

**OWNER : INDIAN OIL CORPORATION LIMITED (IOCL)
PMC : ENGINEERS INDIA LIMITED**

CPP - PARADIP REFINERY PROJECT

VOLUME -IIB

**TECHNICAL SPECIFICATION
FOR
SPECIAL PROCESS HORIZONTAL PUMPS**

Specification No. : PE-TS-353-100-N001 (REV. 0)



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



PREAMBLE

SPECN. NO.:

PE-TS-353-100-N001

REV. NO.

0

DATE:

10.07.2010

1.0 The tender document contains three (3) volumes. The bidder shall meet the requirements of all the three volumes.

1.1 Volume I - CONDITIONS OF CONTRACT

This consists of four parts as below:

Volume - I A : This part contains instructions to bidders for making bids to BHEL.

Volume - I B : This part contains general commercial conditions of the tender and include provision that vendor shall be responsible for the quality of item supplied by their sub-vendors.

Volume - I C : This part contains special conditions of contract.

Volume - I D : This part contains commercial conditions for erection and commissioning site work, as applicable.

1.2 Volume II - TECHNICAL SPECIFICATIONS

Technical requirements are stipulated in Volume II which comprises of:

Volume - II A : General Technical Conditions

Volume - II B : Technical specification including drawings, if any

1.2.1 Volume - II B :

This volume is sub-divided into following sections:

Section - A : This section outlines the scope of enquiry.

Section - B : This section provides "Project Information"

Section - C : This section indicates technical requirements specific to the contract, not covered in Section-D.

Section - D : This section comprises of technical specifications of equipments complete with data sheet A, B & C.

Data sheet - A specifies data and other requirements pertaining to the equipment.


Data sheet - B specifies data to be filled by the bidder (Data Sheet B is contained in Volume - III)


Data sheet - C indicates data documents to be furnished after the award of contract as per agreed schedule by the vendor (as applicable).


1.2.2 Volume - III TECHNICAL SCHEDULES

This volume contains technical schedules and Data Sheets - B, which are to be duly filled by the bidder and the same shall be furnished with the technical bid as per instructions given in Document No.PES-100-901 in Volume-III.

2.0 The requirements mentioned in Section C/Data Sheets-A of Section-D shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section -D.

	TECHNICAL SPECIFICATIONS SPECIAL PROCESS HORIZONTAL PUMPS	SPECN. NO.:		PE-TS-353-100-N001	
		VOLUME:		IIB	SECTION:
		REV. NO.		0	DATE:
INDEX					
SECTION	TITLE				
A	SCOPE OF ENQUIRY				
B	PROJECT INFORMATIONS				
	CPP - PARADIP REFINERY PROJECT				
C	SPECIFIC TECHNICAL REQUIREMENTS FOR				
C1	PUMPS & DRIVE TURBINES				
C2	INSTRUMENTATION SPECIFICATION				
D	STANDARD TECHNICAL SPECIFICATIONS FOR				
	PUMPS				
	<ul style="list-style-type: none">DATA SHEETS-A ALONGWITH LIST OF MANDATORY SPARES & WATER ANALYSIS.DATA SHEET - C				

	TECHNICAL SPECIFICATIONS SPECIAL PROCESS HORIZONTAL PUMPS	SPECN. NO.:	PE-TS-353-100-N001		
		VOLUME:	IIB	SECTION:	A
		REV. NO.	0	DATE:	10.07.2010
<div>SECTION A</div> <div>SCOPE OF INQUIRY</div>					

	TECHNICAL SPECIFICATIONS SPECIAL PROCESS HORIZONTAL PUMPS	SPECN. NO.:	PE-TS-353-100-N001		
		VOLUME:	IIB	SECTION:	A
		REV. NO.	0	DATE:	10.07.2010

1.0 SCOPE

- 1.1 This enquiry covers the design, engineering, manufacture, assembly, inspection and testing at manufacturer's and/or his sub-contractors works, properly packed and painted for delivery, installation checks at site and performance test at site for Special Process Pumps including Steam Turbine drives along with mandatory spares complete with all accessories as per the requirements specified in this specification for CPP - PARADIP REFINERY PROJECT.

The bidder's scope shall also include any other services, etc. if called for in the succeeding sections of the specification.

- 1.2 The miscellaneous pumps covered under this specification shall be Horizontal pumps Group-I and Horizontal pumps Group-II.

Note:

The bidder shall include complete supplies for the Group as above in his scope. Part supplies offered for the Group shall disqualify the bidder's offer for that Group (as applicable).

- 1.3 The Special process pumps and drives covered under this specification are as per Annexure-I. HT drives, wherever applicable and irrespective of motor ratings, shall be issued free of cost by BHEL. The details of pumps with HT drives shall be as per Annexure-II.

The Capacity, Head, Materials of construction, Mandatory spares and other particulars of these pumps, are detailed in Data Sheet-A annexed with Section-D of the specification.

- 1.4 For detailed scope of supply & services refer clause 3.00.00 of Specific technical requirement for Special Process Horizontal pumps specified under Section-C of this volume.

2.0 GENERAL TECHNICAL INSTRUCTIONS

- 2.1 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship, and shall be capable of performing the required duties in a manner acceptable to Engineer/Owner who will interpret the meaning of drawings and specifications and shall be entitled to reject any component or material, which in his judgement is not in full accordance herewith.

- 2.2 The omission of specific reference to any component/accessory necessary for the proper performance of Miscellaneous Pumps and drives shall not relieve the bidder of the responsibility of providing such facilities to complete the supply of equipment at quoted prices.

- 2.3 BHEL's / Customer's representative shall be given full access to the shop in which the equipments are being manufactured or tested and all test records shall be made available to him.

- 2.4 The equipments covered under this specification shall not be despatched unless the same have been finally inspected, accepted and shipping release issued by BHEL/Customer.

- 2.5 ***In case of any deviation from this technical specification (Vol.IIB) and General Technical Conditions (Vol.II A), the same shall be indicated in the schedule of deviations enclosed in Vol.III. In the absence of duly filled schedules it will be assumed that the bid strictly conforms to the specification.***

- 2.6 Unpriced copy of the price bid shall be furnished alongwith the technical bid.



TECHNICAL SPECIFICATIONS
SPECIAL PROCESS HORIZONTAL
PUMPS


SPECN. NO.:	PE-TS-353-100-N001		
VOLUME:	IIB	SECTION:	A
REV. NO.	0	DATE:	10.07.2010

Annexure I

List of Special Process Horizontal Pumps and Steam Turbine drives:

1.0 CPP - PARADIP REFINERY PROJECT

Sl. No.	Pump Description	Total Qty.	Type of Pumps	Group
1	HP Feed Water Export Pumps - Steam Turbine Driven	1 no.	Horizontal	Group-I
2	HP Feed Water Export Pumps - Motor Driven	2 nos.	Horizontal	
3	MP Feed Water Export Pumps - Steam Turbine Driven	1 no.	Horizontal	
4	MP Feed Water Export Pumps - Motor Driven	2 nos.	Horizontal	
5	Condensate Transfer Pumps - Steam turbine Driven	1 no.	Horizontal	Group-II
6	Condensate Transfer Pumps - Motor Driven	2 nos.	Horizontal	
7	HRSG Make-up Heater Transfer Pumps - Motor Driven	3 nos.	Horizontal	

	TECHNICAL SPECIFICATIONS SPECIAL PROCESS HORIZONTAL PUMPS	SPECN. NO.:	PE-TS-353-100-N001		
		VOLUME:	IIB	SECTION:	A
		REV. NO.	0	DATE:	10.07.2010

Annexure II

List of Special Process Horizontal pumps with HT drives irrespective of Motor ratings for CPP - PARADIP REFINERY PROJECT:-

- 1 HP Feed water Export Pumps - Motor Driven - 2 nos
- 2 MP Feed water Export Pumps - Motor Driven - 2 nos
- 3 Condensate Transfer Pumps - Motor Driven - 2 nos.
- 4 HRSG Make-up Heat Transfer Pumps - Motor driven - 3 nos.



TECHNICAL SPECIFICATIONS
SPECIAL PROCESS HORIZONTAL
PUMPS

SPECN. NO.: PE-TS-353-100-N001

VOLUME: IIB

SECTION: B

REV. NO. 0

DATE: 10.07.2010

SECTION B

PROJECT INFORMATION

CPP - PARADIP REFINERY PROJECT

Dated : 18-June-2010

PARADIP REFINERY CPP

PROJECT INFORMATION

1.	Owner	Indian Oil Corporation Limited
2.	Project	PARADIP REFINERY CPP
3.	Owner's consultant	Engineers India Limited
4.	Location	The project Site is located at Paradip in state of ORISSA, India (Approximately 5 kms from the Paradip Port).
5.	Nearest Airport	Bhubaneswar (125 kms)
6.	Nearest Railway Station	Cuttack (94 kms)
7.	Access to site	From Cuttack railway station By bus or taxi
8.	Site data	
A	Altitude	3.91M above Mean Sea Level
B	Ambient Air Temperature	
1.	Design maximum	42.4°C
2.	Design Minimum	11.3°C
3.	Design Wet Bulb	29°C

C	RELATIVE HUMIDITY	
	Mean Daily Humidity	99.7% (Max); 24.7% (Min)
	Average Monthly Humidity	95% (Max); 55% (min)
D	RAINFALL	
1.	Average Annual Rainfall	1572 mm
2.	Design Rainfall (per hour)	125 mm
3.	Maximum Recorded Annual	2251.7 mm
4.	Minimum Recorded Annual	1018.6 mm
E	WIND VELOCITY & PRESSURE [AS PER IS:875]	
1.	Wind Load	In accordance with IS-875 (Part 3) – 1987 (reaffirmed 2003) for a basic wind speed of 65 m/sec.
2.	Average Wind Velocity	Summer: 37 – 45 km/hr Winter: 15 - 26 km/hr Maximum: 259 km/hr (cyclonic)
F	SEISMIC ZONE	Zone-3 as per IS-1893 latest revision
9.0	Power Supply	
	a) In plant generation	11kV \pm 6%, 3ph, 50 \pm 3%Hz
	b) In plant distribution	66kV \pm 6%, 3ph, 50 \pm 3%
	c) Motor rated above 160kW	6.6kV \pm 6%, 3ph, 50 \pm 3%
	d) Motor rated above 18W to 160kW	415V \pm 6%, 3ph, 50 \pm 3%
	e) Motors rated below 18W, Lighting and small power	240V \pm 6%, 1ph, 50 \pm 3%
	f) DC Motors	220V DC \pm 10%, 2 wire ungrounded system
	g) Control supply for relay panel/ 6.6kV	110V DC \pm 10%, 2 wire

	breakers/415V breakers	ungrounded system
	h) UPS for instrumentation & Control system	415V AC $\pm 6\%$, 3 ph, 50Hz $\pm 3\%$
	i) Control supply for 415V Motor contactors/AC Control circuits [to be generated in MCC /panel by vendor]	240V AC $\pm 10\%$, 50Hz $\pm 5\%$
	j) Diesel Generator emergency supply	6.6kV $\pm 6\%$, 3ph, 50 $\pm 3\%$ & 415V $\pm 6\%$, 3ph, 3W, 50Hz $\pm 3\%$
	k) DC emergency lighting.	220V DC $\pm 10\%$, 2 wire ungrounded system
NOTE:	1. All equipment except generator shall be suitable for any combination of voltage and frequency variation. 2. Any other power supply requirement shall be derived by the vendor from the above available power supplies.	
10.0	Design ambient temperature for electrical equipment	45°C
11.0	Fault levels	
	a) 66kV	40 kA rms for 1 sec.
	b) 6.6kV	40 kA rms for 1 sec.
	c) 415V	50 kA rms for 1 sec.



TECHNICAL SPECIFICATIONS
SPECIAL PROCESS HORIZONTAL
PUMPS

SPECN. NO.:	PE-TS-353-100-N001		
VOLUME:	IIB	SECTION:	C
REV. NO.	0	DATE:	10.07.2010

SECTION C

SPECIFIC TECHNICAL REQUIREMENTS



TECHNICAL SPECIFICATIONS
SPECIAL PROCESS HORIZONTAL
PUMPS

SPECN. NO.:

PE-TS-353-100-N001

VOLUME:

IIB

SECTION:

C

REV. NO.

0

DATE:

10.07.2010

SECTION C1

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFIC TECHNICAL REQUIREMENTS FOR PUMPS AND DRIVE TURBINES



TITLE :
**TECHNICAL SPECIFICATION FOR
SPECIAL PROCESS HORIZONTAL
PUMPS**

SPECIFICATION NO. PE-TS-353-100-N001

VOLUME II B

SECTION C

REV. NO. 0 **DATE 10.07.2010**

SHEET 1 OF 7

01.00 INTENT OF SPECIFICATION:

- 01.01 This specification specifies the requirement of Design, Engineering, Manufacturing, Assembling, Inspection & Testing at manufacturer's and/or his sub-contractors' works and Delivery properly packed and painted for delivery, installation checks at site and performance test at site of Special Purpose Process Pumps including all Steam Turbine drives along with mandatory spares complete with all accessories as per the requirements specified in this specification (excluding HT motor drives) for CPP PARADIP REFINERY, IOCL.
- 01.02 This specification shall be read in conjunction with its enclosures. First preference shall be given to EIL specifications only. In case of any discrepancy arising between this job specification & its enclosures, wherein more than one level (i.e. both less stringent level and more stringent levels) of same requirement have been indicated for a particular item, the most stringent of all shall be followed and shall relevantly over-ride others. Otherwise, the requirements indicated in this job specification shall be considered as additional requirements to the ones indicated in the enclosures. 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.
- 01.03 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, 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.
- 02.00 EIL Specifications enclosed with this specifications shall be followed (enclosed as Annexure 1).
- 03.00 For technical details / requirements for various pumps, refer Datasheet-A (enclosed in section-D of this specification)

04.00 SCOPE OF SUPPLY:

04.01 The scope of supply for each pump is as given below.

- 04.01.01 Steam Turbine drives
- 04.01.02 Pump radial bearings shall be cylindrical roller (or) anti friction ball bearings with ring oil (or) sump oil (or) pure oil mist lubrication. Pump thrust bearing shall be anti friction ball bearings with ring oil (or) sump oil (or) pure oil mist lubrication.
- 04.01.03 Hydraulic thrust balancing to be achieved by balancing drum.
- 04.01.04 Forced oil lubrication skid (if required)
- 04.01.05 Lubrication System for pumps and turbines with required instrumentation and control, if required. (Bidder to quote based on requirement of pump model.) LO Piping between pump skid & LO skid, Shaft driven MOP, Motor driven AOP, First fill of oil & Electric oil heater are required. Oil pressure to be greater than coolant pressure.
- 04.01.06 Mechanical seals with flushing plan 23, 61 with SS piping & cooling plan K.
- 04.01.07 Common base frame for Pump & motor including motor fixing bolts. Common base frame for pump & turbine, including fixing bolts. Base frame for forced oil lubrication (if required).
- 04.01.08 "T" type suction strainer. Strainer size & rating shall be same as BHEL suction pipe size. Tap offs shall be provided across the suction strainer for Differential Pressure Transmitter & Differential Pressure Gauge.
- 04.01.09 Coupling, metallic, non-lubricated, flexible element type (i.e. either diaphragm or disc type) with spacer, minimum service factor of 1.5, with non-sparking type coupling guard. Minimum flow control by Automatic Recirculation Control valve with flanged ends.
- 04.01.10 Instrumentation, control & accessories for each pump.



TITLE :
**TECHNICAL SPECIFICATION FOR
SPECIAL PROCESS HORIZONTAL
PUMPS**

SPECIFICATION NO. PE-TS-353-100-N001

VOLUME II B

SECTION C

REV. NO. 0 DATE 10.07.2010

SHEET 2 OF 7

Instrumentation shall include the following as a minimum.

