as per Price Bid format enclosed as Annexure-4.

All the items included in the price bid format shall be quoted as per tender specification and pre-bid clarifications as per annexure-12, if any. Responsibility of ensuring correctness & completeness of scope of supply as per specification requirement solely lies with bidder.

The equipment supplied shall be complete in all respects. The bidder shall not be eligible for any extra payment in respect of such mountings, fittings, fixtures and accessories if required for the safe and reliable operation of the equipment. Any additional equipment, material, etc., which are not specifically mentioned here, but are required to make the supplied equipment complete in all respect, in accordance with the intent of this technical specification, contractual agreement, statutory requirements, relevant/applicable codes/standards, good engineering practices, and for safe and trouble-free operation, shall be deemed to be in bidder scope Only.

Main offer consists of those items which will be part of main order after successful bidder is identified. Optional Items consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under Main offer and Optional items as per the prescribed format. Prices quoted by the bidder shall remain firm till the successful handing over of the entire package to end customer. Any request for upward revision of price during any intermediate stage before handing over the plant to end customer will be summarily rejected by BHEL.

The Priced Bid shall be submitted in Original (without any copy) duly signed and stamped on each page in a separate sealed envelope super scribing "Price Bid –Do not Open" This shall not contain any condition whatsoever failing which the Bids shall be liable to be rejected. In case of any correction, the bidder shall put its signature and its stamp. Eraser fluid will not be allowed for making any correction.
Bidder shall confirm to the un-priced bid as part of their offer.

14.0.0 PRE-BID CLARIFICATIONS & DEVIATIONS:

14.1.0 Bidders shall comply with various requirements of this specification. It may please be noted that the requirements specified here in this specification are the standard practices being followed by the bidders. However, same things are presented in a structured form so that it can be ensured that the requirements of ultimate customer are complied with.

14.2.0 Bidders can bring out only those deviations which are impractical to meet, for our review in pre bid clarification only.

14.3.0 Bidders may also please note that the data sheets for, valves, instruments etc., submitted along with the offer will be considered as indicative only, as the requirements specified in the specification are standard in nature. These will not be reviewed by BHEL before award of contract. Same will be reviewed during order execution stage in line with the requirements of specification and agreed deviations.

14.4.0 All pre-bid clarifications & deviations shall be clear bring as per annexure- 12. Only.

14.5.0 In case bidder doesn't bring any clarification/deviation in prebid stage , the same shall be brought in their offer with following conditions:

a) Any deviations to Customer specifications, same are acceptable provided these deviations are also regularly accepted by Customer for their direct orders on bidders. In such cases, proof of the same shall be furnished along with the offer.
b) Bidders may please note that unless the deviations are specifically brought out under deviations clause, it will be considered that no deviations are taken, even if they are mentioned elsewhere directly/indirectly in the offer.
c) Price implication due to non-acceptance [by BHEL/Customer] of the deviations considered by bidder will not be permitted.
d) Deviations [if any] shall be clear bring as per annexure- 11 only.

15.0.0 LT Motor details:

For all applicable LT motors following details to be referred:
Available Power supply:
Voltage: 3Ph-6.6kV (+/-6%) for Motor >160KW
Voltage: 3Ph-415kV (+/-6%) for Motor >=.18kW to 160KW
Voltage:1Ph-240V (+/-%) for motor<.18kW.
Frequency: 50HZ (+/- 3%)
Combined voltage & Frequency variation +/-10%

LT Motor shall be as per enclosed EIL specifications [annexure-13 H & J.]

Crimp type tinned Copper lugs and double compression SS cable glands shall be supplied along with the motors for the specified cable sizes for power, space heater cables and any other cables terminating at motor end.
Cable sizes shall be informed during detailed engineering.

16.0.0 ANNEXURES:

Following input documents and specifications are enclosed to facilitate the bidder to furnish the offer and ensure compliance:

Annexure No.	Description
1-A	Piping Material Specification
1-B	Schematic
1-C	Scope diagram wrt Instrumentation
02	Pump Data Sheet
03	~~Motor Data Sheet~~
04	Price Bid Format
05	Check List
06	C&I specification
07	QAP guide Line, Formats & specification
08	Experience Record Proforma
09	Sub-vendor List
09-A	Customer approved vendor list
09-B	BHEL PMD List
10	Master DOC List Format
11	Deviation format
12	Prebid clarification
13	EIL Specifications
13-A	Pump Datasheet
13-B	Gearbox datasheet
13-C	Coupling datasheet
13-D	Engineering design basis rotating equipment
~~13-E~~	~~Engineering design basis Electrical~~
13-F	Standard Specification For Centrifugal Pumps (special purpose process service)
~~13-G~~	~~Specification For High Voltage Induction Motors~~
13-H	Specification For Medium Voltage Induction Motors
13-I	~~ITP for HV motor~~
13-J	ITP for MV motor
~~13-K~~	~~Job specification for Instrumentation package~~
~~13-L~~	~~Standard specification for instrumentation of package Units~~
13-M	Job Specification For Surface Preparation and Protective Coating
13-N	EIL specification extracts
14	Hydraulic coupling details

RECORD OF REVISIONS				
Rev. No.	**Date**	**Revision Details**	**Revised By**	**Approved By**
00	27.03.2017	First Issue	----------	Siva Prasad Babu

COPYRIGHT AND CONFIDENTIAL

The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-1-A
Piping Material Specification

Sl No	CONTENTS
1	A2A
2	A3A
3	F2A

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : A2A** Sheet 1 of 6

PIPE CLASS : **A2A**
RATING : 150
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 1.5 MM
SPECIAL REQUIREMENT : IBR SERVICE

TEMPERATURE (Deg. C) AND PRESSURE (Kg/Sq. cm g) RATINGS

TEMP	0	38	93	149	204	260	280	300
PRESS	20.03	20.03	18.28	16.17	14.06	11.95	11.19	10.44

SERVICE

LOW PRESSURE STEAM (IBR), BOILER FEED WATER (IBR) & CONDENSATE (IBR),BOILER BLOWDOWN

NOTES

5 FOR PERMANENT 'T' TYPE BW STRAINERS,REFER EIL'STD 7-44-0303 & 7-44-0304; AND FOR TEMPORARY STRAINERS,REFER EIL'STD 7-44-0300; FOR SPACER AND BLIND REFER EIL'STD 7-44-0162.

7 FOR RESTRICTION ON USE OF BALL,PLUG & BUTTERFLY VALVES,REFER GENERAL NOTES.

8 ALL PIPES,FITTINGS,VALVES,FLANGES,TRAPS AND STRAINERS SHALL BE TESTED AND TEST CERTIFICATE IN FORM III A FOR PIPE AND FORM III C FOR OTHERS SHALL BE REQD. DULY COUNTERSIGNED BY IBR AUTHORITY OR ITS APPROVED REPRESENTATIVE.

9 CARBON CONTENT SHALL NOT EXCEED 0.25% FOR ALL PIPES,FITTINGS FLANGES ETC. THAT MAY REQUIRE WELDING. MOREOVER,FOR FLANGES THE SULPHUR AND PHOSPHOROUS SHALL ALSO BE LIMITED TO 0.05% EACH.

92 GATE VALVES OF SIZE 26" AND ABOVE SHALL BE IN ACCORDANCE WITH B-16.34/ BS-1414 AND FLANGE ENDS SHALL BE IN ACCORDANCE WITH ASME B16.47 SERIES B.

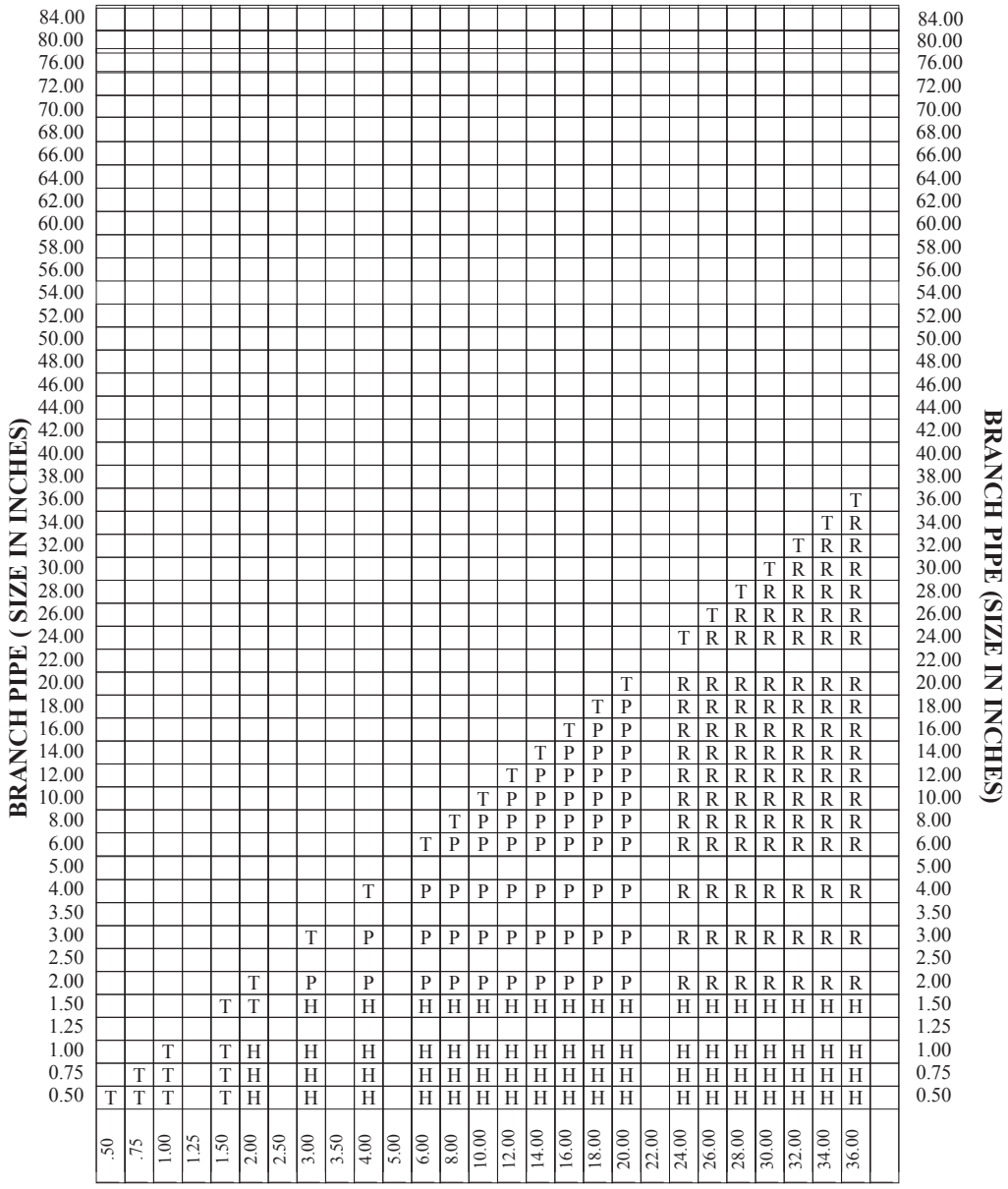
101 NDT REQUIREMENTS AS PER JOB STD. A747-6-44-0016

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER EILSTD 7-44-0350, DF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD. 7-44-0351, D4	
VENTS	ON LINES <= 1.5"	REFER EIL STD. 7-44-0350, VF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD 7-44-0351, V4	
TEMP.CONN	1.5"	FLANGED. REFER EIL STD 7-44-0353	
PRESS.CONN	0.75"	SW NIPPLE WITH VALVE TO SPEC AS PER EIL STD 7-44-0354	

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : A2A** Sheet 2 of 6



CODE	DESCRIPTION				
F	SADDLE FUSED JT	**T**	TEES	**J**	THREADOLET
H	H. COUPLING	**W**	WELDOLETS		
P	PIPE TO PIPE	**I**	INSTRUMENT TEE		
R	REINFORCED	**X**	Refer Notes		
S	SOCKOLETS	**L**	SWEEPOLET		

Package : **IPMCS**
Report No. : **50**

A2A

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : A2A** Sheet 3 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn. STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	.5	.75	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z1	
PIP	PIPE	1	1.5	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z1	
PIP	PIPE	2	2	XS	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	
PIP	PIPE	3	14	STD	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	
PIP	PIPE	16	36	STD	B-36.10	ASTM A 672 GR.B60 CL.12	BE, E.FS.W	PI2A813Z1	
NIP	NIPPLE	.5	.75	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z1	
NIP	NIPPLE	1	1.5	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z1	
Flange Group									
FLG/300	FLNG.SW	.5	1.5	M	B-16.5	ASTM A 105	300, RF/125AARH	FSC0147Z1	
FLG	FLNG.WN	.5	1.5	M	B-16.5	ASTM A 105	150, RF/125AARH	FWC0127Z1	
FLG	FLNG.WN	2	24	M	B-16.5	ASTM A 105	150, RF/125AARH	FWC0127Z1	
FLG	FLNG.WN	26	36	M	B-16.47-B	ASTM A 105	150, RF/125AARH	FWB0127Z1	
FLG/300	FLNG.WN	26	36	M	B-16.47-B	ASTM A 105	300, RF/125AARH	FWB0147Z1	
FLG/300	FLNG.WN	2	24	M	B-16.5	ASTM A 105	300, RF/125AARH	FWC0147Z1	
FLB	FLNG.BLIND	.5	24		B-16.5	ASTM A 105	150, RF/125AARH	FBC0127Z1	
FLB	FLNG.BLIND	26	36		B-16.47-B	ASTM A 105	150, RF/125AARH	FBB0127Z1	
FEF	FLNG.FIG.8	.5	8		ASME-B16.48	ASTM A 105	150, FF/125AARH	FGK0121Z1	
FEF	SPCR&BLND	10	24		ASME-B16.48	ASTM A 105	150, FF/125AARH	FCK0121Z1	
FEF	SPCR&BLND	26	36		EIL'STD	ASTM A 516 GR.70	150, FF/125AARH	FCE6321Z1	
Fitting Group									
ELB90	ELBOW.90	.5	.75		B-16.11	ASTM A 105	SW, 6000	WA602D3Z1	
ELB90	ELBOW.90	1	1.5		B-16.11	ASTM A 105	SW, 3000	WA602D2Z1	
ELB90	ELBOW.90	2	14	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WAG684Z11	
ELB90	ELBOW.90	16	36	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z11	

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : A2A** Sheet 4 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn. STD	Material	Description	Commodity Code	Note No
Fitting Group									
ELB45	ELBOW.45	.5	.75		B-16.11	ASTM A 105	SW, 6000	WB602D3Z1	
ELB45	ELBOW.45	1	1.5		B-16.11	ASTM A 105	SW, 3000	WB602D2Z1	
ELB45	ELBOW.45	2	14	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WBG684Z11	
ELB45	ELBOW.45	16	36	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WBG754Z11	
TEQ	T.EQUAL	.5	.75		B-16.11	ASTM A 105	SW, 6000	WE602D3Z1	
TEQ	T.EQUAL	1	1.5		B-16.11	ASTM A 105	SW, 3000	WE602D2Z1	
TEQ	T.EQUAL	2	14	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ1	
TEQ	T.EQUAL	16	36	M	B-16.9	ASTM A 234 GR.WPB-W	BW	WEG754ZZ1	
TRED	T.RED	.5	.75		B-16.11	ASTM A 105	SW, 6000	WR602D3Z1	
TRED	T.RED	1	1.5		B-16.11	ASTM A 105	SW, 3000	WR602D2Z1	
TRED	T.RED	2	14	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ1	
TRED	T.RED	16	36	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WRG754ZZ1	
REDC	REDUC.CONC	2	14	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ1	
REDC	REDUC.CONC	16	36	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WUG754ZZ1	
REDE	REDUC.ECC	2	14	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ1	
REDE	REDUC.ECC	16	36	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WVG754ZZ1	
SWGC	SWAGE.CONC	.5	3	M, M	BS-3799	ASTM A 105	PBE	WNH026ZZ1	
SWGE	SWAGE.ECC	.5	3	M, M	BS-3799	ASTM A 105	PBE	WPH026ZZ1	
CAP	CAP	2	36	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ1	
CPLF	CPLNG.FULL	.5	.75		B-16.11	ASTM A 105	SW, 6000	WJ602D3Z1	
CPLF	CPLNG.FULL	1	1.5		B-16.11	ASTM A 105	SW, 3000	WJ602D2Z1	
CPLH	CPLNG.HALF	.5	.75		B-16.11	ASTM A 105	SW, 6000	WK602D3Z1	
CPLH	CPLNG.HALF	1	1.5		B-16.11	ASTM A 105	SW, 3000	WK602D2Z1	

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : A2A** Sheet 5 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn. STD	Material	Description	Commodity Code	Note No
Fitting Group									
CPLL	CPLNG.LH	.5	.75		B-16.11	ASTM A 105	SW, 6000	WL602D3Z1	
CPLL	CPLNG.LH	1	1.5		B-16.11	ASTM A 105	SW, 3000	WL602D2Z1	
CPLR	CPLNG.RED	.5	.75		B-16.11	ASTM A 105	SW, 6000	WM602D3Z1	
CPLR	CPLNG.RED	1	1.5		B-16.11	ASTM A 105	SW, 3000	WM602D2Z1	
Valves Group									
GAV	VLV.GATE	.5	1.5		API 602/ ISO 15761	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR STEEL	SW, 800, 3000, B-16.11, SHT NO.- 51002	51002ZZZ1	
GAV	VLV.GATE	2	36		API 600/ ISO 10434	BODY-ASTM A 216 GR.WCB,TRIM-13% CR STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 51302	51302ZZZ1	92
GLV	VLV.GLOBE	.5	1.5		BS EN ISO 15761	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR.STEEL	SW, 800, 3000, B-16.11, SHT NO.- 52002	52002ZZZ1	
GLV	VLV.GLOBE	2	16		BS-1873	BODY-ASTM A 216 GR.WCB,TRIM-13% CR STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 52302	52302ZZZ1	
CHV	VLV.CHECK	.5	1.5		BS EN ISO 15761	BODY-ASTM A 105,TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO.- 53002	53002ZZZ1	
CHV	VLV.CHECK	2	24		BS-1868	BODY-ASTM A 216 GR.WCB,TRIM-13% CR STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 53302	53302ZZZ1	
BLV	VLV.BALL	.5	1.5		BS EN ISO 17292	BODY-ASTM A 105 / A 216GR.WCB,TRIM-BODY SEAT-PEEK	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 54302	54302ZZZ1	
G3V	VLV.PISTON	.5	1		MNF'STD	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	SW, 300, 3000, B-16.11, SHT NO.- 64402	64402ZZZ1	
Bolt Group									
BOS	BOLT.STUD	.5	36		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	.5	24		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL	SPIRAL, 150	GK65072Z0	
GAS	GASKET	26	36		B-16.20-ANSI B16.47B	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 150	GK56272Z0	
GAS/300	GASKET	26	36		B-16.20-ANSI B16.47B	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 300	GK56274Z0	

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : A2A** Sheet 6 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn. STD	Material	Description	Commodity Code	Note No
Gasket Group									
GAS/300	GASKET	.5	24		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL	SPIRAL, 300	GK65074Z0	
Trap/Strainer Group									
TRP	TRAP.STEAM	.5	1.5		MNF'STD	B:A105;T:13%CR;S:SS304	FLGD, THRMDNMC, 150,RF/125AARH	TR3065531	
TSR	STRNR.TEMP	1.5	24		EIL'STD	B:A516GR.70;INT:SS304	CONETYPE, 150,FF/125AARH	ST16831Z1	
PSR	STRNR.PERM	.5	1.5		MNF'STD	B:A105;INT:SS304	SW, Y-TYPE, 800	SP303D511	
PSR	STRNR.PERM	2	24		MNF'STD	B:A216GR.WCB;INT:SS304	FLGD, Y-TYPE, 150,RF/125AARH	SP3805531	

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : A3A** Sheet 1 of 7

PIPE CLASS : **A3A**
RATING : 150
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 1.5 MM
SPECIAL REQUIREMENT :

TEMPERATURE (Deg. C) AND PRESSURE (Kg/Sq. cm g) RATINGS

TEMP	0	38	50	65	100	150	186
PRESS	10.55	10.55	10.55	10.55	10.55	10.55	10.55

SERVICE

NON CORROSIVE UTILITIES (ABOVE GROUND) CATEGORY "D" FLUID - COOLING WATER, RAW WATER, SERVICE WATER, INSTRUMENT AIR(2" & ABOVE), PLANT AIR, INERT GAS, CARBON DI OXIDE (DRY), NITROGEN, CONDENSATE & BOILER FEED SUCTION (NON IBR). THIS CLASS DOES NOT COVER UNDERGROUND PIPING AND THE FIRE WATER SERVICE..

NOTES

5 FOR PERMANENT 'T' TYPE BW STRAINERS,REFER EIL'STD 7-44-0303 & 7-44-0304; AND FOR TEMPORARY STRAINERS,REFER EIL'STD 7-44-0300; FOR SPACER AND BLIND REFER EIL'STD 7-44-0162.

6 FOR FABRICATED REDUCERS,REFER EIL'STD 7-44-0485 & 7-44-0487. FOR MITRES, REFER EIL'STD 7-44-0033.

64 AWWA C207 CL.D FLANGES SHALL BE OF HUB TYPE.

65 FORGINGS ARE ACCEPTABLE IN LIEU OF PLATE MATERIAL FOR BLIND FLANGES AND SPACER & BLINDS.

86 BUTTERFLY VALVES FOR THE SPEC ARE PN10 RATED WITH A MAXIMUM PRESSURE OF 10.2 KG/CM2G.

99 BLIND FLANGES AND SPACER & BLINDS SPECIFIED TO MANUFACTURER'S STANDARD SHALL BE DESIGNED FOR 70 DEG.C AND 7.0 KG/CM2G TO SUIT 150#, FF, 125AARH, AWWA C207 CL.D FLANGES.

101 NDT REQUIREMENTS AS PER JOB STD. A747-6-44-0016

102 USE BUTTERFLY VALVES INSTEAD OF GATE VALVES FROM 12" ONWARDS IN WATER SERVICE AND UPTO 70 DEG C. DESIGN PRESSURE FOR BUTTERFLY VALVES IS LIMITED UPTO 10 BAR.

109 FOR SIZES ABOVE 30", TEMPERATURE AND PRESSURE RATINGS SHALL BE 65 DEG.C & 8.5 KG/CM2G RESPECTIVELY.

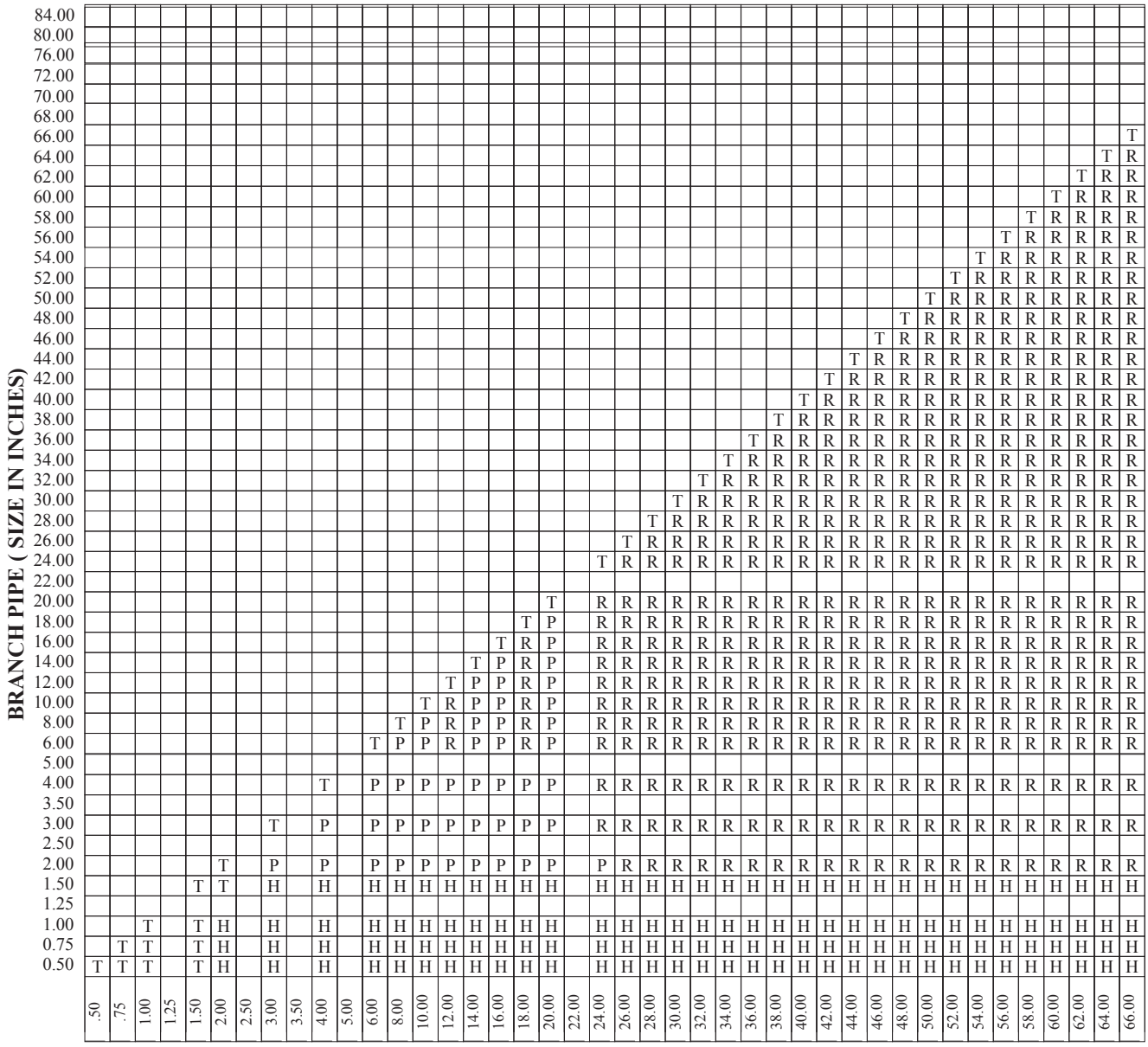
110 USE 5 PIECES 90 DEG MITRE FOR SIZE(S) 16" TO 44" ; 6 PIECES 90 DEG MITRE FOR SIZE(S) 46" TO 56"; 7 PIECES 90 DEG MITRE FOR SIZE(S) 58" TO 76"; 45 DEG MITRE REQUIRES ONE PIECE LESS

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING 3000 LBS.	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER EILSTD 7-44-350, DF3	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER EIL STD. 7-44-351, D4	
VENTS	ON LINES <= 1.5"	REFER EIL STD. 7-44-350, VC1	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER EIL STD 7-44-351, V1	
TEMP.CONN	1.5"	FLANGED. REFER EIL STD 7-44-353	
PRESS.CONN	0.75"	SW, NIPPLE WITH GATE VALVE TO SPEC AS PER EIL STD 7-44-354	

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : A3A** Sheet 2 of 7



RUN PIPE (SIZE IN INCHES)

CODE	DESCRIPTION				
F	SADDLE FUSED JT	**T**	TEES	**J**	THREADOLET
H	H. COUPLING	**W**	WELDOLETS		
P	PIPE TO PIPE	**I**	INSTRUMENT TEE		
R	REINFORCED	**X**	Refer Notes		
S	SOCKOLETS	**L**	SWEEPOLET		

Package : IPMCS
Report No. : 50

A3A

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : A3A** Sheet 3 of 7

								84.00
				T		T		80.00
			T	R				76.00
		T	R	R				72.00
	T	R	R	R				70.00
T	R	R	R	R				68.00
R	R	R	R	R				66.00
R	R	R	R	R				64.00
R	R	R	R	R				62.00
R	R	R	R	R				60.00
R	R	R	R	R				58.00
R	R	R	R	R				56.00
R	R	R	R	R				54.00
R	R	R	R	R				52.00
R	R	R	R	R				50.00
R	R	R	R	R				48.00
R	R	R	R	R				46.00
R	R	R	R	R				44.00
R	R	R	R	R				42.00
R	R	R	R	R				40.00
R	R	R	R	R				38.00
R	R	R	R	R				36.00
R	R	R	R	R				34.00
R	R	R	R	R				32.00
R	R	R	R	R				30.00
R	R	R	R	R				28.00
R	R	R	R	R				26.00
R	R	R	R	R				24.00
								22.00
R	R	R	R	R				20.00
R	R	R	R	R				18.00
R	R	R	R	R				16.00
R	R	R	R	R				14.00
R	R	R	R	R				12.00
R	R	R	R	R				10.00
R	R	R	R	R				8.00
R	R	R	R	R				6.00
								5.00
R	R	R	R	R				4.00
								3.50
R	R	R	R	R				3.00
								2.50
R	R	R	R	R				2.00
H	H	H	H	H	H	H		1.50
					H	H		1.25
H	H	H	H	H	H	H		1.00
H	H	H	H	H	H	H		0.75
H	H	H	H	H	H	H		0.50
68.00	70.00	72.00	74.00	76.00	78.00	80.00		

BRANCH PIPE (SIZE IN INCHES)

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : A3A** Sheet 4 of 7

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn. STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	.5	1.5	HVY	IS-1239-I	IS-1239 (BLACK)	PE, C.WELDED	PI6D471Z0	
PIP	PIPE	2	6	HVY	IS-1239-I	IS-1239 (BLACK)	BE, C.WELDED	PI6D411Z0	
PIP	PIPE	8	14	6.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	
PIP	PIPE	16	18	8.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	
PIP	PIPE	20	24	10.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	
PIP	PIPE	26	30	12.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	
PIP	PIPE	32	38	12.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	109
PIP	PIPE	40	48	14.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	109
PIP	PIPE	50	60	16.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	109
PIP	PIPE	64	70	18.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	109
PIP	PIPE	72	76	20.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	109
NIP	NIPPLE	.5	1.5	HVY	IS-1239-I	IS-1239 (BLACK)	PBE, C.WELDED	PN6D461Z0	
Flange Group									
FLG	FLNG.SW	.5	1.5	M	B-16.5	ASTM A 105	150, RF/125AARH	FSC0127Z0	
FLG/300	FLNG.SW	.5	1.5	M	B-16.5	ASTM A 105	300, RF/125AARH	FSC0147Z0	
FLG/300	FLNG.WN	2	24	M	B-16.5	ASTM A 105	300, RF/125AARH	FWC0147Z0	
FLG	FLNG.SO	2	24		B-16.5	ASTM A 105	150, RF/125AARH	FNC0127Z0	
FLG	FLNG.SO	26	76		AWWA-C207 CL.D	ASTM A 105	150, FF/125AARH	FN40121Z0	
FLB	FLNG.BLIND	.5	24		B-16.5	ASTM A 105	150, RF/125AARH	FBC0127Z0	
FLB	FLNG.BLIND	26	48		AWWA-C207 CL.D	ASTM A 285 GR.C	150, FF/125AARH	FB45321Z0	
FEF	FLNG.FIG.8	.5	8		ASME-B16.48	ASTM A 105	150, FF/125AARH	FGK0121Z0	
FEF	SPCR&BLND	10	24		ASME-B16.48	ASTM A 105	150, FF/125AARH	FCK0121Z0	
FEF	SPCR&BLND	26	76		MNF'STD	ASTM A 285 GR.C	150, FF/125AARH	FCG5321Z0	

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : A3A** Sheet 5 of 7

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn. STD	Material	Description	Commodity Code	Note No
Fitting Group									
ELB90	ELBOW.90	.5	1.5		B-16.11	ASTM A 105	SW, 3000	WA602D2Z0	
ELB90	ELBOW.90	2	6	STD	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WAG684Z10	
ELB90	ELBOW.90	8	14	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z10	
ELB45	ELBOW.45	.5	1.5		B-16.11	ASTM A 105	SW, 3000	WB602D2Z0	
ELB45	ELBOW.45	2	6	STD	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WBG684Z10	
ELB45	ELBOW.45	8	14	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WBG754Z10	
MIT90	MITRE.90	16	76	M	EIL'STD	IS-3589 GR.330	BW, 1.5D	WDKF141Z0	
MIT45	MITRE.45	16	76	M	EIL'STD	IS-3589 GR.330	BW, 1.5D	WGKF141Z0	
TEQ	T.EQUAL	.5	1.5		B-16.11	ASTM A 105	SW, 3000	WE602D2Z0	
TEQ	T.EQUAL	2	6	STD	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ0	
TEQ	T.EQUAL	8	48	M	B-16.9	ASTM A 234 GR.WPB-W	BW	WEG754ZZ0	
TRED	T.RED	.5	1.5		B-16.11	ASTM A 105	SW, 3000	WR602D2Z0	
TRED	T.RED	2	6	STD, STD	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ0	
TRED	T.RED	8	48	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WRG754ZZ0	
REDC	REDUC.CONC	2	6	STD, STD	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ0	
REDC	REDUC.CONC	8	14	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WUG754ZZ0	
REDC	REDUC.CONC	16	76	M, M	EIL'STD	IS-3589 GR.330	BW	WUKF14ZZ0	
REDE	REDUC.ECC	2	6	STD, STD	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ0	
REDE	REDUC.ECC	8	14	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WVG754ZZ0	
REDE	REDUC.ECC	16	76	M, M	EIL'STD	IS-3589 GR.330	BW	WVKF14ZZ0	
SWGC	SWAGE.CONC	.5	3	STD, STD	BS-3799	ASTM A 105	PBE	WNH026ZZ0	
SWGE	SWAGE.ECC	.5	3	STD, STD	BS-3799	ASTM A 105	PBE	WPH026ZZ0	
CAP	CAP	.5	1.5		B-16.11	ASTM A 105	SCRF, 3000	WF60282Z0	

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : A3A** Sheet 6 of 7

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn. STD	Material	Description	Commodity Code	Note No
Fitting Group									
CAP	CAP	2	6	STD	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CAP	CAP	8	48	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CAP	CAP	50	76	CALC	ASME-VIII	ASTM A 285 GR.C	BW	WF3J54ZZ0	
CPLF	CPLNG.FULL	.5	1.5		B-16.11	ASTM A 105	SW, 3000	WJ602D2Z0	
CPLH	CPLNG.HALF	.5	1.5		B-16.11	ASTM A 105	SW, 3000	WK602D2Z0	
CPLL	CPLNG.LH	.5	1.5		B-16.11	ASTM A 105	SW, 3000	WL602D2Z0	
CPLR	CPLNG.RED	.5	1.5		B-16.11	ASTM A 105	SW, 3000	WM602D2Z0	
UNN	UNION	.5	1.5		BS-3799	ASTM A 105	SW, 3000	WQH02D2Z0	
Valves Group									
GAV	VLV.GATE	.25	1.5		API 602/ ISO 15761	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR.STEEL	SW, 800, 3000, B-16.11, SHT NO.- 51001	51001ZZZ0	
GAV	VLV.GATE	2	24		API 600/ ISO 10434	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 51321	51321ZZZ0	
GLV	VLV.GLOBE	.25	1.5		BS EN ISO 15761	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR STEEL	SW, 800, 3000, B-16.11, SHT NO.- 52001	52001ZZZ0	
GLV	VLV.GLOBE	2	16		BS-1873	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 52321	52321ZZZ0	
CHV	VLV.CHECK	.25	1.5		BS EN ISO 15761	BODY-ASTM A 105,TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO.- 53001	53001ZZZ0	
CHV	VLV.CHECK	2	24		BS 1868	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 53321	53321ZZZ0	
CHV	VLV.CHECK	26	48		API-594	BODY-ASTM A 105 / A 216GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, AWWAC207, FF/125AARH, SHT NO.- 53391	53391ZZZ0	
BLV	VLV.BALL	.5	16		BS EN ISO 17292	BODY-ASTM A 105 / A 216GR.WCB,TRIM-BODY SEAT-RPTFE	FLGD, 150, B-16.5, RF/125AARH, SHT NO.- 54321	54321ZZZ0	
BFV	VLV.BTRFLY	3	24		BS EN 593	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	WAFL, 150, B-16.5, WAF/125AARH, SHT NO.- 56321	56321ZZZ0	

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : A3A** Sheet 7 of 7

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn. STD	Material	Description	Commodity Code	Note No
Valves Group									
BFV	VLV.BTRFLY	26	48		BS EN 593	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, AWWAC207, FF/125AARH, SHT NO.- 56316	56316ZZZ0	
BFV	VLV.BTRFLY	50	52		BS EN 593	BODY-ASTM A 216 GR.WCB,TRIM-13% CR.STEEL	FLGD, 150, AWWAC207, FF/125AARH, SHT NO.- 56391	56391ZZZ0	
Bolt Group									
BOS	BOLT.STUD	18	76		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H		BS40404Z0	
BOM	BOLT.M/C	.5	16		B-18.2	BOLT:A307 GR.B, NUT:A563 GR.B		BM41418Z0	
Gasket Group									
GAS	GASKET	.5	24		B-16.21-ANSI B16.5	NONASBESTOS BS7531 GR X	RING, 150, 2 MM	GKBAX52Z0	
GAS	GASKET	26	76		AWWA-C207 CL.D	NONASBESTOS BS7531 GR X	FULLFACE, 150, 2 MM	GK2AX22Z0	
GAS/300	GASKET	.5	24		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL	SPIRAL, 300	GK65074Z0	
Trap/Strainer Group									
TRP	TRAP.STEAM	.5	1.5		MNF'STD	B:A105;T:13%CR;S:SS304	FLGD, THRMDNMC, 150,RF/125AARH	TR3065530	
TSR	STRNR.TEMP	1.5	24		EIL'STD	B:A285GR.C;INT:SS304	CONETYPE, 150,FF/125AARH	ST14431Z0	
PSR	STRNR.PERM	.5	1.5		MNF'STD	B:A105;INT:SS304	SW, Y-TYPE, 800	SP303D510	
PSR	STRNR.PERM	2	6	M	EIL'STD	B:A234GR.WPB;INT:SS304	BW, T-TYPE	SP13344Z0	
PSR	STRNR.PERM	8	24	M	EIL'STD	B:A234GR.WPBW;INT:SS304	BW, T-TYPE	SP13644Z0	
PSR	STRNR.PERM	26	52	M	MNF'STD	B:A234GR.WPBW;INT:SS304	BW, T-TYPE	SP33644Z0	

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : F2A** Sheet 1 of 5

PIPE CLASS : **F2A**
RATING : 1500
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 1.5 MM
SPECIAL REQUIREMENT : IBR SERVICE

TEMPERATURE (Deg. C) AND PRESSURE (Kg/Sq. cm g) RATINGS

TEMP	-29	38	93	149	204	260	316	343	371	399	427
PRESS	260.49	260.49	238.66	229.88	222.85	211.95	199.65	192.97	186.64	178.21	144.46

SERVICE

BOILER BLOWDOWN, BOILER FEED WATER, MEDIUM PRESSURE STEAM, HIGH PRESSURE STEAM (IBR)

NOTES

3 USE PIPE OF CLASS 22 INSTEAD OF CLASS 12 IF PIPE THICKNESS EXCEEDS 20.00 MM.

8 ALL PIPES,FITTINGS,VALVES,FLANGES,TRAPS AND STRAINERS SHALL BE TESTED AND TEST CERTIFICATE IN FORM III A FOR PIPE AND FORM III C FOR OTHERS SHALL BE REQD. DULY COUNTERSIGNED BY IBR AUTHORITY OR ITS APPROVED REPRESENTATIVE.

9 CARBON CONTENT SHALL NOT EXCEED 0.25% FOR ALL PIPES,FITTINGS FLANGES ETC. THAT MAY REQUIRE WELDING. MOREOVER,FOR FLANGES THE SULPHUR AND PHOSPHOROUS SHALL ALSO BE LIMITED TO 0.05% EACH.

32 CORROSION ALLOWANCE HAS BEEN ADJUSTED TO SELECT OPTIMUM SCH. REFER GENERAL NOTES TO PMS.

90 INST. CONNECTIONS LIKE ORIFICE TAPS ETC SHALL BE PROVIDED WITH DOUBLE ISOLATION VALVES.

101 NDT REQUIREMENTS AS PER JOB STD. A747-6-44-0016

132 PIPE THICKNESSES ARE CALCULATED BASED ON ACTUAL LINE CONDITION OF 190 KG/CM2 PRESSURE AT 350 DEG. C FOR SIZES 6" TO 16".

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	ALL	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	AS PER P&ID OR 0.75".TEE, NIPPLE, SINGLE VLV(AS PER P&ID OR LINE ISOLATION VLV), BLIND FLG ASSEMBLY	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75".WELDOLET,NIPPLE,SINGLE VLV(AS PER P&ID OR LINE ISOLATION VLV), BLIND FLG ASMBLY	
VENTS	ON LINES <= 1.5"	AS PER P&ID OR 0.75".TEE, NIPPLE, SINGLE VLV(AS PER P&ID OR LINE ISOLATION VLV), BLIND FLG ASSEMBLY	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75".WELDOLET,NIPPLE,SINGLE VLV(AS PER P&ID OR LINE ISOLATION VLV), BLIND FLG ASMBLY	
TEMP.CONN	2.0"	FLANGED. REFER EIL STD 7-44-0353	
PRESS.CONN	0.75"	TEE/WELDOLET & NIPPLE WITH DOUBLE VALVES (AS PER P&ID OR SIMILAR TO LINE ISOLATION VALVES)	

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : F2A** Sheet 2 of 5

BRANCH PIPE (SIZE IN INCHES)

	.50	.75	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	8.00	10.00	12.00	14.00	16.00
84.00																	
80.00																	
76.00																	
72.00																	
70.00																	
68.00																	
66.00																	
64.00																	
62.00																	
60.00																	
58.00																	
56.00																	
54.00																	
52.00																	
50.00																	
48.00																	
46.00																	
44.00																	
42.00																	
40.00																	
38.00																	
36.00																	
34.00																	
32.00																	
30.00																	
28.00																	
26.00																	
24.00																	
22.00																	
20.00																	
18.00																	
16.00																	T
14.00																T	T
12.00															T	T	T
10.00														T	T	T	T
8.00													T	T	T	T	T
6.00												T	W	W	W	W	W
5.00																	
4.00										T		W	W	W	W	W	W
3.50																	
3.00								T		W		W	W	W	W	W	W
2.50																	
2.00						T		W		W		W	W	W	W	W	W
1.50					T	T		W		W		W	W	W	W	W	W
1.25																	
1.00			T		T	W		W		W		W	W	W	W	W	W
0.75		T	T		T	W		W		W		W	W	W	W	W	W
0.50	T	T	T		T	W		W		W		W	W	W	W	W	W

BRANCH PIPE (SIZE IN INCHES)

RUN PIPE (SIZE IN INCHES)

CODE	DESCRIPTION				
F	SADDLE FUSED JT	**T**	TEES	**J**	THREADOLET
H	H. COUPLING	**W**	WELDOLETS		
P	PIPE TO PIPE	**I**	INSTRUMENT TEE		
R	REINFORCED	**X**	Refer Notes		
S	SOCKOLETS	**L**	SWEEPOLET		

Package : **IPMCS**
Report No. : **50**

F2A

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : F2A** Sheet 3 of 5

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn. STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	.5	4	S160	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	
PIP	PIPE	6	6	S160	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	132
PIP	PIPE	8	8	S140	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	132
PIP	PIPE	10	10	XXS	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	132
PIP	PIPE	12	12	S160	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	132
PIP	PIPE	14	14	S140	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	32,132
PIP	PIPE	16	16	S160	B-36.10	ASTM A 672 GR.B60 CL.22	BE, E.FS.W	PI2A913Z1	3,132
NIP	NIPPLE	.5	1.5	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z1	
Flange Group									
FLG	FLNG.WN	.5	16	M	B-16.5	ASTM A 105	1500, RTJ/63AARH	FWC0189Z1	
FLG/2500	FLNG.WN	.5	12	M	B-16.5	ASTM A 105	2500, RTJ/63AARH	FWC0199Z1	
FLB	FLNG.BLIND	.5	16		B-16.5	ASTM A 105	1500, RTJ/63AARH	FBC0189Z1	
FEF	FLNG.FIG.8	.5	4		ASME-B16.48	ASTM A 105	1500, RTJ/63AARH	FGK0189Z1	
FEF	SPCR&BLND	6	16		ASME-B16.48	ASTM A 105	1500, RTJ/63AARH	FCK0189Z1	
Fitting Group									
ELB90	ELBOW.90	.5	14	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WAG684Z11	
ELB90	ELBOW.90	16	16	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z11	
ELB45	ELBOW.45	.5	14	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WBG684Z11	
ELB45	ELBOW.45	16	16	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WBG754Z11	
TEQ	T.EQUAL	.5	14	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ1	
TEQ	T.EQUAL	16	16	M	B-16.9	ASTM A 234 GR.WPB-W	BW	WEG754ZZ1	
TRED	T.RED	.5	14	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ1	
TRED	T.RED	16	16	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WRG754ZZ1	
REDC	REDUC.CONC	.5	14	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ1	

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : F2A** Sheet 4 of 5

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn. STD	Material	Description	Commodity Code	Note No
Fitting Group									
REDC	REDUC.CONC	16	16	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WUG754ZZ1	
REDE	REDUC.ECC	.5	14	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ1	
REDE	REDUC.ECC	16	16	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WVG754ZZ1	
CAP	CAP	.5	16	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ1	
O'let Group									
WLT	WELDOLET	.5	16	M, M	MSS-SP97	ASTM A 105	BW	YWS024ZZ1	
Valves Group									
GAV	VLV.GATE	.5	1.5		API 602/ ISO 15761	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR STEEL	BW, 1500, B-16.25, SHT NO.- 51102	51102ZZZ1	
GAV	VLV.GATE	2	4		ANSI-B-16.34	BODY-ASTM A 105 / A 216GR.WCB,TRIM-STELLITED,STEM-13%CR STEEL	BW, 1500, B-16.25, SHT NO.- 51702	51702ZZZ1	
GAV	VLV.GATE	6	16		ANSI-B-16.34	BODY-ASTM A 105 / A 216GR.WCB,TRIM-STELLITED,STEM-13% CR.STEEL	BW, 1500, B-16.25, SHT NO.- 51790	51790ZZZ1	
GLV	VLV.GLOBE	.5	1.5		BS EN ISO 15761	BODY-ASTM A 105,TRIM-STELLITED,STEM-13%CR.STEEL	BW, 1500, B-16.25, SHT NO.- 52102	52102ZZZ1	
GLV	VLV.GLOBE	2	4		ANSI-B-16.34	BODY-ASTM A 105 / A 216GR.WCB,TRIM-STELLITED,STEM-13%CR.STEEL	BW, 1500, B-16.25, SHT NO.- 52702	52702ZZZ1	
CHV	VLV.CHECK	.5	1.5		BS EN ISO 15761	BODY-ASTM A 105,TRIM-STELLITED	BW, 1500, B-16.25, SHT NO.- 53102	53102ZZZ1	
CHV	VLV.CHECK	2	4		ANSI-B-16.34	BODY-ASTM A 105 / A 216GR.WCB,TRIM-STELLITED	BW, 1500, B-16.25, SHT NO.- 53702	53702ZZZ1	
CHV	VLV.CHECK	6	16		ANSI-B-16.34	BODY-ASTM A 105 / A 216GR.WCB,TRIM-STELLITED	BW, 1500, B-16.25, SHT NO.- 53790	53790ZZZ1	
BFV	VLV.BTRFLY	3	12		BS EN 593	BODY-ASTM A 216 GR.WCB,TRIM-STELLITED	WAFL, 1500, B-16.5, WAF/125AARH, SHT NO.- 56790	56790ZZZ1	

Copyright EIL- All rights reserved

Client :RFCL	**Dept./Sect. :** 16/43
Project :Revival of Ramagundam Fertilizer Complex	
Location RAMAGUNDAM	**Pipe Class : F2A** Sheet 5 of 5

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn. STD	Material	Description	Commodity Code	Note No
Bolt Group									
BOS	BOLT.STUD	.5	16		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	.5	16		B-16.20-ANSI B16.5	SOFT IRON	OCT-RING, 1500	GK67238Z0	
GAS/2500	GASKET	.5	12		B-16.20-ANSI B16.5	SOFT IRON	OCT-RING, 2500	GK67239Z0	
Trap/Strainer Group									
PSR	STRNR.PERM	.5	1.5	M	MNF'STD	B:A105;INT:SS304	BW, Y-TYPE	SP30345Z1	
PSR	STRNR.PERM	2	16	M	MNF'STD	B:A216GR.WCB;INT:SS304	BW, Y-TYPE	SP38045Z1	

Copyright EIL- All rights reserved

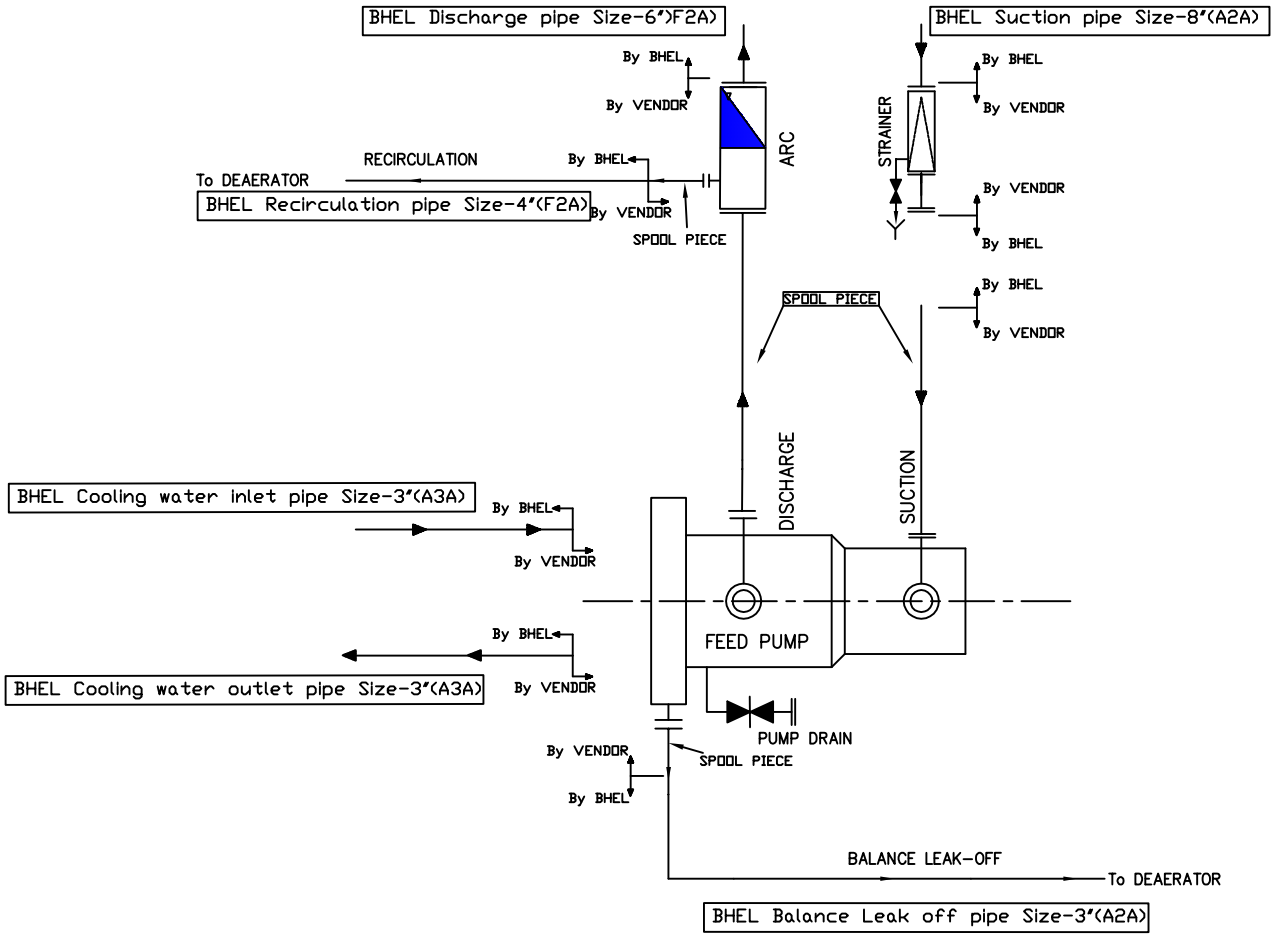
COPYRIGHT AND CONFIDENTIAL

The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-1-B
Schematic Diagram for BFP

ANNEXURE 1–B

TYPICAL SCHEMATIC DIAGRAM FOR BFP



NOTES

1. BHEL pipe sizes are mentioned in the above schematics. Suitable spool pieces, Flanges, Companion flanges with required gaskets & studs, nuts etc , Reducer/Expanders to meet BHEL pipe sizes shall be in bidder scope of supply.
2. BHEL shall provide cooling water at one location for each BFP skid. Further distribution to Pump, Motor, Hydraulic coupling & Gear box shall in bidder scope of supply. For instrumentation in individual CW inlet/outlet line specification shall be referred.
3. This schematic is only for indicating terminal point details. For scope of supply Specification shall be referred. However, for clarity on Instrumentation please refer Annexure 1–C.
4. 1/2" SS tubing shall be provided for pneumatic air requirement for scoop tube actuator for each BFP skid. Bidder to furnish necessary tube fittings to connect BHEL tubing.
5. Bidder to supply Strainer as loose item. Required stubs, isolation valves, hook up arrangements etc for DPG & DPT shall be provided by BHEL on BHEL supplied piping.
6. Bidder to provide spool pieces in BLO & Recirculation line as indicated above. Further bidder to provide required stubs, isolation valves, hook up arrangements etc for PG & PT in BLO line & PG in Recirculation line.
7. 2 nos of PSV on BLO line shall be supplied by the bidder on BLO line spool piece.
8. Please refer clause no 4.0.11.5 reg provision for BHEL supplied instruments.
9. Tag Nos. shall be provided after order placement.

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-1-C
P&ID for complete assembly

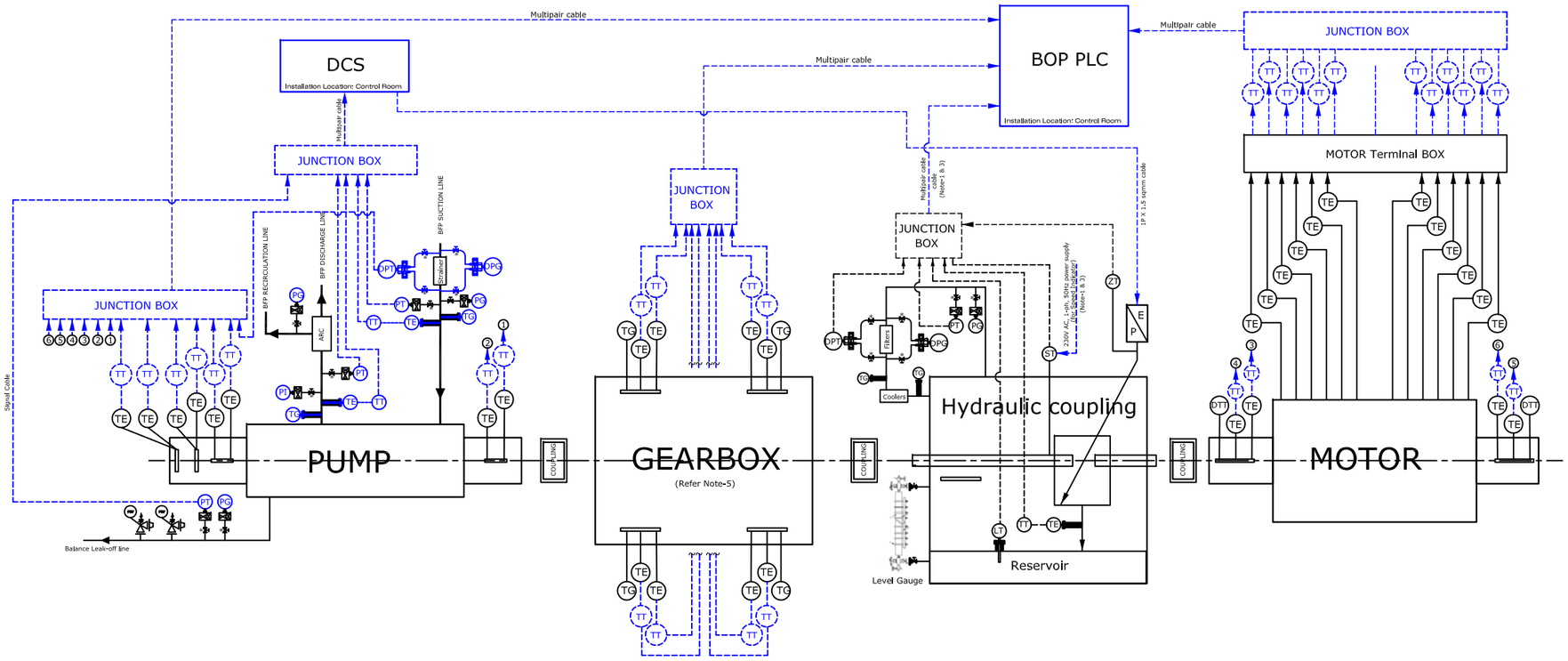
FIRST ANGLE PROJECTION

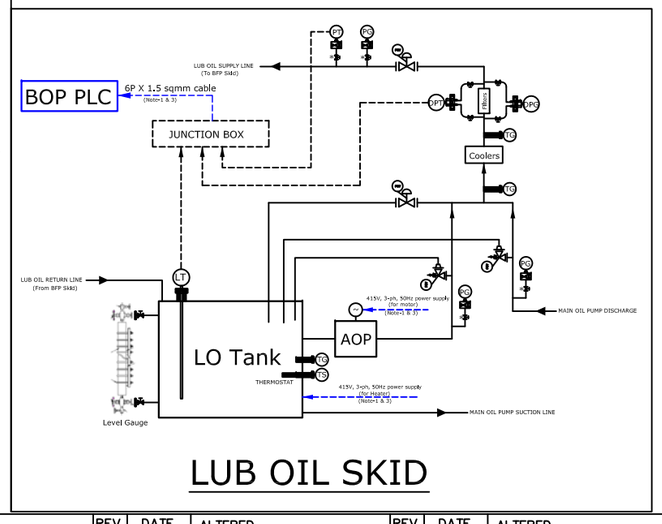
(ALL DIMENSIONS ARE IN mm)

DRG. NO. PYDZ2M095836001

SHT. 01 OF 01

BFP SKID Interface & Scope Matrix between BHEL & BFP Supplier





LUB OIL SKID

LEGENDS:

DTT -> Dial type Thermometer

ST -> Speed Indicator cum Transmitter

XG -> Local Gaues (Pressure / Temperature)

XT -> Field transmitters (Pressure / Temperature / Level)

---------- Instruments / cables indicated with BLUE color are NOT in bidder scope.

NOTES:

1) Termination accessories (like cable glands, lugs, dummy plugs, etc) and termination of all types of cables at bidder supplied items/panels shall be in Bidder scope
2) Vendor shall furnish the Earthing requirements of BFP SKID along with technical bid.
3) Purchaser shall provide the power supplies as per scope markings indicated above.
4) All the instruments / JBs (including BHEL supplies) of above skids shall be installed in Local Gauge Boards supplied by bidder. Necessary structural supports (as required for instruments installation) shall be considered by bidder.
5) Configuration of Pump-Hydraulic coupling-Gearbox-Motor or Pump-Geabox-Hydraulic coupling-Motor shall be as per bidder recommendation.
6) Bidder to include minimum instrumentation as per this scheme. However, for complete scope of supply specifica-tion & applicable codes to be referred.
7) Winding & Bearing RTDs of Motor are excluded from bidder scope.
8) This document refers only for signal exchange and instrument scope.
9) Bidder shall provide the provision on Pump / Gear box / Hydraulic coupling / etc for installation of Vibration probes/ key phasor / etc.
10) Instruments tag numbers / junction box schedules shall be provided during detail engg by BHEL.
11) Bidder shall provide suffiecient space required for maintenance and easy access of instruments / junction boxes / cables.
12) Instrument hookup materials for all BHEL /bidder supplied instruments shall be in bidder scope. These materials shall be hydro tested by connecting dummy plugs in place of instruments before dispatch of the skid.
13) All the drains and vents shall be connected internally and brought to bottom location with common and single drain and vent pipes with flanged connection within skid.
14) Piping, instrument installation and cables shall be properly dressed with suitable erection hardware to have better aesthetic look.
15) Impulse line / hookup line / cable routing shall be done considering aesthetic look of skid and criss-crossing shall be avoided. Routing shall NOT be cause hindrance for maintenance. Routing arrangement shall be submitted to BHEL for approval.

*-> Double isolation valves shall be provided for High pressure applications (i.e. process pressure > 40 kg/cm2(g)) However, double isolation valves shall be provided in re circulation & discharge line line instruments.

REV.	DATE	ALTERED	CHD/APPD
ZONE			

CUSTOMER:	RAMAGUNDAM FERTILIZERS AND CHEMICALS LIMITED		
CONSULTANT:	ENGINEERS INDIA LIMITED (EIL), NEW DELHI EIL JOB NO : A747		
PROJECT:	STEAM AND POWER GENERATION PACKAGE FOR REVIVAL OF RAMAGUNDAM FERTILIZER COMPLEX (1X32.5 MW GTG + 1X125 TPH HRSG + 1X85 TPH UB)		
BHARAT HEAVY ELECTRICALS LTD. HYDERABAD		NAME / SIGN. / DATE	NO.OF VAR.
	DRN.	GIRISH / 13.04.17	–NA–
	CHD.	SIVA / 15.04.17	
	APPD.	SIVA / 15.04.17	

DEPT. / CODE	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
	f/M/f	NTS	–NA–	–NA–	–NA–	–NA–

TITLE: BFP INTERFACE & SCOPE Matrix between BHEL & BFP Supplier

CARD CODE NA

DRG. NO: PYDZ2M095836001 REV. 00

CUST. DRG. NO:

SHT. No 01 NO. OF SHT. 01

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

COMPUTER FILE NAME

REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-2

Pump Datasheet

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-2

Pump Datasheet

CUSTOMER: RAMAGUNDAM FERTILIZERS AND CHEMICALS LIMITED
PROJECT: STEAM AND POWER GENERATION PACKAGE FOR REVIVAL OF RAMAGUNDAM FERTILIZER COMPLEX (1X32.5 GTG + 1X125 TPH HRSG + 1X85 TPH UB)
CONSULTANT:ENGINEERS INDIA LIMITED (EIL), NEW DELHI

DATA SHEET for < BOILER FEED PUMPS - MOTOR DRIVEN>

Sl.no.	Description	BHEL Requirement (if any)	Details
General Data			
1	Service	BFP's envisaged to transfer feed water from De-aerator to HRSG & UB	
2	Number of Pumps	3 nos (2W+1S)	
3	Location	Outdoor	
4	Duty	Continuous	
5	Drive	Motor	
6	Pumping fluid	Feed water and un-deaerated feed water during start-up	
7	Pumping fluid temperature, Deg C	132	
8	Deaerator pressure (suction tank) $Kg/cm^2(a)$	2.9	
9	Low Low water level of Deaertaor	15.65 mtr from top of pump foundation	
10	Deaerator operating temperature, 132 Deg C	132	
11	Pump Type	Horizontal, Centrifugal, Multistage, Barrel casing design pump	
12	Pump Model No.		
13	No. of Stages of pump	In accordance with EIL specificaiton - Maximum 10 stages	
14	Rated Speed of Pump (rpm)		
15	Rated speed of drive (rpm)		
16	Design Standard of pump	API 610 10th Edition , EIL std. Spec. 6-41-0006 & other EIL specifications	
17	Sealing arrangement	Mechanical seal as per API 682 3rd Edition	
Pump Design Parameters			
	Rated Condition		
18	Flow (m^3/hr)	148	
19	Differential Head (mlc)	1675 minimum	
20	Temperature of pumping fluid in Deg C	132	
21	Design temperature of Pump in Deg C	150	
22	Sp. Gravity of pumping fluid	0.9334	
23	Efficiency (Hot) in %		
24	Available pressure on suction side of BFP ,$Kg/cm^2(a)$	3.84	
25	NPSH(A) at pump suction nozzle(mlc)	10.05	
26	NPSH(R) (mlc)		
27	NPSH(A) - NPSH(R)	1 m at rated condition & NPSHR shall be less than NPSHA till end of the curve condition. Refer clause no 5.1.10 of Annexure-13F.	
28	Pump BkW (Hot) kw		
	Condition-4		
29	Flow (m^3/hr)	134	
30	Differential Head (mlc)	1769	
31	Temperature of pumping fluid in Deg C	132	
32	Design temperature of Pump in Deg C	150	
33	Sp. Gravity of pumping fluid	0.9334	
34	Efficiency (Hot) in %		
35	Available pressure on suction side of BFP ,$Kg/cm^2(a)$	3.84	
36	NPSH(A) at pump suction nozzle(mlc)	10.05	
37	NPSH(R) (mlc)		
38	NPSH(A) - NPSH(R)	1 m at rated condition & NPSHR shall be less than NPSHA till end of the curve condition. Refer clause no 5.1.10 of Annexure-13F.	
39	Pump BkW (Hot) kw		
	Condition-1		
40	Flow (m^3/hr)	126	
41	Differential Head (mlc)	1502 minimum	
42	Temperature of pumping fluid in Deg C	132	
43	Design temperature of Pump in Deg C	150	
44	Sp. Gravity of pumping fluid	0.9334	
45	Efficiency (Hot) in %		
46	Available pressure on suction side of BFP ,$Kg/cm^2(a)$	3.88	
47	NPSH(A) at pump suction nozzle(mlc)	10.52	
48	NPSH(R) (mlc)		
49	NPSH(A) - NPSH(R)	1 m at rated condition & NPSHR shall be less than NPSHA till end of the curve condition. Refer clause no 5.1.10 of Annexure-13F.	
50	Pump BkW (Hot) kw		
	Condition-2		
51	Flow (m^3/hr)	116	
52	Differential Head (mlc)	1575 minimum	

53	Temperature of pumping fluid in Deg C	132	
54	Design temperature of Pump in Deg C	150	
55	Sp. Gravity of pumping fluid	0.9334	
56	Efficiency (Hot) in %		
57	Available pressure on suction side of BFP ,Kg/cm^2(a)	3.93	
58	NPSH(A) at pump suction nozzle(mlc)	10.99	
59	NPSH(R) (mlc)		
60	NPSH(A) - NPSH(R)	1 m at rated condition & NPSHR shall be less than NPSHA till end of the curve condition. Refer clause no 5.1.10 of Annexure-13F.	
61	Pump BkW (Hot) kw		
	Guaranteed Case		
62	Flow (m^3/hr)	116	
63	Differential Head (mlc)	1438 minimum	
64	Temperature of pumping fluid in Deg C	132	
65	Design temperature of Pump in Deg C	150	
66	Sp. Gravity of pumping fluid	0.9334	
67	Efficiency (Hot) in %		
68	Available pressure on suction side of BFP ,Kg/cm^2(a)	3.9	
69	NPSH(A) at pump suction nozzle(mlc)	10.69	
70	NPSH(R) (mlc)		
71	NPSH(A) - NPSH(R)	1 m at rated condition & NPSHR shall be less than NPSHA till end of the curve condition. Refer clause no 5.1.10 of Annexure-13F.	
72	Pump BkW (Hot) kw		
Pump Performance & other details			
73	Pump shut off head		
74	Pump shut off head/rated head:	The head rise from rated point to shutoff shall be at least 10%. Discharge orifice shall not be used to achieve required head rise to shut off.	
75	Parallel operation	Yes. Requirement as per API	
76	Thermal minimum flow , m3/hr		
77	Stable minimum flow, m3/hr		
78	BEP of the offered pump, m3/hr	Rated flow shall be within 110% of best efficiency flowrate	
79	Preferred operating range	70% to 120% of best efficiency flowrate	
80	Allowable operating range		
81	Pump End of the curve flow, m3/hr		
82	Pump rated impeller dia, mm		
83	Pump max. impeller dia, mm		
84	Pump minimum impeller dia., mm		
85	Min. 5% head rise possible as per API		
86	Balance leak off connection & Recirculation connection	Back to deaerator	
87	Back pressure at Pump recirculation line nozzle	During detailed engineering Stage	
88	Back pressure at Pump BLO line nozzle	During detailed engineering Stage	
89	BLO flow (m3/hr)	During detailed engineering Stage	
90	BLO pressure (Kg/cm2 g)	During detailed engineering Stage	
91	BLO line safety valve set pressure (Kg/cm2 g)	During detailed engineering Stage	
92	Material of construction	As per S-6 of API 610 10th Edn	
93	Type of axial thrust balancing arrangement	Balancing piston	
94	Type of main bearings for pump		
95	Main bearings lubrication		
96	Type of thrust bearings for pump		
97	Thrust bearing lubrication		
98	Direction of rotation of Pump as seen from DE		
99	Direction of rotation of Motor as seen from DE		
100	Coupling	Metallic, Non-lubricated, flexible element type [diaphragm or disc] with Non sparking type coupling guard & spacer [The spacer nominal length shall be at least 125 mm and shall permit removal of the coupling, bearings, seal and rotor, as applicable, without disturbing the driver or the suction and discharge piping.] & with a minimum service factor of 1.5 over driver rating. DBSE shall be more than the seal cartridge length.	
101	Coupling standard	API 671	

102	Coupling Guard	Removable coupling guard shall be provided which shall be fabricated from nonsparking material, and shall be open at the bottom to permit manual shaft rotation. The guard shall be sufficiently rigid to withstand deflections as a result of bodily contact of nominally 100 kgs.	
103	LO System	(a) Forced oil lubrication system shall be as per chapter 3 of API-614. (b) The interconnection piping between the equipment & Lube oil system. PI refer clause no 10.4.6 of Annexure-13N.	
104	Flushing Plan - API-610 plan no.	SS tubing shall be used for seal flushing plans	
105	Cooling Plan (API-610 plan no.)		
106	Total Cooling Water Quantity required for Pump, Motor & Hydraulic coupling & Gearbox m3/hr		
107	ARC valve type	Modulating type	
108	ARC valve material of construction	Body:CS body ,Internals:SS	
109	ARC Valve size	The ARC valve size shall be as per Bidder's recommendation, however not less than Pump discharge nozzle size.	
110	ARC valve pressure drop	1.0 Kg/cm2 (maximum) & ARC Valves to be selected in such a way that the increase in pressure drop through the ARC Valve from rated flow of the pump to approx. 130% of the rated flow shall be limited to 1.0 kg/cm2 only. This is to ensure flexibility of operating system at marginally higher flows as per site conditions if any.	
111	IBR certification	IBR certification is required for ARC valve	
112	Suction strainer type	Conical	
113	Suction strainer material of construction	Body: CS Internals: SS	
114	Suction strainer size	Same as Suction pipe size	
115	Suction strainer mesh size	Bidder to select the suitable mesh size of the screen for strainer based on the actual pump clearances.	
116	Free flow area of the strainer element	4 times the BHEL inlet pipe area	
117	Strainer pressure drop	0.15 Kg/cm2 in 50% clogged conditions @ rated condition & 0.11 Kg/cm2 in 50% clogged conditions @ condition-2	
118	IBR certification	IBR certification is required for Strainer	
119	Provision for VMS items	As per clause 4.0.12 of specification PYAS4M095836001	
120	Bearing & winding instruments & JB for Pumps , Motors, Gear Box & Hydraulic coupling	As per clause 4.0.13 of specification PYAS4M095836001	
121	Casing skin temperature monitoring system	As per clause 4.0.13.7 of specification PYAS4M095836001	
122	Warm up arrangemet	Bidder shall provide suitable hardware (i.e. piping, valves & fittings) & as part of the operating manual a suitable startup procedure shall be provided.	
123	Dry critical speed (rpm)	During detailed engineering Stage	
124	Wet critical speed (rpm)	During detailed engineering Stage	
Drive Motor details			
125	BKW at the rated point		
126	BKW at end of curve		
127	Selected drive rating, KW	Duly meeting clause no 6.1 of Annexure-13F	
Other Details			
128	Performance test standard & tolerance	As per clause no 8.3.0 of specification PYAS4M095836001	
129	Noise level	85 dBA at a distance of 1.0 m	
130	Maximum vibration level at all operating conditions		
131	Maximum Allowed Working Pressure (MAWP) Kg/cm2 g	Maximum allowable working pressure & temperature of the equipment shall not be less than the design pressure & temperature specified in the data sheet nor less than those specified in specifications, codes & standards. The pump casing shall also be suitable for operation at max. discharge pressure developed at pump minimum flow with sp. Gr. 1.0(i.e. water), this is required during shop performance test with water at rated speed.	

