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		Sheet 1 of 25

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TECHNICAL SPECIFICATION

FOR

BOILER FEED PUMPS - MOTOR DRIVEN

PROJECT	**2X17.5 TPH – HRSGS,**
CUSTOMER	**GAIL, VIJAIPUR, MADHYA PRADESH**
CONSULTANT	**DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS (DCPL), MUMBAI**

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INDEX

Sl. No.	DESCRIPTION
1.0	INTENT OF SPECIFICATION
2.0	SPECIAL INSTRUCTIONS TO BIDDERS
3.0	APPLICATION OF SYSTEM
4.0	TECHNICAL DETAILS/REQUIREMENTS OF BFP
5.0	SCOPE OF SUPPLY
6.0	OPTIONAL PRICES
7.0	EQUIPMENT QUALIFICATION CRITERIA (EQC)
8.0	QUALITY PLAN & INSPECTION AGENCY & TESTING
9.0	PAINTING
10.0	PACKING AND FORWARDING
11.0	SUB VENDORS
12.0	DOCUMENTATION
13.0	PRICE BID FORMAT
14.0	PRE-BID CLARIFICATIONS & DEVIATIONS:
15.0	ANNEXURES
	Annexure 1 –Piping specifications, Schematic Diagram for BFP and BFP Interface & Scope Matrix.
	Annexure 2 - Pump-Motor datasheet
	Annexure 3- Motor Specification
	Annexure 4-Price bid Format
	Annexure 5- Checklist
	Annexure 6- C&I Specifications
	Annexure 7- QAP Guide Line & Formats
	Annexure 8- Experience Record Proforma

	Annexure 9- Sub-vendor List
	Annexure 10- Master DOC List Format
	Annexure 11- Deviation Format
	Annexure 12- Pre-bid clarification format
	Annexure 13- Pump Specification
	Annexure 14- Painting Specification

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 of 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

** Bidder shall submit Annexure-11 indicating as ***NO DEVIATION*** along with their offer. Any specific deviations, which are impractical, shall be raised in form of pre-bid queries as per Annexure-12 before submission of Techno Commercial offer.

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

1. 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 Pumps assembly** with all equipment/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. SPECIAL NOTES TO BIDDERS

2.1 This specification shall be 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 owner/BHEL, it shall be bidder's sole responsibility to clearly bring out the same distinctively in his technical tender offer, so as to enable owner/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 owner/BHEL then, without any cost, delivery, or any other commercial implications.

2.2 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.

2.3 The Bidder shall accept full responsibility for the completeness and for the faultless working of all the equipment's. 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.

2.4 Bidder shall quote strictly as per the scope of supply and requirements of this specification.

2.5 Bidder offer shall be strictly as per these specification requirements. Unsolicited or Alternate offers from the bidders will not be entertained.

2.6 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.

2.7 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. APPLICATION OF SYSTEM

Total 3 Nos. (2 Working + 1 Stand-by) of HRSG BFP's along with drive are envisaged to transfer feed water from De-aerator storage tank to HRSG. All the pumps shall be identical in design and construction.

Location of all Pumps & Motor (Ex-Proof) assembly shall be outdoor.

4. TECHNICAL DETAILS/REQUIREMENTS OF BFP

SL No.	Description	Unit	Rated Condition	Capability Condition-1	Capability Condition-2
1	Suction Temp	Deg. C	113		
2	Design Temp	Deg. C	143		
3	Capacity of each pump	m^3/hr	22	19	19
4	Pump Differential Head	mlc	630	607	678
5	Available Pressure at Pump suction flange	$Kg/cm^2(a)$	2.59	2.62	2.62
6	NPSHA at pump suction flange	mlc	7.89	8.25	8.18
7	Margin between NPSH A & NPSHR		1 m at rated condition & NPSHR shall be less than NPSHA till end of the curve condition.		

Area Classification: Hazardous area, zone -1 with gas group IIC.

All electrical items & field instrument/JB is suitable to zone -1 with gas group IIC, Temp Cl. T3.
All electrical equipment will have CMRI certification.

5. 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 HRSG BFPs: 3 Nos. (2W+1S)

5.1. Pump

Horizontal, Centrifugal, Multistage, Barrel/Ring type of pump complete with all accessories as per specification. Pump shall be as per manufacturing standard duly taking care of Technical purchase specification and enclosed Annexure requirement.

All the pumps shall be identical in design and construction.

First critical speed should be well away from the operating speed in case unit having flexible shaft system, the first critical speed should not be more than 60% of operating speed.

BLO line shall be connected to pump suction line (before strainer) as indicated in Annexure - 1 B. For connection of BLO line to suction line bidder to recommend following:

i. Distance between pump BLO line nozzle to suction line Nozzle (Nozzle where Pump BLO line shall be connected).
ii. Angle of BLO line at which it will connect to Pump suction line

Note: Bidder to comment on feasibility of connecting BLO line within pump casing/skid

5.1.1. Performance Requirement

Head capacity characteristic curves for the pumps should be such that it is continuously rising from operating point towards shut off. Drive motor output capability shall be selected such that a margin of at least 15% is provided over the maximum power required at the rated point. It should also be checked out at 120% of rated flow, the power requirement is lower than drive power.The pumps and drives shall be rated for continuous operation. All the pumps shall have identical performance characteristics. Characteristics of the drives shall match the characteristics of the pumps for stable operation at all loads. Parallel operation of the pumps should be possible at all loads with each pump delivering equal amount of flow.

Discharge orifice [if applicable] as per manufacturer recommendation is provided for continuous head rise to the pump from rated head to shut off head.

5.1.2. Material Construction :

i. Barrel- Forged carbon steel with austenitic stainless steel [applicable in case of barrel casing pump]
ii. Casing [Suction, Delivery and Stage casing] - ASTM A 487 Gr. CA-6NM
iii. Shaft - ASTM A276 - Type 410 or 420 / ASTM A473 - Type 420
iv. Impeller- ASTM A743 Gr CA6NM or A487 Gr CA6NM
v. Wearing ring – 11.5 to 13.5% chromium steel properties with ant galling properties
vi. Balancing drum bush- 11.5 to 13.5% chromium steel properties with ant galling properties
vii. Balancing Drum - Stainless steel
viii. Shaft Sleeves - ASTM A276 - Type 410 or 420

Note: In case of any difficulty bidder to quote equivalent or superior MOC of Pump.

5.2. Motor

Ex –Proof Motor for Zone -1 area with Gas Grade –IIC.

i. Voltage: 3-Ph-415 V (+/-10%)
ii. Frequency: 50HZ (+/- 5%)
iii. Combined voltage & Frequency variation +/-10%
iv. Design standard- IS 325
v. Type - Constant speed, squirrel cage, three-phase induction type.

vi. Starting current:

a) For motor rating up to 132KW starting current shall be considered 7.2 times of FLC inclusive of all tolerances.

b) For motor rating above 132KW & up to 160KW starting current shall be considered 6.0 times of FLC inclusive of all tolerances.

vii. Energy Efficiency class - Efficiency class-IE3 confirming to IS 12615 : 2011 as per IEC:60034-30.

Heavy duty tinned copper type lugs – 36 Nos and double compression nickle brass cable glands -12 Nos 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. Tentative cable sizes is 3Cx2Rx150 sq.mm, Al, XLPE. However, final cable size shall be informed during detailed engineering.

For details Please refer Annexure-3.

5.3. Hydraulic coupling

Not applicable

5.4. Gear Box [If applicable]

Gear Box [if applicable] shall be supplied along with BFP skid. Design standard of Gear Box shall be as per manufacturing standard.

5.5. LO skid [if applicable]

i. Forced oil lubrication system shall be as per as per manufacturing standard. However, Minimum instrumentation as mentioned in Annexure-1.
ii. The interconnection piping between the equipment & Lube oil system.
iii. LO skid shall cater for the LO requirement of Pump & Motor.

All instrumentation shall be as per annexure-6.

5.6. Coupling

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

i. Design standard of coupling shall be as per manufacturer standard.
ii. Couplings shall be of metallic, non-lubricated, flexible element type (i.e. either diaphragm or discs) with spacer, for all equipment.
iii. All coupling models shall be selected for a minimum service factor of 1.5 over driver rating.

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. DBSE shall be more than the seal cartridge length.

5.7. ARC Valve:

i. Modulating type Automatic Recirculation Control valve with flanged ends for minimum flow control.
ii. The ARC valve size shall be as per pump supplier's recommendation, however not less than Pump discharge nozzle size.
iii. ARC valve shall be selected based on required minimum re-circulation flow of the pump.
iv. ARC Valves to be selected in such a way that the pressure drop at guarantee condition is 0.91 kg/cm2.
v. 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.
vi. This is to ensure flexibility of operating system at marginally higher flows as per site conditions if any.
vii. Material of construction: Body: CS, Internals: SS
viii. Additional requirements: IBR certification is required for ARC valve

5.8. Strainer

Y-Type suction strainer with flanged ends, with Strainer size & rating shall be same as BHEL suction pipe size (Refer Annexure-1)

i. MOC of the strainer: Body: CS & Internals: SS
ii. Suction strainer Mesh size: 40 mesh **
iii. Free Flow Area: Minimum 4 times that of BHEL inlet pipe size.
iv. Strainer pressure drop: 0.14 Kg/cm2 in 50% clogged conditions @ rated condition
v. 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

5.9. MECHANICAL SEAL:

Cartridge type Mechanical seal shall be provided at both ends of the shaft of each pump. Adequate cooling arrangement for the seal shall be provided.

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.

5.10. Local Gauge board:

Local gauge board [as required for Pump, Motor] 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(Wherever).

*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.

5.11. Common base frame with fixing bolts, necessary foundation bolts, nuts, shims/grouting pads etc. for Pump and Motor.

5.12. Inter connecting Piping & Instrumentation:

All instrumentation for Pump, Motor, LO skid (If Applicable) shall be as per as per enclosed Annexure-1 & C&I specification, Annexure-6. 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].

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. 1 Nos. of Pressure Safety relief valve at Balance leak off line. PSV shall be as per annexure-1 and 6.
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 header and return header line.
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-6.

5.13. Provision for Instruments

Applicable for Instruments mounted on BFP Suction, Discharge, Recirculation & Balance leak off line

i. 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:

a) Pressure Gauges at:
- pump suction
- pump discharge
- Re-circulation line
- Balance leak off line

b) Pressure Transmitter at:

- pump suction
- pump discharge
- Balance leak off

ii. 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:

a) Temperature Gauges at:
- pump suction
- pump discharge

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

Note:

i. Bidder to provide provision for mounting the above mentioned BHEL supplied instruments.

ii. Referring to clause no 5.12, 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, Motor LO skid (If Applicable) along with all accessories such as hook up arrangements, cabling, Cable trays, JBs etc. shall be in bidder scope of supply.

iii. Only Thermocouple with temperature transmitter to be used for process application. RTD is not applicable for process applications.

iv. Process switches are not applicable.

v. Cable trays & installation of the cable trays for all the instruments [Instruments supplied by both BHEL & bidder] shall be in bidder scope of supply.

5.14. Provision for Vibration Monitoring System items

Only provision for mounting probes shall be made available on All Pumps & Motor. 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.

5.15. Bearing & Winding instruments & JB for Pumps & Motors

All instrumentation shall be as per enclosed C&I specification, Annexure-6.

5.15.1. Pump

i. 2 Nos. Duplex RTD for radial bearing of pump DE
ii. 2 Nos. Duplex RTD for radial bearing of pump NDE
iii. 4 Nos. [2 Nos. for active & 2 Nos. for inactive side] Duplex RTD for thrust bearing of pump
iv. TGs for each bearing

5.15.2. Motor

i. 1 No. Duplex RTD for radial bearing of motor DE
ii. 1 No. Duplex RTD for radial bearing of motor NDE
iii. 3 Nos. Duplex RTD for Motor Winding
iv. DTT for Motor DE and NDE bearings

5.15.3. No. of Junction Boxes: Refer Annexure-1

Each Pump & Drive assembly skid shall be provided with following No. of Junction Boxes.:

i. For Pump – Bidder to recommend as per no of instruments & spare philosophy
ii. For LO skid (If Applicable) - Bidder to recommend as per no of instruments & spare philosophy
iii. For Motor Winding & Bearing RTDs -1 No. (Generally this is provided by motor manufacturer, it is the integral part of motor).

5.16. Casing skin temperature monitoring system

Bidder to recommend requirement of casing skin monitoring system for BFP, if applicable same to be provided by the bidder.

5.17. Lateral Analysis / Torsional Analysis

NA

5.18. Complete Unit Test

Complete unit test is included in Pump vendor scope of supply. For details, pl. refer Annexure-7A and 7B.

5.19. First, Fill of Lubricant: NOT in Bidder's Scope of Supply.

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

5.21. Commissioning Spares:

3 sets [1 set for each Pump assembly] of commissioning spares as per manufacturer's recommendation for HRSG BFPs shall be quoted and included in bidders 's scope of supply. One set stands for requirement for one no. of each pump and drive assembly. Minimum 1 Set of O rings & gaskets for each pump assembly and 1 set of spare Strainer Elements for each pump to be considered in scope of supply. Pump Vendor to furnish the list along with the offer regarding requirement of commissioning spares for entire skid.

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.

5.22. Mandatory Spares:

Following items as a mandatory spare to be included in Bidder's scope of supply for BFP

Sl. No.	Description	Quantity
1.1	Pump:	
a)	Wear rings (set)	2 sets.
b)	All types of bearings; radial, thrust etc. (each)	1 set.
c)	Bearing Liners	4 sets
d)	Mechanical seal(DE +NDE)	2 sets.
e)	Shaft sleeve	1 set.
f)	Gaskets/shims/o-rings (set)	2 sets.
g)	Balancing disc and counter balancing disc (set)	2 sets.
h)	Bare shaft	1 set.
i)	Suction filter	1 set
J)	Tie-rods (if applicable)	1 set
k)	Automatic Recirculation Valve	1 No.
1.2	Motor	
a)	Bearing (driving end)	1 No. of each type
b)	Bearing (Non-driving end)	1 No. of each type
c)	End shield (DE and NDE)	1 No. of each type
d)	Cooling fan of motors	1 No. of each type
e)	Fan cover	1 No. of each type
f)	Lubrication oil pump motor	1 No. of each type & rating
g)	Bearing puller	1 No. of each type

h)	Grease gun	2 Nos.
i)	Special spanners/tools	1 Set
J)	Any other small motor	1 No. of each type & rating
1.3	Field Instrument	
a)	Electronic transmitter (Pressure, differential Pressure, Temperature, level etc.) all types	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more
b)	Limit/Position Switch	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more
c)	RTD	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more
d)	Thermo-well for RTD	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more
e)	Thermocouple	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more
f)	Thermo-well for Thermocouple	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more
g)	Gauge (Pressure, Differential pressure, Temperature, level) all types	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more
h)	Control & instrumentation cable (Type wise)	10% of ordered quantity of each type multiple of 500 meters

Special notes for Mandatory spares:

i. One set means quantity installed on one pump.
ii. All Mandatory spares should be supplied separately with green color painted box.
iii. Loose items sent by Vendor to sites shall be quantified/numbered/tagged and not merely mentioned as ONE lot of loose items.
iv. 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.

5.23. 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.

5.24. LOGIC DIAGRAM & WRITE UP

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

5.25. CONFLICTS IN SPECIFICATION REQUIREMENTS

In case of any conflict between this specification and Annexures, stringent of the requirement will govern.

5.26. COOLING WATER PARAMETERS

BHEL shall provide cooling water at one location for each BFP skid. Further distribution [Pump, Motor, LO Skid 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 1" 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): 5.5 kg/cm2 (a)
Mech. design Pressure: 7.5 kg/cm2 (g)
Max. Allowable pressure drop in the system: 0.5-0.6 kg/cm2
Flow: 10 T/hr.
Inlet Temp.: 33 Deg C (Normal)
Mechanical design Temp.: 65 Deg. C (Max.)
Max. Temp. Rise in the system: 8-10 Deg. C

5.27. SPECIAL FEATURES

NA

5.28. WARM UP ARRANGEMENT

As per Manufacturer Recommendation. In case the same is required all the materials (Pipes, Valves, instrument on lines, Orifice Plate etc.) shall be in Bidder’s Scope of supply.

6. OPTIONAL PRICES

Please Refer to Attached Price Bid Format (Annexure-6).
Bidder to furnish the following as optional prices:
a) 2 year recommended spares as per each equipment manufacturer's recommendations
b) Supervision charges for erection & commissioning of the supplied package

7. EQUIPMENT QUALIFICATION CRITERIA (EQC)

The following criteria shall be applicable for acceptance of the offered Centrifugal Pump model

1) a) The vendor shall be an established manufacturer of 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.

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).

   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:

   a) The vendor shall be a regular & established manufacturer of 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.

   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).

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

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.

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 above, i.e. dynamic balancing & hydrostatic test) from where the vendor intends to supply the proposed pump model.

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:

a) The vendor shall be a regular & established manufacturer of 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.

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.

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.

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.

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. 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.

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.

8.3.0 TESTING

Material used shall be of tested quality. Certificates shall be furnished for material of construction of all critical parts. Non-destructive testing like ultra-sonic test, radiography and magnetic particle inspection shall be employed wherever necessary. Hydrostatic pressure

testing shall be conducted for all pressure parts. Static and dynamic balancing shall be done for all rotating parts. Contractor shall also specify the maximum permissible imbalance. Performance testing will be conducted at shop to find out head, power, efficiency and NPSH characteristics against capacity. Standard of Hydraulic Institute of USA shall be followed for this purpose unless otherwise agreed upon during the time of order. Other requirements of inspection and tests shall be as per approved sheets and QAP.
Testing shall be as per Hydraulic Institute of USA.

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:
iii. 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).
iv. 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.]"

Pumps that have stable head/flowrate curves (continuous head rise to shutoff) are preferred for all applications and are required. Since parallel operation is specified, the head rise from rated point to shutoff shall be at least 10 %. If a discharge orifice is used as a means of providing a continuous rise to shutoff, this use shall be stated in the proposal.

9. PAINTING

For details, please refer Annexure-14.

10. 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.

11. 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 with due intimation to BHEL during offer submission stage. Also they have to ensure the Proven Track record of the sub vendors and Bidder to take prior approval of BHEL for the same.

12. DOCUMENTATION

MASTER DOCUMENT LIST: Refer Annexure-10.

i. 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.

ii. 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.

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

a) APPROVAL (A): Approval is mandatory and bidder cannot proceed without obtaining Purchaser's approval.

b) 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.

12.1. DRAWING APPROVAL / REVIEW CATEGORY

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

ii. 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.

iii. 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.

iv. 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.

v. 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.

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

All the documents shall be submitted as given below:

Sl. No.	Description	No. of Copies (Hard)/ Quantity 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. ***Guidelines(Checklist) for Preparations of Major Document shall be furnished after PO Placement by BHEL**	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 One week of receipt of commented Drawings from BHEL
4	BHEL shall furnish their observation on submitted documents	Soft copy only	Within 2 weeks of document submission
5	Final Drawings/documents	12	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 Only	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:**

i. 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.
ii. Brief description of the system.

iii. All approved documents [Drawings, documents & test procedures as per MDL]
iv. Bill of material, BBU, LO schedule, sub vendor list, Mandatory & commissioning spares list etc.
v. Operation, Instruction & maintenance manuals of all equipments / items fo the complete package
vi. System unloading, storage erection, start up, commissioning, shut down requirements.
vii. Operational & environmental safety instructions.
viii. Test reports and certificates.
ix. Catalogues of the equipment & instrumentation.

13. 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.

14. PRE-BID CLARIFICATIONS & DEVIATIONS

i. 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.
ii. Bidders can bring out only those deviations which are impractical to meet, for our review in pre bid clarification only.
iii. 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.
iv. All pre-bid clarifications & deviations shall be clear bring as per annexure- 12. Only.
v. 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. 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 Diagram for BFP
1-C	BFP Interface & Scope Matrix
02	Pump-Motor Data Sheet
03	Motor Specification
04	Price Bid Format
05	Check List
06	C&I specification
07	QAP guide Line, Formats & specification
08	Experience Record Proforma
09-A	Customer approved vendor list
09-B	BHEL PMD List
10	Master DOC List Format
11	Deviation format
12	Pre bid clarification
13	Pump Specification
14	Painting Specification

VARIANT TABLE:

Variant	Item	Material Code
01	HRSG Boiler Feed Pump Assembly-Main Supply	PY9751352010
02	HRSG Boiler Feed Pump Assembly-Commissioning spare	PY9751352029
03	HRSG Boiler Feed Pump Assembly-Special tool and tackle	PY9751352037
02	HRSG Boiler Feed Pump Assembly-Mandatory Supply	PY9751352045

RECORD OF REVISIONS				
Rev. No.	**Date**	**Revision Details**	**Revised By**	**Approved By**
00	14.05.18	First Issue	----------	M.Siva Prasad Babu

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-1-A
		Rev. No. 00

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Annexure-1-A
Piping Material Specification

Revisions: Refer to record of revisions	**Prepared by :**	**Checked by :**	**Approved by :**	**Date :**
	Ratish Kumar	Girish Prasad Palo	Siva Prasad Babu	12.05.2018

PIPING MATERIAL SPECIFICATION

PIPE CLASS : D2A
RATING : 600
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	316	343	371	399	427
PRESS	104.05	104.05	95.6	92.09	88.92	84.71	79.79	77.33	74.52	71.35	58

SERVICE

STEAM (IBR), BOILER FEED WATER (IBR)

NOTES

1 NDT REQUIREMENTS AS PER EIL STANDARD 6-44-0016.

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

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.

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 SCHEDULE. REFER GENERAL NOTES TO PMS.

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	

PIPING MATERIAL SPECIFICATION

BRANCH PIPE (SIZE IN INCHES)	.500	.750	1.000	1.250	1.500	2.000	2.500	3.000	3.500	4.000	5.000	6.000	8.000		BRANCH PIPE (SIZE IN INCHES)
72.															72.
70.															70.
68.															68.
66.															66.
64.															64.
62.															62.
60.															60.
58.															58.
56.															56.
54.															54.
52.															52.
50.															50.
48.															48.
46.															46.
44.															44.
42.															42.
40.															40.
38.															38.
36.															36.
34.															34.
32.															32.
30.															30.
28.															28.
26.															26.
24.															24.
22.															22.
20.															20.
18.															18.
16.															16.
14.															14.
12.															12.
10.															10.
8.0													T		8.0
6.0												T	R		6.0
5.0															5.0
4.0										T		R	R		4.0
3.5															3.5
3.0								T		R		R	R		3.0
2.5															2.5
2.0						T		R		R		R	R		2.0
1.5					T	T		H		H		H	H		1.5
1.25															1.25
1.0			T		T	H		H		H		H	H		1.0
0.75		T	T		T	H		H		H		H	H		0.75
0.5	T	T	T		T	H		H		H		H	H		0.5

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		

PIPING MATERIAL SPECIFICATION

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

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z1	
PIP	PIPE	1.00	1.50	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z1	
PIP	PIPE	2.00	2.00	XS	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	
PIP	PIPE	3.00	3.00	STD	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	32
PIP	PIPE	4.00	8.00	XS	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	
PIP	PIPE	10.00	14.00	CALC	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	
PIP	PIPE	16.00	24.00	CALC	B-36.10	ASTM A 672 GR.B60 CL.12	BE, E.FS.W	PI2A813Z1	3
NIP	NIPPLE	0.50	0.75	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z1	
NIP	NIPPLE	1.00	1.50	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z1	
Flange Group									
FLG	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 105	600, RF/125AARH	FSC0167Z1	
FLG	FLNG.WN	2.00	24.00	M	B-16.5	ASTM A 105	600, RF/125AARH	FWC0167Z1	
FLB	FLNG.BLIND	0.50	24.00		B-16.5	ASTM A 105	600, RF/125AARH	FBC0167Z1	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A 105	600, FF/125AARH	FGK0161Z1	
FEF	SPCR&BLND	10.00	24.00		ASME-B16.48	ASTM A 105	600, FF/125AARH	FCK0161Z1	
Fitting Group									
ELB90	ELBOW.90	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WA602D3Z1	
ELB90	ELBOW.90	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WA602D2Z1	
ELB90	ELBOW.90	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WAG684Z11	
ELB90	ELBOW.90	16.00	24.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z11	
ELB45	ELBOW.45	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WB602D3Z1	
ELB45	ELBOW.45	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WB602D2Z1	
ELB45	ELBOW.45	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WBG684Z11	
ELB45	ELBOW.45	16.00	24.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WBG754Z11	

PIPING MATERIAL SPECIFICATION

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

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Fitting Group									
TEQ	T.EQUAL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WE602D3Z1	
TEQ	T.EQUAL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WE602D2Z1	
TEQ	T.EQUAL	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ1	
TEQ	T.EQUAL	16.00	24.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW	WEG754ZZ1	
TRED	T.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WR602D3Z1	
TRED	T.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WR602D2Z1	
TRED	T.RED	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ1	
TRED	T.RED	16.00	24.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WRG754ZZ1	
REDC	REDUC.CONC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ1	
REDC	REDUC.CONC	16.00	24.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WUG754ZZ1	
REDE	REDUC.ECC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ1	
REDE	REDUC.ECC	16.00	24.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WVG754ZZ1	
SWGC	SWAGE.CONC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WNH026ZZ1	
SWGE	SWAGE.ECC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WPH026ZZ1	
CAP	CAP	2.00	24.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ1	
CPLF	CPLNG.FULL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WJ602D3Z1	
CPLF	CPLNG.FULL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WJ602D2Z1	
CPLH	CPLNG.HALF	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WK602D3Z1	
CPLH	CPLNG.HALF	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WK602D2Z1	
CPLL	CPLNG.LH	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WL602D3Z1	
CPLL	CPLNG.LH	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WL602D2Z1	
CPLR	CPLNG.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WM602D3Z1	
CPLR	CPLNG.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WM602D2Z1	

PIPING MATERIAL SPECIFICATION

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

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk	Dmn. STD	Material	Description	Commodity Code	Note No
Valves Group									
GAV	VLV.GATE	0.50	1.50		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	2.00	24.00		API 600/ ISO 10434	BODY-ASTM A 216 GR.WCB,TRIM-STELLITED,STEM-13%CR STEEL	FLGD, 600, B-16.5, RF/125AARH, SHT NO.- 51502	51502ZZZ1	
GLV	VLV.GLOBE	0.50	1.50		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	2.00	12.00		BS-1873	BODY-ASTM A 216 GR.WCB,TRIM-STELLITED,STEM-13%CR.STEEL	FLGD, 600, B-16.5, RF/125AARH, SHT NO.- 52502	52502ZZZ1	
CHV	VLV.CHECK	0.50	1.50		BS EN ISO 15761	BODY-ASTM A 105,TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO.- 53002	53002ZZZ1	
CHV	VLV.CHECK	2.00	24.00		BS-1868	BODY-ASTM A 216 GR.WCB,TRIM-STELLITED	FLGD, 600, B-16.5, RF/125AARH, SHT NO.- 53502	53502ZZZ1	
Bolt Group									
BOS	BOLT.STUD	0.50	24.00		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL	SPIRAL, 600	GK65076Z0	
Trap/Strainer Group									
TRP	TRAP.STEAM	0.50	1.50		MNF'STD	B:A105;T:13%CR;S:SS304	FLGD, THRMDNMC, 600,RF/125AARH	TR30655E1	
TSR	STRNR.TEMP	1.50	24.00		EIL'STD	B:A516GR.70;INT:SS304	CONETYPE, 600,FF/125AARH	ST1683IZ1	
PSR	STRNR.PERM	0.50	1.50		MNF'STD	B:A105;INT:SS304	SW, Y-TYPE, 800	SP303D511	
PSR	STRNR.PERM	2.00	24.00		MNF'STD	B:A216GR.WCB;INT:SS304	FLGD, Y-TYPE, 600,RF/125AARH	SP38055E1	

PE&SD-Mech.