- a. Duplex type RTDs with temperature transmitters for each pump bearings for Alarm, Trip interlocks..
 - b. Temperature gauges for each pump bearings & seal coolers.
 - c. Pressure relief valve on each cooling water return line.
 - d. Pump is provided with local gauge board & lube oil plant is provided with local gauge board with junction boxes. Instruments shall be terminated in the junction boxes.
- 04.01.11 All the instruments shall be mounted on a Local gauge board separately for each pump.
- 04.01.12 Suitable reducers & counter flanges with gaskets and fasteners for suction, discharge, recirculation, BLO, Cooling water inlet/outlet and at all other terminal points. IBR requirement for pump, piping & valves etc.
- 04.01.13 Spool pieces as required.
- 04.01.14 Necessary foundation bolts, nuts, etc for mounting Pump-motor/ Pump-turbine unit on civil foundations.
- 04.01.15 Suitable vent (with valves)/ lifting/ handling attachments for the pump/ motor/ accessories.
- 04.01.16 Suitable drain connections with isolating valves as applicable.
- 04.01.17 Supply of first fill of lubricants with topping requirements for one year of operation after commissioning and handing over of equipment.
- 04.01.18 Commissioning spares (as required) for each pump.
- 04.01.19 Cartridge withdrawal fixture/trolley. One set common for HP Feed Water Export Pumps and one set common for MP Feed Water Export Pumps. One set common for condensate transfer pumps, one set common for HRSG MUH pumps.
- 04.01.20 Special tools, if any apart from above. One set common for HP Feed Water Export Pumps, one set common for MP Feed Water Export Pumps, one set common for Condensate Transfer pumps and one set common for HRSG MUH pumps.
- 04.01.21 Orifice plates in Recirculation line, if required, shall be supplied during detailed engg.
- 04.01.22 Orifice plates in balance leak off line, if required, shall be supplied during detailed engg.
- 04.01.23 Noise level shall be limited to 85dba @ 1m, inline with BHEL specification.
- 04.01.24 All other items necessary for safe and smooth running of pump & Accessories required to make the supplied equipment complete in all respect.
- 04.01.25 All others requirements as indicated in this job specification & its enclosures, per pump.
- 04.01.26 Mandatory spares as specified in respective Datasheet-A and EIL specifications.

04.02.01 The scope of supply for each Steam Turbine Drive is as given below:

- 04.02.02 Back pressure steam turbine with emergency stop valve, control valve, governing system, blanket plate, steam strainer, turbine insulation, base plate/mounting plates, gland sealing system etc.
- 04.02.03 Lubrication System for Turbine with required instrumentation and control, if required. (Bidder to provide based on requirement of turbine model.) LO Piping between turbine & LO skid, Shaft driven MOP, Motor driven AOP, First fill of oil & Electric oil heater are required. Oil pressure to be greater than coolant pressure. Turbine Lube oil instrumentation like Pressure Switch, PG, PRV, RTD, Temperature transmitters etc.
- 04.02.04 Coupling, metallic, non-lubricated, flexible element type (i.e. either diaphragm or disc type) with spacer, minimum service factor of 1.5, with non-sparking type coupling guard
- 04.02.05 Instrumentation, control & accessories: Following are required as a minimum. Pressure Gauge, Nozzle ring. RTDs for bearings with temperature transmitters (Steam Inlet, Exhaust), pressure relief valve on each cooling tower return line, Junction Box. Local gauge board.
- 04.02.06 Piping with in terminal points with insulation: Following are required as a minimum. Inlet, Exhaust, Drain & Water piping, Gaskets, fittings, miscellaneous valves & gauges. IBR requirements for turbine, piping & valves etc.
- 04.02.07 Suitable reducers/expanders & counter flanges with gaskets and fasteners at all terminal points. Counter flanges with packing & bolts at all turbines "Purchasers connections".
- 04.02.08 Steam Traps with gate valves for Below Seat Drain, Above Seat Drain, Casing Drain, inlet & exhaust.
- 04.02.09 Y type strainer at inlet (if required).



TITLE :
**TECHNICAL SPECIFICATION FOR
SPECIAL PROCESS HORIZONTAL
PUMPS**

SPECIFICATION NO. PE-TS-353-100-N001

VOLUME II B

SECTION C

REV. NO. 0 DATE 10.07.2010

SHEET 3 OF 7

- 04.02.10 Exhaust Relief Valve.
- 04.02.11 Bolting hardware for Inlet & Exhaust connections. Bolts in Inlet & Exhaust connections to straddle centreline.
- 04.02.12 Sentinel Valve.
- 04.02.13 Turbine Blanket type Insulation
- 04.02.14 Necessary foundation bolts, nuts, etc. Turbine mounting bolts, nuts, washers, dowels, shims.
- 04.02.15 Horizontal & Vertical component positioning screws.
- 04.02.16 Gland Steam Condenser for evacuation of leak off from shaft packing cases, If required.
- 04.02.17 Anti vibration pads with alignment shims.
- 04.02.18 Commissioning spares on as required basis for each steam turbine..
- 04.02.19 Any special tools & tackles, if required.
- 04.02.20 All other items necessary for safe and smooth running of turbine & accessories required to make the supplied equipment complete in all respect.
- 04.02.21 All others requirements as indicated in this job specification & its enclosures.

4.03 The bidder shall make provisions for mounting following on the Pump/ Turbine/ Pump shaft for Vibration monitoring system. Bidder shall also furnish optional prices for supply of vibration & bearing monitoring system:

- 4.03.01 Purchasers Probes in both DE/NDE bearings of Pumps and in both DE/NDE bearings of Steam turbine drives.
- 4.03.02 Key slot on pump/Turbine shaft.
- 4.03.03 Vibration monitor shall be as Bentley Nevada 3500 series or equivalent.

5.00.0 Services included in Bidder's scope.

- 5.01.0 The pumps shall be guaranteed to meet the performance requirements specified vide Data Sheet -A and also for trouble free operation after commissioning. Schedule of performance guarantees (enclosed in Volume-III) duly filled and signed shall be furnished with the bid.
- 5.02.0 Auxiliary power consumption (Electric input power consumption to Motor) for each pump at normal flow condition is to be guaranteed & demonstrated at works.
- 5.03.0 Performance test with water at ambient temperature is acceptable. However bidder to confirm & guarantee pump efficiency with hot water during performance at site.
- 5.04.0 The Special process pumps erected by the purchaser shall be checked by the bidder for correctness of their installation, alignment, etc. at site prior to their commissioning. The charges for same shall be included by bidder in his base price, itself.
- 5.05.0 After commissioning of pumps at site, site performance test for Noise, vibration and parallel running of pumps of all pumps and site performance test for drive turbines for each unit/project shall be conducted by Vendor at project site to ensure that the pumps meet the specified requirements. In case of any deficiency, the vendor shall rectify the same at site at no additional cost to BHEL.
- 5.06.0 IBR approvals/certificates shall be provided by bidder for all piping, valves, fittings, pumps, drive turbines, instrumentation etc. in bidder's scope. The charges for same shall be included by bidder in his base price itself.

6.00.0 Works excluded from Bidder's Scope:

- 6.01.0 HT motors. All HT motors (bare motors only) shall be supplied as free issue by BHEL through BHEL-Bhopal, based on ratings and torque – speed curve selected by the bidders. The responsibility for satisfactory operation for combined performance for pumps & motors shall rest with the bidder only as if, the HT motors has been supplied by the Bidder. Couplings, base plate, foundation bolts, any other fittings, etc. as required shall be supplied by the bidders only. BHEL-Bhopal shall supply one no. of each type of HT motor for shop testing of pumps with job motors. All other motors shall be dispatched by BHEL-Bhopal directly to project sites.
- 6.02.0 Civil foundation
- 6.03.0 Suction/ discharge pipe works
- 6.04.0 MCC/ Switchgear/Power supply



TITLE :
**TECHNICAL SPECIFICATION FOR
SPECIAL PROCESS HORIZONTAL
PUMPS**

SPECIFICATION NO. PE-TS-353-100-N001

VOLUME II B

SECTION C

REV. NO. 0 DATE 10.07.2010

SHEET 4 OF 7

6.05.0 Power and Control Cables, unless specifically specified in Electrical/ Systems portion of the specification.

6.06.0 Erection of equipments.

7.00.0 BID EVALUATION CRITERIA & LIQUIDATED DAMAGES FOR SHORTFALL:

7.01.0 PUMPS

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

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

$$KW = (Q \times H) / (P \times M \times 367.2)$$

Where Q = Rated capacity M3/hr
H = Rated TDH, MWC
P = Pump Efficiency
M = Motor Efficiency.

7.01.2 The maximum permissible efficiencies for pumps and motors for Bid Evaluation shall be as indicated in Data Sheet A for various pumps. No advantage shall be given to bidder for efficiencies quoted higher than the maximum permissible values. However the bids shall be evaluated as above if the efficiencies quoted are lower than these values.

NOTE:

1. HT motors efficiencies for bid evaluation purpose shall be taken based on the maximum value as furnished in Data Sheet A.
2. During contract stage the guaranteed power consumption of Pumps with HT drives for successful bidder shall be reworked by BHEL as below:
Revised guarantee power consumption shall be as per KW calculation formula above, where P = pump efficiency guaranteed by bidder and M = motor efficiency as per approved datasheet of the supplied HT motor.

7.01.3 Liquidated damages for shortfall in Guaranteed KW The above guaranteed power consumption shall be demonstrated by the successful bidder during performance testing at works/ site.
For pumps with HT drives, the power consumption shall be compared with the reworked guarantee power consumption, defined as per note no. 2 of Cl. 7.01.00 above for the purpose of shortfall. The liquated damages @ twice the bid evaluation rate as above per KW per working pump shall be levied in the event of failure of bidder to demonstrate the guaranteed power consumption.

7.02.0 TURBINE

- 7.02.1 The performance of the Drive Steam Turbine shall be evaluated based on the specific steam consumption (Steam consumption in kg/hr per KW basis) at design condition.
- 7.02.2 The maximum specific steam consumption shall be limited to 22.5 kg/hr at design condition. Bids with higher specific steam consumptions than specified above are liable for rejection.
- 7.02.3 Bidder shall furnish the specific steam consumption for minimum & maximum operating conditions also.
- 7.02.4 For evaluation, the evaluation rate will be levied @ Rs. 350000/- per 1% increase in the specific steam consumption with respect to the bidder having lowest specific steam consumption.

8.00.0 TECHNICAL REQUIREMENTS:

8.01.0 GENERAL

8.01.1 Comments / Deviations to our specifications & the standards mentioned in them shall accompany the offer, in the absence of which it will be understood that there are no comments



TITLE :
**TECHNICAL SPECIFICATION FOR
SPECIAL PROCESS HORIZONTAL
PUMPS**

SPECIFICATION NO. PE-TS-353-100-N001

VOLUME II B

SECTION C

REV. NO. 0 DATE 10.07.2010

SHEET 5 OF 7

/ deviations.

- 8.01.2 This specification also includes the supply of commissioning spares as required, special tools & tackles (if any) for necessary operation & maintenance. These shall form an integral part of the supply for the above package irrespective of being separately or explicitly indicated in this-specification/tender-correspondence /purchase-order. However, recommended spares for three (3) years operation shall be quoted separately and shall not form an integral part of the supply for the above package. If required to be ordered, requirement of 3 years operational spares shall be explicitly indicated in this specification/ tender correspondence/ purchase-order.
- 8.01.3 All materials supplied under this contract shall be new and unused. All indigenous equipment/materials offered should be with ISI mark. Any special approvals that may be applicable for certain items, like for explosion-proof items from CMERI-Dhanbad, etc., shall be have to be duly considered and ensured by the bidder. All imported equipment/materials should have an approval of ASME / API / BS / LPC / FM / UL / BASEEFA / NEC / IEC / NFPA / AWWA /other-applicable-authority, as may be applicable.
- 8.01.4 All equipment/items supplied shall conform to the provisions of statutory & other regulations in force in India and the State/Province where the project is executed, such as the Indian Factories Act, Indian Electricity (Supply) Act, Indian Electricity Act, Indian Electricity Rules, International Electric Technical Commission (IEC) Publication, Environmental Rules, etc.
- 8.01.5 Supplies shall be rendered in conformity with proven design principles. The purpose of this contract must be fulfilled in its entirety and the maximum of reliability and economy guaranteed. All the components shall be so designed that repairs and overhauling is minimum and can be carried out easily in the shortest possible time.
- 8.01.6 P&I Diagrams, P&ID part lists, Instrumentation schedules and logic diagrams shall be submitted separately for all the pumps with respective tag nos.
- 8.01.7 Tag nos. for instruments, valves & equipment after order placement.
- 8.01.8 It shall be mandatory for the successful bidder to follow EIL approved sub-vendor list.

8.02.0 MECHANICAL & PIPING

- 8.02.1 Reverse flow through pump shall be considered and maximum attainable reverse speed shall be indicated.
- 8.02.2 Axial thrust balancing device shall be designed for complete range of operation.
- 8.02.3 Pumps shall be so designed to enable a quick startup of the pump i.e. without the necessity of installing a warm up system.
- 8.02.4 Pumps to be delivered with lube oil, cooling, sealing, flushing & quenching piping in assembled condition.
- 8.02.5 Drain lines along with double isolation valve.
- 8.02.6 Margin of NPSHA over NPSHR shall be minimum 1.0 m at all operating conditions.
- 8.02.7 ARC valve recirculation down-stream pressure shall be suitable for deaerator/ suction tank which is situated on a platform at an elevation and pressure as stated in Datasheet A. Pumps base plate bottom elevation will be 0.3 m. Expected pressure drop also shall be considered. Also an orifice plate shall be designed & located near deaerator/ suction tank. The back pressure on ARC valve re-circulation line nozzle shall be 5 Kg/cm² (g).
- 8.02.8 The suction strainer shall be of heavy-duty design. The mesh size shall be 40 mesh. The material of construction of the body shall be CS (A 216 Gr.WCB) and that the strainer element shall be of SS316/SS-304. The strainer should be designed for the end of the curve flow of the pump for a maximum pressure drop under 50% clogged condition as specified in Datasheet A. The free flow area of the strainer element shall be at least 8 times the inlet pipe area. The strainer shall be with flanged ends.
- 8.02.9 The automatic minimum continuous flow recirculation valve shall be with CS body and SS internals. The valve shall be flanged at all ends.
- 8.02.10 The base frame shall be provided with a drip-tray at the bottom, sloping lengthwise towards one end. A suitable drain connection with cap shall be provided at the bottom of the sloped end.
- 8.02.11 Nozzles up to 50NB shall be stiffened with 2 numbers of 40 wide x 6 thick stiffeners welded 90 degrees apart. If stiffening of nozzles up to 50NB is not required, then this clause not applicable.



TITLE :
**TECHNICAL SPECIFICATION FOR
SPECIAL PROCESS HORIZONTAL
PUMPS**

SPECIFICATION NO. PE-TS-353-100-N001

VOLUME II B

SECTION C

REV. NO. 0 DATE 10.07.2010

SHEET 6 OF 7

- 8.02.12 Threaded joints for fittings and valves except instrument tubing are not acceptable.
- 8.02.13 Cold bending of small-bore lines is not acceptable. Suitable elbows shall be used.
- 8.02.14 The seal water system for each pump shall be provided with temperature monitoring device (temperature gauge as minimum).
- 8.02.15 Cooling water shall be provided at one point near each pump skid. Further internal distribution shall be in the scope of the bidder. Flow indicators shall be installed in all individual cooling water lines. Lube oil piping between pump skid and Lube oil skid shall also be in vendor's scope – same shall be supplied pre-fabricated to be erected by BHEL at site. Piping layout for the same shall be as specified by BHEL during contract stage.
- 8.02.16 Lifting lugs shall be provided for ease of handling of skid.
- 8.02.17 Pipe, Flange, Bolting, Gaskets, Reducers and Valves in the respective areas of bidder shall be suitable for the BHEL terminal point pipe specifications as indicated elsewhere in this specification.