132	Hydraulic test pressure of casing Kg/cm²(g)	1.5XMAWP	
133	Pump Suction nozzle - Size - Rating - Standard - Facing - Location		
134	Pump Discharge nozzle - Size - Rating - Standard - Facing - Location		
135	ARC valve inlet/outlet/recirculation sizes - Size - Rating - Standard - Facing - Location		
136	BLO nozzle - Size - Rating - Standard - Facing - Location		
137	Pump Cooling water inlet/outlet sizes - Size - Rating - Standard - Facing - Location		
138	LO Skid Cooling water inlet/outlet sizes(if applicable) - Size - Rating - Standard - Facing - Location		
139	For BHEL Pipe sizes & other terminal point details please refer Annexure-1B		

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-3

Motor Datasheet

Not applicable. Motor is excluded from bidder scope of supply

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-4

Price Bid Format

	BHARAT HEAVY ELECTRICALS LIMITED **R.C.PURAM, HYDERABAD-502032**				
	PROJECT ENGINEERING & SYSTEMS DIVISION				
	PRICE FORMAT (R00) FOR VHP BFP ASSEMBLY WITH ELECTRIC MOTOR DRIVE **CUSTOMER: RAMAGUNDAM FERTILIZERS AND CHEMICALS LIMITED** **PROJECT: STEAM AND POWER GENERATION PACKAGE FOR REVIVAL OF RAMAGUNDAM FERTILIZER COMPLEX (1X32.5 GTG + 1X125 TPH HRSG + 1X85 TPH UB)** **CONSULTANT:ENGINEERS INDIA LIMITED (EIL), NEW DELHI**				
SL NO	ITEM DESCRIPTION	QTY	UNIT	UNIT RATE (RS.)	TOTAL (RS.)
	Bidder's Name : <Bidder to indicate> **Bidder's Offer No. & Dt. : <Bidder to indicate>** **Bidder's Ref No. & Dt. :<Bidder to indicate>** **BHEL Enq. No. & date :<Bidder to indicate>**				
I	**MAIN OFFER** **[Note:Prices for individual items to be quoted as indicated in the price bid format.]**				
A	**MATERIAL SUPPLY: BFP WITH DRIVE ASSEMBLY**				
A.1	Horizontal, centrifugal, multi stage, Barrel casing design pump complete with all accessories as per specification.	3	Set		
A.2	**Commissioning spares**				
	Commissioning spares as per manufacturer's recommendation. Minimum 1 Set of O rings & gaskets for each pump & drive assembly, and 1 sets of spare strainer elements for each pump 1 set stands for requirement for one no. of pump and drive assembly Bidder to furnish the list along with the offer. **(Ref. Note-7)**	3	Set		
A.3	**Special tools & tackles**				
	Special tools & tackles as per manufacture's recommendations. 1 set standas for requirement for each pump, drive and other accessories. Bidder to furnish the list along with offer	1	Set		
A.4	**MANDATORY SPARES:(Ref. Note-8)** **Note:Prices for individual items to be quoted as indicated in the price bid format.**				
	For Pump:				
	a) 1 set of pump element assembly including dynamically balanced rotor	1	Set		
	b) 1 set of mechanical seals (complete cartridge assembly)	1	Set		
	c) 1 set of bearings	1	Set		
	For Gearbox:				
	1 set of bearings	1	Set		
	For Hydraulic coupling & LO skid:				
	a) 1 set of bearings	1	Set		
	b) Gaskets: 400% of total installed qualtity [for all the 3 skids part of vendor scope of supply]	400%			
	c) Bolting (stud & nuts): 20% (Minimum 4 sets) of total installed qualtity [for all the 3 skids part of vendor scope of supply]	20% (Minimum 4 sets)			
	d) Lamiflex sealing strips: 100% of total installed qualtity [for all the 3 skids part of vendor scope of supply]	100%			
	e) Ferrules: 20% of total installed qualtity [for all the 3 skids part of vendor scope of supply]	20%			
	For Coupling:				
	1 set of Coupling Shim Membranes of each type.	1	Set		

	BHARAT HEAVY ELECTRICALS LIMITED **R.C.PURAM, HYDERABAD-502032**				
	PROJECT ENGINEERING & SYSTEMS DIVISION				
	PRICE FORMAT (R00) FOR VHP BFP ASSEMBLY WITH ELECTRIC MOTOR DRIVE **CUSTOMER: RAMAGUNDAM FERTILIZERS AND CHEMICALS LIMITED** **PROJECT: STEAM AND POWER GENERATION PACKAGE FOR REVIVAL OF RAMAGUNDAM FERTILIZER COMPLEX (1X32.5 GTG + 1X125 TPH HRSG + 1X85 TPH UB)** **CONSULTANT:ENGINEERS INDIA LIMITED (EIL), NEW DELHI**				
SL NO	ITEM DESCRIPTION	QTY	UNIT	UNIT RATE (RS.)	TOTAL (RS.)
	Bidder's Name : <Bidder to indicate> **Bidder's Offer No. & Dt. : <Bidder to indicate>** **Bidder's Ref No. & Dt. :<Bidder to indicate>** **BHEL Enq. No. & date :<Bidder to indicate>**				
	For Instrumentation:				
	a) Higher of 10% or minimum one of each type (range, type, material and rating) of complete instruments [for all the 3 skids part of vendor scope of supply] such as Pressure Gauges, Differential pressure gauges, Temperature Gauges, Draft Gauge, Field Indicators, Thermocouple (with Thermowell), Thermowells, speed probes/transmitters, Machine monitoring probes/ transmitters/extension cables etc.	Higher of 10% or minimum one of each type			
	b) Higher of 10% or minimum one of each type (range, type, material and rating) of complete instruments [for all the 3 skids part of vendor scope of supply] such as Transmitters for Pressure, Level (DP type), Flow (DP type), Temperature & Differential Pressure and Field Indicators etc.	Higher of 10% or minimum one of each type			
	c) Pressure safety Valves [for all the 3 skid part of vendor scope of supply]: 10% of quantity subject to minimum 1 No. of each type for the following items: i) Gasket ii) O-ring iii) Seal-ring iv) Packings	10% of quantity subject to minimum 1 No. of each type			
II	**Optional Items**	--	--		
A.1	**Supervison charges for erection & commissioning at site**	--	--		
a	Travel expenses from vendor works to site and back per visit /person	--	--		
b	Per day charges per person for supervision of erection & commissioning at site including boarding, lodging, lcoal transportation etc., except for travel expenses as above	--	--		
A.2	**2 Years Recommended Spares**				
	Recommended spares list for two years normal operation along with unit price breakup for Pump, Drive & other accessories. **(List with price break up to be enclosed)** (1 set stands for quantity required for the replacement of one pump, drive (or) accessories)	As per List	Set		
	TOTAL				
III TAXES AND DUTIES: **(Packing and Forwarding, Frieght, Insurance, Taxes & Duties as applicable to be quoted below separately for both Supply and E&C)**					
(A) For Supply:					
(i) Packing & Forwarding :					
(ii) Frieght:					
(iii) Insurance:					
(iv) Taxes and Duties					
(v) Any other:					
(B) For E&C:					
(i) Service Tax:					

	BHARAT HEAVY ELECTRICALS LIMITED **R.C.PURAM, HYDERABAD-502032**				
	PROJECT ENGINEERING & SYSTEMS DIVISION				
	PRICE FORMAT (R00) FOR VHP BFP ASSEMBLY WITH ELECTRIC MOTOR DRIVE **CUSTOMER: RAMAGUNDAM FERTILIZERS AND CHEMICALS LIMITED** **PROJECT: STEAM AND POWER GENERATION PACKAGE FOR REVIVAL OF RAMAGUNDAM FERTILIZER COMPLEX (1X32.5 GTG + 1X125 TPH HRSG + 1X85 TPH UB)** **CONSULTANT:ENGINEERS INDIA LIMITED (EIL), NEW DELHI**				
SL NO	ITEM DESCRIPTION	QTY	UNIT	UNIT RATE (RS.)	TOTAL (RS.)
	Bidder's Name : <Bidder to indicate> **Bidder's Offer No. & Dt. : <Bidder to indicate>** **Bidder's Ref No. & Dt. :<Bidder to indicate>** **BHEL Enq. No. & date :<Bidder to indicate>**				

(ii) Any other:

Notes:

1) Bidder to quote strictly as per BHEL's NIT requirements.

2) Bidder to note that this is a LUMP SUM Turn-Key Order. However
(a) Changes to the tender specification during execution of the project for successful operation of the system need to be carried out by bidder and commercial implications if any will be settled suitably.
(b) Unit rates quoted by bidder shall be applicable for any changes in BOQ during detailed engineering stage.

3) **Main offer** consists of those items which will be part of main order after successful bidder is identified. **Optional Items** consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under **Main offe**r and **Optional items** as per the prescribed format.

4) Prices quoted by bidders for items under **main offer : Sl. No. I** will be considered for evaluation of lowest bidder.However, BHEL reserves the right
(a) To include any of the optional items in scope of supply (as per customer contract requirements) and accordingly consider the same in evaluation. Any such scope increase and change in evalution will be intimated to vendor during technical evaluation(before price bid opening).
(b) To place PO for any of the Optional items with in the contract period.
Hence bidders need to mandatorily quote reasonable prices for all optional items considering such requirement and keep the validity of the prices till the end of contract period.

5.a) For all items including Optional items, prices to be furnished in this prescribed price bid format only for each individual item. No combined prices, common prices or any other format will be accepted and such bids may be liable for rejection.
5.b) Bidder must not change the indicated item description, quantity & units in the price bid format. Bidder should only fill the unit rates & total price.
5.c) Bidder to quote for all the items as per price bid format. Incomplete/partial offer may be liable for rejection.

6) Bidder to quote the base rates only. All other commercial charges for packing, freight, transportation, insurance, taxes & duties etc., shall be indicated separately.

7 a.) Commissioning spares are those spares which are required at the time of commissioning and shall be recommended(as per bidders experience) and quoted by bidder. However commissioning spares indicated in the price bid format shall be quoted as minimum.
7.b) Commissioning spare consumed over and above the recommended commisioning spares, during commissioning shall be supplied free of cost by the equipment vendor.

8)With respect to Mandatory Spares;
A) If any of above items indicated by the specified name are not applicable, bidder to offer alternative item serving the same function as per equipment's design and indicate below the item being replaced.
B) If bidder is not able to meet the above note, then bidder may mention "Not Applicable". However, if found applicable during detailed engg. stage or alternative item as per equipment design can serve the same function, bidder to supply the specified quantity with out any delivery and commercial implications to BHEL.

9) Reference document: PY51272,Rev 00 , BHEL spec no. **PYAS4M095836001 Rev. 00** & annexures.

10) Unpriced price bid format indicating as quoted against each applicable item shall be submitted duly signed & stamped along with technical offer by bidder as a token of concurrence that prices are submitted in this format only. The offer shall be liable for rejection in case if un-priced price bid format is not submitted or any modification is carried out in price bid format.

11) **In case the systems are being supplied from outside India**, reputed Third Party Inspection like Llyods or equivalent has to be considered and the charges should be included in the Main offer. For those bidders who are supplying from India, such third party inspection charges need not be considered and same will be arranged by BHEL/BHEL nominated inspection agency.

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-5

Check List

Bidder's reply/ confirmation as furnished in this annexure shall supersede the stipulations mentioned elsewhere in their bid.

DESCRIPTION	BIDDER'S REPLY/
Bidder to confirm that Performance requirement, Design and construction of the Pump shall as per API 610 10th Edn & applicable BHEL & EIL specifications.	
Bidder to confirm to the scope of supply as per clause no 4.0.0 of BHEL specification PYAS4M095836001.	
Bidder to confirm that all the Suitable reducers/expanders, Flanges & counter flanges along with gaskets & stud nuts at all the terminal point shall be in their scope.	
Bidder to furnish duly filled Pump datasheet.	
Bidder to furnish Reference list/Equipment Qualification criteria as per clause no 7.0.0 of BHEL specification PYAS4M095836001. Bidder to furnish dully filled in proforma as per Annexure-8.	
Motor rating shall be limited within 1600 kW. Motor rating more than 1600 kW is not acceptable. Pl confirm	
Auxiliary power [Input power to Motor] shall be limited to 820 kW [inclusive of all losses such as Gear Box loss, Hydraulic coupling loss, loss due to motor in efficiency etc] at guaranteed condition ie 116 m3/hr @ 1442 mlc. Auxiliary power above 820 kW @ guaranteed condition is not acceptable. Pl confirm	
If bidder can meet aux power without speed reduction, then hydraulic coupling is not mandatory. Pl confirm applicability	
Bidder to furnish a list of commissioning spares. (Refer Cl no 4.0.19 of BHEL specification PYAS4M095836001.	
Bidder to furnish a list of special tools & tackles. (Refer Cl no 4.0.28 of of BHEL specification PYAS4M095836001.	
Bidder's confirmation required for furnishing a list of 2 year recommended spares in their offer separately with optional price as per 6.0.0 of BHEL specification PYAS4M095836001.	
Bidder to highlight specific comments on the inspection requirements wrt scope of supply. (Refer Cl no 8.0.0 of of BHEL specification PYAS4M095836001.)	
Confirm that all Inspection & acceptance, type Tests as required for each equipment, as per specification and Codes attached.	
Bidder to highlight any deviation wrt the sub vendor list with proper justification. (Refer Cl no 11.0.0 of of BHEL specification PYAS4M095836001.)	
Confirm that all rotating equipment shall be procured from the approved vendors listed in the bid package. [Refer Annexure-9]. Sub vendor list furnished by the bidder shall be ignored by us.	
Bidder to check the master document list and submit all the required documents as per the master document list (Annexure-10) without fail and take the approval of BHEL/EIL.	
Bidders to comment on the instrumentation requirement as per P&ID (Annexure -1) based on their experience. If any other instruments are required as per good engg practice, bidder to highlight the same.	
Deviation list to the specification. Deviations Bidders to furnish deviations [if any] only as per the format enclosed as annexure-11. Any deviations in the scope of supply, works and specifications if listed elsewhere shall be neither be reviewed nor accepted. Bidder to categorically confirm this. All other requirements except for the deviation brought out under deviation list, have been taken into consideration. Pl confirm	
Bidder to quote as per BHEL price format only. Price quoted as per the price bid format, clearly indicating all the applicable items are quoted, and not applicable items are clearly highlighted. Un priced copy of the same is enclosed. [Refer Annexure-4]	
Bidder to quote individual price for each item mentioned in the seal priced bid. Bidder to confirm the same.	

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

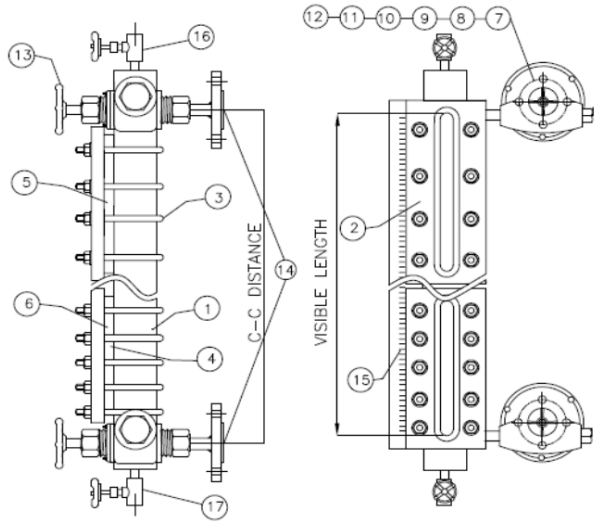
Annexure-6

C&I Specification

HYDERABAD	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	Doc No:LG-RFCL-DS-01 REV. 00

DATA SHEET for REFLEX type LEVEL GAUGE (SIDE MOUNTED)

GENERAL	1	Range & Qty.	Skid vendor to decide	ACCESSORIES	11	Vent & Drain needle valve	2 No's; MOC: SS316; Size : ½" NPT(F)
	2	Type	Field mounted, Weather proof to IP 65		12	Tag Plate	Required, SS 316
	3	Ambient Temp Limit	0 to 50°C and 95% RH max; suitable for tropical climate, ambient of Ammonia & Sulphur; Copper and copper alloys shall be avoided for all the parts exposed to atmosphere.		13	Bolts + Nuts	Required. A193GrB7 + A194Gr2H
					14		
					15		
LEVEL GAUGE	4	Type	Reflex type		16		
	5	Body material	SS 316		17		
	6	Cover plate	Carbon steel		18		
	7	Glass	Toughened Boroslicate (Klinger/Moxos/Bont)				
	8	Gauge Valves	Required at top & bottom of gauge with auto shutoff ball check arrangement				
	9	Minimum Visible length	Shall be intimated after P.O. placement.	TEST REPORT/CERTIFICATE	19	Bill of Material (model, dim., Ta	100% Witness
	10	Hydraulic test pressure	For services rated ANSI #300 : 77 kg/cm2(g) at room temp		20	Spares (BOM, part no's)	100% Witness (if ordered)
			For services rated ANSI #600 : 150 kg/cm2(g) at room temp		21	Material compliance certificate	100% Review
			For services rated ANSI #1500 : 370 kg/cm2(g) at room temp		22	Hydraulic test	100% Review
					23	Radiography for weld joints	100% Review
					24	IBR in Form IIIC (if applicable)	100% Review
					25	Ingress Protection Test	100% Review
					26		



BILL OF MATERIAL

S.NO.	DESCRIPTION	MATERIAL
1	CHAMBER	S.S-316
2	COVER PLATE	S.S-316
3	'U' BOLTS/NUTS	ASTM A193 Gr.-B7/A194 Gr.2H
4	GASKET	NON ASBESTOS
5	CUSHION	NON ASBESTOS
6	GLASS	TOUGHENED BOROSILICATE
7	VALVE BODY	S.S-316
8	VALVE BONNET	S.S-316
9	SPINDLE (TRIM)	S.S-316
10	BALL CHECK	S.S-316
11	RENEWABLE SEAT	S.S-316
12	VALVE PACKING	GRAFOIL
13	HAND WHEEL	C.S
14	PROCESS CONN. (1"X300# RF)	S.S-316
15	SCALE	S.S-304
16	VENT NEEDLE VALVE 1/2" NPT(F)	S.S-316
17	DRAIN NEEDLE VALVE 1/2" NPT (F)	S.S-316

HYDERABAD	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	Doc. No:PG-RFCL-DS-01 REV. 00

Pressure Gauge (PG) Technical Data Sheet

GENERAL	1	Range & Qty.	Skid vendor to decide	MATERIAL	20	Hazardous area class	Zone-1, IIA/IIB, T3.
	2	Type	Surface mount /Local Gauge		21	Case Material	SS304
	3	Ambient Temp Limit	0 to 65°C		22	Element Material	SS316
					23	Window Glass	Shatter Proof.
GAUGE SPECIFICATION	4	Sensor Type	Bourdon Tube		24	Pointer	Alluminium.
	5	Dial Size	150MM (6")		25	Blow out Disc	SS 304
	6	Accuracy	±1% of URV		26	Tag Plate	Reqd, SS 304
	7	Process Connection	1/2" NPT (M), Bottom entry.		27	Bezel ring	SS 304
	8	Blow out Disc	Required.		28	Movement	SS 304
	9	Solid Front Case	Required for ranges > 60Kg/Cm2.		29	Socket Material	SS 304
	10	Over Range Protection	> 130% of full scale.	CERTIFICATE	30	Calibration	100% Review
	11	Protection	IP 65		31	Vibration test	100% Review
	12	Zero & Span adjustment	External Required.		32	Material compliance	100% Review
	13	Anti-corrossive Dial	Non-Rusting Plastic, White with black figure		33	Ingress prot. Test	100% Review
	14	Micro meter Adjustment	Required for pointers.				
	15	Scale type	Concentric, Graduated units	TESTS	34	Calibration	10% or min. 2 of each range
	16	Pointer-270^{O} Deflection	Yes, Metal with Black Finish		35	Over Protection Test for 30 min.	10% or min. 2 of each range
	17	Pointer Stop	Required at both end				
	18	Bezel ring	Bayonet Lock Type		36	Accuracy Test	10% or min. 2 of each range
	19	Movement	Geared / Cam-roller type				

NOTES:

1 The elastic element material shall be as follows:

a) For range ≤ 60 Kg/cm2- AISI-316 seamless drawn stainless steel tube, argon arc welded at AISI-316 forged or wrought stain less steel tube anchorage and tube end piece.

b) For range > 60 Kg/cm2 - AISI-316 bored stainless steel.

HYDERABAD	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	Doc No:LT(G-R)-RFCL-DS-01 REV. 00

Radar (Guided Wave Type) Level Transmitter (LT) Technical Data Sheet

GENERAL	1	Range & Qty.	As per skids	ACCESSORIES	26	Mounting Bracket	For 2" pipe mounting, SS304
	2	Transmitter Type	Guided wave, HART, Ex-proof & intrinsic safe EX 'i" type.		27	U Clamp+Fastner	Reqd, SS 304
	3	Principle of Sensor	Vendor Std.(Pulse/Freq)		28	Cable Glands	2 No's SS Double Compression+Flameproof
	4	Ambient Temp Limit	- 40 to 80°C		29	Cable entry Plugs	Reqd, SS 304 (1 No)
	5	Measuring Media	As per skids		30	Tag Plate	Reqd, SS 304 (1 No)
SENSOR	6	Type of Detector	Vendor to select.		31	Bolts + Nuts	Reqd. A193GrB7 + A194Gr2H
	7	Max Press / Temp	As per skids		32	Gasket	SS 316, Spiral wound type.
					33	**FRP canopy**	**1 No per transmitter**
TRANSMITTER	8	Accuracy	± 3mm (OR) better	TEST REPORT/CERTIFICATE	34	5-Point Calibration	100% Review
	9	Process Connection	Vendor to select.; Flange rating shall be 300#RF minimum		35	Material compliance	100% Review
	10	Electrical Connection	2 Nos of 1/2" NPT (F)		36	Functional Test	100% Review
	11	Power Supply	24V DC, Loop Powered, 2 wire		37	Performance Test	100% Review
	12	Mounting	On closed chamber		38	Ingress Prot. Test	100% Review
	13	Protection	IP 65		39	Intrinsic Safety Test	100% Review
	14	Lighting and surge Protection	Required		40	Conformity Test	100% Review
	15	Display	Integral LCD Digital (in Engg Units & in %)				
	16	Load Resistance	600Ω @ 24 VDC				
	17	Output	4-20mA + HART				
	18	Diagnostic Features	Required				
MATERIAL	19	Hazardous area class	Zone-1, IIA/IIB, T3.	PROJECT SPECIFIC	41	Certification	PESO
	20	Sensor Body	SS316		42	StatutoryApprovals	For Transmitters+Glands+Plugs
	21	chamber body	same as tank material		43	Corrosive Protection	Required
	22	Humidity	0 - 100% RH		44		
	23	Sensor O-Ring	Glass-filled PTFE/Teflon				
	24	**Electronic Housing**	**Die-cast Aluminum**				
	25	Flange	SS				

HYDERABAD	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	Doc. No:TG+TW-RFCL-DS-01 REV. 00

Temperature Gauge (TG) With ThermoWell (TW) Technical Data Sheet

GENERAL	1	Range & Qty.	Skid vendor to decide	THERMOWELL	30	TW Const.	Drilled Bar Stock
	2	Type	Surface mount /Local Gauge		31	TW material	SS 316 /446 & Inconel for temp > 600°C
	3	Ambient Temp Limit	- 40 to 80°C		32	Insertion length "U" (Note-1)	To be provided during order execution
					33	Dimension	Tapered from 21mm to 16 mm
					34	Process Conn.	1.5" flanged for services rated ≤ 600 #
GAUGE SPECIFICATION	4	Sensor Type	Bi-Metallic for Temp ≤ 350°C &				2" flanged for services rated > 600 #
			Gas Filled for Temp > 350°C & underground		35	Flange rating	min 300# RF, higher rating as per piping
			locations like sump				class, stub provision as per EIL spec
	5	Dial Size	150MM (6")		36	Flange material	SS 316 (OR) better (suitable to service)
	6	Accuracy	±1% of full scale deflection		37	Instrument connection	½" NPT(F)
	7	Instrument connection	1/2" NPT(M)		38	Bore diameter	Suitable to TG/TE stem dia (i.e. 9MM)
	8	Over Range Protection	> 130% of full scale.	GAUGE TEST	39	Compatibility (TG+TW)	10% or min. 2 of each range / type
	9	Protection	IP 65		40	Functional Test	10% or min. 2 of each range / type
	10	Zero & Span adjustment	External Required.		41	Calibration & Accuracy	10% or min. 2 of each range / type
	11	Anti-corrossive Dial	Non-Rusting Plastic, White with black figure				
	12	Micro meter Adjustment	Required for pointers.				
	13	Scale type	Concentric, Graduated units	GAUGE CERTIFICATE	42	Material compliance	100% Review
	14	Pointer-270° Deflection	Yes,Metal with Black Finish		43	Internal Test Reports	100% Review
	15	Stem outer dia	8 MM		44	Calibration	100% Review
	16	Adjustable, 3-piece union	Required for 150 MM.		45	Functional test	100% Review
	17	Immersion Adjustment	Required, 100mm to 300mm		46	Ingress prot. Test	100% Review
	18	Bezel ring	Bayonet Lock Type		47	Over Temp Stability	100% Review
	19	Movement	Geared / Cam-roller type				
	20	Pointer Stop	Required at both end	WELL TEST	48	Compatibility (TG+TW)	10% or min. 2 of each type
					49	Dimensional Check	10% or min. 2 of each type
					50	Hydrotest	10% or min. 2 of each type
MATERIAL	21	Hazardous area class	Zone-1, IIA/IIB, T3.	WELL CERTIFICATE	51	Material compliance	100% Review
	22	Case	SS304		52	Radiography	100% Review
	23	Stem	SS316		53	Dimensional Check	100% Review
	24	Window Glass	Shatter Proof.		54	Hydrotest	100% Review
	25	Tag Plate	SS 304.		55	Liquidd penetration test	100% Review for weld joints
	26	3 piece Union	SS304		56	IBR Form-IIIC	100% Review
	27	Pointer	Alluminium.		57	PMI test-SS & AS	100% Review
	28	Bezel Ring	SS 304		58	Wake Frequncy calc.	100% Review as per PTC 19.3 TW: 2010
	29	Temperature Bulb	Min. SS 316				

NOTES ::

1) For Vibration services, U length shall be more than 500 mm

HYDERABAD	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	Doc. No:TC+TW-RFCL-DS-01 REV. 00

Thermocouple (T/C) With ThermoWell (TW) Technical Data Sheet

GENERAL	1	Range & Qty.	As per skids	THERMOWELL	29	TW Const.	Drilled Bar Stock
	2	Type	K-Type, Ex-proof & intrinsic safe EX 'i" type.		30	TW material	SS 316 /446 & Inconel for temp > 600°C
	3	Ambient Temp Limit	- 40 to 80°C		31	Insertion length "U"	To be provided during order execution
					32	Dimension	Tapered from 21mm to 16 mm
					33	Process Conn.	1.5" flanged for services rated ≤ 600 #
							2" flanged for services rated > 600 #
					34	Flange rating	min 300# RF, higher rating as per piping
ELEMENT SPECIFICATION	4	Sensor Type	Duplex, Insulated,filled with MgO				class, stub provision as per EIL spec
	5	Leads	Hermitically sealed		35	Flange material	SS 316 (OR) better (suitable to service)
	6	Accuracy	ClassA/Class1 as per IEC751 / 584-2		36	Instrument connection	½" NPT(F)
	7	Instrument connection	1/2" NPT(M)		37	Bore diameter	Suitable to TG/TE stem dia (i.e. 9MM)
	8	Head Type/Connection	Screwed / 1/2" NPT (F)	ELEMENT TEST	38	Compatibility (TG+TW)	10% or min. 2 of each range / type
	9	Protection	IP 65		39	Functional Test	10% or min. 2 of each range / type
	10	Sensor Wire Size	16 AWG		40	Calibration & Accuracy	10% or min. 2 of each range / type
	11	Element outer dia	8 MM				
	12	Element Length	Suitable to reach at bottom of TW	ELEMENT CERTIFICATE	40	Material compliance	100% Review
	13	Hot Junction	Ungrounded		41	Internal Test Reports	100% Review
	14	Terminal Block	Screw Type		42	Calibration	100% Review
	15	Electrical Connection	2 Nos of 1/2" NPT (F)		43	Functional test	100% Review
	16	Immersion Adjustment	Required, 100mm to 300mm		44	Ingress prot. Test	100% Review
	17	Thermoelectric properties	as per ANSI MC 96.1		45	Over Temp Stability	100% Review
					46	StatutoryApprovals	PESO (For Instrumnet+Glands+Plugs)
ACCESSORIES	18	Adjustable, 3-piece union	Required for 150 MM.				
	19	Cable Glands	2 No's SS Double Compression+FlameProof	WELL TEST	47	Compatibility (TG+TW)	10% or min. 2 of each type
	20	Cable entry Plugs	Reqd, SS 304 (1 No)		48	Dimensional Check	10% or min. 2 of each type
	21	Cap Chain	Reqd, SS 304		49	Hydrotest	10% or min. 2 of each type
	22	**FRP canopy**	**1 No per instrument**				
MATERIAL	23	Hazardous area class	Zone-1, IIA/IIB, T3.	WELL CERTIFICATE	50	Material compliance	100% Review
	24	Case	SS304		51	Radiography	100% Review
	25	Sheath	SS316		52	Dimensional Check	100% Review
	26	Head	SS304		53	Hydrotest	100% Review
	27	Terminal Block	Heat Resist Ceramic		54	Liquidd penetration test	100% Review for weld joints
	28	Tag Plate	SS		55	IBR Form-IIIC	100% Review
					56	PMI test-SS & AS	100% Review
					57	Wake Frequncy calc.	100% Review as per PTC 19.3 TW: 2010

NOTES ::

1) For Vibration services, U length shall be more than 500 mm

HYDERABAD	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	Doc. No:DPT-RFCL-DS-01 REV. 00

Differential Pressure Transmitter (DPT) Technical Data Sheet

GENERAL	1	Range & Qty.	Skid vendor to decide	ACCESSORIES	28	Mounting Bracket	Reqd, For 2" pipe mounting, SS304
	2	Type	Electronic Smart, Ex-proof & intrinsic safe EX 'i" type		29	U Clamp+Fastner	Reqd, SS 304
	3	Principle of Sensor	Vendor Std.,		30	Cable Glands	2 No's SS Double Compression+Flameproof
	4	Ambient Temp Limit	- 40 to 80°C		31	Cable entry Plugs	Reqd, SS 304 (1 No)
	5	Process Temp. Limit	- 40 to 120°C		32	Vent/Drain Plugs	Reqd, SS 304 (1 No)
SENSOR	6	Accuracy	For a rangeability of 1:10		33	Tag Plate	Reqd, SS 304 (1 No)
			a) Equal or Above 760 mmWC: ± 0.075 %		34	Bolts + Nuts	Reqd. A193GrB7 + A194Gr2H
			b) Less than 760 mmWC: ± 0.15 %		35	**FRP canopy**	**1 No per instrument**
	7	Response Time	As per OEM recommendation				
	8	Stability	As per OEM recommendation				
TRANSMITTER	9	Turn Down Ratio	As per OEM recommendation	TEST REPORT/CERTIFICATE	36	5-Point Calibration	100% Review
	10	Process Connection	1/2" NPT (F)		37	Hydro test	100% Review
	11	Electrical Connection	2 Nos of 1/2" NPT (F)		38	Material compliance	100% Review
	12	Power Supply	24V DC, Loop Powered		39	Functional Test	100% Review
	13	Over Range Protection	> 130% of range.		40	Performance Test	100% Review
	14	Protection	IP 65		41	Ingress Prot. Test	100% Review
	15	Zero & Span adjustment	Required.		42	Intrinsic Safety Test	100% Review
	16	Display	Integral LCD Digital (in Engg Units & in %).		43	Conformity Test	100% Review
	17	Impulse Entry	As per OEM recommendation		44	Internal tests (like IR etc.	100% Review
	18	Load Resistance	600Ω @ 24 VDC				
	19	Output	4-20mA + HART				
	20	Diagnostic Features	Required.				
MATERIAL	21	Hazardous area class	Zone-1, IIA/IIB, T3.	PROJECT SPECIFIC	45	Certification	As per OEM recommendation
	22	Body	SS316		46	Compartments	Dual
	23	Element	SS316		47	Manifold Type	Non-Coplanar, Integral 5-Way, 1/2" NPT(F), SS 316
	24	Sensor O-Ring	Glass-filled PTFE/Teflon		48	StatutoryApprovals	PESO (For Instrumnet+Glands+Plugs)
	25	Electronic Housing	**Die-cast Aluminum**		49	Sensor Type	Non-Inductive type.
	26	Sensor fill fluid	Silicon Oil		50	Corrosive Protection	Required
	27	Humidity	0 - 100% RH		51	Terminal Block type	Integral, Non-fly leads

NOTES:

1 All integral parts of the transmitter shall be suitable for the differential over-range in either direction equal to the full rated pressure of the body with the opposite side vented to atmosphere without permanent distortion or calibration error. For vacuum service, the element shall have under-range protection to full vacuum.

2 The square root extraction for the differential pressure based flow measurement shall be carried out in DCS. Transmitter shall indicate both DP & flow values.

HYDERABAD	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	Doc. No:DPG-RFCL-DS-01 REV. 00

Differential Pressure Gauge (DPG) Technical Data Sheet

GENERAL	1	Range & Qty.	Skid vendor to decide	ACCESSORIES	28	Mounting Bracket	Reqd, For 2" pipe mounting, SS304
	2	Type	Bottom entry, 2" Pipe mounting		29	U Clamp+Fastner	Reqd, SS 304
	3	Ambient Temp Limit	0 to 65°C		30	Cable Glands	Not applicable
	4	Static Pressure	Skid vendor to decide		31	Cable entry Plugs	Not applicable
	5				32	Vent/Drain Plugs	Reqd, SS 304 (1 No)
GAUGE	6	Sensing material	Diaphragm in SS 316		33	Tag Plate	Reqd, SS 304 (1 No)
		Dial Size	150MM (6")		34	Bolts + Nuts	Reqd. A193GrB7 + A194Gr2H
		Case & Bezel	SS 304, Bayonet type bezel		35	FRP canopy	Not applicable
	7	Windows	Toughened Glass with rubber ring				
	8	Accuracy	±0.5% of full scale deflection or Better				
	9	Process Connection	1/2" NPT(F)	TEST REPORT/CERTIFICATE	36	Bill of Material (model, d	100% Witness
	10	Blow out Disc	Required.		37	Spares (BOM, part no's)	100% Witness (if ordered)
	11	Over Range Protection	> 130% of full scale.		38	Material compliance cer	100% Review
	12	Ingress Protection	IP 65		39	Calibration	10% witness or min. 2 of each range
	13	Zero & Span adjustment	External Required.		40	Over Protection Test for	10% witness or min. 2 of each range
	14	Anti-corrosive Dial	Non-Rusting Plastic, White with black figure		41	Accuracy Test	10% witness or min. 2 of each range
	15	Micro meter Adjustment	Required for pointers.		42	Vibration test	100% Review
	16	Scale type	Concentric, Graduated units		43	Ingress Protection Test	100% Review
	17	Pointer-270O Deflection	Yes, Metal with Black Finish		44		
	18	Pointer Stop	Required at both end				
	19	Bezel ring	Bayonet Lock Type				
	20	Movement	Geared / Cam-roller type				
MATERIAL	21	Hazardous area class	Zone-1, IIA/IIB, T3.	PROJECT SPECIFIC	45	Certification	As per OEM recommendation
	22	Case Material	SS304		46	Manifold Type	Non-Coplanar, Integral 5-Way, 1/2" NPT(F), SS 316;
	23	Element & Wetted parts	SS316		47	StatutoryApprovals	Not applicable
	24	Windows	Shatter Proof.		48		
	25	Pointer	Aluminum.		49		
	26	Movement	SS 304		50		
	27	Socket Material	SS 316		51		

HYDERABAD	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	Doc. No:PT-RFCL-DS-01 REV. 00

Pressure Transmitter (PT) Technical Data Sheet

GENERAL	1	Range & Qty.	Skid vendor to decide	ACCESSORIES	28	Mounting Bracket	Reqd, For 2" pipe mounting, SS304
	2	Type	Electronic Smart, Ex-proof & intrinsic safe EX 'i" type		29	U Clamp+Fastner	Reqd, SS 304
	3	Principle of Sensor	Vendor Std.,		30	Cable Glands	2 No's SS Double Compression+Flameproof
	4	Ambient Temp Limit	- 40 to 80°C		31	Cable entry Plugs	Reqd, SS 304 (1 No)
	5	Process Temp. Limit	- 40 to 120°C		32	Vent/Drain Plugs	Reqd, SS 304 (1 No)
SENSOR	6	Accuracy	For a rangeability of 1:10		33	Tag Plate	Reqd, SS 304 (1 No)
			a) Equal or Above 760 mmWC: ± 0.075 %		34	Bolts + Nuts	Reqd. A193GrB7 + A194Gr2H
			b) Less than 760 mmWC: ± 0.15 %		35	**FRP canopy**	**1 No per instrument**
	7	Response Time	As per OEM recommendation				
	8	Stability	As per OEM recommendation				
TRANSMITTER	9	Turn Down Ratio	As per OEM recommendation	TEST REPORT/CERTIFICATE	36	5-Point Calibration	100% Review
	10	Process Connection	1/2" NPT (F)		37	Hydro test	100% Review
	11	Electrical Connection	2 Nos of 1/2" NPT (F)		38	Material compliance	100% Review
	12	Power Supply	24V DC, Loop Powered		39	Functional Test	100% Review
	13	Over Range Protection	> 130% of range.		40	Performance Test	100% Review
	14	Protection	IP 65		41	Ingress Prot. Test	100% Review
	15	Zero & Span adjustment	Required.		42	Intrinsic Safety Test	100% Review
	16	Display	Integral LCD Digital (in Engg Units & in %).		43	Conformity Test	100% Review
	17	Impulse Entry	As per OEM recommendation		44	Internal tests (like IR etc.)	100% Review
	18	Load Resistance	600Ω @ 24 VDC				
	19	Output	4-20mA + HART				
	20	Diagnostic Features	Required.				
MATERIAL	21	Hazardous area class	Zone-1, IIA/IIB, T3.	PROJECT SPECIFIC	45	Certification	As per OEM recommendation
	22	Body	SS316		46	Compartments	As per OEM recommendation
	23	Element	SS316		47	Manifold Type	Non-Coplanar, Integral 2-Way, 1/2" NPT(F), SS 316
	24	Sensor O-Ring	Glass-filled PTFE/Teflon		48	Statutory Approvals	PESO (For Instrumnet+Glands+Plugs)
	25	Electronic Housing	**Die-cast Aluminum**		49	Sensor Type	Non-Inductive type.
	26	Sensor fill fluid	Silicon Oil		50	Corrosive Protection	Required
	27	Humidity	0 - 100% RH		51	Terminal Block type	Integral, Non-fly leads

HYDERABAD	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	Doc. No:PT-RFCL-DS-01 REV. 00

Temperature Transmitter (TT) Technical Data Sheet

GENERAL	1	Range & Qty.	Skid vendor to decide	MATERIAL	22	Hazardous area class	Zone-1, IIA/IIB, T3.
	2	Type	Electronic Smart, Ex-proof & intrinsic safe EX 'i" type		23	Humidity	0 - 100% RH
	3	Ambient Temp Limit	- 40 to 75°C		24	Electronic Housing	**Die-cast Aluminum**
					25	Mounting Bracket	Reqd, For 2" pipe mounting, SS304
TRANSMITTER	4	Input	3 wire RTD/Thermocouple (k-type) with dual i/p provision	ACCESSORIES	26	U Clamp+Fastner	Reqd, SS 304
	5	Dual sensor inputs	Bumpless automatic switchover		27	Cable Glands	2 No's SS Double Compression+Flameproof
	6	Accuracy	0.075% of range		28	Cable entry Plugs	Reqd, SS 304 (1 No)
					29	Tag Plate	Reqd, SS 304 (1 No)
					30	Bolts + Nuts	Reqd. A193GrB7 + A194Gr2H
	7	Updated Time	500msec.		31		
	8	Ref. Junction Compensation	Required (automatic for thermocouple sensors).	TEST REPORT/CERTIFICATE	32	5-Point Calibration	100% Review
	9	Burnout protection	Required and selectable UP scale / DOWN scale		33	Material compliance	100% Review
	10	Process Connection	1/2" NPT (F)		34	Functional Test	100% Review
	11	Electrical Connection	2 Nos of 1/2" NPT (F)		35	Performance Test	100% Review
	12	Power Supply	24V DC, Loop Powered		36	Ingress Prot. Test	100% Review
	13	Configuration	By Hand Held Calibrator.		37	Intrinsic Safety Test	100% Review
	14	Surge & Lightening Protection	In built		38	Conformity Test	100% Review
	15	Protection	IP 65		39	Update time test	100% Review
	16	Impulse Entry	Not applicable				
	17	Display	Integral LCD Digital (in Engg Units & in %).	PROJECT SPECIFIC	40	Certification	As per OEM recommendation
	18	Damping	0-32 Sec Adjustable		41	Compartments	Dual
	19	Load Resistance	600Ω @ 24 VDC		42	Statutory Approvals	PESO (For Instrumnet+Glands+Plugs)
	20	Output	4-20mA+HART, Linearised.		43	Corrosive Protection	Reqd.
	21	Diagnostic Features	Required.		44	Terminal Block type	Integral, Non-fly leads

HYDERABAD	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	Doc. No:RTD+TW-RFCL-DS-01 REV. 00

RTD With ThermoWell (TW) Technical Data Sheet [Applicable only for Bearing / winding measurement]

GENERAL	1	Range & Qty.	Skid vendor to decide	THERMOWELL	27	TW Const.	Skid vendor to decide
	2	Type	3-Wire, PT100, Duplex		28	Insertion length "U"	Skid vendor to decide
					29	Dimension	Skid vendor to decide
					30	Process Conn.	Skid vendor to decide
ELEMENT SPECIFICATION	3	Sensor Type	Duplex, Insulated,filled with MgO		31	Flange rating & material	Skid vendor to decide
	4	Leads	Hermitically sealed		32	Instrument connection	½" NPT(F)
	5	Accuracy	As per DIN43760, ClassA / IEC 751		33	Bore diameter	Skid vendor to decide
	6	Instrument connection	1/2" NPT(M)	RTD TEST	34	Compatibility (TG+TW)	10% or min. 2 of each range / type
	7	Head Type/Connection	Screwed / 1/2" NPT (F)		35	Functional Test	10% or min. 2 of each range / type
	8	Protection	IP 65		36	Calibration & Accuracy	10% or min. 2 of each range / type
	9	Sensor Wire Size	1.5 sqmm				
	10	Element outer dia	Skid vendor to decide				
	11	Element Length	Skid vendor to decide	RTD CERTIFICATE	37	Material compliance	100% Review
	12	Hot Junction	Grounded		38	Internal Test Reports	100% Review
	13	Terminal Block	Screw Type		39	Calibration	100% Review
	14	Electrical Connection	2 Nos of 1/2" NPT (F)		40	Functional test	100% Review
	15	Immersion Adjustment	Skid vendor to decide		41	Ingress prot. Test	100% Review
ACCESSORIES	16	Adjustable, 3-piece union	Skid vendor to decide		42	Over Temp Stability	100% Review
	17	Cable Glands	2 No's SS Double Compression+Flameproof		43	StatutoryApprovals	PESO (For Instrumnet+Glands+Plugs)
	18	Cable entry Plugs	Reqd, SS 304	WELL TEST	44	Compatibility (TG+TW)	10% or min. 2 of each type
	19	Cap Chain	Reqd, SS 304		45	Dimensional Check	10% or min. 2 of each type
	20	**FRP canopy**	**1 No per instrument**		46	Hydrotest	10% or min. 2 of each type
MATERIAL	21	Hazardous area class	Zone-1, IIA/IIB, T3.	WELL CERTIFICATE	47	Material compliance	100% Review
	22	Case	SS304		48	Radiography	100% Review
	23	Sheath	SS316		49	Dimensional Check	100% Review
	24	Head	SS304		50	Hydrotest	100% Review
	25	Terminal Block	Heat Resist Ceramic		51	Liquidd penetration test	100% Review for weld joints
	26	Tag Plate	SS		52	IBR Form-IIIC	100% Review
					53	PMI test-SS & AS	100% Review
					54	Wake Frequncy calc.	100% Review as per PTC 19.3 TW: 2010

HYDERABAD		PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD				Doc. No:JB-RFCL-DS-01 REV. 00	
Junction Box (JB) Technical Data Sheet							
GENERAL	1	Range & Qty.	Skid vendor to decide	ACCESSORIES	20	Cable Glands	SS Double Compression+Flameproof
	2	Type	**60 Way, Explosion proof**				**Qty: for all inlet & Outlet entries**
	3	Ambient Temp Limit	- 40 to 80°C		21	Cable entry Plugs	All cable entry with SS 304
							Qty: for all inlet & Outlet entries
JB SPECIFICATION	4	Ingress Protection	IP65		22	Tag Plate	Reqd, SS 304 (1 No per JB)
	5	Fixing type	External Wall mount		23	Gasket	SS 316, Spiral wound type.
	6	Door type	Bolted (self locking Allen screws (SS304) fastene		24	Screws/Hinges	SS
	7	Telephone Socket	Required.		25	Earthing Screws	Internal and external 1 no each with washers
	8	Protection	IP-65		26	**FRP canopy**	**1 No per instrument**
	9	Inlet Cable entries	1/2" NPT - 6 Nos at Right Side		27	**Slipper type PVC hoods**	**Shall be provided for each cable gland**
			1/2" NPT - 6 Nos at Left Side			separate insulated terminal strip	Required for each JB
	10	Outlet Cable entries	1½" NPT x 2 nos at bottom side				
	11	Internal Dimensions	375 x 375 x 200 MM (±10%)	TEST	28	Dimensional Check	10% or min. 2 of each type
	12	Outer Dimensions	400 x 400 x 256 MM (±10%)		29	Inlet & outlet entries size	10% or min. 2 of each type
	13	Terminal size	2.5 Sq.mm, Clip on screw less, 2 Rows		30	Tag Plate Marking	10% or min. 2 of each type
	14	Terminal type	DIN Rail Mount,Stack Type,		31	BOM review	100% witness
	15		Non Double decker.				
	16	Terminal make	Elmex/Connectwell/Phonix/Wago	CERTIFICA	32	Material compliance	100% Review
	17	Hazardous area class	Zone-1, IIA/IIB, T3.		33	PESO certificate	PESO (For Instrumnet+Glands+Plugs)
	18	Painting	Inside: glossy white				
			Outside: IS-5 shade 631	Note::		a) 50 to 60 mm gap between terminals and sides of box parallel to terminal strip for upto 50 terminals and additional 25 mm for each additional 25 terminals. b) 100 to 120 mm between two terminal strips for upto 50 terminals and additional 25mm for each additional 25 terminals. c) Bottom/top of terminal shall not be less than 100 mm from bottom / top of the junction box.	
	19	Body Material	**Die Cast Alluminium, LM-6**				

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. PY-FH-4-M095-9626-01

SH. 01 OF 12

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

COMPUTER FILE NAME

REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

INSTRUMENT INSTALLATION DRAWINGs

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE		

CUSTOMER: RAMAGUNDAM FERTILIZERS AND CHEMICALS LIMITED

CONSULTANT: ENGINEERS INDIA LIMITED (EIL), NEW DELHI
EIL JOB NO : A747

PROJECT: STEAM AND POWER GENERATION PACKAGE FOR REVIVAL OF RAMAGUNDAM FERTILIZER COMPLEX (1X32.5 MW GTG + 1X125 TPH HRSG + 1X85 TPH UB)

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	VINEET		05.04.17	–N.A.–
CHD.	SUJATHA		06.04.17	
APPD.	SEKHAR		07.04.17	

DEPT.	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	~~C/M/F~~	NTS	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 450						

TITLE: INSTRUMENT INSTALLATION DRAWINGs

CARD CODE: N.A.

DRG. NO: PY-FH-4-M095-9626-01 REV. 00

CUST. DRG. NO:

SHT. No 02 NO. OF SHT. 12

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

INDEX

NOTEs::

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

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME

REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE		

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	VINEET		05.04.17	
CHD.	SUJATHA		06.04.17	–N.A.–
APPD.	SEKHAR		07.04.17	

DEPT.	UNTOL. DIMS.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	GR. ~~C/M/F~~		NTS	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 450							

TITLE: INSTRUMENT INSTALLATION DRAWINGs

CARD CODE: N.A.

DRG. NO: PY-FH-4-M095-9626-01

CUST. DRG. NO:

REV. 00

SHT. No 02

NO. OF SHT. 12

FIRST ANGLE PROJECTION

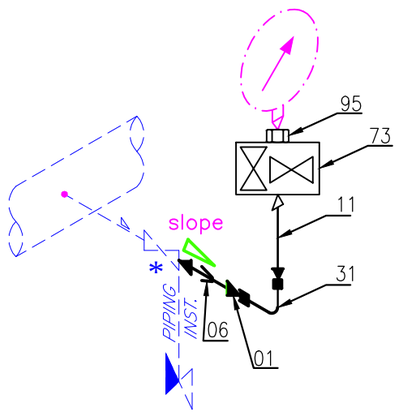
(ALL DIMENSIONS ARE IN mm)

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

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

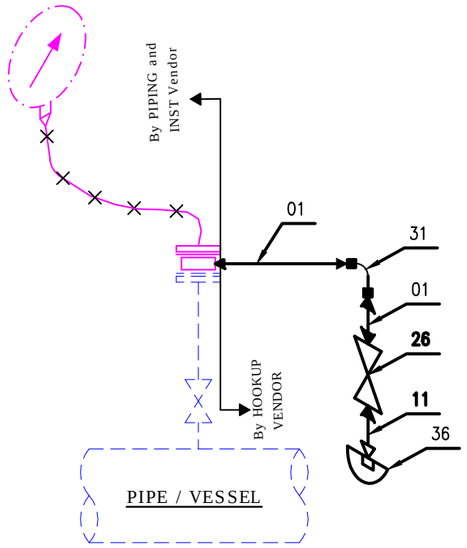
COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

For LIQUID/AIR



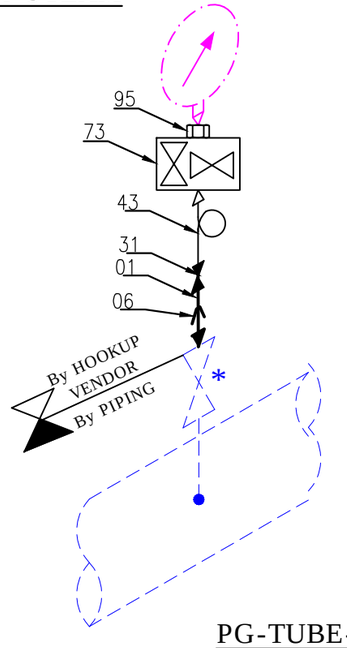
PG-TUBE-L/G

For VISCOUS LIQUIDs / VESSELs



PG/PT-TUBE-V

For STEAM



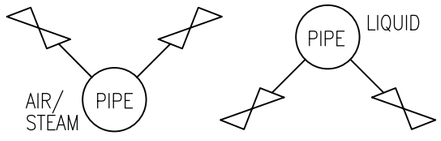
PG-TUBE-S

——— Supply by Hookup vendor

– – – Supply by PIPING agency

——— Supply by INST. vendor

Tapping Orientations



∗-> Double isolation valves shall be provided for High pressure applications.

BOM for Material Code : PY9756xxxxxx; [SCHEME : PG-TUBE-L/G without swagelok]

Pos. No.	DESCRIPTION			QTY/SET	UNITs	IBR in IIIC	Swagelok/ Parker Make
06	REDUCER	SS 316L	3/4" PL x 1/2" PLXPL, SCH160S	1	No's	Required	NO
01	PIPE (SMLS)	SS 316L	1/2" SCH 160S	3	Mtrs	Required	NO
31	ELBOW	SS 316	1/2" SW, CL 6000	1	No's	Required	NO
11	NIPPLE	SS 316L	1/2" PL x NPT(M), SCH 160S	1	No's	Required	NO
73	2 WAY MANIFOLD	SS 316	1/2" NPT(F), CL6000	1	No's	Not required	NO
95	3-piece Union	SS 316	1/2" NPT(M) x 1/2" NPT(F), CL 6000	1	No's	Not required	NO

BOM for Material Code : PY9756xxxxxx; [SCHEME : PG-TUBE-S without swagelok]

Pos. No.	DESCRIPTION			QTY/SET	UNITs	IBR in IIIC	Swagelok/ Parker Make
06	REDUCER	SS 316L	3/4" PL x 1/2" PLXPL, SCH160S	1	No's	Required	NO
01	PIPE (SMLS)	SS 316L	1/2" SCH 160S	3	Mtrs	Required	NO
31	ELBOW	SS 316	1/2" SW, CL 6000	1	No's	Required	NO
43	SYPHON	SS 316	1/2" PL x NPT(M), SCH 160S	1	No's	Required	NO
73	2 WAY MANIFOLD	SS 316	1/2" NPT(F), CL6000	1	No's	Not required	NO
95	3-piece Union	SS 316	1/2" NPT(M) x 1/2" NPT(F), CL 6000	1	No's	Not required	NO

BOM for Material Code : PY9756xxxxxx; [SCHEME : PG/PT-TUBE-V without swagelok]

Pos. No.	DESCRIPTION			QTY/SET	UNITs	IBR in IIIC	Swagelok/ Parker Make
01	PIPE (SMLS)	SS 316L	1/2" SCH 80S	3	Mtrs	Not required	NO
11	NIPPLE	SS 316L	1/2" PL x NPT(M), SCH 80S	1	No's	Not required	NO
26	GLOBE VALVE	SS 316	1/2" SW, CL 800	1	No's	Not required	NO
31	ELBOW	SS 316	1/2" SW, CL 3000	1	No's	Not required	NO
36	CAP	SS 316	1/2" NPT(F), CL 3000	1	No's	Not required	NO

NOTEs ::

(1) All the hookup items shall be supplied in loose condition.

(2) Welding shall be done at site.

(3) BOM listed above shall be packed each material code wise in ONE packing box except pipe/tubes.

(4) Packing of pipes / tubes shall be as per vendor practice.

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE		

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	VINEET		05.04.17	–N.A.–
CHD.	SUJATHA		06.04.17	
APPD.	SEKHAR		07.04.17	

DEPT.	UNTOL. DIMS. GR.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	~~C/M/F~~		NTS	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 450							

TITLE: INSTRUMENT INSTALLATION DRAWINGs

CARD CODE: N.A.

DRG. NO: PY-FH-4-M095-9626-01 REV. 00

CUST. DRG. NO:

SHT. No 03 NO. OF SHT. 12

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

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

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

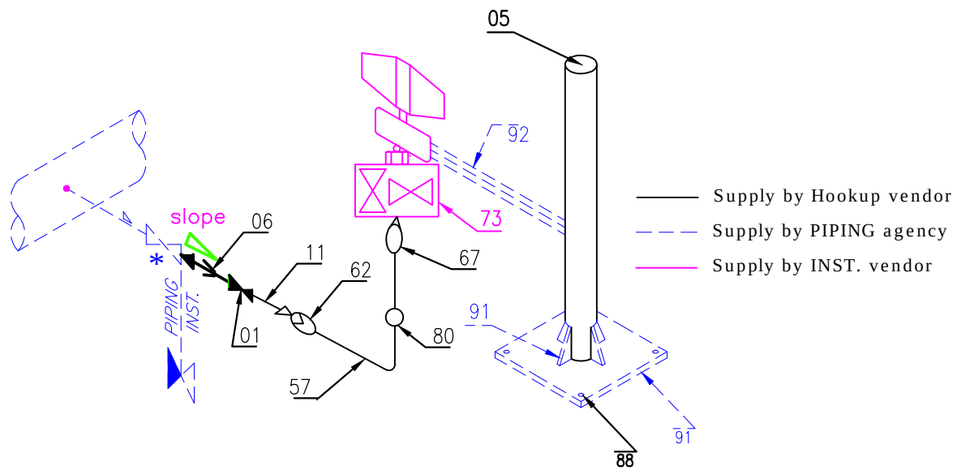
COMPUTER FILE NAME

REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO

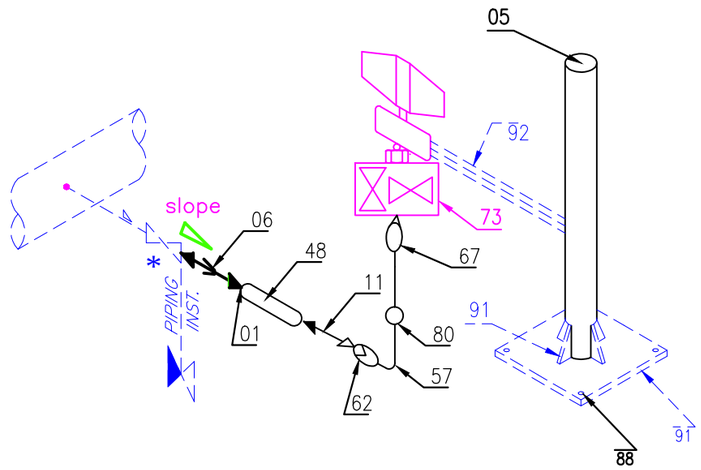
For LIQUID/AIR



PT-TUBE-L/G

*-> Double isolation valves shall be provided for High pressure applications.

For STEAM



PT-TUBE-S

*-> Double isolation valves shall be provided for High pressure applications.

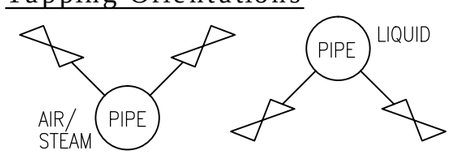
BOM for Material Code : PY9756xxxxxx; [SCHEME : PT TUBE L/G without SWAGELOK]

Pos. No.	DESCRIPTION			QTY/SET	UNITs	IBR in IIIC	Swagelok/ Parker Make
06	REDUCER	SS 316L	3/4" PL x 1/2" PLXPL, SCH160S	1	No's	Required	NO
01	PIPE (SMLS)	SS 316L	1/2" SCH 160S	3	Mtrs	Required	NO
11	NIPPLE	SS 316L	1/2" PL x NPT(M), SCH 160S	1	No's	Required	NO
62	FEMALE CONNECTOR	SS 316	1/2"NPT(F) x 1/2" OD TUBE, CL6000	1	No's	Not required	NO
57	TUBE (SMLS)	SS 316L	1/2" OD X 2.1 mm	12	Mtrs	Not required	NO
80	TUBE UNION	SS 316	1/2" OD, CL6000	1	No's	Not required	NO
67	MALE CONNECTOR	SS 316	1/2"NPT(M) x 1/2" OD TUBE, CL6000	1	No's	Not required	NO
05	PIPE (SMLS)	SA 106 Gr. B	2" SCH 40	1.5	Mtrs	Not required	NO
86	U-BOLT GALVZD	IS 226	1/2"	4	No's	Not required	NO
88	ANCHOR BOLT	Chro coated MS	M10x160mm	4	No's	Not required	NO
73	2 WAY MANIFOLD (BY Transmitter Vendor)			1	No's	Not required	NO
91	STR STEEL MS ANGLE(50x50x6) (BY BHEL PIPING)			2.7012	KG's	Not required	NO
92	STR STEEL 6 mm PLATE (BY BHEL PIPING)			23.55	KG's	Not required	NO

BOM for Material Code : PY9756xxxxxx; [SCHEME : PT-TUBE-S without SWAGELOK]

Pos. No.	DESCRIPTION			QTY/SET	UNITs	IBR in IIIC	Swagelok/ Parker Make
06	REDUCER	A 335 Gr. P91	3/4" PL x 1/2" PLXPL, SCH160	1	No's	Required	NO
04	PIPE (SMLS)	A 335 Gr. P91	1/2" SCH 160	3	Mtrs	Required	NO
48	CONDENSATE POT with Leak-proof Plugs	A 335 Gr. P91	CL 6000, As per fabrication drawing	1	No's	Required	NO
11	NIPPLE	A 335 Gr. P91	1/2" PL x NPT(M), SCH 160	1	No's	Required	NO
62	FEMALE CONNECTOR	SS 316	1/2"NPT(F) x 1/2" OD TUBE, CL6000	1	No's	Not required	NO
57	TUBE (SMLS)	SS 316L	1/2" OD X 2.1 mm	12	Mtrs	Not required	NO
80	TUBE UNION	SS 316	1/2" OD, CL6000	1	No's	Not required	NO
67	MALE CONNECTOR	SS 316	1/2"NPT(M) x 1/2" OD TUBE, CL6000	1	No's	Not required	NO
05	PIPE (SMLS)	SA 106 Gr. B	2" SCH 40	1.5	Mtrs	Not required	NO
86	U-BOLT GALVZD	IS 226	1/2"	4	No's	Not required	NO
88	ANCHOR BOLT	Chro coated MS	M10x160mm	4	No's	Not required	NO
73	2 WAY MANIFOLD (BY Transmitter Vendor)			1	No's	Not required	NO
91	STR STEEL MS ANGLE(50x50x6) (BY BHEL PIPING)			2.7012	KG's	Not required	NO
92	STR STEEL 6 mm PLATE (BY BHEL PIPING)			23.55	KG's	Not required	NO

Tapping Orientations



NOTEs ::

(1) All the hookup items shall be supplied in loose condition.

(2) Welding shall be done at site.

(3) BOM listed above shall be packed each material code wise in ONE packing box except pipe/tubes.

(4) Packing of pipes / tubes shall be as per vendor practice.

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE		

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	VINEET		05.04.17	–N.A.–
CHD.	SUJATHA		06.04.17	
APPD.	SEKHAR		07.04.17	

DEPT.	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	~~C/M/F~~	NTS	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 450						

TITLE: INSTRUMENT INSTALLATION DRAWINGs

CARD CODE: N.A.

DRG. NO: PY-FH-4-M095-9626-01 REV.

CUST. DRG. NO: 00

SHT. No 04 NO. OF SHT. 12

FIRST ANGLE PROJECTION

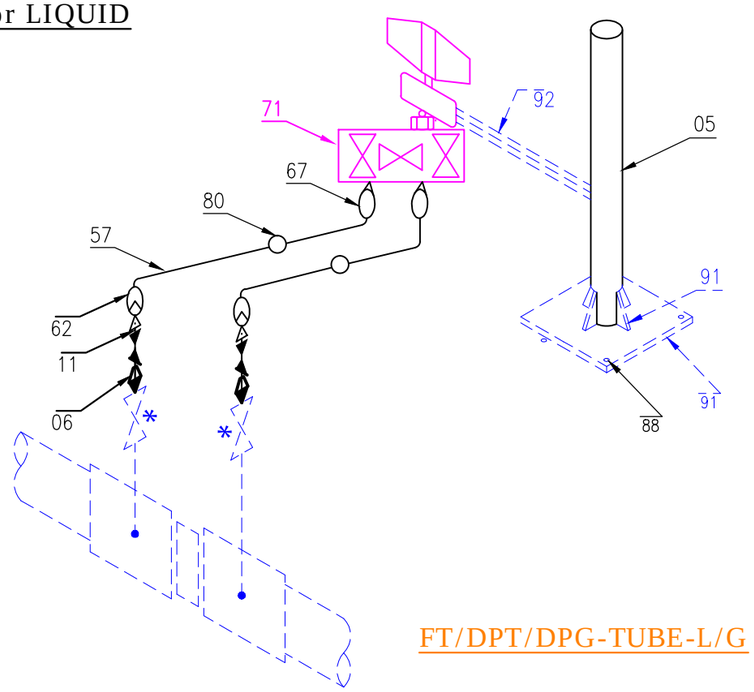
(ALL DIMENSIONS ARE IN mm)

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

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

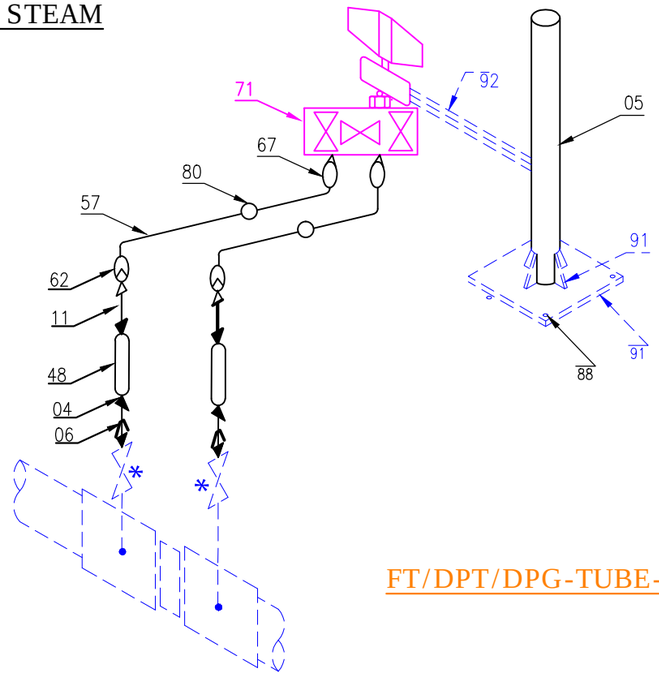
COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

For LIQUID



FT/DPT/DPG-TUBE-L/G

For STEAM



FT/DPT/DPG-TUBE-S

Supply by Hookup vendor

Supply by BHEL PIPING

Supply by INST. vendor

* -> Root Valves for Flow transmitters shall be supplied along with Orifice / Nozzle assemblies

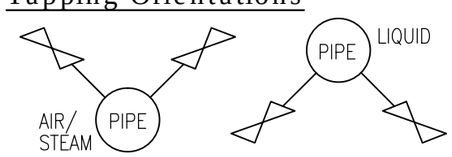
BOM for Material Code : PY9756xxxxxx; [SCHEME : FT/DPT-TUBE-L/G without SWAGELOK]

Pos. No.	DESCRIPTION			QTY/SET	UNITs	IBR in IIIC	Swagelok/ Parker Make
06	REDUCER	SS 316	3/4" PL x 1/2" PLXPL, SCH 160S	2	No's	Required	NO
11	NIPPLE	SS 316L	1/2" PL x NPT(M), SCH 160S	2	No's	Required	NO
62	FEMALE CONNECTOR	SS 316	1/2"NPT(F) x 1/2" OD TUBE, CL6000	2	No's	Not required	NO
57	TUBE (SMLS)	SS 316L	1/2" OD X 2.1 mm	24	Mtrs	Not required	NO
80	TUBE UNION	SS 316	1/2" OD, CL 6000	2	No's	Not required	NO
67	MALE CONNECTOR	SS 316	1/2"NPT(M) x 1/2" OD TUBE, CL6000	2	No's	Not required	NO
05	PIPE (SMLS)	SA 106 Gr. B	2" SCH 40	1.5	Mtrs	Not required	NO
86	U-BOLT GALVZD	IS 226	1/2"	4	No's	Not required	NO
88	ANCHOR BOLT	Chro coated MS	M10x160mm	4	No's	Not required	NO
71	5 WAY MANIFOLD (BY Transmitter Vendor)			1	No's	Not required	NO
91	STR STEEL MS ANGLE(50x50x6) (BY BHEL PIPING)			2.7012	KG's	Not required	NO
92	STR STEEL 6 mm PLATE (BY BHEL PIPING)			23.55	KG's	Not required	NO

BOM for Material Code : PY9756xxxxxx; [SCHEME : FT/DPT TUBE S without SWAGELOK]

Pos. No.	DESCRIPTION			QTY/SET	UNITs	IBR in IIIC	Swagelok/ Parker Make
06	Conc. REDUCER	SA335 Gr. P91	3/4" PL x 1/2" SW, SCH160	2	No's	Required	NO
04	PIPE (SMLS)	SA 335 Gr. P91	1/2" SCH 160	6	Mtrs	Required	NO
48	CONDENSATE POT with Leak-proof Plugs	SA 335 Gr. P91	CL 6000, As per fabrication drawing	2	No's	Required	NO
11	NIPPLE	SS 316L	1/2" PL x NPT(M), SCH 160S	2	No's	Required	NO
62	FEMALE CONNECTOR	SS 316	1/2"NPT(F) x 1/2" OD TUBE, CL6000	2	No's	Not required	NO
57	TUBE (SMLS)	SS 316L	1/2" OD X 2.1 mm	24	Mtrs	Not required	NO
80	TUBE UNION	SS 316	1/2" OD, CL 6000	2	No's	Not required	NO
67	MALE CONNECTOR	SS 316	1/2"NPT(M) x 1/2" OD TUBE, CL6000	2	No's	Not required	NO
05	PIPE (SMLS)	SA 106 Gr. B	2" SCH 40	1.5	Mtrs	Not required	NO
86	U-BOLT GALVZD	IS 226	1/2"	4	No's	Not required	NO
88	ANCHOR BOLT	Chro coated MS	M10x160mm	4	No's	Not required	NO
71	5 WAY MANIFOLD (BY Transmitter Vendor)			1	No's	Not required	NO
91	STR STEEL MS ANGLE(50x50x6) (BY BHEL PIPING)			2.7012	KG's	Not required	NO
92	STR STEEL 6 mm PLATE (BY BHEL PIPING)			23.55	KG's	Not required	NO

Tapping Orientations



NOTEs ::

(1) All the hookup items shall be supplied in loose condition.

(2) Welding shall be done at site.

(3) BOM listed above shall be packed each material code wise in ONE packing box except pipe/tubes.

(4) Packing of pipes / tubes shall be as per vendor practice.

(5) Applicable Tags of above schemes are listed in next pages.

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE		

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	VINEET		05.04.17	
CHD.	SUJATHA	Sujatha	06.04.17	–N.A.–
APPD.	SEKHAR	P.S.L.N. Sekhar	07.04.17	

DEPT.	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	~~C/M/F~~	NTS	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 450						

TITLE: INSTRUMENT INSTALLATION DRAWINGs

CARD CODE: N.A.

DRG. NO: PY-FH-4-M095-9626-01 REV.