PIPING MATERIAL SPECIFICATION

A2A

Customer:	**GAIL VIJAIPUR**
ANSI CLASS:	#150
MATERIAL:	CARBON STEEL
CORR.ALL.	1.7 mm
Special requirement	IBR

Rev.00 14.06.18

TEMPERATURE (Deg.C) & PRESSURE (kg/cm2 g) RATINGS

TEMP	-29	38	50	100	150										
PRESS.	5.00	5.00	5.00	5.00	5.00										

SERVICE

BOILER FEED PUMP SUCTION (DO NOT USE THIS PMS BEYOND 5 KG/CM2G AND 150˚C)

ITEM	SIZE	DESCRIPTION
MAINT. JOINTS	ALL	FLANGED (TO BE KEPT MINIMUM)
PIPE JOINTS	1½" AND BELOW	SW COUPLING (REF NOTE-3)
	2" AND ABOVE	BUTT WELDED AS PER ANSI B16.25
DRAINS	ALL	1" & AS PER BHEL STD DRG NO.4-38101-02488
VENTS	ALL	1" & AS PER BHEL STD DRG NO.4-38101-02488
TEMP. CONN.	M33X2	PLEASE ALSO REFER 'PIPE-INSTRUMENT INTERFACE' DOCUMENT ISSUED BY C&I GROUP
PRESS. CONN.	1/2" SW	PLEASE ALSO REFER 'PIPE-INSTRUMENT INTERFACE' DOCUMENT ISSUED BY C&I GROUP

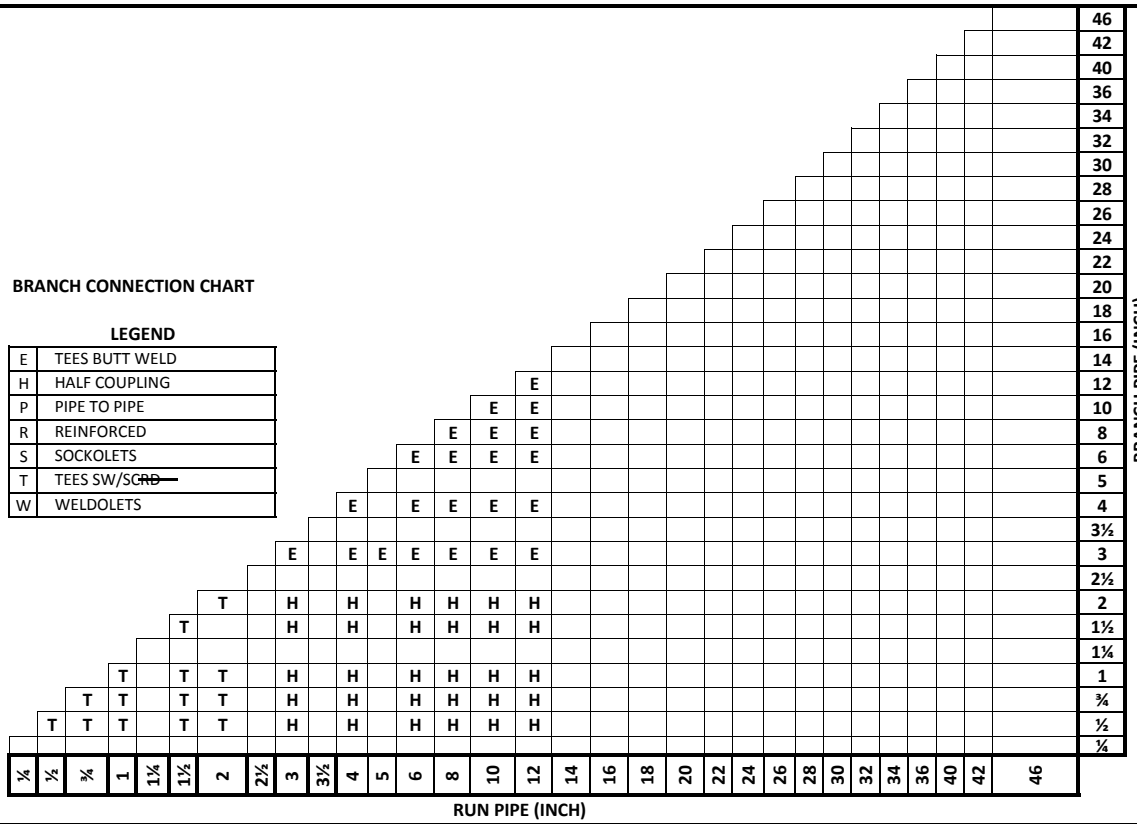
NOTES

1. WELDED PIPE SHALL HAVE ONLY LONGITUDINAL WELD MADE BY EMPLOYING AUTOMATIC WELDING.
2. MINIMUM THICKNESS OF FITTING SHALL BE IN LINE WITH THE PIPE SCHEDULE/THICKNESS.
3. NPT CONNECTIONS ARE PERMITTED IN THERMAL RELIEF VALVES ONLY.
4. MSW GASKET SHALL BE SELF ALIGNING TYPE WITH INNER RING OF SPIRAL STRIP MATERIAL.
5. DELETED.
6. NDT REQUIREMENTS AS PER BHEL STD. DOC. NO. GT 57124
7. ALL PIPES, FITTINGS, VALVES, FLANGES STRAINERS,ETC SHALL BE TESTED & TEST CERTIFICATES IN FORM IIIA FOR PIPES & FORM IIIC FOR OTHERS SHALL BE REQUIRED DULY COUNTER SIGNED BY IBR AUTHORITY OR THEIR APPROVED REPRESENTATIVE.
8. FORGED STEEL FITTINGS SHALL BE IN ACCORDANCE WITH ANSI B 16.11. FOR ITEMS NOT COVERED UNDER B16.11, REFERENCE MAY BE MADE TO BS 3799 OR MSS-SP-STD.
9. BUTT WELDED STEEL FITTINGS SHALL BE IN ACCORDANCE WITH ANSI B 16.9. FOR ITEMS NOT COVERED UNDER B16.9, REFERENCE MAY BE MADE TO MSS-SP-STD.
10. NO REINFORCEMENT PADS SHALL BE USED FOR APPLICATIONS WITH DESIGN TEMP EXCEEDING 150˚C.

BRANCH CONNECTION CHART

LEGEND

E	TEES BUTT WELD
H	HALF COUPLING
P	PIPE TO PIPE
R	REINFORCED
S	SOCKOLETS
T	TEES SW/SCRD
W	WELDOLETS



PE&SD-Mech.

PIPING MATERIAL SPECIFICATION

A2A

Customer:	**GAIL VIJAIPUR**
ANSI CLASS:	#150
MATERIAL:	CARBON STEEL
CORR.ALL.	1.7 mm
Special requirement	IBR

Rev.00 14.06.18

ITEMS	TYPE	ENDS	DIA. RANGE (INCH) LOW	DIA. RANGE (INCH) HIGH	SCH/ THK/ RATING	FACE FINISH / RADIUS	DIM / DESG. STD.	BASIC MATERIAL CARBON STEEL DESCRIPTION	BASIC MATERIAL CARBON STEEL BHEL SPEC	NOTE	Revision
PIPES	SEAMLESS	PE	½	2	S80		B 36.10	ASTM A106 GRB	AA10455		
	SEAMLESS	BE	3	8	S40		B 36.10	ASTM A106 GRB	AA10455		
	SEAMLESS	BE	10	12	S30		B 36.10	ASTM A106 GRB	AA10455	1	
FLANGES	WELD NECK	RF	½	1½	150	125AARH	B 16.5	ASTM A 105	AA7246306		
	WELD NECK	RF	2	12	150	125AARH	B 16.5	ASTM A 105	HY7246361		
	BLIND	RF	½	1½	150	125AARH	B 16.5	ASTM A 105	HY7246772		
	BLIND	RF	2	12	150	125AARH	B 16.5	ASTM A 105	HY7246166		
	FIGURE8 BLANK	RF	½	1½	150	125AARH	B 16.48	ASTM A 105	GT57083-06		
	FIGURE8 BLANK	RF	2	8	150	125AARH	B 16.48	ASTM A 105	GT57083-06		
	SPACER & BLIND	RF	10	12	150	125AARH	B 16.48	ASTM A 105	GT57083-06		
FITTINGS	ELBOWS 90 DEG	SW	½	¾	3000		B 16.11	ASTM A 105	AA7242501		
	ELBOWS 90 DEG	SW	1	1½	3000		B 16.11	ASTM A 105	AA7242501		
	ELBOWS 90 DEG	BW	2	12	M	R=1.5D	B 16.9	ASTM A 234 GR WPB	HY7242695	2	
	ELBOWS 45 DEG	SW	½	1½	3000	R=1.5D	B 16.11	ASTM A 105	HY7242566	2	
	ELBOWS 45 DEG	BW	2	12	M	R=1.5D	B 16.9	ASTM A 234 GR WPB	HY7242566	2	
	EQ. TEE	SW	½	1½	3000		B 16.11	ASTM A 105	AA7242510		
	EQ. TEE	BW	2	12	M		B 16.9	ASTM A 234 GR WPB	AA7242511	2	
	CON. RDCR	BW	2	12	M,M		B 16.9	ASTM A 234 GR WPB	HY7242692	2	
	CAP	BW	2	12	M		B 16.9	ASTM A 234 GR WPB	HY7242570		
	FULL COUPLING	NPT/NPT	½	¾	3000		B 16.11	ASTM A 105	HY7242595	3	
	FULL COUPLING	NPT/NPT	1	1½	3000		B 16.11	ASTM A 105	HY7242595	3	
	FULL COUPLING	SW	½	¾	3000		B 16.11	ASTM A 105	AA7242520		
	FULL COUPLING	SW	1	1½	3000		B 16.11	ASTM A 105	AA7242520		
	VI (HALF CPLG)	SW	½	¾	3000		B 16.11	ASTM A 105	TC56213		
	VI (HALF CPLG)	SW	1	1½	3000		B 16.11	ASTM A 105	TC56213		
VALVES	GATE	SW	½	2	800		API 602	ASTM A 105	AA7521468		
	GATE	BW	3	12	150		API 600	ASTM A 216 GR. WCB	AA7521408		
	GLOBE	SW	½	2	800		BS 5352	ASTM A 105	AA7501468		
	GLOBE	BW	3	12	150		BS 1873	ASTM A 216 GR. WCB	AA7501408		
	Reg GLOBE VLV	SW	½	2	800		BS 5352	ASTM A 105	HY7511943		
	Reg GLOBE VLV	BW	3	12	150		BS 1873	ASTM A 216 GR. WCB	AA7511408		
	CHECK (PISTON LIFT)	SW	½	2	800		BS 5352	ASTM A 105	AA7531468		
	CHECK	BW	3	12	150		BS 1868	ASTM A 216 GR. WCB	AA7541408		
BOLT & GASKET	STUD + 2NUTS		M12	M27			B 18.2	A 193 GR B7/ A194 2H	HY7142198		
	STUD + 2NUTS		M30	M70			B 18.2	A 193 GR B7/ A194 2H	HY7142299		
	GASKET		½	1½	150		B 16.20	NAB MSW (SS316)+ PTFE FILL	HY7240363	4	
	GASKET		2	12	150		B 16.20	NAB MSW (SS316)+ PTFE FILL	HY7240362	4	
MISC	STEAM TRAP	SW	½	2	800	THERMODYNAMIC	MNF. STD.	B:A 105; INT: SS 304	GT57278-00		
	Y-TYPE STRAINER	SW	½	2	800	B 16.11	MNF. STD.	B: A 105; INT: SS 304	HY7577468		
	Y-TYPE STRAINER	FL	2	12	150	B 16.5	MNF. STD.	B: A 216 WCB; INT: SS 304	HY7577408		

B : BODY; INT : INTERNALS

PE&SD-Mech.

PIPING MATERIAL SPECIFICATION

A3A

Customer:	**GAIL VIJAPUR**
ANSI CLASS:	150 #
MATERIAL:	CARBON STEEL
CORR.ALL.	1.7 mm
Special requirement	NON IBR

Rev.00
14.06.18

TEMPERATURE (Deg.C) & PRESSURE (kg/cm2 g) RATINGS

TEMP	38	50	65														
PRESS.	7.00	7.00	7.00														

SERVICE

COOLING WATER LINES, SERVICE WATER LINES (DO NOT USE THIS PMS BEYOND 7 KG/CM^{2}G AND 65° C.)

ITEM	SIZE	DESCRIPTION
MAINT. JOINTS	ALL	FLANGED (TO BE KEPT MINIMUM)
PIPE JOINTS	1½" AND BELOW	SW COUPLING
	2" AND ABOVE	BUTT WELDED AS PER ANSI B16.25
DRAINS	ON LINES ≤ 1½"	AS PER BHEL STD DRG NO.4-38101-02488, TYPE-D1
	ON LINES ≥ 2"	1" OR AS PER BHEL DRG NO. 4-38101-02488, TYPE-D2
VENTS	ON LINES ≤ 1½"	AS PER BHEL STD DRG NO.4-38101-02488, TYPE-V1
	ON LINES ≥ 2"	1" OR AS PER BHEL DRG NO4-38101-02488, TYPE-V2
TEMP. CONN.	M33X2	PLEASE ALSO REFER 'PIPE-INSTRUMENT INTERFACE' DOCUMENT ISSUED BY C&I GROUP
PRESS. CONN.	1/2" SW	PLEASE ALSO REFER 'PIPE-INSTRUMENT INTERFACE' DOCUMENT ISSUED BY C&I GROUP

NOTES

1. NDT REQUIREMENTS AS PER BHEL STD DOC NO GT 57124
2. ALL FLANGED VALVES ABOVE 24" SIZE SHALL HAVE FLANGED END AS PER AWWA C207 CL D.
3. VENT & DRAIN ISOLATION VALVES SHALL BE GATE VALVES .
4. FOR GENERAL NOTES ON PMS,PIPING & VALVES REFER STD. NO GT 69959.
5. BLANK
6. WELDED PIPE SHALL HAVE ONLY LONGITUDINAL WELD MADE BY EMPLOYING AUTOMATIC WELDING.
7. MINIMUM THICKNESS OF FITTING SHALL BE IN LINE WITH THE PIPE SCHEDULE OR THICKNESS.
8. USE BUTTERFLY VALVES INSTEAD OF GATE VALVE FROM 10" ON WARDS IN WATER SERVICE UP TO 70 DEG CEN.

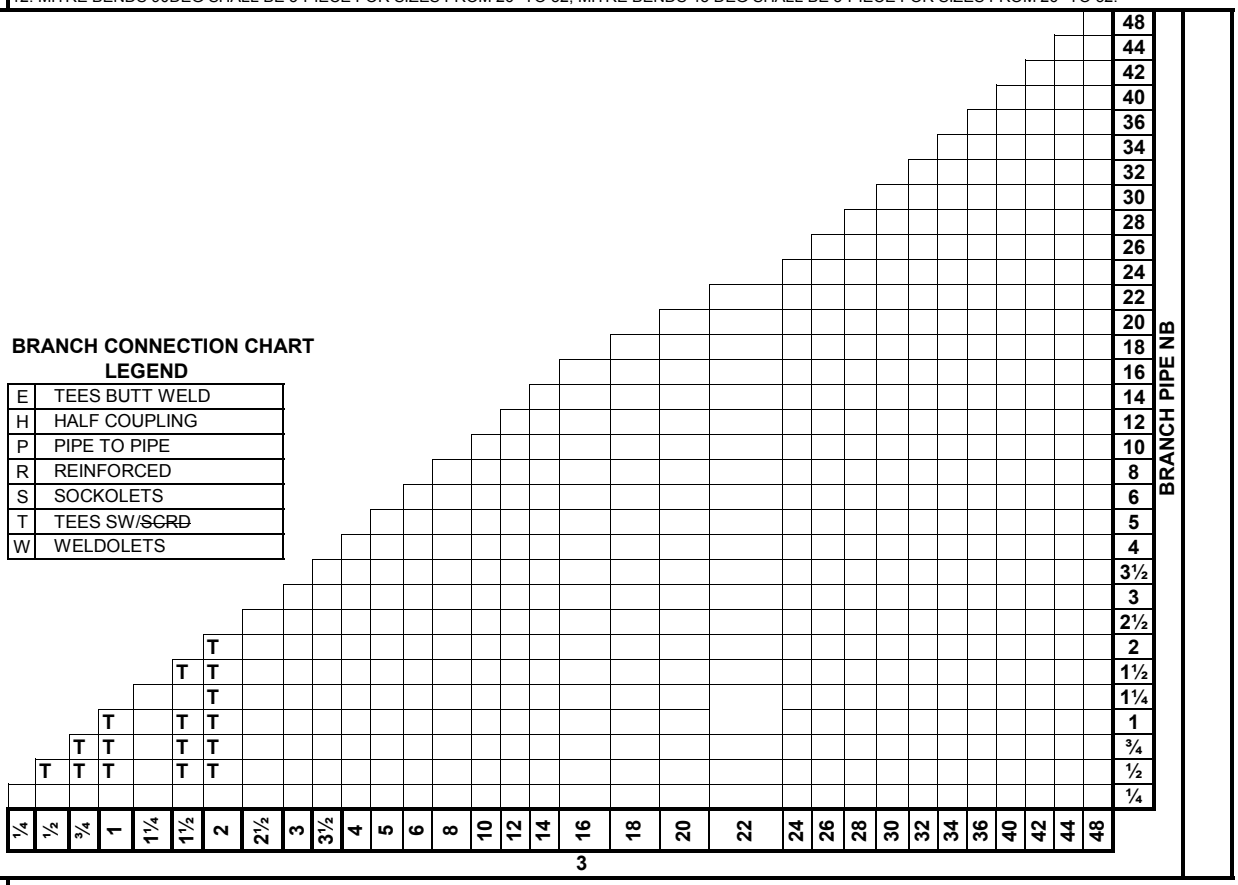
BUTTER FLY VALVE SHALL BE OF PN 10 RATED WITH DESIGN PRESSURE OF 10 KG/CM2 (g).

8. MSW GASKET SHALL BE SELF ALIGNING TYPE WITH INNER RING OF SPIRAL STRIP MATERIAL.
9. ALL WELDS SHALL BE 10% RADIOGRAPHED.
10. BLANK.
11. FORGINGS ARE ACCEPTABLE IN LIEU OF PLATE MATERIAL FOR BLIND FLANGES AND SPACER & BLINDS.
12. MITRE BENDS 90DEG SHALL BE 5-PIECE FOR SIZES FROM 26" TO 52, MITRE BENDS 45 DEG SHALL BE 3-PIECE FOR SIZES FROM 26" TO 52.

BRANCH CONNECTION CHART

LEGEND

E	TEES BUTT WELD
H	HALF COUPLING
P	PIPE TO PIPE
R	REINFORCED
S	SOCKOLETS
T	TEES SW/~~SCRD~~
W	WELDOLETS



PE&SD-Mech.

PIPING MATERIAL SPECIFICATION

A3A

Customer:	**GAIL VIJAPUR**
ANSI CLASS:	150 #
MATERIAL:	CARBON STEEL
CORR.ALL.	1.7 mm
Special requirement	NON IBR

Rev.00
14.06.18

ITEMS	TYPE	ENDS	DIA. RANGE (INCH) LOW	DIA. RANGE (INCH) HIGH	SCH/ THK/ RATING	FACE FINISH / RADIUS	DIM / DESG. STD.	BASIC MATERIAL **CARBON STEEL** DESCRIPTION	BASIC MATERIAL **CARBON STEEL** BHEL SPEC	NOTE	Revision
PIPES	WELDED PIPE	BE	½	2	HVY		IS 1239	IS 1239 PART 1	AA10455	6,9	
FLANGES	SLIP ON	RF	½	2	150	125AARH	B 16.5	ASTM A 105	AA7246106		
	BLIND	RF	½	2	150	125AARH	B 16.5	ASTM A 105	HY7246772		
	FIGURE8 BLANK	FF	½	2	150	125AARH	B 16.48	ASTM A 105	GT57083		
FITTINGS	ELBOWS 90 DEG	SW	½	2	3000		B 16.11	ASTM A 105	AA724501		
	ELBOWS 45 DEG	SW	½	2	3000		B 16.11	ASTM A 105	AA724501		
	EQ. TEE	SW	½	2	3000		B 16.11	ASTM A 105	AA7242510		
	CON. RDCR	BW	2	2	M,M		B 16.9	ASTM A 234 GR WPB	GT57220-0	7	
	ECC. RDCR	BW	2	2	M,M		B 16.9	ASTM A 234 GR WPB	GT57220-0	7	
	CAP	NPT(F)	½	1½	3000		B 16.11	ASTM A 105			
	CAP	BW	2	2	M		B 16.9	ASTM A 234 GR WPB	HY7242570		
	FULL COUPLING	NPT/NPT	½	1½	3000		B 16.11	ASTM A 105	HY7242595	5	
	FULL COUPLING	SW	½	1½	3000		B 16.11	ASTM A 105	AA7242520		
	VI (HALF CPLG)	SW	½	1½	3000		B 16.11	ASTM A 105	TC56213		
	NIPPLE	BW /NPT	½	¾	S 160		B 16.11	A106 GRB	HY7242578	5	
	NIPPLE	BW /NPT	1	1½	S 80		B 16.11	A106 GRB	HY7242578	5	
	NIPPLE	NPT/NPT	½	¾	S 160		B 16.11	A106 GRB	HY7242580	5	
	NIPPLE	NPT/NPT	1	1½	S 80		B 16.11	A106 GRB	HY7242580	5	
VALVES	GATE	SW	½	2	800		API 602 / BS 5352	B:A 105; T:13% Cr;St	AA7521468		
	GLOBE	SW	½	2	800		BS 5352	B:A 105; T:13% Cr;St	AA7501468		
	CHECK (PISTON LIFT)	SW	½	2	800		BS 5352	B:A 105; T:13% Cr;St	AA7531468		
	BUTTER FLY	WAFER	2	2	150	B16.5	BS 5155	B:A 216 GR. WCB; T:13% Cr	GT57213-04		

B:BODY, T:TRIM, BB:BOLTED BONNET, St:STELLITED

ITEMS	TYPE	ENDS	DIA. RANGE (INCH) LOW	DIA. RANGE (INCH) HIGH	SCH/ THK/ RATING	FACE FINISH / RADIUS	DIM / DESG. STD.	BASIC MATERIAL **CARBON STEEL** DESCRIPTION	BASIC MATERIAL **CARBON STEEL** BHEL SPEC	NOTE	Revision
BOLT & GASKET	STUD + 2NUTS		M12	M27			B 18.2	A 193 GR B7/ A194 2H	HY7142198		
	STUD + 2NUTS		M30	M70			B 18.2	A 193 GR B7/ A194 2H	HY7142299		
	GASKET		½	2	150		B 16.20	NAB MSW (SS304)+ PTFE FILL	7240358		
MIS	Y-TYPE STRAINER	SW	½	2	800		B 16.11	B: A 105; INT: SS 304	HY577468		
	RE JOINT	FL	2	2	150		MNF. STD	IS 2062, NEOPRENE RUBBER	GT57214-0		
	AIR RELEASE VALVE	FL	1½	2	150		IS14845	IS 216 WCB	GT57317-0		