9.00.0 SCOPE OF INSPECTION AND TEST:

- 9.01.0** The Scope of Inspection and test for Pump shall be as per EIL Specification. Please note the steam turbine driven pumps shall also be performance tested by same Job motor used for testing of motor driven pumps.

10.00.0 PAINTING :

10.01.0 For Surfaces With Temperature up to 80°C :

- a) Surface Preparation Blast cleaning to SA 2½ (SIS-05-5900) or SSPC-SP-10, i.e. blast cleaning nearly to white metal cleanliness until at least 95% of each element of surface area is free of all visible residues with desired surface profile.
- b) Primer One (1) coat of Inorganic Zinc Silicate Coating DFT = 65 - 75 µ/coat(min.)
➤ A two pack air drying self-curing solvent based inorganic Zinc Silicate Coating with metallic Zinc content 80% min. on dry film. The metallic Zinc powder shall be as per ASTM D 520-84(95) – the metallic Zinc powder should contain min. 94% metal Zinc & max. 6% Zinc Oxide. The particle size of Zinc powder should be max. 4% retention on sieve no. 325 (45 µ) and no retention of powder on sieve no. 100 (150 µ).
➤ Touch dry & hard dry at 30°C (approx.), 30 mts, & 12 hours respectively.
➤ Approx. over coating interval shall be min. 8 hours at 20°C & 50% RH. No max. limit.
➤ Pot life at 30°C for two component paints (approx.), 4 - 6 hours.
- c) Finish Paint Two (2) coats of Epoxy High Build Finish Coating DFT = 100 µ/coat(min.)
➤ Two pack Polyamine cured Epoxy Resin medium, suitably pigmented semi glossy finish.
➤ Touch dry & hard dry at 30°C (approx.), 3 hours, & over-night respectively.
➤ Approx. over coating interval shall be min. overnight & max. 5 days.
➤ Pot life at 30°C for two component paints (approx.), 4 - 6 hours.
- Total min. DFT = 265 µ

10.02.0 For Surfaces With Temperature above 80°C, upto 250°C :



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SPECIAL PROCESS HORIZONTAL
PUMPS**

SPECIFICATION NO. PE-TS-353-100-N001

VOLUME II B

SECTION C

REV. NO. 0 DATE 10.07.2010

SHEET 7 OF 7

- a) Surface Preparation Blast cleaning to SA 2½ (SIS-05-5900) or SSPC-SP-10, i.e. blast cleaning nearly to white metal cleanliness until at least 95% of each element of surface area is free of all visible residues with desired surface profile.
- b) Primer One (1) coat of Inorganic Zinc Silicate Coating
➤ A two pack air drying self-curing solvent based inorganic Zinc Silicate Coating with metallic Zinc content 80% min. on dry film. The metallic Zinc powder shall be as per ASTM D 520-84(95) – the metallic Zinc powder should contain min. 94% metal Zinc & max. 6% Zinc Oxide. The particle size of Zinc powder should be max. 4% retention on sieve no. 325 (45 µ) and no retention of powder on sieve no. 100 (150 µ).
➤ Touch dry & hard dry at 30°C (approx.), 30 mts, & 12 hours respectively.
➤ Approx. over coating interval shall be min. 8 hours at 20°C & 50% RH. No max. limit.
➤ Pot life at 30°C for two component paints (approx.), 4 - 6 hours.
- c) Finish Paint Two (2) coats of Synthetic medium based Heat Resistant Aluminium paint suitable upto 250°C.
➤ Synthetic medium based Heat Resistant Aluminium paint suitable upto 250°C with egg shell finish.
➤ Touch dry & hard dry at 30°C (approx.), 3 hours, & 24 hours respectively.
➤ Approx. over coating interval shall be min. 16 hours & max. 6 months.
➤ TC for heat resistance from paint manufacturer required.

DFT = 65 -
75
µ/coat(min.)

DFT = 20
µ/coat(min.)

Total min. DFT = 105 µ

10.03.0 All primers & finish paints shall be applied in accordance with manufacturer's instructions. The surface preparation, quality and workmanship shall be ensured.

10.04.0 Colour shade shall be specified during detailed engineering stage.

11.00.0 DEVIATIONS

11.01.0 BIDDERS ARE REQUESTED TO CONFIRM COMPLIANCE WITH THE SPECIFICATION AND REFRAIN FROM TAKING DEVIATIONS. ONLY IF A DEVIATION IS UNAVOIDABLE, BIDDER IS ALLOWED TO INDICATE THE SAME, WITH SUITABLE JUSTIFICATION. A DEVIATION WITHOUT JUSTIFICATION SHALL NOT BE CONSIDERED.

11.02.0 In case of deviations, bidder shall have bring out the same, clause-wise, consolidated, under heading 'Deviation List', in his offer, in absence of which it will be construed that the bidder's offer exactly conforms to the specification. Further, any deviation expressed anywhere else in the offer, other than under the Deviation List, will not be taken into cognizance by the Owner/BHEL.

ANNEXURE 1

Section	EIL specification	Specification no.
PART-A	TECHNO COMMERCIAL	
	ITP for Pump centrifugal - Boiler Feed	6-81-0044, Rev 1, 7 pages
	ITP for Pump centrifugal horizontal (Special Purpose process)	6-81-0024, Rev.1, 7 pages
	ITP Steam turbine (General Purpose Process)	6-81-0057, Rev 1, 6 pages
A-4.4	Mandatory spare parts (Static Equipment)	A011-00-16-46-MS01, Rev 0, 2 pages
A-4.8	Mandatory spare parts (Instrumentation)	A011-00-16-51-MS01, Rev 0, 3 pages
A-6.1	Vendor list Captive Power Plant Paradip Refinery Project	12 pages
PART-B	DESIGN SPECIFICATION & BEDB (PART-B)	
B-1	Design Basis for CPP	* Refer "Points noted" file.
B-1	Annexure - II Water quality	PDRP-8820-SP-0001, Rev F1, 4 pages
B-1	Annexure - III Meteorological	PDRP-8820-SP-0001, Rev F1, 3 pages
PART-C	SCOPE/DESIGN BASIS/JOB SPECIFICATIONS	
Section C-1	Scope of supply/works	--
C-1.5	Scope of supply/work (Rotating equipment)	A011-00-16-45-SS01, Rev 0, 3 pages
Section C-2	Design basis/philosophy	--
C-2.5	Design basis/philosophy Rotating Equipment	* Refer "Points noted" file
C-2.7	Engineering Design basis Piping	* Refer "Points noted" file
Section C-3	Job Specifications and data sheets	--
C-3.3	Data sheet for VHP BFW/ HP BFW (Export) Centrifugal Multistage Pump	A011-00-16-45-DS18, Rev 0, 4 pages
C-3.3	Data sheet for MP BFW (Export) Centrifugal Pump	A011-00-16-45-DS21, Rev 0, 4 pages
C-3.3	Data sheet for Centrifugal Pump (Horizontal Special Purpose Process)	A011-00-16-45-DS30, Rev 0, 1 page
C-3.3	Data sheet for steam turbine (General purpose)	A011-00-16-45-DS20, Rev 0, 3 pages
C-3.1	Piping material specification-A2AW	7 pages
C-3.1	Piping material specification-D2AG	6 pages
C-3.1	Piping material specification-A1AG	7 pages
C-3.1	Piping material specification-B1AS	6 pages
C-3.1	Piping material specification-A1LD	6 pages
C-3.9	Job specification for shop & field painting	A011-06-42-PT-G09, Rev 0, 60 pages
PART-E	STANDARD SPECIFICATIONS	
E-3	Standard specification for centrifugal pumps (Special purpose process service)	6-41-0005, Rev.2, 22 pages
E-3	Standard specification for Steam Turbines (general purpose process service)	6-43-0042, Rev.1, 14 pages

* Points applicable for pumps & accessories were extracted from respective EIL specifications & enclosed in the document, **Annexure 2 : Points Noted from EIL specification, 11 Pages.**

ANNEXURE 2

POINTS NOTED FROM EIL SPECIFICATION

PROJECT : CPP-PARADIP REFINERY PROJECT

CUSTOMER : INDIAN OIL CORPORATION LIMITED

CONSULTANT : ENGINEERS INDIA LTD.

PROJECT LOCATION : PARADIP, ORISSA

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B.1 DESIGN BASIS FOR CPP

1.0 DESIGN DATA

1.1 SITE CONDITION

Ambient temp should be considered as 39 Deg C and RH 85 %.

1.2 NOISE LEVEL

The noise level shall not exceed than 85 dBa at a distance of 1 meter from source of Individual Equipment.

1.3 BOILER FEED WATER (Export to Refinery)

Process requirement of HP BFW, MP BFW are defined as below.

CONDITIONS	PRESSURE, kg/cm²g				Required QTY
	Min	Max	Normal	Mech Design	
HP BFW	58	60	58	82	388
MP BFW	28	30	28	40	206

1.4 Flow meters (FE/FT/FI/FAH/FAL) to be provided on steam headers from HRSGs and UBs and all the steam consumers (includes STG) in order to measures flow quantity. Flow meters shall also be provided at all battery limit lines (entry and exit of CPP battery limit).

1.5 Each control valve 2" and above shall have block and bypass valves.

1.6 Steam Turbine Generator (STG)

The power plant shall include two (2) Steam turbine generators. STGs shall be double extraction-cum-condensing, conforming to API 612. HHP steam shall be used at the inlet, extractions at HP and MP levels and exhaust will be at condenser pressure of 0.12 Kg/cm² (a).

ANNEXURE 2

POINTS NOTED FROM EIL SPECIFICATION

1.7 BLACKOUT REQUIREMENT

For black-out condition, two utility boilers are required to sustain without any power backup. For the purpose a number of drives are required to be provided with steam turbine. During black-out, no dependence on DG set should be considered. MOVs should not be provided in piping which require shutdown in case of black-out. Alternately MOVs can be configured for operation on UPS power/ DC power.

1.8 SPARING PHILOSOPHY

The following shall be the sparing philosophy for the major equipments:

DM water/ condensate transfer pumps	2w+1s	1 ST driven and 1 motor driven running normally. 1 motor driven standby
HP BFW export pumps	2w +1s	1 ST driven and 1 motor driven operating. One motor driven standby
MP BFW export pumps	2w +1s	1 ST driven and 1 motor driven operating. One motor driven standby

Auto start facility is to be provided for motor driven pumps and Motor of these pumps shall be designed for end of the curve operation. Reacceleration facility and minimum recirculation facility shall be provided for these pumps.

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C.2.5 DESIGN BASIS/ PHILOSOPHY (ROTATING EQUIPMENT)

SECTION-1: GENERAL

1.1 UNIT RESPONSIBILITY

Other rotating equipment:

All other rotating equipment shall be procured along with its drivers, from the respective rotating equipment manufacturers, complete with all associated auxiliary systems. The unit responsibility shall rest with the rotating equipment manufacturer.

1.2 UNITISATION

- Other rotating equipment shall be unitized at respective rotating equipment manufacturer's works only.

ANNEXURE 2

POINTS NOTED FROM EIL SPECIFICATION

1.3 APPLICABLE CODES AND STANDARDS

- International Standards/Codes along with applicable EIL Standard Specifications as per the Table-1 shall be the basis of design, selection, manufacture, inspection/testing of the equipment.

1.4 EQUIPMENT SELECTION AND SIZING CRITERIA

- Selection of Rotating Equipment shall be based upon the following considerations:
 - Suitability for the specified duty conditions.
 - Standard Models under vendor's regular range of manufacture.
 - Proven Track record in similar service as specified under acceptance criterion.
- Maximum allowable working pressure & temperature of the rotating equipment shall neither be less than the design pressure & temperature specified in the equipment data sheet (if any) nor less than those specified in the specifications, codes & standards.
- All rotating equipment & drivers (including gear units and couplings if any) shall be designed to perform satisfactorily under specified start up conditions, part load operation, maximum differential pressure operation and relief valve set pressure and up to full speed.

1.5 EQUIPMENT QUALIFICATION CRITERIA (EQC)

All Rotating Equipment shall meet the EQC as specified in the standard specification of the relevant rotating equipment, as applicable. Rotating Equipment vendor shall be advised to complete the Experience Record Proforma enclosed with the inquiry document to amply prove that the offered Rotating Equipment meet the EQC for technical acceptance. Vendor shall also be advised to furnish additional information to justify that the EQC is being met. In addition, manufacturer's catalogue and general reference list for Rotating Equipment shall also be furnished.

1.6 SEALING SYSTEM SELECTION CRITERIA

Centrifugal Pumps

- All pumps shall be provided with Mechanical Seals (except, clean cold water service).
- Unless otherwise specified, mechanical seals shall conform to API Standard 682.
- Seal Qualification tests (SQT) shall have been conducted on the proposed mechanical seal model(s). Related certificates shall be obtained during detailed engineering stage.
- Mechanical seals (as per API Std. 682) shall be one of the following makes:

Principals

M/s John Crane

M/s Flowserve

M/s Eagle Burgmann

Indian Counterparts

John Crane Engg. Sealing System India Pvt. Ltd.

Flowserve Sanmar Ltd.

Eagle Burgmann India Pvt. Ltd.

ANNEXURE 2

POINTS NOTED FROM EIL SPECIFICATION

1.7 DRIVE ARRANGEMENT

Generally rotating equipment shall either be directly driven or driven through a gearbox.

1.8 COUPLINGS

- Couplings for the following equipment shall conform to API Standard 671:
Multi-stage (greater than two stages) centrifugal pumps with driver rating greater than 160 kW.
- Unless otherwise specified, couplings shall be of metallic, non-lubricated, flexible element type (i.e. either diaphragm or disc type) with spacer, for all pumps.
- Unless otherwise specified, all couplings shall be selected for a minimum service factor of 1.5.

1.9 ALLOWABLE NOISE LEVEL

Equipment noise level (Driver + Driven equipment train + auxiliaries) shall not exceed 85 dBA when measured at one-meter distance from the equipment skid in any direction.

1.10 EQUIPMENT STORAGE

- All rotating equipment shall be packed for an outside storage period of six (6) months.

1.11 LUBRICANTS & CONSUMABLES

- For all oil & lubricants required for equipment, bidder shall give equivalent Indian brand/ grades.

1.12 INSTALLATION CRITERIA

Centrifugal Pumps

- All pumps shall be suitable for outdoor installation. No equipment shelter is envisaged.

1.13 HEAT EXCHANGERS

- Lube Oil / Seal Oil Coolers
 - (i) Coolers shall be water-cooled shell and tube type as per TEMA 'C'.
 - (ii) The oil side operating pressure shall be higher than water side operating pressure.
 - (iii) The material of construction shall be suitable for the specified service. However as a minimum, MOC shall be as follows:

Shell	:	CS
Channel/Channel Covers	:	CS
Tubes	:	Inhibited Admiralty Brass
Tube Sheet	:	Brass

Fouling Factors

- Shell Side-Oil	:	0.0002 hr m ² °C/kcal
- Tube Side-Water	:	0.0004 hr m ² °C/kcal

ANNEXURE 2

POINTS NOTED FROM EIL SPECIFICATION

1.14 SAFETY

- Equipment design and engineering shall incorporate adequate safety features [as per applicable specifications of respective equipment as well as environment codes (if any) & standards applicable for the subject project] to provide protection to equipment and environment.
- Thermal relief valves shall be provided for components that may be blocked in by isolation valves (including any cooling water return circuit piping of a cooler or a jacket).
- All electrical components & installations, instruments shall be suitable for the electrical area classification and grouping in which the equipment is installed.