CUST. DRG. NO: 00

SHT. No 05 NO. OF SHT. 12

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

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

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

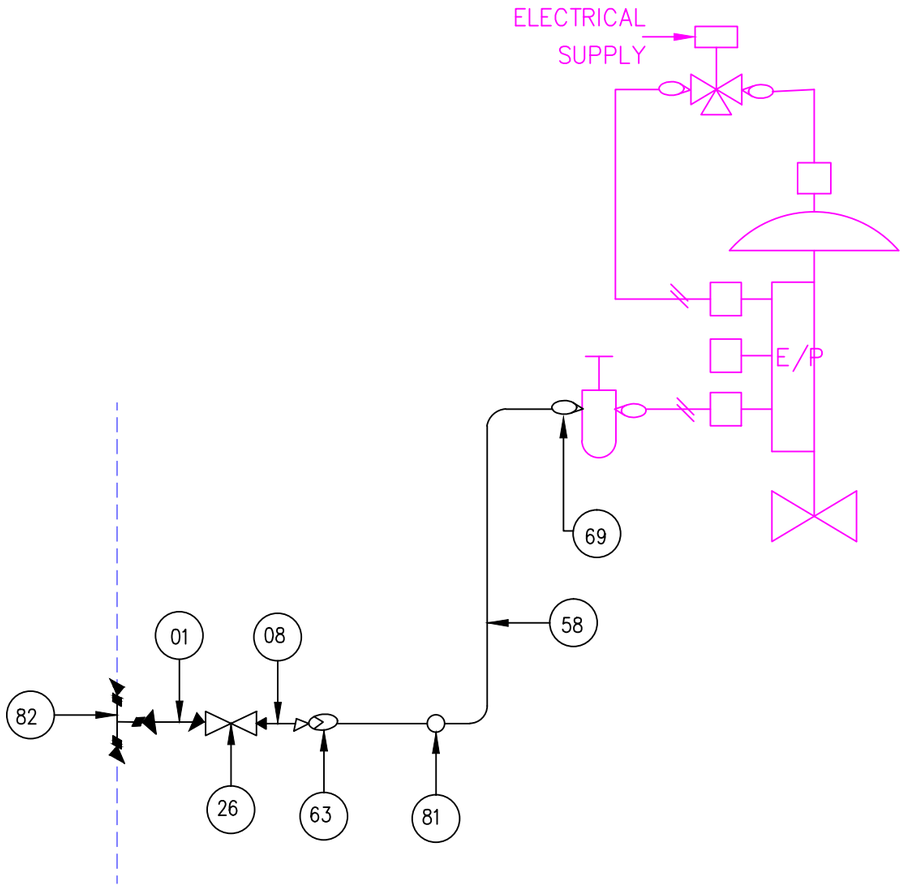
COMPUTER FILE NAME

REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO

Hookup scheme for pneumatic line of E/P Positioner and SOVs



Supply by Hookup vendor

Supply by BHEL PIPING

Supply by INST. vendor

NOTEs ::

(1) All the hookup items shall be supplied in loose condition.

(2) Welding shall be done at site.

(3) BOM listed above shall be packed each material code wise in ONE packing box except pipe/tubes.

(4) Packing of pipes / tubes shall be as per vendor practice.

REV.	DATE	ALTERED	CHD/APPD	REV.	DATE	ALTERED	CHD/APPD	REV.	DATE	ALTERED	CHD/APPD
ZONE				ZONE				ZONE			

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	VINEET		05.04.17	
CHD.	SUJATHA		06.04.17	–N.A.–
APPD.	SEKHAR		07.04.17	

DEPT.	UNTOL. DIMS. GR.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	~~C/M/F~~		NTS	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 450							

TITLE: INSTRUMENT INSTALLATION DRAWINGs

CARD CODE: N.A.

DRG. NO: PY-FH-4-M095-9626-01

CUST. DRG. NO:

REV. 00

SHT. No 06 NO. OF SHT. 12

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

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

COMPUTER FILE NAME

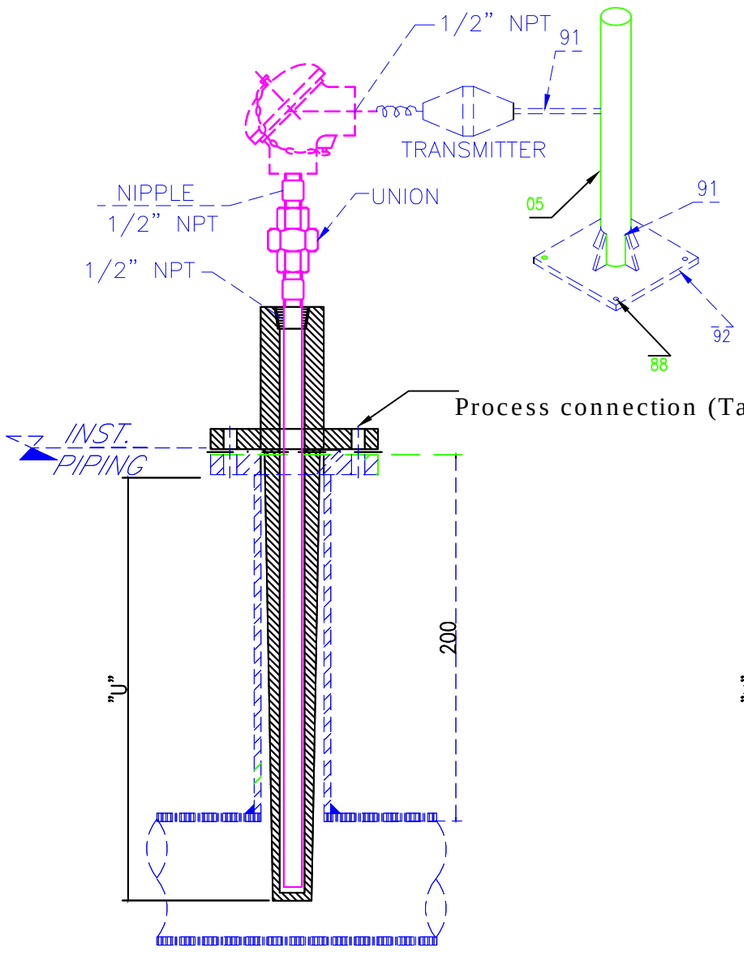
SIGN. AND DATE

REF. DRG. NO.

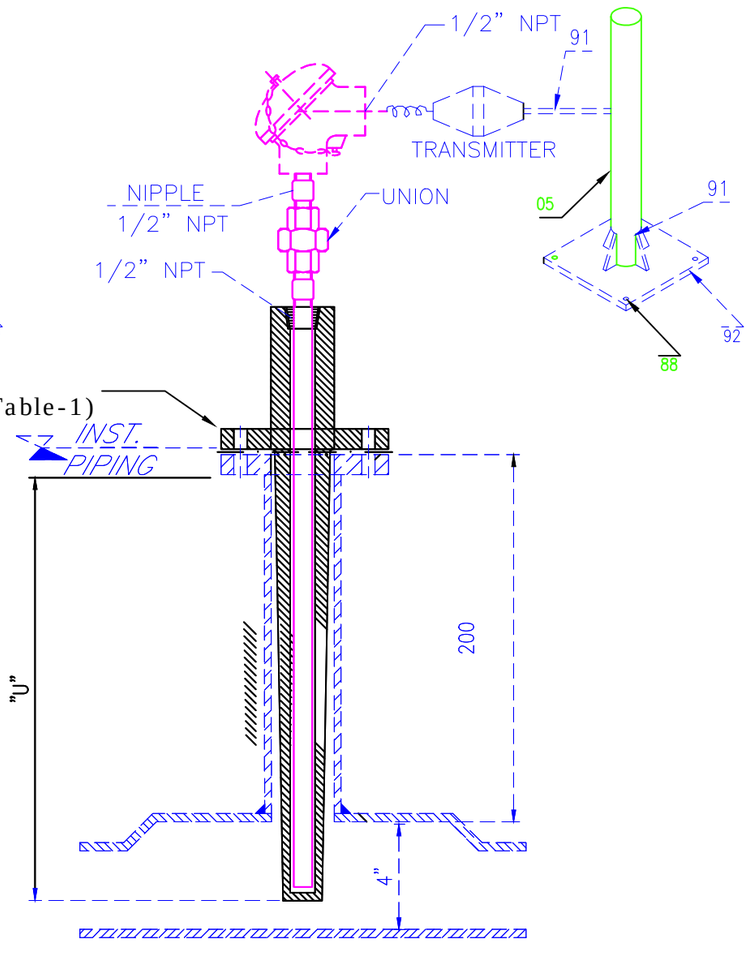
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

INVENTORY NO

FOR LINE SIZE 4" & ABOVE



FOR LINE SIZE BELOW 4"



Line Size	Immersion Length (U)
4" to 6"	280 mm
8" & above	320 mm
Vessels	400 mm

Table-1::

S.No	Type of Instrument		Process connection	Rating
1a	**Thermowell** [for Temperature Gauge & Temperature Element (RTD or Thermocouple)]	**≤ 600 #**	1.5" flanged	min 300# RF, higher rating as per piping class, stub provision as per EIL spec
1b	**Thermowell** [for Temperature Gauge & Temperature Element (RTD or Thermocouple)]	**> 600 #**	2" Flanged	higher rating as per piping class, stub provision as per EIL spec

NOTEs ::

(1) All the hookup items shall be supplied in loose condition.

(2) Welding shall be done at site.

(3) BOM listed above shall be packed each material code wise in ONE packing box except pipe/tubes.

(4) Packing of pipes / tubes shall be as per vendor practice.

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE		

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	VINEET		05.04.17	
CHD.	SUJATHA		06.04.17	–N.A.–
APPD.	SEKHAR		07.04.17	

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	GR. C/M/F	NTS	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 450						

TITLE: INSTRUMENT INSTALLATION DRAWINGs

CARD CODE: N.A.

DRG. NO: PY-FH-4-M095-9626-01 REV. 00

CUST. DRG. NO:

SHT. No 07 NO. OF SHT. 12

FIRST ANGLE PROJECTION

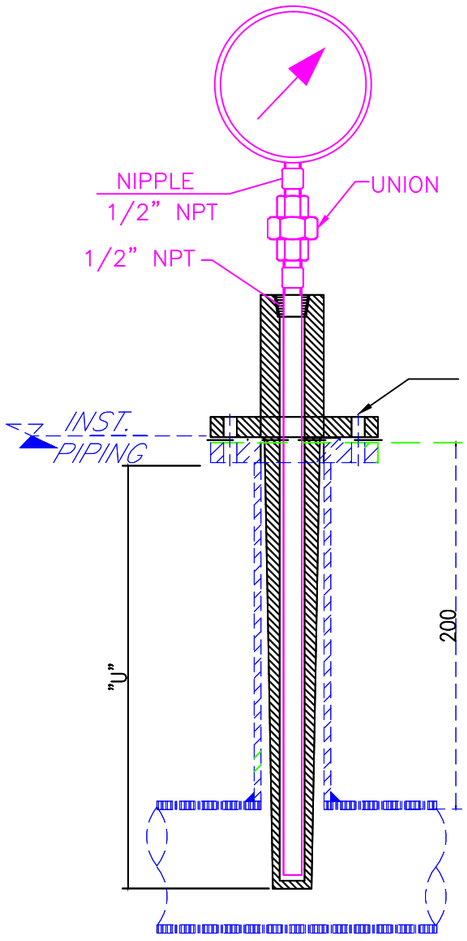
(ALL DIMENSIONS ARE IN mm)

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

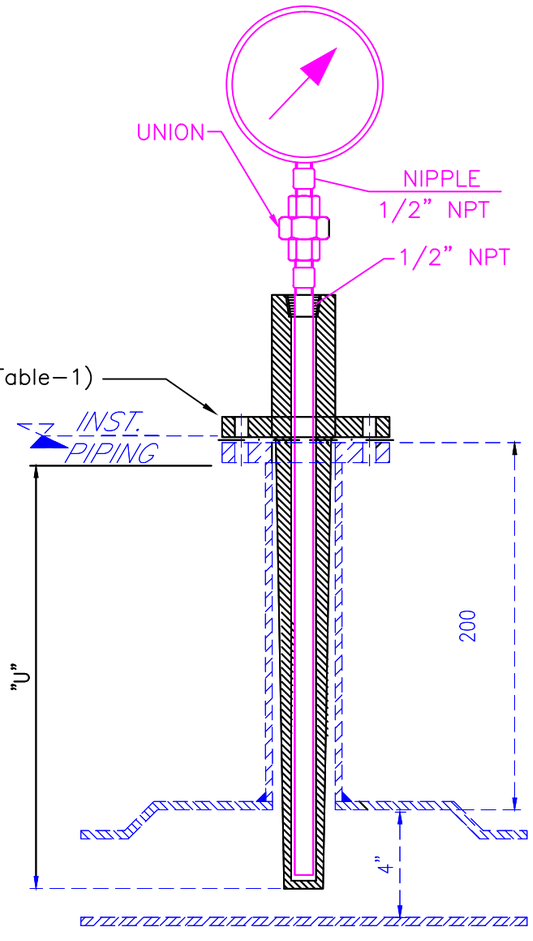
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

FOR LINE SIZE 4" & ABOVE



FOR LINE SIZE BELOW 4"



Line Size	Immersion Length (U)
4" to 6"	280 mm
8" & above	320 mm
Vessels	400 mm

Table-1::

S.No	Type of Instrument		Process connection	Rating
1a	**Thermowell** [for Temperature Gauge & Temperature Element (RTD or Thermocouple)]	**≤ 600 #**	1.5" flanged	min 300# RF, higher rating as per piping class, stub provision as per EIL spec
1b	**Thermowell** [for Temperature Gauge & Temperature Element (RTD or Thermocouple)]	**> 600 #**	2" Flanged	higher rating as per piping class, stub provision as per EIL spec

NOTEs ::

(1) All the hookup items shall be supplied in loose condition.

(2) Welding shall be done at site.

(3) BOM listed above shall be packed each material code wise in ONE packing box except pipe/tubes.

(4) Packing of pipes / tubes shall be as per vendor practice.

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE		

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	VINEET		05.04.17	
CHD.	SUJATHA	Sujatha	06.04.17	–N.A.–
APPD.	SEKHAR		07.04.17	

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	GR. C/M/F	NTS	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 450						

TITLE: INSTRUMENT INSTALLATION DRAWINGs

CARD CODE: N.A.

DRG. NO: PY-FH-4-M095-9626-01 REV. 00

CUST. DRG. NO:

SHT. No 08 NO. OF SHT. 12

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

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

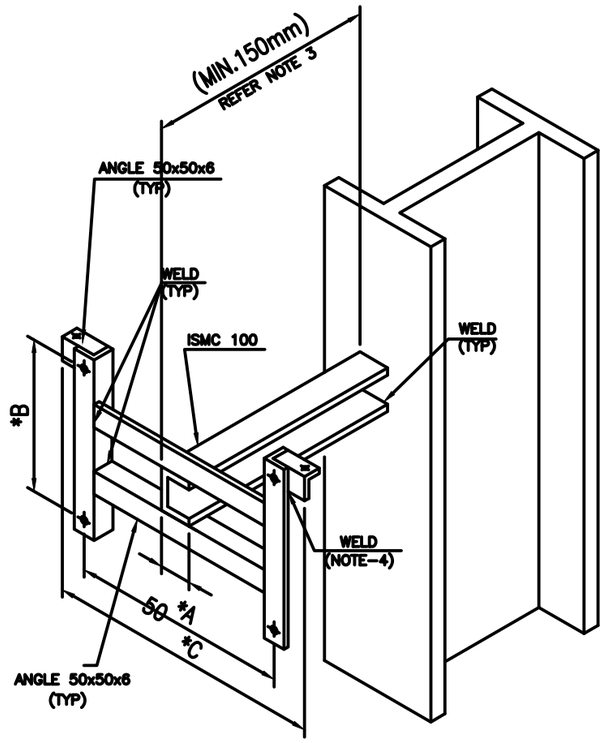
COMPUTER FILE NAME

REF. DRG. NO.

SIGN. AND DATE

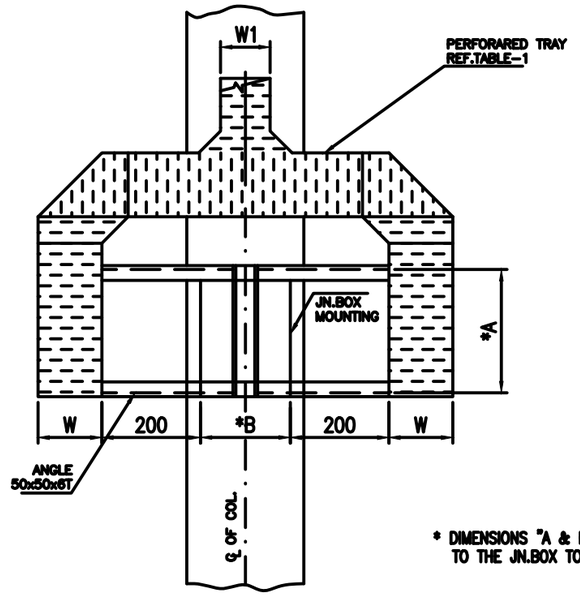
INVENTORY NO

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

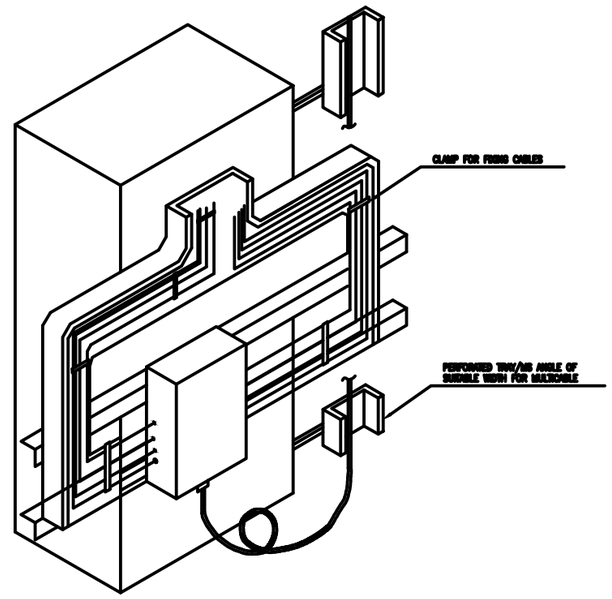


TABLES-1 (TYP)

JN.BOX	W1	W
12PAIR	300	150
8PAIR	300	150
6PAIR	200	100
4PAIR	150	100



* DIMENSIONS "A & B" ARE THE CORRESPONDING TO THE JN.BOX TO BE MOUNTED.



BOM for Material Code : PY9756199156 ; [SCHEME : JB without SWAGELOK]

Pos. No.	DESCRIPTION			QTY/SET [A]	UNITs	IBR in IIIC	Swagelok/ Parker Make
93	SCRU HEX M10X50 P8.8			6	No's	Not required	NO
94	NUT HEX P M10-8			6	No's	Not required	NO
95	WASHER MCD 10.5-ST			12	No's	Not required	NO
88	ANCHOR BOLT	Chro coated MS	M10x160mm	4	No's	Not required	NO

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE		

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	VINEET		05.04.17	
CHD.	SUJATHA		06.04.17	-N.A.-
APPD.	SEKHAR		07.04.17	

DEPT. PE&SD | CODE 450 | UNTOL. DIMS. GR. C/M/F | SCALE NTS | WEIGHT (KG) N.A | REF. TO ASSY. DRG. -N.A.- | ITEM NO. -N.A.- | NO.OF ITEMS -N.A.-

TITLE: INSTRUMENT INSTALLATION DRAWINGs

CARD CODE N.A.

DRG. NO: PY-FH-4-M095-9626-01 | REV.

CUST. DRG. NO: | 00

SHT. No 09 | NO. OF SHT. 12

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

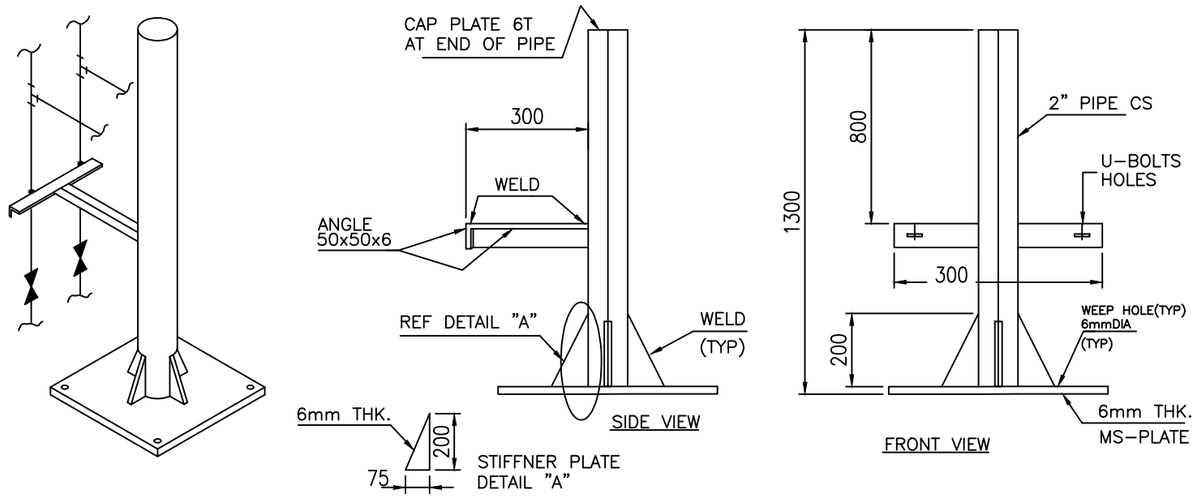
THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

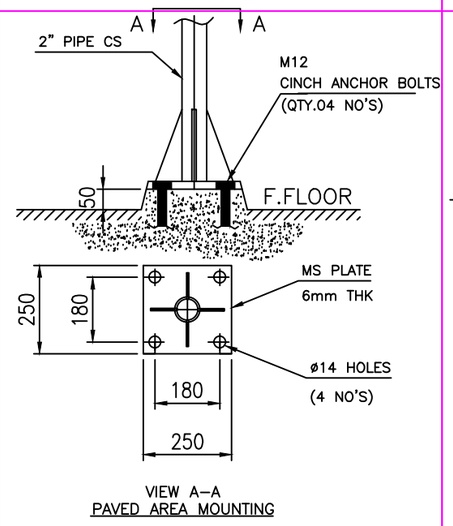
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

SINGLE INSTRUMENT SUPPORT- GENERAL ARRANGEMENT

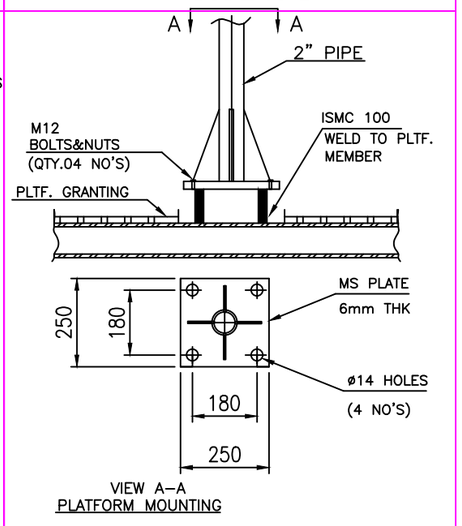
TYPE A



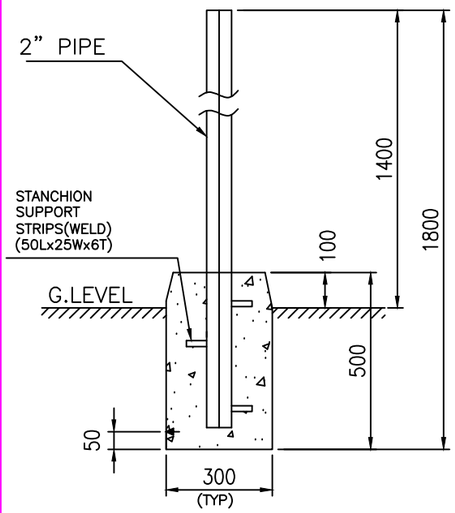
TYPE A-1



TYPE A-2

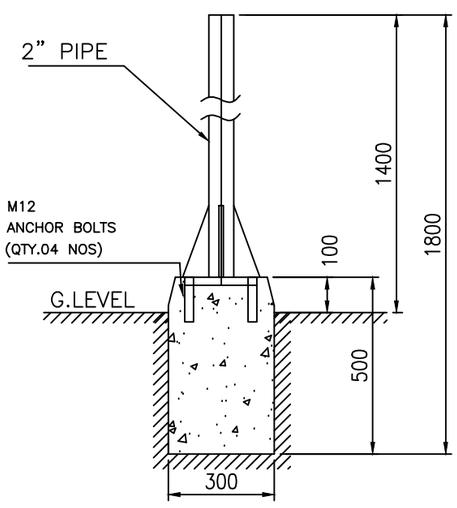


TYPE A-3



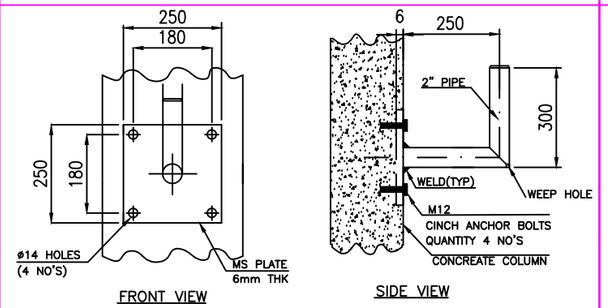
UNPAVED AREA MOUNTING
(WITH INTEGRAL CONC. BLOCK)

TYPE A-4

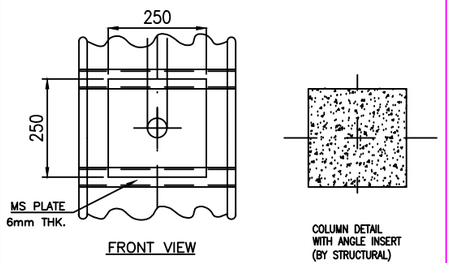


UNPAVED AREA MOUNTING
(WITH SEPARATE CONC. BLOCK)

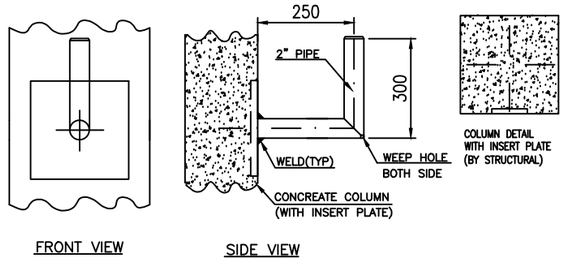
TYPE B (CONCRETE COLUMN MOUNTING)

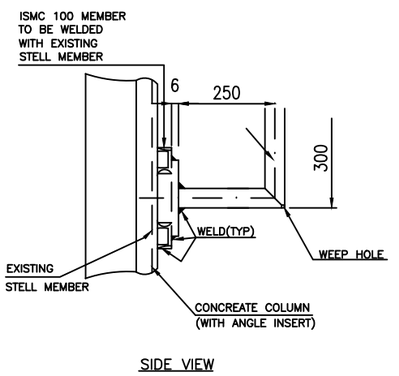


TYPE C CONCRETE COLUMN (WITH ANGLE INSERT) MOUNTING



TYPE D CONCRETE COLUMN (WITH INSERT PLATE) MOUNTING





REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE		

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	VINEET		05.04.17	
CHD.	SUJATHA	Sujatha	06.04.17	
APPD.	SEKHAR	P.Sekhar	07.04.17	–N.A.–

DEPT.	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	~~C/M/F~~	NTS	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 450						

TITLE: INSTRUMENT INSTALLATION DRAWINGs

CARD CODE: N.A.

DRG. NO: PY-FH-4-M095-9626-01

CUST. DRG. NO:

REV. 00

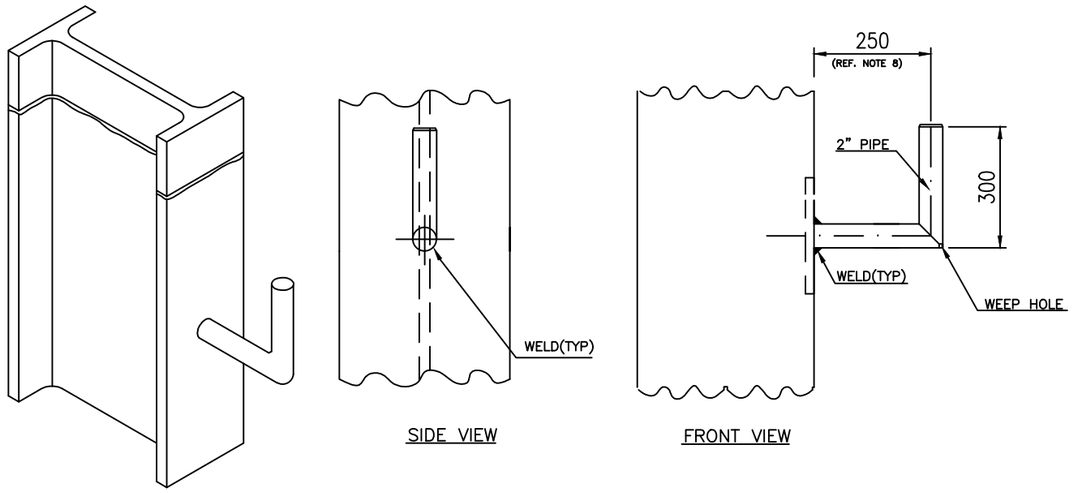
SHT. No 10 NO. OF SHT. 12

FIRST ANGLE PROJECTION

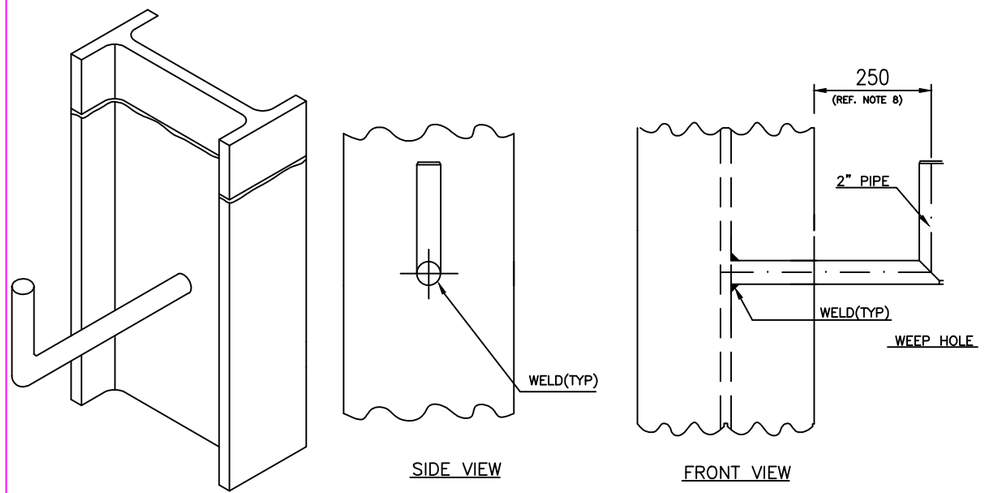
(ALL DIMENSIONS ARE IN mm)

SINGLE INSTRUMENT SUPPORT- GENERAL ARRANGEMENT

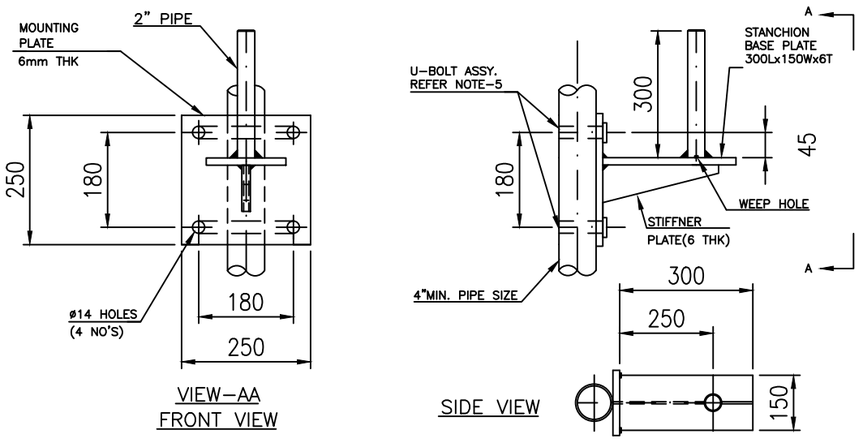
TYPE E (STEEL COLUMN MOUNTING (FLANGE FACE))



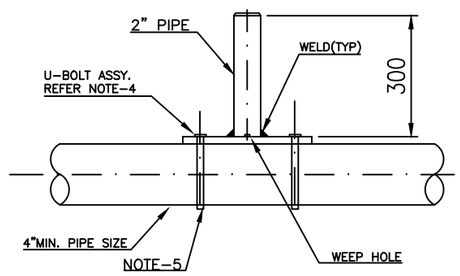
TYPE F (STEEL COLUMN MOUNTING (WEB FACE))



TYPE G-1 PIPE BRACKET MOUNTING (VERTICAL PIPE)



TYPE G-2 PIPE BRACKET MOUNTING (HORIZONTAL PIPE)



(HORIZONTAL PIPE)

NOTES

1. All dimensions are in MM unless otherwise specified.
2. Pipe material shall be IS:2139 heavy grade as a minimum.
3. 6mm DIA weep hole shall be provided at low point.
4. All weld shall be 3mm fillet weld full strength.
5. U-bolt assembly shall be of minimum M12 size with nuts and spring washers.
6. Add 50mm where ever fire insulation is provided.
7. Bolt shall be turned from M.S. rounds confirming to IS: 432 Grade 1.
8. Nuts and washers shall confirm to IS:1363 and IS:3138.

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

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE		

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	VINEET		05.04.17	–N.A.–
CHD.	SUJATHA		06.04.17	
APPD.	SEKHAR		07.04.17	

DEPT.	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	~~C/M/F~~	NTS	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 450						

TITLE: INSTRUMENT INSTALLATION DRAWINGs

CARD CODE: N.A.

DRG. NO: PY-FH-4-M095-9626-01

CUST. DRG. NO:

REV. 00

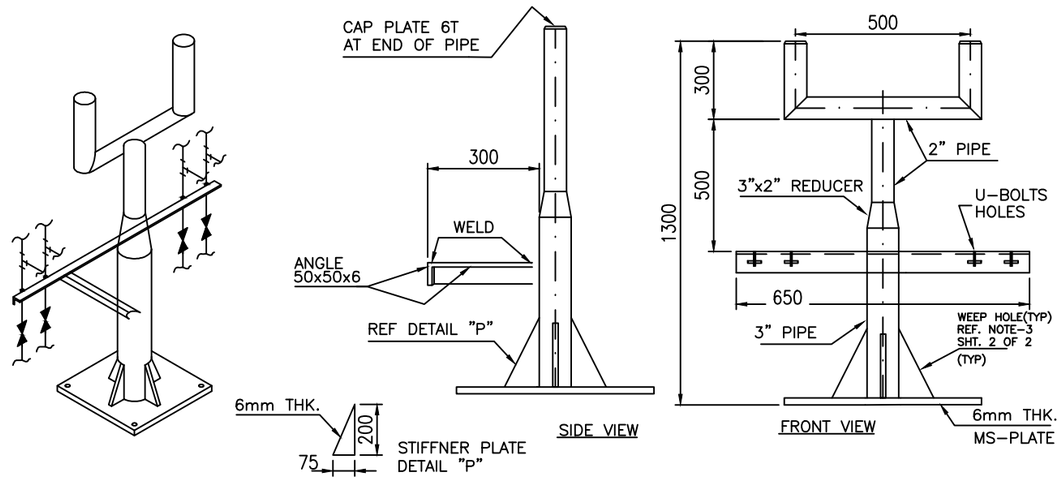
SHT. No 11 NO. OF SHT. 12

FIRST ANGLE PROJECTION

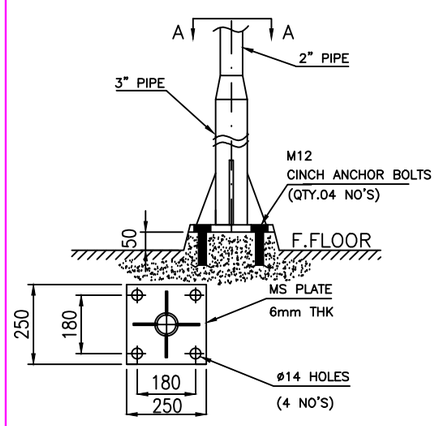
(ALL DIMENSIONS ARE IN mm)

TWO INSTRUMENT SUPPORT- GENERAL ARRANGEMENT

TYPE H

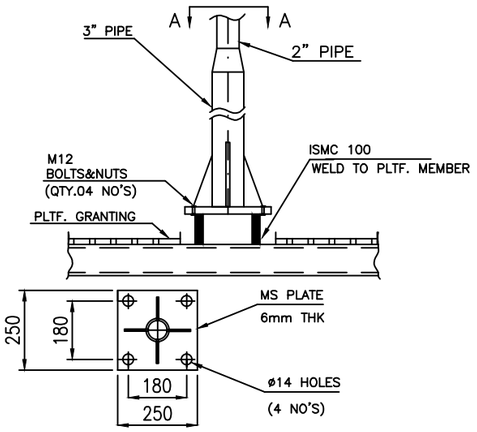


TYPE H-1



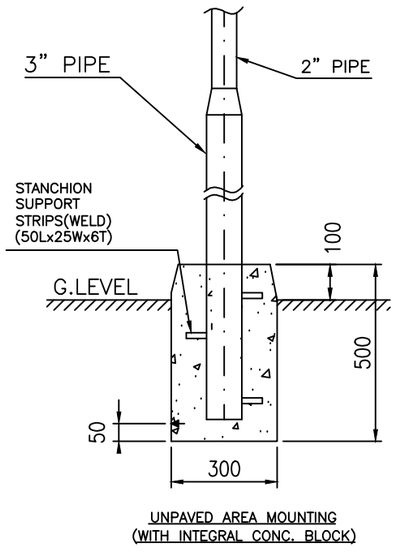
VIEW A–A
PAVED AREA MOUNTING

TYPE H-2



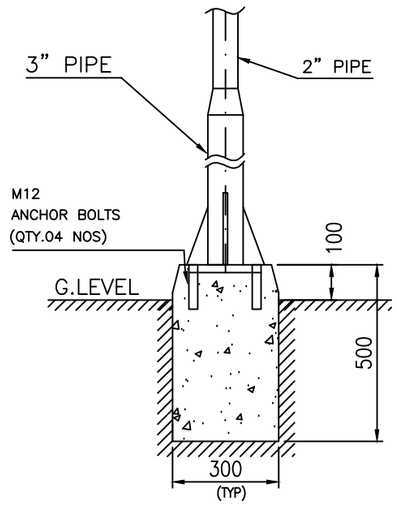
VIEW A–A
PAVED AREA MOUNTING

TYPE H-3



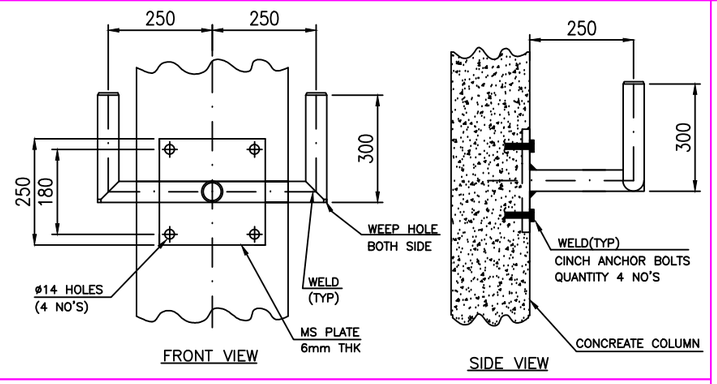
UNPAVED AREA MOUNTING
(WITH INTEGRAL CONC. BLOCK)

TYPE H-4

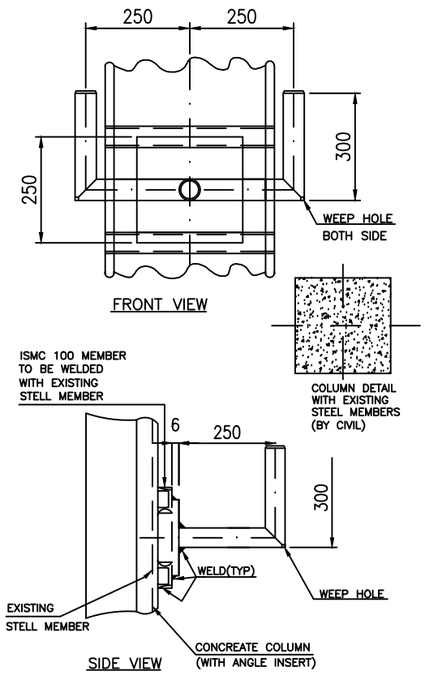


UNPAVED AREA MOUNTING
(WITH SEPARATE CONC. BLOCK)

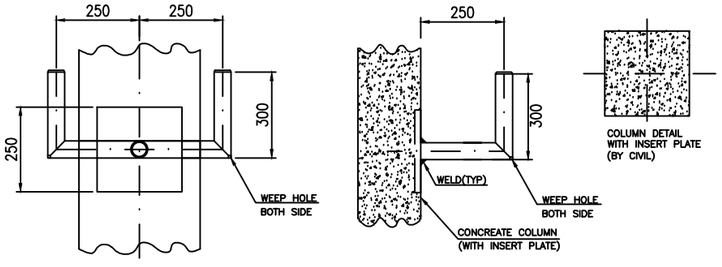
TYPE I CONCRETE COLUMN MOUNTING



TYPE J CONCRETE COLUMN (WITH ANGLE INSERT) MOUNTING



TYPE K CONCRETE COLUMN (WITH INSERT PLATE) MOUNTING



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

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE		

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	VINEET		05.04.17	
CHD.	SUJATHA		06.04.17	–N.A.–
APPD.	SEKHAR		07.04.17	

DEPT.	UNTOL. DIMS. GR.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	~~C/M/F~~		NTS	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 450							

TITLE: INSTRUMENT INSTALLATION DRAWINGs

CARD CODE: N.A.

DRG. NO: PY-FH-4-M095-9626-01

CUST. DRG. NO:

REV. 00

SHT. No 12 NO. OF SHT. 12

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-7

QAP guide Line, Formats & specification

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED,
It must not be used directly or indirectly in any way detrimental to the interest of the company.

QAP GUIDELINES & FORMAT

`

(ANNEXURE)

The QAP format and guidelines for filling up the format shall be used by vendor for preparation and submission of QAP after order placement.

Note :

1. Typical /Indicative /Standard QAP(s) for equipment /package attached is reference document and to use by successful bidder in future for preparation and submission of QAP for BHEL /CUSTOMER approval.

2. No deviation to reference document is acceptable.

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED .
It must not be used directly or indirectly in any way detrimental to the interest of the company.

GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN

1. QAP shall be made in landscape mode on A4 size paper as per the format enclosed. Font size shall be minimum 10.

2. Each page of QAP shall contain the following information.
   a) Vendor's name & address.
   b) Customer: BHEL, Hyderabad.
   c) Project.
   d) BHEL Product Standard Number/revision number as referred in P.O.
   e) BHEL Purchase Order Number & Date.
   f) Product as per P.O. description.
   g) QAP Number (unique and shall not repeat)/revision number/date.
   h) Page number and number of pages

3. QAP shall contain four parts / stages as follows.
   a) Raw materials and bought out items.
   b) In process Control / Inspection.
   c) Final assembly, Inspection & Testing.
   d) Painting, preservation & packing.

4. Under 'Component', indicate name of the component (say casing, rotor, pressure gauge, etc).

5. Under 'Characteristics', indicate appropriately (say chemical analysis, mechanical properties, NDT (UT,DP etc.), hydrostatic test, calibration check etc.)

6. Under 'Class', indicate minor, major or critical depending on the importance of characteristic.

7. Under 'Type of check', indicate appropriately (say chemical, mechanical, UT, DP etc.)

8. Under 'Quantum of check', indicate appropriately (say 100%, 10%, sample, per melt, per heat, all pieces etc.)

9. Under 'Reference document' and 'Acceptance norms', appropriate National & International standards, BHEL standards, approved drawing references etc. should be indicated. It is not correct to mention as "Vendor's internal standards or Vendor's standard practice etc.". If vendors' internal standards are referred, same shall be in line with BHEL Spec. indicated in the P.O. These may require review & approval by our Engineering dept.

10. Under 'Format of record', indicate appropriately supplier's test certificate, calibration certificate, lab report, inspection report etc.

11. Please refer 'Agency' in QAP format.
    Under P: Perform, W: Witness, V: Verify
    Indicate against each characteristic 1: (BHEL CQS/Nominated inspection agency), OR
    2: (Vendor / Sub vendor)

Note: Performing agency is normally vendor or his sub vendor (Legend 2). Where witness points are indicated in specification, P.O., Drawing etc., for such operations, Under Witness (W) column use 1. Under 'Verify' column, use code1.

12. Under 'D' please put (Tick) against each characteristic where vendor proposes to submit test certificate/report etc. OR as required as per BHEL Specification.

13. Vendor's signature & stamp should be available on each page of QAP.

14. Vendor should read the BHEL Product Standard thoroughly and QAP should be made only inline and relevant to the Specification & Approved Drawings.

15. The following operations/characteristics/check points may be included (AS APPROPRIATE)
    a) Visual check
    b) Dimensional check
    c) Mechanical and Chemical properties.
    d) Surface preparation before painting (by chemical cleaning, sand blasting, shot blasting etc. as the case may be.)
    e) Painting check for shade, Dry Film Thickness (DFT), Adhesion/ peel off test etc.
    f) Check for correctness for all components mounted as per General arrangement Drawing, Bill Of Materials (BOM), etc. for range, rating, make, color, size, location as per GA, quantity, label description including tag nos., annunciator facia, loose components, accessories, spares etc.
    g) Verification of test certificate for protection class for the enclosures.
    h) Mechanical functioning of switches.
    i) Continuity of earthing and provision of earth points.
    j) Colour coding of wiring, size, tightness & dressing of wiring.
    k) Review of test certificates of assembled items, raw materials, internal test reports etc.
    l) Witness of functional checks, which may include mechanical run & electrical run, H.V.test, IR measurement, Electrical and Mechanical tests etc.
    m) PQR, WPS, Welder Qualification Record, welding records (fit up, DP) etc.
    n) Material identification (for punch marks of serial numbers, Heat No, Melt No, Inspector's stamp etc.)
    o) Hydraulic Pressure Test, Pneumatic Pressure Test, Liquid Penetration Examination and other Non-Destructive Tests.
    p) Tests on Galvanised items (Visual, Hammer Test, Knife Test, Thickness, Pierce Test (Copper sulphate test), Hydrogen evaluation test, Stripping test (for Mass of Zinc coating)
    q) All tests as per BHEL Product Standard & approved drawings including Type tests and Routine tests on individual items and on System as a whole.
    r) Packing and Preservation.
16. **QAP Format enclosed.**
17. **Typical Manufacturing QAP(s) is /are attached.**

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED .
It must not be used directly or indirectly in any way detrimental to the interest of the company.

VENDOR'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN**		QP. NO.:	
	CUSTOMER: BHEL, HYDERABAD – 32. PROJECT: PRODUCT:	BHEL P.O.NO.: P.O.DATE: BHEL SPEC: REV:	REV NO:	DATE:
			PAGE 1 OF 1	

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**												
2.0	**INPROCESS INSPECTION**												
3.0	**FINAL INSPECTION & TESTING**												
4.0	**PRESERVATION & PACKING**												

VENDOR TO NOTE: THIS FORMAT IS IN MICROSOFT WORD. HEADER & FOOTER SHALL BE AVAILABLE IN EACH PAGE OF QP. QP SHALL BE IN LANDSCAPE & A4 SIZE ONLY. FONT SIZE SHALL BE MIN 10. VENDOR SHALL SIGN & STAMP IN EACH PAGE OF QP. LOI REF. & DATE ARE NOT ACCEPTABLE. P.O.NO. & DATE SHALL BE INDICATED. QP NO. SHOULD BE UNIQUE AND SHALL NOT REPEAT. ALL THE TESTS / CHECKS INDICATED IN THE BHEL SPEC. SHALL BE INDICATED IN THE QP.

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.	PREPARED BY VENDOR'S SIGNATURE & STAMP	APPROVED BY BHEL QA SIGNATURE & STAMP	APPROVED BY CUSTOMER'S SIGNATURE & STAMP

	TYPICAL MANUFACTURING QUALITY PLAN		MQP. NO.:	
	PROJECT ENGINEERING & SYSTEMS DIVISION BHEL, RC PURAM, HYD-502032	PROJECT: PACKAGE: BOILER FEED PUMP BHEL TECH SPEC:	REV NO:	DATE:
			PAGE 1 OF 4	

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**												
1.1	Casing, suction & discharge nozzle, stuffing box	Chemical & Mech. Properties	Major	Chemical & Mech. analysis	1 per heat/lot	Tech Spec/ Approved Datasheet/ Approved Drawing		MTC	√	2	2	1	
1.2		Heat treatment *	Major	Heat treatment	100%			HT chart / TC	√	2	2	1	* for castings
1.3	Impeller, Diffuser and shaft	Chemical & Mech. Properties	Major	Chemical & Mech. analysis	1 per heat/lot			MTC	√	2	2	1	
1.4	Mechanical seal	Material compliance and leakage check	Major	TC review, Air test	100%			MTC / COC	√	2	2	1	
1.5	Bearing and bearing housing	Make and Model compliance	Major	Visual	100%			MTC / COC	√	2	2	1	
1.6	Lube oil system	Routine tests of all valves, instruments, filters, coolers and pump & motor	Major	OEM test certificate verification	100%			MTC	√	2	2	1	
1.7		Piping hydro test	Major	Hydro test	100%			TC	√	2	2	1	
1.8		Performance test	Major	testing	100%			TC	√	2	2	1	

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. ∗ FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
1.9	ARC valve, Hydraulic coupling and Gear box	MOC and routine tests	Major	OEM test certificate verification	100%			MTC	√	2	2	1	
1.10	Accessories * (strainers, coupling and guards, JB, instruments etc.)	Chemical & Mech. Properties	Major	Chemical & Mech. Analysis	1 per heat/lot			MTC	√	2	2	1	
1.11		Leakage, Calibration reports and Type test certificates	Major	Testing and type test certificate review	100%			TC, Type test certificates and Calibration reports	√	2	2	1	*accessories as per scope of supply
1.12	Gaskets, Wear rings, base plate and Fasteners	Chemical & Mech. Properties, Hardness	Minor	Chemical & Mech. Analysis, Hardness test	1 per heat/lot			MTC	√	2	2	1	
2.0	**INPROCESS INSPECTION**												
2.1	Fabrication of casing and other components	WPS, PQR and WQR	Major	Document verification	100%	Tech Spec/ Approved Datasheet/ Approved Drawing		WPS, PQR and WQR	--	2	2	1	
2.2	Butt weld joints *	NDE	Major	RT	As per Spec			IR	√	2	2	1	* if any

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. ∗ FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
2.3	Casing, suction & discharge nozzle, stuffing box	Surface finish & NDE	Major	Visual & DPT/MPI	100%			IR	√	2	2	1	
2.4		Leakage	Critical	Hydro test	100%			IR	√	2	1	--	
2.5	Impeller, Diffuser and Shaft > 50 mm diameter	NDE	Major	For impeller/ diffuser DPT/MPI and for Shaft UT	100%			IR	√	2	2	1	
2.6	Rotor with coupling hub	Dynamic balancing	Critical	Balancing	100%			IR	√	2	2	1	
2.7	Auxiliary piping	Leakage check	Major	Hydro test	100%			IR	√	2	1	--	
3.0	**FINAL INSPECTION & TESTING**												
3.1	Pump Assembly with job motor	Performance test	Critical	Testing	100%	Tech Spec/ Approved Datasheet/ Approved Drawing		TC	√	2	1	--	Only 10% witness by BHEL / BHEL's TPIA, subjective to minimum 1 pump of each size & type.
3.2		Vibration level at five points , Noise level, Bearing temperature rise and leakage from mechanical seal	Critical	Testing	100%			TC	√	2	1	--	
3.3		NPSH (if applicable)	Major	Testing	100%			TC	√	2	1	--	
3.4		Mechanical run test	Critical	Testing	100%			TC	√	2	1	--	

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
3.5		Strip Examination	Critical	Dismantling	100%			TC	√	2	1	--	
3.6		Overall Dimensions	Major	Measurement	100%			IR	√	2	1	--	
3.7		String test	Major	Testing	100%			IR	√	2	1	--	
3.8		Spares (if any)	Major	BOM check	100%			IR	√	2	1	--	
4.0	**PRESERVATION & PACKING**												
4.1	Pump and its components	Direction of rotation, Stamping and Painting	Major	Visual, Shade & DFT	Random	Tech Spec/ Approved Datasheet/ Approved Drawing		IR	√	2	1	--	
4.2		Packing #	Major	Visual	100%			Packing List	√	2	2	1	# Seaworthy packing for export orders

Notes:-

1. This MQP should be read along with specification (latest revision), approved drawings & approved data sheet.
2. Specifications/drawing/data sheet shall prevail over quality plan for contradiction if any between quality plan and drawing/specification.
3. All test certificates/reports reviewed and certified by TPI/BHEL shall be submitted to BHEL as documentation package.
4. Any project/customer specific requirements which shall be notified have to be fulfilled by the vendor at the time of execution of order.

Abbreviations:-

MTC	–	Material Test certificate	WPS	-	Welding Procedure Specification
IBR	–	Indian Boiler Regulations	PQR	-	Procedure Qualification Record
DFT	–	Dry Film Thickness	WPQ	-	Welder Performance Qualification
TC	–	Test Certificate	NDE	-	Non Destructive Examination
PMI	-	Positive Material Identification	OD	-	Outer Diameter
G.I	-	Galvanized Iron	ID	-	Internal Diameter

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-8
Experience Record Proforma

NOTES TO BIDDERS:

1. Prototype pump model/ model series shall not be considered.
2. It is mandatory that all references furnished for pump model/ model series should have similar parameters.

DESCRIPTION OF MODEL DESIGNATION: _____

SL. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS			REMARKS
			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
1	**GENERAL**					
1.1	Make / Model Number					
1.2	Number of units supplied					
1.3	Type of driver / Driver rated kW / Speed(rpm)					
1.4	Drive (Fixed Speed / Variable Speed / Variable Frequency)					
1.5	Shop where pump is designed, manufactured, packaged, tested & supplied with address					
2	**OPERATING CONDITIONS**					
2.1	Fluid handled / Fluid temperature (Min / Max) Deg C					
2.2	Capacity (m^3/hr) / Differential Head Rated (m)					
2.3	Maximum Suction pressure (kg/cm^2,a)					
2.4	Differential Pressure, Rated (kg/cm^2)					
2.5	NPSHR (m)					
2.6	Efficiency (%) / BKW (kW) / Rated Speed (rpm)					
2.7	Minimum Continuous Stable Flow, (m^3/hr)					
2.8	MAWP outer casing (kg/cm^2G) @ 15˚C / @ pumping temperature					
3	**CONSTRUCTION**					

Place:
Date:

[Signature of Authorized Signatory]*

Name:
Designation:
Seal:

*: *To be authenticated in-line with provisions indicated in the Commercial section.* *[To be submitted in original, along with bid]*

Copyrights EIL – All rights reserved

3.1	No. of stages / API Pump Type					
3.2	Casing split - Outer casing (Axial / Radial)					
3.3	Casing split - Inner casing (Axial / Radial)					
3.4	First Impeller Type (Single flow / Double flow)					
3.5	Impeller diameter - Rated/ Maximum / Minimum (mm)					
3.6	Impeller mounting (Inline / Back to back)					
3.7	Balancing Device used (Balance drum / Balance disc / Others)					
3.8	Type of Radial Bearings (Antifriction / Sleeve / Tilting Pad / Others)					
3.9	Type of Thrust Bearings (Taper land / Tilting Pad / Others)					
3.10	Span between bearings (mm) / Shaft diameter under: Seals / Bearings (mm)					
3.11	Shaft Sleeve provided between impeller (interstage bushings) - Yes / No					
3.12	Whether the proposed model and reference models have identical hydraulic design (for impeller / diffuser / volute)					
3.13	Type of lubrication (Pressurised / Splash / Ring / Oil mist / Grease)					
3.14	Lubrication system (API-610 / API-614 / Manufacturer Standard)					
3.15	Type of mechanical seal (Single / Double) / API Sealing Plan No.					
4	**MATERIAL OF CONSTRUCTION**					
4.1	Outer Casing / Inner Casing / Impellers / Shaft					
5	**OTHER INFORMATION ON INSTALLATIONS**					
5.1	Date of supply and commissioning					
5.2	Whether one year of successful field operation completed after commissioning as on bid due date					
5.3	Purchaser's Name, Address, Contact No. & email ID					

Place:
Date:

[Signature of Authorized Signatory]*

Name:
Designation:
Seal:

*: *To be authenticated in-line with provisions indicated in the Commercial section.* *[To be submitted in original, along with bid]*

Copyrights EIL – All rights reserved

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-9

Sub vendor list

Sl No	CONTENTS
9-A	Customer approved vendor list
9-B	BHEL PMD list

ANNEXURE-9-A

VENDOR LIST FOR STEAM & POWER GENERATION PACKAGE

PROJECT: **REVIVAL OF RAMAGUNDAM FERTILIZER COMPLEX**

OWNER: **RAMAGUNDAM FERTILIZERS AND CHEMICALS LTD.**

PMC: **ENGINEERS INDIA LIMITED (EIL)**

EIL JOB NO.: **A747**

TENDER No. **A747-400-83-41-PG-T-7210**

There are few vendors banned by EIL. The list of such vendors shall be forwarded in due course of time.

0	17.08.2016	ISSUED FOR MR	JPSK	SCH	JKM
Rev. No.	**Date**	**Purpose**	**Prepared by**	**Checked by**	**Approved by**

Copyright EIL – Right reserved

ITEM DISCRIPRION(CODE) / VENDOR NAME(CODE)	COUNTRY
Vendor list for main items is as below.	

Copyright EIL – Right reserved

PUMP-ROTARY.SCREW (04DA)	
ALEKTON ENGG INDUSTRIES PVT. LTD	INDIA
FLOWSERVE CORPORATION (FORMERLY I571)	UNITED STATES
NETZSCH TECHNOLOGIES INDIA PVT.LTD	INDIA
POMPE VERGANI SPA	ITALY
PLENTY MIRRLESS PUMPS	UK

Copyright EIL – Right reserved

ROTO PUMPS LTD	INDIA
SEEPEX GMBH	GERMANY
TUSHACO PUMPS PVT. LTD	INDIA
UT PUMPS & SYSTEMS PVT. LTD. (BORNEMAN)	INDIA
WARREN PUMPS INC	UNITED STATES
PUMP-ROTARY.GEAR (04DB)	
DEL PD PUMPS & GEARS PVT. LTD.	INDIA
FLOWSERVE CORPORATION (FORMERLY I571)	U.S.A.
MAAG PUMPS SYSTEMS AG	SWITZERLAND
SHIMADZU CORPORATION	JAPAN
TUSHACO PUMPS PVT. LTD	INDIA
VIKING PUMP INC	U.S.A.
WITTE PUMPS & TECHNOLOGY GMBH	GERMANY
PUMP-RECIPRO(API 675,PLUNGER/DIAPHRAGM) 04FA	
ALLDOS DOSIERTECHNIK GMBH	GERMANY
BRAN + LUEBBE LTD	GERMANY
LEWA GMBH	GERMANY
ACCUDYNE INDUSTRIES INDIA PVT. LTD.	INDIA
NIKKISO CO LTD (NIKKISO K.K.)	JAPAN
ORLITA GMBH & CO KG	GERMANY
OFFICINE MECCANICHE GALLARATESI SPA	ITALY
POSITIVE METERING PUMPS (I) PVT LTD	INDIA
PULSA FEEDER (UNIT OF IDEX CORP)	SINGAPORE
SHAPOTOOLS	INDIA
SWELORE ENGG. (P) LTD	INDIA
V.K. PUMPS INDUSTRIES PVT. LTD	INDIA
WILLIAMS INSTRUMENT COMPANY INC	UNITED STATES
WEIR MINERALS NETHERLANDS BV (FMLY E620)	NETHERLANDS
PUMP - AIR OPERATED DIAPHRAGM 04GC	
HI-LIFE MANUFACTURING CO.	INDIA
MONIBA ANAND ELECTRICALS PVT LTD	INDIA

Copyright EIL – Right reserved

Copyright EIL – Right reserved

SIEMENS AG	GERMANY
TIL LIMITED (SAHIBABAD WORKS)	INDIA
TRADING ENGINEERS(INTERNATIONAL) LTD	
WARTSILA INDIA LTD	INDIA
MECH.SEAL FOR PUMPS/AGITATORS (04MH)	
AESSEAL PLC	U.K.
CHETRA DICHTUNGSTECHNIK AG	
EAGLEBURGMANN INDIA PRIVATE LIMITED	INDIA
FLOWSERVE SANMAR LTD	INDIA
JOHN CRANE SEALOL (I) LTD	INDIA
LEAK PROOF ENGG (I) PVT. LTD	INDIA

Copyright EIL – Right reserved

Copyright EIL – Right reserved

Motor-Induction-HV (Indl. Type Safe Area) 13JA	
ABB INDIA LTD (BARODA)	INDIA

Copyright EIL – Right reserved

BHEL-BHOPAL	INDIA
CROMPTON GREAVES LTD.	INDIA
KIRLOSKAR ELECTRIC CO LTD	INDIA
MARATHON ELECTRIC MOTOR I LTD-(FORM ALSTHOM INDUSTRIAL PRODUCTS)	INDIA
Motor Induction-MV (Indl.Type Safe Area)	13JD
ABB INDIA LTD (BANGALORE)	INDIA
ABB INDIA LTD-FARIDABAD	INDIA
BHARAT BIJLEE LIMITED	INDIA
CROMPTON GREAVES LTD.	INDIA
KIRLOSKAR ELECTRIC CO LTD	INDIA
LAXMI HYDRAULICS PVT LTD	INDIA
MARATHON ELECTRIC MOTOR I LTD-(FORM ALSTHOM INDUSTRIAL PRODUCTS)	INDIA
SIEMENS LIMITED	INDIA
ALSTHOM LIMITED (AREVA T & D)	INDIA
BHEL LTD.	INDIA
Transformers-Power-Above 5 MVA(13KA)	
ALSTOM T & D INDIA LIMITED	INDIA
BHARAT BIJLEE LIMITED	INDIA
BHEL JHANSI	INDIA
CROMPTON GREAVES LTD.	INDIA
EMCO LIMITED	INDIA
KIRLOSKAR ELECTRIC CO LTD	INDIA
KANOHAR ELECTRICALS LTD.	INDIA
VOLTAMP TRANSFORMERS LTD.	INDIA
AREVA T&D.	INDIA
ABB	INDIA
SIEMENS INDIA LTD.	INDIA
Actuators-Mov(13VA)	
AUMA INDIA PRIVATE LTD	INDIA
AUMA RIESTER GMBH & CO. KG	GERMANY
BIFFI ITALIA S.R.L	ITALY
CAIR EUROMATIC AUTOMATION PVT LTD	INDIA
EMERSON PROCESS MGMT VALVE ACTUATION LLC	UNITED STATES
FLO - TORK INC	UNITED STATES
FLOWSERVE LIMITORQUE	UNITED STATES
LIMITORQUE INDIA LIMITED	INDIA
MARSH AUTOMATION PVT. LTD.	INDIA
ROTORK CONTROLS (INDIA) LTD	INDIA
ROTORK CONTROL GMBH	GERMANY
LIMITORQUE	UNITED STATES
13 JC- MOTOR- HV INDUCTION(HV INCREASED SAFETY ZN2/ Ex-n)	
ABB INDIA LTD (BARODA)	INDIA
BHEL-BHOPAL	INDIA

Copyright EIL – Right reserved

CROMPTON GREAVES LTD.	INDIA
KIRLOSKAR ELECTRIC CO LTD	INDIA
MARATHON ELECTRIC MOTOR I LTD-(FORM ALSTHOM INDUSTRIAL PRODUCTS)	INDIA
MOTORS - IMPORTED (13JK)	
ASEA BROWN BOVERY LTD (ABB LTD)	SWITZERLAND
NIDEC ASI SPA	ITALY
GE ENERGY POWER CONVERSION FRANCE SAS	FRANCE
CEMP SRL	ITALY
GENERAL ELECTRIC CANADA	CANADA
HITACHI LTD	JAPAN
HYUNDAI HEAVY INDUSTRIES CO. LTD	KOREA
JEUMONT SA / FRAMATONE ANP	FRANCE
LOHER GMBH	GERMANY
LLOYD DYNAMOWERKE GMBH & CO. KG	GERMANY
SIEMENS AG	GERMANY
TOSHIBA CORPORATION	JAPAN
WEG EQUIPAMENTOS ELETRICOS S.A.	BRAZIL
WEGEURO - INDUSTRIA ELECTRICA S.A.	PORTUGAL
ANSALDO ROBICON	ITALY
FUJI ELECTRIC INTERNATIONAL CORPORATION	JAPAN
MITSUBISHI CORPORATION	JAPAN
ASEA BROWN BOVERI	SWEDEN
ALSTHOM ALLANTIQUE	FRANCE
A.E.G. TELEFUNCUN	GERMANY
BRUSH ELECTRICALS M/C. LTD.	UK
PEEBLES ELECTRICAL M/C.	UK
WESTINGHOUSE ELECTRIC CORP.	UNITED STATES
GENERAL ELECTRIC COMPANY	UNITED STATES
JEUMONT INDUSTRIES/ JEUMONT SCHNEIDER	FRANCE
MOTOR-INDUCTION-M.V(ZONE 2-TYPE e & n) (13JE)	
ABB INDIA LTD (BANGALORE)	INDIA
ABB INDIA LTD-FARIDABAD	INDIA
BHARAT BIJLEE LIMITED	INDIA
CROMPTON GREAVES LTD.	INDIA
KIRLOSKAR ELECTRIC CO LTD	INDIA
LAXMI HYDRAULICS PVT LTD	INDIA
MARATHON ELECTRIC MOTOR I LTD-FORM ALSTHOM INDUSTRIAL PRODUCTS	INDIA
ALSTHOM LIMITED (AREVA T & D)	INDIA
SIEMENS LIMITED	INDIA
BHEL LTD.	INDIA
MOTOR-INDUCTION-M.V (FLAME PROOF)-13JF	
BHARAT BIJLEE LIMITED	INDIA
CROMPTON GREAVES LTD.	INDIA
KIRLOSKAR ELECTRIC CO LTD	INDIA

Copyright EIL – Right reserved

LAXMI HYDRAULICS PVT LTD	INDIA
MARATHON ELECTRIC MOTOR I LTD-FORM ALSTHOM INDUSTRIAL PRODUCTS	INDIA
ALSTHOM LIMITED (AREVA T & D)	INDIA
ABB LTD	INDIA
SIEMENS LIMITED	INDIA
BHEL LTD.	INDIA
Cables-High Voltage-XLPE(13OA)	
FINOLEX CABLES LTD.	INDIA
HAVELLS INDIA LTD	INDIA
KEI INDUSTRIES LIMITED	INDIA
KEC INTERNATIONAL - VADODARA	INDIA
POLYCAB WIRES PVT LTD	INDIA
STERLITE TECHNOLOGIES LIMITED	INDIA
TORRENT CABLES LTD	INDIA
UNIVERSAL CABLES LTD	INDIA
ASIAN CABLES (POWER CABLE)	INDIA
CABLE CORPORATION OF INDIA	INDIA
FORT GLOSTER INDUSTRIES LTD.	INDIA
NICCO CORPORATION LTD.	INDIA
INDUSTRIAL CABLE INDIA LTD.	INDIA
RPG CABLES	INDIA
UNIFLEX CABLES LTD.	INDIA
Batteries-Lead Acid (Flooded)(13HA)	
EXIDE INDUSTRIES LTD.	INDIA
HBL POWER SYSTEMS LTD	INDIA
HBL NIFE	INDIA
Battery Chargers(13HB)	
AMARA RAJA POWER SYSTEMS (P) LTD	INDIA
CHHABI ELECTRICALS PVT LIMITED	INDIA
CHLORIDE POWER SYSTEMS & SOLUTIONS LTD	INDIA
DUBAS ENGINEERING PVT LTD	INDIA
HBL POWER SYSTEMS LTD	INDIA
MASS-TECH CONTROLS PVT LTD	INDIA
UNIVERSAL INSTRUMENT MFG CO PVT LTD	INDIA
HIND RECTIFIER	INDIA
CONTROL PANEL AND ACCESSORIES (15UA)	
ACCUSONIC CONTROLS PVT LTD	INDIA
ELECTRONIC CORPORATION OF INDIA LTD.	INDIA
ELECTRONIC INSTRMNTATION & CONTROL P LTD	INDIA
INSTRUMENTATION LTD	INDIA

Copyright EIL – Right reserved

INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	INDIA
IRIS AUTOMATION PVT LTD	INDIA
POSITRONICS PVT LTD	INDIA
PRIMA AUTOMATION INDIA PVT LTD	INDIA
PYROTECH ELECTRONICS PVT LTD	INDIA
RADHA KRISHNA CONTROLS	INDIA
RITTAL	INDIA
JAISUN & HUTCHISUN CONTROLS LTD.	INDIA
UNITED ELECTRIC CO. (DELHI) PVT. LTD. (UPTO 10MTR.)	INDIA
YOKOGAWA LIMITED	INDIA
INSTROMENT INTERNATONAL N.V.	HOLLAND
ACCUSONIC CONTROLS PVT LTD	INDIA
Programmable Logic Controllers (15JA)	
ABB INDIA LTD (BANGALORE)	INDIA
ASEA BROWN BOVERY LTD (ABB LTD)	SWITZERLAND
EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
GE INTELLIGENT PLATFORMS PVT LTD	INDIA
HONEYWELL AUTOMATION INDIA LTD.	INDIA
HONEYWELL INC.	UNITED STATES
HIMA PAUL HILDEBRANDT GMBH + CO KG	GERMANY
ICS TRIPLEX (EMEA) PLC	UK
INVENSYS SOFTWARE SYSTEMS (S) PTE LTD	SINGAPORE
INVENSYS SOFTWARE SYSTEMS (S) PTE LTD	INDIA
ROCKWELL AUTOMATION INDIA PVT LTD	INDIA
ROCKWELL AUTOMATION INC.	UNITED STATES
SIEMENS LTD - NASHIK	INDIA
SIEMENS AG	GERMANY
YOKOGAWA INDIA LIMITED	INDIA
YOKOGAWA	INTERNATIONAL
TRICONEX (FOR TMR) (FAULT TOLERANT)	SINGAPORE
L&T (FOR HIMA MAKE)	INDIA
MOORE CONTROLS LTD. (FAILSAFE)	INDIA
MARCONI ITALIANA (NON-FAILSAFE)	ITALY
OMRON CORPORATION (NON-FAILSAFE)	JAPAN
GE FANUC AUTOMATION NORTH AMERICA INC. (FAULT TOLERANT TMR)	UNITED STATES
WATER QUALITY ANALYSERS (SILICA) (15FB)	
ABB INDIA LTD (BANGALORE)	INDIA
AMETEK	UNITED STATES
ABB AUTOMATION LTD	UK
EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA

Copyright EIL – Right reserved

EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE
GE SENSING EMEA (FORMERLY P-593)	IRELAND
SECO CONTROLS PVT LTD	INDIA
SERVOMEX GROUP LTD.	UK
TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES
YOKOGAWA INDIA LIMITED	INDIA
YOKOGAWA ELECTRIC CORPORATION	JAPAN
SICK AG	GERMANY
SIEMENS AG	GERMANY
HORIBA LTD.	JAPAN
LEAR SIEGLER MEASUREMENT CONTROLS CORP.	UNITED STATES
M.S.A. INTERNATIONAL	UNITED STATES
THRMO ENVIRONMENT INSTRUMENTS INC.	UNITED STAES
CHEMTROLS INDUSTRIES LTD.	INDIA
WATER QUALITY ANALYSER-DISSOLVED OXYGEN (15FC)	
ABB INDIA LTD (BANGALORE)	INDIA
ABB AUTOMATION LTD	UK
B&C ELECTRONICS SRL	ITALY
EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE
ENDRESS+HAUSER CONDUCTA GMBH+CO	GERMANY
FORBES MARSHALL PVT. LTD.- PUNE	INDIA
HONEYWELL AUTOMATION INDIA LTD.	INDIA
HONEYWELL INC.	UNITED STATES
HACH COMPANY	UNITED STATES
INVENSYS SOFTWARE SYSTEMS (S) PTE LTD	SINGAPORE
METTLER - TOLEDO AG	SWITZERLAND
YOKOGAWA INDIA LIMITED	INDIA
YOKOGAWA ELECTRIC CORPORATION	JAPAN
PROCESS STREAM ANALYSERS (O2-ZIRCONIA) (15FE)	
ABB INDIA LTD (BANGALORE)	INDIA
AMETEK	UNITED STATES
ABB AUTOMATION LTD	UK
EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE
GE SENSING EMEA (FORMERLY P-593)	IRELAND
SECO CONTROLS PVT LTD	INDIA
SERVOMEX GROUP LTD.	UK
TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES
YOKOGAWA INDIA LIMITED	INDIA