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-1-B
		Rev. No. 00

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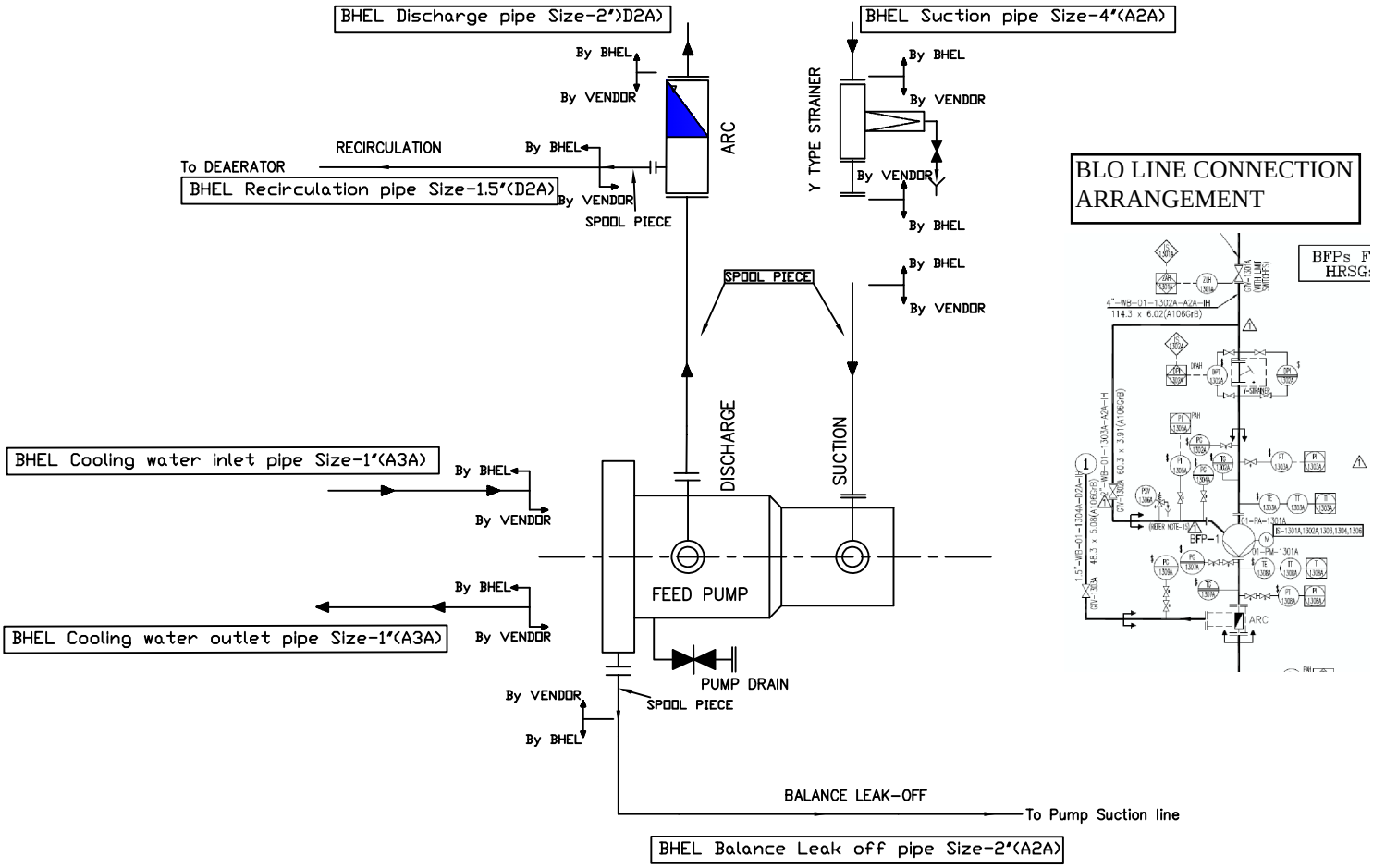
Annexure-1-B
Schematic Diagram for BFPs

Revisions: Refer to record of revisions	**Prepared by :**	**Checked by :**	**Approved by :**	**Date :**
	Ratish Kumar	Girish Prasad Palo	Siva Prasad Babu	12.05.18

ANNEXURE 1–B

1.TYPICAL SCHEMATIC DIAGRAM FOR HRSG 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, LO Skid 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. 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.
5. 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.
6. 2 nos of PSV on BLO line shall be supplied by the bidder on BLO line spool piece.
7. Please refer clause no 4.0.11.5 reg provision for BHEL supplied instruments.
8. Tag Nos. shall be provided after order placement.

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-1-C
		Rev. No. 00

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Annexure-1-C

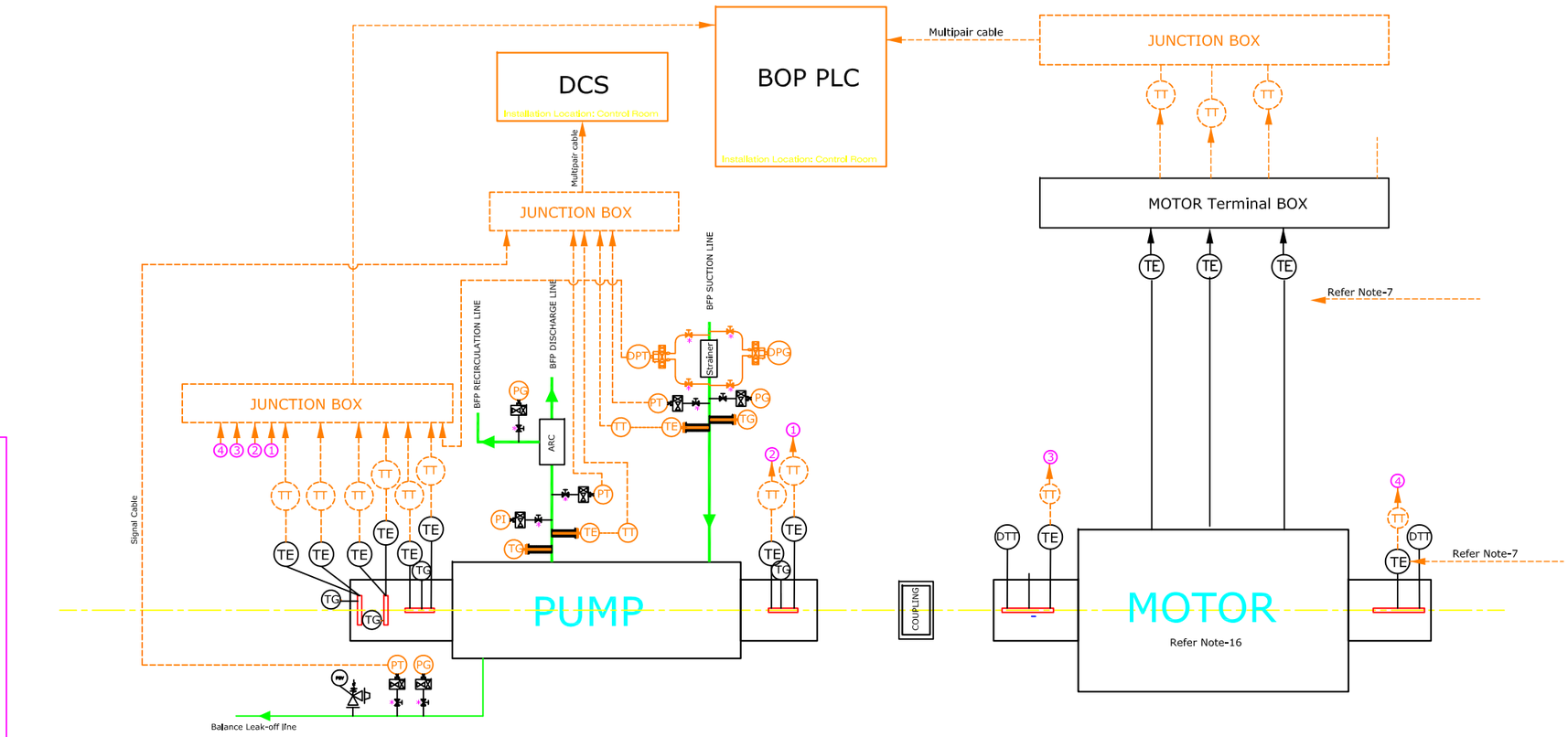
BFP INTERFACE & SCOPE MATRIX

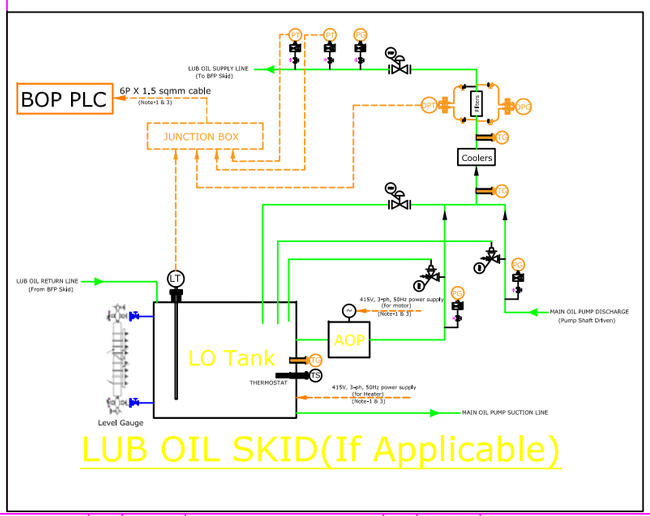
Revisions: Refer to record of revisions	**Prepared by :**	**Checked by :**	**Approved by :**	**Date :**
	Ratish Kumar	Girish Prasad Palo	Siva Prasad Babu	12.05.18

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm)

DRG. NO. SHT. 01 OF 01

BFP SKID Interface & Scope Matrix between BHEL & BFP Supplier





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-Motor & LO Skid 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 and DTTs are included from bidder scope.
8) This document refers only for signal exchange and instrument scope.
9) Bidder shall provide the provision on installation of Vibration probes/Key Phasor on Pump/Motor 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.

16) Motor for HRSG BFP to be considered by bidder.

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 Orange color are NOT in bidder scope.

Instruments indicated for LO Skid is indicative only.Bidder to consider additional instruments if recommended by manufacturer for proper functioning.

CUSTOMER:	GAIL INDIA LIMITED, VIJAIPUR, MADHYA PRADESH
CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS VASHI, NAVI MUMBAI
PROJECT:	2 x 17.5 TPH HEAT RECOVERY STEAM GENERATOR AT GAIL VIJAIPUR

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE
DRN.	RATISH		10.05.18
CHD.	RAJEEV		10.05.18
APPD.	SIVA		10.05.18

NO.OF VAR. –NA–

REV.	DATE	ALTERED	CHD/APPD
ZONE			

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

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

CARD CODE NA | DRG. NO: | CUST. DRG. NO: | REV. 00 | SHT. No 01 | NO. OF SHT. 01

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GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261
COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

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Annexure-2

Pump –Motor Datasheet

CUSTOMER: GAIL, VIJAIPUR, MADHYA PRADESH
PROJECT: 2X17.5 TPH – HRSGS
CONSULTANT:DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS (DCPL), MUMBAI

DATA SHEET for < HRSG 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 storage Tank to HRSG	
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	113	
8	Deaerator pressure (suction tank) $Kg/cm^2(a)$	1.84	
9	Low Low water level of Deaertaor	13.45 mtr from top of pump foundation	
10	Deaerator operating temperature, Deg C	113	
11	Pump Type	Horizontal, Centrifugal, Multistage, Barrel/Ring section casing design pump	
12	Pump Model No.	To be mentioned by Bidder	
13	No. of Stages of pump	To be mentioned by Bidder	
14	Rated Speed of Pump (rpm)	To be mentioned by Bidder	
15	Rated speed of drive (rpm)	To be mentioned by Bidder	
16	Design Standard of pump	To be mentioned by Bidder	
17	Sealing arrangement	Cartridge type Mechanical seal as per Manufacturer Std.	
Pump Design Parameters			
	Rated Condition		
18	Flow (m^3/hr)	22	
19	Differential Head (mlc)	630	
20	Temperature of pumping fluid in Deg C	113	
21	Design temperature of Pump in Deg C	143	
22	Sp. Gravity of pumping fluid	0.9486	
23	Efficiency (Hot) in %	To be mentioned by Bidder	
24	Available pressure on suction side of BFP ,$Kg/cm^2(a)$	2.59	
25	NPSH(A) at pump suction nozzle(mlc)	7.89	
26	NPSH(R) (mlc)	To be mentioned by Bidder	
27	NPSH(A) - NPSH(R)	1 m at rated condition & NPSHR shall be less than NPSHA till end of the curve condition.	
28	Pump BkW (Hot) kw	To be mentioned by Bidder	
	Capability Condition-1		
29	Flow (m^3/hr)	19	
30	Differential Head (mlc)	607	
31	Temperature of pumping fluid in Deg C	113	
32	Design temperature of Pump in Deg C	143	
33	Sp. Gravity of pumping fluid	0.9486	
34	Efficiency (Hot) in %	To be mentioned by Bidder	
35	Available pressure on suction side of BFP ,$Kg/cm^2(a)$	2.62	
36	NPSH(A) at pump suction nozzle(mlc)	8.25	
37	NPSH(R) (mlc)	To be mentioned by Bidder	
38	NPSH(A) - NPSH(R)	1 m at rated condition & NPSHR shall be less than NPSHA till end of the curve condition.	
39	Pump BkW (Hot) kw		
	Capability Condition-2	To be mentioned by Bidder	
40	Flow (m^3/hr)	19	
41	Differential Head (mlc)	678	
42	Temperature of pumping fluid in Deg C	113	
43	Design temperature of Pump in Deg C	143	
44	Sp. Gravity of pumping fluid	0.9486	
45	Efficiency (Hot) in %	To be mentioned by Bidder	
46	Available pressure on suction side of BFP ,$Kg/cm^2(a)$	2.62	
47	NPSH(A) at pump suction nozzle(mlc)	8.18	
48	NPSH(R) (mlc)	To be mentioned by Bidder	

49	NPSH(A) - NPSH(R)	1 m at rated condition & NPSHR shall be less than NPSHA till end of the curve condition.	
50	Pump BkW (Hot) kw	To be mentioned by Bidder	
Pump Performance & other details			
51	Pump shut off head	To be mentioned by Bidder	
53	Pump shut off head/rated head:	Pumps that have stable head/flowrate curves (continuous head rise to shutoff) are preferred for all applications and are required. Since parallel operation is specified, the head rise from rated point to shutoff shall be at least 10 %. If a discharge orifice is used as a means of providing a continuous rise to shutoff, this use shall be	
54	Parallel operation	Yes	
55	Thermal minimum flow , m3/hr	To be mentioned by Bidder	
56	Stable minimum flow, m3/hr	To be mentioned by Bidder	
57	BEP of the offered pump, m3/hr	Rated flow shall be within 110% of best efficiency flowrate	
58	Preferred operating range	70% to 120% of best efficiency flowrate	
59	Allowable operating range	To be mentioned by Bidder	
60	Pump End of the curve flow, m3/hr	To be mentioned by Bidder	
61	Pump rated impeller dia, mm	To be mentioned by Bidder	
62	Pump max. impeller dia, mm	To be mentioned by Bidder	
63	Pump minimum impeller dia., mm	To be mentioned by Bidder	
64	Min. 5% head rise possible as per API	To be mentioned by Bidder	
65	Balance leak off connection & Recirculation connection	Back to Pump suction line	
66	Back pressure at Pump recirculation line	During detailed engineering Stage	
67	Back pressure at Pump BLO line nozzle	During detailed engineering Stage	
68	BLO flow (m3/hr)	During detailed engineering Stage	
69	BLO pressure (Kg/cm2 g)	During detailed engineering Stage	
70	BLO line safety valve set pressure (Kg/cm2 g)	During detailed engineering Stage	
71	Material of construction	Barrel-Forged carbon steel with austenitic stainless steel [applicable in case of barrel casing pump]	
		Casing [Suction, Delivery and Stage casing] - ASTM A 487 Gr. CA-6NM	
		Shaft- ASTM A276 - Type 410 or 420 / ASTM A473 - Type 420	
		Impeller- ASTM A743 Gr CA6NM or A487 Gr CA6NM	
		Wearing ring – 11.5 to 13.5% chromium steel properties with ant galling properties	
		Balancing drum bush- 11.5 to 13.5% chromium steel properties with ant galling	
		Balancing Drum - Stainless steel	
		Shaft Sleeves - ASTM A276 - Type 410 or 420	
Note: In case of any difficulty bidder to quote equivalent or superior MOC of Pump.			
72	Type of axial thrust balancing arrangement	Balancing Disc/Drum	
73	Type of main bearings for pump	During detailed engineering Stage	
74	Main bearings lubrication	During detailed engineering Stage	
75	Type of thrust bearings for pump	During detailed engineering Stage	
76	Thrust bearing lubrication	During detailed engineering Stage	
77	Direction of rotation of Pump as seen from DE	During detailed engineering Stage	
78	Direction of rotation of Motor as seen from DE	During detailed engineering Stage	

79	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.	
80	Coupling standard	As per Manufacturer Std.	
81	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	
82	LO System (IfApplicable)	(a) Forced oil lubrication system shall be as per Manufacturing Std. (b) The interconnection piping between the equipment & Lube oil system.	
83	Flushing Plan - SS tubing shall be used for seal flushing plans	To be mentioned by Bidder	
84	Cooling Plan	To be mentioned by Bidder	
85	Total Cooling Water Quantity required for Pump, Motor,LO Skid(If Applicable), m3/hr	To be mentioned by Bidder	
86	ARC valve type	Modulating type	
87	ARC valve material of construction	Body: CS body ,Internals:SS	
88	ARC Valve size	The ARC valve size shall be as per Bidder's recommendation, however not less than Pump discharge nozzle size.	
89	ARC valve pressure drop	0.91 Kg/cm2 (maximum) a. ARC Valves to be selected in such a way that the pressure drop at guarantee condition is 0.91 kg/cm2. b. 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 0.91 kg/cm2 only. This is to ensure flexibility of operating system at marginally higher flows as per site conditions if any.	
90	IBR certification	IBR certification is required for ARC valve	
91	Suction strainer type	Y-Type	
92	Suction strainer material of construction	Body: CS Internals: SS	
93	Suction strainer size	Same as Suction pipe size	
94	Suction strainer mesh size	Bidder to select the suitable mesh size of the screen for strainer based on the actual pump clearances.	
95	Free flow area of the strainer element	4 times the BHEL inlet pipe area	
96	Strainer pressure drop	0.14 Kg/cm2 in 50% clogged conditions @ condition-1	
97	IBR certification	IBR certification is required for Strainer	
98	Provision for VMS items	As per clause 5.14 of specification PY51352	
99	Bearing & winding instruments & JB for Pumps , Motors	As per clause 5.15 of specification PY51352	
100	Casing skin temperature monitoring system	As per clause 5.16 of specification PY51352	
101	Warm up arrangemet	As per Manufacturer Recommendation. In case the same is required all the materials (Pipes, Valves, instrument on lines, Orifice Plate etc.) shall be in Bidder’s Scope of supply.	
102	Dry critical speed (rpm)	During detailed engineering Stage	
103	Wet critical speed (rpm)	During detailed engineering Stage	
Drive Motor details			

104	BKW at the rated point		
105	BKW at end of curve		
106	Selected drive rating, KW	Duly meeting clause no 5.2. and Annexure-13 of BHEL tender specification requirement	
Other Details			
107	Performance test standard & tolerance	As per clause no 8.3.0 of specification PY51352	
108	Noise level	85 dBA at a distance of 1.0 m	
109	Maximum vibration level at all operating conditions	As per specification	
110	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	
111	Hydraulic test pressure of casing Kg/cm²(g)	1.5 x MAWP	
112	Pump Suction nozzle - Size - Rating - Standard - Facing - Location		
113	Pump Discharge nozzle - Size - Rating - Standard - Facing - Location		
114	ARC valve inlet/outlet/recirculation sizes - Size - Rating - Standard - Facing - Location		
115	BLO nozzle - Size - Rating - Standard - Facing - Location		

116	Pump Cooling water inlet/outlet sizes - Size - Rating - Standard - Facing - Location		
117	LO Skid Cooling water inlet/outlet sizes(if applicable) - Size - Rating - Standard - Facing - Location		
118	For BHEL Pipe sizes & other terminal point details please refer Annexure-1B		
119	Slected drive rating in kW: Motor Drive Rating(At 50 Deg.C ambient) shall be as per clause no 6.1 of Annexure-13F	Bidder to mention motor kW rating for the motor duly taking care of the requirements.	
Motor Details			
120	Slected drive rating in kW:	Bidder to mention motor kW rating for the motor duly taking care of Technical purchase specification requirements.	
121	Design Standard of Motor	IS 325	
122	Manufacturer	As per Approved Sub Vendor List	
123	Ambient Temperature	50 Deg C All motors shall be designed to operate in humid atmosphere with a maximum ambient temperature of 50 Deg C.	
124	Area classification for motor	Hazardous Area, zone -1 with gas group IIC	
125	Rated Voltage & Frequency	415 V & 50 Hz	
126	Permissible variations in Voltage/ Frequency / Combined	(+/-)/10%/(+/-)/5%/(+/-10%)Any combination of both	
127	No of poles / synchronous speed		
128	Energy efficient class	Motor shall be of Energy efficient, Efficiency class-IE3 confirming to IS 12615 :2011 as per IEC:60034-30	
129	Starting Current as % of FLC	a) For motor rating up to 132KW starting current shall be considered 7.2 times of FLC inclusive of all tolerances. b) For motor rating above 132KW & upto 160KW starting current shall be considered 6.0 times of FLC inclusive of all tolerances.	
130	Method of Starting	Motor shall be capable of starting with DOL	
131	Method of cooling	TEFC	
132	Class of Insulation & Temp. rise	Class F with Temperature rise ltd. to class B	
133	Space Heater	Required for all motors 30 kW and above	
134	Degree of protection/FRP Canopy to be provided	IP 55/Yes	
135	TB Short time-Current & Short time-Time	40 kA , 0.25 Sec	
136	Cable, Cable glands & Lugs	Heavy duty tinned copper type lugs – 36 Nos and double compression nickle brass cable glands -12 Nos 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. Tentative cable sizes is 3Cx2Rx150 sq.mm, Al, XLPE. However, final cable size shall be informed during detailed engineering.	
137	No. of Starts(Cold/Hot)	Motor shall be capable of Three equally spread starts per hour (2 Cold Starts/1 hot start)	
138	Bearing RTDs, Winding RTDs & TGs	As per clause No. 5.0 and Annexure-1 of Specification PY51352	
139	Noise	85 DBA at 1 m distance, in any direction	
140	Vibration	As per IS12075/IEC 60034-14	

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-3
		Rev. No. 00

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Annexure-3

Motor Specification

Revisions: Refer to record of revisions	**Prepared by :**	**Checked by :**	**Approved by :**	**Date :**
	Ratish Kumar	Girish Prasad Palo	Siva Prasad Babu	12.05.18

CHAPTER –E1

ELECTRIC MOTORS

1.00.00 CODES AND STANDARDS

1.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standard (IS) except where modified and / or supplemented by this specification.

1.01.01 Equipment and materials conforming to any other national/ international standard, which ensures equal or better quality, may be accepted. In case of any discrepancy between the standards, the most stringent stipulation shall govern.

1.01.02 The equipment shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules and regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

1.01.03 Indian Standards for the equipment covered under this specification are as follows :

IS 325	:	Three phase induction motors
IS 4029	:	Guide for testing three phase induction motors
IS 4691	:	Degree of protection provided by enclosures for rotating electrical machinery
IS: 12615-2011	:	Energy Efficient Motors
IS 15429	:	Storage, installation and maintenance of DC motors

The vendor shall furnish certificates of acceptance of equipment against industrial risk from authorities like Tariff Advisory Committee etc.The equipment shall be designed and manufactured in full compliance with all the work-accident prevention regulations valid in the locality where the equipment shall be located

2.00.00 DESIGN CRITERIA

2.01.00 General

2.01.01 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

In case of any discrepancy, the driven equipment specification shall govern.

2.01.02 The motors will be installed in hot, humid and tropical atmosphere, highly polluted. Canopy to be provided to all outdoor installed motors.

2.01.03 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure of this specification.

2.01.04 For motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

2.01.05 LT Motors upto 200 KW output rating (at 50 deg. C ambient temperature) shall be Energy Efficient Motors, Efficiency class – IE2, confirming to IS-12615-2011 as per IEC:60034-30.
The Motors with variable frequency drive application shall have energy efficiency class IE1 as per IS -12615-2011.

2.02.00 **A.C. Motors**

2.02.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

2.02.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

2.02.03 The motor name-plate rating shall have at least 15% margin over the input power requirement of the driven equipment at rated duty point.

2.02.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

2.02.05 Motors located in hazardous area shall be flameproof type depending upon the Zone and gas group..

2.03.00 **D.C. Motors**

2.03.01 D.C. motor provided for emergency service shall be shunt/compound wound type.

2.03.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

2.03.03 D.C. Motors shall be similar to A.C. Motors with respect to other features like enclosure type, cooling and class of insulation.

3.00.00 **SPECIFIC REQUIREMENTS**

3.01.00 **Running Requirements**

3.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

3.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

3.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 sec without any damage.

3.02.00 **Starting Requirements**

3.02.01 Motor shall be designed for direct on line starting at full voltage. Starting current shall not exceed 6 times full load current for all HT auxiliaries.

For LT motor the applicable staring current shall be min 7.0 times of full load current without tolerance except for motors rated 0.55 kw and below.

3.02.02 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage. The motor shall be designed to withstand 120% rated speed for two minutes without any mechanical damage.