1.15 INSPECTION AND TESTING

- Inspection and test as specified in the bid package shall be carried out by the Equipment Vendor at his works. All witness test inspection reports shall be submitted for Owner/PMC for review/record.
- All the requirements of inspection and testing shall be inline with individual equipment requirements as specified in bid package and ITPs as enclosed elsewhere in bid package.

SECTION-2: SPECIAL REQUIREMENTS

2.1 GENERAL-PURPOSE STEAM TURBINE

- Normally ring oil lubrication is preferred; In case pressurised lube oil system is required the same shall be vendor's proven system. Vendor shall provide proof for the same.
- A sentinel valve shall be supplied on the turbine casing.
- A Relief valve shall be provided on the Turbine exhaust side.
- In case exhaust temperature exceeds the downstream design limits necessary de-superheater and all instrumentation for the same shall be provided by the vendor.

2.2 CENTRIFUGAL PUMPS

- Double suction single stage, two-stage & multi-stage pumps shall be of in-between bearing types.
- Suction flange rating shall be same as that of discharge flange for all pumps.
- Inducers shall not be used for horizontal pumps.
- Wherever pumps are to be provided with ARC valves, the same shall be included in pump vendor's scope of supply.
- Mechanical Seal for pumps shall conform to API-682. Mechanical seals to be suitable for maximum shut off pressure/ casing design pressure under static conditions.
- In case multi-stage pumps require forced feed lubrication system, the same shall be as a minimum as per API 610 Fig. B.10.

ANNEXURE 2

POINTS NOTED FROM EIL SPECIFICATION

- The motor nameplate rating for pumps under parallel operation/auto start shall not be less than the max BKW indicated on pump data sheet (Power at End of the curve for the rated impeller) and the pump motors shall be suitable for start-up under open discharge valve condition.
- For seal flushing plans, piping material shall be of Stainless Steel. For cooling water plans, piping material shall be carbon steel. All piping connections shall be threaded/ flanged. No ferrules/ unions shall be provided in seal flushing lines.
- All pumps shall be provided with plugged connection for oil mist lubrication for future use. All pumps shall be provided with bearing isolators.
- Pressure Balancing Device (For Multistage Pumps): Balance piston shall necessarily be provided for designs where all axial thrust is cumulative (i.e. all impellers facing the same direction) to reduce the axial thrust. Balancing Disc shall not be employed to balance thrust.
The balance line shall be provided with pressure gauge & pressure relief valve. In case it is recommended to connect this balance line to suction vessel, Quantity of flow being returned to suction vessel shall be indicated and shall be added to the rated flow of the pump. Correlation showing the extent of wear to balance line flow shall also be provided. Balance line shall utilize flange joints. Screwed connections are not allowed
- Single and two-stage pumps operating at temperatures less than 150°C and multi- stage pumps operating at temperatures less than 100°C shall be suitable for instantaneous startup from ambient to full operating temperature. For higher operating temperatures the vendor shall provide as part of the operating manual a suitable startup procedure and any required monitoring equipment (i.e., skin couples) to insure that the pump, including seal(s), does not incur damage due to rapid heat up.
- All multistage horizontal centrifugal pumps intended for high temperature service (PT>100C) shall be provided with pump casing – skin temperature monitoring system consisting of the following:
 - Four thermocouples along with Yoke mounted temperature transmitters with integral indicators for each thermocouple.
 - One Junction Box (JB) to be mounted on pump base plate.
 - Cables between the thermocouples and transmitters.
 - Cables between transmitters and junction box.
- Boiler Feed Water Centrifugal Pumps:
In addition to the above stated requirements for Centrifugal Pumps, the following are applicable for BFW pumps:
 - a. NPSH margin in the operating region of the pump shall not be less than 1.0 m.
 - b. In case multi-stage pumps require forced feed lubrication system, the same shall be as a minimum as per API 610 Fig. B.10. In such case of Forced feed lubrication, Pump shall be equipped with vibration and temp. Monitoring system.
 - c. Mechanical Seal shall conform to API-682. Mechanical seals to be suitable for maximum shut off pressure/ casing design pressure under static conditions.

ANNEXURE 2

POINTS NOTED FROM EIL SPECIFICATION

SECTION-3: SPARES & SPECIAL TOOLS

3.1 COMMISSIONING SPARE PARTS

Commissioning Spare Parts shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended spares shall be obtained along with the offer. Any commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor.

3.2 SPECIAL TOOLS/TACKLES

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

3.3 INSURANCE SPARES

Insurance spares shall be procured along with the main equipment, if specified by the client. Such spares shall be as per Table-2 of this Specification. These spares include only those spares, which are critical for equipment and require longer delivery periods. Spare rotors where supplied shall be boxed in a metal containers for vertical storage. Unit price of each of the listed spares shall be indicated separately in the Proposal.

3.4 SPARE PARTS FOR TWO YEARS NORMAL OPERATION

As per equipment manufacturer's recommendations, a quotation for spare parts for two-years normal operation along with unit price shall be obtained with the proposal for customer to order the same separately.

TABLE – 1: Applicable Codes & Standards

S.No.	DESCRIPTION	Standards/ Codes	EIL Standard Specification Number	Remarks
1.	PUMPS :			
1.1	Centrifugal Pumps (Special Purpose Process Service)	API Std. 610, 8th Ed.	6-41-0005	(1)
2.0	MECHANICAL DRIVERS / GEAR BOXES			
2.1	Steam Turbines (General Purpose)	API Std. 611	6-43-0042	(2)
2.2	General Purpose Gear Units	API Std. 677	----	(3)
3.0	AUXILIARIES			
3.1	Lubrication, shaft sealing and control-oil systems and	API Std. 614	----	(4)

ANNEXURE 2

POINTS NOTED FROM EIL SPECIFICATION

	auxiliaries			
3.2	Shaft sealing for centrifugal & rotary pumps	API Std. 682	----	
3.3	Vibration, Axial Position & Bearing Temp. Monitoring Systems	API Std. 670	----	

Remarks:

- (1) Centrifugal pumps for special purpose process service are classified as pumps which are meant for process service (both for on-site & offsite) but excluding the pumps covered either under general- purpose process service or general water service.
- (2) General-purpose steam turbines (conforming to API Std. 611) shall be used where driven equipment is usually spared, or is in non-critical service and where the steam supply conditions will not exceed 48 bar,g inlet pressure or 400°C inlet temperature or both and where speed will not exceed 6000 rpm.
- (3) General-purpose gear units (conforming to API Std. 677) shall be used in equipment trains that are usually spared, or are in non-critical service and up-to a maximum driver rating of 750 kW.
- (4) Lube oil system (conforming to API Std. 614; general purpose or special purpose) shall be as specified on main equipment data sheet.

TABLE – 2: Insurance Spares

S.No.	DESCRIPTION	Description of Insurance Spares/Item	Remarks
1.	PUMPS :		
1.1	Centrifugal Pumps (Special Purpose Process Service)	1) 1 set of mechanical seals 2) 1 set of pump element assembly including dynamically balanced rotor & stationary hydraulic parts. (Only for multi-stage centrifugal barrel type pumps) -- OR -- 1 set of dynamically balanced rotor (Only for multi-stage centrifugal axial split type pumps)	(1)

Remarks :

- (1) **Element** consists of assembled rotor plus stationary hydraulic parts [diffuser(s) or volute(s)].

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ANNEXURE 2

POINTS NOTED FROM EIL SPECIFICATION

C.2.7 ENGINEERING DESIGN BASIS (PIPING)

1.0 Design Philosophy / Criteria: General

1.1 Equipment Layout

- **Pumps**

Pumps shall be arranged in rows with the centre line of the discharge nozzle on a common straight line wherever practicable. Pumps shall be kept outside the pipe rack with pump discharge nozzle kept at a distance of 1metre from pipe-rack with adequate operation & maintenance space and motor towards rack.

Gap between each pump foundation/ and foundation of technical structure should be sufficient for easy removal of equipment after piping. Clearance between two adjacent pumps shall be such that clear 900 mm aisle is available.

All pumps not open to sky with motor rating ≥ 75 KW shall be provided with monorail. No monorail should normally be provided for pumps open to sky and sufficient space below rack shall be available for pump maintenance.

- **Clearance and Accessibility**

- (i) Access to Pumps Maintenance

Clear access of 4.0M vertically and 4.0M horizontally shall be provided centrally under main pipe rack/ways for small mobile equipment to service pumps/motors, wherever these are installed under pipe rack/ways with prior specific approval.

Pumps outside rack shall be approachable by mobile equipments etc. from under the pipe rack.

1.2 UNIT PIPING

- **Pump Piping**

- Pump drives shall have clear access.

- Pump suction piping shall be as short as possible and shall be arranged to avoid vapour pockets.

- Reducers immediately connected to the pump suction shall be eccentric type with flat side up to avoid the accumulation of gas pocket.

- For end suction pumps elbows shall not be directly connected to the suction flange. A straight piece minimum 3 times the line size shall be provided at the suction nozzle.

- Pump discharge check valve if installed in vertical lines shall be fitted with a drain connection as close as possible downstream of the valve.

- Unless otherwise specified, T-type strainers shall be used on pump suction piping for sizes 2" and above.

- Y-type strainers shall be used for all sizes in steam services and for pump suction lines below 2".

ANNEXURE 2

POINTS NOTED FROM EIL SPECIFICATION

- All small bore piping connected to pump (drain to OWS & CBD, seat and gland leak drain) shall have break up flanges for removal of pumps.
- Piping shall be so arranged that the forces and moments imposed on the pump nozzle do not exceed double the allowable values of API610.
- Pump discharge should be preferably routed away from the pump rather than towards the motor side.
- Pump cooling water connection shall be taken from the top of circulating cooling water header.
- Suction & discharge valves shall be located at operable height.

- **Steam Piping**

- (i) Indian Boiler Regulations (IBR)

Steam lines with conditions listed below fall in the scope of IBR.

- Lines having design pressure (max. working pressure) above 3.5 Kg/cm² (g).
- Line sizes above 10" inside diameter having design pressure 1.0 Kg/cm²(g) & above.
- Lines with design pressure less than 1.0 Kg/cm²(g) are excluded.
- Users of steam like steam tracing lines, jacket of the steam jacketed lines, steam heating coil within the equipment are excluded from IBR scope.
- Boiler feed water lines to steam generator, condensate lines to steam generator and flash drum shall be under purview of IBR.

- (ii) **IBR requirements (in brief)**

- All materials used on lines falling under IBR must be accompanied with IBR Inspection Certificate in original. Alternatively, photocopy of the original certificate duly countersigned and attested by local boiler inspector is acceptable. Leading inspection authority viz. Lloyds, EIL etc are authorised inspection authorities for IBR outside India, whereas, for Indian supply only IBR is the inspection authority.
- Drawings like 'General Arrangement Drawings' and Isometrics of lines falling under IBR must also be approved by IBR authority of State in which the system is being installed.
- All welders used for fabrication of IBR system must possess IBR welding qualification certificate.
- IBR system shall be designed to comply with IBR regulations as well as ASME B31.3/B31.1. Design calculations for the same must be approved by IBR authority.
- IBR approval is obtained with requisite fees payable to Indian Boiler Board of the State concerned.

- **Steam Header & Supply Lines**

- All turbines on automatic control for start up shall be provided with a steam trap in the steam inlet line.
- All traps shall be provided with strainers if integral strainers are not provided.

ANNEXURE 2

POINTS NOTED FROM EIL SPECIFICATION

1.3 Strainer

Allowable pressure drop when specified shall be certified along with the offer. If asked specifically, pressure drop calculations shall be furnished.

All 2" & higher sized Y type strainers shall be provided with 3/4" threaded tap and solid threaded plug as drain connection on the blind flange. For less than 2", this shall be 1/2" size.

Bottom flange of Y-type strainer shall not have tapped hole. Full length standard size studs shall be used for joining blind flange.

For fabricated strainers, all BW joints shall be fully radiographed and fillet welds shall be 100% DP/MP checked.

All the strainers shall be hydrostatically tested at twice the design pressure.

1.4 Traps

Vendor shall furnish the performance curve indicating the capacity in mass/hour at various differential pressures across the trap.

Parts subject to wear and tear shall be suitably hardened.

Traps shall function in horizontal as well as in vertical installation.

Traps shall have integral strainers.

All traps shall be hydrostatically tested to twice the design pressure.

बौइलर फीड उपकेन्द्रीय पम्पों के लिये निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN FOR PUMP CENTRIFUGAL – BOILER FEED

1	21.01.08	REVISED AND RE-ISSUED	SMG	SS	MVKK	VC
0	23.07.02	ISSUED FOR IMPLEMENTATION	VKJ	TVD	AKB	GRR
Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
Approved by						

**INSPECTION AND TEST PLAN
FOR PUMP CENTRIFUGAL – BOILER FEED**

STANDARD SPECIFICATION No.

6-81-0044

Rev. 1

Page 2 of 7

1.0 SCOPE:

This Inspection Test Plan covers the minimum testing requirements of BOILER FEED PUMF- CENTRIFUGAL

2.0 REFERENCE DOCUMENTS:

1) PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1a (i)	Incoming Material Casing, Stuffing-Box Impeller Bearing – Housing (Castings)	Surface Quality	100%	Inspection Report	W	H	-
1a (ii)	Incoming Material Outer Casing (Forgings)	Surface Quality	100%	Inspection Report	W	H	-
1b	Incoming Material Outer Casing	Dimensions	100%	Inspection Report	W	H	-
1c	Incoming Material Outer Casing	Chemical Properties/Physical Properties	All Heats	Manufacturers TC	W	R	R

**INSPECTION AND TEST PLAN
FOR PUMP CENTRIFUGAL – BOILER FEED**

STANDARD SPECIFICATION No.

6-81-0044

Rev. 1

Page 3 of 7

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1d	Incoming Material All Casting & Forging Materials	Heat Treatment as per Specs.	All Heats	HT Chart	W	R	R
1e	Incoming Material (Bar Stock) Shaft Material	Chemical Properties/Physical Properties	All Heats	Manufacturers TC OR Lab Report	W	R	R
1f	Hard Ware Items Gaskets, Fasteners , Gland –Packing Valves	Suitability Test Reports	As per Sampling Plan	Inspection Report	W	R	R
2a	Accessories Mechanical Seal	Leakage	Type Test	Manufacturers Inspection and Test Report	W	R	R
2b	Accessories Barrier/Buffer Liquid Reservoir	1)WPS/PQR/WPQ 2)Leakage 3)Dimensional Check 4)Material TC	100%	Manufacturers Inspection and Test Records	W	H	W/R
2c	Accessories Barrier/Buffer Liquid Coolers	1)WPS/PQR/WPQ 2)Leakage 3)Dimensional Check 4)Material TC	100%	Manufacturers Inspection and Test Records	W	H	W/R
2d	Accessories Coupling	1)Dimensions 2)Dynamic Balancing	100%	Manufacturers Inspection and Test Records	W	H	R

**INSPECTION AND TEST PLAN
FOR PUMP CENTRIFUGAL – BOILER FEED**

STANDARD SPECIFICATION No.