Copyright EIL – Right reserved

YOKOGAWA ELECTRIC CORPORATION	JAPAN
SICK AG	GERMANY
SIEMENS AG	GERMANY
HORIBA LTD.	JAPAN
LEAR SIEGLER MEASUREMENT CONTROLS CORP.	UNITED STATES
M.S.A. INTERNATIONAL	UNITED STATES
THRMO ENVIRONMENT INSTRUMENTS INC.	UNITED STAES
CHEMTROLS INDUSTRIES LTD.	INDIA
WATER QUALITY ANALYSERS (PH) (15FH)	
ABB INDIA LTD	INDIA
ABB AUTOMATION LTD	UK
EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
ENDRESS+HAUSER (I) PVT. LTD.	INDIA
EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE
ENDRESS+HAUSER CONDUCTA GMBH+CO	GERMANY
FORBES MARSHALL PVT. LTD.- PUNE	INDIA
HONEYWELL AUTOMATION INDIA LTD.	INDIA
HONEYWELL INC.	UNITED STATES
HACH COMPANY	UNITED STATES
INVENSYS INDIA PRIVATE LIMITED	INDIA
INVENSYS SOFTWARE SYSTEMS (S) PTE LTD	SINGAPORE
METTLER - TOLEDO AG	GERMANY
YOKOGAWA INDIA LIMITED	INDIA
YOKOGAWA ELECTRIC CORPORATION	JAPAN
HACH EUROPE	BELGIUM
ZELLWEGER	FRANCE
FORBES-ZELLWEGER ANALYTICAL	INDIA
HACH	INDIA
ABB PROCESS ANALYTICS	UK
HARTMAN & BRAUN	GERMANY
YOKOGAWA ELECTRUFACT	NETHERLANDS
DR. INGOLD	SWITZERLAND
M.S.A. INSTRUMENT DIVISION	UNITED STATES
EMECON LTD (FOR TELEDYNE MAKE ONLY)	INDIA
BECKMAN COULTER	GERMANY
BECKMAN COULTER	UNITED STATES
EMERSON PROCESS MANAGEMENT	INTERNATIONAL
FORBES POLYMETRON PVT. LTD.	INDIA
FOXBARO FAR EAST PTE LTD	SINGAPORE
WATER QUALITY ANALYSERS (CONDUCTIVITY) (15FQ)	
ABB INDIA LTD (BANGALORE)	INDIA
ABB AUTOMATION LTD	UK
EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA

Copyright EIL – Right reserved

ENDRESS+HAUSER (I) PVT. LTD.	INDIA
EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE
ENDRESS+HAUSER CONDUCTA GMBH+CO	GERMANY
FORBES MARSHALL PVT. LTD.- PUNE	INDIA
HONEYWELL AUTOMATION INDIA LTD.	INDIA
HONEYWELL INC.	UNITED STATES
HACH COMPANY	UNITED STATES
INVENSYS INDIA PRIVATE LIMITED	INDIA
INVENSYS SOFTWARE SYSTEMS (S) PTE LTD	SINGAPORE
METTLER - TOLEDO AG	SWITZERLAND
YOKOGAWA INDIA LIMITED	INDIA
YOKOGAWA ELECTRIC CORPORATION	JAPAN
HACH EUROPE	BELGIUM
ZELLWEGER SA	FRANCE
FORBES-ZELLWEGER ANALYTICAL	INDIA
HACH	INDIA
ABB PROCESS ANALYTICS	UK
HARTMAN & BRAUN	GERMANY
YOKOGAWA ELECTRUFACT	NETHERLANDS
DR. INGOLD	SWITZERLAND
M.S.A. INSTRUMENT DIVISION	UNITED STATES
EMECON LTD (FOR TELEDYNE MAKE ONLY)	INDIA
BECKMAN COULTER	GERMANY
BECKMAN COULTER	UNITED STATES
EMERSON PROCESS MANAGEMENT	INTERNATIONAL
FORBES POLYMETRON PVT. LTD.	INDIA
FOXBARO FAR EAST PTE LTD.	SINGAPORE
PROCESS STREAM ANALYSER (H.C.-TCD/FID) (15FT)	
ABB INDIA LTD (BANGALORE)	INDIA
ABB AUTOMATION LTD	UK
APPLIED INSTRUMENTS TECHNOLOGIES INC.	UNITED STATES
CHEMTROLS INDUSTRIES LTD	INDIA
EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE
SIEMENS AG	GERMANY
SERVOMEX GROUP LTD.	UK
TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES
YOKOGAWA INDIA LIMITED	INDIA
YOKOGAWA ELECTRIC CORPORATION	JAPAN
STACK GAS ANALYSER SYSTEMS (EXTRACTIVE) (15FM)	
ABB INDIA LTD (BANGALORE)	INDIA
ABB AUTOMATION LTD	UK
CHEMTROLS INDUSTRIES LTD	INDIA
EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA

Copyright EIL – Right reserved

ENVIRONNEMENT S.A.	FRANCE
EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE
HORIBA LTD	JAPAN
SERES ENVIRONMENT (FORM. SERES)	FRANCE
SERVOMEX GROUP LTD.	UK
SIGNAL GROUP LTD	UK
SICK AG	GERMANY
THERMO FISHER SCIENTIFIC INDIA PVT. LTD.	INDIA
TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES
THERMO FISHER SCIENTIFIC	UNITED STATES
YOKOGAWA INDIA LIMITED	INDIA
YOKOGAWA ELECTRIC CORPORATION	JAPAN
STACK GAS ANALYSER SYSTEMS (INSITU) (15FV)	
CHEMTROLS INDUSTRIES LTD	INDIA
FORBES MARSHALL CODEL PVT. LTD.	INDIA
KITTIWAKE PROCAL LTD	UK
SIEMENS AG	GERMANY
SERVOMEX GROUP LTD.	UK
SICK AG	GERMANY
STACK GAS ANALYSERS (SPM) (15FW)	
ENVIRONNEMENT S.A.	FRANCE
FORBES MARSHALL CODEL PVT. LTD.	INDIA
SERVOMEX GROUP LTD.	UK
TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES
ANALYSER SHELTER (15FR)	
ABB INDIA LTD (BANGALORE)	INDIA
AXIS SOLUTIONS PVT. LTD.	INDIA
CHEMTROLS INDUSTRIES LTD	INDIA
EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
PYROTECH ELECTRONICS PVT LTD	INDIA
YOKOGAWA	INDIA/SINGAPORE
SIEMENS AG	GERMANY
DESUPERHEATERS & PRDS (15EL)	
ARCA REGLER GMBH	GERMANY
BOMAFA SPECIAL VALVE SOLUTIONS PVT. LTD.	INDIA
CHEMTROLS INDUSTRIES LTD	INDIA
CIRCOR FLOW TECHNOLOGIES INDIA PVT LTD	INDIA
CCI VALVE TECHNOLOGY AB(FORMERLY B-706)	SWEDEN
FORBES MARSHALL ARCA P LTD.(FORMRLY A214	INDIA
HOLTER REGELARMATURE N GMBH &CO.KG (HORA)	GERMANY
IMTECH SYSTEMS BV (FORMERLY K-611)	NETHERLANDS
SAMSON AG MESS-UND REGELTECHNIK	GERMANY

Copyright EIL – Right reserved

SPX VALVES & CONTROLS	UK
WEIR VALVES & CONTROLS UK LTD	UK
YARWAY CORPORATION	UNITED STATES
CONTROL COMPONENTS INC.	UNITED STATES
SPX VALVES & CONTROLS (COPES-VULCAN LTD.)	UNITED STATES
ARCA INDIA	INDIA
ARCA (FORBES MARSHALL) (MECH SPRAY NOXXLE TYPE DESUPERHEATER)	INDIA
CONTROL COMPONENTS INC.	INDIA

FIELD INSTRUMENTS (15RD)	
ABB INDIA LTD (BANGALORE)	INDIA
ABB AUTOMATION PRODUCTS GMBH	GERMANY
EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE
ENDRESS+HAUSER WETZER GMBH+ CO.KG	GERMANY
ENDRESS+HAUSER GMBH+CO. KG	GERMANY
FUJI ELECTRIC SYSTEMS CO. LTD	JAPAN
HONEYWELL AUTOMATION INDIA LTD.	INDIA
HONEYWELL INC.	UNITED STATES
INVENSYS INDIA PRIVATE LIMITED	INDIA
YOKOGAWA INDIA LIMITED	INDIA
YOKOGAWA ELECTRIC CORPORATION	JAPAN
CHEMTROLS LTD. (FOR FUJI LTD.)	INDIA

Copyright EIL – Right reserved

ABB KENT	ITALY
YAMATAKE HONEYWELL	JAPAN
HARTMAN & BRAUN	GERMANY
SIEMENS AG (P, DP, T) (NORMAL TYPE)	GERMANY
EMECON CONTROLS PVT LTD (FOR SPRINO MAKE)	INDIA
CHINO-LAX SONS INDIA LTD. (FOR SMAR MAKE)	INDIA
SUPREME TECHNOLOGY (FOR SIEMENS MAKE)	INDIA
FORBES MARSHALL (FOR MOORE MAKE)	INDIA
ENDRESS & HAUSER (INDIA) PVT. LTD.	INDIA
EMERSON PROCESS MANAGEMENT	INTERNATIONAL
YOKOGAWA	INTERNATIONAL
HONEYWELL AUTOMATION	INTERNATIONAL
YAMATAKE CORPORATION (P, DP, VOL. SEAL P & DP)	JAPAN
SMARSINGAPOREPTE. LTD. (P, DP)	SINGAPORE
MOORE PRODUCTS COMPANY (P, DP, VOL. SEAL P & DP)	UNITED STATES
M-SYSTEM (T)	JAPAN
FUJI ELECTRIC INSTRUMENTS CO. LTD.	INDIA
CONTROL PANEL AND ACCESSORIES (15UA)	
ACCUSONIC CONTROLS PVT LTD	INDIA
ELECTRONIC CORPORATION OF INDIA LTD.	INDIA
ELECTRONIC INSTRMNTATION & CONTROL P LTD	INDIA
INSTRUMENTATION LTD	INDIA
INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	INDIA
IRIS AUTOMATION PVT LTD	INDIA
POSITRONICS PVT LTD	INDIA
PRIMA AUTOMATION INDIA PVT LTD	INDIA
PYROTECH ELECTRONICS PVT LTD	INDIA
RADHA KRISHNA CONTROLS	INDIA
RITTAL	INDIA
JAISUN & HUTCHISUN CONTROLS LTD.	INDIA
UNITED ELECTRIC CO. (DELHI) PVT. LTD. (UPTO 10MTR.)	INDIA
YOKOGAWA LIMITED	INDIA
INSTROMENT INTERNATONAL N.V.	HOLLAND
CONTROL VALVES (15EB)	
ARCA REGLER GMBH	GERMANY
AST APPARECCHI DI SICUREZZA E TENUTA SPA	ITALY
CCI VALVE TECHNOLOGY GMBH	CZECH REPUBLIC
DRESSER VALVE INDIA PVT LTD	INDIA
DRESSER PRODUITS INDUSTRIELS	FRANCE
EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA
FORBES MARSHALL ARCA P LTD.(FORMRLY A214	INDIA
FLOWSERVE INDIA CONTROL PVT LTD-BANGALOR	INDIA
FLOWSERVE PTE LTD	SINGAPORE
ITALVALV S.N.C	ITALY
KOSO INDIA PVT LTD (FORM.K176)	INDIA

Copyright EIL – Right reserved

KENT INTROL UK LTD (FORM. A-718)	UK
MIL CONTROLS LIMITED	INDIA
MOTOYAMA ENGG WORKS LTD	JAPAN
METSO FLOW CONTROL OY	FINLAND
SEVERN GLOCON INDIA PVT LTD	INDIA
SAMSON CONTROLS PVT LTD	INDIA
SEVERN GLOCON LTD	UK
SAMSON AG MESS-UND REGELTECHNIK	GERMANY
SPX VALVES & CONTROLS (FORMERLY DEZURIK)	UNITED STATES
WEIR VALVES & CONTROLS UK LTD	UK
ABB (KENT INTROL) (GLOBE & BALL TYPE)	UK
ARGUS (BALL TYPE)	GERMANY
BOHLER (GLOBE TYPE)	AUSTRIA
CONTROL COMPONENTS INDIA PVT. LTD. (GLOBE TYPE)	INDIA
CRANE PROCESS FLOW TECHNOLOGIES (BALL TYPE)	INDIA
DRESSER MASONEILAN(=<2500#, UREA SERVICE ALSO) (GLOBE & ANGLE VALVES, BALL TYPE))	FRANCE
ELCO-MATIC INDIA PVT. LTD. (BALL TYPE)	INDIA
FISHER (GLOBE & BALL TYPE)	UNITED STATES
FISHER CONTROLS (GLOBE & BALL TYPE)	SINGAPORE
FISHER CONTROLS (GLOBE TYPE)	FRANCE
FISHER SANMAR (GLOBE & ANGLE VALVES) (BUTTERFLY VALVE)	INDIA
FISHER XOMOX (=<2500#) (GLOBE & ANGLE TYPE)	SINGAPORE
FISHER XOMOX (GLOBE & BALL TYPE) (=<2500#) GLOBE & ANGLE TYPE)	INDIA
FLOWSERVE (=<2500#) (GLOBE & ANGLE TYPE)	UNITED STATES
GE POWER SYSTEM (NUOVO PIGNONE) (GLOBE & BALL TYPE)	INDIA
GTC (GLOBE & BALL TYPE)	ITALY
INSTRUMENTATIO LTD. (GLOBE & BALL TYPE) (BUTTERFLY UPTO =<300#) (=<2500#, EXCEPT SLURRY, NOISE, CAVITATION) (GLOBE & ANGLE VALVES)	INDIA
KEYSTONE (BUTTERFLY UPTO 2500#)	SINGAPORE
METSO AUTOMATION (BALL TYPE)	INDIA
METSO AUTOMATION (BALL TYPE) (BUTTERFLY UPTO 2500#)	SINGAPORE
NIGATA MASONEILAN (GLOBE & BALL TYPE)	JAPAN
NIPPON FISHER (GLOBE & BALL TYPE) (=<2500#) (GLOBE & ANGLE TYPE)	JAPAN
PARCOL SPA (GLOBE & BALL TYPE) (BUTTERFLY UPTO 2500#) (=<2500#, UREA SERVICE ALSO) (GLOBE & ANGLE TYPE)	ITALY
PIBIVIESSE (BALL TYPE)	ITALY
R K CONTROLS INSTRUMENTS PVT. LTD. (=<600#,EXCEPT SLURRY, NOISE, CAVITATION) FOR NON CRITICAL APPLICATION ONLY) (GLOBE & ANGLE VALVES)	INDIA
RK ENGG. (GLOBE TYPE)	INDIA
SPX VALVES (GLOBE & BALL TYPE)	UK
TYCO (GLOBE & BALL TYPE)	INDIA
TYCO VALVES AND CONTROLS (BUTTERFLY UPTO =<150#)	INDIA
VALTEK (GLOBE TYPE)	UNITED STATES

Copyright EIL – Right reserved

YAMATAKE CORPORATION (=<2500#) (GLOBE & ANGLE TYPE)	JAPAN
YAMATAKE HONEYWELL (GLOBE & BALL TYPE)	JAPAN
VIRGO ENGINEERS LTD. (=<150#)	INDIA
LEEDS VALVE LTD.	UK
MALBRANQUE S.A.	FRANCE
ADAMS ARMATUREN	GERMANY
NIHON KOSO	JAPAN
KEYSTONE	UNITED STATES
METSO AUTOMATION (UPTO 2500#)	INTERNATIONAL
METSO AUTOMATION (UPTO 2500#)	ITALY
MACHINE MONITORING SYSTEM (15BB)	
GE INDIA INDUSTRIAL PVT LTD	INDIA
ROCKWELL AUTOMATION INDIA PVT LTD	INDIA
SHINKAWA ELECTRIC COMPANY LTD.	JAPAN
BENTLEY NEVADA CORPORATION	INTERNATIONAL
BENTLEY NEVADA SALES & SERVICES	INDIA
BENTLEY NEVADA	INDIA
BRUEL & KJAER GMBH	GERMANY
SKF CONDITION MONITORING INC.	SINGAPORE
BENTLEY NEVADA LLC.	UNITED STATES
SIEMENS LIMITED	INDIA
AREVA T&D LIMITED	INDIA

2. It is sub-vendor responsibility to supply items as per EIL Master supplier list(MSL) or approval granted by Owner on case to case basis. Since EIL MSL is dynamic document, Sub vendor/supplier to ensure the valid enlistment/capability of sub vendors with EIL before procuring items from them.

3. Sub-vendor selected by the sucessful bidder to ensure adequate Proven Track Record as per industry practice & if vendor name is not listed in the MSL then vendor/ Sub-vendor has to take Owner concurrence before supplying such items.

4. This document contains confidential information provided By EIL/Licensor.

5. Vendor list for major critical items are attached herewith. It is the responsibility of the successful bidder to submit the vendor list proposed for this package along with schedule, Quality plan, Document Control Index. Categorisation plan etc. before the KOM for approved by RFCL/EIL.

Copyright EIL – Right reserved

ANNEXURE-9-B

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
MECHANICAL		
VALVES-GATE/GLOBE/REG.GLOBE/NON-RETURN; PR.CL.:#150 & #300; MAT.CS/AS/SS; FL/BW ENDS-FOR SIZES-2" & ABOVE & SW ENDS:#800 CLASS		A.V.VALVES LIMITED
		LEADER VALVES LIMITED
		STEEL STRONG VALVES (I) PVT. LTD.
		SHALIMAR VALVES PVT. LTD.
		SKILT FABRICATORS PVT.LTD,
		NITON VALVE INDUSTRIES LTD
		MICON VALVES (I) PVT. LTD.
		NSSL LIMITED
		WEIR BDK VALVES
		B.F.E.SRL BONNEY FORGE
		VALVITALIA S.P.A
		FLOSTEER ENGINEERS PVT. LTD.,
		OSWAL INDUSTRIES LTD.
		L & T VALVES LIMITED
		FOURESS ENGINEERING (I)PVT.LTD
VALVES-GATE/GLOBE/REG.GLOBE/NON-RETURN; PR.CL.:#600; MAT.CS/AS/SS;FL/BW ENDS-FOR ALL SIZES-2" & ABOVE		A.V.VALVES LIMITED
		LEADER VALVES LIMITED
		STEEL STRONG VALVES (I) PVT. LTD.
		SHALIMAR VALVES PVT. LTD.
		SKILT FABRICATORS PVT.LTD,
		NITON VALVE INDUSTRIES LTD
		MICON VALVES (I) PVT. LTD.
		NSSL LIMITED
		WEIR BDK VALVES
		B.F.E.SRL BONNEY FORGE
		VALVITALIA S.P.A
		OSWAL INDUSTRIES LTD.
		AMPO S CO OP POYAM VALVES
		L & T VALVES LIMITED
		FOURESS ENGINEERING (I)PVT.LTD
VALVES-GATE/GLOBE/REG.GLOBE/NON-RETURN; PR.CL.:#900; MAT.CS/AS/SS, FL/BW ENDS-FOR ALL SIZES-2" & ABOVE		K.S.B PUMPS LTD.
		LEADER VALVES LIMITED
		SHALIMAR VALVES PVT. LTD.

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		NITON VALVE INDUSTRIES LTD
		MICON VALVES (I) PVT. LTD.
		NSSL LIMITED
		WEIR BDK VALVES
		B.F.E.SRL BONNEY FORGE
		VALVITALIA S.P.A
		AMPO S CO OP POYAM VALVES
		L & T VALVES LIMITED
		FOURESS ENGINEERING (I)PVT.LTD
VALVES-GATE/GLOBE/REG.CLOBE/NON-RETURN; PR.CL.:#1500; MAT.CS/AS/SS, SW ENDS-FOR SIZES1/2" TO 1-1/2"; FL ENDS - FOR SIZES 2-1/2"		FOURESS ENGINEERING (I)PVT.LTD
		L & T VALVES LIMITED
		VALVITALIA S.P.A
		B.F.E.SRL BONNEY FORGE
		WEIR BDK VALVES
		NSSL LIMITED
		MICON VALVES (I) PVT. LTD.
		NITON VALVE INDUSTRIES LTD
		SHALIMAR VALVES PVT. LTD.
		LEADER VALVES LIMITED
VALVES-GATE/GLOBE/REG.GLOBE/NON-RETURN; PR.CL.:#2500:MAT.CS/AS/SS;SW ENDS - FOR SIZES 1/2" TO 1-1/2"; FL. ENDS-FOR SIZES 2-1/2"		LEADER VALVES LIMITED
		NITON VALVE INDUSTRIES LTD
		MICON VALVES (I) PVT. LTD.
		NSSL LIMITED
		WEIR BDK VALVES
		B.F.E.SRL BONNEY FORGE
		VALVITALIA S.P.A
		L & T VALVES LIMITED
		FOURESS ENGINEERING (I)PVT.LTD
CAST IRON VALVES (GATE/GLV/NRV/SRV)		KALPANA VALVES MFG. CO. PVT. LTD.
		H.SARKER & COMPANY
		G.M. DALUI AND SONS PVT. LTD.
		VENUS PUMP & ENGINEERING WORKS
		KAMALA VALVES & ENGINEERING
		LEVCON VALVES PVT. LTD.
		FLUIDLINE VALVES COMPANY PVT.
		A.V.VALVES LIMITED
		ATAM VALVES PVT. LTD.

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		LEADER VALVES LIMITED
		CRESCENT VALVES MFG CO. PVT. LTD.
		HAWA VALVES (INDIA) PVT. LTD
BALL VALVES		DELVAL FLOW CONTROLS PVT LTD.,
		VIRGO VALVES & CONTROLS PVT LTD
		METSO INDIA PRIVATE LIMITED
		VAAS AUTOMATION PVT LTD
		PENTAIR VALVES & CONTROLS
		UNIFLOW
		ASIAN INDUSTRIAL VALVES AND
		LEADER VALVES LIMITED
		FLUIDLINE VALVES COMPANY PVT. LTD.
		ANAND TEKNOW AIDS ENGINEERING INDIA
		ROTEX MANUFACTURERS & ENGINEERS
		SHALIMAR VALVES PVT. LTD.
		DEMBLA VALVES LTD.
		MICON VALVES (I) PVT. LTD.
		BELGAUM AQUA VALVES PVT LTD
		WEIR BDK VALVES
		MICON ENGINEERS (HUBLI) PVT. LTD.
		MICRO FINISH VALVES PVT.LTD.,
		AKAY INDUSTRIES PVT LTD
		KITZ CORPORATION
		PIBIVIESSE SRL
		LVF S.P.A
		B.F.E.SRL BONNEY FORGE
		H K ENTERPRISES
		FLOW CHEM INDUSTRIES,
		OSWAL INDUSTRIES LTD.
		AMPO S CO OP POYAM VALVES
		L & T VALVES LIMITED
STRAINERS		SUNGOV ENGINEERING PVT LTD,
		ASIAN INDUSTRIAL VALVES AND
		NISAN SCIENTIFIC PROCESS
		SPIRAX MARSHALL LIMITED
		SKILT FABRICATORS PVT.LTD,
		FILTERATION ENGINEERS INDIA PVT LTD
		JAY-EESH ENGINEERING COMPANY
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT
		GRAND PRIX ENGINEERING PVT. LTD
		H K ENTERPRISES

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		TRIVENI EQUIPMENTS PVT LTD
		GUJARAT OTOFILT,
THERMAL INSULATION - R-MATTRESSES/P-SECN		HI-TEC ROCK FIBRE PVT LTD
		THERMOCARE ROCKWOOL INDIA PRIVATE
		JAMSHEDPUR MINERAL WOOL
		DHANBAD ROCKWOOL INSULATION
		INDOBELL INSULATIONS LIMITED
		SHREERAM EQUITECH PRIVATE LIMITED
		POLYBOND INSULATION PRIVATE LIMITED
		GOENKA ROCKWOOL (INDIA) PVT.LTD.
		ROCKWOOL (INDIA) PRIVATE LIMITED
		LLOYD INSULATIONS (INDIA) LTD.,
THERMAL INSULATION - ANCILLARY MATERIAL		ALLIED INSULATIONS (INDIA)
		SURESH FASTENERS
		SURESH INDUSTRIAL CORPORATION
		ENERGY SAVING AND ALLIED PRODUCTS
		SUDHIR TRADING COMPANY
		LLOYD PROJECTS PVT. LTD.
		LLOYD INSULATIONS (INDIA) LTD.,
ALUMINIUM SHEETS/COILS FOR THERMAL INSULATION CLADDING		BHARAT ALUMINIUM COMPANY LTD
		PRIMACY SYSTEMS PVT. LTD.
		JINDAL ALUMINIUM LIMITED
		HINDALCO INDUSTRIES LTD
		NATIONAL ALUMINIUM COMPANY LTD.
CARBON STEEL (SEAMLESS) TUBES / PIPES OD UPTO AND INCLUDING 114.3 MM		LAL BABA SEAMLESS TUBES PVT. LTD.
		MADRAS STEEL AND TUBES
		TUBOS REUNIDOS,S.A,
		SCORODITE STAINLESS
		TUBES INDIA
		NAGARDAS KANJI SHAH
		POONAM ENTERPRISE
		AMARDEEP STEEL CENTRE
		MOKSHI INDUSTRIES PVT. LTD.
		ISMT LIMITED.,
		HEAVY METAL & TUBES LIMITED,

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		JINDAL SAW LIMITED,
		MAHARASHTRA SEAMLESS LTD.,
		EVERGREEN SEAMLESS PIPES & TUBES
		PATELS AIRFLOW LIMITED
		ZHEJIANG GROSS SEAMLESS
		JIANGSU CHENGDE STEEL TUBE
		YANGZHOU LONTRIN STEEL TUBE
		SHANDONG LIAOCHENG ZGL
		WUXI SPECIAL STEEL MATERIAL CO LTD
		JR SEAMLESS PRIVATE LIMITED
CARBON STEEL AND MILDSTEEL PIPES (WELDED)		STEEL AUTHORITY OF INDIA LIMITED
		JCO GAS PIPE LIMITED
		POONAM ENTERPRISE
		AMARDEEP STEEL CENTRE
		SURINDRA ENGG. CO. PVT. LTD.,
		MUKAT TANKS & VESSELS PVT. LTD
		LALIT PIPES & PIPES LTD
		EVERGREEN SEAMLESS PIPES & TUBES
		RATNAMANI METALS & TUBES LTD.,
STAINLESS STEEL TUBES & PIPES OD UPTO AND INCLUDING 168.3MM		TUBACEX TUBOS INOXIDABLES S.A.
		IGAWARA INDL SERVICE & TRADING
		SCORODITE STAINLESS
		TUBACEX PRAKASH INDIA PVT LTD
		POONAM ENTERPRISE
		AMARDEEP STEEL CENTRE
		HINDUSTAN INOX LTD
		SHEKASA ENGINEERING CO. PVT LTD
		SANDVIK ASIA PRIVATE LIMITED
		REMI EDELSTAHL TUBULARS LIMITED
		HEAVY METAL & TUBES LIMITED,
		PRAKASH STEELAGE LTD.,
		MBM TUBES PRIVATE LIMITED
		SURAJ LIMITED
		Steamline Industries Ltd
		MAXIM TUBES COMPANY PVT. LTD.
		SHUBHLAXMI METALS & TUBES
		CHANDAN STEEL LIMITED
		KRYSTAL STEEL MANUFACTURING
		MODERN TUBE INDUSTRIES
		TPS TECHNITUBE ROHRENWERKE

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		RATNAMANI METALS & TUBES LTD.,
		ZHEJIANG PENGYE STAINLESS STEEL
		WUXI SPECIAL STEEL MATERIAL CO LTD
		ZHEJIJANG HI-TECH METALS CO. LTD.
		LINK WELL SEAMLESS TUBES (P) LTD.
STAINLESS STEEL TUBES & PIPES (WELDED)		SCORODITE STAINLESS
		AMARDEEP STEEL CENTRE
		HINDUSTAN INOX LTD
		REMI EDELSTAHL TUBULARS LIMITED
		HEAVY METAL & TUBES LIMITED,
		PRAKASH STEELAGE LTD.,
		APEX TUBES PVT. LTD.
		QUALITY STAINLESS PVT. LTD.
		MAXIM TUBES COMPANY PVT. LTD.
		SHUBHLAXMI METALS & TUBES
		KRYSTAL STEEL MANUFACTURING
		MODERN TUBE INDUSTRIES
		TPS TECHNITUBE ROHRENWERKE
		RATNAMANI METALS & TUBES LTD.,
		ZHEJIJANG HI-TECH METALS CO. LTD.
M.S & G.I.PIPES (WELDED)		UTKARSH TUBES & PIPE LTD.
		NEZONE TUBES LIMITED
		APL APOLLO TUBES LIMITED
		DADU PIPES PVT. LTD.
		BHARAT TUBES CORPORATION
		STEEL AUTHORITY OF INDIA LIMITED
		MADRAS STEEL AND TUBES
		BHAWANI INDUSTRIES LTD
		TUBES INDIA
		LLOYDS LINE PIPES LIMITED
		MOKSHI INDUSTRIES PVT. LTD.
		MUKAT TANKS & VESSELS PVT. LTD
		MAHARASHTRA SEAMLESS LTD.,
		SURYA ROSHNI LIMITED
		JINDAL PIPES LIMITED
		SWASTIK PIPE LIMITED
		NAVRATAN PIPE AND PROFILE LIMITED
		INDUS TUBES LIMITED,
		FUTNANI STEELS PVT LTD.,

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
CARBON STEEL (SEAMLESS) TUBES / PIPES OD ABOVE 114.3 MM AND BELOW 219.1 MM		MADRAS STEEL AND TUBES
		TUBOS REUNIDOS,S.A,
		SCORODITE STAINLESS
		TUBES INDIA
		NAGARDAS KANJI SHAH
		POONAM ENTERPRISE
		AMARDEEP STEEL CENTRE
		MOKSHI INDUSTRIES PVT. LTD.
		ISMT LIMITED.,
		HEAVY METAL & TUBES LIMITED,
		JINDAL SAW LIMITED,
		MAHARASHTRA SEAMLESS LTD.,
		EVERGREEN SEAMLESS PIPES & TUBES
		ZHEJIANG GROSS SEAMLESS
		JIANGSU CHENGDE STEEL TUBE
		YANGZHOU LONTRIN STEEL TUBE
		SHANDONG LIAOCHENG ZGL
		WUXI SPECIAL STEEL MATERIAL CO LTD
CARBON STEEL (SEAMLESS) TUBE / PIPES OD FROM 219.1 MM UPTO AND INCLUDING 273.1 MM		MADRAS STEEL AND TUBES
		PRODUCTOS TUBULARES S.A.,
		SCORODITE STAINLESS
		TUBES INDIA
		NAGARDAS KANJI SHAH
		POONAM ENTERPRISE
		AMARDEEP STEEL CENTRE
		MOKSHI INDUSTRIES PVT. LTD.
		ISMT LIMITED.,
		JINDAL SAW LIMITED,
		MAHARASHTRA SEAMLESS LTD.,
		EVERGREEN SEAMLESS PIPES & TUBES
		ZHEJIANG GROSS SEAMLESS
		JIANGSU CHENGDE STEEL TUBE
		YANGZHOU CHENGDE STEEL PIPE
		YANGZHOU LONTRIN STEEL TUBE
		SHANDONG LIAOCHENG ZGL
		WUXI SPECIAL STEEL MATERIAL CO LTD
CARBON STEEL (SEAMLESS) TUBES / PIPES OD ABOVE 273.1 MM UPTO AND INCLUDING 355.6 MM		MADRAS STEEL AND TUBES
		PRODUCTOS TUBULARES S.A.,
		TUBES INDIA
		POONAM ENTERPRISE
		AMARDEEP STEEL CENTRE

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		MOKSHI INDUSTRIES PVT. LTD.
		MAHARASHTRA SEAMLESS LTD.,
		EVERGREEN SEAMLESS PIPES & TUBES
		KAVIISH FOCUS PIPES PVT. LTD
		ZHEJIANG GROSS SEAMLESS
		JIANGSU CHENGDE STEEL TUBE
		YANGZHOU CHENGDE STEEL PIPE
		YANGZHOU LONTRIN STEEL TUBE
		SHANDONG LIAOCHENG ZGL
		WUXI SPECIAL STEEL MATERIAL CO LTD
CARBON STEEL (SEAMLESS) TUBE /PIPES OD ABOVE 355.6 MM		MADRAS STEEL AND TUBES
		PRODUCTOS TUBULARES S.A.,
		POONAM ENTERPRISE
		AMARDEEP STEEL CENTRE
		MOKSHI INDUSTRIES PVT. LTD.
		EVERGREEN SEAMLESS PIPES & TUBES
		KAVIISH FOCUS PIPES PVT. LTD
		ZHEJIANG GROSS SEAMLESS
		JIANGSU CHENGDE STEEL TUBE
		YANGZHOU CHENGDE STEEL PIPE
		YANGZHOU LONTRIN STEEL TUBE
		WUXI SPECIAL STEEL MATERIAL CO LTD
STAINLESS STEEL TUBES & PIPES OD ABOVE 168.3 MM UPTO AND BELOW 273.1 MM		TUBACEX TUBOS INOXIDABLES S.A.
		PRODUCTOS TUBULARES S.A.,
		IGAWARA INDL SERVICE & TRADING
		SCORODITE STAINLESS
		TUBACEX PRAKASH INDIA PVT LTD
		POONAM ENTERPRISE
		AMARDEEP STEEL CENTRE
		HINDUSTAN INOX LTD
		SHEKASA ENGINEERING CO. PVT LTD
		REMI EDELSTAHL TUBULARS LIMITED
		SURAJ LIMITED
		Steamline Industries Ltd
		MAXIM TUBES COMPANY PVT. LTD.
		TPS TECHNITUBE ROHRENWERKE
		RATNAMANI METALS & TUBES LTD.,
		ZHEJIANG PENGYE STAINLESS STEEL
		YANGZHOU CHENGDE STEEL PIPE

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		WUXI SPECIAL STEEL MATERIAL CO LTD
		ZHEJIJANG HI-TECH METALS CO. LTD.
STAINLESS STEEL TUBES & PIPES OD 273.1 MM AND ABOVE		PRODUCTOS TUBULARES S.A.,
		IGAWARA INDL SERVICE & TRADING
		SCORODITE STAINLESS
		POONAM ENTERPRISE
		AMARDEEP STEEL CENTRE
		SHEKASA ENGINEERING CO. PVT LTD
		SURAJ LIMITED
		TPS TECHNITUBE ROHRENWERKE
		ZHEJIANG PENGYE STAINLESS STEEL
		YANGZHOU CHENGDE STEEL PIPE
		WUXI SPECIAL STEEL MATERIAL CO LTD
NON IBR BUTT WELDED FITTINGS		ENGINEERING SERVICE ENTERPRISE
		N L HAZRA AND SON
		POONAM ENTERPRISE
		NAV DURGA FORGING AND FITTINGS
		TUBE TURN (INDIA) P. LTD.
		UNITECH MACHINES LIMITED
		K. S. PIPE FITTINGS PVT. LTD.
		P.K. TUBES & FITTINGS PVT. LTD.
		TRUE FAB ENGINEER (P) LTD.
		DEE DEVELOPMENT ENGINEERS LTD.,
		TRUE FORGE PVT.LTD.,
		PIPEFIT ENGINEERS PVT. LTD.
		PETRO CHEM INDUSTRIES
		SAWAN ENGINEERS PVT. LTD.
		GUJARAT INFRAPIPES PVT.LTD.,
		TUBE PRODUCTS INCORPORATE
		WEIFANG HUODA PIPE FITTINGS
		U I PIPE FITTINGS PVT. LTD.
		TRIOMECH ENGINEERING PVT. LTD.
NON IBR SOCKET WELDED, SCREWED FITTINGS		FLOWTECH
		ENGINEERING SERVICE ENTERPRISE
		N L HAZRA AND SON
		M.S. FITTINGS MANUFACTURING CO. PVT
		LEADER VALVES LIMITED

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		NAV DURGA FORGING AND FITTINGS
		FITTECH INDUSTRIES PVT. LTD.
		PRECISION ENGINEERING INDS.,
		SKY FORGE PRIVATE LIMITED
		K. S. PIPE FITTINGS PVT. LTD.
		P.K. TUBES & FITTINGS PVT. LTD.
		TRUE FORGE PVT.LTD.,
		PIPEFIT ENGINEERS PVT. LTD.
		U I PIPE FITTINGS PVT. LTD.
		CARLO DYNATECH INDUSTRIES,
		FLASH FORGE PVT LTD
		PRESHZINGER ENGINEERING
		UNIQUE ENGINEERING ENTPS. P. LTD.
		S.S.PIPE FITTINGS & FORGINGS
NON IBR FLANGES		PRESHZINGER ENGINEERING
		THE PUNJAB STEEL WORKS,
		METAL FORGINGS P. LTD.
		TUBE PRODUCTS INCORPORATE
		PIPEFIT ENGINEERS PVT. LTD.
		TRUE FORGE PVT.LTD.,
		NAV DURGA FORGING AND FITTINGS
		C.D. INDUSTRIES,
		CHW FORGE PRIVATE LIMITED
		KISAAN STEELS (PVT) LTD.,
		C.D.ENGINEERING CO.
		KUNJ FORGINGS PVT. LTD.
NON IBR GASKETS		GOODRICH GASKET PVT. LTD.
		MADRAS INDUSTRIAL PRODUCTS,
		I G P ENGINEERS LIMITED,
		TEEKAY FLOWFLEX PVT. LTD.
		UNI KLINGER LTD.
		UNIQUE INDUSTRIAL PACKINGS PVT. LTD
		JAMES WALKER INMARCO INDS PVT LTD
		STARFLEX SEALING INDIA
		JYOTHI INDUSTRIES,
NON IBR BOLTING		SREE PAVITHRA INDUSTRIES,
		UDEHRA FASTENERS LIMITED
		MORNING STAR INDUSTRIES,
		PIONEER NUTS AND BOLTS PVT.LTD
		MEGA ENGINEERING PVT. LTD.
		PRESIDENT ENGINEERING WORKS
		BOLTMASTER (INDIA)PVT.LTD.
		MULTI FASTNERS PVT. LTD.
		ATLAS FASTENERS

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
Control Valves	DRESSER VALVE INDIA PVT LTD INDIA	DRESSER VALVE INDIA PVT.LTD.
	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD INDIA	EMERSON PROCESS MANAGEMENT
	FORBES MARSHALL ARCA P LTD.(FORMRLY A214 INDIA	FORBES MARSHALL ARCA LTD.,
	KOSO INDIA PVT LTD (FORM.K176) INDIA	KOSO INDIA PRIVATE LIMITED
	MIL CONTROLS LIMITED INDIA	KSB MIL CONTROL LIMITED
	INSTRUMENTATIO LTD. (GLOBE & BALL TYPE) (BUTTERFLY UPTO =<300#) (=<2500#, EXCEPT SLURRY, NOISE, CAVITATION) (GLOBE & ANGLE VALVES),INDIA	INSTRUMENTATION LTD
	AST APPARECCHI DI SICUREZZA E TENUTA SPA ITALY	
	CCI VALVE TECHNOLOGY GMBH CZECH REPUBLIC	
	DRESSER PRODUITS INDUSTRIELS FRANCE	
	FLOWSERVE INDIA CONTROL PVT LTD-BANGALOR INDIA	
	FLOWSERVE PTE LTD SINGAPORE	
	ITALVALV S.N.C ITALY	
	KENT INTROL UK LTD (FORM. A-718) UK	
	MOTOYAMA ENGG WORKS LTD JAPAN	
	METSO FLOW CONTROL OY FINLAND	
	SEVERN GLOCON INDIA PVT LTD INDIA	
	SAMSON CONTROLS PVT LTD INDIA	
	SEVERN GLOCON LTD UK	
	SAMSON AG MESS-UND REGELTECHNIK GERMANY	
	SPX VALVES & CONTROLS (FORMERLY DEZURIK) UNITED STATES	
	WEIR VALVES & CONTROLS UK LTD UK	
	ABB (KENT INTROL) (GLOBE & BALL TYPE) UK	
	ARGUS (BALL TYPE) GERMANY	
	BOHLER (GLOBE TYPE) AUSTRIA	
	CONTROL COMPONENTS INDIA PVT. LTD. (GLOBE TYPE) INDIA	

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
	CRANE PROCESS FLOW TECHNOLOGIES (BALL TYPE) INDIA	
	DRESSER MASONEILAN(=<2500#, UREA SERVICE ALSO) (GLOBE & ANGLE VALVES, BALL TYPE)) FRANCE	
	ELCO-MATIC INDIA PVT. LTD. (BALL TYPE) INDIA	
	FISHER (GLOBE & BALL TYPE) UNITED STATES	
	FISHER CONTROLS (GLOBE & BALL TYPE) SINGAPORE	
	FISHER CONTROLS (GLOBE TYPE) FRANCE	
	FISHER SANMAR (GLOBE & ANGLE VALVES) (BUTTERFLY VALVE) INDIA	
	FISHER XOMOX (=<2500#) (GLOBE & ANGLE TYPE) SINGAPORE	
	FISHER XOMOX (GLOBE & BALL TYPE) (=<2500#) GLOBE & ANGLE TYPE) INDIA	
	FLOWSERVE (=<2500#) (GLOBE & ANGLE TYPE) UNITED STATES	
	GE POWER SYSTEM (NUOVO PIGNONE) (GLOBE & BALL TYPE) INDIA	
	GTC (GLOBE & BALL TYPE) ITALY	
	KEYSTONE (BUTTERFLY UPTO 2500#) SINGAPORE	
	METSO AUTOMATION (BALL TYPE) INDIA	
	METSO AUTOMATION (BALL TYPE) (BUTTERFLY UPTO 2500#) SINGAPORE	
	NIGATA MASONEILAN (GLOBE & BALL TYPE) JAPAN	
	NIPPON FISHER (GLOBE & BALL TYPE) (=<2500#) (GLOBE & ANGLE TYPE) JAPAN	
	PARCOL SPA (GLOBE & BALL TYPE) (BUTTERFLY UPTO 2500#) PIBIVIESSE (BALL TYPE) ITALY	
	R K CONTROLS INSTRUMENTS PVT. LTD. (=<600#,EXCEPT SLURRY, NOISE, CAVITATION) FOR NON CRITICAL APPLICATION ONLY) (GLOBE & ANGLE VALVES) INDIA	
	RK ENGG. (GLOBE TYPE) INDIA	
	SPX VALVES (GLOBE & BALL TYPE) UK	
	TYCO (GLOBE & BALL TYPE) INDIA	

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
	TYCO VALVES AND CONTROLS (BUTTERFLY UPTO =<150#) INDIA	
	VALTEK (GLOBE TYPE) UNITED STATES	
	YAMATAKE CORPORATION (=<2500#) (GLOBE & ANGLE TYPE) JAPAN	
	YAMATAKE HONEYWELL (GLOBE & BALL TYPE) JAPAN	
	VIRGO ENGINEERS LTD. (=<150#) INDIA	
	LEEDS VALVE LTD. UK	
	MALBRANQUE S.A. FRANCE	
	ADAMS ARMATUREN GERMANY	
	NIHON KOSO JAPAN	
	KEYSTONE UNITED STATES	
	METSO AUTOMATION (UPTO 2500#) INTERNATIONAL	
	METSO AUTOMATION (UPTO 2500#) ITALY	
	ARCA REGLER GMBH GERMANY	
SAFETY RELIEF VALVES		BOPP & REUTHER SICHERHEITS- UND
		BLISS ANAND PVT. LTD.,
		INSTRUMENTATION LTD
		WEIR BDK VALVES
		FORBES MARSHALL LTD.,
		FAINGER LESER VALVES PVT. LTD.
		PENTAIR SANMAR LIMITED
Pneumatic On Off Ball Valves		DELVAL FLOW CONTROLS PVT LTD.,
		VIRGO VALVES & CONTROLS PVT LTD
		METSO INDIA PRIVATE LIMITED
		PENTAIR VALVES & CONTROLS
		UNIFLOW
		ANAND TEKNOW AIDS ENGINEERING INDIA
		WEIR BDK VALVES
		L & T VALVES LIMITED
Self-Actuated Control Valves		RICHARDS INDUSTRIES
		EMERSON PROCESS MANAGEMENT
		DRESSER VALVE INDIA PVT.LTD.
		SAMSON CONTROLS PVT LTD.,

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		NIRMAL INDUSTRIAL CONTROLS PVT LTD
		SAMSON AG MESS- UND REGELTECHNIK
ELECTRCIAL		
HV CABLE KITS		RITHVIK ENTERPRISES
		RAYCHEM RPG LIMITED
		BIRLA 3 M LTD
		YAMUNA CABLE ACCESSORIES PVT. LTD.
		HARI CONSOLIDATED PVT. LTD.
LV POWER CABLES		GUPTA POWER INFRASTRUCTURE LTD.
		RAVIN CABLES LTD
		APAR INDUSTRIES LIMITED
		SUYOG ELECTRICALS LTD
		TORRENT POWER LIMITED (CABLE UNIT)
		POLYCAB WIRES PVT.LTD
		GEMSCAB INDUSTRIES LTD.
		SRIRAM CABLES PVT. LTD.
		SPECIAL CABLES PVT. LTD.
		DELTON CABLES LIMITED
		KEI INDUSTRIES LIMITED
		CORDS CABLE INDUSTRIES LTD.
		NICCO CORPORATION LTD HYD
		KEC INTERNATIONAL LIMITED
		THERMO CABLES LIMITED
		UNIVERSAL CABLES LTD
CONTROL CABLES		GUPTA POWER INFRASTRUCTURE LTD.
		PAGODA CABLES PVT. LTD.
		ASSOCIATED CABLES PVT LTD.
		RAVIN CABLES LTD
		SBEE CABLES (INDIA) LIMITED
		ELKAY TELELINKS LIMITED
		SUYOG ELECTRICALS LTD
		POLYCAB WIRES PVT.LTD
		GEMSCAB INDUSTRIES LTD.
		SRIRAM CABLES PVT. LTD.
		SPECIAL CABLES PVT. LTD.
		PARAMOUNT COMMUNICATIONS LTD
		DELTON CABLES LIMITED
		KEI INDUSTRIES LIMITED
		CMI LIMITED
		CORDS CABLE INDUSTRIES LTD.
		NICCO CORPORATION LTD HYD
		KEC INTERNATIONAL LIMITED

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		THERMO CABLES LIMITED
		UNIVERSAL CABLES LTD
CABLE LUGS		AUTOMIC ELECTRIC &
		CHETNA ENGINEERING CO.
		ELECTROMAC INDUSTRIES
		FORWARD ENGINEERING INDUSTRIES
CABLE GLANDS		ELECTROMAC INDUSTRIES
		FCG FLAMEPROOF CONTROL GEARS
		FLAMEPROOF EQUIPMENTS PVT.LTD.
		PROMPT ENGINEERING WORKS, MUMBAI
		FCG POWER INDUSTRIES
		FLEXPRO ELECTRICALS PVT. LTD.,
		UNITED AGRO ENGINEERING PVT. LTD.
Cable Trays		INDUSTRIAL PERFORATION (I) PVT. LTD
		UNITECH FABRICATORS & ENGINEERS
		RUKMANI ELECTRICAL & COMPONENTS
		RABI ENGINEERING WORKS PVT. LTD
		RATAN PROJECTS & ENGG. CO. PVT. LTD
		INDIA ELECTRICALS SYNDICATE
		PREMIER POWER PRODUCTS
		VINFAB ENGINEERS INDIA PRIVATE
		INDIANA GRATINGS PVT. LTD.
		METALEMMS BOMBAY PVT. LTD.
		PASSIVE INFRA PROJECTS (P) LTD.
		PARMAR METALS PVT. LTD
		M J ENGINEERING WORKS (P) LIMITED
		JAMNA METAL COMPANY
		PATNY SYSTEMS PVT. LTD
FRP CABLE TRAYS AND ACCESSORIES		PATNY SYSTEMS PVT. LTD
		SUMIP COMPOSITES PVT. LTD.
		SATYAM COMPOSITES PVT LTD
		GENERAL COMPOSITES PVT. LTD.
		ERCON COMPOSITES
C&I		
INSTRUMENTATION CABLES		PAGODA CABLES PVT. LTD.
		UDEY PYROCABLES PVT. LTD.

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		LEONI CABLE SOLUTIONS (INDIA)
		ASSOCIATED CABLES PVT LTD.
		APAR INDUSTRIES LIMITED
		LAPP INDIA PVT. LTD.
		ELKAY TELELINKS LIMITED
		SUYOG ELECTRICALS LTD
		POLYCAB WIRES PVT.LTD
		T C COMMUNICATION PVT. LTD.
		SPECIAL CABLES PVT. LTD.
		PARAMOUNT COMMUNICATIONS LTD
		DELTON CABLES LIMITED
		KEI INDUSTRIES LIMITED
		CORDS CABLE INDUSTRIES LTD.
		MIDDLE EAST SPECIALIZED CABLES CO.
		KEC INTERNATIONAL LIMITED
		THERMO CABLES LIMITED
FLOW ORIFICE		ASIAN INDUSTRIAL VALVES AND
		EUREKA INDUSTRIAL EQUIPMENTS
		STAR-MECH CONTROLS (I) PVT. LTD.
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT
		DYNAFLUID VALVES AND FLOW CONTROLS
		INSTRUMENTATION LTD
		MICRO PRECISION PRODUCTS (P) LTD.
		HYDROPNEUMATICS PRIVATE LIMITED
		MINCO (INDIA) FLOW ELEMENTS
		MINCO INDIA PVT. LTD.
FLOW NOZZLE		MINCO INDIA PVT. LTD.
		MINCO (INDIA) FLOW ELEMENTS
		HYDROPNEUMATICS PRIVATE LIMITED
		MICRO PRECISION PRODUCTS (P) LTD.
		INSTRUMENTATION LTD
		DYNAFLUID VALVES AND FLOW CONTROLS
		STAR-MECH CONTROLS (I) PVT. LTD.
		ASIAN INDUSTRIAL VALVES AND
Mass flow meter		YOKOGAWA INDIA LIMITED
		KROHNE MARSHALL PVT LTD
		ENDRESS + HAUSER (INDIA) PVT. LTD.
		GE INDIA INDUSTRIAL PVT. LTD.

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		FORBES MARSHALL (HYD) PVT LIMITED,
		EMERSON PROCESS MGT (I) PVT LTD
INSTRUMENT HOOK UP PACKAGE		NAV DURGA FORGING AND FITTINGS
		SWASTIK ENGINEERING WORKS
		PANAM ENGINEERS PVT. LTD.
		DYNAFLUID VALVES AND FLOW CONTROLS
		P.K. TUBES & FITTINGS PVT. LTD.
		TRUE FAB ENGINEER (P) LTD.
		TRUE FORGE PVT.LTD.,
		U I PIPE FITTINGS PVT. LTD.
		CARLO DYNATECH INDUSTRIES,
		PRESHZINGER ENGINEERING
		UNIQUE ENGINEERING ENTPS. P. LTD.
		KWALITY FORGED FITTINGS
LEVEL TRANSMITTER (GUIDED WAVE RADAR TYPE)		MAGNETROL INTERNATIONAL N.V.
		V AUTOMAT AND INSTRUMENTS PVT LTD
		PUNE TECHTROL PVT LTD
		SAAB ROSEMOUNT TANK GUAGING
		VEGA INDIA LEVEL & PRESSURE MEASURE
DIFFERENTIAL PRESSURE INDICATOR / GAUGES		PRECISION MASS PRODUCTS PVT LTD
		WALCHANDNAGAR INDUSTRIES LIMITED
		BAUMER TECHNOLOGIES
		HIRLEKAR PRECISION ENGG. PVT. LTD.
		SAMSON CONTROLS PVT LTD.,
		GAUGES BOURDON INDIA
		SWITZER PROCESS INSTRUMENTS
		A.N. INSTRUMENTS PVT. LTD.,
JUNCTION BOXES (WEATHER PROOF)		PYROTECH ELECTRONICS PVT. LTD.
		FCG FLAMEPROOF CONTROL GEARS
		FLAMEPROOF EQUIPMENTS PVT.LTD.
		EX-PROTECTA
		FLEXPRO ELECTRICALS PVT. LTD.,

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		PANAM CONTROLS,
JUNCTION BOXES (EXPLOSION PROOF)		FLEXPRO ELECTRICALS PVT. LTD.,
		FCG POWER INDUSTRIES
		SAFEX FLAMEPROOF CONTROLS (P) LTD
		FLAMEPROOF EQUIPMENTS PVT.LTD.
		FCG FLAMEPROOF CONTROL GEARS
LIQUID LEVEL FLOAT SWITCH		D.K.INSTRUMENTS (P) LTD.,
		LEVCON INSTRUMENTS(P) LTD
		GAUGES BOURDON INDIA
		PUNE TECHTROL PVT LTD
		CHEMTROLS INDUSTRIES LTD.,
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT
		V AUTOMAT AND INSTRUMENTS PVT LTD
		MAGNETROL INTERNATIONAL, INC.
LIQUID LEVEL GAUGES		D.K.INSTRUMENTS (P) LTD.,
		LEVCON INSTRUMENTS(P) LTD
		GAUGES BOURDON INDIA
		NISAN SCIENTIFIC PROCESS
		PUNE TECHTROL PVT LTD
		CHEMTROLS INDUSTRIES LTD.,
		PRATOLINA INSTRUMENTS PVT.LTD.
		TECNOMATIC (INDIA) PRIVATE LIMITED,
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT
		BLISS ANAND PVT. LTD.,
		V AUTOMAT AND INSTRUMENTS PVT LTD
PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES		INDFOS INDUSTRIES LIMITED,
		TRAFAG CONTROLS INDIA PVT LTD
		BAUMER TECHNOLOGIES
		HIRLEKAR PRECISION ENGG. PVT. LTD.
		KAUSTUBHA UDYOG
		GAUGES BOURDON INDIA
		SWITZER PROCESS INSTRUMENTS
PRESSURE GAUGES		FORBES MARSHALL (HYD) PVT LIMITED,
		PRECISION MASS PRODUCTS PVT LTD

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		H.GURU INSTRUMENTS(S.I)PVT.LTD
		WALCHANDNAGAR INDUSTRIES LIMITED
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT
		BAUMER TECHNOLOGIES
		GAUGES BOURDON INDIA
		A.N. INSTRUMENTS PVT. LTD.,
		PROTECH CONTROL INSTRUMENTS
RESISTANCE TEMPERATURE DETECTORS (RTD & THERMOCOUPLES)		PROTECH CONTROL INSTRUMENTS
		TEMPSENS INSTRUMENTS (I) PVT.LTD.
		THERMAL INSTRUMENT INDIA
		GAUGES BOURDON INDIA
		EXOTHERM INSTRUMENTS
		DETRIV INSTRUMENTATION
		BAUMER TECHNOLOGIES
		PYRO ELECTRIC INSTRUMENTS GOA
		GOA INSTRUMENTS INDUSTRIES
THERMOMETERS		PROTECH CONTROL INSTRUMENTS
		A.N. INSTRUMENTS PVT. LTD.,
		GAUGES BOURDON INDIA
		BAUMER TECHNOLOGIES
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT
		WALCHANDNAGAR INDUSTRIES LIMITED
		H.GURU INSTRUMENTS(S.I)PVT.LTD
		PRECISION MASS PRODUCTS PVT LTD
		GOA INSTRUMENTS INDUSTRIES
		FORBES MARSHALL (HYD) PVT LIMITED,
THERMOWELLS		PROTECH CONTROL INSTRUMENTS
		TEMPSENS INSTRUMENTS (I) PVT.LTD.
		NAV DURGA FORGING AND FITTINGS
		THERMAL INSTRUMENT INDIA
		GAUGES BOURDON INDIA
		EXOTHERM INSTRUMENTS
		PRECISION ENGINEERING INDS.,
		CHEMTROLS INDUSTRIES LTD.,
		BAUMER TECHNOLOGIES
		SCIENTIFIC DEVICES (BOMBAY) PVT. LT

Items Description	Customer Vendor List	BHEL-PE&SD-PMD List
		H.GURU INSTRUMENTS(S.I)PVT.LTD
		MICRO PRECISION PRODUCTS (P) LTD.
		PYRO ELECTRIC INSTRUMENTS GOA
		GOA INSTRUMENTS INDUSTRIES
		CARLO DYNATECH INDUSTRIES,
		VALUE TREK ENGINEERS,
PR. & DIFF. PR. TRANSMITTERS (ELECTRONIC - SMART) & TEMPERATURE TRANSMITTER		EMERSON PROCESS MGT (I) PVT LTD
		ABB INDIA LIMITED,HYD
		YOKOGAWA INDIA LIMITED
		HONEYWELL AUTOMATION INDIA LIMITED
LEVEL TRANSMITTER (RADAR, NON-CONTACT TYPE)		VEGA INDIA LEVEL & PRESSURE MEASURE
		HONEYWELL AUTOMATION INDIA LIMITED
		SAAB ROSEMOUNT TANK GUAGING
		PUNE TECHTROL PVT LTD
		ENDRESS + HAUSER (INDIA) PVT. LTD.
		MAGNETROL INTERNATIONAL N.V.
		EMERSON PROCESS MGT (I) PVT LTD

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-10

Master Document list

MASTER DOCUMENT LIST - Boiler Feed Pump assembly

	Vendor Name:				PROJECT:									
	Vendor Contact Person:				BHEL PO No.		PO date:					PO Dly. Date:		
	Vendor contact No.				Supplier's Job No.									
	SYSTEM/PACKAGE:	BFP				TODAY-DATE	18-Apr-17			Sumission status to BHEL				
Sl.No	DRG/DOC. NAME	DRG/ DOC NO.	NO. OF SHTS.	CAT	CRITICAL FOR MFG?	REQD.FOR CUSTOMER SUBMISSION?	Plan date of submission	Count of DUE as on Dt.	STATUS	Rev-0			Final Rev-(R)	REMARKS
			NO.	(A / I)	(Y/N)	(Y/N)	dd-mmm-yyyy		" "/PV/PB /PC/AA	SD	AD	APP.CAT	Date	
1.0 Mechanical														
A	MECHANICAL													
1	Pump Data Sheet			A										
2	Pump Performance curve			I										
3	Pump assembly GA drawing			A										
4	Pump Cross Sectional Drawing			I										
5	Pump P&ID			I										
6	Logic diagram			I										
7	~~Motor Data Sheet~~			A										
8	~~Motor GA drawing~~			A										
9	~~Motor Curves~~			I										
10	~~T-S Curve~~			I										
11	Hydraulic coupling GA Drawing			A										
12	Hydraulic coupling datasheet			A										
13	Hydraulic coupling CSD			I										
14	Hydraulic coupling P&ID			I										
15	Gear box GA drawing			A										
16	Gear box datasheet			A										
17	Coupling GA Drawing			I										
18	Mechanical Seal GA Drawing and details			I										
19	Strainer GA Drawing and details			A										
20	Strainer Area calculation			I										
21	Strainer Pressure Drop calculation			I										
22	ARC valve GAD, Datasheet			A										
23	LO skid documents [GAD, P&ID, AOP & Motor documents, Instruments datasheets, Heater details etc]													
B	INSTRUMENTTAION													
1	~~Datasheet of Pump & Motor Bearing & Winding RTDs~~			A										
2	~~Datasheet of Motor Bearing TGs~~			A										
3	Instrument datasheets [PG,PT,PS,DPG,DPS,DPT,TG,RTD,PSV etc as per scope of supply]			A										
4	Hydraulic coupling Instrument datasheets as per P&ID			A										
5	Impulse line routing drawing			A										

MASTER DOCUMENT LIST - Boiler Feed Pump assembly

	Vendor Name:				PROJECT:									
	Vendor Contact Person:				BHEL PO No.		PO date:				PO Dly. Date:			
	Vendor contact No.				Supplier's Job No.									
	SYSTEM/PACKAGE:	BFP				TODAY-DATE	18-Apr-17			Sumission status to BHEL				
Sl.No	DRG/DOC. NAME	DRG/ DOC NO.	NO. OF SHTS.	CAT	CRITICAL FOR MFG?	REQD.FOR CUSTOMER SUBMISSION?	Plan date of submission	Count of DUE as on Dt.	STATUS	Rev-0			Final Rev-(R)	REMARKS
			NO.	(A / I)	(Y/N)	(Y/N)	dd-mmm-yyyy		" "/PV/PB /PC/AA	SD	AD	APP.CAT	Date	
C	MISCELLANEOUS													
1	Performance Test Procedure			A										
2	Balancing_LP test & ultrasonic test procedure			I										
3	NPSH test procedure			I										
4	Vibration test procedure			I										
5	Temperature rise test procedure			I										
6	Hydro Test Procedure			A										
7	NDT Procedure			I										
8	Painting proccedure			A										
9	Packing List			I										
10	BILL OF MATERIAL			A										
11	BILLING BREAKUP			A										
12	Complete Unit test procedure			A										
13	QUALITY ASSURANCE PLAN			A										
14	SUB VENDOR LIST			I										
15	COMMISSIONING SPARES LIST			I										
16	Mandatory spare list			A										
17	LUBE OIL SCHEDULE			I										
18	STARTUP PROCEDURE			I										
19	ERECTION PROCEDURE			I										
20	COMMISSIONING PROCEDURE			I										
21	INSPECTION/TESTS REPORTS/CERTIFICATE			I										
22	O& M Manuals(Soft Copies)			I										
23	O& M Manuals(Hard Copies)** ** hard copy shall be furnished after getting concurrence on soft copy.			I										
							TOTAL	0		^APP.CAT				
	A-Approval Category	PV-Commented and pending with vendor					TOTAL "PV"		0	A1-'Approved				
	I-Information Category	PB- Pending with BHEL					TOTAL "PB"		0	A2-'Mfg. Clearance given subject incorpo				
		PC- Pending with Customer					TOTAL "PC"		0	A3-Commented.Revision & resubmission required.				
		AA- Approved					TOTAL "AA"		0	A4- Retained for info.				
		" " - Not yet Due.												
		OD - Over Due.					TOTAL "OD"		0					

Vendor documentation status									
Total No of Docs	Due as on Date	Submitted by vendor as on Dt.	Approved by BHEL as on Dt.	Commented by BHEL as on Dt.	Pending with BHEL/CUSTOMER as on date	%age of Dos Approved	%age of critical Dos Approved	Is Mfg. Clearance given?	Status/ Remarks
(Nos)	(Nos)	(Nos)	(Nos)	(Nos)	(Nos)	% age	% age	(Y/N)./ (If Y) put Dt.	
0	0	0	0	0	0	#DIV/0!		Y	

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-11

Deviation Format

DEVIATION SCHEDULE - TECHNICAL (BFP PACKAGE)

Bidders are requested to mark "√" as applicable

☐ NO DEVIATION REQUIRED

☐ DEVIATION REQUIRED

List of deviations (exceptions and / or additions requested by bidder) from specification, standards and / or drawings etc.

Sl. No.	DOCUMENT(S)/ DRAWING(S)		DEVIATION PROPOSED
	NO. AND TITLE	PARAGRAPH/ CLAUSE/ DETAIL	

BIDDER'S NAME:

BIDDER'S SIGNATURE
AND SEAL/STAMP

DATE:

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-12

Prebid clarification

DEVIATION SCHEDULE TECHNICAL

Bidder are requested to mark "✓" as applicable

☐ **No Deviation required**

☐ **Deviation required**

List of deviations (expectations and /or addition requested by Bidder) from specification, standards and /or drawing etc.

Sl. No.	Section / Part/Subsection	Page No.	Clause No.	Bid Specification	Bidder's Query	Purchaser's Reply

Note: Bidder to furnish this duly filled format along with SEAL & SIGN at pre-bid stage only and any deviations appearing elsewhere shall not be considered.