3.02.03 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals.

3.02.04 Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.

3.02.05 Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.

2.02.06 Cranking motor shall be capable of six equal spread starts per hour, three starts in quick succession and one restart from hot condition .

3.03.00 **Stress During Bus Transfer**

3.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

3.03.02 The motor shall be designed to withstand any torsional and/or high current stresses which may result, without experiencing any deterioration in the normal life and performance characteristics.

3.04.00 **Locked Rotor Withstand Time**

3.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors upto 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.

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

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

3.05.00 **Enclosure**

3.05.01 All motor enclosures shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction.

3.05.02 Motors of large output ratings, located indoor and not directly exposed to dust shall have degree of protection class IPW 55.

3.05.03 For hazardous area approved type of increased safety enclosure shall be furnished.

3.06.00 **Cooling**

3.06.01 The motor shall be totally enclosed fan cooled (TEFC).

3.06.02 For large capacity motors, shall be closed air circuit air cooled (CACA). In case of water-cooling is required for very large motors, prior approval of customer is to be obtained before proceeding with design and manufacture.

3.07.00 **Winding and Insulation**

3.07.01 All insulated winding shall be of copper.

3.07.02 All Motors shall have class F insulation but, limited to class B temperature rise.

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

3.08.00 **Tropical Protection**

3.08.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

3.08.02 All fittings and hardwares shall be corrosion resistant.

3.09.00 **Bearings**

3.09.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application.

3.09.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearings of tilting pad type are preferred.

3.09.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

3.09.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.

3.09.05 Grease lubricated bearings shall be prelubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.

3.09.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.

3.09.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.

3.09.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.

3.09.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage for VFD driven motors.i.e. VFD driven motors shall be provided with insulated bearings for frame size greater than 160

3.10.00 **Noise & Vibration**

3.10.01 The noise level shall be as per IS/IEC.

3.10.02 The peak amplitude of the vibration shall be within I.S/IEC. Specified limits.

3.11.00 **Motor Terminal Box**

3.11.01 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base-plate/foundation

3.11.02 Terminal box shall be capable of being turned 360^{o} in steps of 90^{o}, unless otherwise approved.

3.11.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.

3.11.04 The terminal box shall have sufficient space inside for termination/ connection of XLPE (XLPE (415V) insulated armoured aluminium cables.

3.11.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

3.11.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non- driving end of the motor.

3.11.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

3.11.08 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands.

3.11.09 The gland plate for single core cable shall be non-magnetic type.

3.11.10 In case of motor terminal box being not suitable for specified cable size/number, suitable adopter box/extension box shall be provided.

3.12.00 **Grounding**

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

3.12.02 The cable terminal box shall have a separate grounding pad for termination of grounding conductor.

3.13.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

a) Temperature rise in ^{o}C under rated condition and method of measurement.

b) Degree of protection.

c) Bearing identification no. and recommended lubricant.

d) Location of insulated bearings.

3.14.00 **Accessories**

3.14.01 General

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

3.14.02 Space Heater

a) Motor of rating 30 KW and above shall be provided with space heaters, suitably located for easy removal or replacement.

b) The space heater shall be rated 240 V, 1 phase, 50 Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

3.14.03 Temperature Detectors

a) The temperature detector shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0^{o}C.

b) Five numbers of temperature detectors/thermisters shall be provided for LT motors above 90 kW (3 nos winding temps, 2 nos bearing temp.)

3.14.04 Indicator/Switch

a) Dial type local indicator with alarm contacts shall be provided for the following: -

i) 3.3kV motor bearing temperature.

ii) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

b) Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.

c) Alarm switch contact rating shall be minimum 0.5 A at 220V D.C. and 2A at 240V A.C.

3.14.05 Accessory Terminal Box

a) All accessory equipment such as space heater, temperature detector, etc., shall be wired to and terminated in terminal boxes, separate from motor (power) terminal box.

b) Accessory terminal box shall be completed with double compression brass glands and pressure type terminals.

3.14.06 Drain Plug

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

3.14.07 Lifting Provisions

Motor weighing 25 kg. or more shall be provided with eye bolt or other adequate provision of lifting.

3.14.08 Dowel Pins

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

3.14.09 Painting

Motor including fan shall be painted with corrosion proof paints of colour shade Siemens grey (RAL-7032).

3.15.00 Construction

3.15.01 Stator Core

The stator lamination shall be made of high-grade silicon / magnetic steel sheet varnished on both sides and pressed to form rigid core.

3.15.02 Rotor

The rotor construction shall be such that in case of dislodging of the rotor bar from the end ring, it should not come out and hit the stator core/ stator winding and damage.

4.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS: 325 and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of customer's representative.

a. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.

b. Polarization Index Test as per IS: 7816 as routine test.

c. Test for suitability of IPW – 55 as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on the motors as routine test.

d. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.

e. Test for noise level as routine test.

f. Test for vibrations as routine test.

g. Tan delta measurement on coils.

h. Surge withstand test for inter turn insulation.

i. Test to diagnose rotor bar failure during manufacture.

Tests indicated at (h), (i), (j) shall be carried out during manufacture of the coils and shall be furnished for verification.

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-4
		Rev. No. 00

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Annexure-4

Price Bid Format

Revisions: Refer to record of revisions	**Prepared by :**	**Checked by :**	**Approved by :**	**Date :**
	Ratish Kumar	Girish Prasad Palo	Siva Prasad Babu	12.05.18

BHARAT HEAVY ELECTRICALS LIMITED
R.C.PURAM, HYDERABAD-502032

PROJECT ENGINEERING & SYSTEMS DIVISION

PRICE FORMAT (R00) FOR HRSG BFP ASSEMBLY WITH ELECTRIC DRIVE MOTOR
CUSTOMER: GAIL, VIJAIPUR, MADHYA PRADESH,
PROJECT: 2X17.5 TPH – HRSGS
CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS (DCPL), MUMBAI

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/Ring 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 assembly, and 1 sets of spare strainer elements for each pump 1 set stands for requirement for one no. of pump 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.**				
A.4.1	**Pump:**				
a)	Wear rings (set)	2 sets.			
b)	All types of bearings; radial, thrust etc. (each)	1 set.			
c)	Bearing Liners	4 sets			
d)	Mechanical seal(DE +NDE)	2 sets.			
e)	Shaft sleeve	1 set.			
f)	Gaskets/shims/o-rings (set)	2 sets.			
g)	Balancing disc and counter balancing disc (set)	2 sets.			
h)	Bare shaft	1 set.			
i)	Suction filter	1 set			
j)	Tie-rods (if applicable)	1 set			
k)	Automatic Recirculation Valve	1 No.			
A.4.2	**Motor:**				
	Bearing (driving end)	1 No. of each type			
	Bearing (Non-driving end)	1 No. of each type			
	End shield (DE and NDE)	1 No. of each type			
	Cooling fan of motors	1 No. of each type			
	Fan cover	1 No. of each type			
	Lubrication oil pump motor	1 No. of each type & rating			
	Bearing puller	1 No. of each type			
	Grease gun	2 Nos.			
	Special spanners/tools	1 Set			
	Any other small motor	1 No. of each type & rating			
A.4.3	**Instruments**				
a)	Electronic transmitter (Pressure, differential Pressure, Temperature, level etc.) all types	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more			
b)	Limit/Position Switch	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more			
c)	RTD	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more			
d)	Thermo-well for RTD	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more			
e)	Thermocouple	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more			
f)|	Thermo-well for Thermocouple	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more			

BHARAT HEAVY ELECTRICALS LIMITED
R.C.PURAM, HYDERABAD-502032

PROJECT ENGINEERING & SYSTEMS DIVISION

PRICE FORMAT (R00) FOR HRSG BFP ASSEMBLY WITH ELECTRIC DRIVE MOTOR
CUSTOMER: GAIL, VIJAIPUR, MADHYA PRADESH,
PROJECT: 2X17.5 TPH – HRSGS
CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS (DCPL), MUMBAI

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>**				
h)	Gauge (Pressure, Differential pressure, Temperature, level) all types	10% of total nos. used in the system or 2 nos. of each type and model, whichever is more			
i)	Control & instrumentation cable (Type wise)	10% of ordered quantity of each type multiple of 500 meters			
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, 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:				
(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.

	BHARAT HEAVY ELECTRICALS LIMITED **R.C.PURAM, HYDERABAD-502032**				
	PROJECT ENGINEERING & SYSTEMS DIVISION				
	PRICE FORMAT (R00) FOR HRSG BFP ASSEMBLY WITH ELECTRIC DRIVE MOTOR CUSTOMER: GAIL, VIJAIPUR, MADHYA PRADESH, PROJECT: 2X17.5 TPH – HRSGS CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS (DCPL), MUMBAI				
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>**				
9) Reference document: BHEL Doc. No. PY51352 R00 & 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.					

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Annexure-5

Check List

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-5
		Rev. No. 00
		Sheet 2 of 3

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 BHEL specifications.	
Bidder to confirm to the scope of supply as per clause no 5.0.0 of BHEL specification PY51352.	
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 PY51352. Bidder to furnish dully filled in proforma as per Annexure-8.	
Bidder to confirm that motor shall be Ex-Proof for Zone -1 area with Gas Grade - IIC.	
Bidder to confirm that all electrical items & field instrument/JB is suitable to zone - 1 with gas group IIC, Temp Cl. T3.	
Bidder to confirm that all electrical equipment will have CMRI certification.	
Bidder to confirm that Energy Efficiency class-IE3 confirming to IS 12615: 2011 as per IEC: 60034-30.	
Bidder to confirm that the Motors (Suitable for DOL Starting) for BFP is included in their scope of supply.	
Bidder to confirm that motor starting current shall be considered 7.2 times inclusive of all tolerances for motor rating up to 132 KW and 6.0 times of FLC inclusive of all tolerances for moto rating above132 KW and up to 160KW.	
Bidder to furnish a list of commissioning spares. (Refer Cl no 4.0.18 of BHEL specification PY51352.	
Bidder to furnish a list of special tools & tackles. (Refer Cl no 4.0.24 of BHEL specification PY51352.	
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 PY51352.	
Bidder to highlight specific comments on the inspection requirements w.r.t scope of supply. (Refer Cl no 8.0.0 of BHEL specification PY51352).	
Confirm that all Inspection & acceptance, type Tests as required for each equipment, as per specification and Codes attached.	
Bidder to highlight any deviation w.r.t the sub vendor list with proper justification. (Refer Cl no 11.0.0 of BHEL specification PY51352).	
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	
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 and include in their scope of supply.	
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.	
Bidder to quote individual price for each item mentioned in the seal priced bid. Bidder to confirm the same.	

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-6
		Rev. No. 00

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Annexure-6

C&I Specification

BHEL Specification - Void

Revisions: Refer to record of revisions	**Prepared by :**	**Checked by :**	**Approved by :**	**Date :**
	Ratish Kumar	Girish Prasad Palo	Siva Prasad Babu	12.05.18

I1: C&I TECHNICAL SPECIFICATIONS

SECTION-1

FIELD INSTRUMENTS

I1: C&I TECHNICAL SPECIFICATIONS

SECTION-1: FIELD INSTRUMENTS

INDEX

CLAUSE NO.	DESCRIPTION
1.00.00	GENERAL
2.00.00	TEMPERATURE GAUGE
3.00.00	THERMOCOUPLE
4.00.00	RESISTANCE TEMPERATURE DETECTOR (RTD)
5.00.00	THERMOWELL
6.00.00	ORIFICE PLATE
7.00.00	FLOW NOZZLE
8.00.00	FLOW GAUGE
9.00.00	LEVEL INDICATOR
10.00.00	LEVEL GAUGE
11.00.00	PRESSURE GAUGE
12.00.00	DIFFERENTIAL PRESSURE GAUGE
13.00.00	PRESSURE SWITCH
14.00.00	DIFFERENTIAL PRESSURE SWITCH
15.00.00	TEMPERATURE SWITCH
16.00.00	FLOW SWITCH
17.00.00	LEVEL SWITCH
18.00.00	TOP MOUNTED DISPLACER OPERATED LEVEL SWITCH
19.00.00	CONDUCTIVITY TYPE LEVEL SWITCH

20.00.00	PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER
21.00.00	DISPLACER TYPE LEVEL TRANSMITTER
22.00.00	ULTRASONIC LEVEL TRANSMITTER
23.00.00	RADAR TYPE LEVEL INSTRUMENT
24.00.00	RF TYPE LEVEL TRANSMITTER
25.00.00	TEMPERATURE TRANSMITTER
26.00.00	MASS FLOW METER
27.00.00	ROTAMETER
28.00.00	MAGNETIC FLOW METER
29.00.00	VORTEX FLOW METER
30.00.00	ANNUBAR
31.00.00	AIR FILTER REGULATOR
32.00.00	I/P CONVERTER
33.00.00	E/P POSITNER
34.00.00	CONDUCTIVITY ANALYSER
35.00.00	PH CELL AND TRANSMITTERS
37.00.00	DISSOLVED OXYGEN ANALYSER
37.00.00	SILICA ANALYZER (SIOX)
39.00.00	JUNCTION BOXES
39.00.00	TESTING & INSPECTION

I1: C&I TECHNICAL SPECIFICATIONS

SECTION-1: FIELD INSTRUMENTS

1.00.00 GENERAL

1.01.00 The technical specifications are intended as a general guideline and does not relieve Bidder of any responsibility/liability in selection/engineering or meeting any guarantee or availability figures.

1.02.00 The list of C&I equipment sub-vendors proposed by owner/consultant is enclosed in Annexure-3 of Vol-II, Part-C, Chapter–I0 of the tender specifications, for bidder's reference. Detailed purchase specifications, makes & models etc. shall be subjected to Owner's/Consultant's approval. For items, which are not specified in the attached vendor list, BIDDER has to seek prior approval of OWNER before finalization of vendors.

1.03.00 All accessories shall be provided for the instruments on as required basis.

1.04.00 All field instruments shall be Intrinsically safe to Ex- i(a), as per IEC60079-11 with active safety barriers, installed in marshalling panel, irrespective of field hazardous area classification

1.05.00 All field instruments shall be weatherproof to IP65 as a minimum, as per IEC529.

1.06.00 Instrument sensing element and all other wetted parts shall be compatible to the process fluid and operating condition. Diaphragm seal shall be used for slurry, viscous and corrosive application. The wetted part MOC shall be SS316 as a minimum, unless otherwise specified. The mounting hardware like brackets, clamps, nut/bolts etc. shall be of SS304 for all field instruments.

1.07.00 Fluid system temperature sensors shall be equipped with Flanged thermowells as per PTC 19.3. Thermowells shall be flanged having size of 1 ½" and minimum pressure rating of flange as ANSI 300# and constructed from drilled bar stock to allow seal welding after installation. Each thermowell shall be provided with stainless steel extension nipple to extend a sufficient length outside the insulation and lagging for accessibility. Thermowells shall be designed such that the resonance frequency is above the vortex induced vibration. Thermowells shall be IBR certified as per IBR, wherever applicable.

1.08.0 **NO field switches shall be used for pressure, temperature, level and flow interlocks**. These shall be realized through 4-20 m Amp, 24 VDC, 2 wire SMART transmitters only. In general all field instruments shall be 2 wire,

24 V DC, loop powered, SMART with HART protocol and with local LCD. If 2 wire/24 V DC option is not available, as a special case, 230 V AC powered field instrument shall be used with isolated 4-20 ma dc output with HART protocol (For example Mass Flow / Magnetic flow meters, analysers, etc.). Field switches to realize interlocks shall be used only for On-Off control valves position. These shall be 2 wire, NAMUR sensor. These shall be wired with Isolation amplifier/barriers installed in marshalling panels. Other field switches like pressure/level can be used for alarm purpose in PLC.

1.09.0 There shall be separate transmitters/sensors for Control and interlock realization in PLC.

2.00.00 TEMPERATURE GAUGE

2.01.00 TYPE-1

01.	Type	:	Filled System
02.	Material	:	i) Bourdon, Bulb & Capillary - AISI 316 SS ii) Armoring - SS flexible, Movement - AISI 304 SS
03.	Range	:	Normal Operating Temperature 60% - 75% of range (appx.).
04.	Over range Protection	:	125%
05.	Dial size	:	150 mm.
06.	Case & Bezel	:	Die-cast aluminium, black epoxy finish with screwed bezel
07.	Enclosure type	:	Weather-proof to IP-65
08.	Instrument connection	:	3/4 inch NPT/engineering requirement
09.	Connection location	:	Bottom connection for local mounting, back connection for panel mounting
10.	Scale	:	Black numerals on white back ground is 270 deg.
11.	Dial window	:	Crystal clear glass of minimum 3 mm thickness
12.	Pointer	:	Externally adjustable
13.	External zero reset	:	To be provided
14.	Accuracy	:	± 1.0% of FSD
15.	Repeatability	:	Less than 0.5% of FS.
16.	Response Time	:	To be less than 30 seconds in a drilled bar-stock thermowell and 15 sec bare
17.	Thermowell connection size	:	¾" NPTM / ¾", 1" SW as applicable (for Process), ½" NPTF (for Element).

18.	Immersion length	:	To suit individual application requirement
19.	Others	:	Capillary and case compensation, zero adjusting by screw from front.
20.	Applicable standards	:	BS 1041/ ASME PTC 19.3

2.02.00 TYPE-2

1.	Sensing element	:	Bimetal Helical Spring
2.	Stem	:	AISI 316 SS.
3.	Range	:	Normal Operating Temperature 60% - 75% of range (appx.).
4..	Dial size	:	150 mm.
5.	Case & Bezel	:	Die-cast aluminium, black epoxy finish with screwed bezel.
6.	Enclosure type	:	Weather-proof to IP-65
7.	Instrument connection	:	3/4 inch NPT/engineering requirement
8.	Connection location	:	Bottom connection for local mounting, back connection for panel mounting
9.	Scale	:	Black numerals on white back ground is 270 deg.
10.	Dial window	:	Crystal clear glass of minimum 3 mm thickness
11.	Pointer	:	Externally adjustable.
12.	External zero reset	:	To be provided
13.	Accuracy	:	± 1.0% οϕ ΦΣΔ
14.	Repeatability	:	Less than 0.5% of FS.
15.	Response time	:	To be less than 30 seconds in a drilled bar-stock thermowell and 15 sec bare
16.	Over-range protection	:	1.25
17.	Thermowell connection size	:	¾” NPTM / ¾”, 1” SW as applicable (for Process), ½” NPTF (for Element).
18.	Immersion length	:	To suit individual application requirement

19.	Applicable standard	:	BS 1041/ ASME PTC 19.3

3.00.00 THERMOCOUPLE

01.	Element	:	Type K; Ungrounded (Duplex by default); Wire gauge 18AWG for single and 20 AWG for duplex, with extension length as per process requirement.
02.	Connection Head	:	Die Cast Aluminium body and universal screwed cover Zinc plated with S.S retaining chain, heat & moisture proof gaskets and spring loaded ceramic terminal block with SS terminal block fixing screws; IP 65 or better as per IEC 529; dual entry.
03.	Cable gland	:	½" NPT, Double Compression, MOC SS 316, Flameproof to Ex-d IIC/T6 and WP to IP65 or better as per IEC 529, spare entry shall be provided with SS304 blind plug.
04.	Terminal Block	:	Ceramic with Screwed type Brass, Silver plated
05.	Response Time	:	Less than 10 sec for control & 20 sec for measurement.
06.	Protecting Tube	:	AISI 316 SS seamless (8mm OD) filled with MgO powder (99.4% pure) as per ASTM E 585.
07.	Codes & Standards	:	ANSI - MC 96.1 /IEC 584
08.	Ignition protection category	:	EEx-i(a)
09.	Thermowell	:	SS 316 (general purpose) designed as per ANSI PTC 19.3, Sintered tungsten carbide for coal air / flue gas temperature, Alloy Steel for high temperature steam. SS316 for all other service.
10.	Thermowell connection size	:	Flanged 1 ½"; 300# RF as minimum. For 600# and above RTJ.

11.	IBR certificate	:	Required in case of fluid is steam, BFW and condensate.

4.00.00 RESISTANCE TEMPERATURE DETECTOR (RTD)

01	Type	:	PT-100(Duplex), ungrounded, 3 wire, 20 AWG (Extension. Wire - Silver/Constantan) with extension length as per process requirement.
02	Calibration Tolerance	:	As per DIN 43760 /IEC751 Class-A/IS-2848
03	Head	:	Die Cast Aluminium body and universal screwed cover Zinc plated with S.S retaining chain, heat & moisture proof gaskets and spring loaded ceramic terminal block with SS terminal block fixing screws; IP 65 or better as per IEC 529; dual entry.
04	Cable gland	:	½"NPT, Double compression SS 316, Flameproof to Ex-d IIC/T6 and IP65 or better , spare entry shall be provided with SS304 blind plug.
05	Accuracy	:	0.6% (600 Deg.C span) or better – Pls. Confirm, it should be in absolute resistance change or degree C.
06	Stability	:	0.05% after thermal cycling
07	Response	:	Less than 10 sec for control & 20 sec for measurement.
08	Protecting Tube	:	AISI 316 SS seamless (6 mm OD) filled with MgO powder (99.4% pure) as per ASTM E 585.
09	Element hot junction type	:	Platinum Resistance Bulb Encapsulation Glass Or Ceramic pot. Hermetically Sealed

10	Thermowell	:	SS 316 (general purpose) designed as per ANSI PTC 19.3,. Sintered tungsten carbide for coal air / flue gas temperature, Alloy Steel for high temperature steam. SS316 for all other service.
11	Thermowell connection size	:	Flanged 1 ½"; 300# RF as minimum. For 600# and above RTJ.
12	Codes & Standards	:	IS-2848/ DIN-43760/IEC-751
13	IBR Certificate	:	For BFW, steam and condensate
14	Ignition protection services category	:	EEx-i(a)

5.00.00 THERMOWELL

a) Thermowells shall be provided for all thermocouples, resistance temperature detectors, temperature switches and direct reading thermometers except for temperature sensors used for metal temperature bearing casing temperature measurements.

b) The design of thermowell shall take into consideration the temperature, pressure and velocity of the fluid.

c) Standard : ASME PTC - 19.3 - 1974

d) Design : Tapered design and drilled from solid bar stock. For flue gas/furnace applications protecting sheath/tube of adequate strength with welded cap on the end located inside the duct shall be provided.

e) Material : In general AISI 316 SS, 440C SS may be used for furnace/flue gas applications.

f) Connection : Process connections of thermowells shall be suitably selected based on the process temperature and pressure and OEM standards during detailed engineering.

g)	Bore	:	Suitable for insertion of the respective temperature elements.
h)	Calibration	:	Temperature elements with thermowells, shall be calibrated with the specified thermowell as per assembly.
i)	IBR Certificates	:	Shall be provided for all thermowells as steam & feed water application.

6.00.00 ORIFICE PLATE

01.	Design Standard	:	i) BS-1042 : Part-II; 1984 ii) ASME PTC19.5 (1972) [Interim supplement Part-II] iii) ISO 5167 iv) ANSI B16.36
02.	Measuring element	:	Square edge orifice
03.	Element Material	:	AISI-316 SS (For 4" & above with carrier ring)
04.	Construction	:	With integral handle with Orifice Plate data stamped on upstream side with 6 mm lifting hole.
05.	Pressure tap / Meter Run	:	Flange / D-D12, Qty. Min. 2 pairs, extra as required/ Meter run for size less than 2" with integral orifice assly.
06.	Flange material	:	Same as piping MOC, min ANSI 300#
07.	Beta ratio	:	0.4 to 0.7
08.	No. of Root Valves	:	i) Two for static pressure above 40 kg/cm^2 ii) One for static pressure upto 40 kg/cm^2
09	Carrier Ring	:	Required for size above 4" and higher
10	Pair of Jack Screw	:	Required for size 3" and above

11	Flange Rating	:	Min. ANSI 300#, for pipe class 600# and above, RTJ.
12	Diff. Range	:	For static pressure between 1 to 2.5 kg/cm2g : < 500 mmwc, for static pressure between 2.5 to 5 kg/cm2g < 1250 mmwc, for static pressure above 6 kg/cm2: 2500 mmwc

7.00.00 FLOW NOZZLE

01.	Design Standard	:	i) BS 1042 ii) ASME PTC 19.5 (1972) [Interim supplement Part-II] iii) ISO 5167
02.	Material of Nozzle	:	AISI 316 SS / 321 SS
03.	No. of Root Valves	:	i) Two for static pressure above 40 kg/cm^2 ii) One for static pressure upto 40 kg/cm^2

8.00.00 FLOW GAUGE

01.	Type	:	Orifice based
02.	Accuracy	:	±2% Full scale deflection (D.P.)
03.	Max. Line Pressure	:	30 bar (depending on gauge model)
04.	Overload	:	7 bar (depending on gauge model)
05.	Wetted Parts	:	Brass as standard Stainless steel, if process requires
06.	Max. Temperature	:	80° C

9.00.00 LEVEL INDICATOR

01.	Type	:	Float type mechanical level gauge with linear scale

02.	Accuracy	:	± 1.0% of scale range
03.	Material	:	To suite process, Wetted part MOC : SS316 as a minimum or better. Gauge Board - Al. Epoxy Supports - M.S. Guide Wire & Float - AISI 316 SS Elbow - Al. Indicator - Al. & SS
04	Orientation		Side/Side
05	Max. Length		1500 mm

10.00.00 LEVEL GAUGE

01.	Type	:	Reflex/ Transparent type
02.	Material	:	As per process requirement, Wetted part MOC=AISI 316 SS (Liquid Chamber) as a minimum, Tempered Borosilicate (Glass)
03.	C-C distance, end conn. & rating	:	As per process requirement
04.	Visible Length	:	Not less than top & bottom levels of liquid (more than one assembly may be used , if required)
05.	Accessories	:	Two nos. gauge valves with integral ball check.
06.	Mounting		Side/Side
07.	Max. Length		1500 mm
08.	IBR Form IIIC		As per process requirement for BFW, Steam and condensate
09.	Illuminator		Not required
10.	GA DRAWING		Required

11.00.00 PRESSURE GAUGE (WITH AND WITHOUT SEAL)

11.01.00 PRESSURE GAUGE

01.	Type	:	Direct reading
02.	Sensing Element	:	Bourdon/Bellow/Diaphragm - AISI 316 SS or as applicable.
03.	Movement	:	AISI 304 SS or non-ferrous for Phosphor Bronze Bourdon as per process requirement.
04.	Case	:	S304, conforming IP 65
05.	Bezel ring	:	SS 304
06.	Lens	:	Shatter proof glass
07.	Dial Size	:	150 mm, in general.
08.	Dial colour	:	Black Numerals on white background
09.	Pointer type	:	Micrometer screw type
10.	Process connection	:	Bottom/Rear, ½" NPT (M)
11.	Range Selection	:	Normal Operating Pressure 60% - 75% of range approx.
12.	Accuracy	:	±1.0% of span
13.	Others	:	External zero adjustment facility required
14.	Gauge saver	:	Non-bleed type with internal pressure release/block.
15.	Ambient Temperature	:	0 - 50 Deg.C
16.	Over range protection	:	Required as per IS 3624 or latest/1.3 times the calibrated range for min. 30 minutes
17.	Blow out protection	:	Required as per IS 3624 & for > 60Kg/cm2. Solid front type.