6-81-0044

Rev. 1

Page 4 of 7

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2e	Accessories Bearing Lube Oil Console	Suitability	100%	Manufacturers Inspection and Test Records	W	H	W
3a	In Process Outer Casing & Stage Casing, Impeller, Stuffing Box	Defects open to surface (DP Examination)	100% on Machined Surface	Manufacturers Inspection and Test Records	-	H	R
3b	In Process Butt Weld Joint (if Applicable)	Weld Defects Radiography	On Nozzle to Casing joint	Manufacturers Inspection and Test Records	-	R	R
3c	In Process Shaft/Forged Outer Casing	1)Internal Defects 2)Surface Defects	100%	Manufacturers Inspection and Test Records	-	H	W/R
3d	WPS,PQR,WPQ procedure Qualifications for Overlay (Wear Rings)	Thickness of Overlay Hardness	100%	Manufacturers WPS/PQR/WPQ	-	H	R
4a	Test before assembly Pump Outer & Stage Casing & Stuffing Box	Leak Tightness	Each Set	Manufacturers Inspection and Test Records	-	H	W
4b	Test before assembly Shaft	Demagnetization and Measurement of Mechanical and Electrical Run Out	Each	Manufacturers Inspection and Test Records	-	H	R
4c	Test before assembly Rotor Assembly	Unbalance	Each Rotor	Manufacturers Inspection and Test Records	-	H	O

**INSPECTION AND TEST PLAN
FOR PUMP CENTRIFUGAL – BOILER FEED**

STANDARD SPECIFICATION No.

6-81-0044

Rev. 1

Page 5 of 7

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5a	Testing Assembled Pump	1)Performance 2)NPSH 3)Vibration 4)Sound 5)Bearing Temp. Rise 6) Mech. Run	Each Pump	Manufacturers Inspection and Test Records & FFT Spectra for Vibrations	-	H	H
5b	Testing Dismantled Pump	Strip Examination	Each Pump	Manufacturers Inspection and Test Records	-	H	H
5c	Testing Unitized, Pump with Job Driver, Gear Unit, Base Frame, Lube Console Control Panel, ATS and Instruments including Vibration Monitoring Probes	String Test	Each Set	Manufacturers Inspection and Records	-	H	W
5d	Testing Auxiliary Piping	Leak Tightness Hydro Test	Each Set	Manufacturers Inspection and Test Records	-	H	R
5e	Testing Base Plate	Dimensions	Each Plate	Manufacturers Inspection and Test Records	-	H	W

**INSPECTION AND TEST PLAN
FOR PUMP CENTRIFUGAL – BOILER FEED**

STANDARD SPECIFICATION No.

6-81-0044

Rev. 1

Page 6 of 7

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5f	Testing Instruments	Document Review	Each Test Reports	Manufacturers TC & Statutory Certificates if applicable	W	W/R	R
5g	Testing Rotor Assembly	Torsional and Lateral Analysis	Type Test	Computer Analysis Print Out	-	R	R
5h	Final Pump Assembly	Documents & Stamping	100%	IRN	-	-	H
6	Documentation	Verification & Compilation Of Inspection & Test Records For Submission To Customer	100%	Dossier	-	H	H

Legends: CCE or CCOE-Chief Controller of Explosives, DT- Destructive Testing, HT- Heat treatment, H- Hold (Do not proceed without approval), IBR-Indian Boiler Regulations, ITP-Inspection and Test Plan, ,M- Monitor, NDT- Non Destructive Testing, O-Observe, P-Perform, PO- Purchase Order, PR-Purchase Requisition, PQR- Procedure Qualification Record, QAP-Quality Assurance Plan, Random -10% (min.1 no.) of each size and type of Bulk item, R-Review, RT- Radiography Testing , RW- random Witness, TC-Test Certificate, TPI or TPIA - Third Party Inspection Agency, VDR- Vendor Data Requirements, WPS- Welding Procedure Specification, WPQ- Welders Performance Qualification, W-Witness (Give due notice, work may proceed after scheduled date).

**INSPECTION AND TEST PLAN
FOR PUMP CENTRIFUGAL – BOILER FEED**

STANDARD SPECIFICATION No.

6-81-0044

Rev. 1

Page 7 of 7

NOTES (As applicable):

1. Wherever W/R or H/W is indicated, EIL Inspection Engineer shall decide the option to be exercised for the particular stage and supplier.
2. Supplier's in house procedures may be accepted in case TPI / EIL is satisfied with adequacy of procedures to comply with Purchase Order/Specifications requirements, in case of non availability of suitable procedures fresh procedures may be qualified under TPI / EIL witness.
3. In case of conflict between purchase specification, contract documents and ITP more stringent conditions shall be applicable.
- 4 This document describes generally the requirements pertaining to all types of the item. Requirements specific to PO and the item are only applicable.
5. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
6. Weld repair if any to be done after approval of purchaser/authorized representative of purchaser as per applicable code and qualified WPS and welder.
7. String test with steam turbine shall be demonstrated at site however functional test of all other accessories shall be conducted in the shop using shop motor and test bed.
8. String test for motor/diesel engine driven pump shall be done on job base plate and using other job accessories including arc valve.
9. Lube oil console is applicable only where forced lubrication is required for the bearings.
10. Hard facing of wear rings shall be as per approved cross sectional drawing/data sheet.
11. Pump driver shall be inspected at driver manufacturers shop as per relevant inspection and test plan.
12. Outer casing is applicable only if pump is double casing barrel type.
13. Performance tolerances shall be as per applicable Order Specifications.

विशेष प्रयोजन प्रक्रिया हेतु धरातलीय उपकेन्द्रीय पम्प के लिये निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR PUMP CENTRIFUGAL HORIZONTAL (SPECIAL PURPOSE PROCESS)

1	21.01.08	REVISED AND RE-ISSUED	SMG	SS	MVKK	VC
0	23.07.02	ISSUED FOR IMPLEMENTATION	VKJ	TVD	AKB	GRR
Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
						Approved by

**INSPECTION AND TEST PLAN
FOR
PUMPS CENTRIFUGAL HORIZONTAL (SPECIAL PURPOSE PROCESS)**

1.0 SCOPE:

This Inspection Test Plan covers the minimum testing requirements of Pump Centrifugal Horizontal

2.0 REFERENCE DOCUMENTS:

- 1) PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1a	Incoming Material Casing Stuffing Box Impeller Bearing – Housing (Castings)	Surface Quality	100%	Inspection Report	W	H	-
1b	Incoming Material Casing Stuffing Box Impeller Bearing – Housing	Dimensions	100%	Inspection Report	W	H	-
1c	Incoming Material Casing Stuffing Box Impeller Bearing – Housing	Chemical Properties/Physical Properties	All Heats	Manufacturers TC	W	R	R

**INSPECTION AND TEST PLAN
FOR
PUMPS CENTRIFUGAL HORIZONTAL (SPECIAL PURPOSE PROCESS)**

STANDARD SPECIFICATION No.

6-81-0024

Rev. 1

Page 3 of 7

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1d	Incoming Materials All casting materials	Heat Treatment as per Specs	All Heats	HT Chart or TC	W	R	R
1e	Incoming Material (Bar Stock) Shaft material	Chemical Properties/ Physical Properties	All Heats	Manufacturers TC OR Lab Report	W	R	R
1f	Hardware Items Gaskets Fasteners, Gland – Packings, Valves	Visual Review of TC	As per sampling plan	Inspection Report	W	R	R
2a	Accessories Mechanical Seal	Hydro Test Air Test Measurement of Leakage	Type Test	Manufacturers Inspection/Test Report	W	R	R
2b	Accessories Barrier/Buffer liquid Receiver	1. WPS/PQR/WPQ 2. Material TC 3. Dimensional Check 4. Leakage Check	100%	Manufacturers Inspection/Test Report	W	H	W/R

**INSPECTION AND TEST PLAN
FOR
PUMPS CENTRIFUGAL HORIZONTAL (SPECIAL PURPOSE PROCESS)**

STANDARD SPECIFICATION No.

6-81-0024

Rev. 1

Page 4 of 7

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2c	Accessories Barrier/Buffer liquid Coolers	1. WPS/PQR/WPQ 2. Material TC 3. Dimensional Check 4. Leakage Check	100%	Manufacturers Inspection and Test Records	W	H	W/R
2d	Accessories Coupling	1. Dimensions 2. Dynamic Balancing	100%	Manufacturers Inspection & Test Records	W	H	R
3a	In Process Casing Impeller Stuffing Box	Defects open to Surface (D.P.Examination)	100% on Machined Surface	Manufacturers Inspection & Test Records	-	H	R
3b	In Process Butt Weld Joint (if applicable)	Internal Defects (Radiography)	On Nozzle to Casing Joint	Manufacturers Inspection & Test Records	-	R	R
3c	In Process Shaft	Internal Defects (Ultrasonic)	100%	Manufacturers Inspection and Test Records	-	H	W/R
3d	WPS, PQR, WPQ Procedure Qualifications for Overlay Wear ring	Thickness of Overlay Hardness	100%	Manufacturers WPS/PQR/WPQ Records	-	H	R
4a	Test before Assembly Pump casing & stuffing box	Leak Tightness	Each Set	Manufacturers Inspection and Test Records	-	H	W
4b	Test before Assembly Rotor Assembly	Dynamic Balancing	Each Rotor	Manufacturers Inspection and Test Records	-	H	W

**INSPECTION AND TEST PLAN
FOR
PUMPS CENTRIFUGAL HORIZONTAL (SPECIAL PURPOSE PROCESS)**

STANDARD SPECIFICATION No.

6-81-0024

Rev. 1

Page 5 of 7

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5a	Testing Assembled Pumps	1. Performance 2.NPSH (R) 3. Vibration 4. Noise Measurement 5. Bearing Temp Rise 6.Mech.Running	Each Pump	Manufacturers Inspection and Test Records	-	H	H
5b	Testing Dismantled Pump	Strip Examination (Visual Check Wear Ring Clearance Measurement	Each Pump	Manufacturers Inspection and Test Records	-	H	H
5c	Testing Unitized Pump with Job Driver Jack Screws Based Frame and Instruments	Alignment Direction of Rotation	Each Set	Manufacturers Inspection and Test Records & FFT Spectra for Vibration	-	H	W
5d	Testing Auxiliary Piping	Leakage tightness	Each Set	Manufacturers Inspection and Test Records	-	H	R
5e	Testing Base Plate	Dimensions	Each Plate	Manufacturers Inspection and Test Records	-	H	W

**INSPECTION AND TEST PLAN
FOR
PUMPS CENTRIFUGAL HORIZONTAL (SPECIAL PURPOSE PROCESS)**

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5f	Testing Instruments	Document Review	Each Test Report	Manufacturers TC & CMRI, BIR & CCOE, Certificates wherever applicable	W	W/R	R
6	Documentation	Verification & Compilation Of Inspection & Test Records For Submission To Customer	100%	Dossier	-	H	H

Legends: CCE or CCOE-Chief Controller of Explosives, DT- Destructive Testing, HT- Heat treatment, H- Hold (Do not proceed without approval), IBR-Indian Boiler Regulations, ITP-Inspection and Test Plan, ,M- Monitor, NDT- Non Destructive Testing, ,P-Perform, PO- Purchase Order, PR-Purchase Requisition, PQR- Procedure Qualification Record, QAP-Quality Assurance Plan, Random -10% (min.1 no.) of each size and type of Bulk item, R-Review, RT- Radiography Testing , RW- random Witness, TC-Test Certificate, TPI or TPIA - Third Party Inspection Agency, VDR- Vendor Data Requirements, WPS- Welding Procedure Specification, WPQ- Welders Performance Qualification, W-Witness (Give due notice, work may proceed after scheduled date).

**INSPECTION AND TEST PLAN
FOR
PUMPS CENTRIFUGAL HORIZONTAL (SPECIAL PURPOSE PROCESS)**

STANDARD SPECIFICATION No.

6-81-0024

Rev. 1

Page 7 of 7

NOTES (As applicable):

1. Wherever W/R or H/W is indicated, EIL Inspection Engineer shall decide the option to be exercised for the particular stage and supplier.
2. Supplier's in house procedures may be accepted in case TPI / EIL is satisfied with adequacy of procedures to comply with Purchase Order/Specifications requirements, in case of non availability of suitable procedures fresh procedures may be qualified under TPI /EIL witness.
3. In case of conflict between purchase specification, contract documents and ITP more stringent conditions shall be applicable.
4. This document describes generally the requirements pertaining to all types of the item. Requirements specific to PO and the item are only applicable.
5. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
6. Weld Repair if any to be done after approval of purchaser/authorized representative of purchaser as per applicable code and qualified WPS and welder.
7. Materials for low temperature services to be impact tested as per applicable specification.
8. For austenitic stainless steel micro structure and IGC tests to be conducted as per applicable code and purchase requisition
9. Hard facing of wear rings shall be as per approved cross sectional drawing /data sheet.
10. Pump Driver shall be inspected at driver manufacturers shop as per relevant inspection and test plan
11. Performance tolerances shall be as per applicable Order Specifications.

INSPECTION AND TEST PLAN
FOR STEAM TURBINE (GENERAL PURPOSE)

STANDARD SPECIFICATION No.

6-81-0057

Rev. 1

Page 1 of 6

सामान्य सेवा हेतु स्टीम टर्बाइन के लिये
निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN
FOR STEAM TURBINE (GENERAL PURPOSE)

1	21.01.08	REVISED AND RE-ISSUED	CS	SS	MVKK	VC
0	06.08.2002	ISSUED FOR IMPLEMENTATION	VKJ	TVD	AKB	SB
Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
						Approved by

INSPECTION AND TEST PLAN FOR STEAM TURBINE (GENERAL PURPOSE)

STANDARD SPECIFICATION No.

6-81-0057

Rev.1

Page 2 of 6

1.0 SCOPE:

This Inspection Test Plan covers the minimum testing requirements of Steam Turbine

2.0 REFERENCE DOCUMENTS:

1) PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

S. N O	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1a	Incoming Material Casing, bearing Housing	Surface Quality	100%	Inspection Report	H	W	-
1b	Incoming Material Casing, bearing Housing	Dimensions	100%	Inspection Report	H	W	-
1c	Incoming Material Casing, bearing Housing	Chemical Properties Physical Properties	All Heats	Manufacturers TC	H	R	R
1d	Incoming Material All Casting Materials	Heat Treatment as per Specs.	All Heats	HT Chart or TC	H	R	R

INSPECTION AND TEST PLAN FOR STEAM TURBINE (GENERAL PURPOSE)

STANDARD SPECIFICATION No.

6-81-0057

Rev. 1

Page 3 of 6

S. N O	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1e	Incoming Material (Forgings) Rotor Shaft, Gear Blanks and Disc. Material	Chemical Properties Physical Properties	All Heats	Manufacturers TC OR Lab Report	H	R	R
1f	Hardware Items Gaskets, Fasteners, Gland-Packing	Surface Defects Visual	As per Sampling Plan	Inspection Report	W	R	R
2a	In Process Casing, Bearing Housing	Surface Defects	100% on Machined Surface	Manufacturers Inspection and Test Records	-	H	R
2b	In Process Rotor Shaft Gear Blanks Disc. Material	Non Destructive Examination for Defects	100%	Manufacturers Inspection and Test Records	-	H	R
2c	In process Weld Joints	Soundness of Weld Joint	Type Test	Manufacturers Inspection and Test Records	-	W	R
2d	In Process Weld Joints	Soundness of Weld Joint	100%	Manufacturers Inspection and Test Records	-	H	R

INSPECTION AND TEST PLAN FOR STEAM TURBINE (GENERAL PURPOSE)

STANDARD SPECIFICATION No.