SIGNATURE : _____

NAME : _____

DESIGNATION : _____

COMPANY : _____

DATE : _____

COMPANY SEAL

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-13

EIL Specifications

Sl No	CONTENTS	Doc No.
13-A	Pump Datasheet	A747-400-80-42-DS-7810
13-B	Gearbox datasheet	A747-400-80-42-DS-7212
13-C	Coupling datasheet	A747-400-80-42-DS-7213
13-D	Engineering design basis rotating equipment	A747-999-16-45-EDB-1001
~~13-E~~	~~Engineering design basis Electrical~~	~~A747-999-16-50-EDB-1001~~
13-F	Standard Specification For Centrifugal Pumps (special purpose process service)	6-41-0006
~~13-G~~	~~Specification For High Voltage Induction Motors~~	~~6-51-0031~~
13-H	Specification For Medium Voltage Induction Motors	6-51-0064
~~13-I~~	~~ITP for HV motor~~	~~6-81-1031~~
13-J	ITP for MV motor	A747-6-81-1031 & 6-81-1032
~~13-K~~	~~Job specification for Instrumentation package~~	~~A747-400-16-51-SP-7210~~
~~13-L~~	~~Standard specification for instrumentation of package Units~~	~~6-52-0052~~
13-M	Job Specification For Surface Preparation and Protective Coating	A747-000-79-41-PLS-01
13-N	EIL specification extracts	A747-400-80-42-SP-7210 & 7- 44 - 0321

1	**GENERAL**							
2	Project: REVIVAL OF RAMAGUNDAM FERTILIZER COMPLEX				Job No.: **A747**			
3	Owner: **M/s RF&CL**				Site: **RAMAGUNDAM, TELENGANA**			
4	Purchaser:				Unit: **Steam & Power Gen.**		Unit No.: **400**	
5	Item No.:				Service:			
6	No. Required:	Working:	Standby:		Driver Type: Working:		Standby:	
7	Applicable to	☐ Proposals			☐ Purchase		☐ As Built	
8	■ Scope, Option & Information Specified By Purchaser ☐ Information required from and options left to vendor. Vendor to cross ☒ the selected option							
9	Manufacturer:				Model:			
10	Driver supplied & mounted by:				☐ Pump Manufacturer		☐ Other	
11	Gear(If reqd.) supplied & mounted by:				☐ Pump Manufacturer		☐ Other	
12	**Applicable Code & Standards: Job Spec and API 610 10th edition alongwith EIL Std. Spc. No. 6-41-0006 .**							
13								
14	**OPERATING CONDITIONDS**				**SITE AND UTILITY DATA**			
15	☐ **Capacity (m^3/hr)**				**Location:** ☐ Indoor	☐ Heated	☐ Underroof	
16	Normal:	Rated:	Other:		☐ Outdoor ☐ Unheated	☐ Grade	☐ Partial Side	
17	☐ Suct. Pressure (kg/cm^2G) [Max./Rated]:				☐ Mezzanine	☐ Other:		
18	☐ Discharge Pressure (kg/cm^2G):				☐ **Electrical Area Classification:**			
19	☐ Differential Pressure (kg/cm^2):				Class	Group	Division	
20	☐ Differential Head (m)		NPSHA (m)		☐ Winterisation Required	☐ Tropicalisation Required		
21	☐ Process Variations				☐ **Site Data:**			
22	☐ Starting Conditions				☐ Altitude (m):	☐ Barometer (kg/cm^2G):		
23	☐ Service:	☐ Continuous	☐ Intermittent(Start/Day)		☐ Range of Amb.Temp.(EC): Min./Max.			
24	☐ Parallel Operation Required	☐ Yes	☐ No		☐ Relative Humidity(%):Min./Max.			
25	**PERFORMANCE**				☐ **Unusual Conditions:**			
26	Proposal Curve No.				☐ Dust	☐ Fumes	☐ Other	
27	Visc. Correction Factor	C_n / C_Q / C_H :			☐ **Utility Conditions:**			
28	☐ NPSH Reqd. (m)		F/L Speed (rpm):		☐ **Steam:**	Driver	Heating	
29	■ No. of Stages: **<=10**		Efficiency (%):		☐ Press.	@ °C	@ °C	
30	☐ Rated BKW (**+/-** 0% Tol.):				☐ Press.	@ °C	@ °C	
31	☐ Max. BKW Rtd. Implr. (kW):							
32	☐ BKW @ MCF (Δ=1) (kW):							
33	☐ Recom. Driver Rating (kW):				☐ **Electricity:**	Drivers	Heating	Control Shutdown
34	☐ Max. Head @ Rated Impeller (m):				☐ Voltage			
35	☐ Capacity @ BEP(m^3/hr):				☐ Hertz			
36	☐ Min. Cont. Flow (m^3/hr):	Stable:	Thermal:		☐ Phase			
37	☐ Preferred Operating Region(m^3/hr):		To		☐ **Cooling Water:**			
38	☐ Allowable Operating Region(m^3/hr):		To		☐ Temp. Inlet (EC):	Max. Return (EC):		
39	☐ Suction Specific Speed:				☐ Pressure: Nor. (kg/cm^2G)	Design (kg/cm^2G):		
40	■ Max. Sound Pressure Level Allowable(dBA): **85 @ 1 m**				☐ Return: Min. (kg/cm^2G)	Max. Allow.)P(kg/cm^2G):		
41	☐ Expected Sound Pressure Level(dBA):				☐ Water Source:			
42					☐ Chloride Concentration (PPM):			
43	**CONSTRUCTION**				☐ Instrument Air Pressure (kg/cm^2G):			
44	■ **PUMP TYPE: BB5**				Max.	Min.		
45	☐ BB Axially Split, Multistage				**LIQUID**			
46	■ BB Radially Split, Multistage: ☐ Single Casing ■ Double Casing				☐ Type/Name of Liquid:			
47	☐ Vert. Suspended Double Casing: ☐ Diffuser ☐ Volute				☐ Pumping Temperature(EC):			
48	**Nozzle Connections:**				Normal	Max.	Min.	
49		Size	Rating	Facing	Position	☐ Vapour Pressure(kg/cm^2A):	@ °C	
50	Suction					☐ Relative Density(Specific Gravity):		
51	Discharge					Normal	Max.	Min.
52	Balance Drum					☐ Specific Heat(Cp)	kJ/kgEC	
53	☐ Impeller Diameter (mm):					☐ Viscosity(~~cP~~/cst) @PT	@ °C	
54	Rated:	Max.	Min.			☐ Max. Viscosity(~~cP~~/cst)	@ °C	
55	☐ **Pressure Casing Connections:**					☐ Corrosive/Erosive Agent:		
56		No.	Size	Type		☐ Chloride Concentration (PPM):		
57	■ Drain			With Valve		☐ H2S Concentration (PPM):		
58	■ Vent			With Valve		☐ Hazardous	☐ Flammable	☐ Other
59	☐ Pressure Gage							
60	☐ Temp. Gauge							

Copyrights EIL – All rights reserved

61					**MATERIAL**		
62					Material Class(API-610):	MOC	ASTM Grades
63	**Press. Casing Conn. Contd.**				Casing		
64		No.	Size	Type	Barrel		
65	■ Warm Up				Inner Casing		
66	■ Balance/Leak off				Impeller(Suction)		
67	☐ Cylindrical Threads Required				Impeller(Others)		
68	■ **Casing Mounting(*See Separate Sheet for Vertical*):**				Shaft Sleeve		
69	■ Centerline ☐ Near Centerline ☐ Foot				Interstage Sleeve		
70	☐ Separate Mounting Plate ☐ In-Line				Casing Wearing Ring)H-BHN		
71	■ Casing ☐ Axial ☐ Radial				Imp. Wearing Ring =50 (min)		
72	■ **Casing Type:**				Shaft		
73	☐ Single Volute ☐ Multiple Volute ☐ Diffuser				Throat Bush		
74	■ Between Bearings ☐ Barrel				Throttle Bush		
75	■ **Case Pressure Rating:**				Diffuser		
76	■ MAWP (kg/cm²G): @ EC				Drive Shaft		
77	■ Hydrotest Pressure (kg/cm²G): **1.5 X MAWP**				Intermediate Shaft		
78	■ Suction Press. Region must be Designed for MAWP				Pump Shaft		
79	☐ Rotation (Viewed from Coupling End):				Bearing for Intermediate Shaft		
80	☐ CW ☐ CCW				Column Pipe		
81	■ Impellers Individually Secured						
82	■ **SHAFT:**						
83	☐ Shaft Dia. at Coupling		mm				
84	☐ Shaft Dia. Between Bearings		mm				
85	☐ Span Between Bearings		mm		**Legends:** I-Cast Iron, B- Bronze, S- Carbon Steel, C- 11-13% Chr. Stl.,		
86	☐ Span Between Brg. & Impeller		mm		h- Hardened, f- Faced, K- SS 304, L-SS 316		
87	Remark:				X		
88					Y		
89					Z		
90							
91	**Couplings:**	**Driver-Pump**					
92	☐ Make:				Remarks:		
93	☐ Model:						
94	☐ Coupling Rating(kW/100 RPM):						
95	☐ Lubrication:						
96	☐ Limited End Float Required:						
97	☐ Spacer Length: mm						
98	■ Service Factor: 1.5 minimum						
99	■ Driver Half Coupling Mounted By:						
100	■ Pump Mfr. ☐ Driver Mfr. ☐ Purchaser						
101	■ Coupling Per API 671						
102	■ Base Plate:						
103	☐ API Base Plate Number: ☐ Non Grout Const.						
104	Remark:						
105							
106							
107	**Bearings And Lubrication**						
108	☐ Bearing Type Number:						
109	■ Radial						
110	■ Thrust						
111	☐ Review and Approve Thrust Bearing Size						
112	☐ Lubrication:						
113	☐ Grease	☐ Flood		☐ Ring Oil			
114	☐ Flinger	☐ Purge Oil Mist		☐ Pure Oil Mist			
115	☐ Constant Level Oiler Preferance						
116	☐ Pressure Lub. System:	☐ API 610		☐ API 614			
117	☐ Oil Viscosity ISO Grade						
118	☐ Oil Heater Required:	☐ Electric		☐ Steam			
119	☐ Oil Pressure to be greater than Coolant Press.						
120	Remarks:						

Copyrights EIL – All rights reserved

121	**MECHANICAL SEAL OR PACKING**	**Steam and Cooling Water Piping**
122	☐ **Seal Data:**	☐ Cooling Water Piping Plan
123	☐ See Attached API 682 Data Sheet	☐ Cooling Water Requirement (m^3/hr):
124	☐ Non API 682 Seal	Seal Jacket/Brg Hsg @ kg/cm^2
125	☐ API Seal Code	Seal Heat Xchanger @ kg/cm^2
126	■ Seal Manufacturer Refer Job Spec.	Quench @ kg/cm^2
127	☐ Size and Type	☐ Total Cooling Water (m^3/hr):
128	☐ Manufacturer Code:	☐ Steam Piping:
129	**Seal Chamber Data**	☐ Tubing ☐ Piping
130	☐ Temperature (EC):	Remark:
131	☐ Pressure (kg/cm^2G):	
132	☐ Flow (m^3/hr):	
133	☐ Seal Chamber Size:	
134	☐ Total Length (mm) ☐ Clear Length(mm)	
135	**Seal Construction:**	
136	■ Sleeve Material: **SS**	**Instrumentation**
137	■ Gland Material: **SS**	■ Vibration
138	■ Aux. Seal Device: **Floating Throttle Bush**	■ Non Contacting (API 670) ☐ Transducer
139	☐ Jacket Required: ☐ Yes ☐ No.	☐ Provision for mounting only
140	☐ **Gland Taps:**	■ Flat surface required
141	■ Flush (F) ☐ Drain (D)	☐ See attached API 670 Data Sheet
142	■ Barrier/Buffer (F) ☐ Quench (Q)	■ Monitors and Cables
143	☐ Cooling (C) ☐ Lubrication (G)	
144	☐ Heating (H) ☐ Leakage	Remark:
145	■ Pumped Fluid (P) ☐ Balance Fluid (E)	
146	☐ External Fluid Injection (X)	
147	**Seal Fluids Requirement and Available Flush Liquid:**	
148	Note: If flush liquid is pumpage liquid (As in flush piping	
149	plan 11 to 41) following flush liquid data is not required.	
150	☐ Supply Temperature (EC)	**Temperature and Pressure:**
151	Max. Min.	■ Radial Brg. Metal Temp. ■ Thrust Brg. Metal Temp.
152	☐ Relative Density (Sp. Gr.) @ °C	☐ Provision for Instruments only
153	☐ Name of Liquid	☐ See attached API 670 Data Sheet
154	☐ Specific Heat, cP (kJ/kgEC):	☐ Temp. Gauge (With Thermowell).
155	☐ Vapour Press.(kg/cm^2A): @ °C	Other
156	☐ Hazardous ☐ Flammable ☐ Other	☐ Pressure Gauge Type
157	☐ Flow Rate (m^3/hr): Max. Min.	☐ Location
158	☐ Press. Reqd. (kg/cm^2G): Max. Min.	Remark:
159	☐ Temp. Required (EC): Max. Min.	
160	**Barrier/Buffer Fluid:**	**Motor Driver**: See Electrical Specification
161	☐ Supply Temp.: Max. Min.	■ **Surface Penetration and Paint:**
162	☐ Relative Density(Sp Gg.) @ °C	■ Manufacturer's Standard
163	☐ Name of Fluid:	☐ Other (See below)
164	☐ Vapour Pressure (kg/cm^2A): @ °C	**Pump**
165	☐ Hazardous ☐ Flammable ☐ Other	■ Pump surface penetration:
166	☐ Flow Rate (m^3/hr): Max. Min.	■ Primer
167	☐ Pressure Required (kg/cm^2G): Max. Min.	■ Finish Coat
168	☐ Temp. Required (EC): Max. Min.	**Base Plate**
169	**Quench Fluid:**	■ Base Plate Surface Preparation
170	☐ Name of Liquid:	■ Primer
171	☐ Flow Rate (m^3/hr):	■ Finish Coat
172	**Seal Flush Piping:**	■ **Shipment**
173	☐ Seal Flush Piping Plan:	☐ Domestic ☐ Export ☐ Export Boxing Required
174	■ Tubing ☐ Carbon Steel	■ Outdoor Storage more than 12 months
175	☐ Pipe ■ Stainless Steel	■ **Spare Rotor Assembly Packaged for :**
176	☐ Aux. Flush Plan:	☐ Horizontal Storage ■ Vertical Storage
177	☐ Tubing ☐ Carbon Steel	☐ Type of Shipping Preparation
178	☐ Pipe ☐ Stainless Steel	Remark:
179		
180		

Copyrights EIL – All rights reserved

181	**Mechanical Seal OR Packing (Contd.)**						
182	■ **Piping Assembly:**				☐ **Weights**		
183	☐ Threaded	☐ Unions	☐ Socket Welded		☐ Motor Driven:		
184	☐ Flanged	■ Tube Type Fitting			☐ Weight of Pump (kg):		
185	☐ Pressure Switch (Plan 52/53) Type				☐ Weight of Base Plate (kg):		
186	☐ Pressure Gauge (Plan 52/53)				☐ Weight of Motor (kg):		
187	☐ Level Switch (Plan 52/53) Type				☐ Weight of Gear (kg):		
188	☐ Level Gauge (Plan 52/53)				☐ Total Weight (kg):		
189	☐ Temp. Indicator (Plan 21,22,23,32,41)				☐ Turbine Driven		
190	☐ Heat Exchanger (Plan 52/53)				☐ Weight of Baseplate (kg):		
191	Remark:				☐ Weight of Turbine (kg):		
192					☐ Weight of Gear (kg):		
193	☐ **Packing Data:**				☐ Total Weight (kg):		
194	☐ Manufacturer:				Remark:		
195	☐ Type:						
196	☐ Size		☐ No. of Rings				
197	☐ Packing Injection Required:				**Other Purchase Requirement**		
198	☐ Flow (m^3/hr):		@	°C	■ Coordination Meeting Required		
199	☐ Lantern Ring:				■ Review Foundation Drawings		
200					■ Review Piping Drawings		
201	**SHOP INSPECTION AND TESTS (EACH PUMP)**				■ Observe Piping Check		
202	■ Review Vendor's QA Programme				■ Observe Initial Alignment Check		
203	■ Performance Curve Approval				■ Check Alignment at Operating Temp.		
204	■ Shop Inspection				☐ Connection Design Approval		
205	☐ Test With Substitute Seal				☐ Hydrodynamic Thrust Bearing Size Review Requd.		
206	TESTS		WITNESS	OBSERVE	■ Lateral Analysis Requd.		
207	■ Hydrostatic		■	☐	■ Rotor Dynamic Balance		
208	■ Performance		■	☐	☐ Mount Seal Reservoir off Base Plate		
209	■ NPSH, if reqd.		■	☐	■ Installation List in Proposal		
210	■ Complete Unit Test		■	☐	■ Spare Rotor Vertical Storage		
211	■ Sound Level Test		■	☐	■ Torsional Analysis/Report		
212	■ Cleanliness prior to Final Assembly		■	☐	■ Progress Report Requd.		
213	■ Nozzle Load Test, if reqd.		■	☐	☐ Driver suitable for pump starting with open disch. valve condition.		
214	■ Auxiliary Equipment Test		■	☐			
215	■ Remove/Insp. Hyd.dyn. Brgs After Test:		■	☐	Remark:		
216	■ Visual, Dimension & Skid Completeness Check		■	☐	**GENERAL REMARKS**		
217	■ Rotor Dynamic Balancing (Both Main & Spare Rotor)		☐	■	1) Max. allowable Casing Working Pressure shall not be		
218	■ Unitization/ Check of direction of rotation of pump		☐	■	less than_____ kg/cm²G @___□C.		
219	■ **Material Certificates Required**				2) Down stream Design Pressure is___ kg/cm²G.		
220	■ Casing	■ Impeller			3) Accessories and Instrumentation shall be as per		
221	■ Shaft	☐ Other			EIL approved vendors only.		
222	☐ Casing Repair Procedure Approval Required.				4) Unitisation of Pump,Gear(If Reqd.) and Driver shall be done in		
223	■ **Inspection Required for Connection Welds**				Pump Manufacturer's shop.		
224	☐ MAG Practice	■ Liquid Penetrant			5) Dismantle inspection of pump after performance test shall be		
225	■ Radiographic	■ Ultrasonic			applicable only in case of abnormality in mechanical behavior viz.		
226	■ **Inspection Required for Casting**				excessive noise, vibration, bearing temperature rise etc. during		
227	■ MAG Practice	☐ Liquid Penetrant			performance test		
228	☐ Radiographic	■ Ultrasonic					
229	☐ Additional Inspection Required for						
230	☐ MAG Practice	☐ Liquid Penetrant					
231	☐ Radiographic	☐ Ultrasonic					
232	☐ Alternate Acceptance Criteria (See Remarks):						
233	☐ Hardness Test Required for						
234	☐ Wetting Agent Hydrotest						
235	■ Vendor Submit Test Procedures						
236	■ Record Final Assembly Running						
237	■ Inspection Check List						

DATE	**REV**	**JOB ENGINEER**	**REV. & APPROVED BY**

Copyrights EIL – All rights reserved

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt of India Undertaking)

SPECIAL PURPOSE GEAR UNIT

Format Rev.2 Issue Date-22/10/2014

1	**GENERAL**													
2	Project :	**REVIVAL OF RAMAGUNDAM FERTILIZER COMPLEX**						Job No. :	**A747**					
3	Owner :	**M/s RFCL**						Site :	**KARIMNAGAR, TELANGANA, INDIA**					
4	Purchaser :							Unit :	**Steam & Power Gen.**			Unit No.:	**400**	
5	Item No. :							Service :	**Speed reducer**					
6	No. reqd. :		Working:		Standby:			Driver Type:				Driven Eqpt.:		
7	Applicable to :		■ Proposals					☐ Purchase				☐ As Built		
8	■ : Scope, Option & Information specified by Purchaser. ☐ : Information required from and options left to vendor. Vendor to cross (☒) the selected option.													
9	Manufacturer :							Model :						
10	**☐ RATING REQUIREMENTS**							**☐ BASIC GEAR DATA**						
11	Driven Eqpt. Power (kW):		Nor.:		Max.:			Mechanical rating :			kW @		rpm	
12	Driver Power (kW):		Rated:		Max.:			Full load power loss (kW):						
13	Gear rated power (kW): **(Rem-7)**							Mechanical efficiency (%):						
14	Torque @ Max. Cont. Speed (kg-m):							Pitch line velocity (m/s):						
15	Max. Torque :		kg-m @				rpm	Tooth pitting index, "K" :	Actual:		Allowble:			
16	Rated speed (rpm) :							Tangential load, "W_t" (kg):						
17	- Input		☐ Specified		☐ Nominal			Bending stress number S_t "W_t"	Pinion		Gear			
18	- Output		☐ Specified		☐ Nominal			Actual :						
19	Allow variation in gear ratio :		±				%	Allowable :						
20	Max continuous speed (rpm) :							Material index no. :						
21	Trip speed (rpm) :							Anticipated SPL :	**< 85dBA**		dBA @	1.0	m	
22	Gear service factor **(Min. 1.6) :**		**(Rem-7)**					Journal static weight loads :						
23	Pinion Hardness :							Pinion :		kg	Gear:		g	
24	Shaft assembly designation :							WR^2 referred to LS shaft (kg-mm²):						
25	- HS shaft rot. facing coupling end		☐ CW		☐ CCW			Breakaway Torque (kgf-m) @ LS shaft :						
26	- LS shaft rot. facing coupling end		☐ CW		☐ CCW									
27	HS shaft end :	☐ Cylindrical	☐ Taper		☐ 1-Key			**☐ CONSTRUCTION FEATURES**						
28	☐ 2-Keys	☐ Hydraulic taper			☐ Integral flange			**Type of Gear**	☐ Reducer		☐ Increaser			
29	LS shaft end :	☐ Cylindrical	☐ Taper		☐ 1-Key				☐ Single stage		☐ Double stage			
30	☐ 2-Keys	☐ Hydraulic taper			☐ Integral flange				☐ Single helical		☐ Double helical			
31	External loads :								☐ Epicyclic		☐			
32	Other operating conditions :							**Teeth**						
33	**■ INSTALLATION DATA**							Number of teeth: Pinion:			Gear:			
34	■ Indoor	☐ Heated		■ Under roof				Gear ratio			Center Distance (mm):			
35	☐ Outdoor	■ Unheated		☐ Partial sides				Pitch Dia: Pinion (mm)			Gear (mm):			
36	☐ Grade	☐ Mezzanine		☐ Offshore				Finish (RA):						
37	☐ Winterisation Required		■ Tropicalization Required					AGMA Geometry factor "J" :						
38	Electrical Area Class:Ref.job spec		Grp:		Div.:			Pinion:			Gear :			
39	Max. allow. SPL :	**85**	dBA @	1.0			m	Helix angle (°) :						
40	Elevation (m):		Barometer (kg/cm²A):					Normal pressure angle (°):						
41	Range of ambient temperatures:							Net face width, "Fw" (mm) :			Pinion L/D:			
42		Dry Bulb		Wet Bulb				Normal Diametrical Pitch:			Backlash (mm):			
43	Minimum	°C		°C				Tooth plating : ☐ Recommended ☐ Not Recommended						
44	Normal	°C		°C				**MANUFACTURING METHODS**						
45	Maximum	°C		°C				Teeth generated by the :			Process			
46	Unusual Conditions	☐ Dust	☐ Fumes	☐ Others:				Teeth finished by the :			Process			
47	**☐ ADDITIONAL REQUIREMENTS**							Teeth hardening method :						
48	**MOUNTING PLATES**							Gear to shaft : ☐ Integral ☐ Shrunk-on						
49	■ Gear suitable for Base plate mounting.							Rim attachment :						
50	☐ Baseplate	☐ Soleplate(s)		☐ Subplate(s)				**☐ RADIAL BEARINGS**						
51	■ Mounting plate(s) furnished by : GTG Vendor								Pinion		Gear			
52	■ Equipment on baseplate: GT, GB, Alternator, Lube oil sys.							Type						
53	☐ Baseplate with levelling pads :							Diameter mm						
54	☐ Baseplate suitable for column mounting :							Length mm						
55	☐ Grout type :	☐						Journal Velocity m/s						
56	■ **PAINTING**:	☐Mfr.St	■Refer Doc. No.A747-000-06-42-PLS-01					Loading kg/cm²						
57	**APPLICABLE SPECIFICATIONS**							Clearance (min-max) mm						
58	■API Std. 613, 5th Edition along with Job specification-Rotating Eqpt							Span mm						
59	☐ Other :													
60														

Copyrights EIL – All rights reserved

61	**MISCELLANEOUS**				**☐ THRUST BEARING(S)**		
62	■ Undamped critical analysis report : with train	■ Yes	☐ No			Pinion	Gear
63	☐ With damped rotor response analysis report				Location		
64	■ Torsional analysis by	☐ Gear Vendor	■ Other: GTG Vendor		Manufacturer		
65	☐ Spare set of gear rotors				Type		
66	☐ Gear case furnished with inlet purge connection				Size		
67	☐ Orientation of oil inlet and drain connection				Area mm²		
68					Loading kg/cm²		
69	**■ VIBRATION DETECTORS**				Rating kg/cm²		
70	**Radial:**				Int. thrust load N (±)		
71	■ Manufacturer:				Ext. thrust load N (±)		
72	■ No. at each shaft bearing	**Two**	Total No.:		**☐ COUPLING & GUARDS**		
73	■ Oscillator-Demodulators supplied by : Vendor					High Speed	Low Speed
74	☐ Manufacturer :				Coupling Manufacturer		
75	■ Monitor supplied by : Vendor				Coupling Furnished by		
76	■ Location Remote Panel	Enclosure:			Coupling Type		
77	☐ Manufacturer:				Coupling Model		
78	☐ Alarm :	☐ Shutdown :			Coupling rating kW/100 rpm		
79	☐ Shutdown time delay	seconds			Coupling Lubrication		
80	**Axial :**				Taper mm/m		
81	■ Manufacturer:	No. reqd.: **Two on each thrust brg.**			Taper guage furnished by		
82	■ Location: Remote Panel				Limited end float		
83	■ Oscillator-Demodulators supplied by: Vendor				Mount coupling halves	☐	☐
84	☐ Manufacturer ;				Cplg. gear pitch dia mm	☐	☐
85	■ Monitor supplied by: Vendor				Cplg. pressure angle °	☐	☐
86	■ Location: Remote Panel	Enclosure			Cylindrical / 1-key	☐	☐
87	☐ Manufacturer:				Cylindrical / 2-keys	☐	☐
88	☐ Alarm :	☐ Shutdown :			Tapered / 1-key		
89	☐ Shutdown time delay	seconds			Tapered / 2-keys		
90					Tapered / keyless		
91	**Accelerometer:** Each Bearing housing(X,Y,Z directions)- **N.A.**				**☐ PIPING CONNECTIONS**		
92	Manufacturer:	No. Required				No.	Size	Type
93	Location: Remote Control Panel				Service			
94	Monitor supplied by: Vendor				Lube oil inlet			
95					Lube oil outlet			
96	**■ INSTRUMENTS**				Casing drain			
97	☐ Mercury Thermometers				Vent			
98	■ Bearing metal temperature sensors (Remark -3)				Casing purge			
99	**■ CONTRACT DATA**							
100	☐ Vendor's Representative at site							
101	■ Test data prior to shipment				**☐ LUBRICATION REQUIREMENTS**		
102	☐ Progress reports				■ Oil System Furnished by (Common with GT & Alt.)		
103	**■ SHIPMENTS**				☐ Oil Visc.: cP @ 40°C cP @ 100°C		
104		Contract unit	Spares		Min. startup oil temperature		°C
105	Export boxing	■	■		Unit oil flow(total)		m³ / hr
106	Domestic boxing	☐	☐		Unit oil pressure		kg/cm²g
107	Outdoor strg. over 6 months	■	■		Oil flow, Mesh		m³ / hr
108					Oil flow, HS Bearings		m³ / hr
109	**MATERIALS**				Oil flow, LS Bearings		m³ / hr
110	Gear Casing		Oil Seals		Oil flow, Thrust Bearing(s)		m³ / hr
111	Radial Bearings				**Additional Requirements**		
112	Thrust Bearing(s)				Filter breather location		
113	HS Shaft		LS Shaft				
114	Pinion(s)		Hardness				
115	Gear Rim(s)		Hardness				
116	Teeth core hardness: Pinion:		Gear :				
117	Low Temp. Operation						
118							
119							
120							

Copyrights EIL – All rights reserved

	■ SHOP INSPECTION AND TESTS					☐ GEAR DATA			
		Regd.	Observe	Witness	Test log	Power loss each HS bearing			
	Shop Inspection	■	■			Power loss each LS bearing			
	Cleanliness inspection	☐	☐	☐		Power loss each thrust bearing			
	Hardness verification Insp	■	■	☐	■			Pinion	Gear
	Dismantle-Reassembly Insp.	■	☐	■		Outside diameter	mm		
	Contact check	■	■	☐	■	Root Diameter	mm		
	Contact check tape lift (2.5.2.2)	☐	☐	☐	☐	Center Groove Diameter	mm		
	Journal runout check	■	■	☐	■	Durability Power			
	Axial stability check	☐	☐	☐	☐	Strength Power			
	Rotor balancing machine }	☐	☐	☐	☐	Face overlap ratio			
	Sensitivity Check }					Transverse contact ratio			
	Residual Unbalance Check	☐	☐	☐	☐	Length line of action	mm		
	Mech. run test	■	☐	■	■				
	Mech. run test (Spare rotors)	☐	☐	☐	☐	☐ WEIGHTS & DIMENSIONS			
	Add'l mech. Test	☐	☐	☐	☐	Net Weight:			
	~~Part or~~ full load and full speed test	☐	☐	☐	☐	Gear Box :	kg	Auxiliaries :	kg
	Full torque slow roll test	☐	☐	☐	☐	Max. Maintenance Weight [Identify]:			kg
	Full torque static test	☐	☐	☐	☐	Total Shipping Weight :			
	Back-to-back locked torque test	☐	☐	☐	☐	Total Shipping Dimensions:		L: m W: m H:	m
	Sound level test	■	☐	■	■				
	Add'l gear tooth test	☐	☐	☐	☐				
	Use shop lube system	■	☐	■					
	Use job lube system	☐	☐	☐					
	Use shop vibration probes, etc.	☐	☐	☐					
	Use job vibration probes, etc.	■	☐	■					
	Other:	☐	☐	☐					
	Final assembly maintenance &	■	☐	■	☐				
	running clearance								
	Oil system cleanliness	■	■	☐					
	Oil system casing joint tightness	■	■	☐					
	Warning and protection devices	☐	☐	☐					

REMARKS:

1) For Electrical area classification , please refer Electrical specifications.
2) For site data, please refer Annexure-3 of GTG Process Datasheet.
3) Hydrodynamic radial bearings shall be fitted with at least two (2) temperature probes & Hydrodynamic thrust bearings shall be fitted with at least two (2) temperature probes each on active and inactive side.
4) Gear vendor to review GTG supplier's base plate.
5) Gear vendor not to proceed without GTG supplier's review of Drawings.
6) GTG vendor shall furnish duly filled-in Data sheet for Purchaser's/PMC's approval during detailed engineering stage.
7) The service factor shall be calculated over ISO rating of Gas Turbine.

Date	**Rev**	**Job Engineer**	**Rev. & Approved By**

Copyrights EIL – All rights reserved

SPECIAL PURPOSE COUPLING

1	**GENERAL**																		
2	Project :	**REVIVAL OF RAMAGUNDAM FERTILIZER COMPLEX**									Job No. :	**A747**							
3	Owner :	**M/s RFCL**									Site :	**KARIMNAGAR, TELANGANA, INDIA**							
4	Purchaser :										Unit :	**Steam & Power Gen.**				Unit No.:	**400**		
5	Item No. :										Service :								
6	No. of Units :		Working :		Standby :														
7	Applicable to:		■ Proposal		☐ Purchase						☐ As Built								
8	■ : Scope, Option & Information specified by Purchaser. ☐ : Information required from and options left to vendor. Vendor to cross (:) the selected option.																		
9	☐ Driver:	Type:						Manufacturer:						Model:					
10		Nameplate Power (kW):						Service Factor:		S.No.:				Tag No.:					
11	☐ Driven Unit:							Manufacturer:						Model:					
12			Serial No.:										Tag No.						
13	Coupling Type:		☐ Flexible Element		☐ Gear			☐ Quill Shaft		☐ Other:									
14	☐ Manufacturer:				Model:			Size:			Assy. Dwg. No.:								
15																			
16	☐ **CONDITIONS CONSIDERED FOR COUPLING SELECTION**							☐ **RATINGS**											
17	Conditions			Torque (kgf-m)		@ rpm			Torque (kgf-m)		@ rpm	Serv. Factor							
18	Normal							Normal											
19	Driven Rated Load							Peak											
20	Maximum Steady State							Momentary											
21	Maximum Transient							Shaft Juncture (Driving)											
22	Trip Condition							Shaft Juncture (Driven)											
23	Continouos Cyclic																		
24	Other:																		
25	☐ Frequency of Transients (Events/Time):							☐ Non-synchronus exciting frequency:											
26	■ Coupling Minimum Required Service Factor, SF: **1.75 (Rem-2)**							☐ Actual SF											
27	☐ Ambient Temperature (°C):			Maximum:				Minimum:											
28	Environment :	☐ Hyd. Chloride		☐ Hyd. Sulphide		☐ Other:													
29	**LUBRICATION**																		
30	☐ Continuous	☐ Batch		■ Non-Lubricated				☐ Viscosity :			cP @	°C							
31	☐ Filtration Microns:							☐ Pressure (kg/cm²g)			☐ Temp. (°C):								
32								☐ Flow (m^3/hr)											
33	**COUPLING DATA**																		
34	☐ Shaft Separation (including thermal growth) (mm B.S.E):																		
35		@ Ambient Temp.:			@ Normal Operation:				@ Maximum Transient:										
36	☐ Motor Rotor Float (mm):				☐ Limited End Float (mm):														
37	☐ Marine Type Required				☐ Flex-Hub Type Required (2.2.2)				☐ Electrically Insulated										
38	☐ Required Misalignment Capability :																		
39		Steady State :	Angular (°) :		Parallel Offset (mm):				Axial (mm):										
40		Transient :	Angular (°) :		Parallel Offset (mm):				Axial (mm):										
41	☐ Maximum Allowable Misalignment :																		
42		Steady State :	Angular (°) :		Parallel Offset (mm):				Axial (mm):										
43		Transient :	Angular (°) :		Parallel Offset (mm):				Axial (mm):										
44	☐ Component Balance -**OR**- ■ Component Balance & Assembly Check Balance -**OR**- ☐ Component Balance with Assy. Balance																		
45	☐ Residual Unbalance Check of Assembled Couplings							☐ Balance Repeatability Check											
46	■ Check sensitivity of Balance Machine																		
47	☐ Max. Allowable Residual Unbalance		g-mm	Driver End :				Driven End :											
48	☐ Max. Actual Residual Unbalance		g-mm	Driver End :				Driven End :											
49	☐ Torsional Stiffness (kg-mm/Rad):																		
50	☐ WR² (kg-m²):			Driver End :				Driven End :											
51	☐ Spacer Lateral Natural Frequency :				☐ Torque Capacity of Hub/Shaft Interface for keyless fits (kgf-m):														
52	**Flexible-Element Coupling:**																		
53	☐ Initial Deflection (mm):			☐ Pre-Stretch		☐ Compression		☐ Max. Axial Deflection (mm):											
54	☐ Calculated Axial Natural Frequency:							☐ Test of ANF:			☐ Actual ANF:								
55	☐ Maximum Enclosure Temperature at Max. Continuous speed (°C):																		
56	REMARKS:																		
57																			
58																			
59																			
60																			
61																			

Copyrights EIL – All rights reserved

62	**MATERIALS**				
63	Component	Drive End Materials		Driven End Materials	
64	Hub / Flange				
65	Spacer				
66	Sleeve				
67	Flexible-Element				
68	Flexible-Element Guard				
69	Bolts				
70	Nuts				
71	☐ Protective Coating :	■ Vendor Standard	☐ Other:		
72	☐ Internal Teeth Hardness : Rockwell C	Drive End Actual :	Driven End Actual :		
73	☐ External Teeth Hardness : Rockwell C	Drive End Actual :	Driven End Actual :		
74	**COUPLING HUB MACHINING**				
75			Drive End	Driven End	
76	☐ Type (Integral / Cylinderical / Taper)				
77	☐ Keyed or Hydraulically Fitted				
78	☐ Taper (Note-1)				
79	☐ Keyway Dimensions and Number				
80	☐ Nominal Bore Diameter (mm)				
81	☐ Interference Fit (mm) : Max. | Min.		|	|	
82	☐ Puller Holes				
83	☐ Trim Balance Holes				
84	**COUPLING GUARD**				
85	■ Co-ordinator : GTG Vendor		☐ Purge Gas:	☐ Dry Air Purge:	
86	■ Flanged Cylinderical :	☐ Base Mount:	☐ Purge Connection Size & Type:		
87	☐ Air Tight:	■ Oil Tight:	☐ Purge m^3/hr Required:		
88	■ Spark Resistant		☐ Oil Mist Cooling	☐ Gas Cooling	
89	☐ Transparent Window for Each Oil Spray Point:		■ Contract Guard to be used during Shop Test		
90	☐ Vent Connection:		☐ Additional Guard Details:		
91	☐ 1 inch NPT with Filter Breather				
92	☐ 1 inch Flanged, Rating & Facing :				
93	**ACCESSORIES (Vendor to mark & provide accessories as required)**				
94	☐ Prime Eqpt. supplier to furnish one set of Plug & Ring Gauges (Appe. D)		☐ Hydraullic Installation/Removal Tooling (To include Hand		
95	☐ Lapping Tools		Pump(s), Pressure Gauge(s), Fittings & Hose(s)) By :		
96	☐ Drill Template for Internal Flanged Hubs by:		☐ Coupling Manufacturer	☐ Purchaser	
97	☐ Coupling Manufacturer	☐ Purchaser	☐ Puller By Coupling Manufacturer / Vendor		
98	☐ Two-Piece Stop Rings by Coupling Manufacturer		☐ Moment Simulator	☐ Solo Plate	
99	**APPLICABLE SPECIFICATIONS**		**PREPARATION FOR SHIPMENT**		
100	■ API 671, 4th Edit, Special Purpose Couplings		■ Outdoor Storage for more than 6 months		
101	■ Others : Job Specification No. A747-400-82-41-SP-5400		☐ Expected Storage Time (Months) :		
102	☐		☐ Shipping ☐ Domestic	☐ Storage	☐ Indoor
103	☐ Coordination Meeting Attendance Required		■ Export		☐ Outdoor
104	REMARKS:				
105	1. 1° included angle / ½ dia. Inch. per foot length / ¾ dia. inch. per foot length				
106	2. The service factor shall be calculated over ISO rating of Gas Turbine.				
107					
108					
109					
110					
111					
112					
113					
114					
115					
116					
117					

Date	**Rev**	**Job Engineer**	**Rev. & Approved By**

Copyrights EIL – All rights reserved

ENGINEERING DESIGN BASIS
ROTATING EQUIPMENT

JOB NO: **A747**

PROJECT: **Ramagundam Revival Project**

CLIENT: **Ramagundam Fertilizers and Chemicals Limited**

CLIENT SIGNATURE:

EIL SIGNATURE: AK Prashar 26/06/15

Rev. No.	Date	Purpose	Prepared by	Reviewed by	Approved by
0	26/Jun/2015	Issued For Implementation	ATLURI MOHAN KRISHNA	MANDAL A	BHATIA DINESH
A	25/May/2015	Issued For Comments	ATLURI MOHAN	MANDAL A	BHATIA DINESH

Legend: ***Bold italic*** text denotes change with respect to previous revision.

Copyrights EIL – All rights reserved

Table of Contents

Copyrights EIL – All rights reserved

Copyrights EIL – All rights reserved

1.0 SCOPE

This Specification covers the design criteria for the purpose of carrying out Engineering for Procurement of various rotating equipment required including requirements with regard to spare parts & special tools.

Electrical items, Instrumentation & Controls, Piping, Pressure Vessels, Heat exchangers etc. associated with rotating equipment shall comply with the design requirements as given in the respective discipline specifications.

2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

2.1 ABBREVIATIONS

Code	Description
API	American Petroleum Institute
ARC	Automatic Re-circulation Valve
CP	Chain Pulley
DG	Diesel Engine-Generator
EDB	Engineering Design Basis
EOT	Electric Overhead Traveling
EQC	Equipment Qualification Criteria
FD	Forced Draft
GEG	Gas Engine-Generator
GTC	Gas Turbine-Compressor
GTG	Gas Turbine-Generator
HEI	Heat Exchange Institute, Inc.
HOT	Hand Overhead Traveling
ID	Induced Draft
LSTK	Lump-sum Turn Key
MOC	Material of Construction
MVL	Master Vendor List
PMC	Project Management Consultant / Consultancy
PTR	Proven Track Record
QAP	Quality Assurance Plan
SPRV	Single Point Responsibility Vendor
STG	Steam Turbine-Generator
SQT	Seal Qualification Test

2.2 CODES & STANDARDS / PUBLICATIONS

International Standards/Codes along with applicable EIL Standard Specifications as per the table given below shall be the basis of design, selection, manufacture, inspection/testing of the equipment.

For design aspects not specifically covered by Data Sheets, Specifications, Codes and Standards or Regulations, the design shall be based on good engineering practice.

S.No.	Description	Standards / Codes	Edition	Note
1	PUMPS			
1.1	Centrifugal Pumps (Special Purpose Process Service)	API Std. 610 10th Ed. & EIL std. Spec. 6-41-0006		Note-1

Copyrights EIL – All rights reserved

S.No.	Description	Standards / Codes	Edition	Note
1.2	Centrifugal Pumps (General Purpose Process Service)	EIL std. spec. 6-41-0002		Note-2
1.3	Centrifugal Pumps (General Water Service)	EIL std. spec. 6-41-0003		Note-3
1.4	Centrifugal Pumps (Slurry & Liquor Service)	Mfr. Std.		
1.5	Positive Displacement Pumps (Reciprocating)	API Std. 674, 3rd Ed. & EIL std. spec. 6-41-0020		
1.6	Positive Displacement Pump (Controlled Vol.)	API Std. 675, 2nd Ed. & EIL std. spec. 6-41-0021		
1.7	Positive Displacement Pumps (Rotary)	API Std. 676, 3rd Ed. & EIL std. spec. 6-41-0022		
1.8	Liquid Ring Vacuum pump and compressors	API Std. 681, 1st Ed.		
1.9	Seal-less Pumps	API Std 685, 1st Ed.		
2	COMPRESSORS / FANS & BLOWERS			
2.1	Centrifugal Compressors	API Std. 617, 7th Ed. & EIL std. spec. 6-42-0005		
2.2	Axial Compressors	API Std. 617, 7th Ed. & EIL std. spec. 6-42-0005		
2.3	Expander-Compressors	API Std. 617, 7th Ed. & EIL std. spec. 6-42-0005		
2.4	Integrally Geared Process Centrifugal Compressors	API Std. 617, 7th Ed. & EIL std. spec. 6-42-0005		
2.5	Packaged Integrally Geared Centrifugal Air Compressors	API Std. 672, 4th Ed. & EIL std. spec. 6-42-0004		
2.6	Reciprocating Compressors (Utility & Instrument Air Service)	EIL std. spec. 6-42-0010		
2.7	Reciprocating Compressors (Process Service)	API Std. 618, 5th Ed. & EIL std. spec. 6-42-0011		
2.8	Positive Displacement Compressors (Rotary)	API Std. 619, 4th Ed. & EIL std. spec. 6-42-0015		
2.9	Centrifugal Fans	EIL std. spec. 6-42-0002		
2.10	Induced Draft / Forced Draft Fans	API Std 560, 4th Ed. & EIL std. spec. 6-42-0003		
2.11	Roots Blowers	Mfr. Std.		
2.12	Diaphragm Compressors	EIL std. spec. 6-42-0012		

Copyrights EIL – All rights reserved

S.No.	Description	Standards / Codes	Edition	Note
3	MECHANICAL DRIVERS / GEAR BOXES			
3.1	Diesel Engines	ISO 3046, EIL std. spec. 6-43-0040		
3.2	Gas Turbines	API Std. 616, 4th Ed., EIL std. spec. 6-43-0041		
3.3	Steam Turbines (General Purpose)	API Std. 611, 5th Ed., EIL std. spec. 6-43-0042		Note-4
3.4	Steam Turbines (Special Purpose)	API Std. 612, 6th Ed., EIL std. spec. 6-43-0043		
3.5	Special Purpose Gear Units	API Std. 613, 5th Ed.		
3.6	General Purpose Gear Units	API Std. 677, 3rd Ed.		
3.7	Special Purpose Coupling	API Std. 671, 4th Ed.		Note-5
4	AUXILIARIES			
4.1	Lubrication, shaft sealing and control-oil systems and auxiliaries	API Std. 614, 5th Ed.		Note-6
4.2	Shaft sealing for centrifugal & rotary pumps	API Std. 682, 3rd Ed.		
4.3	Vibration, Axial Position & Bearing Temp. Monitoring Systems	API Std. 670, 4th Ed.		
4.4	Steam Condensers	HEI + TEMA		
4.5	All other rotating equipment not listed above	Mfr. Std.		

Notes:
1) Centrifugal pumps for special purpose process service are classified as pumps which are meant for process service (both for on-site & offsite) but excluding the pumps covered either under general- purpose process service or general water service.

2) Centrifugal pumps for general purpose process service are classified as pumps for applications where maximum pressure by all considerations does not exceed 16.0 kg/cm2 g, pumping temperature remains within -29 Deg C to 205 Deg C, Specific gravity is not less than 0.7 at the specified operating conditions or when dual pressurised / un-pressurised mechanical seals are not required/ specified. Typical areas of application are non-process services, utility & offsite services.

3) Centrifugal pumps for general water service are classified as pumps for applications such as Large Capacity Cooling Water Pumps, Auxiliary Cooling Water Pumps, fire water pumps & other centrifugal pumps handling clean & cold water and sump pumps handling predominantly water/liquid similar to water as pumping fluid. Pumps handling cooling water in Process units are not covered.

4) a) General-purpose steam turbines shall be used where driven equipment is usually spared or is in non-critical service.

Copyrights EIL – All rights reserved

b)In addition to criteria specified in API 611, General-purpose steam turbines may also be used for cases where all the following conditions exist, subject to market availability & with proven track record:
- Inlet pressure < 60 bar g;
- Inlet temperature < 475 DEG C;
- Speed < 6000 rpm;
- Turbine rating < 1500 kW;

5) Special-purpose couplings (conforming to API Std. 671) shall be used in equipment trains, as specified in the EDB.

6) Lube oil system (conforming to API Std. 614; general purpose or special purpose) shall be as specified on main equipment data sheet.

7) EIL standard specification will not be applied to pumps in auxiliary systems such as lube oil system/cooling water system etc of Rotating Equipment Packages. These items can be sourced by Package Vendor as per their past experience & shall be of field proven design. The equipments sourced by the package vendors shall however comply the relevant API / IS standards.

3.0 GENERAL / DESIGN CONSIDERATIONS

3.1 UNIT RESPONSIBILITY

S.No.	Equipment Type	Unit Responsibility
1	All equipments (except for Steam /Gas Turbine Gen-sets, Diesel/ Gas Engine Gen-sets, Gas Turbine driven compressors, Integrally geared centrifugal air compressor & screw compressor)	With the driven equipment manufacturer, who shall also be the SPRV (Single Point Responsibility Vendor) for the complete equipment unit including driver, driven equipment & all other associated auxiliary systems, instrumentation & controls etc. All Rotating Equipments complete with drivers and all associated auxiliary system shall be procured from the respective driven equipment manufacturers.
2	Steam/Gas Turbine Generating Sets	With the Steam/Gas Turbine manufacturer, who shall also be the SPRV of the package. Steam/Gas Turbine Generating Sets shall be procured along with alternators from the Steam/Gas Turbine Manufacturers, complete with all associated auxiliary systems.
3	Diesel Engine/ Gas Engine Gen-sets	With either the Diesel / Gas engine manufacturer or Gen-Set Packager, who shall also be the SPRV of the package. Diesel/ Gas engine Gen-Sets shall be procured from engine manufacturer or an authorized Packager of engine manufacturer.
4	Gas Turbine driven Compressors	With either GT or Compressor manufacturer, who shall be the SPRV of the package. GTCs sets complete with all associated auxiliary system shall be procured either from compressor manufacturer or from Gas Turbine manufacturer.

Copyrights EIL – All rights reserved

S.No.	Equipment Type	Unit Responsibility
5	Integrally geared centrifugal air compressor & screw compressor	With either the manufacturer of Integrally geared centrifugal air compressor/ screw compressor or their authorized Packager, who shall also be the SPRV of the package. Above compressor packages shall be procured from the manufacturer of Integrally geared centrifugal air compressor/ screw compressor or their authorized Packager.

3.2 UNITISATION

Rotating equipment units shall be unitised along with their respective drivers as under:

S.No.	Equipment Unit	Unitisation Location
9	All pumps	At respective pump manufacturer's works

3.3 EQUIPMENT SELECTION AND SIZING CRITERIA

S.No.	Project Philosophy
1	Selection of Rotating Equipment shall be based upon the following considerations: - Suitability for the specified duty conditions - Standard Models under vendor's regular range of manufacture - Proven Track record as specified under qualification criterion
2	Unless otherwise specified in the process package, sizing of centrifugal fans, internal combustion engines, air compressors & gas turbines shall be based on maximum site coincident ambient temperature and relative humidity.
3	Allowable working pressure & temperature of the rotating equipment shall be most stringent of design pressure & temperature out of: - Design Pressure & temp as specified in Mechanical/Process data sheets (if any) - The licensor's specifications and other codes & standards attached or referred to.

3.4 ECONOMIC COMPARISION OF VENDORS OFFER

S.No.	Project Philosophy
1	Loading & Penalty (on account of equipment energy consumption/ Specific fuel consumption) shall be done only for the following equipment: - Centrifugal Pumps - HPRTs - Centrifugal Compressors - Screw Compressors - Reciprocating Air Compressors with atmospheric suction pressure - Centrifugal Fans/Forced Draft Fans/Induced Draft Fans - Gas Turbines - Gas Engine Generators - Diesel Engine gensets (except for emergency DG)
2	In case of driven equipment, their shaft power consumption shall be considered for economic comparison of vendors offer. However for gas turbine, gas engine and diesel engine drivers, specific fuel consumption shall be considered for economic comparison of vendors offer. For HPRT power generated shall be considered for economic comparison of vendors offer.
3	Vendor's offers shall be loaded by Net Present Value of the cost of excess energy consumption (over the vendor having least energy consumption) over a period of 5 years starting from one year after delivery.
4	Loading shall be applied on operating units only and not on standby units.

Copyrights EIL – All rights reserved

S.No.	Project Philosophy
5	Loading shall not be done on equipment, which are for intermittent operation.
6	Commercial comparison on account of supervision charges: The rotating equipment vendor shall provide his services for supervision during erection and commissioning of the rotating equipment packages. Electrical & Instrumentation engineers shall also be present along with vendor's erection and commissioning engineers, as required. The supervisory cost of mandays as specified for each rotating equipment package (as specified in cl 3.4.1) shall be considered for the purpose of commercial comparison (which he may decide between days for Indian/Foreign supervisors and also discipline wise but total of man days per equipment package). The vendor shall indicate in his proposal the cost of providing the above services on per diem basis. The presence of OEM vendor for the purpose of erection and commissioning shall be on need basis and criticality of the equipment as decided at site, based on the site conditions. Per diem rates, as quoted by the vendor shall be the basis of payment, based on actual requirements.
7	For economic comparison of equipment vendor's offer, 'Equipment Cost + Cost of mandatory spares (if specified) + Loading (as defined above) + Supervision charges (as defined above) + Customer training charges (as applicable) + AMC charges (as applicable)' shall be considered.
8	The following values for estimating loading & penalty shall be considered: i) Cost of Electrical Power : **_per kWh ii) Rate of Interest : 12% per year iii) No of years : 5 Years (starting from one year after delivery of equipment) iv) Cost of Fuel: ** per ton [**: These values shall be provided by the client later.]
9	The maximum loading & penalty to be applied on account of equipment power consumption/specific fuel consumption however shall not exceed 10% of the total package cost.

3.4.1 NO OF MANDAYS

No. of Mandays are defined for commercial comparison purpose for each equipment package. These Mandays shall include the mandays required for Mechanical + Electrical + Instrumentation + Compressor control system engineer (as applicable).

S.No.	Rotating Equipment Package	No. of Mandays
1	Centrifugal Pumps (Single/Two Stages) - Electric Motor Driven Package	3
2	Centrifugal Pumps (Single/Two Stages) - Steam Turbine Driven Package	15
3	Centrifugal Pumps (Multistage) - Electric Motor Driven Package	20
4	Centrifugal Pumps (Multistage) - Steam Turbine Driven Package	25
5	Large Capacity Centrifugal Pump - Electric Motor Driven Package	3
6	Fire Water Pumps - Diesel Engine Driven Package	10
7	Rotary Pump - Electric Motor Driven Package	3
8	Metering Pump - Electric Motor Driven Package	3
9	Reciprocating Pump - Electric Motor Driven Package	10

Copyrights EIL – All rights reserved

S.No.	Rotating Equipment Package	No. of Mandays
10	Reciprocating Pump - Diesel Engine Driven Package	15
11	Centrifugal Compressor (Single Casing) - Electric Motor Driven Package (without inter-stage process piping)	30
12	Centrifugal Compressor (Single Casing) - Steam Turbine Driven Package (without inter-stage process piping)	60
13	Centrifugal Compressor (Single Casing) - Gas Turbine Driven package (without inter-stage process piping)	60
14	Centrifugal Compressor (Multi Casing) - Steam Turbine Driven Package (without inter-stage process piping)	60
15	Centrifugal Compressor (Multi Casing) - Gas Turbine Driven package (without inter-stage process piping)	60
16	Axial Compressor - Steam Turbine Driven Package (without inter-stage process piping)	60
17	Package integrally geared centrifugal compressor-electric motor driven package	30
18	Screw Compressor - Electric Motor Driven Package	40
19	Skid mounted Reciprocating Compressor - Electric Motor Driven Package	25
20	Reciprocating Compressor - Electric Motor Driven Package (without inter-stage process piping)	60
21	Reciprocating Compressor - Electric Motor Driven (with inter-stage process piping)	75
22	Reciprocating compressor + Electric Motor + Soft Starter (with inter-stage process piping)	75
23	Reciprocating compressor + Electric Motor + Soft Starter (without inter-stage process piping)	60
24	Diaphragm Compressor - Electric Motor Driven Package	15
25	Induced Draft (ID) Fan - Electric Motor Driven Package	25
26	Induced Draft (ID) Fan - Electric Motor Driven Package with variable speed fluid coupling	30
27	Forced Draft (FD) Fan - Electric Motor Driven Package	25
28	Forced Draft (FD) Fan - Electric Motor Driven Package with variable speed fluid coupling	30
29	Steam Turbine driven Induced Draft (ID)/ Forced Draft (FD) fans	35
30	Diesel/Gas Engine - Generator Sets	45
31	Steam Turbine - Generator Sets	90
32	Gas Turbine Generator sets	90
33	Chemical Dosing/Injection Package	10

Copyrights EIL – All rights reserved

3.5 EQUIPMENT QUALIFICATION CRITERIA (EQC)

Unless otherwise specified, all Rotating Equipment shall meet the EQC as specified in the standard specification of the relevant rotating equipment, as applicable. Rotating Equipment Vendor shall complete the Experience Record Proforma enclosed with the inquiry document to amply prove that the offered Rotating Equipment meet the EQC for technical acceptance.

3.6 EQUIPMENT SUPPLIERS

Unless otherwise specified by the Owner, the equipment shall be sourced from one of the approved suppliers from Project Vendor List as applicable for the Project.

3.7 SEALING SYSTEM SELECTION CRITERIA

3.7.1 CENTRIFUGAL PUMPS

S.No.	Project Philosophy
1	All Pumps shall be provided with mechanical seals (except general water service pumps handling clean cold water), unless specified otherwise. The type of mechanical seal (i.e. single or dual un-pressurised / pressurised) shall be as defined in the process package.
2	Unless otherwise specified, mechanical seals shall conform to API Standard 682, 3rd edition for centrifugal pumps. However, Large capacity water service pumps shall be provided with Non-API mechanical seals.
3	Seal Qualification tests (SQT) shall have been conducted on the proposed mechanical seal model(s) for standard API 682 seals.
4	In case, the offered mechanical seal is intended to be supplied by any of the subsidiaries of the principals of seal manufacturer, following requirements shall be met: - For standard mechanical seals, for which SQT has been conducted by the principals, critical components such as Bellows, Springs and seal faces shall be sourced from their principals. - For Engineered seals, the complete mechanical seal along with sleeve and gland plate shall be sourced from their principals. Seal drawings shall be from the principals or duly vetted by principals.
5	Any seal offered under "Engineered Seal" category or seals having high dynamic sealing pressures (>= 20 kg/cm2 G) shall undergo Seal Qualification Test (SQT): All seals installed in one pump per item / tag shall undergo SQT as per the following: "Four hour static test, four hour dynamic test and one hour cyclic test with test fluid selection as per API 682 and test conditions commensurate with either API 682 test conditions or the conditions expected during operation in normal as well as start-up / shut-down conditions, whichever is more stringent. However for temperature, API limit of 260 degree C may be followed for testing." SQT certificates shall also be furnished as part of final documentation.
6	Mechanical seals shall be suitable for maximum shut-off pressure under static conditions for pusher type seals. For Bellows seal, mechanical seal shall be suitable upto bellows design pressure, as a minimum.
7	Unless otherwise specified, Tank/Pit mounted vertical pumps, type VS4 (process service) shall be provided with dry running vapour seals as per vendor's standard. However, VS1 type pump (if specified) shall be provided with seals as per API 682.

3.7.2 CENTRIFUGAL/SCREW COMPRESSORS

S.No.	Project Philosophy

Copyrights EIL – All rights reserved

S.No.	Project Philosophy
1	Centrifugal Compressors/Oil free screw compressors (for gas service) shall be provided with Dry Gas Seals except for services (like Air, N2 etc.) where normally labyrinths shall be used for sealing. Oil flooded screw compressors shall be provided with mechanical contact seals with seal oil system.
2	The offered model of Dry Gas Seal shall be field proven and similar in terms of specified process gas service, shaft diameters, speeds, sealing pressures and configuration as compared to at least Two Units designed, manufactured, tested and supplied and at least ONE of these units shall have completed atleast one year of satisfactory operation as on the bid due date of main (driven) equipment. Compressor vendor shall be asked to furnish past supply experience list of the seal manufacturer for the offered model of seal and justify meeting acceptance criteria.
3	The offered dry gas seal skid and panel shall be field proven and similar to the specified operating parameters as compared to at least FIVE UNITS designed, manufactured, tested and supplied by the proposed manufacturer and atleast TWO of these units shall have completed atleast one year of satisfactory operation as on the bid due date of main (driven) equipment.
4	Dry gas seals shall be bi-directional and of cartridge design. Configuration for Dry Gas Seal shall be Tandem with intermediate labyrinth unless specified otherwise. Seal faces lift off speed shall always be below than compressor no load trial speed or compressor train minimum operating speed suggested by compressor train vendor.
5	Dry gas seals & sealing system (Primary seal gas supply and vent) shall be designed for Compressor Casing MAWP.
6	Seal gas skid shall be compact and design shall ensure that there is no condensate ingress in dry gas seals.

3.7.3 ADDITIONAL EQUIPMENT

3.8 DRIVE ARRANGEMENT

S.No.	Project Philosophy
1	All equipment shall be either directly driven or driven through gear box. However, belt driven arrangement (only Toothed belt) may be used for Reciprocating/Diaphragm Compressors upto driver rating of 160 kW.
2	Belt drive arrangement may also be provided for other rotating equipment e.g. roots blowers etc.
3	Belts used for equipment located in hazardous area i.e. Div. I or Div.II (NEC) area (Zone 1 or Zone 2 (IEC) area) shall be static non-conducting type and shall be certified suitable for the area classification.
4	All pulleys shall be provided with taper lock bushes.

3.9 COUPLINGS

S.No.	Project Philosophy
1	Unless otherwise specified, Couplings shall be of metallic, non-lubricated, flexible element type (i.e. either diaphragm or discs) with spacer, for all equipment. All coupling models shall be selected for a minimum service factor of 1.5 over driver rating. DBSE shall be more than the seal cartridge length.

Copyrights EIL – All rights reserved

S.No.	Project Philosophy
2	Couplings for the following equipment shall conform to API Standard 671: - Centrifugal compressors (API Std. 617) - Special purpose Steam Turbines (API Std. 612) - Gas Turbines (API Std. 616) - Rotary Screw Compressors (API Std. 619) - Packaged Integrally Geared Air Compressor (API Std 672) - Multi-stage (greater than two stages) centrifugal pumps with Forced lubrication system (or) speed greater than 3000 rpm. In case of gearbox driven multistage pumps, both low speed and high speed couplings shall conform to API 671.
3	Couplings as per manufacturer's standard may be supplied for the following equipment: - Reciprocating Compressors - Packaged Rotary Compressors (Screw type for Plant & Instrument Air Service) - Diesel/Gas Oil Engine driven equipment - High speed integrally geared pumps The couplings for the above equipment shall however comply to the requirements of the individual codes as applicable for the equipment above (e.g. API-618 for Recip Compressors etc.).
4	Universal type coupling (hook joint) can be used for engine and driven equipments.
5	Removable coupling guard shall be provided which shall be fabricated from non-sparking material, and shall be open at the bottom to permit manual shaft rotation. The guard shall be sufficiently rigid to withstand deflections as a result of bodily contact of nominally 100 kgs. Centrifugal compressors and Gas Turbines coupling guards may have vendor standard features.

3.10 ALLOWABLE NOISE LEVEL

S.No.	Project Philosophy
1	Equipment noise level (Driver + Driven equipment train + auxiliaries) shall not exceed 85 dBA when measured at One-meter distance from the equipment skid in any direction. This requirement is not applicable for equipment for infrequent operation such as diesel engine driven fire water pump package/emergency DG/GEG/CEG Sets.
2	Acoustic hoods shall not be used for any equipment excepting for DG sets (rating up-to 1000 kVA), gas turbines, rotary compressors & roots blowers, sundyne type pumps/compressors. DG Sets of rating higher than 1000 kVA shall be installed in an acoustically treated DG Room/Building.

3.11 EQUIPMENT STORAGE

All rotating equipment shall be packed for an outside storage period of six (6) months. Equipment vendor to ensure the following before despatch:

- All the openings shall be plugged & sealed condition during dispatch
- Instruments like gauges, speed indicators, probes, oiler etc shall be removed from the main equipment and dispatched separately to avoid the damage of these components during transportation handling and erection.
- In addition to normal packing the pump and motor skids shall be separately covered with transparent polythene cover with opening for piping.

3.12 INITIAL FILL

The initial fill of lubricants, sealing fluid & other consumables shall not be included in the scope of supply of rotating equipment vendor. However vendor shall furnish list of

Copyrights EIL – All rights reserved

recommended make oils for bearing lubrication & seal pot buffer Liquid (as applicable).

3.13 INSTALLATION CRITERIA

3.13.1 PUMPS

S.No.	Project Philosophy
1	All pumps shall be suitable for outdoor installation. No equipment shelter is envisaged.

3.13.2 COMPRESSORS

S.No.	Project Philosophy
1	Unless otherwise indicated, process gas compressors shall be located under-roof with side walls partially open.
2	Centrifugal compressors driven by gas turbine: All centrifugal compressors driven by gas turbine can be installed on ground floor (i.e. on finished floor level) with air filtration system located outside the compressor house. A provision of suitable rain-hood / shelter adjacent to the proposed compressor house can protect the filters from high humidity & long monsoon period. Further air needs to be drawn from safe area.
3	Centrifugal compressors driven by steam turbine/Axially split Centrifugal Compressor driven by motor: All centrifugal compressors driven by steam turbine/ Axially split Centrifugal Compressor driven by motor shall be installed on Mezzanine floor with adequate working platform all around and drop out facility for maintenance. Other associated auxiliaries such as lube oil system, surface condenser, gland steam condenser, Condensate extraction pumps etc. shall be located on ground floor (i.e. on finished floor level).
4	Radially Split Centrifugal compressors driven by electric motor: All barrel centrifugal compressors driven by electric motor shall be installed on ground floor (i.e. on finished floor level). However, in case in the vicinity of such compressor, other compressors are being installed on the mezzanine floor, then electric motor driven radially split centrifugal compressor shall also be installed on the mezzanine floor with adequate working platform all around and drop out facility for maintenance. Other associated auxiliaries such as lube oil system etc. shall be located on ground floor (i.e. on finished floor level).
5	Integrally Geared Packaged Centrifugal Compressors/Rotary Screw Compressor: All Integrally Geared Packaged Centrifugal Compressors/Rotary Screw Compressor can be installed on ground floor (i.e. on finished floor level). Air filtration system, as applicable shall be located outside the compressor house.
6	Reciprocating multi-stage/multi-cylinder compressors: Reciprocating compressors shall be so located that no trenches are required for volume/pulsation bottles. Large reciprocating multi-stage/multi-cylinder compressors shall be installed on Mezzanine floor with its interstage piping/auxiliary equipment located on the ground floor. Skid mounted reciprocating compressors can be located on finished floor level.

3.13.3 STEAM TURBINE GENERATORS

S.No.	Project Philosophy
1	All STGs shall be located under-roof with side walls partially open and shall be suitable for outdoor installation.

Copyrights EIL – All rights reserved

S.No.	Project Philosophy
2	All STGs shall be installed on Mezzanine floor. Other associated auxiliaries such as lube oil system, surface condenser, gland condenser, condensate extraction pumps etc. shall be located on ground floor (i.e. on finished floor level).

3.13.4 DIESEL/GAS/CRUDE OIL ENGINE & GAS TURBINE DRIVEN GENERATING SETS

S.No.	Project Philosophy
1	All GEG, DG & GTGs shall be installed on ground floor (i.e. on finished floor level) under roof/generator set room.

3.13.5 GENERAL

S.No.	Project Philosophy
1	All other rotating equipment shall be suitable for outdoor installation and shall be installed on ground floor (i.e. on finished floor level). No equipment shelter is envisaged.

3.14 MATERIALS

The material of construction of the wetted parts of rotating equipment shall be as specified in the process package.

3.15 HEAT EXCHANGERS

3.15.1 LUBE OIL COOLERS

S.No.	Project Philosophy
1	Coolers shall be water-cooled, shell and tube type as per TEMA 'C' with oil in shell and water in tube.
2	The oil side operating pressure shall be higher than water side operating pressure.
3	For shell-and-tube heat exchangers, the low pressure (LP) side shall be preferably specified with a design pressure at least equal to 10/13 of high pressure (HP) side design pressure.
4	The material of construction shall be suitable for the specified service and as per governing API specification.

3.16 SAFETY

S.No.	Project Philosophy
1	Equipment design and engineering shall incorporate adequate safety features [as per applicable specifications of respective equipment as well as environment codes (if any) & standards applicable for the subject project] to provide protection to equipment and environment.
2	Thermal relief valves shall be provided for components that may be blocked in by isolation valves (including any cooling water return circuit piping of a cooler or a jacket).
3	All electrical components & installations, instruments shall be suitable for the electrical area classification and grouping in which the equipment is installed.

3.17 INSPECTION AND TESTING

Copyrights EIL – All rights reserved

S.No.	Project Philosophy
1	Each rotating equipment shall be subjected to mechanical run test at vendor's works.
2	Each rotating equipment shall be subjected to a performance test at vendor's works except the following: - Steam Turbines (Special / General Purpose) - Reciprocating Compressors (Other than for Air Service) - Reciprocating Air Compressors with suction pressure other than atmospheric pressure.
3	All other requirement with regard to inspection & testing shall be as specified in the inquiry document.
4	Owner and/or his Consultant may participate along with the their inspectors in any inspection and tests. The vendor shall notify to owner of all inspection and tests atleast four weeks before the scheduled date of inspection and test and reconfirm the same at least one week before the date of inspection and testing.

3.18 SCOPE OF SUPPLY AND WORK

Scope of supply and work shall be as indicated in the inquiry document.

3.19 INTERFACE

Equipment nozzles especially at purchaser's interface shall be as per purchaser's piping specifications.

In case, non-standard sizes are unavoidable, companion flanges along with gaskets and fasteners shall be procured from the equipment vendor.

3.20 ERECTION OF EQUIPMENT

Erection of all rotating equipment shall be carried out by the mechanical works contractor, under the supervision of equipment vendor, except for diesel/gas oil engine power generating sets. Erection of these power generation sets shall be in equipment vendor's scope.

4.0 SPECIFIC DESIGN REQUIREMENTS

Specific design Requirements shall be as indicated in the standard specifications for the relevant rotating equipment. Refer Table-1 for the applicable standard specifications.

4.1 CENTRIFUGAL PUMPS

S.No.	Project Philosophy
1	Double suction single stage, two-stage & multi-stage pumps shall be of between bearing types.
2	Suction flange rating shall be same as that of discharge flange for all pumps.
3	No cast iron pressure containing parts shall be used for hydrocarbon service except for shaft driven lube oil pumps.
4	Inducers shall not be used except for integrally geared type of pumps.
5	Hydraulic Power Recovery Turbines shall be optimised for best efficiency at Normal Flow.
6	Pumps shall be selected to have their rated operating point falling in the range of 70% to 110% of best efficiency point (BEP) flow.

Copyrights EIL – All rights reserved

S.No.	Project Philosophy
7	Single and two-stage pumps operating at temperatures less than 150 Deg C and multi-stage pumps operating at temperatures less than 120 Deg C shall be suitable for instantaneous startup from ambient to full operating temperature. For higher operating temperatures the vendor shall provide suitable hardware (i.e. piping, valves & fittings) & as part of the operating manual a suitable startup procedure shall be provided. Any required monitoring equipment (i.e., skin thermo couples) to ensure that the pump, including seal(s), does not incur damage due to rapid heat up shall be supplied by pump vendor.
8	All multistage horizontal centrifugal pumps intended for high temperature service (Process Temperature > 120 Deg C) shall be provided with pump casing - skin temperature monitoring system consisting of the following: - Four thermocouples along with Yoke mounted temperature transmitters with integral indicators for each thermocouple. - One Junction Box (JB) to be mounted on pump base plate. - Cables between the thermocouples and transmitters. - Cables between transmitters and junction box.
9	All rotating equipment base plates shall have jacking provision for aligning the prime movers.
10	Baseplate drain shall be provided with 2" flanged connection.
11	For the bearing housings, a gate valve and a magnetic drain plug shall be provided for inspecting the oil level while the pump is running.
12	For non API pumps, unfiltered vibration limit at vendor test bed and site test shall be governed by ISO 10816 – 3 (Table: A.3 & A.4). Limits mentioned in this standard shall be measured & applicable in radial (X & Y direction) and axial directions.
13	All high temperature pumps with hot circulation provision shall have provision of hot liquid circulation from pump bottom to suction line. This ensures uniform heating of complete pump.

4.2 RECIPROCATING PUMPS

S.No.	Project Philosophy
1	All reciprocating pump (reciprocating pumps as per API 674 & and controlled volume/metering type as per API 675) units shall be procured complete with speed reducer, driver, suction pulsation dampener (if required or specified), discharge pulsation dampener, relief valves, instrumentation, suction & discharge manifolded piping duly pre-fabricated for multi-head pumps etc. all duly mounted on a single common base plate as a skid mounted package.
2	All controlled volume pumps (as per API 675) shall be hydraulically operated double diaphragm type with rupture detection system.
3	All controlled volume pumps (except for pneumatically driven solenoid or by an AC operated solenoid) shall have positive return stroke mechanism. Controlled volume pumps with lost motion design or with spring return stroke mechanism shall not be permitted.
4	Pulsation suppression shall be provided at the discharge of all metering pumps. When necessary, Pulsation dampener shall be provided at suction to maintain adequate margin between NPSHA & NPSHR.
5	For pulsation dampeners, the first preference shall be for volume bottle type dampener and if the same is not sufficient a bladder type N2 precharged dampener shall be provided. In that case, Vendor shall also supply the N2 pressure regulator along with gas charging kit.

4.3 PACKAGED INTEGRALLY GEARED CENTRIFUGAL AIR COMPRESSOR

S.No.	Project Philosophy

Copyrights EIL – All rights reserved

S.No.	Project Philosophy
1	Air Compressors for Instrument Air service shall be of minimum 3 stages.
2	Unless otherwise specified, Oil cooler, Intercooler and Aftercooler should be as per proven manufacturer standard design, however coolers shall be shell and tube design with removable tube bundle and water in tube type. Material of construction shall be as specified in data sheet.
3	Driver rating shall be at least 110% of Compressor rated BKW at rated condition or BKW at unthrottled minimum ambient temperature & maximum atmospheric pressure, whichever is higher.
4	Individual components such as compressor, gear box & Intercoolers shall be individually maintainable without interference with each other. Intercoolers integral with compressor casing are not acceptable.

4.4 RECIPROCATING COMPRESSORS

S.No.	Project Philosophy
1	Horizontal Reciprocating compressor of BKW greater than 160kW will be balanced opposed type.
2	Unless otherwise specified, rotational speeds of reciprocating compressors in hydrogen rich service (Mol. Wt. Less than 12) shall generally be limited to a maximum of 350 rpm.
3	Unless otherwise specified, reciprocating compressors shall be skid mounted packages upto a motor rating of 300 kW.
4	Mechanical Run Test shall be carried out with shop lube oil system.
5	Compressor shall be fitted with UNI valves in case the compressors are designed for dual services like nitrogen and hydrogen. Compressor vendor shall inform the limitation, if any, for continuous operation period of these valves on dual service.
6	All supports for Suction, Discharge and other piping shall be taken from grade. No support shall be taken from compressor house columns or other compressor house structural members.
7	Drain of Suction volume bottle shall be routed to separate drain pot. Drain pot should not be integral part of suction volume bottle. Drain pot shall be equipped with instrumentation for auto draining on level.

4.5 LIQUID RING VACUUM PUMPS/COMPRESSORS

S.No.	Project Philosophy
1	The vendor for the complete unit shall be an established manufacturer of LRVP and shall also be the manufacturer of the proposed LRVP having adequate engineering, manufacturing & testing facilities for the same.
2	The LRVP model offered shall be from regular manufacturing range of the manufacturer and shall meet the following minimum experience requirements: LRVP shall be identical in terms of model & similar in terms of power rating, Rotational Speed, Inlet and discharge pressures, Inlet temperatures, Actual Inlet flow, process gas, Mechanical Design, Materials,Type of shaft seals etc. as compared to at least ONE unit designed, manufactured, tested and supplied from the proposed manufacturing plant and as a minimum, this package shall have completed one year of satisfactory operation at site, as on bid due date.
3	The motor name plate rating (with service factor equal to one) shall be atleast 110% of the maximum power required (including gear and coupling losses) for any of the specified operating conditions or for power required at relief valve set pressure whichever is higher.

Copyrights EIL – All rights reserved

4.6 POSITIVE DISPLACEMENT (ROOTS TYPE) BLOWER

S.No.	Project Philosophy
1	The vendor for the complete unit shall be an established manufacturer of roots blowers having adequate engineering, manufacturing and testing facilities for the same.
2	The compressor model offered shall be from regular manufacturing range of the manufacturer and shall meet the following minimum experience requirements: Blowers shall be identical in terms of model & similar in terms of power rating, Rotational Speed, Inlet and discharge pressures, Inlet temperatures, Actual Inlet Flow, Process Gas, Mechanical Design, Type of Rotor, Rotor Dynamics, shaft Sealing system, Materials etc. as compared to at least ONE units designed, manufactured, tested and supplied from the proposed manufacturing plant and as a minimum, this package shall have completed one year of satisfactory operation at site, as on bid due date.
3	The motor nameplate rating (with Service Factor equal to one) shall be at least 110% of the maximum power required for any of the specified operating conditions or for power required at relief valve set pressure whichever is higher.
4	Relief Valve set pressue shall be "(Suction Pressure + (1.1 X Differential Pressure))" only. Relief Valve can be of manufacturer's standard.

4.7 SEALLESS PUMPS

S.No.	Project Philosophy
1	The vendor shall be established sealless pump manufacturer having adequate engineering, manufacturing and testing facilities for the same.
2	The pump model offered shall be from the existing regular manufacturing range of the vendor. The mechanical as well as the hydraulic performance (including NPSHR) for the complete range of operation of the offered model shall have been established in the shop test. The offered pump model shall meet the following minimum experience requirements: Pumps shall be identical in terms of model & similar in terms of Mechanical Design and Operating/Service conditions of Capacity, Differential Head, NPSHR, Temperature, Pressure and Power rating, pump speed etc. as compared to at least ONE UNIT of the proposed model designed, manufactured, tested and supplied from the proposed manufacturing plant in the last ten years and as a minimum, this package shall have completed one year of satisfactory operation at site, as on bid due date.

4.8 CRYOGENIC PUMPS

S.No.	Project Philosophy
1	The vendor shall be an established Cryogenic pump manufacturer having adequate engineering, manufacturing and testing facilities for the same.

Copyrights EIL – All rights reserved

S.No.	Project Philosophy
2	The pump model offered shall be from the existing regular manufacturing range of the vendor. The mechanical as well as the hydraulic performance (including NPSHR) for the complete range of operation of the offered model shall have been established in the shop test. The offered pump model shall meet the following minimum experience requirements: Pumps shall be identical in terms of model & similar in terms of Mechanical Design and Operating/Service conditions of Capacity. Differential Head, NPSHR, Temperature, Pressure and Power rating, pump speed etc. as compared to at least ONE UNIT of the proposed model designed, manufactured, tested and supplied from the proposed manufacturing plant in the last ten years and as a minimum, this package shall have completed one year of satisfactory operation at site, as on bid due date.

4.9 SPECIAL PURPOSE GEAR UNITS

S.No.	Project Philosophy
1	The vendor shall be established Special purpose gear manufacturer having adequate engineering, manufacturing and testing facilities for the same.
2	The offered gearbox models shall be of proven design and shall be from the gearbox manufacturer's existing regular production range. Each of the gearbox model offered shall be identical in terms of model series & similar in terms of size (centre to centre distance, power rating, pinion speed, bearing journal speed, pitch line velocity and tooth profile) as compared to at least ONE UNIT designed, manufactured, tested and supplied by the vendor earlier from the proposed manufacturing plant, as a minimum, this package shall have completed one year of satisfactory operation at site, as on bid due date.
3	In case of alternators, gears shall be designed for short-circuit condition of the alternator.
4	Gears shall be double helical type.

4.10 ADDITIONAL EQUIPMENTS

S.No.	Project Philosophy

Copyrights EIL – All rights reserved

S.No.	Project Philosophy
1	Centrifugal fans and blowers: (a) For centrifugal fans and blowers first critical speed of the rotor shall be higher than 120% of rated speed. (b) For centrifugal fans and blowers capacity control shall be achieved by means of dampers (preferably on suction side). (c) For centrifugal fans and blowers the fan/ blower casing shall be suitably split such that impeller assembly can be removed for maintenance without disturbing inlet and outlet ducting. (d) For centrifugal fans and blowers SS Bolt and nuts shall be provided for the split casing joints of fans/blowers for corrosive services. (e) For centrifugal fans and blowers Fans operating in hot gas service shall be provided with a deflector plate or other suitable provision between shaft seal and bearing housing to deflect hot gas leakage away from the bearing housing. (f) For centrifugal fans and blowers the inlet guide vanes, if specified, shall be provided with following: • An external guide vane position indicator. • Spindles shall be supported at both ends. • Manual operation of guide vane from grade level shall be possible. • The guide vane ring shall be protected by a dust cover which shall allow full access to all parts for inspection. • Dampers shall be louver type with opposed blade.