18.	Applicable Standard	:	IS : 3624/PTC 19.2/BS 1780
19.	Enclosure protection	:	IP 65 or better as per IEC 529
20.	Accessories	:	Pulsation dampener, Syphon, Diaphragm seals, as required. SS316 MOC, 2 valve manifold (½" NPT(F)) is required for all Pressure gauges.

11.02.00 PRESSURE GAUGE WITH SEAL

01.	Type	:	Direct reading
02.	Sensing Element	:	Bourdon/Bellow/Diaphragm - AISI 316 SS or as applicable.
03.	Movement	:	AISI 304 SS or non-ferrous for Phosphor Bronze Bourdon as per process requirement.
04.	Case	:	SS 304, conforming IP 65
05.	Bezel ring	:	SS 304
06.	Lens	:	Shatter proof glass
07.	Dial Size	:	150 mm, in general.
08.	Dial colour	:	Black Numerals on white background
09.	Pointer type	:	Micrometer screw type
10	Process Connection	:	2" Flanged min. rating 300# (higher ratings may be required as per pipe class), Flange MOC SS316 as a min.(better to suit process) For remote seal type, 2" x 300# ANSI min. flange rating, for 600# and above RTJ. All remote seal PG shall be provided with SS316 MOC calibration/spacer ring of suitable size/rating with drain/vent valve/plug for on-line zero check/calibration.
11.	Studs & Nuts	:	ASTM A193GrB7 & ASTM A 194 CLASS 2H
12.	Range Selection	:	Normal Operating Pressure 60% - 75% of range approx.
13.	Accuracy	:	±1.0% of span

14.	Others	:	External zero adjustment
15.	Gauge saver	:	Non-bleed type with internal pressure release/block.
16.	Ambient Temperature	:	0 - 50 Deg.C
17.	Over range protection	:	Required as per IS 3624 or latest/1.3 times the calibrated range for min. 30 minutes
18.	Blow out protection	:	Required as per IS 3624 & for > 60Kg/cm2. Solid front type.
19.	Applicable Standard	:	IS : 3624/PTC 19.2/BS 1780
20	Accessories	:	Pulsation dampener, Syphon, Diaphragm seals, 2 valve manifold etc. as required.
21	Seal Matl & capillary length	:	SS 316L as a minimum (Better to suit process) / 5 meter, Capillary shall be SS armoured with PVC coating.
22	Gasket Matl.	:	Teflon
23	Seal fluid	:	Suitable for operating temperature
24	Enclosure protection	:	IP 65 or better as per IEC 529
25	Accessories	:	All Dia. Seal type Pressure gauges shall be provided with SS316 (or better MOC to suit process) **calibration/spacer ring** with ¼" NPT needle valve and ¼" NPT blind plug of SS316 MOC.

12.00.00 DIFFERENTIAL PRESSURE GAUGE

(To be used only for alarm purpose and not to be used in interlock. All interlock shall be realized with 24 V DC, 4-20 ma, SMART Diff. Pressure Transmitters.)

01.	Type	:	Bellows/Diaphragm
02.	Sensing Element	:	AISI 316 SS or better to suit process.

03.	Enclosure/Bezel Ring MOC	:	SS304, conforming IP 65
04.	Dial Size	:	150 mm, in general.
05.	Range Selection	:	Normal Operating D.P. 50% - 70% of range approx.
06.	Accuracy	:	±1.0% of span
07.	Repeatability	:	Less than 0.5% of FS
08.	Others	:	External Zero Adjustment, 5 way -Valve SS Manifold

13.00.00 PRESSURE SWITCH (WITH AND WITHOUT SEAL)

(To be used only for alarm purpose and not to be used in interlock. All interlock shall be realized with 24 V DC, 4-20 ma, SMART Pressure Transmitters.)

13.00.01 PRESSURE SWITCH WITHOUT SEAL

01.	Type	:	Bellow or Diaphragm, Blind type.
02.	Sensing Element	:	AISI 316 SS or other as applicable
03.	Enclosure / Process Connection / Cable Entry	:	Die cast aluminium conforming IP 65 with epoxy paint, / ½" NPT(F) with SS 316 MOC 2-way manifold/ WP to IP65 or better, Flameproof to Ex-d IIC/T6, Double compression cable gland.
04.	Over range protection	:	150% of range
05.	Switch Type	:	Snap acting micro switch, shock & vibration proof. Hermetically sealed.
06.	Configuration / Rating	:	2 nos. SPDT, 240V AC/5A, 220V DC/0.5A
07.	Adjustability		i) Set point over span range
			ii) Differential by 10% of span

08.	Accuracy	:	±1%
09.	Dead band	:	Fixed,min.
10.	Repeatability	:	Less than 0.5%
11.	Ignition protection category	:	EEx-I(a) as per CENELEC/ATEX
12.	Ingress protection	:	IP 65 or better as per IEC 529
13.	Accessories	:	½" NPT(F) 2-Valve SS Manifold and Diaphragm seal with capillary and SS316 spacer ring, as required.

13.00.02 PRESSURE SWITCH WITH SEAL

01.	Type	:	Diaphragm
02.	Ignition protection category	:	EEx-i(a) as per CENELEC / ATEX
03.	Ingress protection	:	IP65 OR Better as per IEC529
04.	Housing mtl.	:	Die cast aluminium with epoxy paint
05.	Sensor / flange matl.	:	SS 316L or better to suite process.
06.	Process conn.	:	2" 300# RF Min. Flange MOC = SS316 as min. For 600# & above pipe class RTJ flange. Each Dia. Seal type Pressure switch shall be supplied with 1 no. of SS316 (or better to suite process) MOC Calibration/spacer ring with ¼" NPT SS316 needle valve and ¼" NPT blind plug for vent.
07.	Contact rating	:	SPDT 2A, 24VDC
08.	Dead band	:	Fixed
09.	Switch type	:	1 NO + 1 NC SPDT Switch Hermitically sealed.

10.	Seal fluid	:	To suit process temperature
11.	Cable entry	:	1/2" NPT (F)
12.	Cable Gland	:	½"NPT, Double compression SS 316, Flameproof to Ex-d IIC/T6 and IP65 or better, spare entry shall be provided with SS304 blind plug.

14.00.00 DIFFERENTIAL PRESSURE SWITCH

01.	Type	:	Bellow or Diaphragm, Blind type.
02.	Sensing Element	:	AISI 316 SS or other as applicable
03.	Enclosure / Process connection / Cable Entry	:	Die cast aluminium conforming IP 65 with Epoxy Paint, ½" NPT/ ½" NPT (F) with SS MOC, WP to IP65, Flameproof to Ex-d IIC/T6, Double compression cable gland.
04.	Ignition protection category	:	EEx-I(a) as per CENELEC/ATEX
05.	Over range Protection	:	Static pressure on one side, the other side being open to atmosphere
06.	Switch Type	:	Snap acting micro switch, shock & vibration proof, hermetically sealed
07.	Configuration / Rating	:	2 nos. SPDT, 240V AC/5A, 220V DC/0.5A, Hermetically sealed.
08.	Adjustability		i) i) Set point over span range ii) Differential by 10% of span
09.	Accuracy	:	±1%
10.	Repeatability	:	Less than 0.5%
11.	Accessories	:	5- Valve SS 316 Manifold, ½" NPT(F)

15.00.00 TEMPERATURE SWITCH

01.	Type	:	Filled in system / Bimetallic strip, blind type
02.	Material	:	i) Bourdon, Bulb & Capillary - AISI 316 SS ii) Armoring-SS, Movement - AISI 304 SS
03.	Enclosure	:	Die cast aluminum conforming IP 65
04.	Ignition protection category	:	EEx-I(a) as per CENELEC/ATEX
05.	Switch	:	2 nos., SPDT, 230 V AC/5A, 220 V DC/0.5A, Shock & Vibration proof
06.	Accuracy	:	± 1%
07.	Repeatability	:	Less than 0.5%
08.	Adjustability	:	i) Set point adjustable over the span externally. ii) Differential adjustable by 20% of span (minimum).
09.	Overrange Protection	:	125%
10.	Cable Entry	:	½" NPT(F) with SS MOC, WP to IP65 or better, Flameproof to Ex-d IIC/T6, Double compression cable gland.

16.00.00 FLOW SWITCH

01.	Type	:	Paddle Type
02.	Switches	:	SPDT 2 nos., 230 V AC/5A, 220V DC/0.5A. Magnetic operated in a hermetically sealed enclosure.
03.	Adjustability		i) Set point throughout the range. ii) ON-OFF differential
04.	Repeatability	:	±0.5% of F.S. or better
05.	Material	:	Paddle - AISI 316 SS,

06.	Enclosure	:	Die cast aluminium conforming IP 65
07.	Ignition protection category	:	EEx-I(a) as per CENELEC/ATEX
08.	Cable Entry	:	½" NPT(F) with SS MOC, WP to IP65 or better, Flameproof to Ex-d IIC/T6, Double compression cable gland.

17.00.00 LEVEL SWITCH

01.	Type	:	External Cage float operated. Magnetically coupled.
02.	Material	:	Float & Wetted Parts - AISI 316 SS External Cage – CS (welded)
03.	Enclosure / Cable Entry	:	Die cast aluminium with epoxy paint, conforming IP 65 or better as per IEC 529 / ½" NPT(F) with SS MOC, WP to IP65 or better, Flameproof to Ex-d IIC/T6, Double compression cable gland.
04.	Type of Switch	:	External Cage float operated. Magnetically coupled. Side mounted, Direct on vessel
05.	Contact type / Rating	:	Snap acting micro switch, magnetically operated, shock & vibration proof, hermetically sealed. 2 nos. SPDT, 240V AC/5A, 220V DC/0.5A.
06.	Adjustable set point	:	Required
07.	Repeatability	:	Less than 0.5%
08.	Tapping/Process connection	:	Flanged, 2" x 300 RF As a minimum, Higher rating 600# and onwards shall be with RTJ flange.
06.	C-C distance	:	As per process requirement

10.	Ignition protection category	:	EEx-I(a), IIC, T6 as per CENELEC/ATEX
11.	IBR requirement	:	For steam/BFW/condensate

18.00.00 TOP MOUNTED DISPLACER OPERATED LEVEL SWITCH

01.	Displacer	:	SS 316
02.	Displacer Assembly	:	ANSI SS 316 Stainless Steel
03.	Wire Rope / Spring	:	SS 316
04.	Guide Pipe	:	Mild Steel
05.	Process Connection	:	ANSI CS Flange with Gaskets, Nuts & Bolts; rating as per process pressure and temperature
06.	Repeatability	:	±3 mm or better
07.	Switch Housing	:	Die cast Aluminium with anti-corrosive paints
08.	Switching Differential	:	Adjustable
09.	Switch Housing Protection	:	IP-65
10.	Type of Switch	:	Snap acting, vibration resistant, mercury bottle or hermitically sealed micro switch type magnetically coupled to the displacer.
11.	Switch Configuration	:	2 SPDT
12.	MOC of Switching Mechanism	:	AISI 304 Stainless Steel
13.	Contact Rating	:	5A, 230 V AC / 0.5A, 220 V DC
14.	Cable Entry	:	¾” ET
15.	Cable Gland	:	SS MOC, WP to IP65 or better, Flameproof to Ex-d IIC/T6, Double compression

16.	Accessories	:	a) Counter flange, nuts & bolts, suitable gasket etc. ; rating as per process pressure and temperature b) SS Tag Plate etc.
17.	Safety Feature	:	Neoprene Safety Diaphragm (Blowout disc) at the back
18.	Preferred Feature	:	Switch operating point marked on cage.
19.	Ignition protection category	:	EEx-I(a), IIC, T6 as per CENELEC/ATEX

19.00.00 CONDUCTIVITY TYPE LEVEL SWITCH

01.	Type	:	Based on difference of conductivity of air/water.
02.	Construction	:	External Cage - CS (welded), Side/Side Flanged mountable
03.	Mounting	:	Flanged – on standpipe.
04.	Probe / Float & Wetted Parts Material	:	AISI SS316.
05.	Probe rating	:	> Maximum design pressure of vessel.
06.	Input	:	Four independent channel with selectable switching threshold for water conductivity.
07.	Relay Output	:	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
08.	Contact type & rating	:	SPDT 2Nos., Electrically isolated 240 V AC/5A, 220 V DC/0.5A, hermetically sealed
09.	Local Display	:	Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.
10.	Power supply	:	230 V AC 50- Hz.

11.	Enclosure	:	Dual Compartment type, IP–65 or better as per IEC 529, corrosion resistant & wall mounting type.
12.	Remote indicator	:	Remote at Control room with bar graph display
13	Accessories	:	i) PTFE cable from probe to electronics ii) Mounting accessories iii) Standpipe iv) Washer & gasket
14.	Test pressure	:	Two times rated pressure
15.	Cable connection	:	½" NPT (F) with SS MOC, WP to IP65 or better, Flameproof to Ex-d IIC/T6, Double compression cable gland.
16.	Tapping/ Process connection	:	2" ; min. rating 300# (higher ratings may be required as per pipe class, for 600# and above RTJ flange)
17.	Nos. of probes	:	Depending on C=to=C length, min. 5% step.
18.	Repeatability	:	Less than 0.5%

20.00.00 PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER

01.	Type	:	Silicon Res. / Piezo / Capacitance type, 2-wire, 24 V DC, Loop powered, SMART with HART protocol with local LCD.
02.	Output	:	4-20 mA DC, Linear, Superimposed Digital Signal HART.
03.	Material	:	Measuring Capsule - AISI 316 SS or better; Body Stainless Steel as a minimum or better as per fluid application.

04.	Sensor (Diaph. / Capsule) and lower housing / Material		Diaphragm / SS 316L min. Or better to suite process.
05.	Span & Zero	:	Continuously adjustable externally non-interacting, both local and remote calibration facility.
06.	Enclosure Class	:	Dual compartment type, Die cast aluminium conforming IP 65 or better as per IEC 529, with Epoxy paint as a minimum
07.	Ignition protection category	:	EEx-i(a) with CENELEC/ATEX approval.
08.	Ambient Temp.	:	0 - 50 Deg.C
09.	Accuracy	:	± 0.1% of span or better
10.	Range	:	About 1.5 times normal value (min.)
11.	Repeatability	:	± 0.05% of span or better
12.	Sensitivity	:	0.05% of span or better
13.	Drain / Vent Valve Material	:	Required / SS316
14.	Adapter 'O' Ring	:	PTFE
15.	Body/Element Rating	:	1.5 times the maximum span / Full static Pressure on one side with other side venting for DPT , Min. 250 Kg/Cm2
16.	Over range limit	:	150% of maximum span.
17.	Turn down ratio	:	40:1 or better
18.	Output Indicator	:	Integral LCD Type with engg. Unit display
19.	Hand held calibrator	:	Required
20.	Instrument Valve Manifold	:	2 way manifold with SS MOC for all PTs / 5 way manifold with SS MOC for all DPTs (COPLANAR design not acceptable for DPT)

22.	Transmitter assembly bolts, screw & nuts material	:	Required with SS 316 flanges for DPTs, other parts MOC SS 316
22.	Mounting Accessories		Suitable for 2" pipe mounting with SS MOC mounting brackets and nut/bolts.
23.	Cable gland		NPT, SS Double Compression WP to IP-65 or better, Flameproof to Ex-d IIC/T6

21.00.00 DISPLACER TYPE LEVEL TRANSMITTER
(This shall be used only for interface type level measurement)

01.	Type		:	24 V DC, 2 wire, 4-20mA, SMART with HART protocol
02.	Float movement		:	Vertical
03.	Stages of operation		:	Continuous
04.	Material -			
	a)	Displacer/Float /Drain valve	:	AISI 316 SS/304 SS
	b)	Wire rope, spring housing, sleeve pipe	:	AISI 304 SS/316 SS
	c)	Torque tube	:	Inconel Only
	d)	Transmitter Encl	:	Dual compartment type, Die cast aluminum with Expoxy paint, ½" NPT cable entry with SS MOC double compression WP to IP65 cable gland.
05.	Transmission		:	2-wire, 24 V DC, Loop powered
06.	Output Signal		:	Simultaneous transmission of digital and 4-20 mA DC signal with HART protocol
07.	Signal processing		:	Solid-state electronic circuitry, Microprocessor based
08.	Static/overload pressure		:	Maximum static pressure without permanent deformation or loss of accuracy.

09.	Turn-down ratio	:	10 : 1 minimum
10.	Zero & Span	:	Easily accessible (local zero & span adjustment and non-interactive type)
11.	Zero Suppression / elevation	:	i) Suppression = 150 % of span (min.). ii) Elevation = 50 % of span (min.).
12.	Enclosure Class	:	WP to IP-65 or better as per IEC 529 and Intrinsically safe to EEx-I(a) certified by CENELEC/ATEX.
13.	Body/Cage	:	Side/side mounting with 2" x300 # as minimum flange size/rating. For 600# and above, RTJ rating, Forged Carbon Steel or Stainless Steel depending upon fluid condition.
14.	Nozzle size, rating, orientation, matl.	:	2" ;300# RF Min., Side-Side, SS 316 . For pipe class 600# and above all Flanges shall be RTJ type
15.	Nozzle c/c distance	:	As per process requirement
16.	Output Indicator	:	Integral LCD type in Engg. Unit/ %
17.	Performance -		
	a) Accuracy/Linearity	:	±0.5 % of span or better
	b) Repeatability	:	±0.05 % span or better
18.	Ignition protection category	:	EEx-I(a)IIC T6
19.	Accessories	:	i) ANSI RF Counter Flange; rating as per process pressure. Necessary nuts, bolts, gaskets etc. ii) Special calibration tool / configurator, if any. iii) Stilling chamber
20.	Cable gland	:	SS Double Compression WP to IP-65 or better, Flameproof to Ex-d IIC/T6

22.00.00 ULTRASONIC LEVEL TRANSMITTER

01.	Type	:	Microprocessor based , Smart (HART)
02.	Mounting	:	Wall / Pipe
03.	Displacer	:	LCD
04.	Enclosure Class	:	WP to IP-65 or better as per IEC 529 and Intrinsically safe to EEx-I(a) certified by CENELEC/ATEX.
05.	Accuracy	:	0.25% of measured range or better
06.	Resolution	:	0.1% of span or better
07.	Power Supply	:	24 V DC, 50 Hz
08.	Output	:	4-20 mA DC (2-Wire)
09.	Cable Length	:	25 Meters (minimum)
10.	Accessories	:	a) Transducer & Counter Flange with Nuts, Bolts & Gaskets. ; rating as per process pressure and temperature b) SS Tag Plate etc. c) SS Double Compression WP to IP-65 or better, Flameproof to Ex-d IIC/T6 cable gland

23.00.00 RADAR TYPE LEVEL INSTRUMENT

01	Type	:	2 wire, Radar instrument with ROD type Antenna
02	Power supply	:	24V DC Loop powered
03	Transmitter	:	2 wire transmitter, SMART with HART protocol with 4-20 mA

04	Transmitter Housing MOC	:	Dual Compartment type with Die cast aluminum MOC with epoxy paint
05	Wetted Part MOC	:	SS316 as a minimum, better to suite process.
06	Connection / Size	:	Flange type / 3" 300# RF (Min Size / Rating) Flange MOC: SS316
07	Ignition Protection category	:	EEx-i(a) certified by CENELEC/ATEX
08	Ingress protection	:	IP 65 OR Better as per IEC 529
09	Display	:	Local LCD display
10	Options	:	Dual Compartment transmitter housing with Epoxy Paint
11	Nozzle height	:	150 mm min for process connection
12	Options	:	For side mounted chamber installation, the Radar will be guided wave antenna type with all other specifications same as above. Additionally there shall be Calibration / Spacer Ring for this type of RADAR with SS316 MOC, suitable for pipe class ratings.) with SS316 MOC blind plug/needle valves.
13.	Cable Gland	:	SS Double Compression WP to IP-65 or better, Flameproof to Ex-d IIC/T6 cable gland

24.00.00 RF TYPE LEVEL TRANSMITTER:

1	Type	:	RF Capacitance type
2	Probe material	:	SS 316

3	Enclosure class	:	WP to IP 65 or better as per IEC 529 and Intrinsically safe to EEx-I(a) certified by CENELEC/ATEX.
4	Power supply	:	24 V DC / 230 VAC
5	Output	:	a) 4 –20 mA DC
		:	b) 2 SPDT or 1 DPDT @ 5A, 30 VDC.
6	Repeatability	:	less than 0.5%
7	Mounting	:	On vessel. Suitable mounting accessories to be supplied
8.	Cable Gland	:	SS Double Compression WP to IP-65 or better, Flameproof to Ex-d IIC/T6 cable gland

25.00.00 TEMPERATURE TRANSMITTER

(All temperature transmitters shall be SMART, field mounted, dual compartment type. Head mountable temperature transmitters are not acceptable in whole project)

01.	Type	:	Solid State, Microprocessor based, 24 V DC, 2 wire, SMART with HART protocol.
02.	Input	:	Universal input type with all types of 2/3/4 wire RTD as per IEC751 and all types of diff. T/C inputs as per IEC584 (both grounded/ungrounded)
03.	Output	:	4-20 mA DC, Linear, Superimposed Digital Signal with HART protocol.
04.	Adjustments	:	Zero & Span, Local & Remote calibration facility. In-built cold, junction compensation for T/C
05.	Enclosure Class	:	Dual Compartment type, Die cast aluminium conforming IP 65 or better as per IEC 529 with Epoxy paintas a minimum and 2 nos. of ½" NPT(F) cable entry.

06.	Cable Gland	:	½" NPT(F), SS Double Compression WP to IP-65 or better, Flameproof to Ex-d IIC/T6
07.	Accuracy	:	± 0.1% of span
08.	Zero Drift	:	1 micro volt per Deg.C or better
09.	Mounting Brackets	:	2" Pipe mounting, Head Mounted temperature transmitters are not acceptable. Mounting bracket / nut/bolts with SS MOC.
10.	Local Display	:	LCD type, Integral, with Engg. Unit facility.
11.	Burn out	:	Programmable with last good value, High/low value
12.	Electrical Protection	:	EEx-i(a), Certified by ATEX/CENELEC and Weatherproof to IP65 as per IEC529

26.00.00 MASS FLOW METER

(Mass flow meters with weights & measures approval shall be used for all custody / gtr data)

01.	Application	:	Measurement of Oil Flow/ Gas flow and all other custody transfer parameters and all GTR related data.
02.	Working Principle	:	Coriolis principle.
03.	Type	:	Smart with HART protocol, 4 wire for Flow/Density measurement.
04.	Output	:	1 no. of isolated 4-20 mA DC, Linear, Superimposed Digital Signal. With HART protocol, as well 0-10KHz pulse output and 1 no. of RS485 ouput.
05.	Material of Wetted Parts	:	SS 316 L or better to suit process.

06.	Enclosure	:	IP 65 corrosion proof/ Flame proof to Ex-d IIC / T6 certified by CENELEC/ATEX is must. Only FM Explosion proof versions are not acceptable.
07.	Accuracy	:	±0.1% of F.S.
08.	Display	:	4 line LCD for flow rate, temp, density & total flow. With local push button for programming.
09	Transmitter Housing MOC	:	Die cast aluminum with Epoxy paint with ½" NPT cable entry for sensor cable, various output cables, 1 for each.
10.	Transmitter type	:	Remote mount type with 15 mtr. Armored Signal cable between sensor/flow tube and transmitter. Transmitter shall be 2" pipe mountable with SS mounting hardware.
11	Power Supply	:	230 V AC, 50 Hz.
12	Other Approval	:	Weights And Measures approval is must.
13	Meter size	:	Same as pipe line or shall be selected such that at max. flow, the pressure drop shall not exceed 0.2 kg/cm2
14	Meter End Connection	:	Flanged, SS316 as a minimum or better MOC to suite process, Rating shall be ANSI 300# as a minimum, for 600# and higher, RTJ
15	Sensor/Transmitter cable	:	Min. 15 meter with each unit, SS armoured signal cable
16	Cable Entry	:	½" NPT(F) with SS304 MOC, double compression, Flameproof to Ex-d IIC/T6 and WP to IP65 cable glands
17	Mounting Hardware	:	Remote Transmitter Mounting material with SS304 MOC clamps, Nut/bolts, etc.