6-81-0057

Rev. 1

Page 4 of 6

S. N O	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3a	Test before Assembly Turbine casing	Leak tightness	Each Turbine	Manufacturers Inspection and Test Records	-	H	W
3b	Test before Assembly Rotor Assembly	1) Unbalance 2) Run Out	Each Rotor	Manufacturers Inspection and Test Records	-	H	W
4a	Testing Assembled Turbine	1) Mechanical Running 2) Vibration 3) Bearing Temperature Rise 4) Governing 5) Over Speed Trip 6) Verification of Lateral critical Speed	Each Turbine	Manufacturers Inspection and Test Records	-	H	H
4b	Testing Dismantled Bearings	Strip Examination	Each Turbine	Manufacturers Inspection and Test Records	-	W	W
4c	Testing Auxiliary Piping	Leak Tightness	Each Set	Manufacturers Inspection and Test Records	-	W	W
4d	Instruments	Document Review	Each Test Report	Manufacturers TC	W	W/R	R

INSPECTION AND TEST PLAN FOR STEAM TURBINE (GENERAL PURPOSE)

STANDARD SPECIFICATION No.

6-81-0057

Rev. 1

Page 5 of 6

S. N O	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4e	Rotor Assembly	Torsional Analysis Lateral Analysis	Type Test	Computer Analysis Print Out	-	R	R
5	Documentation	Verification & Compilation of inspection & test records for submission to customer	100%	Dossier	-	H	H

Legends: CCE or CCOE-Chief Controller of Explosives, DT- Destructive Testing, HT- Heat treatment, H- Hold (Do not proceed without approval), IBR-Indian Boiler Regulations, ITP-Inspection and Test Plan, M- Monitor, NDT- Non Destructive Testing, P-Perform, PO- Purchase Order, PR-Purchase Requisition, PQR- Procedure Qualification Record, QAP-Quality Assurance Plan, Random -10% (min.1 no.) of each size and type of Bulk item, R-Review, RT- Radiography Testing, RW-random Witness, TC-Test Certificate, TPI or TPIA - Third Party Inspection Agency, VDR- Vendor Data Requirements, WPS- Welding Procedure Specification, WPQ- Welders Performance Qualification, W-Witness (Give due notice, work may proceed after scheduled date).

INSPECTION AND TEST PLAN FOR STEAM TURBINE (GENERAL PURPOSE)

STANDARD SPECIFICATION No.

6-81-0057

Rev.1

Page 6 of 6

NOTES :

1. Wherever W/R or H/W is indicated, EIL Inspection Engineer shall decide the option to be exercised for the particular stage and supplier.
2. Supplier's in house procedures may be accepted in case TPI / EIL is satisfied with adequacy of procedures to comply with Purchase Order/Specifications requirements, in case of non availability of suitable procedures fresh procedures may be qualified under TPI / EIL witness.
3. In case of conflict between purchase specification, contract documents and ITP more stringent conditions shall be applicable.
4. This document describes generally the requirements pertaining to all types of the item. Requirements specific to PO and the item are only applicable.
5. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
6. Weld repair if any to be done after approval of purchaser/authorised representative of purchaser as per applicable code and qualified wps and welder.
7. String test with steam turbine shall be demonstrated at site however functional test of all other accessories shall be conducted in the shop using shop motor and test bed.
8. String test for motor/diesel engine driven pump shall be done on job base plate and using other job accessories including arc valve.
9. Lube oil console is applicable only where forced lubrication is required for the bearings.
10. Hard facing of wear rings shall be as per approved cross sectional drawing/data sheet.
11. Pump driver shall be inspected at driver manufacturers shop as per relevant inspection and test plan.
12. Outer casing is applicable only if pump is double casing barrel type.
13. Performance tolerances shall be as per applicable Order Specifications.

MANDATORY SPARE PARTS (STATIC EQUIPMENT) CAPTIVE POWER PLANT

PROJECT : CPP-PARADIP REFINERY PROJECT

OWNER : INDIAN OIL CORPORATION LTD.

PMC : ENGINEERS INDIA LTD.

JOB NO. : A011

0	24.07.2009	ISSUED FOR BIDS	TK	KA	AKM
No	Date	Purpose	Prepared by	Checked by	Approved by

MANDATORY SPARE PARTS

1. PRESSURE VESSELS & TANKS

SL. No	PART DESCRIPTION	Quantity Required	Quoted: Yes/No/Not Applicable
1	Bolting for each nozzle with blind/ companion flange and for each pad nozzle	10% (2 min) Sets	
2	Gaskets for each nozzle with blind/ companion flange and for each pad nozzle	2 Sets	
3	Bolting for internal flanges	10% (2 min)	
4	Gasket for each internal flange	2 Sets	
5	Sight/light glasses assembly complete with bolting and gasket	4 Sets	

2. SHELL & TUBE HEAT EXCHANGERS

SL. NO	PART DESCRIPTION	QTY	QUOTED-YES/NO/Not Applicable
1	Gaskets	400%	
2	Bolting (stud & nuts)	20% (Minimum 4 sets)	
3	Lamiflex sealing strips	100%	
4	Ferrules	20%	

3. FILTERS, COALESCERS & SILENCERS

SL. NO	PART DESCRIPTION	QTY	QUOTED-YES/NO/Not Applicable
1	Filter Elements/Cartridge for Cartridge Filter	50% (Min. 4 per Filter)	
2	Bolting (stud & nuts)	10%	
3	Gaskets	100%	

MANDATORY SPARES (INSTRUMENTATION)

CAPTIVE POWER PLANT

PROJECT: CPP-PARADIP REFINERY PROJECT

OWNER: INDIAN OIL CORPORATION LTD.

PMC: ENGINEERS INDIA LTD.

JOB NO: A011

0	22.07.09	Issued for Bids	AM	SM	TGM
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

MANDATORY SPARES

INSTRUMENTATION

Mandatory spares shall be quoted and included in Base price as per the following table. A list of spares shall be furnished as part of the bid:

S. No.	PART DESCRIPTION	QUANTITY REQUIRED
1.0	Field Instruments	
1.1	Pressure Gauges, Temperature Gauges, Differential Pressure Gauges, Draft Gauge, Field Indicators, RTD/ Thermocouple (with Thermowell), Thermowells, Skin Thermocouple Sets, speed probe and transmitters	10% subject to minimum 1 No. of each type
1.2	Transmitters for Pressure, Level (excluding displacer/ guided wave radar transmitter), Flow, Temperature & Differential Pressure (complete transmitter)	10% subject to minimum 1 No. of each type
1.3	I/P convertor (wherever applicable)	10% subject to minimum 1 No. of each type
1.4	Gas detectors	10% subject to minimum 1 No. of each type
2.0	Line Mounted Instruments	
2.1	Control Valves, Shutdown Valves & Dampers	
	i) Proximity type limit switches ii) Air filter Regulator iii) Solenoid valve	10% subject to minimum 1 No. of each type
3.0	DCS/ PLC/ Machine Monitoring	
3.1	Each type of Module used in DCS, PLC, MMS like I/O Cards, all type of processor cards, all type of power supply cards, communication cards, Interface cards, controller cards etc. as required for the System	5% of total installed quantity or one of each type.
3.2	IS isolating Barriers	20% of total installed quantity of each type
3.3	Isolators/ Signal Multipliers	20% of total installed quantity of each type
3.4	IS mV/I Converters, IS RTD/I Converters, Alarm cards (receiver switches)	20% of total installed quantity of each type
3.5	Field multiplexer i) Processor module ii) I/O module	20% of total installed quantity of each type
3.6	Prefabricated cables	20 Sets with connecting plugs for each type of peripherals and I/O hardware
3.7	Relays	20% of total installed quantity of each type
3.8	Push Buttons, Lamps, Selector switches, Switches	20% of total installed quantity of each type

S. No.	PART DESCRIPTION	QUANTITY REQUIRED
3.9	MCBs	20% of total installed quantity of each type
3.10	System Cabinet Air Filter	100%
3.11	Annunciators	
	- Power Supply Module	5% subject to minimum 1 No. of each type
	- Flasher Module	5% subject to minimum 1 No. of each type
	- Tone Generator Card	5% subject to minimum 1 No. of each type
	- I/O Module	5% subject to minimum 1 No. of each type
	- Lamps	10 dozens
	- Fuses	1 dozen
3.12	Consumables (after commissioning and handing over the system)	
a)	Printer Paper	For twelve month operation (Minimum 20 boxes of each type)
b)	Inking arrangement for Hard Copy Unit	For twelve month operation (Minimum 10000 hard copies / copier)
c)	Printer Head	For twelve month operation (Minimum 4 nos. / printer)
d)	Magnetic Cartridge Tape	For twelve month operation (Minimum 50 nos.) Note-4
e)	CD s	For twelve month operation (Minimum 50 nos.)
f)	Printer Ribbons	For twelve month operation (Minimum 20 nos. / printer)
3.13	Fuses	100% of each type
3.14	Lamps	Minimum 150 nos.
4.0	Other system oriented items like Steam Governor Control	5% subject to minimum 1 No. of each type
5.0	GTG Control System	5% subject to minimum 1 No. of each type
6.0	GT skids	5% subject to minimum 1 No. of each type

NOTES:

1. The word 'TYPE' means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.
2. Wherever % age is identified, Contractor shall supply next rounded figure. The terminology used under 'Part Description' is the commonly used name of the part and may vary from manufacturer to manufacturer.
3. Commissioning spares are part of contractor scope of supply.
4. Mandatory spares as indicated above does not cover commissioning spares.
5. Mandatory spares shall be applicable for instrumentation items of sub-packages as per mandatory spares philosophy

Project: CPP-PARADIP REFINERY PROJECT
Owner: INDIAN OIL CORPORATION LIMITED
PMC: ENGINEERS INDIA LIMITED

Tender No: A011/T-063/09-10/SKK/01

Package Title: CAPTIVE POWER PLANT.

Section: A-6
Sub Section: A-6.1
Subject: Vendor List

0	27.07.09	Issued For Bid	BG	SKG	RBS
Rev. No	Date	Revisions	Prep. By	Chkd. By	Approved By



6.1 NOTES

- I) Attached "Master Vendor List" shall strictly be followed for all equipments/materials. Other make of equipment/material may be accepted subjected to prior approval of IOCL/EIL.
- II) Where make of equipment/material is not covered in the "Master Vendor List", contractor shall select the make of such equipment/material with prior approval of IOCL/EIL.

1313A Rotary Positive Displacement Pumps - (2/3 screws)		
1	Alektro Engg. Industries Pvt. Ltd.	India
2	Roto Pumps Ltd	India
3	UT Pumps & Systems Ltd	India
4	Tushaco Pumps Pvt. Ltd	India
5	Allweiler Ag	Germany
6	Leistritz AG	Germany
7	IMO AB	International
8	Pompe Vergani Spa	Italy
9	Plenty Mirrless Pumps	UK
10	IMO Industries Inc	USA
11	Warren Pumps Inc	USA
1313B Rotary Positive Displacement Pumps - Gear Type		
1	Flowserve	India/International
2	Hydropower Corporation	India
3	Dal Pd Pumps & Gears Pvt. Ltd.	India
4	Tushaco Pumps Pvt. Ltd	India
5	Nagano Keiki Seisakusho Ltd	Japan
6	Maag Pumps Systems Ag	International
7	Shimadzu Corporation	Japan
8	Viking Pump Inc	International
1313E Pump - Rotary - Vane		
1	Fluid Pumps (Bristol) Ltd	UK
2	Plenty Mirrless Pumps	UK
3	Viking Pump Inc	International
1314 A Metering Pumps Reciprocating (Controlled Volume)		
1	Shapo Tools	India
2	Swalore Engg (P) Ltd.	India
3	V.K.Pumps Industries	India
4	Flowserve	India/International
5	Milton Roy	India/International
6	SPX Process Equipment Limited	India/International
7	Peroni Pompe Spa (Formerly F.Peroni)	Italy
8	Syndyne Nikkiso	Japan
9	GEHO Pumps	Netherlands
10	Pulsa Feeder (Unit Of Idex Corp)	USA
11	Williams Instrument Company Inc	USA
12	Lewa Herbert Ott GmbH	Germany
13	Orlita GMBH & Co Ltd	Germany
1316A Mechanical Seals [API 682 Type & Dry Gas Seal]		
1	Eagle Burgmann	International
2	Flowserve	International
3	John Crane	International
1321A Centrifugal Compressors (API 617) (Special Purpose Process)		
1	Drassier Rand	India/International
2	GE Oil & Gas (Nuovo Pignone)	International
3	Hitachi Ltd	International
4	Bharat Heavy Electricals Limited	India
5	Elliott Ebara Turbomachinery	International
6	Man Turbomaschinen AG	International
7	Mitsubishi Heavy Industries Ltd.	International
8	Siemens	International
9	IHI Corporation	Japan
10	Kawasaki Heavy Industries Ltd	Japan
11	Kobe Steel Ltd	Japan
12	Mitsui Engineering & Shipbuilding Co. Ltd	Japan
13	Cooper Energy Services	Singapore
14	Rolls Royce Energy Systems Inc	Singapore
1322A Reciprocating Compressors (API 618) - (Special Purpose Process)		
1	Bharat Pumps & Compressors Ltd	India
2	Drassier Rand	India/International
3	GE Oil & Gas (Nuovo Pignone)	International
4	Hitachi Ltd.	International
5	Atlas Copco	International

1329A	Compressor - Reciprocating (Diaphragm)	
1	Andreas Hofer Hochdrucktechnik GmbH	Germany
2	Burckhardt Compression AG	Switzerland
3	Fluiftron Inc	USA
4	Hawdens BC	International
5	Pressure Products Industries Inc	USA
1382A	Steam Turbine - General Purpose (API 611)	
1	APE Bellis	India
2	Bharat Heavy Electricals Limited	India
3	Triveni	India
4	Dresser Rand	India/International
5	Hitachi Ltd.	International
6	Novvo Pignone Spa	International
7	Elliott Ebara Turbomachinery	International
8	Mitsubishi Heavy Industries Ltd.	International
9	Siemens	International
10	Franco Tosi Meccanica Spa	Italy
11	Shin Nippon Machinery Co. Ltd.	Japan
12	Shunko Industries Ltd.	Japan
13	Hayward Tyler Fluid Dynamics Ltd.	UK
14	Westinghouse Electric Corporation	USA
15	Blohm & Voss Ag	Germany
16	Man Turbomaschinen Ag	Germany
1382B	Steam Turbine - Special Purpose (API 612)	
1	Dresser Rand	International
2	Oil & Gas (Novvo Pignone)	International
3	Hitachi Ltd.	International
4	Bharat Heavy Electricals Limited	India
5	Gas Alsthom Turbine Generators	India
6	Blohm & Voss Ag	Germany
7	Man Turbomaschinen Ag	Germany
8	Elliott Ebara Turbomachinery	International
9	Mitsubishi Heavy Industries Ltd.	International
10	Siemens	International
11	Franco Tosi Meccanica Spa	Italy
12	Shin Nippon Machinery Co. Ltd.	Japan
13	Asao Brown-Boveri Limited	Switzerland
14	Westinghouse Electric Corporation	USA
1391A/B	Mixers & Agitators	
1	AJ Services	India
2	GMM Pfaffler Ltd.	India
3	Mixrite Corporation	India
4	Romi Process Plant & Machinery Ltd.	India
5	Hitachi Ltd. (Japan)	International
6	Milton Roy	India/International
7	SPX Process Equipment Limited	India/International
8	Mitsubishi Kakoki Kaisha Ltd.	Japan / India
9	Chaplineer Inc	UK
10	Mixing Solutions Ltd.	UK
11	Dorr - Oliver	USA
12	Jensen Mixer International	USA
13	Standard Engineers	India
14	Lump S.A.	France
15	M. Leonard - Quin Industries	France
16	Mutso Minerals Canada Inc.	Canada
Special Purpose Gear Unit		
1	Avon	USA
2	SHS	USA
3	Philadelphia	USA
4	Nippon Gear Co. Ltd.	Japan
5	Flandar-Graffensteden	International
6	Mang	International
7	Lufkin	Germany
8	Rack	Germany
Feed Pump - Gear Motor Clutch Power Recovery Turbine Package		
1	Ebara Corporation	International