5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

Notes:

6.0 MATERIAL HANDLING FACILITIES FOR NORMAL MAINTENANCE OF EQUIPMENT

6.1 MATERIAL HANDLING FACILITIES

Equipment layout shall incorporate adequate maintenance platforms, support structures, hand rails, operational access, material handling facilities for inspection and maintenance of equipment & for operation of these facilities. Non-skid decking covering all walk & work areas shall be provided on top of the base plate, as required.

Material handling facilities for normal maintenance of rotating equipment shall be provided as per the following criteria:

Type of Equipment	Type of Maintenance Facility
Centrifugal Pumps	Refer Piping EDB
Reciprocating Pumps excluding Metering Pumps	Refer Piping EDB
Centrifugal Compressor (Gas)	EOT Crane
Plant & Inst. Air Compressor (Centrifugal)	EOT Crane
Reciprocating Compressor (Gas)	EOT Crane
STG/GTG	EOT Crane
GEG/DG/CEG Sheds	
< 1000 kVA	Trolley mounted CP Block + Monorail
> 1000 kVA	EOT Crane / HOT Crane
Pump Houses	HOT Crane

Note-1: Electric motor driver/ Alternators (if applicable) shall be considered as a single

Copyrights EIL – All rights reserved

component for maintenance except for single bearing electric motors where motor stator & rotor shall be considered as individual components.

Note-2: Electric power generator shall be considered as a single component for maintenance except for single bearing electric power generator where generator stator & rotor shall be considered as individual components.

Note-3: Where the equipments are installed in open area, no permanently installed material handling facility shall be provided.

7.0 SPARE PARTS

7.1 MANDATORY SPARES

Mandatory spares shall be procured along with the main equipment, if specified by the client. Such spares for each equipment item shall be as per the below table. These spares include only those spares, which are critical for equipment and require longer delivery periods. Spare rotors where supplied shall be boxed in a metal containers for vertical storage with N2 purging. Unit price of each of the listed spares shall be indicated separately in the Proposal.

Description	Description of Mandatory Spares(Qty per Item Tag No.)(i.e. Total qty for working and standby)
PUMPS:	
Centrifugal Pumps Multistage Horizontal (Special Purpose Process Service) / Hydraulic Power Recovery Turbine	1 set of pump element assembly including dynamically balanced rotor (Only for multi-stage horizontal centrifugal barrel type) (Note-1) + 1 set of mechanical seals (complete cartridge assembly) + 1 set of bearings -- OR -- 1 set of dynamically balanced rotor (Only for multi-stage horizontal centrifugal axial split type) + 1 set of mechanical seals (complete cartridge assembly) + 1 set of bearings
Centrifugal Pumps Single/Two stage (Special Purpose Process Service) Horizontal/Vertical	1 set of mechanical seals (complete cartridge assembly)
Centrifugal Pumps (General Purpose Process Service)	1 set of mechanical seals (complete cartridge assembly)
Centrifugal Pumps (General Water Service)	1 set of mechanical seals (complete cartridge assembly)(if applicable)
Centrifugal Pumps (Slurry & Liquor Service)	1 set of mechanical seals (complete cartridge assembly
Positive Displacement Pumps (Reciprocating)	1 set of valve assembly
Positive Displacement Pumps (Controlled Volume)	1 set of valve assembly + 1 set of diaphragms
Positive Displacement Pumps (Rotary)	1 set of rotor assembly + 1 set of mechanical seals
Liquid Ring Vacuum Pumps/Compressors	1 set of dynamically balanced rotor

Copyrights EIL – All rights reserved

Description	Description of Mandatory Spares(Qty per Item Tag No.)(i.e. Total qty for working and standby)
Seal-less Pumps	1 set of impellers/rotor (If multistage)
COMPRESSORS / FANS & BLOWERS	
Centrifugal Compressors/Blowers	1 set of dynamically balanced rotor + 1 set of compressor shaft end seals + 1 set of bearings + 1 set of dry gas seal filters + 1 set of lube oil filters
Axial Compressors	1 set of dynamically balanced rotor + 1 set of compressor shaft end seals + 1 set of bearings + 1 set of dry gas seal filters (if applicable) + 1 set of lube oil filters
Expander-Compressors	1 set of dynamically balanced rotor (Rotor implies complete machine centre section including bearing and seals.) + 1 set of lube oil filters
Integrally Geared Process Centrifugal Compressors	1 set of Dynamically balanced Rotors (including all pinions, shafts and impeller) + 1 set of bearings + 1 set of compressor shaft end seals + 1 set of dry gas seal filters (If applicable) + 1 set of lube oil filters
Centrifugal Fans	1 set of shaft & impeller + 1 set of end seals + 1 set of bearings
Induced Draft / Forced Draft Fans	1 set of dynamically balanced rotor + 1 set of seals + 1 set of bearings
Packaged Integrally Geared Centrifugal Air Compressors	1 Set of Dynamically balanced Rotors (including all pinions, shafts and impeller) + 1 set of shaft seals + 1 set of bearing assemblies + 1 set of lube oil filters
Reciprocating Compressors (Utility & Instrument Air Service)	1 set of cylinder valve assemblies + 1 set of piston ring & rider band + 2 sets of packing (stuffing box + intermediate box). + 1 set of big end, small end and crank shaft bearings
Reciprocating Compressors (Process Service)	1 set of cylinder valve assemblies + 1 set of piston ring & rider band + 2 sets of packing (stuffing box + intermediate box). + 1 set of big end, small end and crank shaft bearings + 1 set of lube oil filters (If applicable)
Positive Displacement Compressors (Rotary)	1 set of dynamically balanced rotor + 1 set of compressor seals + 1 set of bearing assemblies
Diaphragm Type Positive Displacement Compressors	4 Sets of Diaphragm + 1 set of bearings

Copyrights EIL – All rights reserved

Description	Description of Mandatory Spares(Qty per Item Tag No.)(i.e. Total qty for working and standby)
Roots Blowers	1 set of dynamically balanced rotor + 1 set of bearings + 1 set of shaft end seals (including labyrinth seals)
MECHANICAL DRIVERS / GEAR BOXES	
Diesel Engines	NIL
Gas Turbines	NIL
Steam Turbines (General Purpose)	1 set of dynamically balanced rotor + 1 set of mechanical seals (if applicable) + 1 set of bearings
Steam Turbines (Special Purpose)	1 set of dynamically balanced rotor + 1 set of bearings
Special Purpose Gear Box	1 set of bearings
General Purpose Gear Box	1 set of bearings
Special Purpose Coupling	1 set of Coupling Shim Membranes

Notes:
1) Element consists of assembled rotor plus stationary hydraulic parts [diffuser(s) or volute(s)].
2) The word "set" means the quantity required for full replacement of that part in one machine.
3) Spare rotors shall be boxed in a metal containers for vertical storage with nitrogen purging. Storage container shall be property of the owner.

7.2 COMMISSIONING SPARES

Erection & Commissioning Spare Parts shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended spares shall be obtained along with the offer. Any spare consumed over and above the recommended erection & commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor. Any leftover (unused) spares after commissioning, out of those included by vendor in his offer, shall be handed over to the owner.

7.3 RECOMMENDED SPARE PARTS FOR NORMAL OPERATION & MAINTAINENCE

As per rotating equipment manufacturer's recommendations, a quotation for spare parts for two-years normal operation (over and above mandatory spares) along with unit price shall be obtained with the proposal. The order for these two year operation spares shall be placed by owner separately.

7.4 SPECIAL TOOLS AND TACKLES

Special Tools and Tackles shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended special tools/tackles shall be obtained along with the offer.

8.0 INSTRUMENTATION ASSOCIATED WITH EQUIPMENTS

8.1 MACHINE HEALTH MONITORING THROUGH DEDICATED MACHINE CONDITION MONITORING SYSTEM

Copyrights EIL – All rights reserved

S.No.	Project Philosophy
1	Centrifugal Compressors, Expander Compressor, Screw Compressor (with hydrodynamic bearings and forced feed lubrication), Special Purpose Steam Turbine, Gas Turbine (with hydrodynamic bearing and forced feed lubrication), Special Purpose Gear Units and Multi stage Centrifugal Pumps/HPRT (with forced feed lubrication) shall be provided with proximity probes/detector and monitors for measuring shaft radial vibration, axial position and bearing temperatures etc.Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.
2	Special Purpose Gearbox, Gas Turbines and Screw Gas Compressor (with anti-friction bearing) shall be provided with accelerometer based probes/detector and monitors, for measuring vibration.Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.
3	Reciprocating Gas Compressors (Driver rating >= 160KW) shall be provided with probes/detector and monitors, for measuring frame and cylinder vibration,piston rod drop (each cylinder) and bearing temperatures.Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.

8.2 MACHINE HEALTH MONITORING THROUGH PLC / DCS

S.No.	Project Philosophy
1	Packaged Integrally Geared Instrument Air Compressor, General Purpose Steam Turbine (with forced feed lubrication) (Driver rating >= 160KW), Multi stage Centrifugal Pumps (without forced feed lubrication) (Driver rating >= 160KW), General Purpose Gear Box (Driver rating >= 160KW) shall be provided with probes/detector for measuring vibration and bearing temperature.Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.

8.3 VIBRATION MONITORING INSTRUMENTATION

Vibration monitoring instrumentation shall be provided as follows:

S.No.	Project Philosophy
1	Hydrodynamic radial bearings with forced feed lubrication shall be fitted with X-Y proximity probes except for Reciprocating Compressors, Integrally Geared Air Compressor & high speed integrally geared pumps.
2	Hydrodynamic thrust bearings shall be fitted with two numbers proximity type axial probes except for Integrally Geared Air Compressor.
3	Integrally Geared Air Compressor shall be fitted with minimum one no. proximity radial probe for each bearing adjacent to an impeller.
4	A key-phasor is required for each speed change of the shaft system for hydrodynamic bearings.
5	Casing mounted accelerometers(X & Y) shall be provided for special purpose gearboxes and gas turbines.
6	Reciprocating Gas Compressor Frame & cylinder shall be fitted with accelerometers.
7	Bearing housings with anti-friction bearings, for equipments covered in 8.2 above, shall be fitted with accelerometers(X & Y).

8.4 TEMPERATURE MONITORING INSTRUMENTATION

For temperature monitoring instrumentation shall be fitted as follows:

S.No.	Project Philosophy

Copyrights EIL – All rights reserved

S.No.	Project Philosophy
1	Hydrodynamic radial bearings shall be fitted with at least two (2) temperature probes except for Integrally Geared Air Compressor.
2	Hydrodynamic thrust bearings shall be fitted with at least two (2) temperature probes each on active and inactive side except for Integrally Geared Air Compressor.

8.5 GENERAL INSTRUMENTATION

S.No.	Project Philosophy
1	All other process pumps, not covered in above Cl. Nos. 8.1, 8.2, 8.3 & 8.4, shall have provision for mounting accelerometers (X & Y) on each bearing housing.(Tapping size 1/4"- 28 tap set, minimum depth 6mm).
2	Also refer Electrical Specifications for Instrumentation requirements w.r.t. motors.

9.0 VENDOR DATA REQUIREMENT

Vendor Data Requirement as indicated in the respective equipment Material Requisitions shall be followed.
Only critical vendor data/documents such as Equipment Data Sheets, P&ID's, Foundation Drawing, Equipment Layout, Major Inspection & Test Procedures etc. shall be taken for Owners/Consultant's review. All other drawings/documents shall be retained for Owners/Consultant's records.

Copyrights EIL – All rights reserved

Annexure-13F

उपकेन्द्रीय पम्पों के लिए मानक विनिर्देश विशिष्ठ प्रयोजन प्रक्रिया पम्प

STANDARD SPECIFICATION FOR CENTRIFUGAL PUMPS (SPECIAL PURPOSE PROCESS SERVICE)

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
2	13.02.2013	Revised & Issued as Standard Specification	JSD	TK	DB	DM
1	21.03.2011	Re-affirmed and Reissued	SPS	DB	AKN	DM
0	13.10.2005	Issued as Standard Specification	DB	KDS	RK	VJN

Copyright EIL – All rights reserved

Abbreviations:

API	:	American Petroleum Institute
ASME	:	The American Society of Mechanical Engineers
EDMS	:	Electronic Document Management System
EQC	:	Equipment Qualification Criteria
ISA	:	Instrumentation Society of America
MAWP	:	Maximum Allowable Working Pressure
MKS	:	Meter, Kilogram, Seconds
MOP	:	Main Oil Pump
P&ID	:	Piping and Instrumentation Diagram
PTC	:	Power Test Codes
PTR	:	Proven Track Record
VDR	:	Vendor Data Requirements

Rotating Equipment Standards Committee

Convenor: Mr. Dinesh Bhatia

Members:
Mr. Nalin Kumar
Mr. Tarun Kumar
Mr. Anukul Mandal
Mr. Rakesh Mishra
Mr. JS Duggal
Mr. M.P Jain

Copyright EIL – All rights reserved

CONTENTS

Copyright EIL – All rights reserved

1 SCOPE

i. This specification together with the attendant Data Sheets and other specifications/attachments to inquiry / order defines the minimum requirements for vertical and horizontal centrifugal pumps including pumps running in reverse direction as hydraulic power recovery turbines and their accessories / auxiliaries for use in the petroleum, petrochemical and natural gas industries.

ii. Vendor shall make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.

In case deviations are considered essential by the vendor (after exhausting all possible efforts) these shall be separately listed in the vendor's proposal under separate section titled as "List of deviations/exceptions to the inquiry document". Deviation shall be listed separately for each document with cross-reference to Page No./Section/Clause No./Para etc. of the respective document supported with proper reasons for the deviation for purchaser's consideration. Any deviation not listed under the above section, even if reflected in any other portion of the proposal shall not be considered applicable.

No deviation or exception shall be permitted without the written approval of the purchaser.

iii Compliance with this specification shall not relieve the vendor of the responsibility of furnishing equipment and accessories/auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions.

In case the vendor considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, he shall recommend the same along with reasons in a separate section along with his proposal and include the same in his scope of supply.

1A CONFLICTING REQUIREMENTS

In case of conflict between this specification and the attendant data sheets, job specifications (if any) and other attached specification the following order of precedence shall govern:

1. Equipment Data Sheets.
2. Job Specifications (if any)
3. P&ID's (if any)
4. This specification
5. Other specifications
6. Other referred codes and standards

Copyright EIL – All rights reserved

1B EQUIPMENT QUALIFICATION CRITERIA

1B.1 Unless otherwise specified elsewhere, the Equipment Qualification Criteria (EQC) specified vide para 1B.2 thru 1B.6 of this specification shall be applied for acceptance of the offered pump model and its manufacturer.

1B.2 a)The vendor shall be an established manufacturer of API-610 centrifugal pumps having adequate design, engineering, manufacturing, packaging and testing facilities for pumps and shall be the single point responsibility vendor for the complete centrifugal pump package.

b) The vendor shall have designed, engineered, packaged, tested and supplied, in the last TEN (10) years, from the proposed manufacturing plant, at least ONE (1) centrifugal pump package with same type of driver having similar driver power.
As a minimum, this package shall have completed ONE Year of satisfactory operation at site, as on the bid due date.

1B.3 a) The pump model offered shall be from the existing pump model series and shall be from the regular manufacturing range of the vendor. The mechanical as well as the hydraulic performance (including NPSHR) for the complete range of operation of the offered model shall have been established in the shop test.

The offered pump model shall meet the minimum service and manufacturing experience requirements specified in clause# 1B.3 b) below.

b) Pumps shall be identical in terms of Hydraulics and similar in terms of Power Rating, Inlet flow, Differential Head, Operating Pressure & Temperature, Pumping Liquid, Speed, Number & Type of Impellers, Mechanical Design, Materials, Bearing span (applicable for between bearing pumps), Column Length (applicable for vertically suspended pumps) etc. as compared to at least ONE (1) unit of the proposed model designed, manufactured, tested and supplied from the proposed manufacturing plant in the last TEN (10) years and the reference unit shall have completed ONE year of satisfactory operation at site, as on the bid due date.

In case all the above parameters are not available from single past reference, more than one reference can be cited/considered to satisfy the above qualification requirement.

1B.4 In case the vendor is a licensee / member of a group company (As defined in 1B.6 below) and does not meet on his own, the experience criteria of clause# 1B.3 b), the vendor can substitute the references of his Collaborator (licensor) / another member of the group company, who shall also be a regular manufacturer of the proposed pump model, provided the following conditions are met by the vendor:

1B.4.1 The vendor shall be a regular & established manufacturer of API 610 centrifugal pumps and shall have supplied smaller & larger sizes of pump models of the same series, from the proposed manufacturing plant and proves to the satisfaction of the purchaser that the vendor does possess the manufacturing & testing facilities for the offered pump model.

1B.4.2 The vendor's collaborator (licensor) / the member of group company whose references are being used to establish proven track record of the proposed pump model, meets the criteria as per 1B.3 above.

1B.4.3 The vendor's license agreement is valid and continues to remain valid till, at least TWO years after the delivery of the pumps.

Copyright EIL – All rights reserved

1B.4.4 The vendor imports as a minimum the following critical components (including components required for spare parts) from his Collaborator (licensor)/Group Company or their sub-vendors:

- Impellers/Diffusers (fully machined)
- Complete Rotor Assembly (dynamically balanced) for multi-stage pumps
- Casing (proof machined, hydrostatically tested)
- Bearing Bracket.

The vendor need not import the components defined above, if the same have been designed, manufactured, assembled, tested & supplied by the vendor, in the past from the vendor's proposed manufacturing plant and such references have completed ONE year of satisfactory operation at site as on the bid due date.

1B.4.5 The vendor shall have adequate testing facilities and shall carry out all the inspection and tests as specified in the inquiry/order at the proposed manufacturing plant (except for tests specified in 1B.4.4 above, i.e. dynamic balancing & hydrostatic test) from where the vendor intends to supply the proposed pump model.

1B.4.6 The vendor shall indicate the details of such arrangement in the proposal.

1B.5 In case the vendor is a licensee / member of a group company (As defined in 1B.6 below) and does not possess the manufacturing experience of the proposed pump models at his own manufacturing plant as per Clause 1B.3 and 1B.4 above, the vendor may propose to supply the complete package with duly performance tested bareshaft pump sourced from the vendor's licensor / another member of the group company, who shall be a regular manufacturer of the proposed pump model, provided the following requirements are met:

1B.5.1 The vendor shall be a regular & established manufacturer of API 610 centrifugal pumps and shall be a licensee / member of group company (As defined in 1B.6 below) from where the bareshaft pump is proposed to be sourced.

1B.5.2 a) The vendor's license agreement is valid and continues to remain valid till, at least TWO years after the delivery of the pumps. Necessary documents to establish that vendor has requisite facilities and has been authorised to package the proposed pump model shall be furnished in the proposal.

b) In case of member of group company also, vendor to furnish requisite documents from group company to establish that vendor has requisite facilities and has been authorised to package the proposed pump model.

1B.5.3 The vendor's collaborator (licensor) / the member of group company whose references are being used to establish proven track record of the proposed pump model, meets the criteria as per 1B.3 above.

1B.5.4 The vendor shall have adequate equipment handling and testing facilities and shall carry out the Unitization/Complete Unit Test (As applicable) of the complete pump package at his shop.

Hydrostatic test, Performance Test, Mechanical Run Test, Sound & Vibration Level Test, NPSH Test, Dismantle inspection and reassembly after the running test of the bareshaft pump shall be carried out at the pump manufacturer's shop i.e. the shop from where the pump is proposed to be sourced. All the above tests at pump manufacturer's shop shall be duly witnessed as specified/required in Inquiry document. The vendor shall furnish the test certificates for tests carried out at pump manufacturer's shop at the time of final inspection.

Copyright EIL – All rights reserved

1B.5.5 The vendor shall indicate details of such arrangement in the proposal.

1B.6 For the purpose of Cl. 1B, Group Company shall mean one of the following:

a) Wholly owned subsidiary of the bidder.
b) Principal of whom the bidder is a wholly owned subsidiary.
c) Another wholly owned subsidiary of the Principal of whom the bidder is a wholly owned subsidiary.

Necessary documents to justify above shall be furnished in the proposal.

1B.7 PROVEN TRACK RECORD (PTR)

The vendor shall complete the Experience Record Proforma's enclosed with the inquiry document to amply prove that the offered pumps meet the EQC for technical acceptance. Special attention is drawn to applications involving high suction pressure, high/low operating temperature and low NPSHR. The vendor shall also identify the imported components against each specific reference in the PTR. The vendor may furnish additional information to justify that the EQC is being met. In addition, manufacturer's catalogue and general reference list for Centrifugal Pumps shall also be furnished along with the proposal.

1C AMENDMENTS/SUPPLEMENTS TO API STANDARD 610

1C.1 Except as modified herein, the centrifugal pumps shall be designed, manufactured, tested and supplied strictly in accordance with the **API Standard 610 - Centrifugal Pumps for Petroleum, Petrochemical and Natural gas industries, Tenth Edition, October 2004.**

1C.2 Except for new paragraphs, the number and title of the paragraphs in this specification correspond to the respective sections and paragraphs of the above standard. Paragraphs not addressed in this specification shall be strictly in accordance to **API Standard 610, Tenth Edition, October 2004** requirements.

The word in parenthesis following the number or title of a paragraph indicates the following:

(Addition)	:	An addition to a part, section or paragraph referred to.
(Modification)	:	An amplification or rewording has been made to a part of the corresponding section or paragraph but not a substitution replacing the entire section or paragraph.
(Substitution)	:	A substitution has been made for the corresponding section or paragraph of the standard in its totality.
(New)	:	A new section or paragraph having no corresponding section or paragraph in the Standard.
(Delete)	:	The paragraph is deleted.

Copyright EIL – All rights reserved

1 SCOPE

Paragraph 1 of **API Standard 610 - Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas industries, Tenth Edition, October 2004** stands modified as per para 1, para 1A, para 1B and para 1C above.

2 NORMATIVE REFERENCES (Addition)

Add the following after NACE MR0175:
NACE MR0103, Materials resistant to sulfide stress cracking in corrosive petroleum refining environments (item no. 21305)

3 TERMS AND DEFINITIONS

3.20 Maximum Discharge Pressure (Modification)
Replace 'normal relative density' by 'maximum specified relative density at any specified operating condition'.

4 CLASSIFICATION AND DESIGNATION

4.3 Units and Governing Requirements

4.3.1 (Modification)
Unless otherwise specified, MKS system of units shall be used.

5 BASIC DESIGN

5.1 General

5.1.10 (Addition)
Pumps where difference between NPSHA and NPSHR from quoted minimum flow to rated flow is less than 0.6 meter are not acceptable. The said NPSHR value shall correspond to the maximum value of NPSHR from rated flow down to the recommended minimum continuous stable flow specified by the vendor. However, in case of parallel operation and/or autostart against open discharge valve condition, NPSHR at end of curve shall not exceed specified NPSHA in addition to above margin requirement.
Pumps fitted with inducers for reducing NPSHR are not acceptable.

5.1.13 (Substitution)
Pumps shall have stable head/flowrate curves (continuous head rise to shutoff) for all applications. If parallel operation is specified, the head rise from rated point to shutoff shall be at least 10%. Unless otherwise specified, discharge orifice shall not be used to achieve required head rise to shut off in case of parallel operation.

5.1.14 (Substitution)
Pumps shall have preferred operating region of 70% to 120% of best efficiency flowrate of the pump as furnished. Rated flow shall be within 110% of best efficiency flowrate of the pump as furnished. Vendor shall indicate "Preferred Operating Range" and "Allowable Operating Range" on the characteristic curve.

5.1.16 (Modification)
The last sentence of this para reading " the equipment...for guidance" stands substituted with the following:

Unless otherwise specified, the maximum permissible sound level shall not exceed 88 dBA measured at one (1) meter in any direction from pump train for the recommended range of operation.

Copyright EIL – All rights reserved

5.1.22 (Modification)
Unless otherwise specified, water cooling systems (jackets, heat exchangers and so forth) shall be designed for the following conditions on the water side:

Velocity over heat exchanger surface	:	1.5 - 2.5 m/sec.
Maximum Allowable Working Pressure (MAWP)	:	∃ 8.0 kg/cm²g
Test Pressure (1.5 X MAWP)	:	∃ 12.0 kg/cm²g
Maximum Pressure Drop	:	1.0 kg/cm²
Maximum Inlet Temperature	:	33EC
Maximum Outlet Temperature	:	45EC
Maximum Temperature Rise	:	12EC
Minimum Temperature Rise	:	6EC
Fouling Factor on Water Side	:	0.0004 m² hrEC/kcal
Shell Side Corrosion allowance (not for tubes)	:	3.2 mm

5.1.30 (Addition)
Unless otherwise specified, equipment shall be designed to be suitable for outdoor installation without a roof.

5.1.32 (New)
For balancing axial thrust in multi-stage pumps, only the following arrangements shall be used:
- Opposed arrangements of impellers.
- A balancing piston

5.1.33 (New)
For rated flows exceeding 1000 m^3/Hr, only "Between Bearing Type" pump shall be supplied.

5.2 Pump Types (Modification)
Unless otherwise specified, pump types as listed in Table 2 shall not be offered.

5.3 Pressure Casings

5.3.1 (Substitution)
The maximum discharge pressure shall be the maximum suction pressure plus the maximum differential pressure (including the allowable positive performance tolerance) the pump is able to develop when operating with the furnished impeller at the rated speed and specified maximum relative density (specific gravity).

5.3.3 (Modification)
The 'NOTE' stands modified as under:
Vendor to note that the criteria specified in a) above shall also be used for design of purchaser's associated piping system.

5.3.6 (Modification)
Regions of vertically suspended, double-casing and horizontal multistage pumps (pumps with three or more stages) that are subject only to suction pressure shall be designed for the same MAWP as the discharge section.

5.3.11 (Modification)
The words "except as allowed in 8.2.1.2" stand deleted.

5.5 External Nozzle Forces and Moments

Copyright EIL – All rights reserved

5.5.1 (Modification)
The pump's pressure casing shall be suitable to withstand twice the forces and moments in Table 2-1A (2-1B) applied simultaneously to the pump through each nozzle, plus internal pressure, without distortion that would impair operation of the pump or seal.
Note: Vendor to note that the above criteria shall be used for design of purchaser's associated piping system.

5.7 Wear Rings and Running Clearances

5.7.3 (Modification)
Tack welding shall not be employed for fitting of the wear rings.

5.7.4c) (Modification)
Non-metallic wear rings, if offered, shall be subject to purchaser's specific approval.

5.7.4d) (New)
The maximum permissible running clearances shall not be less than twice the new running clearances.

5.8 Mechanical Shaft Seals

5.8.1 (Addition)
For the applicable flushing plans, the vendor shall also include in his scope of supply, all items shown as optional items in Annexure D of API standard 682 (Standard Flush Plan and auxiliary Hardware) along with other additional specified/ required items, if any.

5.9 Dynamics

5.9.2.6 (Modification)
Replace the words 'If specified' by 'If torsional analysis is performed'.

5.9.3 VIBRATION
5.9.3.3 (Modification)
The words 'if specified' in the last sentence stand deleted.

5.10 Bearings and Bearing Housings

5.10.2 BEARING HOUSINGS

5.10.2.7 (Modification)
Bearing housings shall be equipped with suitable replaceable noncontact type bearing isolators where shaft passes through the housing.

5.10.2.12 (Substitution)
A flat surface at least 25 mm in diameter shall be supplied for the location of magnetic based vibration measuring equipment, whether or not vibration measuring equipment is included in the vendor's scope of supply.

5.10.2.13 (New)
Bearing housing shall be equipped with magnetic drain plug except for multistage pumps where vendor's standard design may not permit this.

5.11 Lubrication

5.11.3 (Substitution)
Provision shall be made for pure/purge oil mist lubrication as specified.

Copyright EIL – All rights reserved

5.12 Materials

5.12.1.6c) (Substitution)
Unless otherwise specified, casing in cast iron construction shall not be offered.

5.12.1.8 (Modification)
The words 'if specified' stand deleted.

5.12.1.12 (Modification)
Where even trace quantities of wet H2S are indicated to be present, reduced hardness materials in accordance with NACE MR0175/MR0103 shall be provided by the vendor.

5.12.2.5 (Modification)
The words 'if specified' stand deleted.
The second sentence also stands deleted.

5.12.3.4 (Modification)
e) Requirements of additional examination shall be as specified vide clause 7.2.1.3 of this specification.

5.12.4.3 (Modification)
ASME Sec VIII, Div 1 shall apply with regard to impact testing requirements.

6 ACCESSORIES

6.1 Drivers

6.1.3 (Modification)
Electric motor drivers shall have a maximum continuous rating (MCR) (i.e. service factor equal to 1) not lower than the following unless higher rating is dictated by the Note 1 and / or Note 2:

Pump Rated BKW		**Motor MCR (% of Pump Rated BKW)**
Up-to 22 kW	:	To suit maximum BKW indicated on pump data sheet or 125% of rated pump BKW, whichever is higher.
22 kW to 55 kW	:	115%
Higher than 55 kW	:	110%

The electric motor shall be suitable for the electrical area classification specified on the data sheet.

Note:
1. The motor nameplate rating for pumps under parallel operation or for pumps with auto-start operation shall not be less than the max. BKW indicated on pump data sheet (maximum power at any point on the pump performance curve from shutoff to end of the curve for the rated impeller) or shall have the specified margin as per this clause whichever is greater. The pump motors shall also be suitable for start-up under open discharge valve condition.

2. The motor nameplate rating for applications where the specific gravity of pumped fluid is less than 1.0 shall either be 100% of the BKW of pump at minimum continuous stable flow with clean cold water of sp. gravity 1.0 or shall have the specified margin as per this clause, whichever is greater.

Copyright EIL – All rights reserved

6.1.8 (Modification)
Unless otherwise specified, steam turbine drivers shall be sized to deliver continuously 110% of pump rated power at minimum inlet and maximum exhaust steam conditions.
The steam turbine rating (with minimum inlet and maximum exhaust steam conditions) for pumps under parallel operation or for pumps with auto-start operation shall not be less than the max. BKW indicated on pump data sheet (maximum power at any point on the pump performance curve from shutoff to end of the curve for the rated impeller). The turbine shall also be suitable for start-up under open discharge valve condition.
In any case, Turbine Rating shall be at least equal to the Motor Rating of the standby pump.

6.2 Couplings and Guards

6.2.3 (Modification)
The words 'if specified' stand deleted

6.2.4 (Substitution)
Unless otherwise specified, all couplings required for multistage pump package(s) (greater than two stages) shall conform to API standard 671 where either the driver rating is greater than 160 kW or the maximum continuous speed is greater than 3000 rpm.
However in case of gear box driven multistage pump units, both low speed and high speed couplings shall conform to API standard 671 if any of the above criteria of speed or power is satisfied.

6.2.7 (Addition)
The coupling service factor shall not be less than 1.5 over the driver rating.

6.2.14 a) (Addition)
Coupling guard shall be open at the bottom to permit manual shaft rotation.

6.2.14 c) (Modification)
Coupling guard shall be fabricated from non-sparking material.

6.3 Base Plates

6.3.1 (Addition)
Pumps in corrosive service shall have provision to collect and drain the leakage from mechanical seal or packing, through a drip pan of metallurgy equivalent or superior to pump casing. Leakages from drip pan shall be piped to base-plate with a flanged connection for onward disposal by purchaser. Where the design of bearing prohibits provision of drip pan, the material of bearing bracket shall be suitable for the corrosive service.

6.3.3 (Modification)
Replace "if specified" by "For all multistage pumps".

6.3.6 (Modification)
The vendor shall furnish the results of the pipe load test data for the proposed pump model(s) along with their proposal indicating the shaft deflections at coupling end.
In case pipe load test has not been conducted in the past, the vendor shall demonstrate the pipe load test (Either Physical Testing or Computer Simulation Study) for the proposed pump model(s) at their manufacturing shops within four months of placement of order.

6.3.19 (Modification)
The pump manufacturer shall furnish the anchor bolts.

Copyright EIL – All rights reserved

6.3.21 (New)
Skid layout of pump trains along-with their auxiliary systems (i.e. seal flushing plans) shall be designed in a manner so as to ensure that there is enough space within the skid for maintenance and operation. Special care shall be taken for pumps provided with seal flushing plans 23 and 52 so that couplings and seals can be attended for maintenance without disturbing any seal piping/cables/other items located on the skid. As far as possible, area on motor terminal box side shall be left clear of all piping and accessories for ease of maintenance.

6.4 Instrumentation

6.4.2.2 (Modification)
The words 'if specified' stand deleted. The vendor shall supply the detectors.

6.4.2.3 (Modification)
The words 'if specified' stand deleted.

6.4.2.4 (Modification)
The words 'if specified' stand deleted.

6.4.2.5 (New)
Horizontal multistage pumps intended for pumping temperature above 120°C shall be provided with pump casing skin temperature monitoring system consisting of the following:

- Four thermocouples along-with yoke mounted temperature transmitters with integral indicator for each thermocouple.
- One Junction Box (JB) to be mounted on the pump base-plate.
- Cables between the thermocouples and transmitters.
- Cables between transmitters and junction box.

6.5 Piping and Appurtenances

6.5.1 GENERAL

6.5.1.6 (Modification)
The words 'if specified' stand deleted.

6.5.1.7 (Modification)
Flange fasteners on stainless steel piping systems shall be of stainless steel.

6.5.2 AUXILIARY PROCESS FLUID PIPING

6.5.2.3 (Modification)
Auxiliary process fluid piping material shall be SS-316 as a minimum.

6.5.2.6 (Substitution)
Casing shall be provided with drain connection with nipple, threaded and seal welded and provided with a socket welded gate valve terminated at edge of the base plate. Gate valve shall be of 800# rating with material of construction (MOC) equal or superior to the pump casing. For multistage pumps with more than one drain point, block valves at each drain point shall be provided and the piping shall be terminated at edge of the base plate with a flange. Unless made self venting design, vent connections shall also be provided with a nipple, threaded and seal welded and terminated with a gate valve. Pressure gauge connection shall not be provided unless specifically required in the inquiry. Nipples shall meet the requirements of 5.4.3.5 & 5.4.3.6.

Copyright EIL – All rights reserved

6.5.2.8 (Modification)
Flanges are required instead of socket welded unions for all auxiliary process fluid piping.

6.5.2.9 (New)
Unless otherwise specified, material for seal flushing liquid cooler shall be as under:

Tube or Coil	:	Type 316 stainless steel or Monel.
Casing (or Shell)	:	Carbon Steel.

Cooling water shall be on the casing (Shell) side.

6.5.3 COOLING WATER PIPING

6.5.3.3 (Addition)
Sight flow indicator shall have ball or flag for easy verification of water flowing through pipes.

6.5.3.5 (New)
Thermal relief valve (in each isolatable cooling water circuit) shall be provided upstream of globe valve on the cooling water outlet line.

7 INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

7.1 General

7.1.8 (New)
Prior to start of test, manufacturer shall furnish the certificate of latest calibration / re-calibration of driver and measuring instruments for review by purchaser's inspection agency..

Unless electrical or mechanical failure occurs, driver used for shop testing need not be recalibrated and original calibration certificate shall remain valid.

Duration of recalibration for all measuring instruments shall be as per the recommendations of HI Standards.

Copyright EIL – All rights reserved

7.2 Inspection

7.2.1 GENERAL

7.2.1.3 (Substitution)
The minimum inspection requirement for pressure containing casings shall be as per the following:

Inspection category	Inspection requirement	Remarks
CATEGORY A	Visual inspection and Magnetic Particle or Liquid Penetrant inspection of following components as a minimum: - Nozzle weld - Butt welds on pressure containing components - Fillet welds on pressure containing components. - Shaft Radiographic or ultrasonic inspection of the following as a minimum: - Nozzle weld - Butt welds on pressure containing components.	C1. Liquid penetrant inspection shall be performed only when specified magnetic particle inspection is not feasible. C2. Magnetic particle or liquid Penetrant inspection shall be carried out in accordance with table 13. C3. Ultrasonic inspection shall be carried out when radiography is not feasible. Radiography or ultrasonic inspection shall be carried out in accordance with table 13.
CATEGORY B	Visual inspection and Magnetic Particle or Liquid Penetrant inspection of following components as a minimum: - Nozzle weld - Butt welds on pressure containing components - Fillet welds on pressure containing components. - Shaft	B1. Liquid penetrant inspection shall be performed only when specified magnetic particle inspection is not feasible. B2. Magnetic particle or liquid penetrant inspection shall be carried out in accordance with table 13.
CATEGORY C	As per vendor's standard Quality Assurance Plan	

Note:
Category A:
This category is applicable for services with process design pressure above 70 kg/cm²g or process design temperature below -29°C or above 300°C.

Category B:
This category is applicable for services within the design pressure and temperature range other than covered under category A above and category C below.

Category C:
This category is applicable for carbon steel and cast iron for services with process design pressure up to 40 kg/cm²g and design temperature from 0 to 150°C.

7.2.1.5 (New)
Inspection shall also include dimensional check of pump, driver and auxiliaries (if any) duly mounted on the base plate, in accordance with certified general assembly drawing. This will include all main pump dimensions, base plate dimensions, location of foundation bolt holes, size/position/rating of flanges, coupling guard arrangement, verification of the

Copyright EIL – All rights reserved

required material certificates and their trace-ability to the respective components. In addition, following checks shall also be carried out:

- A measurement of the actual running clearances throughout the pump.
- A check for the hardness of wear rings.
- A check for good workmanship and finish throughout.

7.2.2 MATERIAL INSPECTIONS

7.2.2.2 (Modification)
The words "if specified" stand deleted.

7.2.2.3 (Modification)
The words "if specified" stand deleted.

7.3 Testing

7.3.1 GENERAL

7.3.1.1 (Modification)
Table 14 stands modified as under:

Rated Head	:	Zero negative tolerance @ rated flow rate & rated speed
Shut-off Head	:	Following criteria shall apply: a) Positive tolerance permitted as long as maximum shutoff pressure corresponding to shut-off head (as observed during the shop performance test) and the maximum suction pressure (as specified on pump data sheet), does not exceed the downstream design pressure (as specified on pump data sheet). 14 b) Negative tolerance (as per Table 4-2 of API Std. 610, 10 8th edition) may be permitted only if test curve still shows rising characteristics. c) Negative tolerance is not permitted for pumps required for pumps under parallel operation. [Note: Generally shutoff head should be limited within 120% of rated head.]"
NPSHR	:	Zero positive tolerance.
Rated BKW	:	Zero positive tolerance. (However, pumps may be accepted up-to 104% of guaranteed BKW subject to Penalties as defined elsewhere.

7.3.1.2 (Modification)
The words 'if specified' stand substituted with 'Unless otherwise specified'.

7.3.1.4 (New)
Unless otherwise specified the following tests shall be witnessed by the Purchaser or by their authorised representative or by both together.

1. Hydrostatic test as per 7 3.2 for Multistage Pumps.
2. Performance test as per 7 3.3.
3. NPSHR test as per 7.3.4.2 when specified in the material requisition or when the difference between NPSHA and NPSHR is less or equal to one (1) meter.
4. Unitization of Pump with Job Driver at shop.
5. Dismantling inspection and reassembly, after the running test
6. Dynamic balancing of Complete Rotor in case of Multistage Pumps
7. Sound level test.

Copyright EIL – All rights reserved

Test Certificates for Hydrostatic Test & Dynamic Balancing of Impeller(s) will suffice for single & two stage pumps. These test certificates shall be furnished to purchaser's inspector for review prior to performance testing.

7.3.3 PERFORMANCE TEST

7.3.3.2 (New)

i) Shop driver shall be used for testing and the rating of the driver shall not exceed 150% of power that may be consumed while running at duty point with water; or power at full valve open condition, whichever is higher. The limitation of 150% is applicable only for medium voltage motors.

7.3.3.4 (Modification)

b) During the performance test, rise in temperature of bearing oil shall be measured and results recorded on the test log. If specified, pumps provided with oil mist lubrication (Purge/Pure) shall be tested with shop oil mist system & suitable performance at vendor's shop shall be demonstrated.

7.3.3.5b) (Modification)
The words 'if specified' stand deleted.

7.3.4 OPTIONAL TESTS

7.3.4.2 NPSHR Test

7.3.4.2.1 (Substitution)
If NPSHR test is specified or if it is required to be done as per para 7.3.1.4(3), NPSHR shall be determined at each test point (7.3.3.3a) except shut-off.

7.3.4.4 Sound Level Test (Modification)
The words "if specified" stand deleted.
During the performance test, the equipment shall be checked for its sound level at minimum flow, at rated flow, at flow at best efficiency point and at 120% BEP flow.
The maximum allowable value shall not exceed the value specified under clause 5.1.16 or as specified in the datasheet, whichever is lower, when measured at one (1) meter from pump surface.
Where complete unit test is specified, vendor is required to demonstrate the noise levels within the maximum permissible sound level for the complete unit.
Recorded sound levels during shop test shall be taken for reference only & not for final acceptance or rejection. However sound level as specified in the inquiry document shall be guaranteed at site.

7.3.4.5 Auxiliary Equipment Test (Modification)
The words "if specified" stand deleted.

7.3.4.7 Mechanical run test

7.3.4.7.1 (Delete)

7.3.4.7.2 (Modification)
The words 'if specified' stand deleted.

7.3.4.7.3 (Modification)
The words 'if specified' stand deleted.

Copyright EIL – All rights reserved

7.4 Preparation for Shipment

7.4.1 (Modification)
Unless otherwise specified, the equipment shall be protected for an outdoor storage of 12 months at site. If any extra precaution is to be taken by the Purchaser for storage beyond 12 months the same shall be explicitly indicated in the operation and maintenance manuals.

7.4.6 (Substitution)
Two copies of the manufacturer's job specific installation manual shall be packed and shipped with the equipment.

8 SPECIFIC PUMP TYPES

8.1 Single Stage Overhung Pump

8.1.1 (Addition)
Unless otherwise specified, overhung pumps for rated flow exceeding 1000 m^3/hr are not acceptable.

8.1.3 INTEGRAL GEAR DRIVEN (TYPE OH6) PUMPS
8.1.3.6 (Modification)
Diameter of gauges shall be 100mm (4 in.) as a minimum.

8.2 Between Bearing Pumps

8.2.1.2 (Substitution)
Pumps for all services shall be centreline mounted irrespective of pumping temperature.

8.2.2.3 (Modification)
The words 'if specified' stand deleted.

8.2.2.5 (New)
Unless otherwise specified, Maximum number of stages shall not exceed 10 for horizontal pumps.

8.2.4 DYNAMICS

8.2.4.1.2 Table 16-Decision logic for rotor lateral analysis (Modification)
The words 'similar or' stand deleted from step-2.

8.2.4.1.2b) Deleted.

8.2.6 LUBRICATION

8.2.6.2 (Modification)
The words 'ISO 10438-3' shall be replaced with' ISO 10438-3/API standard 614, Chapter 3'

8.2.6.5 (Modification)
The words 'ISO 10438-2' shall be replaced with' ISO 10438-2/API standard 614, Chapter 2'

8.2.6.6 (New)
The pump manufacturer shall supply all the specified/required instrumentation. However, purchaser shall approve the make, type and the specification.

Copyright EIL – All rights reserved

8.2.6.7 (New)
In case a pressure lubrication system is required and is supplied with shaft-driven main oil pumps (MOP), the MOP shall be suitable for safe coast down of the complete equipment train without necessitating the requirement of overhead rundown tank.

In case MOP is not suitable for safe shutdown of the complete equipment train, the vendor in his offer may propose for purchaser's consideration any special arrangement/provision provided for equipment safety and protection when the equipment decelerates. Provision shall be adequate for coast down time and cool-off time as applicable.

8.2.6.8 (New)
External pressure-lubrication systems shall comply with the following additional requirements:

- Pumps, filters, strainers, coolers, traps, valves and all other components that retain oil under pressure and are external to the reservoir shall be made of steel.
- Except in case of shaft driven pumps, if a positive displacement type of oil pump is supplied, a separate relief valve (not integral with the pump) shall be provided. The relief valve shall not be used for pressure regulation. Horizontal oil pumps shall not be installed on top of the oil reservoir.
- A removable tube bundle design is required for shell and tube coolers with more than 0.5 m^2.
- The oil side operating pressure of the oil cooler shall be higher than the water-side operating pressure to prevent contamination of oil in case of cooler failure.
- Filters shall be equipped with a continuous flow transfer valves and an equalising line.
- Oil system shall have drain rim or pan to catch oil spills.
- Unless otherwise specified, heating element shall not be provided. However, if in the opinion of vendor such an arrangement is required (especially in view of the lowest ambient temperature prevailing at job site), the same shall be supplied by the pump manufacturer with specific approval of the purchaser.

8.2.7 TESTING

8.2.7.1 (Modification)
The words 'ISO 10438-3' shall be replaced with' ISO 10438-3/API standard 614, Chapter 3'

8.2.7.5 (Modification)
The words 'if specified' stand deleted.

8.2.8 PREPARATION FOR SHIPMENT

8.2.8.2 (Modification)
The words 'if specified' stand deleted.

8.2.8.3 (Modification)
The words 'if specified' stand deleted.

8.2.8.4 (Modification)
The words 'if specified' stand deleted.

8.3 Vertically Suspended Pumps (types VS1 through VS7)

8.3.1 GENERAL

8.3.1.1 (Modification)
Hydraulic performance shall also be corrected for friction head losses in the inlet strainer.

Copyright EIL – All rights reserved

8.3.1.3 (New)
Unless otherwise specified, in case of tank-mounted pumps, the setting depth shall be so arrived that the pump minimum submergence is ensured within the boot of the vessel, i.e. minimum liquid level shall be considered to correspond to bottom of the tank level for ensuring complete evacuation of the tank.

8.3.2 PRESSURE CASINGS

8.3.2.3 (New)
Bowls and columns shall be flanged and bolted.

8.3.3 ROTORS

8.3.3.3 (Addition)
Multi-piece vertical pump line shaft shall not be joined by threaded couplings.

8.3.6 BUSHINGS AND BEARINGS

8.3.6.2 (Modification)
Pump thrust shall not be transferred to driver motor. Vertical pumps shall be provided with their own thrust bearing to carry rotor weight and pump generated axial forces.
Thrust bearing shall be positively locked on the pump shaft (shouldered shaft) and the bearing housing.

8.3.7 LUBRICATION (Addition)
For self-lubrication pumps, guide bushing shall be suitable for dry running during start-up.

8.3.8 ACCESSORIES

8.3.8.1 Drivers (Modification)
For vertical pumps, not provided with non-reverse ratchet, vendor shall describe the precaution taken, to prevent damage due to reverse rotation.

8.3.8.3 Mounting Plates

8.3.8.3.1 (Modification)
The words 'if specified' stand deleted.

8.3.8.3.3 (Modification)
The words 'if specified' stand substituted with 'unless otherwise specified'.

8.3.10 SINGLE CASE DIFFUSER (VS1) AND VOLUTE (VS2) PUMPS

8.3.10.5 (Modification)
The words 'if specified' stand deleted.

8.3.13 DOUBLE CASING DIFFUSER (VS6) AND VOLUTE (VS7) PUMPS

8.3.13.2 (Modification)
The words 'if specified' stand deleted.

8.3.13.5 (Modification)
The words 'if specified' stand deleted.

Copyright EIL – All rights reserved

9 VENDOR'S DATA

9.1 General

9.1.2a) (Substitution)
The purchaser's/owner's/consultant's corporate name.

9.1.3 CO-ORDINATION MEETING (Substitution)
When specified, a co-ordination meeting shall be held at Purchaser's office, preferably within 4 weeks of order.
An agenda shall be prepared for this meeting and would include the following points related to technical aspects:

- Any clarifications required by the vendor on purchaser's order.
- Document Control Index (DCI).
- Vendor Data Review/approval modalities.
- Sub-vendor lists proposed by vendor.
- Utility requirements.
- Preliminary General Arrangement & layout drawings & purchaser's interface drawings.

9.2 Proposals (Substitution)

The vendor's proposals shall as a minimum include the following:

- All data sheets, drawings and documents listed under "PRINTS WITH QUOTE" in the enclosed Vendor Data Requirement Form.
- Vendor's confirmation/comments on post-order Vendor Data Requirements (Type of Documents, no. of prints and date needed) indicated in Vendor Data Requirement forms data sheets and specs.
- List of recommended commissioning spares included in the offer.
- List of insurance/mandatory spares (where specified by the purchaser) included in the offer.
- List of Spare Parts For Two Years Normal Operation

  This list shall be made separately for each items including auxiliaries and drivers in the form of a table & shall show:

  i) Part name, description and number.

  ii) Quantity installed in one unit.

  iii) Quantity recommended per unit for 2 years normal operation.

  iv) Quantity recommended for number of units of an item as specified in the inquiry.

  v) Quantity recommended as insurance for the number of units of an item specified in the inquiry.
- An itemised list of special tools included in the offer.
- Any start-up, shutdown or operating restrictions required to protect the integrity of the equipment.
- Any limitations of vendor's test-facility to carryout the specified tests.
- A specific statement that the scope of supply, the offered equipment/systems and all its components are in compliance with the requirement specified in data sheets, job

Copyright EIL – All rights reserved

specifications, this specifications and all other attachments forming part of the enquiry documents except for specific deviations as listed in the proposal.

Note: Clearance less than those required by Table 5 shall be stated as an exception to API 610.

9.3 Contract Data (Substitution)

9.3.1 GENERAL

9.3.1.1 Drawings and data as required after purchase order has been specified in Vendor Data Requirement. Vendor to note that the drawing/document descriptions/titles as given in the Vendor Data Requirement are generic in nature. It is possible that against one drawing / document specified there are several drawings to be furnished by the vendor or vice versa.

9.3.1.2 Vendor shall complete & forward a document "Document Control Index (DCI)" to the purchaser (Destination & contact person as per order). This shall be the first document to be submitted by vendor within two weeks of order.
This document shall list out in consolidated form all drawings and documents required by purchaser (As specified in Data Sheets, Specifications and Vendor Data Requirement forms enclosed with the order).

Against each drawing/document vendor shall indicate the vendor's drawing numbers, titles, Rev. No., category (whether for information or approval) and schedule of submission.
No drawing shall be taken up for review till DCI for the inquiry/order is finalized by vendor.

9.3.1.3 All transmittal letters (covers), drawings and data shall have a title block (in addition to vendor's standard title block) which shall as a minimum contain the following contract information:

- Purchaser's and Consultant's Corporate Name
- Project Name.
- Equipment Name and Item No.
- Purchase Order No.
- Purchase Requisition No.

Title Block on drawings shall be placed on the lower right hand corner.

9.3.1.4 All vendor data/drawings/documents shall be in English Language and in Metric Systems.

9.3.1.5 Data specified in the VDR is the minimum requirements of Purchaser. Any additional document/data required or requested by Purchaser for engineering or construction shall also be made available by the vendor.

9.3.1.6 Whether or not specified the vendor shall furnish the following, before shipment:

- As built running clearances and when applicable; thrust bearing, radial bearing and seal running clearances.
- A supplementary list of spare parts other than those included in his original proposal. The supplementary list shall include recommended spare parts, cross-sectional or assembly type drawings, parts numbers, materials, prices and delivery period. The vendor shall forward this supplementary list to the purchaser promptly after receipt of the reviewed drawings and in time to permit order and delivery of parts before field start-up.

Copyright EIL – All rights reserved

- A parts list for all equipment supplied. The list shall include pattern, stock, or production drawing numbers and materials of construction. The list shall completely identify each part so that the purchaser may determine the interchangeability of the parts with other equipment furnished by the same manufacturer. Standard purchased items shall be identified by the original manufacturer's name and part number.
- At least 8 weeks before shipment, the vendor shall submit his preservation, packaging and shipping procedures to the purchaser's for his review.

9.3.2 DRAWINGS

9.3.2.1 The number of prints and/or reproducible required and the times within which these are to be submitted by vendor are specified in Purchaser's inquiry/order.
If specified, drawing review may be through EDMS/VDOCS in soft as per the details provided elsewhere in inquiry document.

9.3.2.2 The purchaser's review of the vendor's drawings shall not constitute permission to deviate from any requirements in the purchase order/specifications unless specifically agreed upon in writing. After the drawings have been reviewed, the vendor shall furnish certified copies in the quantity specified. All drawings must be clearly legible and shall be either in A3 or A4 size.

9.3.3 TECHNICAL DATA

9.3.3.1 General Arrangement Drawing

A general arrangement drawing shall contain as a minimum, the following information:

- Outline dimensions (minimum three views) (All principal dimensions).
- Allowable forces and moments on suction and discharge nozzles.
- Location (in all three planes), size, type, rating and identification of all purchaser's interface connections including those of vents, drains, lubricating oil, sealing fluid, cooling water, steam & Electrical/Instrumentation.
- Direction of rotation viewing from the driving end.
- Weight of each assembly/component.
- The weight & location of center of gravity of the heaviest assembly/ components that must be handled for erection.
- Identification and weight, dimensions of the heaviest assembly / subassembly / component required to be handled for maintenance.
- Maintenance clearances and dismantling clearances.
- Speeds of Driven Equipment and Driver with Driver rating. Location of driver terminal box (in case of Electric Motor Driver).
- Layout of auxiliary equipment and operating platform, as applicable.
- Make, Type and Size of couplings and the location of guards and their coverage.
- A list of reference drawings if any.
- A list of any special weather-protection and climatic features.

9.3.3.2 Foundation Drawings

A foundation drawing shall indicate complete information required for foundation design by purchaser including the following:

- Foundation bolt sizes, pipe sleeve details, pocket sizes and locations.

Copyright EIL – All rights reserved

- Grouting thickness and other necessary technical details.
- Static weight of each skid/independently grouted item and location of center of gravity of each of such skid/items in all three planes.
- Weight distribution for each bolt/subsole plate location and total static weight.
- Dynamic loading caused due to various items grouted independently.
- The direction and magnitude of unbalance forces and moments generated by each such item at the worst operating condition and short circuit moments of motor drivers.
- GD^2 value of each item resolved to driver speed.
- Maximum permissible amplitude of vibration on the foundation at base level.
- Total mass of rotating parts.
- Suggested dynamic factor and ratio of foundation weight to weight of skid/equipment as per vendor experience.

NOTE : Vendor shall necessarily indicate the recommended type, make & quantity of recommended grouting material (i.e. cementitious or epoxy grout).

9.3.3.3 Layout Drawing (For multi-skid packages)

This drawing shall include at-least the following information:

- Layout of all skid/equipment and their auxiliaries, vessels, control panels, exchangers etc. Vendor shall furnish an optimised layout (considering the space allocated, site wind conditions, area classification, the type of equipment located in the vicinity etc.) indicating elevation and dimension of skids/equipment.
- Minimum spacing required between the various skids / equipment and between the skids and the walls / columns / roof for an easy accessibility and maintenance.
- Layout for water piping, trenches for water piping, cable tray/trenches layout.
- Piping arrangement and piping support arrangement/location for piping in vendor's scope.
- Layout for auxiliary equipment and operating platform details.
- Specification for crane/mono rail (including suggested mono rail layout) recommended for maintenance and height of the lifting hook from the centerline of equipment.

9.3.3.4 Field Alignment Diagram

The diagram shall indicate the relative displacement to be kept between the centerlines of various equipments at the time of installation, so that under normal running conditions the equipments get fully aligned. This relative displacement should be decided on the basis of centerline temperature rise data of driver, gear box/transmission system, driven equipment.

9.3.3.5 Heat Exchanger Drawings

Heat exchanger drawing and data shall include heat and mass balance data, details of provisions for separating and withdrawing the condensate, construction details, cross sections & general arrangement drawings of heat exchangers, vendors recommendations regarding provision for support and piping expansion.

9.3.3.6 P&I Diagrams (with Bill of Materials)

Vendor shall supply P&I Diagrams along with Bill of Materials of each system in the vendor's scope of supply or specified in the order. P&I Diagram shall indicate the system details, location of various auxiliaries, instruments, controls and safety devices as required. Line sizes, piping class, valve sizes and class shall be clearly marked on the P&ID.

Copyright EIL – All rights reserved

Vendor's scope and purchaser's scope shall be clearly demarcated. Each item shall be identified by an item no./ item tag no., which shall correspond to the item no. shown on the bill of materials. The bill of materials shall include items number, normal value, set value, range, quantity per unit, make and other specifications as applicable.
Legends adopted shall be indicated either at the bottom of drawing or on a separate drawing. The legends shall be as per ISA.

9.3.3.7 Cross-sectional Drawing with Bill of Materials

The vendor shall supply cross-sectional or assembly type drawings for all equipment furnished showing all parts, design assembly and running clearances(minimum and maximum permissible), and balancing data required for erection and maintenance. Each part shall be numbered which shall correspond to the part number on the bill of materials. The bill of materials shall include the part no., name of component, materials quantity installed per unit & sizes where applicable (say for bolts, nuts, rings, gaskets etc.). All boughtout items shall also be indicated with make and brief specifications.
A separate cross-sectional drawing showing installation and setting dimensions for the seals shall be furnished.

9.3.3.8 Performance Characteristic Curves

9.3.3.8.1 The vendor shall provide complete performance curves to encompass the map of operations, with any limitations indicated thereon.

9.3.3.8.2 All curves submitted prior to final performance testing shall be marked "PREDICTED". Any set of curves resulting from a test shall be marked "TESTED".

9.3.3.8.3 Certified test curves and data shall be submitted within 15 days after testing and shall include head, power recalculated to the proper specific gravity and efficiency plotted against capacity. If applicable, viscosity corrections shall be indicated. If NPSHR test is specified, the water NPSHR curve (drawn upto minimum continuous flow) shall also be included. The curve sheet shall include the maximum and minimum diameters of the impeller design supplied, the eye area of the first stage impeller, the identification number of the impeller or impellers and the pump serial number.

9.3.3.9 Data Sheet

The Vendor shall provide completely filled in data sheets, first for "As Purchased" and then for "As Built". The vendor by shall do this by correcting and filling out the data sheets and submitting copies to the purchaser.

9.3.3.10 Installation Manual

The vendor shall provide sufficient written instructions, including a cross-reference list of all drawings, to enable the purchaser to correctly install, operate and maintain all the equipment. It shall include any special information required for proper installation that is not on the drawings, special alignment or grouting procedures, utility specifications (including quantity) and all installation data. It shall also contain the following information:

9.3.3.10.1 Instructions for erecting, aligning (including the expected thermally induced shaft center-line shift between normal site ambient temperature position and that at normal equipment operating temperature) and piping.

9.3.3.10.2 A description of rigging procedures, including the lifting of the assembled equipment, and methods of disassembly, repair, adjustment, inspection and reassembly of the equipment and auxiliaries.

Copyright EIL – All rights reserved

9.3.3.10.3 Pre-commissioning/commissioning/functional test procedures and acceptance criterion.

9.3.3.11 Operation and Maintenance Manual

This shall provide sufficient written instructions and data to enable purchaser to correctly operate and maintain the equipment ordered. It shall include a section to cover special instructions for operation at extreme environmental and/or extreme operating conditions. The following shall be included in this manual:

9.3.3.11.1 Instructions covering start-up, normal shutdown, emergency shutdown, operating limits and routine operational procedures.

(a) A description of equipment construction features and the functioning of component parts or systems (such as control, lubrication, sealing systems etc.).

(b) Outline and sectional drawings, schematics and illustrative sketches in sufficient details to identify all parts and clearly show the operation of all equipment and components and the methods of inspection and repair. Standardised sectional drawings are acceptable only if they represent the actual construction of the equipment.

9.3.3.11.2 The following maintenance information:

(a) Maximum and minimum bearing, labyrinth and seal clearances including any other clearance between moving and stationary parts of the equipment affecting proper running and maintenance of the equipment.

(b) Instructions for measuring and adjusting cold clearances, shaft runout, concentricity etc.

(c) Rotor float allowance.

(d) Interference fits on parts that are required to be removed or replaced for maintenance of normally consumable spares.

(e) Balancing tolerances.

(f) Lubricating schedules indicating recommended grades of oil, their properties, replacement period etc.

(g) Normal maintenance procedure.

(h) Preventive maintenance schedules and criterion for replacement of parts.

(i) Trouble - shooting procedures.

9.3.3.11.3 The following reassembly information:

(a) Bolting sequence and torque values for all bolts affecting equipment performance/integrity/safety.

(b) Reassembly sequences together with required inspection checks.

(c) Adjustment procedures to achieve required positions, clearances, float and so forth.

(d) Detailed procedures for pre-operational checks, including settings and adjustments.

(e) Seals and coupling installation procedures.

(f) Parts list indicating cross-sectional drawings of various assemblies and sub-assemblies, part numbers, materials of construction (ASTM) etc.to facilitate identification of parts and for procurement of spares.

9.3.4 FINAL DOCUMENTATION

9.3.4.1 Technical Data Manual / Mechanical Catalogue

Copyright EIL – All rights reserved

9.3.4.1.1 Technical data manual / mechanical catalogue is a compilation of "as built" drawings and data, manufacturing and test records, installation, operating and maintenance instructions.

9.3.4.1.2 Not later than two weeks after successful completion of all specified tests, the vendor shall furnish the required number of technical data manual / mechanical catalogues for the equipment, any auxiliaries and instruments that the vendor is providing. The technical data manual / mechanical catalogue shall include the following documents as a minimum:

a) All drawings and data as listed in the vendor data index & schedule. (For drawings, where purchaser's approval is required, the final certified drawings shall be attached.) Sections of technical data manual / mechanical catalogue shall be organised in a manner that data and drawings related to one subject are grouped together such as Mechanical, Electrical, Instrumentation etc.

b) All manufacturing, inspection and test data and records.

9.3.4.1.3 Following information shall also be included in the Technical data manual / mechanical catalogue:

(a) Storage instructions for storing and preserving the equipment (including driver and all the auxiliary units) at the plant site before installation of the same.

(b) Instructions for preserving the equipment after it has been installed. This is particularly required in cases where a long time gap is expected between equipment installation and commissioning.

(c) Field performance test procedures and acceptance criterion.

9.3.4.1.4 Technical data manual / mechanical catalogue shall be in Hard board folder(s) of size 265 mm x 315 mm (10½" x 12½") and shall not be more than 90 mm thickness; it may be of several volumes and each volume shall have a volume number, index of volumes & index of contents of that particular volume.

9.3.4.1.5 Title sheet (Top sheet) of each volume of technical data manual / mechanical catalogue shall contain the contract information as defined under 5.2.1.2 besides the volume number.

9.3.4.1.6 In case order contains more than one item, separate dedicated mechanical catalogues shall be submitted for each item.

9.3.4.1.7 Two (2) sets of Final / "As Built" drawings & documents shall also be submitted as electronic files on secondary storage media (i.e. CD-ROM / DVD-ROM disk).

Copyright EIL – All rights reserved

ऊर्जा दक्ष मध्यम वोल्टेज इंडक्शन मोटरों के लिए विनिर्देश

SPECIFICATION FOR ENERGY EFFICIENT MEDIUM VOLTAGE INDUCTION MOTORS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
1	12.08.14	REVISED & ISSUED AS STANDARD SPECIFICATION	SS/SHIRALI	VKJ	BRB	SC
0	20.04.09	ISSUED AS STANDARD SPECIFICATION	SD	BRB	JMS	ND

Copyright EIL – All rights reserved

Abbreviations:

AL	:	Aluminium
BASEEFA	:	British Approvals Service for Electrical Equipment in Flammable Atmospheres
BIS	:	Bureau of Indian Standards
BS	:	British Standards
CEA	:	Central Electricity Authority
CIMFR	:	Central Institute of Mines and Fuel Research
CPRI	:	Central power research institute
CT	:	Current Transformer
CU	:	Copper
DGMS	:	Directorate General of Mines Safety
DOL	:	Direct On Line
EIL	:	Engineers India Limited
ERTL	:	Electronics Regional test laboratory
FM	:	Factory Mutual
FRP	:	Fiber Reinforced Plastic
IEC	:	International Electro-technical Commission
IEEE	:	Institute of Electrical & Electronics Engineers
IP	:	Ingress Protection
IS	:	Indian Standard
JEC	:	Japanese Electro-technical Committee
KLPL	:	Karandikar laboratories Pvt. Ltd.
LCIE	:	Laboratoire Central des Industries Electriques
NEMA	:	National Electrical Manufacturers Association
PESO	:	Petroleum and Explosive Safety Organisation
PO	:	Purchase Order
PVC	:	Poly Vinyl Chloride
RPM	:	Revolutions per Minute
UL	:	Underwriter's Laboratories
VFD	:	Variable Frequency Drive
VDE	:	Verband Deutscher Elektrotechniker

Electrical Standards Committee

Convenor: Mr. B.R. Bhogal

Members: Ms. S. Anand
Mr. Parag Gupta
Mr. M.K. Sahu
Mr. A.K. Chaudhary (Inspection)
Ms. N.P. Guha (Project)

Copyright EIL – All rights reserved

CONTENTS

Copyright EIL – All rights reserved

1.0 SCOPE

This specification covers the design, manufacture, testing, packing and supply of energy efficient-High efficiency (IE2) three phase medium voltage squirrel cage induction motors.

2.0 CODES AND STANDARDS

2.1 The squirrel cage induction motors and their components shall comply with the latest editions of following standards issued by BIS (Bureau of Indian Standards) unless otherwise specified:

IS - 5	:	Colours for ready mixed paints and enamels.
IS - 325	:	Three phase induction motors.
IS - 1076	:	Preferred numbers.
IS - 1231	:	Dimensions of three phase foot mounted induction motors.
IS - 1271	:	Electrical insulation- Thermal evaluation and designation.
IS - 2223	:	Dimensions of flange mounted AC Induction motors.
IS - 2253	:	Designation for types of construction and mounting arrangement of rotating electrical machines.
IS - 2254	:	Dimensions of vertical shaft motors for pumps.
IS - 2968	:	Dimensions of slide rails electric motors.
IS - 4029	:	Guide for testing three phase induction motors.
IS - 4889	:	Method of determination of efficiency of rotating electrical machines.
IS - 6362	:	Designation of methods of cooling of rotating electrical machines.
IS - 7816	:	Guide for testing insulation resistance of rotating machines.
IS - 8223	:	Dimensions and output series for rotating electrical machines.
IS - 8789	:	Values of performance characteristics for three phase induction motors.
IS - 9283	:	Motors for submersible pump sets.
IS - 12065	:	Permissible limits of noise level for rotating electrical machines.
IS - 12075	:	Mechanical vibration of rotating Electrical Machines with shaft heights 56 mm and higher - measurement, evaluation and limits of vibration severity.
IS – 12615	:	Energy Efficient induction motors - Three phase squirrel cage.
IS - 12824	:	Type of duty and classes of rating assigned to rotating electrical machines.
IS - 13529	:	Guide on effects of unbalanced voltages on the performance of three phase cage induction motors.
IS - 13555	:	Guide for selection and application of three phase induction motors for different types of driven equipment.
IS - 14568	:	Dimensions and output series for rotating electrical machines, frame numbers 355 to 1000 and flange numbers 1180 to 2360.
IS / IEC60079-0:		Electrical apparatus for explosive gas atmospheres (General requirements)
IS/IEC-60079-1:		Explosive atmospheres-Equipment protection by flame proof enclosures “d”.
IS/IEC60079-2 :		Explosive protection by pressurized enclosure “p”.
IS/IEC60079-7 :		Explosive atmospheres-Equipment protection by increased safety – “e”.
IS/IEC-60079-15:		Construction, test & marking of type of protection “n” electrical apparatus.
IS/ IEC: 60529	:	Degree of protection provided by enclosures (IP Code)
IS/IEC 60034-1 :		Rotating electrical machines:-Rating & Performance
IS/IEC-60034-5:		Degrees of protection provided by the internal design of rotating electrical machines.

Copyright EIL – All rights reserved

IS/IEC 60034-8: Rotating electrical machines-Terminal marking and direction of rotation
IS/IEC 61241: Electrical apparatus for use in the presence of combustible dust

2.2 In case of imported motors, standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable Indian Standards.

2.3 The motors shall also conform to the provisions of CEA regulations and other statutory regulations currently in force in the country.

2.4 In case Indian Standards are not available, standards issued by IEC/ BS/ VDE/ IEEE/ JEC/NEMA or equivalent agency shall be applicable.

2.5 In case of any conflict between requirements specified in various applicable documents, the most stringent one shall prevail. However, owner's decision in this regard shall be final and binding.

3.0 GENERAL REQUIREMENTS

3.1 The offered equipment shall be brand new with state of the art technology and proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment at least for 10 years from the date of supply.

3.3 Vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the product/spares to ensure the end user for placement of order for spares and services.

4.0 OPERATING CONDITIONS

4.1 Ambient Conditions

Motors shall be suitable for operating satisfactorily in humid and corrosive atmosphere found in refineries, petrochemical, fertilizer and metallurgical plants. Service conditions shall be as specified in the motor data sheet. If not specifically mentioned therein, a design ambient temperature of 40 ° C and an altitude not exceeding 1000 meters above mean sea level shall be taken into consideration.

4.2 Frequency and Voltage Variations

Unless otherwise agreed, motors shall be designed for continuous operation at rated output under the following conditions:

a) The terminal voltage differing from its rated value by not more than $\pm$ 6 % or
b) The frequency differing from its rated value by not more the $\pm$ 3 % or
c) Any combination of (a) and (b)

4.3 Starting

a) Motors shall be designed for direct-on-line starting or other method of starting as specified in datasheet.
b) Motors shall be designed for re-acceleration under full load after a momentary loss of voltage with the residual voltage being 100% and is in phase opposition to the applied voltage.
c) Minimum locked rotor thermal withstand time at rated voltage shall be 10 seconds under cold conditions and 8 seconds under hot conditions. In addition, Locked Rotor

Copyright EIL – All rights reserved

withstand time under hot conditions at 75% & 100% voltages, shall be minimum 1.4 times the starting time at the corresponding voltage.

d) Unless otherwise specified, all motors shall be suitable for starting under specified load conditions with 75 % of the rated voltage at the motor terminals.

e) Motors shall be designed to allow the minimum number of consecutive starts indicated in Table below:

Starts	Min. no. of consecutive starts
No. of consecutive start-ups with initial temp. of the motor at ambient level (cold)	3
No. of consecutive start-ups with initial temp. of the motor at full load operating level (hot).	2

4.4 Direction of Rotation

Motors shall be suitable for either direction of rotation. In case unidirectional fan is provided for motors, direction of rotation for which the motor is designed shall be permanently indicated by means of an arrow. Directional arrow should be manufactured from corrosion resistant material. When a motor is provided with bi-directional fans, a double-headed arrow should be provided.

Normally, clockwise rotation is desired as observed from the driving (coupling) end, when the terminals UVW are connected to a power supply giving a terminal phase sequence in the order UVW. Counter-clockwise rotation of the motor shall be obtained by connecting the power supply to terminals so that the phase sequence corresponds to the reversed alphabetical sequence of the terminal letters. Ample space shall be provided at the terminal box for interchanging any two external leads for obtaining the reverse phase sequence.

5.0 PERFORMANCE

5.1 Motors shall be rated for continuous duty (S_1), unless otherwise specified.

5.2 Unless specified, the starting current (as % rated current) shall be limited to maximum 600-700% (based on number of poles and KW rating) as per IS 12615:2011, subject to IS tolerance

5.3 In particular cases, when the starting current is to be limited, care shall be taken such that the design values of torque meets the load requirement while at the same time complying to clause 4.3 above of this specification. Unless otherwise specified the minimum pull-up torque of motors, at rated voltage & frequency shall be minimum 50% of the rated full load torque.