27.00.00 ROTAMETER

01	Line Size, rating	:	Equal to line size, End connections shall be Flanged with min. 300# rating. For pipe class 600# and above, RTJ flange end
02	Environ. Protection	:	IP-65 OR Better as per IEC 529
03	Meter tube	:	Metal tube only
04	Meter size/rating	:	Same as line size
05	Meter tube material	:	SS316 Min.
06	Float material and other wetted part MOC	:	SS 316 min.
07	Meter housing material	:	Die cast Aluminium with epoxy paint
08	Meter scale range / Flow min/nor/max	:	Manufacturer to specify / As per process requirement
09	Rangeability	:	10:1
10	Rated accuracy	:	±2%(or better) of full scale

28.00.00 MAGNETIC FLOW METER

01.	Type	:	Magnetic flow meter with remote mount transmitter
02.	Power supply	:	230V AC +/- 10% & 50 Hz +/-6%
03.	Transmitter	:	4 wire transmitter, remote mount, SMART transmitter with isolated 4-20mA output superimposed with digital output (HART) (EEx-I(a)) and Pulse output in 0-10 KHz range Flameproof to Ex-d IIC/T6 certified by CENELEC/ATEX is must. Only FM explosion proof versions are not acceptable.
04.	Meter size	:	Flow meter size shall be equal to line size for all magnetic flow meters

05.	Meter end-connections	:	Flanged, ANSI 300# RF as a minimum. For 600# and above pipe class RTJ flanges
06.	Flow sensor/ Tube and Flange MOC	:	SS316 as a minimum, better to suit process.
07.	Electrode MOC	:	Tantalum only
08.	Grounding ring	:	SS316 or better to suit process
09.	Mounting accessories bracket material	:	Suitable for 2" pipe, SS-304 with SS nuts and bolts
10.	End connection MOC	:	SS316
11.	Electrical conductivity	:	As per process fluid
12.	Ignition protection category	:	Transmitter to flow tube sensor circuitry may be intrinsically safe to EEx-i(a), Transmitter shall be Flameproof to Ex-d IIC/T6 and WP to IP65 or better as per IEC 529.
13.	Ingress protection	:	IP 65 OR Better as per IEC 529
14.	Display	:	Local LCD display with local push buttons for programming.
15.	Accuracy	:	+/-0.3% for analog & pulse output
16.	Options	:	15m cable with SS armoured for flow sensor and remote mount transmitter.
17.	Mounting accessories	:	2" Pipe Mountable SS304 MOC Mounting accessories for Transmitter
18.	Cable Gland	:	SS304 MOC, double compression, Flameproof to Ex-d IIC/T6 and WP to IP65 cable glands

29.00.00 VORTEX FLOW METER

01.	Type	:	In line vortex flow meter (tube) with remote mount transmitter. Insertion type vortex flow meter shall not be used.
02.	Power supply	:	230V AC +/- 10% & 50 Hz +/-6%
03.	Transmitter	:	4 wire transmitter, remote mount, SMART transmitter with 4-20mA output and Pulse output both EEx-i(a), Transmitter enclosure shall be Flameproof to Ex-d IIC/T6 and certified by ATEX/CENELEC. Only FM Explosion versions are not acceptable.
04.	Transmitter MOC	:	Dual compartment type, die cast aluminum with epoxy paint
05.	Flow sensor MOC	:	Flange and flow tube shall be SS316
06.	Flow sensor/ Tube MOC	:	SS316
07	Flow tube size	:	Same as line size
08	Bluff Body	:	Hardened Steel
09	Mounting Accessoreis	:	For 2” Pipe, Remote mount Transmitter with SS MOC mounting hardware
10.	End Connection size/ Rating	:	Flange type, size same as pipe line size and min. rating will be ANSI 300#. For 600 # and above, RTJ.
11	Haz. Area Classificaiton	:	The circuitry between transmitter and sensor may be intrinsically safe to Eex-i(a), Transmitter must be Flameproof to Ex-d IIC/T6 certified by ATEX/CENELEC
12	Display	:	Local LCD with engg. Unit and programming key pad
13	Ingress Protection	:	IP65 as per IEC529
14	Accuracy	:	+/-0.3% for analog & pulse output

15	Cable entry	:	½" NPT(F) with SS304 MOC, Flameproof to Ex-d IIC/T6 and WP to IP65 or better as per IEC 529 cable glands.

30.00.00 ANNUBAR

01.	Type	:	Retractable, averaging pitot tube type Annubar
02.	Element size	:	Vendor to specify
03.	Element material	:	SS 316
04.	Process conn. Size	:	1 ½" or 3" weldolet / weld coupling with end support.
05.	Coupling rating, matl.	:	300# Min, SS316 as a min., size as above
06.	Impulse conn. Size	:	½" NPT (F)
07.	Ball valve size, rating, matl.	:	Flanged, 1 ½"x300 RF# or 3"x300 # RF, SS trim ball valve, body MOC same as piping
08.	Needle valve size, rating, matl.	:	½" NPT, SS316 as a min., rating as per process req. with SS316 MOC, 3 way manifold.
09.	Packing gland / gasket	:	PTFE
10.	Retractable	:	Yes, with SS MOC retractable mechanism having double rod support.
11.	Bottom support	:	Required

31.00.00 AIR FILTER REGULATOR

01.	Filter Element	:	Sintered Bronze
02.	Filter Size	:	5 (five) microns
03.	Output	:	Adjustable from 0-7.0 Kg/Sq.Cm (continuous)
04.	Effect of supply pressure variation	:	Maximum 0.02 Kg/Sq.Cm for a change in supply pressure of 4 Kg/Sq.Cm

05.	Bowl Material	:	Clear transparent polycarbonate/ metallic
06.	Accessories	:	2" dial size output pressure gauge with SS Bourdon and SS Casing/Bezel MOC
07.	Desirable	:	No perceptible drop of pressure on Feature opening the drain port.

32.00.00 I / P CONVERTER

01.	Type	:	Analog, Direct acting
02.	Output	:	0.2 to 1.0 Kg/Sq.Cm
03.	Enclosure	:	Die cast aluminium conforming IP 65 / Explosion proof as applicable.
04.	Accuracy	:	± 0.5% of span
05.	Repeatability	:	± 0.1% of span
06.	Ambient Effect	:	0.5% of span / 50 Deg. C

33.00.00 E / P POSITIONER

01.	Type	:	Smart, Analog, Direct acting
02.	Output	:	0.2 to 1.0 Kg/Sq.Cm
03.	Enclosure	:	Die cast aluminium conforming IP 65 / Explosion proof as applicable.
04.	Accuracy	:	± 0.5% of span
05.	Repeatability	:	± 0.1% of span
06.	Ambient Effect	:	0.5% of span / 50 Deg. C

34.00.00 CONDUCTIVITY ANALYSER

a) Applicable standard ASME PTC 19.11, Part-II, Water and Steam in power cycle ASTM Standards-31 water and ASTMD 1066-69 Standard method of sampling system (except as modified in this specification)

b) Type:
   i) Cell Flow through type/ removable type (withdrawable with sealing valve)
   ii) Monitors Electronic (Microprocessor based) indicating type with multi range facility

c) Material :

   i) Cell Epoxy resin

   ii) Electrode Platinised

   iii) Monitors body Carbon steel

d) Monitor output:

   i) 4 to 20 m Amp, DC isolated output

   ii) 4 to 20 m Amp, DC isolated output for DCS/PLC

e) Power supply 230V, AC, 50 Hz

f) Accuracy ± 1% of FSD

g) Stability ± 1% of full scale per month non cumulative

h) Repeatability ±0.3% of span

i) Annunciation contacts for monitors

   i) Number 2SPDT

   ii) Type Snap action microswitch

   iii) Rating 5 amp, 230 V, 0.2 Amp, 220V DC

   iv) Cell On line/pipe mounted (ON LINE in sample table)

   v) Monitors Wall mounted/flush panel mounting

j) Connection:

i) Cell

ii) Process 1/4 (Quarter) inch NPT(F) SCRD for on-line type Three quarter (3/4) inch NPT (M) SCRD for pipe mounted

k) Electrical Half (1/2) inch NPT (F) SCRD

l) Accessories
- i) Automatic temperature compensation in the range 0-100°C
- ii) Ammonia (NH3) removal equipment.
- iii) Sample coolers
- iv) Flow and pressure regulators
- v) SS impulse tubing and fittings
- vi) Isolation & drain valves as required
- vii) Other accessories as required
- viii) Adequate length of cables for connecting coils to monitors
- ix) Sample rate set valves
- x) Alarm settings and Alarm indications on monitor.

m) Range As per sample stream detail table

n) Other particulars Cell shall be suitable for maximum pressure of 7 kg/cm^2 and maximum temp. of 100°C

o) Electrical Protection: EEx-i(a), Certified by ATEX/CENELEC and Weatherproof to IP65 as per IEC529

35.00.00 pH CELL AND TRANSMITTERS

a) Applicable Standard pH electrodes shall conform to IS: 6804-1972 except as modified in this specification

b) Type:

i) Cell Measuring and Reference Electrode Combination with Flow through type (Polypropylene flow chambers)
ii) Monitors Electronic (microprocessor based) indicating type with adjustable range facility , HART

c) Material:
- i) Measuring & reference: Toughened sensitive
- ii) Electrode: pH glass
- iii) Monitor body: Die-cast aluminium

d) Monitor output i) 4-20 m Amp D.C. isolated out put
ii) 4-20 m Amp DC Isolated output for DCS/PLC

e) Power supply 230V AC, 50 Hz

f) Accuracy/repeatability ± 0.02PH

g) Resolution ± 0.01 pH or 1 mV. 1C

h) Stability 0.02 pH per week

i) Annunciation contacts for monitors:

i) Number 2 SPDT 'Hi' and 'Lo'

ii) Type Snap action microswitch

iii) Rating 5 amp, 230V AC, 0.2 Amp, 220V DC

j) Connection:

i) Process One-quarter (1/4)inch NPT(F) SCRD ON-LINE

ii) Electrical Half (1/2) inch NPT(F) SCRD

k) Mounting:

i) Cell Pipe Mounted

ii) Monitors Flush panel mounting

l) Accessories

i) Automatic temperature compensation with fast response integral temperature sensors in the range 0-100°C
ii) Co-axial cable as required
iii) Sample coolers
iv) Flow and pressure regulators
v) Standard pH solutions
vi) SS impulse tubing and fittings
vii) Isolation & drain valves as required
viii) Electrode holders
ix) Other accessories as required
x) Sample rate set valves

xi) Alarm settings and indications on monitor
xii) RFI/EMI shielded, weather and corrosion proof casing

m) Ranges As per sample stream detail table.

n) Electrical Protection EEx-i(a), Certified by ATEX/CENELEC and Weatherproof to IP65 as per IEC529

36.00.00 DISSOLVED OXYGEN ANALYSER

a) Applicable Standards ASTM PTC 19.11 except as modified in this specification

b) Type Electro-chemical

c) Material Die-cast aluminium

d) Output i) 4-20 mAmp DC isolated output , HART
ii) 4-20 m Amp, DC Isolated output , HART for DCS/PLC.

e) Supply 230V AC, 50 Hz

f) Accuracy ±4% of full scale value

g) Response:

i) Sensitivity ± two (2) per cent overall

ii) Time (sensor) Less than 30 seconds for 90% step change.

h) Connection:

i) Process One quarter (1/4) inch NPT(F) SCRD

ii) Electrical Half (1/2) inch NPT (F) SCRD

i) Accessories
i) Sample cooler assembly with shut off valve at cooling water inlet, with thermometer and reducing valve at sample outlet

ii) Flow stabilizer
iii) Automatic temperature compensation
iv) Other accessories as required including chillier.
v) Calibration device.

j) Ranges As per sample stream detail table

k) Mounting Flush

l) Annunciation contacts:

i) Number 2 SPDT

ii) Type Snap action microswitch

iii) Rating 5 Amp 230V AC, 0.2 amp 220V DC

m) Electrical Protection EEx-i(a), Certified by ATEX/CENELEC and Weatherproof to IP65 as per IEC529

37.00.00 SILICA ANALYZER (SIOX)

a) Applicable standard ASME PTC 19.11 except as modified in this specification

b) Type: Multi Channel Calorimetric Analyzer (with auto reagent shut off feature in case of sample loss or power loss) built in phosphate inhibition feature. Micro processor based.

c) Material:

i) Case Die cast aluminium

d) Cycle Time Twelve (12) minutes Maximum

e) Analyser output i) 4 to 20 m Amp DC isolated output, HART for DCS

f) Power supply 230V AC, 50 Hz

g) Accuracy ± 1% of span

h) Repeatability ± 2% of full scale

i) Sensitivity 0.2 micrograms/litre

j) Connection:

i) Process Quarter (1/4) inch NPT(F) SCRD

ii) Electrical Half (1/2) inch NPT (F) SCRD

k) Ranges As per sample stream detail table

l) Mounting Flush

m) Annunciation contacts:

i) Number 2 SPDT

ii) Type Snap action microswitch

iii) Rating 5 amp 230V AC 0.2 Amp 220V DC

n) Accessories

i) Chilling plant (if required)

ii) Automatic temperature compensation between 5 to 50°C

iii) Automatic zeroing provision

iv) SS tubing & vessels

v) All chemical reagents for 12 months operation of the analyzer

vi) Sample rate set values

vii) Comprehensive diagnostic and alarm features.

o) Electrical and Protection

EEx-i(a), Certified by ATEX/CENELEC

Weatherproof to IP65 as per IEC529

38.00.00 JUNCTION BOXES

1) Type	: Explosion proof/Flame proof/weather proof and dust tight
2) Enclosure	: IP-65
3) Material	: Dia cast aluminium (LM6) with protective coating
4) Cable entry	: Bottom (for branch cables and multi pair cable)
5) Cable glands	: Double compression type SS MOC, Flameproof to Ex-d IIC/T6 and WP to IP65
6) Mounting	: Outdoor
7) No. of terminals , Mounting rails, end Clamps, lugs	: As required with standardization
8) Terminals	: DIN rail mounted, screwless, side entry type and in general suitable for 0.5 to 4 sqmm wires, unless otherwise specified
9) Grounding	: Two terminals for body and shield ground bus bar
10) Door	: Hinged, lockable type.
11) Gasket	: Gasket between door and body to be provided
12) Name plate	: SS name plate to be firmly fixed
13) Electrical protection	: Ex-d IIC/T6 certified by ATEX/CENELEC

39.00.00 TESTING & INSPECTION

Instruments offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar product shall be furnished. Routine tests, Acceptance tests and all special tests (if any) shall be carried out for all the instruments as per quality plan and applicable standards.

The type, routine & acceptance tests shall be witnessed by Inspection agency as per requirements given by the quality plan. Bidder shall give at least 15 days advance notice for witnessing the test. Copies of the

certified reports of all tests carried out at the works should be furnished. The equipments shall be dispatched from works, only after receipt of purchasers' written approval of the test reports

Certified reports of all the tests carried out at the works shall be furnished for approval of Owner. Test reports shall be completed with all details and also contain specified limiting values, wherever applicable, to facilitate review. The instruments shall be dispatched from works only after receiving the owner's approval of the test reports. The bidders shall have to carry out all the tests within his quoted price and no extra payment can be claimed by bidders.

Type test certificates for test conducted earlier on similar product may be furnished for owner's review.

However, the routine & acceptance tests shall be witnessed by owner/owner's authorised representative as per mutually agreed QAPs during detailed engineering.

6.02.00 The level of water in the drum shall be monitored by regulating the feed control valves. This control system shall consist of the following logics:
i) Single element control of low load feed water control valve
ii) Three element control of full load feed water control valve.

Five standpipe mounted GWR type level transmitters shall be used for boiler drum level.
Out of 5 level transmitters 3(2 out of 3 logic) are used for closed loop control and 2(1 out of 2logic) are used for tripping action.

6.03.00 For 0-30% of load the single element control shall be envisaged to control the low load feed control valve. For load higher than 30%, three element controls shall prevail. This control shall maintain the drum water level within specified limits for load swings up to 20% of the load capacity per minute

6.04.00 HP steam temperature at HRSG outlet shall be measured and compared with suspect to a fixed set point in a PID controller. The controller output shall regulate the water injection to desuperheating station.

6.05.00 The HRSG unit shall be provided with a diverter damper and guillotine Gate at the junction of bypass stack and flue gas duct leading to HRSG. This control is effected by regulating the bypass damper and guillotine Gate to divert exhaust gas to the bypass stack. During normal operation, the diverter damper shall remain fully closed towards bypass and the flue gas line to HRSG shall remain fully open. However the control on this damper may be required during start-up, up to some load. Position Limit Switches shall be provided on each Damper and Integral Motorized Actuator shall be used to control the Dampers

6.06.00 Guillotine Gate seal air fans shall operate either on or off. Modulating control is not required.

6.09.00 <u>FIELD INSTRUMENTS</u>

6.09.01 Field instruments shall be suitable for area in which these are located. In general field instruments shall be weatherproof, dust tight and corrosion resistant with protection class IP-65. All field instruments shall be Intrinsically safe to Ex-i(a), as per IEC60079-11 with active barriers installed in marshalling panel, irrespective of field hazardous area classification. Field instruments shall be suitably grouped or clustered area-wise and shall be mounted on instrument racks / on 2” pipe supports & terminated in local junction boxes. Mounting of field instruments on instrument racks / on 2" pipe supports shall be in-line with approved hook-up drawings during detailed engineering.

For applications which are corrosive in nature, the wetted part material to be selected which shall meet the process applications, preferably diaphragm

seal to be used. Hastealloy C wetted part material and SS316L impulse piping / root valve material to be considered for the above applications

In general, range of the instrument shall be so selected that max. Operating value lies in 60-75% of full scale range, unless specified otherwise.

Pressure gauge/transmitters shall be supplied with integral mounted two valve manifolds. Differential pressure gauge/transmitters shall be supplied with integral mounted three valve manifolds for air service and 5 way valve manifold for steam & water service.

A. As a minimum the following pressure measurement points to be provided by the bidder,

(i) Pressure gauges at the suction and discharge of the pumps, compressor & fan outlets, common header of pumps and fans, inlets and outlet of heat exchangers, pressurized vessels and other main equipment outlet and inlet.

(ii) Pressure transmitters for permissive and trip of pumps and fans/blowers, discharge pressure low for auto-start of standby pumps and pre-trip alarm conditions

(iii) Differential pressure transmitters across filters (water, oil service, air), strainers (water, oil service, air).

(iv) Differential pressure indicators across filters (water, oil service, air), strainers (water, oil service, air), cooling water line of the condensers.

(v) Pressure transmitters at the discharge of main process / pumps, discharge of fans, at the cooling water outlet of the equipment for all controlled parameters etc.

B. As a minimum the following temperature measurement points to be provided by the bidder:

(i) Tem

(ii) Temperature transmitters shall be provided for all closed loop control applications. However, for monitoring purposes, temperature elements may be directly connected to RTD/thermocouple cards of existing utility boiler control system.

(iii) Thermocouple/RTD for monitoring points shall be provided where temperature changes occur, including bearing/winding temperatures.

(iv) Metal temperature measurement shall be provided for super-heater, re-heater and Boiler drum.

(v) Thermo-wells for performance test point, RTD, thermocouple, temperature transmitter, temperature indicators.

C. As a minimum the following flow measurement points to be provided by the bidder:

(i) Coriolis mass flow meter to be used for Fuel oil.

(ii) Flow glass to be provided for coolant from equipment, coolant from the coolers.

(iii) Variable area flow indicators to be provided at the common outlet header of the identical equipment etc.

(iv) Doppler effect type flowmeters shall be used for sludge and slurry applications

(iv) Flow nozzles shall be provided for main steam flow measurement; feed water flow measurement; auxiliary steam flow measurement.

(v) Orifices shall be provided for spray water flow measurement..

(vi) Annubars/ piezometers/ pitot tubes shall be used for measuring fan inlet flows and flows in large pipes or ducts where installation of flow nozzles, orifice plates, or airfoils is impractical.

D. As a minimum the following level measurement points to be provided by the bidder:

(i) Level gauges shall be provided for all tanks for local level indication.

(ii) Level transmitters shall be provided for all tanks/sumps for low and high alarm, for all tanks /sumps for very low tripping of pump, for all tanks/sumps for normal starting of the pumps.

(iii) Level gauges shall be provided for all surface mounted overhead tanks, deaerator and any other storage tanks.

(iv) The primary level measuring elements shall be guided wave radar or differential pressure transmitters (guided wave radar, where possible, shall be the preferred technology, only when properties such as Dielectric Constants are within allowable limits). Guided wave radar transmitters shall be mounted in external chambers; pressure rated for the duty, Non-contactable radar transmitters shall be used for dirty services. Non contact type level measurement shall be provided storage bulk acid storage, acid dosing tank, acid preparation tank etc.

(v) Level signals from fuel oil tanks, fuel flow totalized signal shall be connected to control system via hardwired link.

(vi) For all low pressure & vacuum applications involving two phase media, shall be displacement type.

Chapter no. I1-Sec.2 (Field instruments) to be referred to for Data sheets of the Field instruments.

6.09.02 PROCESS TRANSMITTERS

All the Process Transmitters shall be 2-wire smart type with HART protocol facility for remote calibration and with integral LCD indicator. Transmitters shall also have 4-20 mA DC output with driving capacity upto 500 ohms. Transmitters shall be properly grouped and mounted in transmitter rack to be placed at suitable locations.

All Process Transmitters shall be Intrinsically safe to Ex-i(a), as per IEC60079-11 with active barriers installed in marshalling panel, irrespective of field hazardous area classification

Min. 2 nos. of Hand Held Communicators with HART protocol shall be supplied for configuration/programming all the transmitters of each unit. This shall be latest with support of all the smart instruments available/used in the project. Memory module shall be sufficient to store min. 1000 transmitters configuration, which can be used at later date to download in any of the failed transmitters.

All pressure transmitters shall be capable of withstanding their body rating conditions without permanent damage or loss of calibration.

Secondary elements for differential type flow sensors shall be strain gauge or capacitance type differential pressure transmitters. Square root extraction required for the DP transmitters shall be performed electronically in the transmitter itself.

Differential pressure transmitters shall be capable of withstanding a differential pressure equal to full process pressure on either side of the measurement element without damage or loss of calibration.

6.09.03 PROCESS GAUGES

Process gauges shall be provided for local indication, trial run and testing of various equipment. Local Gauge boards shall be provided for operator convenience. Each vessel shall be provided with direct level gauges to monitor the level locally. All pump pressure gauges at discharge and suction line, where pressure variation is more, the pressure gauges shall be oil or glycerin filled type. Pulsation dampers will be provided for pulsating pressure services.

Gauges shall be generally 100mm dial, ½" NPT bottom connection, die cast aluminum case/stainless steel, 316SS bourdon and socket, stainless steel movement, micrometer pointer.

Transparent gauge glasses will be used for low-pressure applications. Transparent or reflex gauges will be used for high-pressure applications. All gauge glasses will be equipped with gauge valves, including a safety ball check, drain valve.

In general, range of the gauges shall be so selected that max. Operating value lies in 60-75% of the full scale range, unless specified otherwise.

6.09.04 TEMPERATURE SENSORS

All temperature elements shall be of duplex type with thermowell. Depending on temperature ranges, Pt-100 Resistance Temperature Detector (RTD) and thermocouple of type J and K (ISA standard) shall be used. For low temperature application upto 400 deg. C, RTD shall be used. For higher temperature K-type thermocouples shall be used. Metal temperature thermocouples shall be used for drum and super heater and re-heater. Cold junction compensation should be applied for thermocouple measurements.

6.09.06 FLOW ELEMENTS

For the measurement of flow for clean fluids, concentric square edge orifice plates shall be provided. For high pressure fluid lines having nominal size 100 mm and above flow nozzles shall be used. For oil service, positive displacement or coriolis type flow meters shall be used. Aerofoils / annubars / venturis shall be used for air flow measurement. All flow element calculation, design and construction shall be based on BS/ASME Standard. Wherever required, flow signals shall be pressure and temp. compensated.

6.10.00 FINAL CONTROL ELEMENT

Response time of the final control elements shall be carefully considered vis-a-vis the process dynamic requirement during selection of the type of final control element.

a) In general, Pneumatic Power Cylinders for control dampers and diaphragm operated Control Valves shall be envisaged for control purpose. However, electrically operated actuator may also be used if response time permits safe plant operation in all regimes.

b) For system like Governing Control, etc. hydraulically controlled final control element shall be used to match the dynamic response of the plant.

c) For isolating and inching services, electric actuators shall be provided unless fast response is required.

d) For fast trip applications like fuel oil shut off valve etc. solenoid operated pneumatic trip valve shall be used.

All the final control elements shall be complete with suitable smart electro pneumatic type valve positioners, Air lock Valve, local mechanical indicators, Position transmitters, Limit Switches, hand wheel, solenoid valves, filter regulators, integral tubing etc., as required for the operation of the plant. The final control element shall be designed for stay put/open position as per the plant requirement upon failure of power/air supply.

Chapter no. I1-Sec.3 (Control valves) to be referred to for detailed specifications of the Control valves.

6.11.00 C&I ERECTION AND COMMISSIONING:

Chapter no. I2 to be referred to for the guidelines on the C&I erection and commissioning to be done by bidder in the power plant.