	2	Flowserve	
	3	Clyde Union	International
	4	Nuovo Pignone	International
	5	Sulzer	International
No FCC Code		One-Way Running Clutch	
	1	Marland	USA
	2	SSS Clutch	USA
No FCC Code		Vertical Sulphur Pumps	
	1	KSB	
	2	Flowserve	India/International
	3	Chas S Lewis & Co	International
	4	ITT Industries - Gould Pumps	USA
	5	Lawrence Pumps	USA
No FCC Code		Flexible Metallic Couplings	
	1	Euroflex	
	2	Roth	India
	3	Unique	India
	4	Eagle Burghman	India
	5	Emerson	International
	6	John Crane	International
	7	Goodrich	International
	8	Thomas	UK
No FCC Code		Column Bottom Pumps for FCC (Slurry Service)	
		Lawrence Pump Inc.	USA
		Nigata Worthington Co. Ltd.	Japan

Mechanical Equipment - Package & Miscellaneous

Foster Wheeler Reference code	Category	Country
1359B	Coalescers	
1	Grand Prix Fab (P) Ltd.	India
2	Multitex Filtration Engineers Ltd.	India
3	Pall Pharma Lab.	India
4	Petromar Engineered Solutions	India
5	Larsen & Toubro	India
6	Fai Officine Di Carico Spa	Italy
7	Ionics Italia Spa	Italy
8	Siirtech Nigi SpA	Italy
9	Wake Industrial	Japan
10	Ama Filter BV	Netherlands
11	Idesa	Spain
12	Axsis Howmat	UK
13	Bartch Fintop Engineering Co Ltd.	UK
14	Dörmick-Hunter Ltd.	UK
15	Knitmesh Ltd.	UK
16	Facet Enterprises	USA
17	Howe Baker Engineers Inc.	USA
18	Perry Equipment Corporation	USA
No FW Code	Cryogenic Air Separation Plant	
1	Air Liquid Engineering India Pvt Ltd.	India
2	BOC India Ltd.	India
3	Praxair India Pvt. Ltd.	India
4	Linde AG	Germany
1392D	Drier - Air/Gas	
1	Clean Air	India
2	Délair India Pvt. Ltd.	India
3	Gasco Energy Systems India Pvt. Ltd.	India
4	Indcon Projects & Equipments Ltd.	India
5	Kilburn Engineering	India
6	Lloyds Steel Industries Ltd.	India
7	Process Equipment Engineering	India
8	Purifier India Ltd.	India
9	Trident Pneumatic Pvt. Ltd.	India
10	Ultra Filter	India
11	Nouvelle Application Technology (NAT)	France
12	Atlas Copco	International
13	ISG (Impianti Sistema Gel S.v.L)	Italy
1353D / 1354F	FILTER - CARTRIDGE/ CANDLE (Gas/Solid Separation, Liquid/Solid Separation & Dust Suppression)	
1	BOLL & KIRCH FILTERBAU GMBH	GERMANY
2	BURGESS MANNING GmbH	GERMANY
3	EPE EPENSTENNER GMPB & CO	GERMANY
4	EUROFILTEC	FRANCE
5	FAIREY ARLOH BV	NETHERLAND
6	FAUDI PROCESS FILTRATION GMBH	GERMANY
7	FILTRATION ENGINEERS (I) PVT. LTD (New enlistment with EIL w.e.f. 13.08.05)	INDIA
8	FILTAN - FILTER -ANLAGENBAU GMBH	GERMANY
9	FLOWTECH FLUID HANDLING LTD	U.K
10	FORAIN S.R.L	ITALY
11	FUJI FILTER	JAPAN
12	GRAND PRIX FAB. (P) LTD (FORMLY A.G. STEEL)	INDIA
13	GUJARAT OTOFILT	INDIA
14	MULTITEX FILTRATION ENGINEERS LTD.	INDIA
15	PALL CORPORATION	USA
16	PERRY EQUIPMENT CORPORATION	USA

17 PLENTY FILTERS
 18 PTI TECHNOLOGIES INC.
 19 PETROMAR ENGINEERED SOLUTIONS
 20 SIIRTEC NIGI SPA
 21 ULTRAFILTER (INDIA) PVT LTD

UK
 USA
 INDIA
 ITALY
 INDIA

No FW Code

	Desalter	
1	Petraco International Inc.	USA
2	Mackenzie Hydrocarbons	Australia
3	NATCO UK Ltd	UK
4	Prosernat	France
5	Godraj & Boyce Mfg *	India
6	GR Engineering Works Limited *	India
7	ISGEC *	India
8	Larsen & Toubro *	India
9	Lloyds Steel Industries Ltd *	India
10	Techno Process Equipment (India) Ltd *	India
11	Universal Heat Exchangers Ltd *	India
12	Indus Project Limited	India

* Vessel Manufacturers at St.nos 5 to 12 to be considered with a condition that they would supply desalter with design and supply of Internals for desalter from any of the four vendors appearing at St.nos. 1 to 4.

5	Vega Gaire Shhabar	Germany
No FW Code	Steam Drum Level Indicator (Electronic)	
1	Levelstate Systems Ltd	UK
2	Narvik - Yarway B.V	Netherlands
3	Solartron Mobrey Limited	England
4	Yarway Corporation	India
No FW Code	Tank Level (Radar Type)	
1	Endress + Hauser (I) Pvt. Ltd.	Germany
2	Enraf Bv	Netherlands
3	SAAB Marine	Sweden
No FW Code	Portable Nucleonic Survey Meter (Beta-Gamma-Neutron)	
1	FLUKE Bio Medical Radiation Management Service	USA
2	Graetz Strahlungsmesstechnik GmbH	Germany
3	Ludlum Measurements	USA
4	Thermo Measuretech	USA
	PRESSURE	
1614A 1614K 1614L	Pressure Gauge / Diff Pressure Gauges	
1	Wika, Alexander Wiegand & Co. GmbH	Germany
2	Budenberg Gauge Co. Ltd.	UK
3	Badotherm Process Instruments Bv	Netherlands
4	Precision (Ashcroft)	India
5	A.N Instruments	India
6	General Instruments Consortium	India
7	Baumer India PVT Ltd.	France
8	Waree Instruments Ltd	India
1614B	Pressure Transmitter Electrical Type	
1	ABB Ltd.	India
2	Fuji	Japan
3	Emerson Process Management (3051 series)	India
4	Yokogawa (Eja Series)	India
5	Honeywell	India
1614F	Differential Pressure Transmitter Electrical Type	
1	ABB Ltd.	India
2	Fuji	Japan
3	Emerson Process Management (3051 series)	India
4	Yokogawa (Eja Series)	India
5	Honeywell	India
1614J	Draft Gauge	
1	An Instruments Pvt. Ltd.	India
2	General Instruments Consortium	India
3	Switzer Instrument Ltd.	India
4	Wika Instruments India Pvt. Ltd.	India
5	Badotherm Instruments	Netherlands
	TEMPERATURE	
1611A	Dial Thermometer With Thermowell (BI METALLIC, GAS FILLED SYSTEM)	
1	Wika	Germany
2	Solartron ISA	USA
3	Badotherm Process Instruments	NETHERLANDS
4	A.N Instruments	India
5	General Instruments Consortium	India

1611C

1611D

1611E

1611J

1611K

1611K

1611K

1611L

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6

7

SKIN T

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1621A

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6

7

6	Pyro Electric Instruments	India
7	Baumer India PVT Ltd.	FRANCE
1611C	Thermo-Couple With Thermowell	
1	GAYESCO LLC	USA
2	Altop Industries Ltd.	India
3	Detriv Instrumentation & Electronics Ltd.	India
4	General Instruments Consortium	India
5	Electrical & Electronics Corporation	India
6	Pyro Electric Instruments	India
7	Nagman Sensors	India
8	Thermocouple Products	USA
1611D	RTD With Thermowell	
1	Altop Industries Ltd.	India
2	Detriv Instrumentation & Electronics Ltd.	India
3	General Instruments Consortium	India
4	GAYESCO LLC	USA
5	Electrical & Electronics Corporation	India
6	Pyro Electric Instruments	India
7	Nagman Sensors	India
8	Thermocouple Products Limited	USA
1611F	Temperature Electrical Transmitter	
1	Honeywell Control Systems Ltd.	INDIA
2	Emerson Process Management	INDIA
3	Yokogawa	INDIA
4	ABB Ltd.	INDIA
5	Fuji	JAPAN
1611J	Pyrometer	
1	E2T	USA
1611K	Multi- Thermocouple-Regenerator Reduction Zone / Catalyst Bed (For Unit 43)	
1	GAYESCO Llc	USA
2	Thermocouple Products	USA
3	Vulcanic	France
1611K	Multi-Point Thermocouple Element - Regenerator Tower (For Unit 43)	
1	Daily Thermometrics or Equal	USA
1611K	Special Thermocouples- Flexible Type, Washer Type, Pad Type, Multipoint Type	
1	GAYESCO Llc	USA
2	Thermocouple Products	USA
3	Vulcanic	France
1611L	SKIN THERMOCOUPLES (Knife edge type)	
1	ABB Ltd.	UK
2	Baumer Group	FRANCE
3	Halmann & Braun GmbH	Germany
4	GAYESCO Llc	USA
5	Vulcanic	France
6	Thermo Electric Co. Ltd.	UK
7	Thermocouple Products	USA
SKIN THERMOCOUPLES (XTRACTO-PAD DESIGN TYPE) -HEATER TUBES		
1	GAYESCO Llc	USA
2	THERMOCOUPLE PRODUCTS	USA
CONTROL VALVE		
1621A	Control Valve - Globe Type	
1	Flowserve	Singapore
2	Dresser	France
3	Hogkings	UK
4	Innova Pionera	Germany
5	Metso Automation Pte Ltd.	USA
6	Emerson Process Management	Singapore / USA

2	R. Stahl (P) Ltd	India
3	Teknik	India
1623A	Process Steam Traps	
1	Yarway Corporation	India
2	Armstrong International Inc	USA
3	Miyawaki Inc	Japan
4	TLV International	Japan
5	Clarke-Reliance Corp	USA
1641A	Local Control Panel / Prefabricated & Assembled Control Panel	
1	Industrial Control & Appliances	India
2	Pyrotech Electronics Pvt Limited	India
3	Ecil Hyderabad	India
4	J&H Control	India
5	Instrumentation Ltd	India
6	Rittal	Germany
1641E 1641F	Cabinets	
1	Rittal	Germany
1654A	Instrument Tubing-Stainless Steel	
1	Heavy Metals & Tubes Ltd. (Mehsana)	India
2	Nuclear Fuel Complex	India
3	Ratnamani Metals & Tubes Ltd.	India
4	Remi	India
1654C	Instrument Tubing Copper (Coated, Bare)	
1	Alcobex Metals Pvt. Ltd.	India
2	Multimetals Ltd.	India
3	Rajco Metal Industries Pvt. Ltd.	India
4	Industrial Tubes	India
5	Kamani Tubes	India
6	Hindustan Steel & Metal Works	India
7	Reliance Engineers Limited	India
1656A	Compression Fittings (Tube Fittings)	
TUBE FITTINGS (SEAL OIL, LUBE OIL, HYDROCARBON, ANALYSER & OTHER CRITICAL APPLICATIONS)		
1	PARKER HANNIFIN	U.K.
2	SWAGELOK CO.	U.S.A.
TUBE FITTINGS (FOR CONTROL VALVE, DAMPERS, POSITIONERS, I/P CONVERTERS ETC)		
1	ASTEC	INDIA
2	EXCEL-HYDRO	INDIA
3	FLUID CONTROL ENGG.	INDIA
4	HILOK	INDIA
5	PRECISION IND.	INDIA
6	EXCELSIOR ENGG WORKS	INDIA
7	PRECISION ENGG INDUSTRIES	INDIA
1659A	Instrument Manifold Valves	
1	Tyco Valves & Controls	USA
2	Autoclave Engineers Fluid Components	USA
3	Hoke International	UK
4	Parker Hannifin	UK
5	Swagelok Co.	USA
6	Astec	India
7	Precision Ind.	India
8	Excel-Hydro	India
9	Excelsior Engrg Works	India
1692A	Instrument Signal Cable	

3.	RSI SWITCHGEAR PVT. LTD	INDIA
4.	SR NARKHEDE ENGINEERING PVT. LTD	INDIA
5.	NATIONAL SWITCHGEARS	INDIA

Q. CAPACITOR - HIGH VOLTAGE

S.NO.	NAME OF VENDOR	COUNTRY
1.	ASEA BROWN BOVERI LTD (BANGALORE)	INDIA
2.	BHEL (BHOPAL)	INDIA
3.	CROMPTON GREAVES LTD	INDIA
4.	KAPSALES ELECTRICAL LTD	INDIA
5.	SHAKTI CAPACITORS	INDIA
6.	SHREEM CAPACITORS P LTD.	INDIA
7.	UNIVERSAL CABLES LTD	INDIA

R. PLANT COMMUNICATION SYSTEM

S.NO.	NAME OF VENDOR	COUNTRY
1.	INDUSTRIONIC GMBH & CO KG	INDIA
2.	NEUMAN ELEKTRONIK GMBH & CO	INDIA
3.	SIEMENS ENTERPRISE COMMUNICATIONS	INDIA

S. MOTOR-INDUCTION - HV (INDL. TYPE SAFE AREA)

S.NO.	NAME OF VENDOR	COUNTRY
1.	BHEL (BHOPAL)	INDIA
2.	CROMPTON GREAVES LTD	INDIA
3.	KIRLOSKAR ELECTRIC CO LTD	INDIA
4.	ABB LTD	INDIA
5.	ANSALDO SISTEM INDUST (ASI ROBICON)	ITALY
6.	ALSTOM MOTEURS SA	FRANCE
7.	ASEA BROWN BOVERY LTD	SWITZERLAND
8.	JEUMONT INDUSTRIES	FRANCE
9.	PEEBLES ELECTRIC LTD	UK
10.	HITACHI LTD (JAPAN)	INDIA
11.	FUJI	JAPAN
12.	SIEMEN AG	INDIA
13.	TOSHIBA CORPORATION	INDIA

T. MOTOR INDUCTION - MV (INDL TYPE SAFE AREA)

S.NO.	NAME OF VENDOR	COUNTRY
1.	ALSTOM LTD	INDIA
2.	ASEA BROWN BOVERY LTD (FARIDABAD)	INDIA
3.	BHARAT BIJLEE LTD	INDIA
4.	BHEL (BHOPAL)	INDIA

5.	CROMPTON GREAVES LTD	INDIA
6.	KIRLOSKAR ELECTRIC CO LTD	INDIA
7.	SIEMENS LTD	INDIA
8.	ANSALDO SISTEMI INDUSTRIALI(ASI ROBICON) ITALY	

U MOTOR INDUCTION MV (FLAME PROOF)

S.NO.	NAME OF VENDOR	COUNTRY
1.	ABB	SWEDEN
2.	ALSTOM LTD	INDIA
3.	BHARAT BIJLEE LTD	INDIA
4.	BHEL (BHOPAL)	INDIA
5.	CEMP	ITALY
6.	CROMPTON GREAVES LTD	INDIA
7.	KIRLOSKAR ELECTRIC CO LTD	INDIA
8.	SIEMENS	GERMANY
9.	LOHER	GERMANY
10.	WEG ELECTRIC (INDIA) PVT. LTD	INDIA