5.4 In particular cases, when the starting with reduced voltage is specified, care shall be taken such that the design values of torque meets the load requirement while at the same time complying to clause 4.3 above of this specification.

5.5 Starting torque and minimum torque of the motor shall be compatible with the speed torque curve of the driven equipment under specified starting and operating conditions.

In case where characteristics of driven equipment are not available while selecting the motor, minimum starting torque shall be 110% of rated value for motors up to 75 kW and shall be 90% of rated value for motors above 75 kW.

5.6 The breakdown torque at the rated voltage shall be not less than 175% of the rated load torque with no negative tolerance. Unless otherwise agreed, the breakdown torque shall not exceed 300% of the rated load torque.

Copyright EIL – All rights reserved

In case of motors driving equipment with pulsating loads (e.g. reciprocating compressors, crushers, ball mills) the minimum value of pull out torque at 75% of the rated voltage shall be more than the peak value of pulsating torque and the current pulsation shall be limited to 40%.

5.7 Motors fed by variable frequency drive shall additionally meet the following requirements.

5.7.1 The motors shall be suitable for the current wave forms produced by the power supply including harmonics generated by the drive. The necessary coordination by motor manufacturers with drive manufacturers regarding harmonics generated by VFD shall be taken care and incorporated in motor design suitably.

5.7.2 The motors shall be designed to operate continuously at any speed over the range as per process requirement with minimum range as 10–100% of rated speed or as specified in data sheet. The characteristics shall be based on the application – in terms of constant torque / variable torque as per the driven equipment. Additional cooling fan shall be provided if required to limit the temperature rise to specified limits, alternatively option of applying suitable de-rating may be considered.

5.7.3 The motors shall withstand torque pulsation resulting from harmonics generated by the solid state power supply.

5.7.4 The motors required to be transferred to DOL bypass mode shall be rated for specified variations in line voltage and frequency.

5.8 The minimum values for performance characteristics of these motors shall be as given in the tables 1, 2 & 3 of IS 12615-2011 for IE2 motors, subjected to tolerance as per IS/IEC. Motor meant for application with VFD, the efficiency value can be one class lower as per IS.

6.0 CONSTRUCTIONAL DETAILS

6.1 Windings

6.1.1 Unless otherwise specified, motors shall be provided with class `B' insulation as a minimum. In case of motors with class 'F' insulation, the permissible temperature rise above the specified ambient temperature shall be limited to those specified in the applicable Indian standards for class `B' insulation.

6.1.2 The winding shall be tropicalised. The windings shall preferably be vacuum impregnated. Alternately the windings shall be suitably varnished, baked and treated with epoxy gel for operating satisfactorily in humid and corrosive atmospheres.

6.1.3 Windings shall be adequately braced to prevent any relative movement during operation. In this respect, particular care shall be taken for the stator windings for direct-on-line starting squirrel cage motors. Insulation shall be provided between coils of different phases that lie together. Core laminations must be capable of withstanding burnout for rewind at 350 °C without damage or loosening.

6.1.4 In case of motors driving equipment with pulsating loads, special care shall be taken for the joints of rotor bars and end rings to avoid premature failures due to induced fatigue stresses.

6.1.5 The windings shall be connected in delta. However, for motors rated 2.2 kW and below, star connection may be accepted. In case of motors with star-delta starting, the motor windings shall be fully insulated for delta connection.

Copyright EIL – All rights reserved

6.1.6 The ends of the windings shall be brought out into a terminal box. These shall be terminated by means of terminals mounted on an insulating base made of non-hygroscopic and non-flammable material.

6.1.7 All motors shall be provided with six terminals and suitable links to connect them in star or in delta except for motors rated up to and including 2.2 kW which may be accepted with three terminals.

6.2 Terminal Box and Cable Entries

6.2.1 Unless otherwise agreed, the terminal box shall be located on the right hand side as viewed from the driving (coupling) end. The terminal box shall have side cable entry from non-driving end. However, as a special case, terminal box located on top may also be accepted, particularly for hazardous area motors, in case manufacturer has only top mounted terminal box design which is duly tested/certified by CIMFR and approved by PESO for installation in hazardous area. The terminal box design shall allow rotation in steps of 90 ° C to facilitate cable entry from any direction at site.

6.2.2 Terminal box cover shall be provided with handles to facilitate easy removal. However, for terminal box covers weighing less than 5 kg., terminal box covers without handles can be accepted.

6.2.3 The terminal box shall be provided entries for suitable cable glands corresponding to the size of the specified cable. Crimp type tinned Copper lugs and nickel-plated brass (or aluminum if specifically required), double compression type cable glands shall be supplied along with the motors for the specified cable sizes for power and space heater cables.

6.2.4 For flameproof motors, terminal box can be provided in increased safety 'Exe' execution.

6.2.5 The terminals, cable lugs, terminal box, cable entries and cable glands shall be suitable for the maximum cables sizes as specified below for 2 pole, 4 pole or 6 pole motors:

Motor rating up to and including	Size of phase conductor (mm^2)
2.2 kW and below	2.5 cu
3.7 kW	6 cu
5.5 kW	10 cu
7.5 kW	16 cu
9.3 kW	16 cu
11.0 kW	16 cu
15.0 kW	50 Al.
18.5 kW	70 Al
22.0 kW	70 Al
30.0 kW	95 Al
37.0 kW	120 Al
45.0 kW	150 Al
55.0 kW	240 Al
75.0 kW	2x95 Al
90.0 kW	2x120 Al
110.0 kW	2x240 Al
125.0 kW/132 kW	2x240 Al
160.0 kW	2x240 Al

6.2.6 Cable sizes for motors having synchronous speeds 750 RPM and below shall be as agreed between the purchaser and manufacturer.

Copyright EIL – All rights reserved

6.3 Motor Casing and Type of Enclosure

6.3.1 The minimum degree of motor enclosures including terminal boxes and bearing housing shall be IP-55 as per IS.

6.3.2 Motors for outdoor use shall be suitable for installation and satisfactory operation without any protective shelter or canopy. Motor casing shall be provided with a suitable drain for removal of condensed moisture except in case of flameproof motors (Type Ex d/Exde).

6.3.3 All internal and external metallic parts, which may come into contact with cooling air, shall be of corrosion resistant material or appropriately treated to resist the corrosive agents, which may be present in the atmosphere. Screws and bolts shall be of rust proof material or protected against corrosion.

6.3.4 Unless otherwise agreed, motors shall have standard frame sizes (min.) for various output ratings as stipulated in IS.

6.4 Bearing and Lubrication

6.4.1 Motors shall have grease lubricated ball or roller bearings. In all cases, the bearings shall be chosen to provide a minimum L-10 rating life of 5 years, (40, 000 hours) at rated operating conditions
(The L-10 rating life is the number of hours at constant speed that 90% of a group of identical bearings will complete or exceed before the first evidence of failure).

6.4.2 The bearings shall be adequate to absorb axial thrust produced by the motor itself or due to shaft expansion. Motors designed to handle external thrust from the driven equipment shall be supplied with a thrust bearing at the non-driving end.

6.4.3 In cases such as pumps for hot liquids where the driven equipment operates at high temperatures, bearings shall be cooled by a shaft-mounted fan. This shall ensure efficient ventilation of the bearing and disperse the heat transmitted from the driven equipment by conduction or convection.

6.4.4 Bearings shall be capable of grease injection from outside without removal of covers with motors in the running conditions. The bearing boxes shall be provided with necessary features to prevent loss of grease or entry of dust / moisture e.g. labyrinth seal/ oil seal/ V seal. Where grease nipples are provided, these shall be associated, where necessary, with appropriately located relief devices, which ensure passage of grease through the bearings.

6.4.5 Pre-lubricated sealed bearings may be considered provided a full guarantee is given for 4 to 5 years of trouble-free service without the necessity of re-lubrication.

6.5 Cooling System

All motors shall be self ventilated, fan cooled. Fans shall be corrosion resistant or appropriately protected. They shall be suitable for motor rotation in either direction without affecting the performance of the motor. If this is not possible for large outputs, it shall be possible to reverse the fan without affecting the balancing of the motor.

For motors operating in hazardous area, the fans shall be of an anti-static non-sparking material.

Copyright EIL – All rights reserved

6.6 Rotor

The rotor shall be of squirrel cage type, dynamically balanced to provide a low vibration level and long service life for the bearings. Die cast aluminum rotors for motors in hazardous areas may be accepted provided the same are type tested and approved by competent authorities.

6.7 Shaft Extension

Motors shall be provided with a single shaft extension with key-way and full key. Motor shaft shall be sized to withstand 10 times the rated design torque.

6.8 Lifting Hooks

All motors weighing more than 30 kg. shall be provided with lifting hooks of adequate capacity.

6.9 Earth Terminals

Two earth terminals located preferably on diametrically opposite sides shall be provided for each motor. Necessary nuts and spring washers shall be provided for earth connection.

7.0 MISCELLANEOUS ACCESSORIES

7.1 Anti-Condensation Heaters

All motors rated 30 kW and above shall be provided with 240 V anti-condensation heaters, sized and located so as to prevent condensation of moisture during shutdown periods.

For motors with heaters installed in hazardous atmospheres (Zone - 1 or Zone - 2), such heaters shall conform to the provisions of applicable Indian Standards and temperature classification specified in the motor data sheet.

The heater leads shall be brought out, preferably, to a separate terminal box which shall be of the same specification and grade of protection as the main terminal box.

A warning label with indelible red inscription shall be provided on the motor to indicate that the heater supply shall be isolated before carrying out any work on the motor.

7.2 Name Plates

In addition to the motor rating plate, a separate number plate for motor tag number shall be fixed in a readily visible position. This number shall be as per the motor data sheets.

8.0 CRITICAL SPEEDS

The first actual critical speed of stiff rotors shall not be lower than 120 % of the synchronous speed. For flexible rotors this shall be between 60 % and 80 % of the synchronous speed; the second actual critical speed shall be above 120 % of the synchronous speed.

9.0 PAINTING

All metal surfaces shall undergo manufacturer's standard cleaning /painting cycle. After preparation of the under surface, the equipment shall be painted with two coats of epoxy based final paint. Color shade of final paint shall be 632 of IS: 5/ RAL-7035. All unpainted steel parts shall be suitably treated to prevent rust formation. If these parts are moving elements, then these shall be greased.

Copyright EIL – All rights reserved

10.0 INSPECTION AND TESTING

10.1 All tests shall be carried out at manufacturer's shop under his care and expense.

10.2 The manufacturer shall submit all internal test records of the tests carried out by him on the bought-out items, motor sub-assembly and complete motor assembly.

10.3 The manufacturer shall carry out the following routine and acceptance tests as per applicable Standards/ITP on all the motors.

a) Visual check (Nameplate, terminal box location, terminal type, clearance, size, entries, space adequacy & gland size, direction of rotation etc.)
b) Dimension check (shaft height etc.)
c) Cable glands, cable lugs size and no. of entries in terminal box.
d) Winding resistance
e) No load test & measurement of voltage, speed, current, power input
f) Measurement of starting torque, starting current, full load torque, breakdown torque
g) Reduced voltage starting & running
h) Insulation resistance before and after high voltage test
i) High voltage
j) Vibration

10.4 The manufacturer shall submit the following type test certificates (one sample from each type/rating):

a) Full load test & measurement of voltage, current, power slip, power factor, bearing, noise
b) Efficiency & pf at 100%, 75% and 50% load
c) Temperature rise test
d) Momentary overload test
e) Vibration
f) Noise level
g) Over speed
h) Measurement of starting torque, starting current, full load torque.

10.5 For VFD fed motors, all tests as specified in the VFD specification shall be followed in addition to the above.

11.0 CERTIFICATION

The motors and associated equipment shall have test certificates issued by recognised independent test house (CIMFR/ CPRI/ ERTL/ BASEEFA/ LCIE/ UL/ FM/ KLPL or equivalent). All indigenous motors shall conform to Indian standards and shall be certified by recognised testing agencies. All motors (indigenous & imported) shall also have valid statutory approvals (e.g. PESO, DGMS etc). as applicable for the specified location. All indigenous flameproof motors shall have valid BIS license and marking as required by statutory authorities.

12.0 PACKING AND DESPATCH

All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to the finish. Crates/cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Center of gravity', 'Weight', 'Owner's particulars', 'PO Nos.' etc. shall be clearly marked on the package together with other details as per purchase order.

Copyright EIL – All rights reserved

The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature, unless otherwise agreed.

Copyright EIL – All rights reserved

Annexure-13-J

INSPECTION AND TEST PLAN

FOR

LOW VOLTAGE MOTOR

PROJECT : REVIVAL OF RAMAGUNDAM FERTILIZER COMPLEX

OWNER : RAMAGUNDAM FERTILZERS AND CHEMICALS LTD

EPCM/PMC: ENGINEERS INDIA LTD

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
0	10.12.2015	Issued for implementation	HKM	HP	SCG

Abbreviations

AS	:	Alloy Steel	MPT/MT	:	Magnetic Particle Testing
BASEEFA	:	British Approval Service for Electrical Equipment in Flammable Atmospheres	MRT	:	Mechanical Run Test
IEC	:	International Electro technical Commission	MTC	:	Material Test Certificate
JEC	:	Japanese Electro technical Committee	MOC	:	Material of Construction
LPT	:	Liquid Penetrate Testing	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	WPQ	:	Welders Performance Qualification
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DT	:	Destructive Testing	XLPE	:	Cross Linked Poly Ethylene
DPT	:	Dye Penetrate Testing	PQR	:	Procedure Qualification Record
VDR	:	Vendor Data Requirement	PR	:	Purchase Requisition
WPS	:	Welding Procedure Specification	PMI	:	Positive Material Identification
FM	:	Factory Mutual	PVC	:	Poly Vinyl Chloride
FLP	:	Flame Proof	QC	:	Quality Control
HIC	:	Hydrogen Induced Cracking	RT	:	Radiography Testing
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IC	:	Inspection Certification	UT	:	Ultrasonic Testing
IGC	:	Inter Granular Corrosion	UL	:	Under writer Laboratories

Copyright EIL – All rights reserved

1.0 SCOPE

This Inspection and Test Plan covers the minimum testing & inspection requirements of three phase Low Voltage squirrel cage induction motors.

2.0 REFERENCE DOCUMENTS

PO/PR & Standards referred there in /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION			
					SUB SUPPLIER	SUPPLIER	TPIA	PMC/ EMPLOYER
1.0	**Procedures**	--	--	--	--	--	--	-
2.0	**Inward Material Inspection**							
2.1	Raw Material: Body(casting or fabrication), Rotor shaft, Core laminations, Copper, Insulation material, Bearings, Terminals, cable boxes, Cable glands, etc.	Chemical, Physical properties , finish as per relevant standard	100%	Material Test Certificates / Test records	H	H	R	-
3.0	**In process Inspection**							

Copyright EIL – All rights reserved

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION			
					SUB SUPPLIER	SUPPLIER	TPIA	PMC/ EMPLOYER
3.1	Motor Assembly	Vacuum impregnation and bracing of winding, core assembly, Rotor bars and end rings assembly, Rotor balancing, Terminal box mounting and clearances in between, Bearing setting, etc as per supplier's internal standards	100%	Test Records	-	H	R	-
4.0	**Final Inspection**							
4.1	Motor (Routine Tests)	• Visual check (Nameplate, Terminal box location, terminal type, clearances, size, entries, space adequacy & gland size, Direction of rotation etc.) • Dimensions check (shaft height etc.) • Cable Glands, cable lugs size and no. of entries in Terminal Box • Winding Resistance • No load test and measurement of Voltage, Speed, Current, Power Input • Measurement of Starting Torque, Starting current , full Load Torque, Pull out torque by JEC (Logarithmic proportion Current method II). • Reduced voltage Starting and running • Insulation resistance Before & after High Voltage test	100%	Inspection test records	-	H	H	-

Copyright EIL – All rights reserved

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION			
					SUB SUPPLIER	SUPPLIER	TPIA	PMC/ EMPLOYER
		• High Voltage • Vibration						
4.2	Motor (Type Tests)	• Full load test and measurement of Voltage, Current, Power, Slip, Power factor, Bearing Noise. • Efficiency and Pf at 100%, 75% and 50% load • Temp Rise test • Momentary overload test • Vibration • Noise Level • Over speed • Measurement of Starting Torque, Starting Current, Full Load Torque	One sample from each type/rating	Inspection test records	-	H	H	-
5.0	**Painting**							
5.1	Painting and Packing	• Visual • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation and storage.	100%	Packing list / Supplier's Records	-	H	RW	-
6.0	**Documentation and IC**							
6.1	Documentation and IC	• Review of Internal Test Reports • Test certificate from recognized testing laboratory for area classification. • Applicable statutory certificate for FLP motors and accessories	100%	Supplier's Test Records / Certificates from statutory bodies / Inspection Certificate (IC)	-	H	H	-

Copyright EIL – All rights reserved

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION			
					SUB SUPPLIER	SUPPLIER	TPIA	PMC/ EMPLOYER
		as applicable. • Applicable statutory approved certificates for motors and accessories as applicable. • Degree of protection of enclosure • IC issuance •						-
6.2	Final Document submission	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H	R

Measurements will be made in accordance with standard IEC (Logarithmic proportion method II)

Legends: H- Hold (Do not proceed without approval, R-Review, RW-Random witness (As specified or 10 % - Samples must include min 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents

Copyright EIL – All rights reserved

मध्यम वोल्टेज मोटरों के लिए निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR MEDIUM VOLTAGE MOTORS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	31.07.2015	Revised and Re-issued	MJ	SA	RKM	SC
4	04.09.2014	Revised and Re-issued	MJ	RS	SCG	SC
3	21.11.2013	Revised and Re-issued	MJ	RS	SCG	SC
2	15.07.2011	Revised and Re-issued	GS	SA	AKC	DM
1	24.12.2007	Revised and Re-issued	SA	CRM	MVKK	VC

Copyright EIL – All rights reserved

Abbreviations:

AS	:	Alloy Steel	MPT/ MT	:	Magnetic Particle Testing
BASEEFA	:	British Approval Service for Electrical Equipment in Flammable Atmospheres	MRT	:	Mechanical Run Test
BIS	:	Bureau of Indian Standards	MTC	:	Material Test Certificate
CCE or CCOE	:	Chief Controller of Explosives	MOC	:	Material of Construction
CEIL	:	Certification Engineers International Limited	NPSH	:	Net Positive Suction Head
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NEMA	:	National Electrical Manufacturers Association
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DT	:	Destructive Testing	PESO	:	Petroleum Explosive Safety Organization
DPT	:	Dye Penetrate Testing	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
FM	:	Factory Mutual	PVC	:	Poly Vinyl Chloride
FLP	:	Flame Proof	QC	:	Quality Control
HIC	:	Hydrogen Induced Cracking	RT	:	Radiography Testing
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IC	:	Inspection Certification	UT	:	Ultrasonic Testing
IGC	:	Inter Granular Corrosion	UL	:	Underwriters Laboratories
IEC	:	International Electro technical Commission	VDR	:	Vendor Data Requirement
JEC	:	Japanese Electro technical Committee	WPS	:	Welding Procedure Specification
LPT	:	Liquid Penetrate Testing	WPQ	:	Welders Performance Qualification
			XLPE	:	Cross Linked Poly Ethylene

Inspection Standards Committee

Convenor : Mr. R.K. Medhavi

Members :

Mr. R.K. Singh	Mr. Rajeev Kumar	Mr. Himangshu Pal
Mr. Neeraj Mathur	Mr. T. Kamalakannan	Mr. Deepak Gupta (Project)
Mr. Mahendra Mittal		

Copyright EIL – All rights reserved

1.0 SCOPE

This Inspection and Test Plan covers the minimum testing & inspection requirements of three phase medium voltage squirrel cage induction motors.

2.0 REFERENCE DOCUMENTS

PO/PR & Standards referred therein/ Job specifications/ Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	--	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Raw Material: Body (casting or fabrication), Rotor shaft, Core laminations, Copper, Insulation material, Bearings, Terminals, Cable boxes, Cable glands, etc.	Chemical, Physical properties , finish as per relevant standard	100%	Material Test Certificates / Test records	H	H	-
3.0	**In Process Inspection**						
3.1	Motor Assembly	Vacuum impregnation and bracing of winding, core assembly, Rotor bars and end rings assembly, Rotor balancing, Terminal box mounting and clearances in between, Bearing setting, etc. as per supplier's internal standards	100%	Test Records	-	H	-

Copyright EIL – All rights reserved

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	**Final Inspection**						
4.1	Motor (Routine Tests)	• Visual check (Nameplate, Terminal box location, terminal type, clearances, size, entries, space adequacy & gland size, Direction of rotation etc.) • Dimensions check (shaft height etc.) • Cable Glands, cable lugs size and no. of entries in Terminal Box • Winding Resistance • No load test and measurement of Voltage, Speed, Current, Power Input • Locked Rotor Test • Reduced voltage Starting and running • Insulation resistance Before & after High Voltage test • High Voltage • Vibration	100%	Inspection test records	-	H	See Note 3 & 4
4.2	Motor (Type Tests)	• Full load test and measurement of Voltage, Current, Power, Slip, Power factor, Bearing Noise. • Efficiency and Pf at 100%, 75% and 50% load • Temp Rise test • Momentary overload test • Vibration • Noise Level	One sample from each type/ rating	Inspection test records	-	H	See Note 3 & 4

Copyright EIL – All rights reserved

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		• Over speed • Measurement of Starting Torque, Starting current , full Load Torque, Pull out torque by JEC *					
5.0	**Painting**						
5.1	Painting and Packing	• Visual • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation and storage.	100%	Packing list/ Supplier's Records	-	H	-
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Review of Internal Test Reports • Test certificate from recognized testing laboratory for area classification. • BIS certificate for FLP motors and accessories as applicable. • PESO approved certificates for motors and accessories as applicable. • Degree of protection of enclosure • IC issuance	100%	Supplier's Test Records/ Certificates from statutory bodies/ Inspection Certificate (IC)	-	H	H
6.2	Final Document submission	Compilation of Inspection reports, drawings, etc. as per VDR / PR	100%	Final data folder/ Completeness certificate	-	H	H

* Measurements will be made in accordance with standard JEC (Logarithmic proportion method II & I as per rotor design).

Copyright EIL – All rights reserved

Legends: H - Hold (Do not proceed without approval), R - Review, RW - Random witness (As specified or 10 % - Samples must include min. 1 No of each type), W - Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/ PR/ Standards referred therein/ Job specifications/Approved documents
3. Motors up to 55 KW would be accepted based on Manufacturer's test certificates. Higher rating will have witness by TPIA appointed by Main Supplier.
4. Motors ordered with integration test (VFD fed motors) requirement as per PR shall be witnessed by EIL/ TPIA and main supplier for integration test (irrespective of rating) at motor manufacturer's works.

Copyright EIL – All rights reserved

INSPECTION AND TEST PLAN

FOR

MEDIUM VOLTAGE INDUCTION MOTORS

PROJECT : REVIVAL OF RAMAGUNDAM FERTILIZER COMPLEX

OWNER : RAMAGUNDAM FERTILZERS AND CHEMICALS LTD.

EPCM/PMC: ENGINEERS INDIA LTD

Rev. No.	Date	Purpose	Prepared By	Checked By	Approved by
0	28.12.2015	ISSUED FOR IMPLEMENTATION	HKM	HP	SCG

Copyright EIL – All rights reserved

Abbreviations:

AS	:	Alloy Steel	MRT	:	Mechanical Run Test
BASEEFA	:	British Approval Service for Electrical Equipment in Flammable Atmospheres	MPT/MT	:	Magnetic Particle Testing
			MTC	:	Material Test Certificates
IEC	:	International Electro technical Commission	MOC	:	Material of Construction
JEC	:	Japanese Electro technical Committee	NPSH	:	Net Positive Suction Head
LPT	:	Liquid Penetrate Testing	NDT	:	Non Destructive Testing
XLPE	:	Cross Linked Poly Ethylene	VDR	:	Vendor Data Requirement
CE	:	Carbon Equivalent	PO	:	Purchase Order
DFT	:	Dry Film Thickness	IR	:	Insulation Resistance
DT	:	Destructive Testing	PQR	:	Procedure Qualification Record
DP or DPT	:	Dye Penetrate Testing	PR	:	Purchase Requisition
WPS	:	Welding Procedure Specification	PMI	:	Positive Material Identification
WPQ	:	Welders Performance Qualification	PTB	:	Physikalisch-Technische Bundesanstalt
FM	:	Factory Mutual	QC	:	Quality Control
FLP	:	Flame Proof	RT	:	Radiography Testing
HART	:	Highway Addressable Remote Transducer	SS	:	Stainless Steel
HV	:	High Voltage	TC	:	Test Certificate
ITP	:	Inspection and Test Plan	TPI or TPIA	:	Third Party Inspection Agency
IP	:	Ingress Protection	UT	:	Ultrasonic Testing
IC	:	Inspection Certification	UL	:	Under writer Laboratories

Copyright EIL – All rights reserved

1.0 SCOPE

This Inspection and Test Plan covers the minimum testing & inspection requirements of Medium Voltage Squirrel Cage Induction Motors.

2.0 REFERENCE DOCUMENTS

PO/PR & Standards referred there in /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION			
					SUB SUPPLIER	SUPPLIER	TPIA	PMC/ EMPLOYER
1.0	**Procedures**	--	--	--	--	--	--	
2.0	**Inward Material Inspection**							
2.1	Raw Material like Copper, Frame castings, Core laminations, Insulation material, Shaft, Cooling fans, Cage covers, Heat Exchanger, Lubrication system, Bearings, CT, RTD, BTD and Terminal box, Cable glands, etc	Chemical, Physical properties , finish as per relevant standard Shaft – NDT	100%	Material Test Certificates / Test records / NDT reports	H	H	R	-
3.0	**In process Inspection**							
3.1	Motor Assembly	Vacuum impregnation and bracing of winding, core assembly, Rotor bars and end rings assembly, Rotor balancing, Terminal box mounting and clearances in between, Bearing setting, Heat Exchanger type, Lubrication system type etc as per Supplier's internal standards	100%	Test Records	-	H	-	-

Copyright EIL – All rights reserved

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION			
					SUB SUPPLIER	SUPPLIER	TPIA	PMC/ EMPLOYER
4.0	**Final Inspection**							
4.1	Motor (Routine Tests)	• Visual check (Terminals type, direction of rotation, etc.) • Dimensional check • Phase sequence. • Winding resistance • Reduced voltage starting (to be checked) • No load test and measurement of Voltage, Speed, Current, Wattage. • Locked Rotor test at reduced voltage and measurement of Voltage, Current and Wattage. • Insulation resistance before and after HV • Polarization Index • High Voltage • Vibration Measurement [under no-load] • Measurement of Shaft Vibrations in case of sleeve bearing motors. (to be checked) • Verification of marking of End play on Shaft and measurement of end play, in case of Sleeve Bearing Motors. • Shaft voltage • Resistance measurement of Space heaters, RTD's and BTD's. • Operation of control panel (in case of	100%	Inspection test records	-	H	H	-

Copyright EIL – All rights reserved

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION			
					SUB SUPPLIER	SUPPLIER	TPIA	PMC/ EMPLOYER
		Ex-p motors)						
4.2	Motor (Type Tests)	• Full load test and measurement of Voltage, Current, Power, Slip, Efficiency and Power factor at 100%, 75% and 50% load • Temp Rise test • Momentary overload test • Noise Level • Over speed • Measurement of Starting Torque, Starting Current , full Load Torque, Pull out torque by JEC (Logarithmic proportion Current method II). • Tan delta test • Measurement of radial and axial clearance between fan and stationary parts and Measurement of air gap.(if provision for measurement is not available in fully assembled motor stage records/calculations to be reviewed)	One sample from each type/rating	Inspection test records	-	H	H	-
4.3	Submission of Certificates/ Documents	• Test certificate from recognized testing laboratory for area classification. • Approved certificate for FLP motors and accessories as applicable. • Approved certificates for motors and accessories as applicable. • Fault level of Terminal Box • Degree of protection of enclosure as per latest IEC Standards.	1 Machine/ Type/Rating	Statutory Body Test Certificates, Supplier Test Certificates, Inspection Test Records	-	H	R	-

Copyright EIL – All rights reserved

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION			
					SUB SUPPLIER	SUPPLIER	TPIA	PMC/ EMPLOYER
		• Impulse test certificate for coils • Hydraulic test certificate for coolers						
5.0	**Painting**							
5.1	Painting of Motor Frames	• Visual. • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation.	100%	Test records	-	H	RW	-
6.0	**Documentation and IC**							
6.1	Documentation and IC	• Review of Internal Test Certificates • IC issuance	100%	Supplier Test Certificates/ Inspection Certificate (IC)	-	H	H	-
6.2	Final Document submission	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H	-

Legends: H- Hold (Do not proceed without approval, R-Review, RW-Random witness (As specified or 10 % - Samples must include min 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents

Copyright EIL – All rights reserved

JOB SPECIFICATION FOR SURFACE PREPARATION AND PROTECTIVE COATING (NEW CONSTRUCTION)

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
1	30-9-15	Incorporated RFCL comments	DHANANJAY	SRIDHAR	S. GHOSAL
0	10.06.2015	ISSUED AS JOB SPECIFICATION	DHANANJAY	SRIDHAR	S. GHOSAL

Copyright EIL – All rights reserved

Abbreviations:

AS	:	Alloy Steel
CS	:	Carbon Steel
SS	:	Stainless Steel
DFT	:	Dry Film Thickness
WFT	:	Wet Film Thickness
ID	:	Internal Diameter
IRN	:	Inspection Release Note
LTCS	:	Low Temperature Carbon Steel
MS	:	Mild Steel
NB	:	Nominal Bore
OD	:	Outside Diameter
RCC	:	Reinforced Cement Concrete

Copyright EIL – All rights reserved

CONTENTS

Copyright EIL – All rights reserved

1.0 SCOPE

This specification outlines the technical requirement of protective coating for new construction. This specification shall be applicable for shop & field painting of equipment, structures, vessels, piping, storage tanks, chimneys, under insulation painting for hot and cold insulation of equipments and piping etc.
This specification shall not be applicable for gratings and structural members which are galvanized as per other standard given elsewhere in the contract.

2.0 GENERAL

2.0.1 In general, this specification is applied but not limited to the following:

- All uninsulated Carbon Steel & Alloy Steel equipments like vessels, Columns, storage Tanks, Exchangers if any, parts of boilers etc.
- All uninsulated carbon steel, low alloy and related piping, fittings and valves (including painting of identification marks), furnace ducts and stacks.
- All insulated parts of vessels, boilers, chimneys, stacks, piping and steam piping and if any other insulated items present.
- All items contained in a package unit as necessary.
- All structural steel work, pipe, structural steel supports, handrails, platforms etc.
- Flare lines, external surfaces of MS chimney with or without refractory lining and internal surfaces of MS chimney without refractory lining. (If present)
- Identification of colour bands on all piping as required including insulated aluminium clad, SS and nonferrous piping.
- Identification lettering/ numbering on all painted surfaces of equipment/piping insulated aluminium clad, SS and non-ferrous piping.
- Marking / identification signs on painted surfaces of equipment/piping including hazardous service.
- Supply of all primers, paints and all other materials required for painting (other than Owner supplied materials)
- Painting of pre-erection/fabrication and Shop primer.
- Repair work of damaged pre-erection/ fabrication and shop primer and weld joints in the field/site before and after erection as required.
- All internal surfaces of CS storage tanks & vessels and RCC tanks in ETP plant.

Copyright EIL – All rights reserved

- Quality control, testing and inspection during all stages of work (surface preparation, application of coating and testing of furnished coating).

2.0.2 The following surfaces and materials shall not require painting in general. However, if there is any specific requirement by the owner, the same shall be painted as per the relevant specifications:

a. Un-insulated austenitic stainless steel.

b. Plastic and/or plastic coated materials.

c. Galvanized steel.

d. Non-ferrous materials like aluminum, Cu-Ni alloy.

2.1 Documents

2.1.1 The contractor shall perform the work in accordance with the following documents issued to him for execution of work.

a. Bill of quantities for piping, equipment, machinery and structures etc.

b. Piping Line List.

c. Painting specifications including special civil defense requirements.

2.2 **Unless otherwise instructed, final paint coating (i.e., application of field primer, wherever required, intermediate and top coats) on pre-erection/ shop primed equipments shall be applied at site, only after all welding, testing on systems are completed as well as after completion of steam purging wherever required .**

2.3 Changes and deviations required for any specific job due to clients requirement or otherwise shall be referred to EIL for deviation permit.

3.0 REFERENCE CODES & STANDARDS

3.1 The following standards & codes are referred in this specification. Latest revision of these shall be referred.

RAL DUTCH	:	International Standard for color shade (Dutch Standard)
IS-101	:	Methods of test for ready mixed paints and enamels
IS-2379	:	Indian Standard for Pipe line identification-color code
ISO-12944	:	Corrosion Protection of steel Structures by Protective Paint System
ASTM-Vol 6.01&6.03	:	American standard test methods for Paints and Coatings.
ANSI A 13.1	:	Scheme for identification of piping systems: American National Standards Institution
SSPC	:	Steel Structures Painting Council

Copyright EIL – All rights reserved

EIL STANDARD 6-79-0011: Standard specification for tape coating for underground plant piping

3.2 Surface Preparation Standards

The latest editions of any of the following standards shall be followed for surface preparation:

3.2.1 ISO 8501-1 / SIS-05 59 00: ISO standard for Preparation of steel substrates before application of paints and related products. This standard contains photographs of the various standards on four different degrees of rusted steel and as such is preferable for inspection purpose by the Engineer-In-Charge.

3.2.2 Steel Structures Painting Council, U.S.A. (Surface Preparation Specifications (SSPC-SP).

3.2.3 National Association of Corrosion Engineers, U.S.A., (NACE).

3.2.4 Various International Standards equivalent to Swedish Standard for surface preparations are given in Table-I.

3.3 The contractor shall arrange, at his own cost, to keep a set of latest edition of above standards and codes at site.

4.0 EQUIPMENT

4.1 All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning and all equipments, scaffolding materials, shot & grit blasting equipments & air compressors etc. required to be used shall be suitable for the work and all in good order and shall be arranged by the contractor at site and in sufficient quantity. The manufacturer's test certificates / data sheets for all the above items shall be reviewed by Engineer-in-charge at site before start of work.

4.2 Mechanical mixer shall be used for paint mixing operations in case of two pack systems except that the Engineer-In-Charge may allow the hand mixing of small quantities at his discretion in case of specific requirement for touch up work only.

5.0 SURFACE PREPARATION, SHOP PRIMER COATING APPLICATION & REPAIR AND DOCUMENTATION

5.1 General

5.1.1 In order to achieve the maximum durability, one or more of following methods of surface preparation shall be followed, depending on condition of surface to be painted and as instructed by Engineer-In-Charge. Adhesion of the paint film to surface depends largely on the degree of cleanliness of the metal surface. Proper surface preparation contributes more to the success of the paint protective system.

a. Abrasive blast cleaning

b. Mechanical or power tool cleaning

Copyright EIL – All rights reserved

5.1.2 Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. Unless otherwise specified, surface preparation shall be done as per provisions of relevant tables given elsewhere in this specification.
Before surface preparation by blast cleaning, the surface shall be degreased by aromatic solvent to remove all grease, oil etc.

5.1.3 Irrespective of whether external or internal surface to be coated, blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceed 85%. In case of internal coating of storage tanks, dehumidifier shall be used, to control humidity level below 60%. Dehumidifier should depress the dew point of air in the enclosed space, sufficient enough so as to maintain it 3°C below the metal substrate temperature during centre period of blasting and coating application. During the interval time between application of primer coat and subsequent intermediate and top coats or between blast cleaning completion and start of application of primer coat, dehumidifier unit should be in continuous operation to ensure that no condensation occurs on substrate.
Dehumidifier should be able to maintain grain drop (moisture removal) at the rate of 25 grains per pound of air per hour. Dehumidifier should have capacity of at least 2 air changes per hour of the enclosed space. All necessary psychometric data should be collected by contractor for the given site conditions before starting operation of dehumidifier to ensure that desired values of dew point, moisture content in enclosed scope is achieved.
Dehumidification to be maintained round the clock for surface preparation and painting till the total coating application is over.
Dehumidifier shall not be stopped under any condition till the entire blasted surface is primed to the satisfaction of the technical representative of the paint manufacturer interested with quality assurance for the work. In case the dehumidifier breaks down in middle of the job, the same shall be replaced at the risk and the cost of the contractor and the entire unfinished work shall be repeated.

5.1.4 The Engineer in-charge shall have the right to disallow usage of dehumidifier if the performance is not meeting the specified requirements. Under such circumstances the contractor shall remove the equipment and replace the same with another equipment to provide satisfactory results without any additional cost to the owner.

5.1.5 Irrespective of the method of surface preparation, the first coat of primer must be applied by airless spray/ air assisted conventional spray if recommended by the paint manufacturer on dry surface. This should be done immediately and in any case within 4 hours of cleaning of surface. However, at times of unfavorable weather conditions, the Engineer-In-Charge shall have the liberty to control the time period, at his sole discretion and/or to insist on re-cleaning, as may be required, before primer application is taken up. In general, during unfavorable weather conditions, blasting and painting shall be avoided as far as practicable.

5.1.6 The external surface of R.C.C. chimney to be painted shall be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed by scrubbing with soft wire brush. Acid etching with 10-15% HCL solution for about 15 minutes shall be carried and surface must be thoroughly washed with water to remove acid & loose particles and then dried completely before application of paint.

Copyright EIL – All rights reserved

5.2 Procedure for Surface Preparation

5.2.1 Air Blast Cleaning with abrasives

The surfaces shall be blast cleaned using one of the abrasives like angular chilled cast iron or steel grit, copper slag or Nickel slag, $A1_2O_3$ particles at pressure of 7kg/cm^2 at an appropriate distance and angle depending of nozzle size maintaining constant velocity and pressure. Chilled cast iron or steel shall be in the form of shot or grit of size in the range of G16 – G42 conforming to SSPC AB1 and S250 grade size of steel shots (maximum) to obtain a desired surface profile of 35-50 microns trough to peak. For all other abrasives, size shall be in the range of G16 – G24. The combination of steel grits and shots shall be normally in the ratio of 3:1. The quality of abrasives shall be free from contaminants and impurities and shall meet the requirements of SSPC AB1. Compressed air shall be free from moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the materials for liners. Nozzles orifice may vary from 3/16" to ¾". On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic luster. Primer/first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bad weather without adequate protection or when there is dew on the metal, which is to be cleaned. Surface profile shall be uniform to provide good key to the paint adhesion (i.e. 35 to 50 microns). If possible vacuum collector shall be installed for collecting the abrasives and recycling.

5.2.2 Mechanical or Power Tool Cleaning

Power tool cleaning shall be done by mechanical striking tools, chipping hammers, grinding wheels or rotating steel wire- brushes. Excessive burnish of surface shall be avoided as it can reduce paint adhesion. On completion of cleaning, the detached rust mill scale etc. shall be removed by clean rags and /or washed by water or steam and thoroughly dried with compressed air jet before application of paint.

5.3 Non-Compatible Shop Coat Primer

For equipments on which application of total protective coating (Primer + Intermediate + top coat) is carried out at shop, compatibility of finish coat with primer should be checked with paint manufacturer. If the shop coat is in satisfactory condition showing no major defect upon arrival at site, the shop coat shall not be removed.

5.4 Shop coated equipments (coated with Primer & finishing coat) should not be repainted unless paint is damaged. Repair shall be carried out as per Table 5.0 of paint systems depending upon compatibility of paint.

5.5 Shop primed equipment and surfaces will only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer should be completely removed before application of selected paint system for particular environment.

5.6 For Package units/equipment, shop primer should be as per the paint system given in this specification. However, manufacturer's standard can be followed after review.

Copyright EIL – All rights reserved

5.7 Coating Procedure and Application

All paint coatings shall be applied by airless spray excepting at the following special cases where application can be carried out by brush subject to suitability of the application of the paint product by brush.

- **Spot repair**
- **Stripe coating on edges**
- **Small bore parts not suitable for spray application.**

Irregular surfaces such as sharp edges, welds, small brackets, and interstices may stripe coated to ensure specified DFT is achieved. Paint manufacturer recommendation should be followed before deciding for brush application.

5.7.1 Surface shall not be coated in rain, wind or in environment where injurious airborne elements exists, when the steel surface temperature is less than 5°F above dew point when the relative humidity is greater than 85% or when the temperature is below 40°F and when the ambient/substrate temp is below the paint manufacturer's recommended temperature of application and curing. De-humidifier equipment shall be used to control RH and Dew point. The paint application shall not be done when the wind speed exceeds 20km per hour.

5.7.2 Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hrs the same day.

5.7.3 To the maximum extent practicable, each coat of material shall be applied as a continuous film uniform thickness free of probes. Any spots or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.

5.7.4 Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer instruction shall be followed for inter coat interval.

5.7.5 When the successive coat of the same colour have been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate complete coverage of the surface. The tinting material shall be compatible with the material and not detrimental to its service life and shall be recommended by the original paint manufacturer.

5.7.6 Airless spray application shall be in accordance with the following procedure: as per steel structure paint Manual Vol.1 & Vol.2 by SSPC, USA, Air less spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor is used to operate a pump to produce pressures of 1000 to 6000 psi. paint is delivered to the spray gun at this pressure through a single hose within the gun, a single paint stream is divided into separate streams, which are forced through a small orifice resulting in atomization of paint without the use of air. This results in more rapid coverage with less over spray. Airless spray usually is faster, cleaner, more economical and easier to use than conventional air spray.

Copyright EIL – All rights reserved

Airless spray equipment is mounted on wheels, and paint is aspirated in a hose that sucks paint from any container, including drums. The unit shall have in built agitator that keep the paint uniformly mixed during the spraying. The unit shall consist of in built strainer. Usually very small quantity of thinning is required before spray. In case of high build epoxy coating (two packs). 30:1 pump ratio and 0.020-0.023" tip size will provide a good spray pattern. Ideally fluid hoses should not be less than 3/8" ID and not longer than 50 ft to obtain optimum results.

In case of gun choking, de-choking steps shall be followed immediately.

5.7.7 Brush application of paint shall be in accordance with the following:

a. Brushes shall be of a style and quality that will enable proper application of paint.

b. Round or oval brushes are most suitable for rivets, bolts, irregular surface, and rough or pitted steel. Wide flat brushes are suitable for large flat areas, but they shall not have width over five inches.

c. Paint shall be applied into all corners.

d. Any runs or sags shall be brushed out.

e. There shall be a minimum of brush marks left in the applied paint.

f. Surfaces not accessible to brushes shall be painted by spray, doubers, or sheepkin.

5.7.8 For each coat the painter should know the WFT corresponding to the specified DFT and standardize the paint application technique to achieve the desired WFT. This has to be ensured in the qualification trial.

5.7.9 The paint manufacturers instruction shall be followed as far as practicable at all times for best results. Particular attention shall be paid to – instructions for storage, mixing and thinning and over coating intervals etc.

5.8 Drying of Coated Surfaces

5.8.1 No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or maxing is faulty.

5.8.2 No paint shall be force dried under conditions which will cause chalking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.

5.8.3 No drier shall be added to paint on the job unless specifically called for in the manufacturer's specification for the paint.

5.8.4 Paint shall be protected from rain, condensation, contamination, snow and freezing until dry to the fullest extent practicable.

Copyright EIL – All rights reserved

5.9 Spot Repair of Damaged Primer

5.9.1 Where pre erection shop primer has been damaged at isolated localized spots during handling and transportation, or after erection / welding, the repair of damaged coating of pre-erection / pre-fabrication or shop primer shall be done as given below and as per the Table 5.0 of this specification.

5.9.2 **Repair of damaged inorganic zinc silicate pre-erection / pre-fabrication or shop primer (F9) after erection / welding in the design temperature of -90ºC to 400ºC and damaged silicone aluminium (F-12) pre-erection / pre-fabrication or shop primer after erection / welding for design temperature range of 401 – 550 °C.**

Surface Preparation: Quickly remove the primer from damaged area by mechanical scraping and emery paper conforming to SSPC-SP-3 to expose the white metal. Blast clean the surface, if possible. Feather the primed surface over the intact adjacent surface surrounding the damaged area by emery paper.

Primer coating: One coat of F-9 shall be applied wherever damage was observed on pre-erection / pre fabrication or shop primer of inorganic zinc silicate coating (F-9). Similarly one coat of F-12 shall be applied wherever damage observed on pre-erection / pre-fabrication shop primer of silicone aluminium (F-12).

5.9.3 Wherever if damaged areas are found extensive and spread over large areas, then entire pre-erection / pre-fabrication or shop primer shall be removed by blasting to achieve SSPC-SP-10 then entire blasted surface shall be primed again with F-9 or F-12 as applicable for the intended design temp. (See note under table 5.0).

5.10 Paint Application

5.10.1 Shop priming/pre-erection priming with F9 or F12 shall be done only on blasted surface (SSPC-SP-10)

5.10.2 Shop priming / pre-erection priming with F9 or F12 shall be done only with airless spray.

5.10.3 **Assessment of Painting Requirement**

The paint system to be applied for a specific job shall be arrived at sequentially as given below:

- Identify the environment from area classification details and chose the appropriate table.

- Identify the design temperature from the technical documents

- Identify the specific field paint system and surface preparation requirement from the above identified table and temperature range.

- Identify shop priming requirement from Table 2&3 based on compatibility of the above paint system.

- Identify the need of repair of shop primer and execute as per Table 5.0.

Copyright EIL – All rights reserved

5.11 Documentation / Records

5.11.1 A written quality plan with procedure for qualification trials and for the actual work including test and inspection plan & procedure for approval before start of work.

5.11.2 Daily progress report with details of weather conditions, particular of applications, no of coats and type of materials applied, anomalies, progress of work versus program.

5.11.3 Results of measurement of temperatures relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.

5.11.4 Particulars of surface preparation and paint application during trials and during the work.

5.11.5 Details of non-compliance, rejects and repairs.

5.11.6 Type of testing equipments and calibration.

5.11.7 Code and batch numbers of paint materials used.

The coating applicator must maintain a job record consisting of all the information as per 5.11.2 -5.11.7 above as well as the approved procedure of work (5.11.1 above). The job record consisting of information as required in accordance to 5.11.2 – 5.11.7 shall be entered on daily basis and should be daily signed by Engineer-in-charge.

Copyright EIL – All rights reserved

TABLE-1 (FOR CLAUSE 5.0)

SURFACE PREPARATION STANDARDS

Sl. No.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
1	Manual or hand tool cleaning Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, standing and wire brushing. Surface should have a faint metallic sheen	ST.2	SSPC-SP-2	--	This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.
2	Mechanical or power tool cleaning Removal of loose rust loose mill scale and loose paint to degree specified by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.	ST.3	SSPC-SP-3	--	
3	Dry abrasive Blast cleaning There are four common grades of blast cleaning				
3.1	White metal Blast cleaning to white metal cleanliness. Removal of all visible rust. Mill scale, paint & foreign matter 100% cleanliness with desired surface profile.	SA 3	SSPC-SP-5	NACE#1	Where extremely clean surface can be expected for prolong life of paint system.
3.2	Near white metal Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues with desired surface profile.	SA 2½	SSPC-SP-10	NACE#2	The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc silicate paints, also for conventional paint systems used under fairly corrosive conditions to obtain desired life of paint system.
3.3	Commercial Blast Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.	SA 2	SSPC-SP-6	NO.3	For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.
3.4	Brush-off Blast Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint & foreign matter. Surface profile is not so important	SA 1	SSPC-SP-7	NO.4	

Copyright EIL – All rights reserved

6.0 PAINT MATERIALS*

TABLE No. 2 PRIMERS

Sl. No.	DESCRIPTION	P-2	P-4	P-6	F-8	F-9
1	Technical name	Chlorinated rubber Zinc Phosphate primer.	Etch primer/wash primer	Epoxy zinc phosphate primer	Self priming type surface tolerant high build epoxy coating (complete rust control coating).	Inorganic zinc silicate coating
2	Type and composition	Single pack, air drying chlorinated rubber based medium plasticised with unsaponifiable plasticizer, pigmented with zinc phosphate.	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.	Two component polyamine cured epoxy resin medium, pigmented with zinc phosphate.	Two pack epoxy resin based suitable pigmented and capable of adhering to manually prepared surface and old coating.	A two pack air drying self curing solvent based inorganic zinc silicate coating with minimum 80% zinc content on dry film. The final cure of the dry film shall pass the MEK rub test.
3	Volume Solids %	40 ±3	10±1	50±1	78±3	60±3
4	DFT (Dry Film thickness) per coat in microns	40-45	8-10	40-50	100-125	65-75µ
5	Theoritical covering capacity in M^2/coat/ litre	8-10	8-10	8-10	6.0-7.2	8-9
6	Weight per litre in kgs/litre	1.3±0.05	1.2±0.05	1.4±0.05	1.41±0.03	2.3±0.03
7	Touch dry at 30°C (minimum)	30 minutes	2 hrs.	After 30 min.	3 hrs.	30 minutes.
8	Hard dry at 30°C (maximum.)	8 hrs.	24 hrs.	8 hrs	24 hrs 5days	12 NA
9	Overcoating interval	Min.: 8 hrs	Min: 4-6 hrs.	Min.:8hrs.	Min.: 10 hrs	Min.: 12 hrs.at 20°C & 50 % RH
10	Pot life at 30°C for two component paints	Not Applicable	Not applicable	6 - 8 hrs.	90 minutes.	4-6 hrs.
11	Temperature (Resistance (minimum)	60 °C Dry service	NA Dry service	80°C Dry service	80 °C Dry service	400 °C Dry service

Copyright EIL – All rights reserved

TABLE No. 3 FINISH PAINTS

Sl. No	DESCRIPTION	F-2	F-3	F-6A/B	F-6C
1	Technical name	Acrylic Polyurethane finish paint	Chlorinated rubber based finish paint	Epoxy-High Build coating	Solvent less epoxy coating
2	Type and composition	Two-pack aliphatic isocynate cured acrylic finish paint.	Single pack plasticised chlorinated rubber based medium with chemical and weather resistant pigments.	F-6A Two-pack Aromatic amine cured epoxy resin medium suitably pigmented. F-6B: polyamide cured epoxy resin medium suitably pigmented	Two pack, cured with Amine Adduct; catalyzed epoxy resin suitably pigmented
3	Volume Solids %	40 ± 3	38±2	60±3	99±1
4	DFT (Dry Film thickness) per coat in microns	30-40µ	30-40	100-125µ	200-500
5	Theoritical covering capacity in M^2/coat/litre	11-15	11-15	5-6	2-3
6	Weight per liter in kgs/litre	1.15±0.03	1.15±0.03	1.42±0.03	1.40±0.03
7	Touch dry at 30°C	30 minutes	30 minutes.	3 hrs.	3 hrs.
8	Hard dry at 30°C (max) Full cure at 30°C (for immersion/ high temperature service)	8 hrs	8 hrs	16 hrs 5 days	16 hrs
9	Over-coating interval at 30 °C	Min.12 hrs.	Min.: Overnight	Min.: Overnight Max.: 5 days	Min.: 8 hrs. Max.: 48 hrs.
10	Pot life (approx.) at 30°C for two component paints	6-8 hrs.	Not applicable	4-6 hrs	30 minutes
11	Temperature Resistance (minimum)	80 °C Dry service min	60 °C Immersion service	80°C Dry service	120°C(Dry service), 50°C (Immersion service)

Copyright EIL – All rights reserved

TABLE No. 3 (CONTD.) FINISH PAINTS

Sl. No	DESCRIPTION	F-11	F-7	F-12
1	Technical name	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C dry temp.	High build coal tar epoxy coating.	Heat resistant silicone Aluminium paint suitable upto 500°C dry temp.
2	Type & composition	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C.	Two pack polyamide cured epoxy resin blended with coaltar medium, suitably pigmented	Single pack silicone resin based medium with Aluminium flakes.
3	Volume Solids %	38±0.03	65±3	20±2
4	DFT (Dry Film thickness) per coat in microns	15-20µ	100-125µ	15-20µ
5	Theoritical covering capacity in M^2/coat/ litre	10-12	5.2-6.5	8-10
6	Weight per liter in kgs/litre	0.95±0.03	1.40±0.03	1.00±0.03
7	Touch dry at 30°C (maximum)	3 hrs.	4 hrs.	30 minutes.
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temperature service)	12 hrs NA	48 hrs 5 days	24 hrs NA
9	Over-coating interval	Min. 24 hrs	Min.: 24 hrs Max.: 5 days.	Min.: 24 hrs
10	Pot life at 30°C for two component paints	Not applicable	4-6 hrs.	Not applicable
11	Temperature Resistance (minimum)	250°C Dry service	125°C Immersion service	500°C Dry service

Copyright EIL – All rights reserved

TABLE No.3 (CONTD.) FINISH PAINTS

Sl. No	DESCRIPTION	F-14	F-15	F-16	F-17
1	Technical name	Polyamine cured coal tar epoxy	Two-component Epoxy phenolic coating cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint)	Ambient temperature curing Poly Siloxane coating/High build cold applied inorganic copolymer based aluminium coating.	Novalac epoxy phenolic coating cured with Polyamine adduct hardner system
2	Type & composition	Specially formulated polyamine cured coal tar epoxy suitable for application under insulation	Two pack ambient temperature curing epoxy phenolic coating system suitable for application under insulation of CS/SS piping	Suitable for under insulation coating of CS and SS piping for high temperature service	Novalac epoxy phenolic coating cured with Polyamine adduct hardner system
3	Volume Solids %	70±3	70±3	60±2	98-100
4	DFT (Dry Film thickness) per coat in microns	100-125	75-100	75-100	125- 150
5	Theoritical covering capacity in M^2/coat/ litre	5-8	4-5	7.0- 9.0	6.5 - 8
6	Weight per liter in kgs/litre (mix paint)	1.45±0.03	1.65±0.03	1.3	1.7
7	Touch dry at 30°C (maximum)	4 hrs	3 hrs	1 hr	2 hrs
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temp. service)	24 hrs 168 hrs (7 days)	24 hrs 168 hrs (7 days)	16 hrs -	24 hrs 168 hrs (7 days)
9	Over-coating interval	Min. 6 hrs Max.5 days	Min. 36 hrs Max.21 days	Min.16 hrs Max. Not applicable	Min. 16 hrs Max.21 days
10	Pot life at 30°C for two component paints	4 hrs	4-6 hrs	1 hr	1 hr
11	Temperature Resistance	-45°C to 125°C under insulation And immersion	-45°C to 150°C under insulation & immersion	up to 600 deg C	-45°C to 150°C for immersion service

*Paint manufacturers shall furnish the characteristics of all paints materials on original printed literature, along with the test certificate for all specified characteristics given in this specification. All the paint materials shall be of first quality and conform to the above general characteristics as per the Tables 2 and 3.

Copyright EIL – All rights reserved

NOTES (for tables 2 & 3):

1. Covering capacity and DFT depends on method of application. Covering capacity specified above is theoretical. Allowing the losses during application, min specified DFT should be maintained.

2. All primers and finish coats should be cold cured and air drying unless otherwise specified.

3. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured. In case of conflict between this specification and manufacturer's recommendation, the same shall be clarified through EILs SMMS department.

4. Technical data sheets for all paints shall be supplied at the time of submission of quotations for full filling Material approval Request (MAR) requirement.

Copyright EIL – All rights reserved

7.0 COATING SYSTEMS

The coating system should be selected based on the Plant location as given below:

Classification based on Plant Location:

a) Plant located in Inland area (more than 50 km from coast);
Environment Classification – Industrial

- For offsite areas: Table 6.0 to be followed
- For all unit areas including DM,CPP and Cooling Tower: Table 7.0 to be followed

b) Plant located on sea coast or within 50 km from sea coast;
Environment classification- Industrial marine

- For offsite area, as well as all unit area including DM, CPP, Cooling Tower: Table 7.0 to be followed

c) For external surface of above ground tanks, table 9.0 to be followed for all locations (Inland or coastal)

7.1 COATING SYSTEM SELECTION CRITERIA

Repair of pre-erection/pre-fabrication or shop primer after erection/welding For all un-insulated CS, LTCS & low allow steel items in all Environments	ANNEXURE 1 Table 5.0
Coating system for offsite area (inland plants) (Carbon Steel, LTCS & Low Alloy Steel) For external surfaces of Un-insulated & aboveground Structures, Piping, Vessels, Equipments, Pumps, etc..	ANNEXURE 1 Table 6.0
Coating system applicable for areas like Process units, DM, CPP, cooling tower, bagging plants, conveyor belts, Urea silos, Urea transfer towers of inland plants and for 2) All areas like process units, offsites, DM, CPP, etc. of coastal plants (carbon steel, LTCS & low alloy steels) For external surfaces of un-insulated and above ground structures, piping, vessels, equipments, external surface of MS chimney/stacks, RCC chimney, internal surface of MS chimney without refractory lining, towers, columns, pumps, compressors, blowers etc.	ANNEXURE 1 Table 7.0
Coating system for effluent treatment plant (ETP)	ANNEXURE 1 Table 8.0
External coating systems for un-insulated carbon steel and low alloy steel storage tanks (For all plant locations, All Process Units & Off-sites)	ANNEXURE 1 Table 9.0
Internal coating systems for carbon steel and low alloy storage tanks All Process Units & Off-sites	ANNEXURE 1 Table 10.0

Copyright EIL – All rights reserved

Coating systems for external side of underground carbon steel plant piping and underground vessels	ANNEXURE 1 Table 11.0
Painting under insulation (all environments) All areas (Process Units & Off-sites) for insulated Piping, Storage Tanks, Equipments etc (Note-1); (For Carbon Steel, LTCS, Low Alloy Steel & Stainless Steel)	ANNEXURE 1 Table 12.0
Coating system for carbon steel components of coolers / condensers (internal protection) for fresh water service Fresh Water boxes, channels, partition plates, end covers and tube sheets etc**.**	ANNEXURE 1 Table 13.0
Coating system (internal protection) for galvanized or non ferrous or stainless steel/ duplex stainless steel components of coolers/ condensers for fresh water service	ANNEXURE 1 Table 14.0

Notes:

1. Repair of Pre-Erection/Pre-Fabrication & Shop priming after erection/ welding shall be done as per Table 5.0 of ANNEXURE-1

8.0 STORAGE

8.1 All paints and painting materials shall be stored only in rooms to be arranged by contractor and approved by Engineer-in-charge for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent building. A signboard bearing the word "PAINT STORAGE – NO NAKED LIGHT – HIGHLY INFLAMABLE" shall be clearly displayed outside. Manufacturer's recommendation shall be followed for storage of paint materials.

9.0 PAINT COLOUR CODE FOR PIPING AND EQUIPMENT

Unless otherwise specified, the following shall be followed:

9.1 IDENTIFICATION

The system of colour coding consists of a ground colour and secondary colour bands superimposed over the ground colour. The ground colour identifies the basic nature of the service and secondary colour band over the ground colour distinguishes the particular service. The ground colour shall be applied over the entire length of the un-insulated pipes. For insulated lines ground colour shall be provided as per specified length and interval to identify the basic nature of service and secondary colour bands to be painted on these specified length to identify the particular service. Above colour code is applicable for both unit and offsite pipelines.
The following ground colour designation for identification of basis classification of various important services shall be followed.

Post Office Red	Fire protection materials
Off White / Aluminium	Steam (all pressures)

Copyright EIL – All rights reserved

Canary Yellow	Chemicals and dangerous materials
Dark Admiralty Grey	lube oil
Orange	Volatile petroleum products (motor sprit and lighter)
Oxide red	Non-Volatile petroleum products (kerosene and heavier, including waxy distillates and diesel, gas oil)
Black	Residual oils, still bottoms, slop oils and asphalts, fuel oil
Sky blue	Water (all purities and temperatures)
Sea green	Air and its components and Freon

9.1.1 Secondary colours: The narrow bands presenting the secondary colour which identifies the specific service may be applied by painting.

9.2 COLOUR BANDS AND IDENTIFICATION LETTERING

9.2.1 The following specifications of colour bands shall be followed for identifying the piping contents, size and location of bands & letters. The bandwidth and size of letters in legends will depend to some extent upon the pipe diameter. Either white or black letters are selected to provide maximum contrast to the band colour. Bands usually are 100 mm wide and regardless of band width, are spaced 50 mm apart when two bands are employed.

Colour bands and size of lettering for piping:

Outside diameter of pipe or covering in mm	Width of colour bands in mm	Size of legend Letters in mm
19 to 32	200	13
38 to 51	200	19
64 to 150	300	32
200 to 250	600	64
Over 250	800	89

In addition, ground colour as per specified length should be provided on insulated piping for easy identification of nature of fluid, on which the colour bands should be painted for identification of each service. The length of the ground colour should be 3 times the width of normal bands or 2 meters, whichever is suitable depending on the length of the pipe.

Size of letters stenciled/ written for equipment shall be as given below:

Column and vessel : 150 mm (Height)
Pump, compressor and other machinery : 50 mm (Height)
Piping : OD / 2 with Maximum 100 MM.

In addition, the contents of the pipe and/or direction of flow may be further indicated by arrows and legend. If a hazard is involved it must be identified clearly by legend.

Note:
For insulated pipes, NB indicates OD of the insulation

9.2.2 Colour bands: The location and size of bands, as recommended, when used, shall be applied to the pipe.

Copyright EIL – All rights reserved

- On both sides of the valves, tees and other fittings of importance.
- Where the pipe enters and emerges from walls and where it emerges from road & walkway overpasses, unit battery limits.
- At uniform intervals along long sections of the pipe.
- Adjacent to tanks, vessels, and pumps.

9.2.3 For piping, writing of name of service and direction of flow for all the lines shall be done at following locations:

9.2.3.1 Offsite Lines: Both sides of culverts, any one side of walkways, near tank dykes, at tank inlet/outlet points and suction/ discharge of pumps/ compressors.

9.2.3.2 Unit Lines: At the battery limit, suction/ discharge of pumps/ compressors, near vessels, columns, Tanks, Exchangers etc.

9.2.4 The letters will be in black on pipes painted with light shade colours and white on pipes painted with dark shade colours to give good contrast.

9.2.5 Only writing of service name shall be done on stainless steel lines. Precautions should be taken while painting by using low chloride content painting to avoid any damage to the stainless steel pipes. It is preferable to use adhesive plastic tapes to protect stainless steel pipes.

9.2.6 Colour band specification:

a) Unit Area: Bands at intervals of 6.0 meters.
Offsite Area: Bands at intervals of 10.0 meters.
b) Each pipe segment will have minimum one band indication, irrespective of length.
c) The bands shall also be displayed near walkways, both sides of culverts, tanks dykes, tanks, vessels, suction and discharge of pumps/ compressors, unit battery limit, near valves of line, etc.

9.3 For alloy steel/ stainless steel pipes and fittings in stores/ fabrication yard, color band (Minimum ½" wide) should be applied along the complete length of pipe, bends/ tees, side-curved surface (on thickness) of flanges as well as valves as per the metallurgy.

9.4 In case of camouflaging requirements of civil defence or any other locational requirements, the same shall be followed accordingly.

9.5 The specification for application of the complete Piping identification colour code, including base and bands colours, are presented in the enclosed table.

10.0 RECOMMENDED PAINT COLOUR CODE

- Liquid & Gas Ammonia lines shall be painted in dark Violet ground colour .
- For other services Pipe identification colour coding shall be as per **IS 2379**
- All drains & Vents shall be painted in Main line colour.
- The colour code scheme is for identification of piping service group, It consists of a ground colour and 1 / 2 colour bands.

Copyright EIL – All rights reserved

10.2 Ground Colour

On uninsulated pipes, the entire pipe has to be painted in ground colour., and on metal cladded insulated lines, minimum 2M long portion should be painted.

10.3 Colour Bands

Location of colour bands:

- At Battery Limits
- Intersection points & change of direction points in piping
- Midway of piping section, near valves, across culverts
- At 50 M interval on long stretch pipes
- At starting and termination points.

Sequence:

Colour bands shall be arranged in sequence showing Table above and the sequence follows the direction of flow. The width of the 1st Band to 2nd band is 4:1,

!!! Note : Wherever deemed required by Process Department or Safety, pipes handling hazardous substances will be given hazard marking of 30 mm wide diagonal stripes of Black and Golden Yellow as per IS : 2379.

10.4 Identification Markings on Equipment / Piping

Equipment tag Numbers & piping line number shall be Stenciled / neatly painted using normal 'Arial' Lettering Style on all equipment and piping (Both insulated & uninsulated) after completion of all paint works. Lettering colour shall be either BLACK or WHITE, depending upon the background, so as to obtain good contrast.

Operations Group shall specify location.

Sizes shall be:

Columns, Vessels, Heaters:	150 mm
Pumps and other M/c	50 mm
Piping	OD / 2 with Maximum 100 MM.
Storage Tanks	(As per Drawings)

10.5 Colour Coding for Control Valve

a) Carbon steel body - Light grey
Alloy steel body - Canary yellow
Stainless steel body - Natural

b) The actuator of the Control valve shall be painted as :

Direct action (open on air failure) valves - Green
Reverse acting (close on air failure) valves - Red

The painting Status shall be comprehensively updated every 6 months for compliance

Copyright EIL – All rights reserved

10.6 Colour Coding for Structural & Others

Sl No	Item	Color
1	Pipe rack structural	Dark Admiralty Grey
2	Chequered Plate (Both faces)	Black
3	Grating	Black
4	Ladder Rungs & Railing Vertical Posts	Black
5	Hand Rail, Middle rail, Toe Plate	Golden yellow
6	Ladder Vertical Posts	Golden yellow
7	Building Structural, Steel Columns, brackets, beams, bracings, roof trusses, purling, side grits, louvers, stringers	Dark Admiralty Grey
8	Overhead Monorail	Signal Red
9	Gantry Girder & Monorail	Dark Green
10	Monorail Stopper Plates	Signal Red.
12	EOT / HOT Cranes	Canary Yellow
13	Transformers, & Battery room structural	Dark Admiralty Grey
14	Electrical Motors	Dark Blue

11.0 PAINTING FOR CIVIL DEFENCE REQUIREMENTS

Following items shall be painted for camouflaging if required by the OWNER.

a. All Columns
b. All tanks in Offsite
c. Large Vessels
d. Spheres

Two coats of selected finishing paint as per defense requirement shall be applied in a particular pattern as explained below and as per the instructions of Engineer-In-Charge.

Method of Camouflaging

Disruptive painting for camouflaging shall be done in three colours in the ratio of 5:3:2 (all matte finish).

Dark Green		Light Green		Dark Medium Brown
5	:	3	:	2

11.1 The patches should be asymmetrical and irregular.

11.2 The patches should be inclined at 30º to 60º to the horizontal.

11.3 The patches should be continuous where two surfaces meet at an angle.

11.4 The patches should not coincide with corners.

11.5 Slits and holes shall be painted in dark green shades.

11.6 Width of patches should be 1 to 2 meters.

Copyright EIL – All rights reserved

12.0 SELECTION OF PAINTING MATERIALS

Paint manufacturers are expected to conduct periodic evaluation/testing of products including long term performance tests which shall include following

-Resistance to Moisture vapour permeability for 2000h (ASTM 2247)
-Cyclic tests for 4200h (ISO7253 & ASTM D 5894-10)
-Resistance to DM water immersion (ASTM D870)
- Chemical Resistance test, ASTM D 1308/D 543/DIN 50905 Part4
-Water vapor transmission, ASTM D1653 & test method B section A -wet cup method, 3 weeks duration

Contractor shall submit MAR (Material Approval Request) along with datasheets, MSDS, relevant information and Test results as indicated below including test results of long term tests for all paint products against system indicated for approval.

Test	Test Method
Specific gravity	ASTM D 1475
Dipping properties	ASTM D 823
Film characteristics	-
Solids content by weight	ASTM D 2369
Drying time	ASTM D 1640
Flexibility	ASTM D 1737/ D 522
Hardness	ASTM D 3363
Adhesion	ASTM D 2197
Abrasion resistance	ASTM D 968/ D 1044
DFT/coat	As per SSPC guidelines
Storage Stability	ASTM D 1849
100% Humidity test, duration 2000 hrs,	ASTM D 2247
% Zn in Dry film for Inorganic Zinc Silicate primer	ASTM D 521
Chemical Resistance test - 10% & 40% NaOH (applicable only for F-6A F-6C,F-7, F-14, F-15 and F-17) - 10% H_2SO_4 (applicable only for F-6A F-6C,F-7, F-14, F-15 and F-17) - 10 % Nitric Acid test (applicable only for F-15 and F-17) - Xylene, Acetone, Ethanol, Kerosine (applicable only for F-6A, F-6C, F-9, F-15 and F-17) - Sea water (applicable only for F-6A, F-6C, F-7, F-14, F-15, F-17) - 5% Ammonium sulphate and 5% Ferric Chloride(applicable only for F-6A, F-6C, F-7, F-8, F-13, F-14, F-17) - Glacial acetic acid (applicable only for F-15 and F-17) - MIBK test (applicable only for F-2, F-6 A/B/C, F-8, F-9, F-15 and F-17)	ASTM D 543

Copyright EIL – All rights reserved

Cyclic Test for the duration of 4200 h Salt spray: 72h;Drying in air:16 h; UV-A 340 nm weatherometer: 80 h One cycle: 168 h (25 cycles at 168 hours each cycle) (Applicable for all except P2, F16, F11, F12, F14)	ISO 7253, ASTM 5894
Resistance to water immersion (applicable only for F11, F12, F15, F16, F17)	ASTM D 870
Dry Heat Resistance test (Method B-applicable only for F-9,F11,F12,F15,F16,F17) (Method A- applicable only for P6, F2,F-6A/B/C,F7,F14)	ASTM D 2485
Water vapor transmission, & test method B section A -wet cup method, 3 weeks duration (applicable only for F9, F11, F12, F16)	ASTM D 1653
Thermal shock resistance test (only for F-9, F-6, poly-siloxane)	ASTM D 2485 - 91

The contractor shall be fully responsible for the quality of the paints meeting technical requirements of the products as per approved datasheets. Along with the delivery of the paint products, the contractor shall furnish batch wise test report from the manufacturer.
Once the paint material is supplied to site, In addition to the quality control system as specified in section 13.0, for each product, the supplier shall organize random sampling and testing in a *third party laboratory* as per discretion of the Engineer-in-charge. Failing to meet the specified quality requirements may cause rejection of the paint products.

13.0 QUALITY CONTROL, INSPECTION AND TESTING

13.1 All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable (see section 12.0).

The painting work shall be subject to inspection by Engineer-In-Charge at all times. In particular, following stage-wise inspection will be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection are as follows:

(a) Surface preparation
(b) Primer application
(c) Each coat of paint

13.2 during surface preparation, following tests are to be carried out:

- Test for presence of oil/grease and contamination

The steel substrate after degreasing as per SSPC-SP 1 shall be tested as per following procedure to validate absence of oil and grease contamination.

a) Visual inspection - Continue degreasing until all visible signs of contamination are removed.

Copyright EIL – All rights reserved

b) Conduct a solvent evaporation test by applying several drops or a small splash of residue-free tri-chloromethane on the suspect area especially pitting, crevice corrosion areas or depressed areas. An evaporation ring formation is indicative of oil and grease contamination.

Continue degreasing and inspection till test is passed.

- Tests for surface finish of blasted surface shall be done by visual inspection using SSPC-VIS1. Clear cellophane tape test as per ISO 8502-3 shall be used to confirm absence of dust on blasted surface. Checks shall be done on each component at least once per 200 m^2 of blasted surface and minimum of 3 checks per shift.
- Test for presence of soluble salt as per method ISO 8502-9. Maximum allowable salt content shall be considered 20 mg/m^2 (2 mg/cm^2). Checks shall be done on each component at least once per 200 m^2 of blasted surface and minimum of 3 checks per shift. In case salt exceeds specified limit, the contaminated surface shall be cleaned by method as per Annexure-C of IS 12944-4 (water cleaning). After cleaning surface shall be retested for salt after drying.