7.00.00 UTILITIES

7.01.00 ELECTRIC POWER SUPPLY

The power supply shall be designed to meet the electric power requirements of various C & I systems including control systems of HRSG & Aux. systems. The power supply to the entire Control & Instrumentation System shall be 230VAC 50 Hz from existing UPS system (Single source). Necessary derivation (24V DC etc) and distribution to make the system complete and reliable shall be done.

Bidder to refer to the Electrical part of the tender specifications for details of UPS System scope

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-7
		Rev. No. 00

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Annexure-7

QAP guide Line, Formats & specification

Annexure-7A-BHEL QAP
Annexure-7B-CUSTOMER QAP

Revisions:	Prepared by :	Checked by :	Approved by :	Date :
Refer to record of revisions	Ratish Kumar	Girish Prasad Palo	Siva Prasad Babu	12.05.18

QAP GUIDELINES & FORMAT

`

(ANNEXURE 7-A)

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.

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.

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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

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	
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
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	--	
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	--	
3.5		Strip Examination	Critical	Dismantling	100%		TC	√	2	1	--	
3.6		Overall Dimensions	Major	Measurement	100%		IR	√	2	1	--	
3.7		Complete unit 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

1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**											
1.1	COPPER WIRE Enameled Copper Wire	Overall diameter, elongation, Mandrel winding test, Peel test, springiness, Abrasion test, Cut through test, Heat shock test, Continuity test	Major	Measurement and mechanical & electrical testing	One sample per heat/lot	National & international standard (IS or IEC) / technical specification/ approved drawing/ datasheet	IR / supplier test certificate	√	2	2	1	
1.2	STEEL SHAFT Straightened Steel bar in black Finish	Dimensions, surface finish, chemical composition	Major	Visual, measurement and chemical testing	One sample per heat/lot		supplier test certificate	√	2	2	1	
1.3		NDT	Major	UT	100%		supplier test certificate	√	2	2	1	
1.4	ALUMINIUM INGOTS	Chemical properties	Major	Chemical testing	One sample per heat/lot		supplier test certificate	√	2	2	1	
2.0	**INPROCESS INSPECTION**											
2.1	ASSEMBLY	Completeness and correctness of assembly	Major	Visual verification	100%	MO and manufacturer's internal processes	Log book	--	2	2	2	

3.0	**FINAL INSPECTION & TESTING**												
3.1	**ROUTINE TESTING**	Measurement of winding resistance in cold condition	Major	Testing	100%	National & international standard (IS or IEC) / technical specification		TC	√	2	1	--	
3.2		SH heater resistance (if applicable)	Major	Testing	100%			TC	√	2	1	--	
3.3		Insulation resistance (before and after HV test)	Major	Testing	100%			TC	√	2	1	--	
3.4		High voltage test at 1.8 KV for 1 minute and space heater HV test	Major	Testing	100%			TC	√	2	1	--	
3.5		Direction of rotation	Major	Testing	100%			TC	√	2	1	--	
3.6		No load test (measurement of NL A, voltage, NL power and NL RPM)	Major	Testing	100%			TC	√	2	1	--	
3.7		Reduced run up voltage test at (rated volt√3)	Major	Testing	100%100%			TC	√	2	1	--	
3.8		Locked rotor test at full load current	Major	Testing	100%			TC	√	2	1	--	
3.9		Vibration measurement	Major	Testing	100%			TC	√	2	1	--	
3.10		Measurement of noise level	Major	Testing	100%			TC	√	2	1	--	
3.11		120% over speed test	Major	Testing	100%			TC	√	2	1	--	

3.12	**TYPE TESTS**	Measurement of winding resistance in cold condition	Major	Testing	One /rating	National & international standard (IS or IEC) / technical specification	TC	√	2	--	1	Verification of Identical Type test Report of same Rating Identical type test reports for motor ratings (not more than 5 years old) will be provided.
3.13		Temp. rise test at full load (load point for 100%, 75% & 50% load (full load, ¾ and ½ load)	Major	Testing	One /rating		TC	√	2	--	1	
3.14		160% momentary overload test	Major	Testing	One /rating		TC	√	2	--	1	
3.15		Locked rotor amp and torque test	Major	Testing	One /rating		TC	√	2	--	1	
3.16		No load test	Major	Testing	One /rating		TC	√	2	--	1	
3.17		Reduced voltage running up test	Major	Testing	One /rating		TC	√	2	--	1	
3.18		Insulation resistance test (before and after HV test)	Major	Testing	One /rating		TC	√	2	--	1	
3.19		HV test – 1.8 KV for winding and 1.5 KV for space heater	Major	Testing	One /rating		TC	√	2	--	1	
3.20		Vibration test	Major	Testing	One /rating		TC	√	2	--	1	
3.21		120% over speed test	Major	Testing	One /rating		TC	√	2	--	1	

4.0	**PRESERVATION & PACKING**											
		Painting*, (Shade, DFT,) Marking	Major	Visual, Measurement	Random	Technical specification/ approved drawing/datasheet	TC	√	2	--	1	
		Packing*	Major	Visual	Random		Packing List	√	2	--	--	

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
IS	–	Indian Standards	UTS	-	Ultimate Tensile Strength
G.I	-	Galvanized Iron	YS	-	Yield Strength
EL.	-	Elongation	ID	-	Internal Diameter
PMI	-	Positive Material Identification	OD	-	Outer Diameter

NOTE:

1. This standard MQP should be read along with specification (latest revision), approved drawings & approved data sheet.
2. Specification/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.

	Outlet of makeup water heater °C	*	100
06.	a) HRSG Efficiency % b) HRSG Turndown Possible % 	*	*

11.0 INSPECTION AND TESTING

11.1 Quality Assurance Plan (QAP)

11.1.1 Bidder shall submit, along with the bid, Quality Assurance Plans (QAP) , together with relevant procedures, covering various activities like material procurement, manufacture, inspection and testing, documentation and maintenance of quality records etc. the Bidders shall submit their QAP prepared in line with the guideline format of DCPL Limited to be given to the supplier for approval, within 2 weeks or receipt of purchase order. All IBR items shall be got inspected by the supplier from respective IBR inspector

11.1.2 The QAP shall be finalized before placement of order for bought out items.

11.1.3 Inspection for all items will be carried out only as per the QAP approved by Gail/DCPL. All tests shall be covered in QAP as required in relevant codes. Witnessing of test/inspection shall be decided by DCPL/GAIL

11.1.4 Material test certificate pertaining to chemical, physical, NDT and other tests, if any, conforming to the relevant standard shall be submitted from Govt./Govt. approved agency/ laboratory for bought out items.

11.2 Inspection:

11.2.1 Inspection will be carried out by GAIL/DCPL or authorised representative who reserves the right to carryout stage inspection during manufacture and at final stage at the manufacturer's works and at site.

11.2.2 Inspection shall be carried out on the basis of the purchaser's drawings/ manufacturer's approved drawings and instructions contained in the specifications.

11.2.3 Inspection notice to specify as follows:

a) Items offered
b) Qty. offered
c) Stage of inspection, i.e., Final/ Stage

11.2.4 Following documents are to be sent along with inspection notice:

a) Internal inspection report including dimension sheet. b) Material test certificate, wherever required.

11.2.5 Access to the works: At all times for the authorised representatives of the purchaser.

11.2.6 Assistance for inspection: (To be provided by the supplier).

- All the laborers required.
- All tools & tackles, electricity, stores and handling equipment.
- All measuring instruments, templates, gauges, jigs & fixtures including special ones to be made by the supplier as per specific requirement of the inspectors.
- All secretarial assistance for preparation of inspection report & related documents.

11.3 Notice period:

Two weeks from the receipt of inspection notice at the purchaser's office.

11.4 Inspection & Expediting for sub-Bidder:

All activities pertaining to Inspection at Bidders & Bidders works sites shall be the complete responsibility of the HRSG Bidder. HRSG Bidder is required to issue final "Inspection Release Note" after inspection.The Inspection and test plans for material and construction site activities shall be developed by the HRSG Bidder and got approved from the DCPL/GAIL. HRSG supplier shall ensure following Inspection & Expediting activities for his sub Bidders;

(i) Preparation and Submission of all drawings / documents to Bidders / Bidders. Granting approval to all drawings / documents being submitted by Bidder for start & during manufacturing within seven working days of the submission of document by Bidder / Bidders.
(ii) Prepare inspection and expediting procedure
(iii) Establish Bidders manufacturing and delivery schedules. (iv) Expedite Bidders for timely action on sub-contracted items.
(v) Qualify and approve Bidder's procedures in time for manufacturing. (vi) Carryout Material identification and marking.
(vii) Carry out Inspection of bought out items of Bidder supply, as specified elsewhere in the tender. All charges for Inspection / expediting is in the scope of the HRSG Bidder.
(viii) Ensure that items procured by Bidders are acceptable as per PO specifications and standards.
(ix) Carryout inspection of the items procured through the Bidders by professionals of concerned discipline/system.
(x) Witness performance/acceptance tests as applicable.
(xi) Carryout expediting of the items.
(xii) Prepare periodic inspection and expediting reports

Witnessing of inspection by DCPL at sub-Bidder's work shall be as per approved QAP.

11.5 Factory Acceptance Tests:

GAIL/DCPL shall witness & certify the Factory Acceptance Tests in the premises of Bidder/ sub Bidder for steam HRSG, pumps, piping Instrumentation, electrical system etc. It will be the responsibility of HRSG supplier to get necessary clearance / certification from IBR, other statutory authorities and for Electrical equipment also.

11.6 Site Acceptance Tests:

Respective Bidders shall carry out the Site Acceptance Tests of steam HRSG, Instrumentation, electrical system etc. and shall be witnessed & certified by HRSG BIDDER at site along with DCPL.

11.7 Supplier's obligation:

The inspection of materials at manufacturer's works and despatch of materials does not relieve the supplier of his obligation to replace/rectify free of cost FOR GAIL site basis, those materials which are found defective due to bad workmanship or bad quality of

materials at the time of final inspection at plant site or during agreed warrantee/guarantee period.

12.0 LIST OF MANDATORY SPARES FOR HRSG

(Common for two HRSG)

One lot of spares is the quantity of spares as mentioned below and shall be ordered and considered for price comparison. List of Mandatory spare prices to be enclosed in **Priced Bid Envelope**.

Price of mandatory spares shall be loaded for evaluation purpose

1 set means the quantity installed in one machine

S.No.	DESCRIPTION	QUANTITY (NOS)
a)	**HRSG**	
1.0	**Straight tubes**	
	Superheater each type	5% (rounded off to the nearest digit)
	Evaporator tubes	5% (rounded off to the nearest digit)
	Economiser tubes	5% (rounded off to the nearest digit)
	Makeup Water Heater tubes	5% (rounded off to the nearest digit)
2.0	**Tube Bends**	
	Superheater each type	5% (rounded off to the nearest digit)
	Evaporator tubes	5% (rounded off to the nearest digit)
	Economiser	5% (rounded off to the nearest digit)
	Makeup Water Heater tubes	5% (rounded off to the nearest digit)
3.0	**IBR valves**	
	GLV 25 NB 800 # / SA 105 (SW)	4
	GLV 40 NB 800 # / SA 105 (SW)	1
4.0	**De-superheater internals**	1 set per HRSG
5.0	**Boiler Drum consumables such as gaskets, gauge glass, O-rings etc.**	2 set per HRSG
6.0	**Dosing Pumps (for each pump)**	
	Internal spares such as bearings, impellers, bushes	1 set per pump
	Consumables such as gaskets, gauge glass, O-rings	2 set per pump

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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/cm²,a)					
2.4	Differential Pressure, Rated (kg/cm²)					
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/cm²G) @ 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]

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]

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: _____

S. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS		REMARKS
			Ref.- 1	Ref.-2	
1	**GENERAL**				
1.1	Model Number				
1.2	Type of Driver / Driver Rating (kW)				
1.3	Rated Speed(rpm)				
1.4	Shop where pump is designed, manufactured, packaged, tested & supplied				
2	**OPERATING CONDITIONS**				
2.1	Service / Fluid handled / Fluid temperature (deg C)				
2.2	Rated Capacity (m^3/hr) & Rated Diff. Head (m)				
2.3	NPSHR (m)/ Efficiency (%)				
2.4	No. of stages/ Impeller Dia. (Max/Rated/min.) (mm)				
2.5	Maximum Suction pressure (kg/cm^2g)				
2.6	Type of lubrication system				
2.7	Type of Bearing/ Bearing span (mm)				
2.8	Shaft Diameter under Bearing (mm)				
3	**MATERIAL OF CONSTRUCTION**				
3.1	Casing / Impeller / Shaft				
4	**OTHER INFORMATION ON INSTALLATIONS**				
4.1	Date of supply and commissioning				

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

S. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS		REMARKS
			Ref.- 1	Ref.-2	
4.2	Whether one year of successful field operation completed after commissioning as on bid due date				
4.3	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

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Annexure-9

Sub vendor list

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

Instrument Panels Instruments	-	Pastel Green/ apple green
	-	Forest green/ pastal green

13.4 Paints Suppliers

Asian Paint	APCOSIL ML9551	Heat Resistant Silicone Paint.
Berger Paint	Zinc Anode 304	Berger Heat Resistant Silicone
Goodlass Nerolac	DIMAT COAT 6	Aluminum Coating.
Shalimar Paint	-	AMERCOAT – 878 Silicone Aluminium Paint Lustotherm HT 600

14.0 LIST OF PREFERRED MAKES

14.1 Mechanical Equipment

Item		Bidder	Country
Tubes	:	TISCO	India
		TI	India
		MSL	India
		ISMT	India
Fins	:	Jord	India
		Progen	India
		LpSPA	Italy
		EWHA	Korea
		Enertech	Korea
Insulation	:	Lloyds	India

Item		Bidder	Country
		Rockwool	India
		Minwool	India
		Orient	India
Chemical dosing system	:	Enpro	India
		Metapow	India
Sample coolers	:	J N Marshall	India
		Metapow	India
		Dandekar	India
Expansion Joints	:	TBW	India
		Keld	India
		Fouress	India
		Bachmann	India
		Indira	India
Pipe supports	:	Myrick Systems	India
		Sarathi	India
Drums	:	Thermax Limited	India
		BHPV	India

14.2 Valves and Fittings:

Item		Bidder	Country
Control valves with positioners	:	Instrumentation Limited	India
		Fisher Xomox	India

		Valtek	India
Blowdown valve	:	Levcon	India
		Bharat Heavy Electricals Limited	India
Process valves	:	Audco	India
		KSB	India
		Bharat Heavy Electricals Limited	India
		Steel strong	India
		Babcock & Wilcox	Spain
		BDK	
Pneumatic actuators	:	Keltron	India
		RK Controls	India
Safety Valves	:	Bharat Heavy Electricals Limited	India
		Tyco Sanmar	India
Relief valves	:	JN Marshall	India
		Tyco Sanmar	India
Direct Level gauges	:	Levcon	India
		Hitech	India
		Yarway Narvik	India
		Chemtrol	India
Ball Valves	:	Audco	India
		KSB	India

Item		**Bidder**	**Country**
		Virgo	India
		Burner Bidder	
Quick shut off valves with	:	Prima	India
		El-O-Matic	India
		Virgo	India
		Burner Bidder	

Instrumentation and Control: Please refer Part -03
Electrical: Please refer Part -02

The choice of final Bidder out of the above options shall be with HRSG supplier. For any other Bidder apart from the Bidders specified above, HRSG Bidder shall take prior approval from GAIL. Equivalent International makes shall also be used subjected to prior approval from GAIL.

ANNEXURE-C&I-3
INSTRUMENTATION VENDOR LIST

INSTRUMENTATION VENDOR LIST:

1.Control System
Yokogawa (compatible to Yokogawa centum VP DCS)

2.PROGRAMMABLE LOGIC CONTROLLER:

a) SIEMENS
b) HONEYWELL
c) MODICON

3.TRANSMITTERS (PRESSURE, FLOW & LEVEL)

a) EMERSON (ROSEMOUNT),
b) ABB.
c) HONEYWELL

4.BARGRAPH INDICATORS

a) YOKOGAWA LTD,
b) MASIBUS ELECTRONICS.

5.DIGITAL INDICATORS

a) YOKOGAWA LTD,
b) MASIBUS ELECTRONICS,
c) ABB.

6.PRESSURE / TEMPERATURE GAUGES

a) A.N. INSTRUMENTS PVT LTD,
b) GENERAL INSTRUMENTS,
c) WIKA

7.RTDs & THERMOCOUPLES WITH THERMOCOUPLES

a) GENERAL INSTRUMENTS,
b) NORGEN
c) DETRIEV

8.TEMPERATURE TRANSMITTER

a) YOKOGAWA LTD,
b) EMERSON (ROSEMOUNT) LTD,

ANNEXURE-C&I-3
INSTRUMENTATION VENDOR LIST

9.DIGITAL SCANNER

a) JYOTI,
b) LECTROTEK,
c) PROCON,
d) MASIBUS.

10.PRESSURE SWITCH

a) SWITZER INSTRUMENTATION PVT LTD.
b) DANFOSS
c) VARMA TRAFAG

11.LEVEL SWITCH / SENSORS

a) SWITZER
b) CHEMTROL,
c) LEVCON INSTRUMENTS PVT LTD,
d) V.AUTOMAT
e) S B ELECTROMECHANICALS,

12.LEVEL GAUGE

a) J N MARSHALL & SONS,
b) LEVCON INSTRUMENTS PVT LTD,
c) SIGMA.

13.CONTROL VALVES (BUTTERFLY & GLOBE)

a) INSTRUMENTATION(I)LTD.,
b) VALTEK
c) FISHER- XOMOX SANMAR,

14.ELECTRICAL ACTUATORS

a) AUMA (INDIA) LTD.,

15.PNEUMATIC ACTUATORS

a) INSTRUMENTATION LTD.,
b) MASONEILAN (INDIA) LTD.,
c) FISHER - XOMOX,
d) FOURESS ENGG. (INDIA) LTD.

ANNEXURE-C&I-3
INSTRUMENTATION VENDOR LIST

16.I/P CONVERTERS

a) SHREYAS BARTON,
b) MOORE,
c) FISHER - XOMOX.

17.ELECTROPNEUMATIC POSITIONERS

a) INSTRUMENTATION LTD.,
b) MASONEILAN (INDIA) LTD.,
c) FISHER- XOMOX,
d) FOURESS ENGINEERING.

18.AIR FILTER REGULATORS

a) SHAVO-NORGREN (INDIA) PVT. LTD.,
b) PLACKA,
c) SIEMAG

19.SOLID STATE ALARM ANNUNCIATOR

a) APPLIED ELECTRONICS LTD (APLAB),
b) PROCON INSTRUMENTATION PVT LTD,
c) PIRI SYSTEMS PVT LTD,
d) MASIBUS.

20.INSTRUMENTATION SCREENED CABLES

a) CABLE CORPORATION OF INDIA LTD,
b) FINOLEX CABLES LTD,
c) TOSHNIWAL CABLES,
d) DELTON CABLES,
e) KEI,
f) ASIAN CABLES,
g) FORT GLOSTER,
h) UNIVERSAL CABLES.

21.COMPENSATING CABLES

a) POPULAR
b) THERMOPAD
c) UDAY PYRO
d) ASSOCIATED CABLES

22.SOLENOID VALAVES

a) ASCO

ANNEXURE-C&I-3
INSTRUMENTATION VENDOR LIST

b) ROTEX
c) ALLAN BRADLEY

23.LIMIT SWITCHES

a) BHARTIA CUTLER HAMMER
b) SIEMENS

24. JUNCTION BOXES

a) SB ENGINEERS
b) SANJAY ELECTRICALS
c) BALIGA

25.ORIFICE PLATES

a) STAR MECH CONTROLS

26.DRAFT GAUGES

a) SWITZER

S.NO.	ITEM/ VENDOR NAME	COUNTRY
1.	**FIELD INSTRUMENTS**	
	ABB LTD.	INDIA
	ABB AUTOMATION PRODUCTS GMBH	GERMANY
	EMERSON PROCES MGMTG ASIA PACIFIC PTE LTD	INDIA/SINGAPORE
	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
	FUJI ELECTRIC INSTRUMENTS CO.LTD	INDIA
	HONYWELL AUTOMATIN INDIA ITD	INDIA
	YOKOGAWA ELECTRIC CORPORATION	INDIA
	YOKOGAWA INDIA LIMITED	INDIA
	HONEYWELL INC.	
2.	**CONTROL VALVES**	
	INSTRUMENTATION LTD.	INDIA
	MIL CONTROL LTD.	INDIA
	CONTINENTAL VALVE LTD	INDIA
	DRESSER PRODUITS INDUSTRIES	FRANCE
	FORBES MARSHAL ARCA P LTD	INDIA
	SPX VALVES AND CONTROLS	USA
	WEIR VALVES AND CONTROLS	DUBAI/UK
	ARCA REGLER GMBH	GERMANY
	FLOW SERVE PTE. LTD.	SINGAPORE
	KENT INTROL	UK
	MOTO YAMA ENGG. WORKS LTD.	JAPAN
	SAMSON AG MESS – UND REGELTECHNIK	GERMANY
	SEVERN GLOCON	UK
	FISHER SANMAR LIMITED	SINGAPORE/USA
	SAMSON CONTROLS PVT LTD	INDIA
	DRESSER VALVE INDIA PVT LTD	INDIA
	CCI VALVE TECHNOLOGY GMBH	GERMANY
	FLOW SERVE INDIA CONTROL PVT LTD	INDIA
	ITALVALV S.N.C.	ITALY
	KOSO FLUID CONTROLS (PVT) LTD	INDIA
	METSO AUTOMATION PTE LTD (FORMERLY NELES)	USA/FINLAND/GERMANY
	SEVERN GLOCON INDIA PVT LTD	INDIA
3.	**ON OFF VALVES**	
	CAMERON ITALY SRL	ITALY
	CONTINENTAL VALVE LTD	INDIA
	COOPER CAMERON (SINGAPORE) PTE LTD.	SINGAPORE
	EL- O- MATIC INDIA (PVT) LTD.	INDIA
	FLOWSERVE INDIA CONTROL PVT LTD- BANGALOR	BANGALORE
	INSTRUMENTATION LTD. (PALGHAT)	INDIA

ITALVALV S.N.C	ITALY
KITAMURA VALVE MANUFACTURING CO LTD	INDIA
KITZ CORPORATION OF EUROPE S.A.	SPAIN
KOSO FLUID CONTROLS (PVT) LTD	INDIA
METSO AUTOMATION PTE LTD(FORMERLY NELES)	INDIA/FINLAND/GERMANY
MICROFINISH VALVES PVT LIMITED	INDIA
MOTOYAMA ENGG WORKS LTD	JAPAN
PERRIN GMBH	GERMANY
PIBIVIESSE S.P.A.	ITALY
SAMSON AG MESS- UND REGELTECHNIK	GERMANY
SPX VALVES & CONTROLS (FORMERLY DEZURIK)	USA
TYCO VALVES & CONTROLS	INDIA
VIRGO ENGINEERS LIMITED	INDIA
WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT	INDIA
WEIR VALVES & CONTROLS UK LTD	UK

4. PRESSURE RELIEF VALVE

ANDERSON GREEWOOD CROSBY	INDIA
BHEL (TRICHY)	INDIA
BLISS ANAND PVT LTD	INDIA
CURTIS WRIGHT FLOW CONTROL CORPORATION	INDIA
DRESSER INC.	INDIA
FUKUI SEISKUSHO CO. LTD.	JAPAN
LESSER GMBH & CO. KG	GERMANY
MEKASTER ENGINEERING LTD	INDIA
NAKAKITA SEISAKUSHO CO. LTD.	JAPAN
SAFETY SYSTEMS UK LTD.	UK
TYCO SANMAR LTD.	INDIA

5. PILOT OPERATED SAFETY VALVE

ANDERSON GREENWOOD CROSBY	U.S.A.
CURTISS WRIGHT FLOW CONTROL CORPORATION	USA, CANADA/UK
DRESSER INC.	U.S.A.
SAFETY SYSTEMS UK LTD	U.K.
TYCO SANMAR LTD	INDIA
WEIR POWER & INDUSTRIAL	FRANCE
BLISS ANAND PVT LTD	INDIA

6. **DESUPERHEATER**

ARCA REGLER GMBH	INDIA
CHEMTROLS INDUSTRIES LTD	INDIA
CIRCOR FLOW TECHNOLOGIES INDIA PVT LTD	INDIA
CCI VALVE TECHNOLOGY AB	INDIA
FORBES MARSHALL ARCA P LTD	INDIA
HOLTER REGELARMATURE N GMBH &CO.KG(HORA)	GERMANY

INSTRUMENTATION LTD. (PALGHAT)	INDIA
IMTECH SYSTEMS BV	NETHERLANDS
SAMSON AG MESS-UND REGELTECHNIK	INDIA
SPX VALVES & CONTROLS	UK
WEIR VALVES & CONTROLS UK LTD	UK
YARWAY CORPORATION	INDIA

7. **PROGRAMMABLE LOGIC CONTROLLERS**

ABB LTD (BANGALORE)	INDIA
ASEA BROWN BOVERY LTD (ABB LTD)	SWITZERLAND
GE INTELLIGENT PLATFORMS PVT LTD	INDIA
GE FANUC AUTOMATION NORTH AMERICA INC.	USA
HONEYWELL AUTOMATION INDIA LTD	INDIA
HIMA PAUL HILDEBRANDT GMBH + CO KG	GERMANY
ICS TRIPLEX (EMEA) PLC	INDIA
INVENSYS SOFTWARE SYSTEMS (S) PTE LTD	INDIA
LARSEN & TOUBRO LTD-MAHAPE	INDIA
ROCKWELL AUTOMATION INDIA PVT LTD	INDIA
ROCKWELL AUTOMATION INC.	USA
SIEMENS LIMITED	INDIA
SCHNEIDER ELECTRIC INDIA PVT LTD	INDIA
SIEMENS AG	INDIA
YOKOGAWA INDIA LIMITED	INDIA