- Blast Profile Measurement:

The angular profile depth measurement shall be done by profile tape as per method NACE Standard RP 0287 or ASTM D 4417 method B (Profile depth gauge micrometer). Spot measurement shall be carried out every 15m2 of blasted surface. At each spot three measurements shall be taken over an area of 10 cm2 and average of measurements to be recorded and reported.

If profile is <65 microns blasting shall continue till greater than 65 microns depth profile is achieved.

- Tests for blasting media, blasting air

Blasting Media (For every fresh batch of media and one random test during blasting)

Blasting Media shall be visually inspected for absence of contamination and debris using 10 X magnification.

a) Inspection for the absence of oil contamination shall be conducted using following procedure:

- Fill a small clean 200 ml bottle half full of abrasive.

- Fill the bottle with potable water, cap and shake the bottle.

- Inspect water for oil film/slick. If present, the blasting media is not to be used.

b) Soluble salt contamination if suspected shall be verified by method ASTM D 4940. If present, media to be replaced.

c) Clean blasting equipment, especially pot and hoses, and then replace blasting media and retest.

Test for Blasting Air (Once Daily before start of blasting and once at random during blasting)

The air for blasting shall be free from moisture and oil. The compressor air shall be checked for oil and water contamination per ASTM D 4285.

In addition to above, record should include type of shop primer already applied on equipment e.g. zinc silicate, or zinc rich epoxy, or zinc phosphate.

Copyright EIL – All rights reserved

Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of Engineer-In-Charge before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work, contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to owner, the extra coat should have prior approval of Engineer-in-charge.

13.3 Primer Application

After surface preparation, the primer should be applied to cover the crevices, corners, sharp edges etc. in the presence of inspector nominated by Engineer-In-Charge.
The shades of successive coats should be slightly different in colour in order to ensure application of individual coats, the thickness of each coat and complete coverage should be checked as per provision of this specification. This should be approved by Engineer-In-Charge before application of successive coats.
The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Dry film thickness of each coat, surface profile, gauge for checking of surface profile in case of sand blasting. Holiday detectors and pinhole detector & protector whenever required for checking in case of immersion conditions.

Prior to application of paints on surfaces of chimneys, the thickness of the individual coat shall be checked by application of each coat of same paint on M.S.test panel. The thickness of paint on test panels shall be determined by using gauge such as 'Elko meter'. The thickness of each coat shall be checked as per provision of this specification. This shall be approved by Engineer-In-Charge before application of paints on surface of chimney.

At the discretion of Engineer-In-Charge, the paint manufacturer must provide the expert technical service at site as and when required. This service should be free of cost and without any obligation to the owner, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations. The contractor is responsible to arrange the same.

13.4 Final inspection of finished coating shall consist of measurement of:

1) Paint dry film thickness (DFT)
2) Adhesion
3) Holiday detection check as well as for finish and workmanship.

1) **Coating DFT** measurement shall be as per ISO 2808. Type II electromagnetic gauges should be used for ferrous substrates. DFT gauge calibration, number of measurement shall be as per SSPC-DA 2. Measured DFT shall be within + 10% of the dry film thickness, specified in the specifications.

2) **Adhesion** of the primer to the steel substrate and intercoat adhesion of the subsequent coat(s) after curing for at least a week after application of the topcoat shall be examined by a knife test in accordance with ASTM D 6677. For the knife test, if the rating is better than 8, the adhesion is considered acceptable. The adhesion is destructive and tested areas shall

Copyright EIL – All rights reserved

be repaired afterward using the spot repair procedure. Alternatively, the applicator may perform the adhesion test on a steel panel coated using the same surface preparation and coating application procedure as the work piece. Adhesion testing shall be carried out for each component at least once per 200 m^2 (2000 ft^2) of coated surface.

3) **Holiday testing** shall be conducted in accordance with NACE SP 0188. For immersion services, 100% of coated area shall be inspected for holidays. For atmospheric exposure, 10% of coated area which must include weld seams, corners and edges to be holiday tested. Voltage at which test is to be carried out will depend upon DFT of coating being tested and shall be as per NACE SP 0188. Any holiday is unacceptable and should be marked and repaired immediately.

The contractor shall arrange for spot checking of paint materials for Specific gravity, glow time (ford cup) and spreading rate.

13.5 Final Inspection of coating system

A final inspection shall be conducted prior to the acceptance of the work. The coating contractor and the facility owner shall both be present and they shall sign an agreed inspection report. Such reports shall include:

General

- Names of the coating contractor and the responsible personnel
- Dates when work was performed

Coating Materials

- Information on coating materials being applied
- Condition of coating materials received

Environmental Conditions

- Weather and ambient conditions
- Coating periods

Surface Preparation

- Condition of surface before preparation
- Tools and methods used to prepare surface
- Condition of surface after preparation

Coating Application

- Equipment used
- Mixing procedure prior to application
- Coating application techniques used

Testing

- Type and calibration of inspection instruments used
- Type of quality control tests performed, and results

14.0 GUARANTEE

The contractor shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein/to be provided during execution of work.

Copyright EIL – All rights reserved

.

ANNEXURE 1

(COATING SYSTEMS)

Copyright EIL – All rights reserved

TABLE 5.0

REPAIR OF PRE-ERECTION/PRE-FABRICATION OR SHOP PRIMER AFTER ERECTION/WELDING

Sl. No.	Design Temp. in °C	Surface Preparation	Coating System	Total DFT in Microns (min.)	Remarks
5.1	-90 to 400	SSPC-SP-3	1 coat of F-9	65-75	See note below and clause 5.9.3
5.2	401 to 550	SSPC-SP-3	1 coat of F-12	20-25	

NOTES:

The application and repair of pre-erection/pre-fabrication or Shop Primer given in above tables shall be done for all the items to be painted. In case the damages to primer are severe and spread over large area, entire primer shall be removed by blasting to achieve SSPC-SP-10 and surfaces to be primed again with F-9 or F-12 as applicable.

Copyright EIL – All rights reserved

TABLE 6.0
COATING SYSTEM FOR OFFSITE AREAS OF INLAND PLANTS *

Sl. No.	Design Temp. °C	Surface Preparation & Pre-erection/Shop Primer	Coating System (Post-erection / Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
6.1	-90 to <-14	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	None	65-75	No over-coating over F-9 is allowed
6.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	1 coat of P-6 @40 µ	1 coat of F-6B@100 µ + 1 coat of F-2 @ 40µ DFT/coat	245-255	
6.3	81 to 250	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-11 @ 20µ DFT/coat; (2x20=40)	105-115	
6.4	251 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat (2x20=40)	105-115	
6.5	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20-25µ DFT/coat	None	2 coats of F-12 @20-25µ DFT/coat (2x20=40)	60-75	F-12 shall be ambient temperature curing type

*Flare line within unit or offsite areas shall be coated as per Sl.no.7.3 of Table 7.0

NOTES:

1 The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.

2 If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-Erection primer, if required, shall be done as per Table 5.0.

3 In case of coating systems as per Sl. Nos. 6.4 and 6.5, the color bands shall be applied over the Aluminum paint as per the Color coding requirement for specific service of piping given in Clause 9.0.

4 All coating system including surface preparation, primer, and finish coat for piping shall be done at field only.

Copyright EIL – All rights reserved

TABLE 7.0

COATING SYSTEM FOR

- Areas of Process units, Bagging plants, Conveyor belts, Urea silo, Urea transfer towers, DM, CPP & COOLING TOWER etc. OF **INLAND PLANTS**
- ALL AREAS (PROCESS UNIT, OFFSITE, DM, CPP, etc.) OF **COASTAL PLANTS**

For external surfaces of un-insulted structures, piping, equipment, columns, vessels, pumps, compressors, blowers, etc of CS, LTCS & alloy steels

Sl. No.	Design Temp. °C	Surface Preparation & Pre-erection/Shop Primer	Coating System (Post-erection / Field)		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
Carbon steel, LTCS, Alloy and Low alloy steels						
7.1	-90 to < -14	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	None	65-75	**a)** No over coating on F-9 is allowed **b)** F-12 shall be ambient temperature curing type **c) Finish coat including primer compatible with finish coat (i.e. field primer) shall be applied at site only. Finish coating is not permitted at equipment manufacture shop.**
7.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	1 coat of P-6 @ 40 µ DFT/coat	2 coats of F-6B @ 100 µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat; (2x100 + 40= 240)	345-355	
7.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat 2x20=40	105-115	
7.4	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20-25µ DFT/coat	None	2 coats of F-12 @ 20-25µ DFT/coat; (2x20=40)	60-75	
Stainless Steel Piping, Flanges, Valves & Equipments						
7.4	Up to 200	Sweep blasting/Light Blast clean as per grade Sa-1.0, of Swedish Standards SIS-05-5900 (Latest)	1 coat of F-15 @ 75 µ DFT/ coat	2 coats of F-15 @ 75 µ DFT/ coat t + 1 coat of F-2 @ 40-50 µ	265	

Copyright EIL – All rights reserved

NOTES:

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.

2. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 5.0.

3. For external surface of RCC Chimney, 2 coats of F-6B @ 100µ DFT/coat to obtain total DFT of 200 µ shall be applied after proper surface preparation as per guidelines in clause 5.1.6.

4. In case of paint systems as per Sl. Nos. 7.3 and 7.4, the colour bands shall be applied over the Aluminum paint as per the Color coding requirement for specific service of piping given in Clause 9.0.

5. All coating system including surface preparation, primer, finish coat for piping shall be done at site/field only.

Copyright EIL – All rights reserved

TABLE 8.0
COATING SYSTEM FOR EFFLUENT TREATMENT PLANT (ETP)

Sl. No.	Design Temp. in °C	Surface Preparation	Coating System		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
8.1	For External Surfaces of C.S./M.S. items: Screens, Walk way bridges, Baffles, Dual media filters, Vertical pumps, piping in treated effluent sump, bio sludge pump, Screw pump and pump house, CS tanks, sumps and vessels.					
	-14 to 80	SSPS-SP-10	1 coat of F-9 @ 65-75µ DFT/coat	2 coats of F-6A @100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat; (2x100+40=240)	305-315	-
8.2	For Internal Surfaces of CS/MS Items: Bio-sludge sump, Filter feed sump, Process sump, Sanitary sump, Transfer sump, Sludge, Slop oil tank, scrapping mechanism in Clarifier					
	-14 to 80	SSPS-SP-10	1 coat of F-9 @ 65-75µ DFT/coat.	3 coats of F-6A @100µ DFT/coat (3x100=300)	365-375	Note:1
8.3	All R.C.C./concrete surfaces exposed to effluent water / liquid such as tanks, structures, drains etc. in Process sump, TPI separator (Process and Oil), Aeration Tank and Transfer sump etc.					
	-14 to 80	Blast cleaning to SSPC-SP guide lines and Acid etching with 10-15% HCl acid followed by thorough water washing.	Epoxy Screed lining		3mm	Epoxy screed lining shall be applied as per specific manufacturer and Engineer-in-Charge instructions and shall be suitable for urea and HC service.
8.4	C.S/M.S Dual media filters (Internal), SSF (internal,) Chemical dosing tanks(internal) such as Di-Ammonium Phosphate (DAP), Ammonia and Urea					
	Up to 60	SSPC-SP-10	Natural Rubber Lining (As per IS 4682, Part 1)		4.5mm	Natural Rubber lining shall be applied as per specific manufacturer recommendations and Engineer-in-Charge instructions Note-2

NOTES

1. The paint /coating manufacturers shall provide their Quality control test certificate of coating materials (F-6A) for immersion service of the exposed effluent given in 8.2.
2. Supplier shall ensure that, Natural rubber lining is suitable for urea, Ammonia, and hydrocarbon service.

Copyright EIL – All rights reserved

TABLE 9.0

EXTERNAL COATING SYSTEMS FOR UNINSULATED CARBON STEEL AND LOW ALLOY STEEL STORAGE TANKS

Sl. No.	Design Temp. °C	Surface Preparation	Coating system [1]		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
9.1	All external surfaces of shell, wind girders, appurtenances, roof tops of all above ground tank including top side of external and internal floating roof and associated external structural works.					
9.1.1	-14 to 80	SSPC-SP-10	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat ;	2 coats of F-6B @ 100µ DFT /coat + 1 coat of F-2 @ 40µ DFT/ coat;	345-355	F-6 should be suitable for occasional water immersion
9.1.2	81 to 150	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat + 1 coat of F-15 intermediate coat @ 80µ DFT/coat ;	1 coat of F-15 finish coat @80µ DFT/ coat + 1coat of F-2 @ 40µ DFT/ coat;	280	-
9.1.3	151 to 500	SSPC-SP-10	1coat of F-9 @ 65-75µ DFT/coat	2 coats of F-12 @20 µ DFT/ coat Or 1 coat of F-16 @ 50 µ DFT / coat	105 or 115	-
9.2	External surfaces of bottom plate (soil side) for all storage tanks.					
9.2.1	-14 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75µ DFT/ coat	3 coats of F-7@ 100µ DFT/coat (3x100=300)	365-375	F-7 should be suitable for immersion service of the products given
9.2.2	81 to 150	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat + 1 coat of F-15 intermediate coat @ 80µ DFT/coat ; (80+80=160)	1 coat of F-15 finish coat @ 80µ DFT/ coat	240	-
9.2.3	151 to 550	SSPC-SP-10	1 coat of F-16 @ 125 µ DFT /coat	1 coat of F-16 @ 125 µ DFT /coat	250	-
9.3	For underside of the bottom plate (in case tank is not lifted during PWHT) (see Note 2c)					
	-180 to 650	For CS SSPC SP-6 Commercial Blast	1 coat of inert polymeric matrix coating @ 125 µ	2 coats of inert polymeric matrix coating @ 125 µ	350-400	

Copyright EIL – All rights reserved

		For SS SSPC SP-1 with non-chloride solvent				

NOTES

1. All paint coating application including primer for tankage shall be carried out at field after erection and completion of all welding.
2. For underside of bottom plate :
   a) Painting shall be carried out before laying of bottom plate for tanks with Non-Post Weld Heat Treatment (PWHT).
   b) For tanks with PWHT, painting shall be carried out after PWHT.
   c) In case tank is not lifted during PWHT then painting shall be applied before laying of bottom plate, Sl.no. 9.3 shall be followed.

Caution: PWHT temperature shall not exceed 650°C.

Copyright EIL – All rights reserved

TABLE 10.0

INTERNAL COATING SYSTEMS FOR CARBON STEEL AND LOW ALLOY STORAGE TANKS

Sl. No.	Design Temp °C	Surface Preparation	Coating system [1]		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
10. 1	**PETROLEUM PRODUCTS & INTERMEDIATES, NAPHTHA, ISOMERATE AND KEROSENE.** Underside of Floating roofs, internal surface of cone roof, inside of bottom plate, internal surfaces of Bare shell for full height, underside of floating roof, oil side surfaces of deck plates, oil side surfaces of pontoons, support structures and ladders etc.					
10.1.1	-14 to 45	SSPC-SP-10	1 coat of F-9 @ 75 µ DFT/coat	-	75	Note 2
10.1.2	46 to 90	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat;	240-300	-
10.2	**POTABLE, RAW & FIRE WATER** All internal surfaces, accessories and roof structures of Cone and Dome roof tanks					
10.2.1	-14 to 60	SSPC-SP-10	1 Coats of P-6 @ 100 µ DFT/coat;	2 Coats of F-6A @ 100µ DFT/ Coat; (2x100=200)	300-350	Note-4
10.3	**DM WATER & CONDENSATES** All internal surfaces, accessories and roof structures of Cone and Dome roof tanks					
10.4.1	-14 to 60	SSPC-SP-10	1 Coats of P-6 @ 100µ DFT/coat;	2 coats of F-6C @ 200µ DFT/ coat; (2x200=400)	400-450	-
10.4.2	61 to 100	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat; (80+80=160)	240-300	-
10.5	**HYDROCHLORIC ACID (HCl) 10 %** All internal surfaces, accessories and roof structures of Cone and Dome roof tanks					
	-14 to 60	SSPC-SP-10	None	Natural Rubber Lining	4.5 mm	-
10.6	**AGGRESSIVE SOLVENTS LIKE HEXANE, HEXENE, BENZENE, XYLENE AND TOLUENE** All internal surfaces, accessories and roof structures of Cone and Dome roof tanks					
	-14 to 65	SSPC-SP-10	1 coat of F-9 @ 75µ DFT/ coat	---	75	-
10.7	**ETHYLENE GLYCOL (EG) TANKS** Internal shell-full height, bottom plate, underside of roof and all accessories					

Copyright EIL – All rights reserved

	All	SSPC-SP-10	None	3 coats of vinyl chloride co-polymer @ 75µ /Coat; (3x75=225)	225	-
10.8	**Inside pontoon and inside of double deck of all floating roofs**					
	-14 to 80	SSPC-SP-3	1 coat of F-8 @ 100µ DFT/coat	1 coat of F-8 @ 100µ DFT/coat	200	-
10.9	**WET SLOPS, AMINE solutions, SOUR WATER , WATER DRAW OFF** All internal surfaces, accessories and roof structures of Cone and Dome roof tanks					
10.9.1	-14 to 90	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat; (80+80=160)	240	-
10.10	**VACUUM RESIDUE, FUEL OIL , DRY SLOP, BITUMEN AND OTHER HIGH TEMPERATURE HYDROCARBON LIQUIDS** Underside of floating roof, internal surface of cone roof, bottom plate, inside of bare shell – including wetted and non wetted surfaces, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel and ladders					
	Up to 150°C	SSPC-SP-10	1 coat of F-17 primer @ 125µ DFT/ coat	1 coat of F-17 intermediate coat @ 125µ DFT/coat + 1 coat of F-17 finish coat @125µ DFT/ coat; (125+125=250)	375	Note:3
10.11	**ALKALIS UP TO 50 % CONCENTRATION** All internal surfaces, accessories and roof structures of Cone and Dome roof tanks					
10.11.1	Up to 60°C	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	2 Coats of F-6 A @ 100µ DFT/coat; (2x100=200)	280-100	-

NOTES

1. All paint coating application including primer shall be carried out after erection and completion of all welding work at site.
2. F-6A should be suitable and resistant for immersion service for the respective service.
3. This system can be used where maximum operating temperature is below 150°C and design temperature is up to 200°C. For operating temperatures >150 °C, contractor shall propose suitable coating system for review/approval by owner/PMC.

4 F-6 A shall be suitable for drinking water service and should have competent authority certification.

Copyright EIL – All rights reserved

TABLE 11.0
COATING SYSTEMS FOR EXTERNAL SIDE OF UNDERGROUND CARBON STEEL PLANT PIPING AND UNDERGROUND VESSELS

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating system (Field)[1]		Total Final DFT in Microns (min.)	Remarks
			Surface Preparation & Primer	Finish Coat		
11.1	**Underground carbon steel plant piping**					
11.1.1	25 to 65	---	SSPC-SP-10; 1 coat of synthetic fast drying primer 25 @µ DFT/ coat	1 layer of coaltar tape coating @ 2mm +1 coat of synthetic fast drying primer 25 @µ DFT/ coat + 1 layer of coal tar tape coating @ 2mm /layer as per EIL Standard Specification .No 6-79-0011	4 mm	The primer DFT is not measurable. Reconciliation primer shall be done by coverage of maximum 10 sq.m/litre
11.1.2	66 to 150	---	SSPC-SP-10; 1 coat of F-17 primer @ 125µ DFT/ coat	1 coat of F-17 intermediate coat @ 125µ DFT/coat + 1 coat of F-17 finish coat @125µ DFT/ coat	375	-
11.1.3	151 to 400	---	SSPC-SP-10; 1 coat of F-16 primer @ 125µ DFT/ coat	1 coat of F-16 finish coat @125µ DFT/ coat	250	-
11.2	**External side of un-insulated underground storage vessels**					
11.2.1	-40 to 80	SSPC-SP-10; 1 coat of F-9 @ 65-75µ DFT/ coat	---	3 coats of F-7 @ 100µ DFT/coat	365-375	-
11.2.2	81 to 150	SSPC-SP-10; 1 coat of F-17 primer @ 125µ DFT/ coat	---	1 coat of F-17 intermediate coat @ 125µ DFT/coat + 1 coat of F-17 finish coat @125µ DFT/ coat	375	-
11.2.3	151 to 400	SSPC-SP-10; 1 coat of F-16 primer @ 125µ DFT/ coat	---	1 coat of F-16 finish coat @125µ DFT/ coat	250	-

1 Application of Primer & field paint shall be in accordance with applicable SOR/MR/PRs.

Copyright EIL – All rights reserved

TABLE 12.0
PAINTING UNDER INSULATION (ALL ENVIRONMENTS)

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)[3]		Total Final DFT in Microns (min.)
			Primer	Finish paint	
12.1	**Carbon steel, LTCS and low allow steel Piping, Storage tanks, equipments etc**				
12.1.1	-45 to 125	SSPC-SP-10; 1coat of F-9 @ 75µ DFT/coat	None	3 coats of F-15 @ 75µ DFT/coat	305- 315
12.1.2	126 to 400	SSPC-SP-10; 1coat of F-9 @ 75µ DFT/coat for up to 400 °C 1 coat of F-12 @20µ DFT/coat for 400-450 °C	None	3 coats of F-12 @ 20µ DFT/coat	125-135
12.2	**Stainless Steel, Alloy Steel, Alloy-20 Piping & Equipments (Note:2)**				
12.2.1	-30 to 125	Sweep blasting/Light Blast clean as per grade Sa-1.0, of Swedish Standards SIS-05-5900 (Latest) (15-25µ surface profile) 1 coat of F-15@ 80 µ DFT/coat	None	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/coat; (80+80=160)	240
12.2.2	126 to 500	1 coat of F-16@ 125µ DFT/coat	None	1 coat of F-16@ 125µ DFT/coat	250
12.2.3	>500	Painting, if any, shall be as per required for insulation system suitable for exposure temperature	---	---	---
12.3	**Cyclic service of SS, Alloy Steel & CS and LTCS, SS & alloy steels under cold insulation**				
	-180 to 350	SSPC-SP-10 Inert polymeric matrix coating*@ 125µ DFT/coat for SS sweep blasting/Light Blast clean as per grade Sa-1.0, of Swedish Standards SIS-05-5900 (Latest) (15-25µ surface profile)	none	Inert polymer matrix coating* @ 125µ DFT/coat	250

* Alternatively Thermally Sprayed Aluminium (TSA) is acceptable.
AMERCOAT 738/JOTATEMP-650 or equivalent is acceptable.

NOTES

1. The blast cleaning abrasives for SS and Alloy steel surfaces shall be SS grits/shots or Aluminium oxide grits/shots.
2. For piping with cyclic temperature of -45 to125 deg. C Sr.no 12.2.1 is applicable.
3. Application of Primer, field paint & repair shall be in accordance with applicable SOR/MR/PRs.

Copyright EIL – All rights reserved

TABLE 13.0

COATING SYSTEM FOR CARBON STEEL COMPONENTS OF COOLERS / CONDENSERS (INTERNAL PROTECTION) FOR WATER SERVICE

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating System (Post-erection / Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
13.1	Up to 80 °C	SSPC-SP-10	1 coat of F-15 @ 80µ DFT/coat	2 coats of F-15 @ 80µ DFT/coat	240	-
13.2	80 to 140	SSPC-SP-10	---	1 coat of Glass Fibre Reinforced Novolac epoxy of 1.5 mm DFT	1500	-

TABLE 14.0

COATING SYSTEM (INTERNAL PROTECTION) FOR GALVANIZED OR NON FERROUS OR STAINLESS STEEL/ DUPLEX STAINLESS STEEL COMPONENTS OF COOLERS/ CONDENSERS FOR WATER SERVICE

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating System (Post-erection / Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
14.1	Up to 80	Sweep Blasting	1 coat of F-15 @ 80µ DFT/coat;	1 coat of F-15 @ 80µ DFT/coat;	160	-
14.2	80 to 140	Sweep Blasting	---	1 coat of Glass Fibre Reinforced Novolac epoxy of 1.5 mm DFT	1500	-

Copyright EIL – All rights reserved

ANNEXURE 1

(COLOUR CODE-IS)

Copyright EIL – All rights reserved

Table 2: Colour Codes for Pipe Lines as per IS: 2379

Sr. No.	Service	Ground colour		First Band		Second Band	
		Colour	IS No.	Colour	IS No.	Colour	IS No.
1	Ammonia Gas/Liquid	Dark Violet	796	----	----	----	----
2	Nitrogen	Canary Yellow	309	Black		----	----
3	Synthesis	Canary Yellow	309	Signal Red	537	Black	
4	Carbon dioxide	Canary Yellow	309	Light Grey	631	----	----
5	Fuel Gas	Canary Yellow	309	Signal Red	537	White	
6	Hydrogen	Canary Yellow	309	Signal Red	537	French Blue	116
7	Process Gas	Canary Yellow	309	Signal Red	537	White	
8	Natural Gas	Canary Yellow	309	Signal Red	537	Light Grey	631
9	Process Air	Sky Blue	101	Signal Red	537	French Blue	116
10	Instrument Air	Sky Blue	101	----	----	----	----
11	Instrument Air Wet	Sky Blue	101	Signal Red	537	White	
12	Service Air	Sky Blue	101	Signal Red	537	Brilliant Green	
13	Cooling Water	Sea Green	217	French Blue	116	----	----
14	Service Water	Sea Green	217	French Blue	116	White	
15	Sweet Cooling Water	Sea Green	217	Black		----	----
16	Ammonia Water	Dark Violet	796	Canary Yellow	309	Light Grey	631
17	D.M. Water	Sea Green	217	Signal Red	537	----	----
18	Drinking Water	Sea Green	217	French Blue	116	Signal Red	537
19	Boiler Feed Water	Sea Green	217	----		----	----
20	Process Condensate	Sea Green	217	Canary Yellow	309	----	----
21	Steam Condensate	Sea Green	217	Canary Yellow	309	French Blue	116
22	Raw Water	Sea Green	217	White		----	----
23	Effluents Water	Sea Green	217	French Blue	116	Black	
24	Boiler Blow Down	Sea Green	217	Signal Red	537	French Blue	116
25	Steam Low Pressure	Silver Grey	628	French Blue	116	----	----
26	Steam Medium pressure	Silver Grey	628	White		----	----
27	Steam High Pressure	Silver Grey	628	Signal Red	537	----	----
28	Seal Oil	Light Brown	410	French Blue	116	----	----
29	Governor Oil	Light Brown	410	White		----	----
30	Lubrication Oil	Light Brown	410	Light Grey	631	----	----
31	HPC Mixture	Terra Cota	444			----	----
32	Hydrazine	Dark Violet	796	Canary Yellow	309	----	----
33	Phosphate	Dark Violet	796	Light Grey	631	Canary Yellow	309

and the reference unit shall have completed ONE year of operation at site as on the date of issue of enquiry.

In case all the above parameters are not available from single past reference, more than one reference can be cited / considered to satisfy the above qualification requirement, but not exceeding three references.

The vendor shall also furnish documentary evidence like copies of Purchase Order and Inspection Release Note (IRN) as an evidence of meeting the PTR requirement, based on which the qualification is sought. The vendor may also furnish additional documentation to justify meeting the PTR.

10.10. **ID/FD Fans**

10.10.1. ID/FD Fans shall meet the requirements as specified in Process Data Sheet, P&IDs, this Job specification & EIL Std. Spec. # 6-42-0003.

10.10.2. EQUIPMENT QUALIFICATION CRITERIA

10.10.3. The following criteria shall be applicable for acceptance of the offered Centrifugal Fan model and EQC requirements specified in “Standard Specification for Centrifugal Fans (Doc. # 6-42-0003)” and elsewhere in the tender shall be considered void.

The vendor shall furnish the filled in Experience Record Pro-forma (ERP) enclosed with the tender for the offered equipment model ensuring that the equipment shall be identical in terms of model and similar in terms of power rating, flow rates, differential pressure, operating pressure & temperature, gas handled, speed range, type of drive, impeller diameter, type of impeller blades, mechanical design, materials, etc. for at least ONE (1) unit designed, manufactured, tested and supplied from the proposed manufacturing plant and the reference unit shall have completed ONE year of operation at site as on the date of issue of enquiry.

In case all the above parameters are not available from single past reference, more than one reference can be cited / considered to satisfy the above qualification requirement, but not exceeding three references.

The vendor shall also furnish documentary evidence like copies of Purchase Order and Inspection Release Note (IRN) as an evidence of meeting the PTR requirement, based on which the qualification is sought. The vendor may also furnish additional documentation to justify meeting the PTR.

10.11. **Electrical**

10.11.1. All electrical items shall conform to the requirements of electrical specifications forming part of inquiry document.

10.12. **Instrumentation**

10.12.1. Vendor's scope of Instruments, controls, safety devices is detailed out in various data sheets, specifications & P&IDs. Vendor shall furnish all instrumentation and controls as specified and shall meet the requirements as detailed out in the instrument specifications, requirements as enclosed. Refer Instrumentation Specifications for complete details.

10.13. **Machine Condition Monitoring System**

Copyright EIL – All rights reserved

10.13.1. **Machine health monitoring through dedicated machine condition monitoring system:**

(a). Special Purpose Gear Units and Multi stage Centrifugal Pumps/HPRT (with forced feed lubrication) shall be provided with proximity probes/detector and monitors for measuring shaft radial vibration, axial position and bearing temperatures etc. Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.

(b). Special Purpose Gearbox shall be provided with accelerometer based probes/detector and monitors, for measuring vibration. Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.

10.13.2. **Machine health monitoring through PLC/DCS:**

Multi-stage Centrifugal Pumps (without forced feed lubrication) and Driver rating ≥ 160KW, General Purpose Gear Box (Driver rating ≥ 160KW) shall be provided with probes/detector for measuring vibration and bearing temperature. Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.

10.13.3. **Vibration monitoring Instrumentation:**

Vibration monitoring instrumentation shall be provided as follows:

(a). Hydrodynamic radial bearings with forced feed lubrication shall be fitted with X-Y proximity probes.
(b). Hydrodynamic thrust bearings shall be fitted with two numbers proximity type axial probes.
(c). A key-phasor is required for each speed change of the shaft system for hydrodynamic bearings.
(d). Casing mounted accelerometers(X & Y) shall be provided for special purpose gearboxes.
(e). Bearing housings with anti-friction bearings, for equipment's covered above, shall be fitted with accelerometers(X & Y).

10.13.4. **Temperature monitoring Instrumentation:**

Temperature monitoring instrumentation shall be provided as follows:

(a). Hydrodynamic radial bearings shall be fitted with at least two (2) temperature probes.
(b). Hydrodynamic thrust bearings shall be fitted with at least two (2) temperature probes each on active and inactive side.

10.13.5. All other process pumps, not covered in above shall have provision for mounting accelerometers (X & Y) on each bearing housing (Tapping size 1/4"- 28 tap set, minimum depth 6mm).

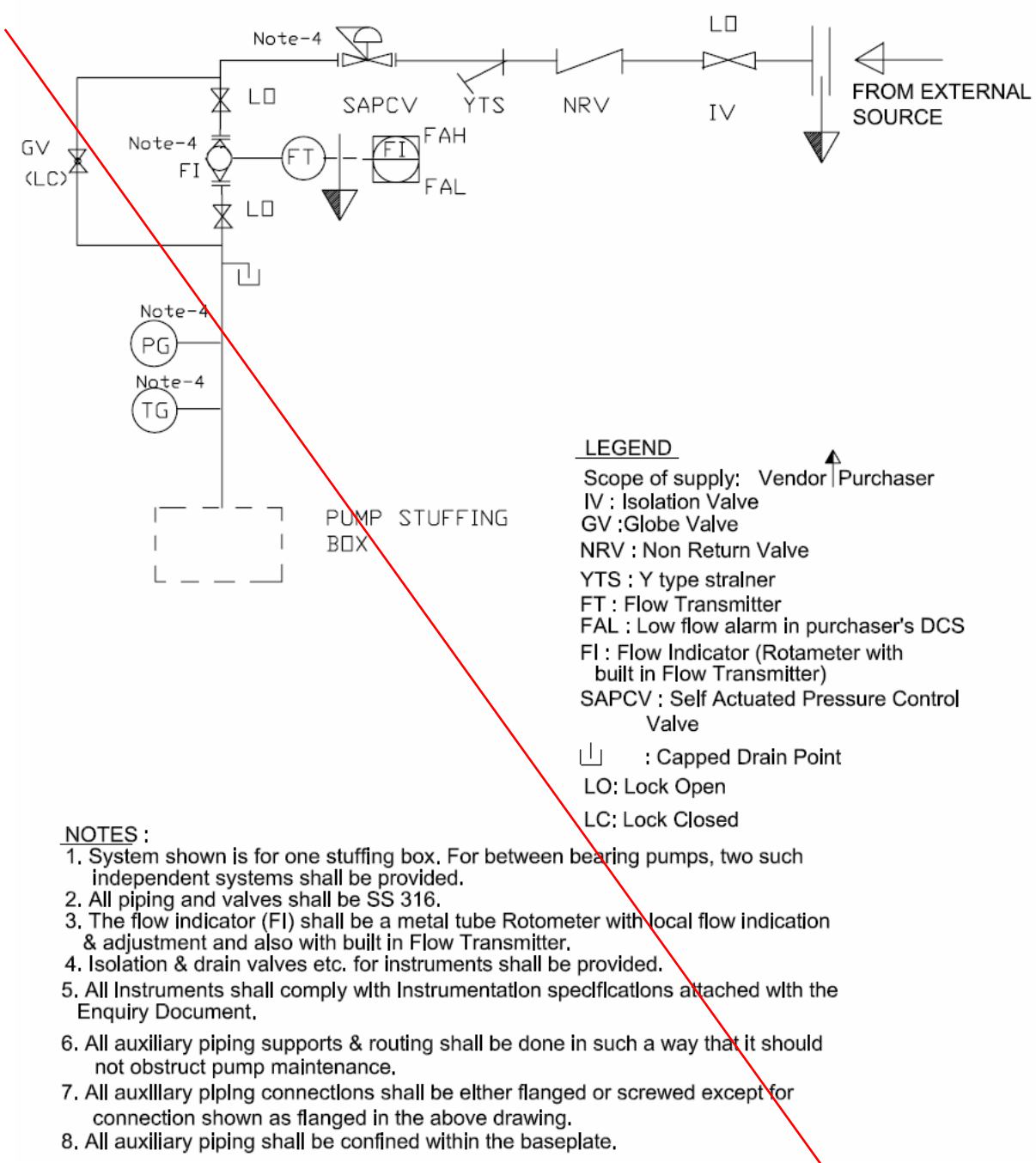
10.13.6. Instrumentation Data sheets, Instrumentation requirements & specifications and standards attached and referred to elsewhere in the bid package shall be referred for the purpose of Instrumentation requirements.

10.13.7. Instruments shall be from any one of the EIL approved makes only.

11. MATERIAL HANDLING EQUIPMENT

11.1. Equipment layout shall incorporate adequate maintenance platforms, support structures, hand rails, operational access, material handling facilities for inspection and maintenance

Copyright EIL – All rights reserved



NOTES :

1. System shown is for one stuffing box. For between bearing pumps, two such independent systems shall be provided.
2. All piping and valves shall be SS 316.
3. The flow indicator (FI) shall be a metal tube Rotometer with local flow indication & adjustment and also with built in Flow Transmitter.
4. Isolation & drain valves etc. for instruments shall be provided.
5. All Instruments shall comply with Instrumentation specifications attached with the Enquiry Document.
6. All auxiliary piping supports & routing shall be done in such a way that it should not obstruct pump maintenance.
7. All auxiliary piping connections shall be either flanged or screwed except for connection shown as flanged in the above drawing.
8. All auxiliary piping shall be confined within the baseplate.
9. Sealing system shall be designed for casing design pressure at design temperature.

Remark 1: Refer Instrumentation specification for details of instruments

27. **TABLE-1: MODIFICATIONS TO EIL STANDARD SPECIFICATION 6-41-0006 REV. 2**

Sl. No.	Clause No. of EIL Std. Spec. 6-41-0006	Page No.	Modifications

Copyright EIL – All rights reserved

1.0	Clause No. 5.5.1	Page 10 of 27	"Table 2-1A (2-1B)" shall be read as "Table-4".
2.0	Clause No. 5.8.1	Page 10 of 27	"Annexure-D of API 682" shall be read as "Annex-G of API 682 3rd edition".
3.0	Clause No. 7.3.1.1	Page 16 of 27	Shut-off head: Sl. no. b) "Negative Tolerance as per Table 4-2 of API 610 8th edition" shall be read as "Negative Tolerance as per Table-14 of API 610 10th edition".
4.0	Clause No. 7.3.1.4	Page 16 of 27	Sl. No. 1: "Hydrostatic test as per 4.3.2" shall be read as "Hydrostatic test as per 7.3.2".
			Sl. No. 2: "Performance test as per 4.3.3" shall be read as "Performance test as per 7.3.3".
			Sl. No. 3: "NPSHR test as per 4.3.4.1" shall be read as "NPSHR test as per 7.3.4.2".

Copyright EIL – All rights reserved

(h) All devices like vibration and axial displacement detection sensors shall be mounted for easy access for replacement with minimum replacement time.

(i) All auxiliary skids and associated items coming in the GTG package [(e.g. Fuel (gas) Conditioning Skids, water wash skid, water injection skid, etc.] shall be supplied by the vendor complete in all respect i.e. in ready to erect condition. Any item which is required to facilitate such arrangement, shall be in the GTG vendor's scope.

(j) Each skid shall be capable of being lifted, as a "Single lift" from both ends without causing deflections, which would result in permanent deformation of the skid or damage any of the equipment or affect the performance of the components and the package.

10.2.32. Equipment Layout & Piping Termination

(a) GTG set shall be installed in a generator house, which shall be ventilated adequately to meet the requirements of a safe area. Combustion, ventilation and cooling air shall be taken from outside the building and from a safe area and all the exhaust shall be ducted outside. The exhaust from bypass stack shall be at a suitable distance from the air inlet to prevent re-circulation of hot exhaust gases.

(b) Battery limit shall be as per P&IDs and Equipment Layout attached with inquiry document.

10.3. Centrifugal Pumps

10.3.1. All the centrifugal pumps envisaged in this package shall be categorized as "Centrifugal Pump (Special Purpose Process)" for the purpose of pump selection.

10.3.2. Centrifugal Pumps shall meet requirements as specified in the Process Data Sheet, P&IDs, this Job specification, API 610 10th edition, EIL Std. Spec. 6-41-0006 Rev. 2 and other Specification referred therein.

10.3.3. EQUIPMENT QUALIFICATION CRITERIA

10.3.4. The following criteria shall be applicable for acceptance of the offered Centrifugal Pump model and EQC requirements specified in "Standard Specification for Centrifugal Pumps (Special Purpose Process) (Doc. # 6-41-0006 Rev. 2) and elsewhere in the tender shall be considered void.

The vendor shall furnish the filled in Experience Record Proforma enclosed with the tender for the offered equipment model ensuring that the equipment shall be identical in Terms of Hydraulics and similar in terms of power rating, Inlet flow, Differential Head, Operating Pressure & Temperature, Pumping Liquid, Speed, Number & Type of Impeller, Mechanical Design, Materials etc. for at least ONE (1) unit designed, manufactured, tested and supplied from the proposed manufacturing plant and the reference unit completed ONE year of operation at site as on bid due date.

In case all the above parameters are not available from single past reference, more than one reference can be cited / considered to satisfy the above qualification requirement, but not exceeding three references.

The vendor shall also furnish documentary evidence like copies of Purchase Order and Inspection Release Note (IRN) as an evidence of meeting the PTR requirement, based

Copyright EIL – All rights reserved

on which the qualification is sought. The vendor may also furnish additional documentation to justify meeting the PTR.

10.3.5. For Seal flushing plans & auxiliary Pump Process piping (Casing Vent, Casing Drain and Balance line), the piping material shall be of SS 316 as a minimum. For cooling water plans, piping material shall be carbon steel.

10.3.6. Preferred Operating Region and Allowable Operating Region to be marked on the characteristic curve for each pump item. The rated and the normal operating points shall be marked on the characteristic curve. The rated flow shall not exceed 110% of pump capacity at best efficiency point (BEP).

10.3.7. Vendor shall indicate the values of thermal minimum continuous flow (MCF) & stable MCF on the pump data sheet(s).

10.3.8. Maximum allowable working pressure & temperature of the equipment shall not be less than the design pressure & temperature specified in the data sheet nor less than those specified in specifications, codes & standards. The pump casing shall also be suitable for operation at max. discharge pressure developed at pump minimum flow with sp. Gr. 1.0(i.e. water), this is required during shop performance test with water at rated speed.

10.3.9. Pumps shall be suitable to operate at its corresponding minimum continuous flow for prolonged duration. Pump minimum continuous flow shall not be higher than the Process Maximum and Normal flow.

10.3.10. The maximum permissible running clearances shall not be less than twice the running clearances as specified in API 610.

10.3.11. The standard performance envelope curves covering the maximum and minimum impeller sizes, for the offered model, NPSH Curve, Power Curve and efficiency curve at the offered speed of pump shall be furnished along with other data, drawings and documents as per specified VDR with the offer.

10.3.12. Refer EIL std. spec. # 7-44-0321 enclosed elsewhere, for location of seal plans & interfacing piping connections.

10.3.13. All auxiliary piping interface connection shall be terminated with flanged valve at the equipment battery limit (refer EIL Standard 7-44-0321). The purchaser shall provide/receive utilities (like water, air, N2 etc.) at single point inlet/outlet at the edge of base plate for seal cooler & bearing cooling. The terminating flanges at the skid edge shall be of 3/4"(minimum) size. Vendor shall provide sight flow glass at each CW outlet. Complete interconnecting piping from and/or to Purchaser's battery limit including Vent, flare, drain, utility piping (i.e. cooling water, instrument air etc) shall be in vendor's scope of supply.

10.3.14. Baseplates of all Machinery equipment shall have 8 nos. jack bolts for ease of alignment (4 nos. in Radial & 4 Nos. in Axial directions). For heavy motors, jack bolts shall also be provided for jacking the motors at bolting locations for inserting shims.

10.4. **Centrifugal Pumps (Multistage - more than 2 stages) – Additional Requirements**

10.4.1. Impeller of multistage centrifugal pumps shall also be positively locked against axial movement in the direction opposite to normal hydraulic thrust.

10.4.2. Number of stages shall not be more than 10 (Ten).

Copyright EIL – All rights reserved

10.4.3. Balance piston shall necessarily be provided for designs where all axial thrust is cumulative (i.e. all impellers facing the same direction) to reduce the axial thrust. Balancing Disc shall not be employed to balance thrust. Pump vendor shall provide pressure gauge & pressure relief valve in the Pump balance line. Balance off line shall be designed for casing MAWP.

10.4.4. In case it is recommended to connect this balance line to suction vessel (i.e. external balancing), quantity of flow being returned to suction vessel shall be indicated and shall be added to the rated flow of the pump. Correlation showing the extent of wear to balance line flow shall also be provided. Balance line shall utilize flange joints. Screwed connections are not allowed. Balance leak-off line shall be designed for casing MAWP. As a minimum, the Pump vendor shall supply Pressure relief valve, Pressure Gauge, Globe Valve, Non-Return Valve and orifice to be installed in the external balance line.

10.4.5. In addition to requirements as per Clause no. 1.8 of this Job Specification, Couplings for Multistage Centrifugal Pumps with forced feed lubrication or speed greater than 3000 RPM shall be as per API 671. In case of Gear-box driven multistage pumps, both low speed and high speed couplings shall be as per API 671. Coupling DBSE shall be more than the Seal Cartridge length and shall be sufficient for replacement of Mechanical Seals without disturbing the Pump and Driver from position.

10.4.6. Forced feed Lube-Oil system (as applicable) for Pumps:

(a). The lube oil system shall be as per Chapter 3 of API std. 614 with twin LO pumps, twin LO filters and twin LO coolers etc.

(b). The lube oil system shall be console type, mounted separately at adequate level difference from the main pump skid so as to ensure positive drain to tank of return lube oil and to maintain bearing oil temperature rise within the limits specified in applicable specifications & API standards.

(c). Each pump train shall be provided with independent lube Oil Console.

(d). The lube oil console shall be located adjacent to the main pump package skid.

(e). Twin lube oil coolers with on-line interchangeability shall be provided as per API 614, Chapter-3. The lube oil cooler shall be as per lube oil cooler data sheets, TEMA-C & specifications referenced therein. Filters & other pressure vessels included in lube oil system shall be as per ASME Sec. VIII Div.1.

(f). Heating arrangement for lube oil reservoir may be provided (if required). The minimum retention time for the reservoir sizing shall be 3 minutes based upon normal oil flow and total reservoir volume below the minimum operating level. Also the reservoir shall be sized to provide rundown capacity of at least 10% more than the amount of oil contained in all components, bearing housing and return oil piping of the L.O. system.

(g). Main lube oil pump shall be shaft driven. The standby lube oil pump shall be motor driven and shall be of identical performance characteristic as that of main LO pump. The LO pump capacity shall be based on maximum system usage plus a minimum of 10% and motor shall also be rated to operate at lowest ambient viscosity of oil of rated capacity.

(h). The standby lube oil pump shall be rotary positive displacement type, as per API 676.

(i). Alarms and shutdown system shall be installed with provisions for testing while the lubrication system remains in operation. Such testing shall be possible by an operator with the use of tools or test equipment provided by vendor.

Copyright EIL – All rights reserved

(j). All lube oil piping (supply & return) along with flanges, fittings & valves shall be SS 316 construction. Any tubing required shall be of SS-316 with compression type fittings of like material.

(k). Lube oil system shall have following additional instruments in vendor's scope.

- Lube oil reservoir shall have a Level Gauge & level transmitter with low level alarm indication in Main Control Panel (located near pump).
- High Pressure transmitter at upstream of check valve on main lube oil pump discharge line.
- High Temperature transmitter at downstream of cooler with alarm indication in Main Control Panel.
- Oil filter shall have High Differential pressure transmitter with alarm indication in Main Control Panel.
- Pressure indicator at lube oil inlet line of each bearing location.

(l). Vendor shall furnish duly filled in data sheets for lube oil pumps & lube oil coolers as attached, during detailed engineering stage.

10.4.7. Lateral Analysis/Torsional Analysis:

(a). Following information shall be furnished during detailed engineering for review:

- Dry Critical Speed
- 1st wet Critical Speed at 100 % design clearances.
- 1st wet Critical Speed at 200 % design clearances.

(b). Lateral analysis shall be performed as per the requirement of Clause 8.2.4.1 & Appendix-I of API 610, 10th edn.

(c). The pump vendor shall conduct a train torsional analysis of the complete pump package in case the pump package includes a Gear-box.

10.4.8. Gear-box (if required) for Centrifugal Multistage (more than Two stages) Pumps shall be as per API 613, 5th edition. Duly filled-in Datasheet for Gear-unit shall be furnished during detailed engineering (in case of an order).

10.4.9. Single and two-stage pumps operating at temperatures less than 150°C shall be suitable for instantaneous start-up from ambient to full operating temperature. For higher operating temperatures the vendor shall provide suitable hardware (i.e. piping, valves & fittings) & as part of the operating manual a suitable start-up procedure shall be provided. Any required monitoring equipment (i.e., skin thermo couples) to ensure that the pump, including seal(s), does not incur damage due to rapid heat up shall be supplied by pump vendor.

10.4.10. Baseplate drain shall be provided with 2" flanged connection.

10.4.11. For the bearing housings, a gate valve and a magnetic drain plug shall be provided for inspecting the oil level while the pump is running.

10.4.12. Contractor to ensure the installation of pressure gauge mounted on pump suction line for pressure indication.

10.4.13. The seal instruments used for seal plans shall be Wireless type and the same shall be connected to purchaser's DCS through wireless Gateways. For further details, refer Instrumentation specifications.

Copyright EIL – All rights reserved

10.4.14. All auxiliary piping interface connections shall be terminated with flanged valve at the equipment battery limit.

10.5. **MECHANICAL SEALS**

10.5.1. All pumps shall be provided with mechanical seals, unless specified otherwise. The type of mechanical seal (i.e. single or dual un-pressurized/pressurized) shall be as defined in the process package.

10.5.2. Vendor shall recommend Seal plans/systems based on their past experience for the intended service in each case. Seal type/selection shall be as per API 682 3rd edn. Any seal falling out side purview of API 682 shall be considered as engineered seal. Seal code as per API 682 3rd edn. shall be furnished on the respective pump data sheet along with the offer.

10.5.3. Stuffing Box Dimensions shall be as per API Standard 610, 10th edition (ISO:13709).

10.5.4. Seal Qualification tests (SQT) shall have been conducted on the proposed mechanical seal model(s) for standard API 682 seals.

10.5.5. In case, the offered mechanical seal is intended to be supplied by any of the subsidiaries of the principals of seal manufacturer, following requirements shall be met:

- For standard mechanical seals, for which SQT has been conducted by the principals, critical components such as Bellows, Springs and seal faces shall be sourced from their principals.
- For Engineered seals, the complete mechanical seal along with sleeve and gland plate shall be sourced from their principals. Seal drawings shall be from the principals or duly vetted by principals.

10.5.6. Any seal offered under "Engineered Seal" category or seals having high dynamic sealing pressures (>= 20 kg/cm2 G) shall undergo Seal Qualification Test (SQT):

(a). All seals installed in one pump per item / tag shall undergo SQT as per the following:

"Four hour static test, four hour dynamic test and one hour cyclic test with test fluid selection as per API 682 and test conditions commensurate with either API 682 test conditions or the conditions expected during operation in normal as well as start-up / shut-down conditions, whichever is more stringent. However for temperature, API limit of 260 degree C may be followed for testing."

(b). SQT certificates shall also be furnished as part of final documentation.

10.5.7. Mechanical seals to be suitable for maximum shut-off pressure under static conditions for pusher type seals. For Bellows seal, mechanical seal shall be suitable upto bellows design pressure, as a minimum. However, Mechanical Seal pressure casing components shall be designed for the Pump casing design pressure as a minimum.

10.5.8. Sealing Flushing Plans (Plan 23/32/52/53B, as applicable) (refer special Requirements for seal flushing Plans attached to this Job Specification):

(a). The complete sealing system along with instruments and all accessories shall be mounted/ installed on the pump base plate. In case of between bearing pumps there shall be two such independent units, one each for each stuffing box and both the system shall be mounted on the same side to allow for maintenance of the

Copyright EIL – All rights reserved

pump. Aux. Seals/Flushing Systems & Plans/Cooling Systems & Plans shall be as per API 682 requirements & also as per the attached specification requirements. The Vendor shall ensure that all seal flush plan piping & cooling piping shall be supplied as pre-fabricated. Such piping shall be pre-installed on the pump skid. If due to transportation limitations, such piping is required to be supplied as loose, the same shall be supplied as pre-fabricated along with all fasteners, bolts/studs, nuts gaskets & shall be properly match marked so that assembly at site can be done without requiring any field adjustment and / or welding at site.

(b). Vendor shall furnish recommended Buffer/Barrier Fluids for various pump items in their offer. Process compatibility of the recommended fluids shall be checked at purchaser's end and final Buffer Fluids shall be firmed up during detailed engineering stage. Special or synthetic buffer fluids shall not be recommended.

(c). The seal system temperature for seal plan 52 shall not exceed 70°C during normal operation.

(d). Instrumentation associated with Mechanical seal plan 52 shall be as per the Common Notes for Plan 52 and instrumentation specifications, data sheets etc.

(e). Vendor's scope of supply and the scheme for various seal plans shall be as per Sketch entitled: "Seal Flushing Plan 52".

(f). The complete sealing system along with instruments and all accessories shall be mounted / installed on the pump base plate.

(g). Refer "Special Requirements for Seal Flushing Plan 32/52/53B" at the last section of this job specification.

10.6. Positive Displacement Pump (Controlled Volume)

10.6.1. Pump shall meet the requirements as specified in Process Data Sheet, P&IDs, this Job specification & API 675, 2nd edition along with EIL Std. Spec. # 6-41-0021.

10.6.2. All controlled volume pumps (as per API 675) shall be hydraulically operated double diaphragm type with rupture detection system.

10.6.3. EQUIPMENT QUALIFICATION CRITERIA

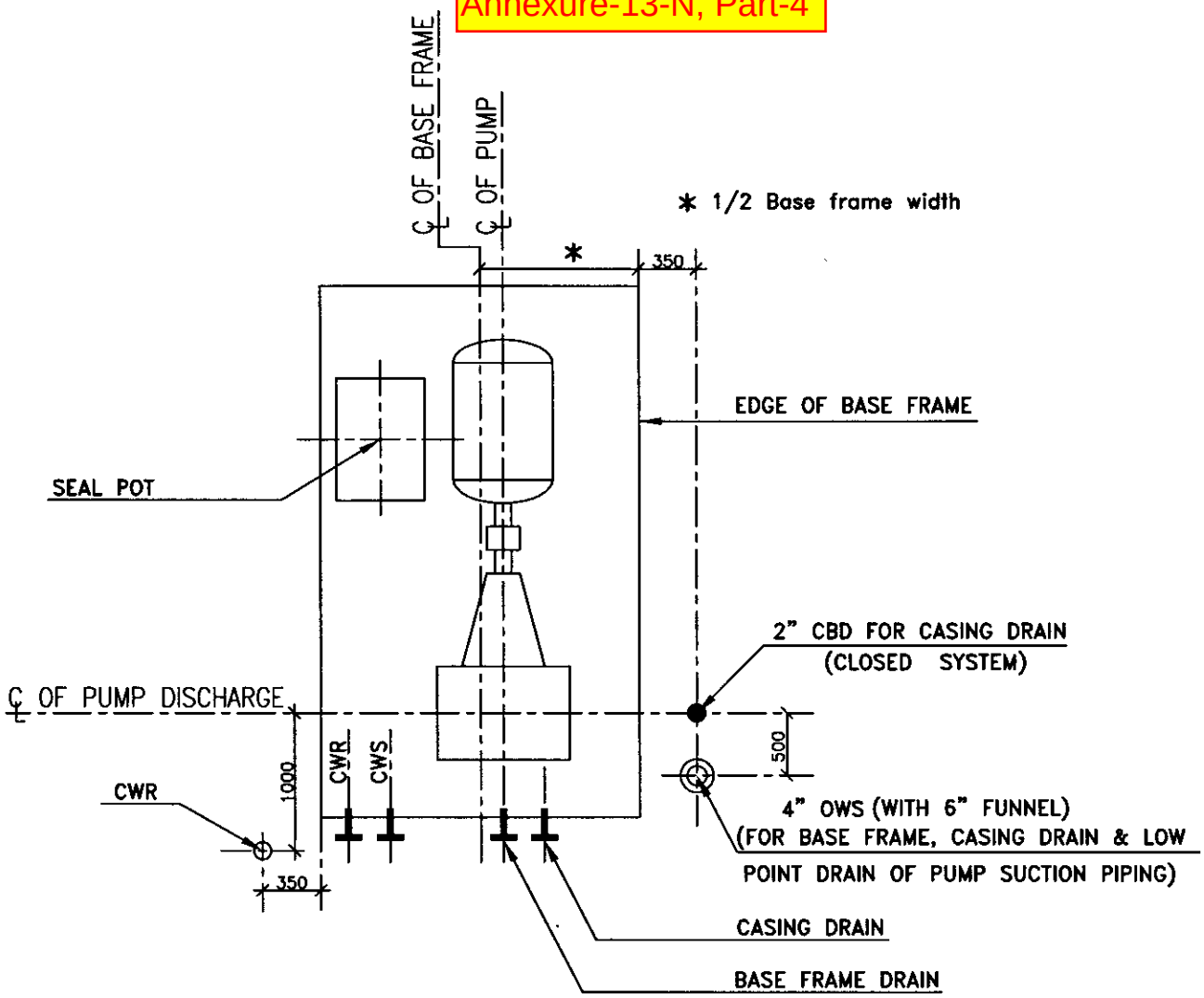
10.6.4. The following criteria shall be applicable for acceptance of the offered pump model and EQC requirements specified in "Standard Specification for Positive displacement Pumps (Controlled Volume) (Doc. # 6-41-0021)" and elsewhere in the tender shall be considered void.

The vendor shall furnish the filled in Experience Record Pro-forma (ERP) enclosed with the tender for the offered equipment model ensuring that the equipment shall be similar in terms of Power rating, Hydraulic Performance, Inlet flow, Differential Pressure, Operating Pressure & Temperature, Pumping Liquid, Speed, Number & Type of Pump Heads (i.e. Simplex/Duplex/Triplex etc.), Plunger/Diaphragm(Single/Double/Sandwitch), Mechanical Design, Materials etc. for at least ONE (1) unit designed, manufactured, tested and supplied from the proposed manufacturing plant and the reference unit shall have completed ONE year of operation at site as on the date of issue of enquiry.

In case all the above parameters are not available from single past reference, more than one reference can be cited / considered to satisfy the above qualification requirement, but not exceeding three references.

Copyright EIL – All rights reserved

Annexure-13-N, Part-4



APPLICABLE FOR PUMPS WITH

1. END SUCTION/TOP DISCHARGE
2. TOP SUCTION/TOP DISCHARGE
3. SIDE SUCTION/SIDE DISCHARGE

NOTES

1. Pump supplier to ensure that the locations / orientation of seal pot , Drain connections , CWS & CWR shall be as indicated in this drawing.
2. All dimensions are in mm, unless other wise specified.
3. Seal pot, CW supply/return, U/G points shall be mirror image for the pump tag nos identified during detail engineering, considering access/client requirements. Input shall be provided in MR.

LEGEND

- ● CBD : CLOSED BLOW DOWN
- ◎ OWS : OILY WATER SEWER
- CWS : COOLING WATER SUPPLY
- ○ CWR : COOLING WATER RETURN

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
1	30.03.15	REVISED & REISSUED AS STANDARD	RJ	AK	RN	ATD / SC
0	29.06.12	ISSUED AS STANDARD	TR	HC	ATD	DM

Approved by

Copyright EIL - All rights reserved

4.13.1 **Pressure Relief Valves** and Temp Relief Valves

4.13.1.1 All pressure relieving devices shall be designed in accordance with ASME code for 'Boilers and Pressure Vessels', API-521 and Indian Boiler Regulations. The pressure relief valve sizing shall be as per API 520. For mixed phase fluids, sizing shall be as per Leung-Omega method (or Diers) sizing shall be followed. The orifice sizing, area and designation, valve size and rating shall be as per API RP 526.

4.13.1.2 Pressure relief valves shall be full nozzle full lift type except for thermal relief valves.

4.13.1.3 Conventional valves shall be specified for constant back pressure while bellows seal type valves shall be specified for variable back pressure. Pilot operated pressure relief valves shall be used when Back pressure is greater than 50% of set pressure or when the difference between operating pressure and set pressure is within 10% of the set pressure.

4.13.1.4 Lifting lever shall be specified for steam, air or water above 65 degree service. Open bonnet shall be used for steam service.

4.13.1.5 The percentage accumulation in case of pressure relief valves/safety valves shall be as follows:

a)	Steam Service	
	- ASME SEC I(steam generation/consumption)	3%
	- IBR (Before steam let-down station)	5%
	- IBR (Distribution & utilities) and ASME Section VIII	10%
b)	Gas, Vapour or liquid for process service	10%
c)	Liquid for thermal Relief	25/ 10% (as per Process requirement)
d)	Fire exposure on unfired vessels	21%

4.13.1.6 3/4" x 1" threaded (NPT) modified nozzle type valves with typically 0.38 cm^2 orifice size shall be specified for thermal relief. However, if discharge is connected to flare or with variable back pressure more than 10% of set pressure, 1D2 flanged valves as per API-526 as a minimum to be provided.

4.13.1.7 The body material shall, as a minimum, be as per piping specifications. Nozzle and disc material shall be SS 316 as a minimum with machined stainless steel guide and spindle. Whenever semi nozzle designs are unavoidable, body material shall be atleast same as nozzle and disc material.

4.13.1.8 The spring material of pressure relief valves shall be as follows unless otherwise necessary because of process conditions;

(-)29^{O}C to 230^{O}C	:	Carbon steel with weather protective coating.
above 230^{O}C	:	Tungsten alloy steel.
Below (–)29^{O}C	:	316 Stainless Steel

4.13.1.9 Flanged connection shall be for standard sizes 1" or larger.

4.13.1.10 Where permissible, screwed connections shall be used on sizes 3/4" and below.

Copyright EIL – All rights reserved

4.9.8 Vortex meter shall be considered where high rangeability is the prime requirement.

4.9.9 Differential Pressure type flow transmitter shall meet all the requirements specified in clause 2.16.

4.9.10 Wedge flow meter shall be considered in slurry services or where powder deposits may form. However, Diaphragm seal type DP transmitter shall be provided along with wedge flow meter duly calibrated with both sensor and the transmitter.

4.10 Control Valves

4.10.1 Control valves shall normally be globe type. Other valve types like butterfly, ball, rotary plug, angle or 3way etc., shall be selected as per service and process requirements.

4.10.2 Control valve sizing shall be carried out as per ISA S75-01. The valve shall permit upto 150% of normal flow or 110% of maximum flow, whichever is higher. In general, control valves shall be sized so that the valve opening is as noted below:

At max. flow	:	about 90% open
At normal flow	:	about 75% open
At minimum flow	:	about 20% open.

4.10.3 Flanged control valves shall be used. Body material, body rating and flange rating shall be as per piping specifications. However body and flange rating shall be minimum 300#.

4.10.4 Minimum control valve body size shall be 1" in general. Reduced trims can also be considered.

4.10.5 For globe valves trim characteristics shall be equal percentage type unless required otherwise. Control valve plugs shall be heavy top guided for single seated valves. Cage guiding may be used in clean applications.

4.10.6 Anti-cavitation trim shall be selected wherever cavitation is expected in the valve. For flashing services and hardened trim shall be used and anti-cavitation trim shall not be provided.

4.10.7 Noise from control valve during operation shall be limited to OSHA specified level or better. The maximum allowable noise is 85 dBA SPL (Sound Pressure Level). Source treatment for noise may be performed by using special trims like low noise trims, in case noise exceeds the specified level. Other methods based on merit are also permissible.

4.10.8 Valve seat leakage shall be minimum class IV as per ANSI/FCI 70.2 unless tight shutoff requirement is required as per the P&ID.

4.10.9 Flanged bolted type gland packing boxes shall be used. Packing shall normally be PTFE on liquid and gas service up to 200^{O}C (design). Graphite/grafoil shall be used above 200°C(design) temperature. Asbestos based packing material shall not be used.

4.10.10 Bellows seal shall be used where it is required to isolate the packing from the process fluid or where no leakage to atmosphere can be tolerated like toxic, explosive and precious fluids.

4.10.11 Material used for trim shall be minimum SS 316, with guide bushing of hardened stainless steel like 440 C, 17-4 PH. For higher pressure drops (more than 10 kg/cm^2) or erosive and slurry services and in general for all steam services, flashing and cavitating services, plug and seat shall be stellited.

Copyright EIL – All rights reserved

Special cases may require 17-4 PH seat ring and 440 C solid plugs or other materials like Hastelloy, Monel etc.

4.10.12 Valve actuator shall be pneumatic spring opposed diaphragm type, in general. Piston type actuators may be used for very high shut off pressure requirements. Additional equipment including volume bottle necessary to meet fail safe condition shall also be included in case double acting piston type actuator is selected. In either case, actuator shall be able to withstand maximum shut-off pressure (1.5 times of design pressure) with the minimum instrument air pressure specified.

4.10.13 Whenever limit switches are specified as inductive proximity type, these shall meet NAMUR (DIN-19234) requirements.

4.10.14 Solenoid valves, wherever used, shall be universal and continuous rated type with class H coil insulation. These shall be SS body as a minimum.

4.10.15 Self-actuating regulators for flow, pressure and temperature shall be used where loads are constant and requirements of precision and accurate controls are not stringent.

4.10.16 The actuator shall be painted as below:

Direct action (open on air failure) valves	-	Green
Reverse acting (close on air failure) valve	-	Yellow
Actuator for shutdown valves	-	Red

Items like air volume tanks etc., supplied as an accessory along with the actuators, shall be painted as per corresponding actuator.

4.11 ON-OFF VALVE

4.11.1 On-off valves shall have flanged end connections integral to the valve body. Top entry valve design shall not be offered unless specifically indicated. Body rating of valve shall be minimum 300#.

Whenever flangeless on-off valve body design is specified, following shall apply:

a) Wafer type or lug type body design for butterfly type on-off valves body size up to 6 inches.

b) Lug type body design for butterfly type of on-off valve body size more than 6 inches.

4.11.2 For on-off valves with fire safe design, flanged body construction shall only be acceptable.

4.11.3 For all services where full port valves are specified, following shall apply:

a) Port size shall be equal to line size for rating up to ASME Class 1500.

b) Port size shall not be less than one size than the line size for rating ASME Class 2500 and above.

4.11.4 For steam jacketed valves, the body and port size shall be one size lower than the on-off valve end connections.

4.11.5 On-off valve body, bonnet, bottom flange, line flanges and other pressure containing assemblies shall be of the same material of construction as specified for valve body.

Copyright EIL – All rights reserved

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED,**
It must not be used directly or indirectly in any way detrimental to the interest of the company.

Annexure-14

Hydraulic coupling details

1. Design Standard: Hydraulic coupling shall be as per manufacturer's standard.
2. Cooler type: Duplex coolers
3. Filter type: Duplex filters
4. Minimum instrumentation shall be as per this scheme [PYAZ3M095836001] attached with this annexure. However, For smooth & reliable operation bidder to include any other items/instruments in their scope of supply.
5. All instruments & hooks up arrangements make shall be as per Annexure-6.
6. All instruments along with JB, cabling etc shall be in bidder scope of supply. BHEL terminal point shall be beyond JB.
7. For other details pl refer specification & Annexure-1.
8. Bidder to include any other items in line with Hydraulic coupling supplied to other EIL projects.
9. BHEL shall provide 1" SS piping at one location of each BFP skid for pneumatic air requirement. Bidder to supply necessary Bidder to supply necessary piping/tubing along with hook up piping/tubing along with hook up arrangement as per annexure-6.
10. BHEL shall provide CW inlet & outlet at one location of each skid. Further distribution to Pump, Motor, Gear Box & Hydraulic coupling shall be in bidder scope of supply.
11. For other details please refer to the schematic in the next page.
12. Make :

    VOITH TURBO PVT. LTD.,
    EBARA CORPORATION
    VOITH TURBO GMBH & CO. KG
    NARA CORPORATION

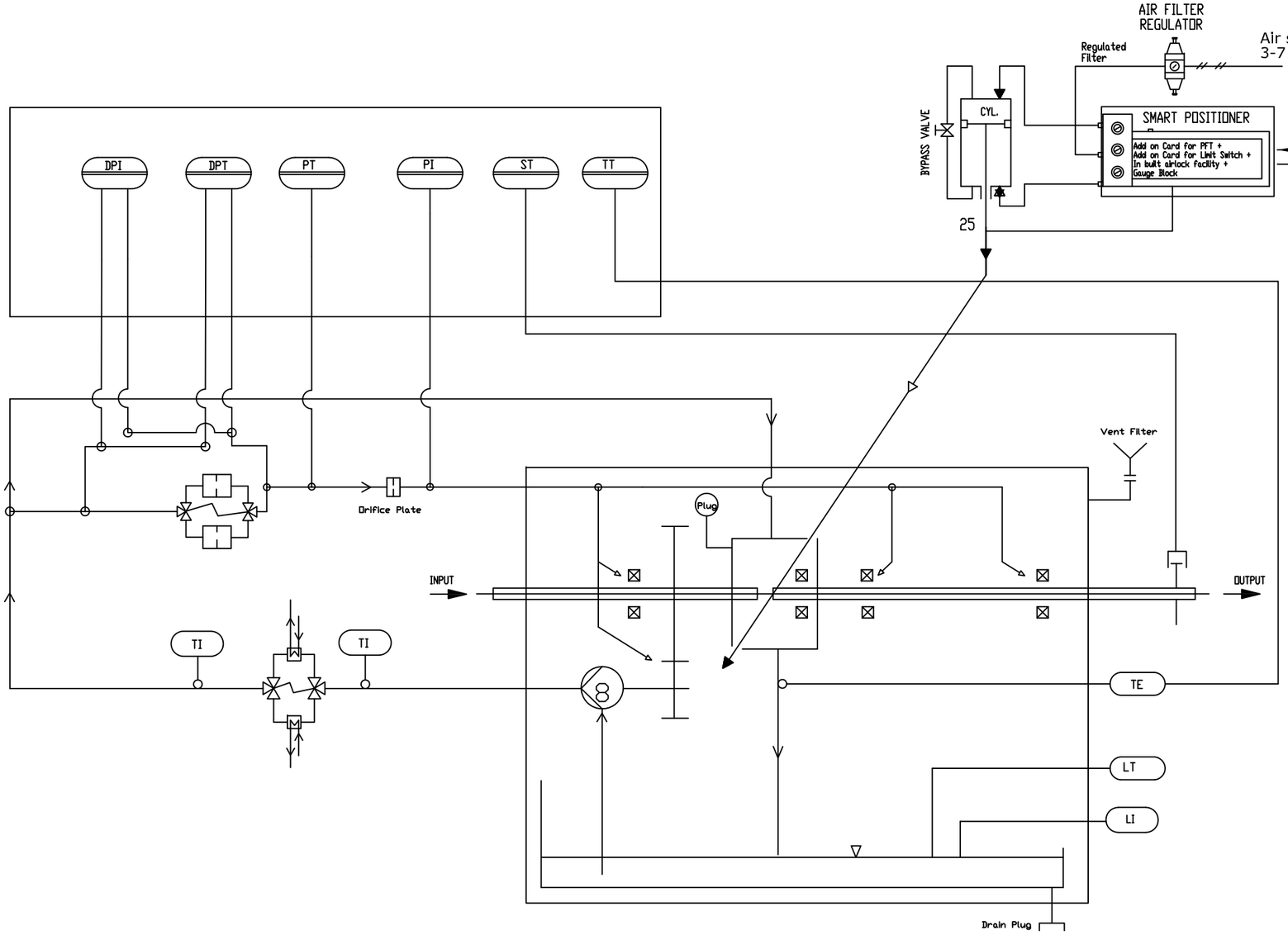
    However, bidder to ensure the Proven Track record of Hydraulic coupling supplier and take prior approval of BHEL for the same. Bidder to furnish PTR of validly similar model supplied to various projects [preferably to EIL projects] in last ten years.

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

COMPUTER FILE NAME :

REF. DRG. NO.

INVENTORY NO



Notes:

1. All instruments & hooks up arrangements make shall be as per Annexure-6
2. BHEL shall provide 1" SS piping at one loaction of each BFP skid for pneumatic air requirement. Bidder to supply necessary Bidder to supply necessary piping/tubing along with hook up piping/tubing along with hook up arrangement as per annexure-6.
3. Duplex coolers & duplex filters shall be provided.
4. All instruments along with JB, cabiling etc shall be in bidder scope of supply. BHEL terminal point shall be beyond JB.
5. Bidder to include minimum instrumentation as per this scheme. However, For smooth & reliable operation bidder to include any other items/instruments in their scope of supply.
6. Bidder to include any other items in line with Hydraulic coupling supplied to other EIL projects.
7. For other details pl refer specification & ANeexure-1

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE		

TYPE OF PRODUCT
OR
NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	Girish		13.04.17	
CHD.	Siva Prasad		15.04.17	
APPD.	Siva Prasad		15.04.17	-N.A.-

DEPT.	UNTOL. DIMS.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	GR. ~~C/M/F~~				-N.A.-	-N.A.-	-N.A.-
CODE 450							

TITLE
Hydraulic coupling schematic

CARD CODE N.A.

BHEL DRG NO. PYAZ3M095836001 REV.

CUST DRG NO.

SHT. No 1 NO. OF SHT. 1

GEN. DIM. LIMITS , FITS , & TOLERANCES AS PER P.S :- HY0230261