8. GUIDED WAVE RADAR LEVEL INSTRUMENT

EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
ENDRESS+HAUSER (I) PVT. LTD	INDIA
ENDRESS + HAUSER INSTRUMNTS INTL.	INDIA
KROHNE MESSTECHNIK GMBH & CO KG(K582)	INDIA
K-TEK CORPORATION	INDIA
L & J TECHNOLOGIES	SINGAPORE
MAGNETROL INTERNATIONAL N.V	INDIA

9. SOLENOID VALVES

ALCON ALEXANDER CONTROLS LIMITED	UK
ASCO	INDIA/FRANCE
HERION	GERMANY
AVCON CONTROLS PVT. LTD.	INDIA
PRECISION INSTRUMENT COMPANY	INDIA
ROTEX AUTOMATION LTD.	INDIA
SCHRADER DUNCAN LIMITED	INDIA
THOMPSON VALVES LTD	UK
VERSA BV	NETHERLANDS

10. INDUCTIVE PROXIMTY SWITCH

P&F

11. CONDUCTIVITY ANALYSER

ABB LTD (BANGALORE)	INDIA

EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
ENDRESS+HAUSER (I) PVT. LTD.	INDIA
FORBES MARSHALL PVT. LTD.- PUNE	INDIA
HONEYWELL AUTOMATION INDIA LTD-	INDIA
INVENSYS INDIA PRIVATE LIMITED	INDIA
YOKOGAWA INDIA LIMITED	INDIA
HACH COMPANY	INDIA

12. ANALYSER SHELTER

ABB LTD (BANGALORE)	INDIA
AXIS SOLUTIONS PVT. LTD.	INDIA
CHEMTROLS INDUSTRIES LTD	INDIA
EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
PYROTECH ELECTRONICS PVT LTD	INDIA

13. ANALYSER SYSTEM

ABB LTD (BANGALORE)	INDIA
CHEMTROLS INDUSTRIES LTD	INDIA
EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
YOKOGAWA INDIA LIMITED	INDIA
APPLIED INSTRUMENTS TECHNOLOGIES INC.	INDIA
SERVOMEX PLC	INDIA
SIEMENS AG	INDIA
TELEDYNE ANALYTICAL INSTRUMENTS	USA
YOKOGAWA ELECTRIC CORPORATION	INDIA

14. STACK GAS ANALYSER(IN SITU)

CHEMTROLS INDUSTRIES LTD	INDIA
HORIBA LTD	INDIA
SERVOMEX PLC	INDIA
SICK MAIHAK GMBH	GERMANY
SIEMENS AG	INDIA

15. pH ANALYSER

ABB LTD (BANGALORE)	INDIA
CHEMTROLS INDUSTRIES LTD	INDIA
EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
ENDRESS+HAUSER (I) PVT. LTD	INDIA
FORBES MARSHALL PVT. LTD. PUNE	INDIA
HONEYWELL AUTOMATION INDIA LTD	INDIA
INVENSYS INDIA PRIVATE LIMITED	INDIA
YOKOGAWA INDIA LIMITED	INDIA
HACH COMPANY	INDIA

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

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-10
		Rev. No. 00

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Annexure-10

Master Document list

Revisions: Refer to record of revisions	**Prepared by :**	**Checked by :**	**Approved by :**	**Date :**
	Ratish Kumar	Girish Prasad Palo	Siva Prasad Babu	12.05.18

MASTER DOCUMENT LIST - Boiler Feed Pump assembly [HRSG BFP]

	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	12/May/18			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 (In Case of MP BFP)			A										
8	Motor GA drawing(In Case of MP BFP)			A										
9	Motor Curves(In Case of MP BFP)			I										
10	T-S Curve			I										
11	Coupling GA Drawing			I										
12	Mechanical Seal GA Drawing and details			I										
13	Strainer GA Drawing and details			A										
14	Strainer Area calculation			I										
15	Strainer Pressure Drop calculation			I										
16	ARC valve GAD, Datasheet			A										
17	LO skid documents(If Applicable) [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										

MASTER DOCUMENT LIST - Boiler Feed Pump assembly [HRSG BFP]

	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	12/May/18			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	
3	Instrument datasheets [PG,PT,PS,DPG,DPS,DPT,TG,RTD,PSV etc as per scope of supply]			A										
4	LO Skid Instrument datasheets as per P&ID			A										
5	Impulse line routing drawing[3D]			A										
6	Complete Skid Drawing[3D]													

MASTER DOCUMENT LIST - Boiler Feed Pump assembly [HRSG BFP]

	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	12/May/18			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										

MASTER DOCUMENT LIST - Boiler Feed Pump assembly [HRSG BFP]

	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	12/May/18			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	
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 incorp				
		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	

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-11
		Rev. No. 00

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Annexure-11

Deviation Format

Revisions: Refer to record of revisions	**Prepared by :**	**Checked by :**	**Approved by :**	**Date :**
	Ratish Kumar	Girish Prasad Palo	Siva Prasad Babu	12.05.18

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:

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-12
		Rev. No. 00
		Sheet 1 of 2

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Annexure-12

Prebid clarification

Revisions: Refer to record of revisions	**Prepared by :**	**Checked by :**	**Approved by :**	**Date :**
	Ratish Kumar	Girish Prasad Palo	Siva Prasad Babu	12.05.18

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-12
		Rev. No. 00
		Sheet 2 of 2

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

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-13
		Rev. No. 00

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Annexure-13

Pump Specifications

Revisions: Refer to record of revisions	**Prepared by :**	**Checked by :**	**Approved by :**	**Date :**
	Ratish Kumar	Girish Prasad Palo	Siva Prasad Babu	12.05.18

Damper shall be provided in the stack for isolation and to keep the HRSG warm after shutdown as well as providing weather protection. This damper is operated manually.

6.2.12 Boiler Feed Pumps

a) **SCOPE OF SUPPLY :**

The Scope of Supply covers the design, fabrication, testing at manufacturer's works, properly packed for transport, transportation to the site of Boiler Feed Pumps, and other accessories and auxiliaries such as specified herein after complete in all respects, for efficient and trouble free operation.

b) GENERAL INFORMATION :

The boiler feed water pumps shall be provided as under :

Three (3) (2W+1S) numbers each having 20 m3/hr capacity Boiler Feed Pumps for both the HRSG have been considered. One (1) BFP shall be provided by the bidder as a stand-by with automatic start-up on failure of a running BFP for trouble free operation.

All the pumps will be electric motor driven. Each pump shall have capacity for supplying feed water to the steam generating unit under maximum load condition. Normally two will be working and one pump will be common stand-by. BFP's will take suction from existing suction header and then pump the feed water to the HRSG drum through Economizer.

c) PERFORMANCE REQUIREMENT:

Pumps will be located on the ground floor while the deaerator, will be already located at suitable elevation to provide required NPSH to the pump. The NPSHr for boiler feed pump shall be as minimum as possible. At least a margin of 1 meter should be available over the required NPSH.

Head capacity characteristic curves for the pumps should be such that it is continuously rising from operating point towards shut off. Drive motor output capability shall be selected such that a margin of at least 15% is provided over the maximum power required at the operating point. It should also be checked out at 120% of rated flow, the power requirement is lower than drive power. Detailed calculations shall be furnished about selection of the pumps and drives while selecting the drive for BFPs, margin of 10% on capacity and 20% on head shall

be considered. The pumps and drives shall be rated for continuous operation. All the pumps shall have identical performance characteristics. Characteristics of the drives shall match the characteristics of the pumps for stable operation at all loads. Parallel operation of the pumps should be possible at all loads with each pump delivering equal amount of flow. The feed pump shall have manual as well as automatic start-up facility under stand by condition.

The maximum allowable sound level (pump & driver combined) is 85 dB(A) 1 m apart from the equipment surface, unless otherwise specified.

The discharge from the HRSG feed pumps combines to a single line which goes upto Economiser through (2 x 100 % + 1 x 30%) control station.

d) Design & construction :

Pumps shall be of multistage, horizontal centrifugal type with barrel type construction, supported in such a manner as to permit free expansion both axially and radially whilst maintaining alignment. The HRSG feed pumps will be expected to accept from the main pipe work reasonable forces and moments. Therefore, the Contractor shall ensure that all materials and terminal connections are satisfactory. All the pumps shall be identical in design and construction. First critical speed should be well away from the operating speed. In case of pump unit having flexible shaft system, the first critical speed should not be more than 60% of operating speed.

Mechanical seal shall be provided at both ends of the shaft of each pump. Adequate cooling arrangement for the seal shall be provided.

A minimum flow recirculation arrangement shall be provided along with each pump. It would be preferable to have the pump discharge non-return valve of special type with arrangement for bypassing part of the flow depending on the position of the piston of the non-return valve. A pressure break-down arrangement will also be inbuilt. Capacity of the device shall be adequate such that even under closed discharge valve operation the pump does not get over heated. Equipment at discharge of feed pumps shall be designed for shut-off pressure of the pumps.

A suitable method of hydraulic balancing shall be supplied. The balancing drum, disc & counter disc arrangement shall be designed to balance pump axial thrust. The designs shall be relatively long so as to reduce the pressure per linear unit and thus the rate of wear. This should be optimized with the pump shaft span.

e) CLEANING AND PAINTING :

Grease, oil and other contaminants shall be removed by using degreasing solvent and then blast cleaned as per details covered in cl No 13.0

f) **INSPECTION AND TESTING AT MANUFACTURER'S SHOP** :

Material used shall be of tested quality. Certificates shall be furnished for material of construction of all critical parts. Non-destructive testing like ultra-sonic test, radiography and magnetic particle inspection shall be employed wherever necessary. Hydrostatic pressure testing shall be conducted for all pressure parts. Static and dynamic balancing shall be done for all rotating parts. Contractor shall also however specify the maximum permissible imbalance.

Performance testing will be conducted at shop to find out head, power, efficiency and NPSH characteristics against capacity. Standard of Hydraulic Institute of USA shall be followed for this purpose unless otherwise agreed upon during the time of order. Other requirements of inspection and tests shall be as per approved sheets and QAP.

g) DRAWING AND DATA :

- To be submitted along with the proposal :

  Preliminary General arrangement drawing of pumps, Cross sectional drawing showing material of construction of various parts, Calculation indicating sizing of BFPs, pump characteristic curves.

- To be submitted after award of contract :

Foundation drawing with load data, Process and instrumentation diagram, Piping drawings, Detailed drawings for components like level indicators, switches, safety valves, Materials test certificate and inspection report, instruction manual.

h) EQUIPMENT AND MATERIAL TO BE FURNISHED BY BIDDER :

The Bidders' scope of supply for each pump shall include, but not limited to, the following:

i) Pump

ii) Motor driver

iii) Flexible Coupling

iv) Coupling Guard

v) Common base frame with anchor bolts/shim plates as applicable.

v) Piping components for seal flushing

vi) Modulating type minimum bypass valve with provision for manual bypass with all components for return to deaeration tank.

vii) Balancing device with all components of balancing leak off device for return to deaerator tank.

viii) ARC (Automatic Recirculation-cum-Non-Return) Valve.

ix) All instrumentation e.g.two (2) nos pressure gauge at inlet and outlet, two (2) Nos. temperature gauges at inlet and outlet, regulating valve at inlet and isolating valve and NRV at outlet, sight flow indicator, provision for bearing metal temperature detection.

ix) Integral piping for cooling, sealing, lubrication, leak off, etc. for the pumps and drive motors.

ix) Suction filter for initial flushing of pipelines system.

x) Suction strainer with differential pressure switch and indicator shall be provided.

xi) Mechanical seal

xii) Commissioning spares

xiii) Special Tools and Tackles

i) Material of Construction

Description	Data
BOILER FEED PUMPS	
Design Code	HIS
Type of pump	Horizontal Centrifugal multistage barrel type / ring section type pump.
Barrel	Forged carbon steel with austenitic stainless steel inlay in high velocity zones and sealing surface
Shaft	13% chromium steel forging
Impeller, inner casing, stage pieces	13% chromium steel casting
Wearing ring	13% chromium steel properties with antigalling properties
Balancing drum bush	13% chromium steel properties with antigalling properties
Balancing Drum	Stainless steel
Shaft Sleeves	High alloy chromium or chromium nickel alloy steel
Radial Bearings	Sleeve type
Thrust Bearings	Double acting, 100% thrust bearing(suitable material)
BFP suction strainer	

Description	Data
Type	Y- type
Strainer Insert Material	Stainless Steel
Clear area of strainer (Flow opening area)	At least four times the inlet cross sectional area of the connecting pipe

6.2.13 Piping Systems

All materials for piping, valves, fittings, pressure vessels, and associated piping components shall conform to the applicable ANSI Codes. All power piping shall conform to ANSI B31.1 piping codes. Valves shall be appropriate for the Pressures and temperatures of each specific application. The HRSG installation is to be supplied with a complete set of integral piping and all necessary valves.

a) Main Steam Header in the scope of HRSG Bidder

The HP steam from all two HRSG's will be connected to a common header which is almost 1.5 km away from the HRSG plant. The following will be the basis for sizing the main steam header-

Flow: **Normal operating Pressure**	42 TPH (with 20% margin) 45 kg/cm2 (g)
Normal operating Temp **Max operating pressure**	380 deg C 54 Kg/cm2
Max operating Temperature	400 deg C

Considering the above design parameters, the following has been recommended.

Size (NPS) 200 NB

Service	Medium Pressure **Material of Steam pipe** ASTM A106 Gr B
Thickness of the pipe	Schedule 40
Insulation	Resin Bonded mineral wool (as per IS 8183) of density 150 kg/ m3
Cladding	Aluminum Cladding with 20 SWG thickness

6.2.14 Refractory and insulation

The HRSG setting refractory and heat insulating materials complete with cladding, lagging, reinforcement, wire mesh, cleats and supports for all the equipment, auxiliaries, piping and valves shall be in the scope of this specification. Fixtures required for installing insulating material and suitable aluminium sheet material for insulation finish shall also be included.

Necessary outer casing of steel for HRSG and of aluminium for all other equipment including hot air and flue ducts shall be included.

All materials for insulating flue gas ducts, economiser, superheater connecting tubes, exposed superheater headers, down comer pipes and exposed down comer tubes, water wall header systems, shall be provided.

All hot surfaces having outer surface temperature more than 60 deg.C shall be insulated. Insulation shall be provided to restrict skin temperature maximum 20 deg C above the ambient temperature. Asbestos is not allowed for insulation purposes. The refractory shall be capable of withstanding service temperature of 1700 deg C. All inner casing shall be fabricated from 10 SWG sheet steel.

7.0 BATTERY LIMIT

7.1 Battery limits of the various HRSGs are indicated below.

Sl. No.	***Description***	**Battery limit**

ESP-001-2A Rev.00	PROJECT ENGINEERING & SYSTEMS DIVISION	Std. / Doc. Number
		Annexure-14
		Rev. No. 00

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Annexure-14

Painting Specification

Revisions: Refer to record of revisions	**Prepared by :**	**Checked by :**	**Approved by :**	**Date :**
	Ratish Kumar	Girish Prasad Palo	Siva Prasad Babu	12.05.18

15.00.00 PAINTING

a) All surfaces shall be sand blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease and rust.

b) After cleaning, the surfaces shall be given a phosphate coating followed by 2 coats of high quality primer and stoved after each coat.

c) The equipments shall be finished in Siemens grey (RAL-7032)

d) Sufficient quantity of touch-up paint shall be furnished for application at site.

16.00.00 METERING

General Metering

Electrical parameters shall be metered to the extent required for proper operation and monitoring of plant conditions. As a minimum, the following metering shall be provided for the equipment indicated: -

A) Low Voltage Switchgear

Current, voltage, and watthours measured on each incomer and for each bus. Current measured on each feeder.

Voltage measured on each bus.

B) Motor Control Centres

Voltage measured on each bus. Current measured on each feeder.

17.00.00 CABLING

17.00.01 The scope of bidder with regard to cabling activities are as under

a) Supply and installation (including laying and termination) of control cables/ special cables/ instrumentation cables.
b) Supply and installation (including laying and termination) of all power cables LV
c)The cable trays for installation of cables

b)	**Boiler feed Pump**	
1	Wear rings (set)	2 sets.
2	All types of bearings; radial, thrust etc. (each)	1 set.
3	Bearing Liners	4 sets
4	Mechanical seal(DE +NDE)	2 sets.
5	Shaft sleeve	1 set.
6	Gaskets/shims/o-rings (set)	2 sets.
7	Balancing disc and counter balancing disc (set)	2 sets.
8	Bare shaft	1 set.
9	Suction filter	1 set.
10	Tie-rods	1 set
11	Low load recirculation valve	1 set

Note 1 : One set means quantity installed on one pump.
Note 2 : List of mandatory spare parts for electrical is given in electrical chapter.

13.0 PAINTING AND COLOUR SCHEME

13.1 Painting

Painting covers the materials, tools, facilities and quality requirement for surface preparation and painting of steel works, equipment, piping, ducts, chutes, etc. required for the proposed plant.

The term "painting" referred herein covers rust preventive, preventive and decorative coating along with surface protection of all the items like structural steel work, Various types of static and rotary equipment inclusive of electric motors, etc., Steel tanks and vessels, Pipe work including trestles, supports, hangers, etc., Metallic duct work such as ventilation ducts, gas ducts including supports, hangers, etc.

All machined mating surfaces (e.g. Flanges) shall be properly cleaned, greased and protected before dispatch.

The complete paint system for any item includes the following activities:

i) Proper surface preparation
ii) Application of primer coats
iii) Application of intermediate coats
iv) Application of finished coats

13.1.2 Surface Preparation

Surface preparation being a pre-requisite for any paint application, shall be such as to clean the surface thoroughly of any materials which will be conducive to premature failure of the paint substrates.

All surfaces shall be cleaned of loose substances and foreign materials, such as dirt, rust, scale, oil, grease, welding flux, etc. irrespective of whether the same has been spelt out in the standards in order that the prime coat is
rigidly anchored to the virgin metal surface. The surface preparation grade
of Swedish Standards Institution SIS - 055900 or equivalent standards
such as SSPC - VIS -1.67 or DIN 55928 (Part 4) or BS 4232 or IS:1477 (Part I)

The acceptable surface preparation quality/grade area solvent cleaning, hand tool cleaning, power tool cleaning and blast cleaning.

13.1.3 Primer Paints (P)

Primer paints shall be applied only on dry and clean surfaces.

Primer paint P1 - (Epoxy based)

A two pack air drying Epoxy polyamide resin based red oxide - zinc phosphate (primer).

Epoxy content (% wt.)	-	15 to 18
Air drying time	-	About 30 minutes (touch dry)
	-	Overnight (hard dry)
Dry film thickness	-	30 microns (min) (DFT / Coat)

Temperature resistance	-	upto 120 deg. C dry heat
Primer paint P2	-	(Epoxy based)

A two pack air drying Epoxy polymide with zinc dust of at least 92% zinc dust on the dry film.

Epoxy content (% wt.)	-	8 to 10
Air drying time	-	10 minutes (touch dry)
	-	2 hours (hard dry) DFT / coat - 40 microns (min)
Temperature resistance	-	upto 300 deg. C dry heat
Primer paint P3	-	(Ethyl zinc silicate, EZS, based)

A two pack heavy duty zinc dust rich silicate primer.

Total solid (3 wt)	-	84 +/- 2
Density	-	3.07 +/- 0.005
Air drying time	-	16 hours
DFT / coat	-	60 microns
Temperature resistance	-	upto 450 deg. C dry heat

13.1.4 Intermediate paints (I)

These paints shall be applied over primer coats as an intermediate layer to provide weather proof seal of primer coats.

Intermediate Paint (I1)

A two pack air drying high build epoxy resin based paint with MIO.

Air drying time	-	6 to 8 hours (touch dry)
	-	7 days (full cure)
DFT / coat	-	100 microns

Temperature resistance	-	upto 180 deg. C dry heat
Compatible with	-	Primer P1 and P2

13.1.5 Finish paints (F)

Finish paint coats shall be applied over primer coats and intermediate coats after proper cleaning and touch up of primed coats.

Finish Paint F1

A two pack air drying epoxy polyamide enamel suitably pigmented.

Air drying time	-	2 to 3 hours (touch dry) - 7 days (full cure)
DFT / coat	-	40 microns (min)
Temperature resistance	-	upto 130 deg. C dry heat
Compatible with	-	Primers P1 and P2 Intermediate I1
Colour	-	Generally all shades

Finish paint F2

A single pack synthetic rubber based aluminium paint.

Air drying time	-	2 hours (touch dry) - 24 hours (hard dry)
DFT / coat	-	25 microns
Temperature resistance	-	up to 200 deg. C dry heat
Compatible with	-	no primers
Colour	-	smooth aluminium

Finish Paint F3

A single pack heat resistant silicon resin based paint with leafing aluminium.

Air drying time	-	3 to 4 hours (touch dry) - 24 hours (hard dry)
DFT / coat	-	20 microns (min)
Temperature resistance	-	upto 400 deg.C dry heat
Compatible with	-	no primer paint except
Colour	-	smooth aluminium

13.1.6 Paint application

Paint shall be applied in accordance with manufacturer's recommendations. The work shall generally follow IS 1477 (Part II) for jobs carried out in India and SSPC-PA-I or DIN 55928 or equivalent for jobs carried out outside India.

13.2 Painting scheme

The painting scheme to be followed for various equipment/ structures is briefly given below for guidance to the Bidder.

Sl.No.	Description	Painting Scheme		Total DFT
		At shop	At site	
1.	Steel structure	SP-Sa 2 ½ 2P1 + 1/1	2F1	20
2.	Mechanical equipment (temp. not over 80 deg.C) Both static and rotary equipment for indoor or outdoor duty.	SP-Sa 2 ½ 2P1+1/1	2F1	240

3.	Equipment with hot surfaces (temp. up to 400 deg. C)	SP-Sa 2 ½ 2P2	2F2	180
4.	Equipment with hot surfaces (temp. up to 400 deg. C)	SP-Sa 2 ½ 2P3	2F3	180
5.	Non insulated pipe/duct works			
	Temperature not over 80 deg.C	SP-Sa 2 ½ 2P1+1/1	2F1	240
	Temperature up to 200 deg.C	SP-Sa 2 ½ 2P2	2F2	180
	Temperature up to 400 deg.C	SP-Sa 2 ½ 2P3	2F3	180
6.	Insulated pipe/duct works	SP-Sa 2 ½ 2 coats primer suit able for intended temperature application as per the manufacture's recommendation. The primers selection shall be done generally in line with	2F2 Final painting shall be done over the cladding. In case of aluminium cladding, final painting will not be required.	180

13.3 Colour Scheme

Colour schemes for plant and industrial building and equipments are recommended for brightening the interior or buildings, for safety or for improving operational efficiency.

Exterior schemes are chosen in a combination of colours to suit the local conditions. Materials like powdered distempers, PVA emulsion paints and flat or eggshell alkyd paints are not recommended for out door use. Pink and blue cement based distempers are usually more prone to fading than many other colours and their use on exteriors should be avoided.

Pipe, conduits, structural etc. close to ceilings, walls or columns are painted in the same colour as their background unless special colour schemes for them are in use.

Colour Code for Painting Thickness, Pipelines, Structures etc.

Heater Structure	-	Black
Heater Roof	-	Heat resisting aluminum
Vessels, column etc.	-	Aluminum paint (silver shine)
Heat exchangers	-	Heat resisting aluminum paint

Tanks

Solvent Tank	-	Deep cream
All other tanks	-	Aluminum paint (sliver shine)
Pumps	-	Navy blue
Ventilator etc.	-	Dark admiralty grey
Outer surface in HRSG house	-	Heat resisting aluminum paint
Motors, switch-gear machines	-	Blue green etc.
Load lifting equipment & mono	-	Leaf brown rails etc.

Steel structures and service	-	Black

Auxiliaries

Industrial water line	-	Azme blue
Treated water line	-	Bus green
Drinking water line	-	Bus green with white bands
Steam lines	-	Deep orange
Condensate	-	Deep orange with white bands
Industrial/ Service	-	Light grey
Air lines,		
Instrument air lines	-	Light grey with white bands
Fire water lines	-	Post offices red
Fire water steam lines	-	Post office red with white bands
Blow down lines	-	Canary yellow
Acid lines	-	Middle Buff Gas lines - Red oxide
Trisodium Phosphate line	-	Yellow with brown bands
Caustic Soda line	-	Yellow
Sodium Chloride	-	Yellow with white bands
Hexameter phosphate line	-	Yellow with black bands

Safety Colour Schemes

Dangerous obstruction	-	Black and alert orange bands
Dangerous or exposed parts Of machinery e.g moving parts (including coupling flanges)	-	Alert orange
Dangerous points of Electrical installation	-	Blue
Fire – fighting equipment	-	Post office red
First – Aid equipment	-	Green tri anole

Instrument Panels Instruments	- -	Pastel Green/ apple green Forest green/ pastal green

13.4 Paints Suppliers

Asian Paint	APCOSIL ML9551	Heat Resistant Silicone Paint.
Berger Paint	Zinc Anode 304	Berger Heat Resistant Silicone
Goodlass Nerolac	DIMAT COAT 6	Aluminum Coating.
Shalimar Paint	-	AMERCOAT – 878 Silicone Aluminium Paint Lustotherm HT 600