V. MOTOR INDUCTION MV (ZONE 2 TYPE e & n)

S.NO.	NAME OF VENDOR	COUNTRY
1.	ASEA BROWN BOVERI LTD (FARIDABAD) (type e & n)	INDIA
2.	BHARAT BIJLEE LTD (type n only)	INDIA
3.	CROMPTON GREAVES LTD (type e & n)	INDIA
4.	KIRLOSKAR ELECTRIC CO LTD (type e & n)	INDIA
5.	SIEMENS LTD (type e & n)	INDIA
7.	LOHER	GERMANY
8.	ALSTOM LTD	INDIA

W. MOTOR -INDUCTION HV (INCREASED SAFETY ZONE - 2)

S.NO.	NAME OF VENDOR	COUNTRY
1.	BHEL (BHOPAL)	INDIA
2.	CROMPTON GREAVES LTD	INDIA
3.	KIRLOSKAR ELECTRIC CO LTD	INDIA
4.	ALSTOM LTD	INDIA
5.	LOHER	GERMANY

X. A.C (MV) VARIABLE SPEED DRIVE

S.NO.	NAME OF VENDOR	COUNTRY
1.	ROCKWELL AUTOMATION PVT LTD	INDIA
2.	ALSTOM PROJECTS INDIA LTD	INDIA
3.	BHEL (BANGALORE)	INDIA
4.	L & T LTD	INDIA



**PARADIP
PROJECT SPECIFIC STANDARD
PROJECT ENGINEERING**



**PDRP-8820-SP-0001
PAGE 15 OF 46
REV F1**

BASIC ENGINEERING DESIGN DATA

5.2 Condensate

5.2.1 Condensate shall be recovered.

5.2.2 Condensate from HP steam system shall discharge at 38.5 kg/cm²g (Normal)

5.2.3 Condensate from MP steam system shall discharge at 12.5 kg/cm²g (Normal)

5.2.4 Condensate from LP steam system shall discharge at 3.3 kg/cm²g (Normal)

SYSTEM CONDITIONS	Pressure kg/cm ² g				Temperature °C			
	Min	Max	Normal	Design	Min	Max	Normal	Design
HP	36.5	40.5	38.5	46.0	247	253	250	280
MP	10.5	13.5	12.5	18.0	186	197	194	225
LP	2.3	4.0	3.3	7.0	137	152	147	170
LLP	Atm	0.5	0.3	3.5	105	112	107	140

Condensate will be flashed to LLP steam and pumped to the condensate header at 7.7 kg/cm²g at BL. Small condensate streams will be collected and flashed outside BL and pumped at the same BL pressure.

5.2.5. Clean (Polished) Condensate

Battery limit conditions at CPP

CONDITIONS	Min	Normal	Max	Mech Design
Supply pressure, kg/cm ² g	4.0	5.5	6.0	9.0
Supply temperature, °C	50	64	70	90

Clean Condensate Quality	Units	Value
Condensate suspended solids	ppm wt	Nil
pH		7.0 – 8.5
Silica as SiO ₂	ppm wt	0.02 max
Hardness as CaCO ₃	ppm wt	Nil
Oil Content	ppm wt	Nil
Iron as Fe	ppm wt	0.01 max
Ammonia	ppm wt	0.1 max
Sodium as Na	ppm wt	0.02 max
Dissolved Oxygen	ppm wt	Not measured
Total Dissolved Solids (TDS)	ppm wt	0.5 max
Conductivity at 20°C	Micro S/cm	0.2 max
M alkalinity as CaCO ₃	ppm wt	Nil
Chlorides	ppm wt	0.02 max

5.3 Water

5.3.1 Cooling Water

CONDITIONS	Min	Normal	Max	Mech Design
Supply pressure, kg/cm ² g	4.5	5.5	6.5	8.0
Return pressure, kg/cm ² g	2.5	3	3.5	8.0
Supply temperature, °C	-	35	35	65
Return temperature, °C	-	44	44	65



PARADIP
PROJECT SPECIFIC STANDARD
PROJECT ENGINEERING



BASIC ENGINEERING DESIGN DATA

PDRP-8820-SP-0001
PAGE 16 OF 46
REV F1

5.3.2 Raw Water

WATER QUALITY	Units	Value
Source	-	Mahanadi River, Cuttak
Availability	MGD	40
Appearance		Clear on settling
Odour		Unobjectionable
pH	-	7.5
Totals dissolved solids	ppm wt	183
Chlorides as Cl	ppm wt	12
Phenolphthalein alkalinity as CaCO ₃	ppm wt	nil
Turbidity	NTU	500
Total alkalinity	ppm wt	76
Ca hardness as CaCO ₃	ppm wt	40
Total hardness as CaCO ₃	ppm wt	73
Magnesium hardness as CaCO ₃	ppm wt	33
Temporary hardness as CaCO ₃	ppm wt	73
Permanent hardness as CaCO ₃	ppm wt	nil
Dissolved silica as SiO ₂	ppm wt	4
Colloidal silica	ppm wt	2 (Note 1)
Dissolved iron as Fe	ppm wt	< 0.01
Sulphates as SO ₄	ppm wt	< 2.0
Carbonates as CaCO ₃	ppm wt	Nil
Bicarbonates as CaCO ₃	ppm wt	76
Magnesium as Mg	ppm wt	7.9
Sodium as Na	ppm wt	12
Phosphate as P	ppm wt	< 0.05
Nitrates as N	ppm wt	0.5

Note 1: Occasional seasonal excursion in Colloidal Silica up-to 5 mg/l is expected

5.3.3 Treated Raw Water

WATER QUALITY	Units	Value
pH		7-8.5
Colour	Hazen	5.0
Smell		Agreeable
Taste & Odour		Unobjectionable
Turbidity	NTU	1.0 max
Totals dissolved solids	ppm wt	150 max
Total Hardness	ppm wt	85 max
Chlorides (as Cl)	ppm wt	15 max
Sulphate (SO ₄)	ppm wt	60 max
Total Iron (Fe)	ppm wt	0.01 max
Dissolved Silica	ppm wt	4 max
Colloidal Silica	ppm wt	2 max (Note 1)

Note 1: Occasional seasonal excursion in Colloidal Silica up-to 5 mg/l is expected



PARADIP
PROJECT SPECIFIC STANDARD
PROJECT ENGINEERING



PDRP-8820-SP-0001
PAGE 17 OF 46
REV F1

BASIC ENGINEERING DESIGN DATA

5.3.4 RO Permeate Water

CONDITIONS	Min	Normal	Max	Mech Design
Supply pressure, kg/cm ² g	-	8.0	-	10.0
Supply temperature, °C	-	Ambient	-	65

WATER QUALITY	Units	Value
pH	-	5.7-6.7
Total Hardness as CaCO ₃	ppm wt	6
Total dissolved solids	ppm wt	100 max
Alkalinity as CaCO ₃	ppm wt	20
Chlorides as Cl	ppm wt	40
Sulphate as SO ₄	ppm wt	5.0
Silica as SiO ₂	ppm wt	0.5 max
Colloidal Silica	ppm wt	0.01 max
TOC	ppm wt	0.2 max

5.3.5 Demineralised Water

CONDITIONS	Min	Normal	Max	Mech Design
Supply pressure, kg/cm ² g	4.0	5.5	6.0	10.0
Supply temperature, °C	-	Ambient	Ambient	65

WATER QUALITY	Units	Value
pH	-	6.5 – 7.5
Hardness	ppm wt	Zero
Total dissolved solids	ppm wt	0.1 max
Conductivity at 20 °C	micromho/cm	0.2 max
M alkalinity as CaCO ₃	ppm wt	Nil
Chlorides	ppm wt	Nil
Iron as Fe	ppm wt	0.01 max
Silica as SiO ₂ (Note 1)	ppm wt	0.02 max
Colloidal Silica	ppm wt	0.01 max
TOC	ppm wt	0.2 max
Sodium as Na	ppm wt	0.1 max

Note 1: Include Colloidal Silica

5.3.6 Boiler Feed Water

CONDITIONS	Min	Normal	Max	Mech Design
HP supply pressure, kg/cm ² g	58.0	58.0	60.0	82.0
HP supply temperature, °C	105	105	116	150
MP supply pressure, kg/cm ² g	28.0	28.0	30.0	40.0
MP supply temperature, °C	105	105	116	150
WATER QUALITY	Units	Value		
pH	-	8.5 – 9.5		
Conductivity at 20 °C	micromho/cm	0.2 max		
Chlorides	ppm wt	1.0 max		
Iron as Fe	ppm wt	0.01 max		
Silica as SiO ₂ (Note 1)	ppm wt	0.02 max		
Colloidal Silica	ppm wt	0.01 max		
Oil Content	ppm wt	Nil		
Oxygen	ppm wt	0.005 max		

Note 1: Include Colloidal Silica



PARADIP
PROJECT SPECIFIC STANDARD
PROJECT ENGINEERING



PDRP-8820-SP-0001
PAGE 18 OF 46
REV F1

BASIC ENGINEERING DESIGN DATA

5.3.7 Service Water

CONDITIONS	Min	Normal	Max	Mech Design
Supply pressure, kg/cm ² g	4.0	6.0	8.0	10.5
Supply temperature, °C	ambient	ambient	ambient	65

5.3.8 Drinking Water

CONDITIONS	Min	Normal	Max	Mech Design
Supply pressure, kg/cm ² g*	4.0	6.0	6.5	12.5
Supply temperature, °C	Ambient	Ambient	Ambient	65

*supply conditions for the refinery units

5.3.9 Fire Water

CONDITIONS	Min	Normal	Max	Mech Design
Supply pressure, kg/cm ² g	7.0	7.0	11.5	16.0
Supply temperature, °C	Ambient	Ambient	Ambient	65

Conditions are at furthest hydrant.

5.3.10 Stripped Sour Water

CONDITIONS	Min	Normal	Max	Mech Design
Supply pressure, kg/cm ² g	3.0	5.0	6.0	10.0
Supply temperature, °C	20	40	50	65

5.4 Air

5.4.1 New plant and instrument air systems shall be provided

5.4.2 Plant Air

CONDITIONS	Min	Normal	Max	Mech Design
Header pressure, kg/cm ² g	4.0	7.0	8.0	10.5
Supply temperature, °C	40	40	50	65

QUALITY	Value
Design Dew point	Ambient
Oil content	Nil (oil free)

5.4.3 Instrument Air

CONDITIONS	Min	Normal	Max	Mech Design
Header pressure, kg/cm ² g	4.5	7.0	8.0	10.5
Supply temperature, °C	ambient	40	50	65

QUALITY	Value
Design Dew point	-40°C at Atmospheric Pressure
Oil content	Nil (oil free)

Remarks: Electrical Compressor driver



**PARADIP
PROJECT SPECIFIC STANDARD
PROJECT ENGINEERING**



**PDRP-8820-SP-0001
PAGE 8 OF 46
REV F1**

BASIC ENGINEERING DESIGN DATA

3 Climatic Data

3.1. Wind

3.1.1 Wind Velocity

Average velocity	
- Summer	37 – 45 km/hr
- Winter	15 – 26 km/hr
Maximum velocity	72 m/sec (259 km/hr)(During 1999 cyclone)
- cyclone	200 - 250 km/hr (S-SE)
Basic wind speed for structural design	65 m/sec (234 km/hr)

A basic wind speed of 65m/s shall be used in accordance with IS 875 (Part 3)- 1987 (reaffirmed 2003), Wind Loads.

3.1.2 Wind Direction and Percentage of Time for Each Quadrant

% of time	N	NE	E	SE	S	SW	W	NW	Calm
Morning (0830)	13.8	6.4	2.1	2.4	7.7	21.6	11.0	8.2	(Δ26.8)
Evening (1730)	15.0	6.7	9.41	8.16	15.0	24.8	4.8	1.8	(Δ27.8)

Wind Loading

The applicable standard for wind loading is IS 875, refer also to 3.1.1

Note- The K_2 factor shall be based on a Terrain Category Class 2 and the K_3 factor shall be taken as 1.0.

3.2 Air Temperature

	Temp, °C	Notes
Maximum recorded	42.4	
Minimum recorded	11.3	
Mean dry bulb	30.7	
Mean wet bulb	28.0	
Average max monthly	37	
Average min monthly	16	
Design maximum	42.4	Note 1
Design minimum	11.3	
Design wet bulb	29	

Note 1: Max solar gain temperature on bare piping 65 °C

For Air Coolers:

Design maximum 42°C



**PARADIP
PROJECT SPECIFIC STANDARD
PROJECT ENGINEERING**



**PDRP-8820-SP-0001
PAGE 9 OF 46
REV F1**

BASIC ENGINEERING DESIGN DATA

3.3 Relative Humidity

RELATIVE HUMIDITY	RH%	Notes
Mean daily maximum	99.7	
Mean daily minimum	24.7	
Average monthly humidity	95% (max) 55% (min)	
Summer mean (months)	90	
Winter mean (months)	45	

3.4 Rainfall

RAINFALL	Value	Notes
Maximum recorded annual	2251.7 mm	
Minimum recorded annual	1018.6 mm	
Average annual	1572.0 mm	
Maximum recorded in 1 hr	125 mm	During 1999 cyclone
Maximum recorded in 24 hrs	335 mm	
Design rainfall (per hour)	125 mm	
Rainy season	May to November	Note 1

Note1: Indian meteorological Department data and the Indian Maritime Authority Data

3.5 Snowfall

Not applicable

3.6 Barometric Pressure



BAROMETRIC PRESSURE	mbar	Notes
Maximum	1010	
Minimum	966.3	
Average	1005	

3.7 Solar Heat

SOLAR HEAT FLUX AT MIDDAY	Kcal/m ² .hr	Notes
Minimum		
Maximum	678.2	
Average		

3.8 Atmosphere

- a) Extreme moisture (tropical climate) _____ **YES**
- b) Marine exposure (salt spray) _____ **YES**
- c) Sand storms _____ **NO**
- d) Copper-attacking fumes (ammonia, sulphur, etc.)

	<p align="center">PARADIP PROJECT SPECIFIC STANDARD PROJECT ENGINEERING</p>	 <p align="center">PDRP-8820-SP-0001 PAGE 10 OF 46 REV F1</p>
	<p align="center">BASIC ENGINEERING DESIGN DATA</p>	

SO₂: 16.6 micro gm (maximum)

- e) Exposure to conductive or corrosive dusts
(carbon, iron oxide ammonium nitrates or phosphates, etc.)
NO_x: 32.5 micro gm (maximum) at Paradip Phosphate Ltd which is adjoining industry
- f) Exposure to corrosive agents
(nitric or sulphuric acids, chlorine, caustic, etc.) _____ SO₂
and NO_x as above
- g) Exposure to other pollutants originating from surrounding industrial plant _____ NO

3.9 Miscellaneous Site Data

- a) Frost Level NA m
- b) Thunderstorm Frequency In 30 occasions in 1991
- c) Sandstorm Frequency NA
- d) Temperature Inversion Occurrence Not Available
- e) Ground Temperature. The results of earth temperature measurements are given in the Geotechnical Investigation Report. Readings taken at depths of between 0.6 m and 1.6m were in the range of 29 °C to 34 °C

3.9.1 Seismic design shall be as follows;

Seismic design shall be in accordance with IS 1893 Part 1 & 4, and the Earthquake Engineering Analysis Report, prepared by Fugro GeoConsulting/Fugro West, Project No. 3193.026 dated Sept.2008. This report includes site specific seismic response spectra that shall be used to calculate seismic loading. The project site falls under Zone 3 as described in IS 1893.

3.9.2 The maximum recorded flood level is elevation 3910 mm (IMSL)

Remarks: Site shall be raised equal to or above the maximum recorded flood level

4 Economics

4.1 Economic evaluations shall be made as required.

4.2 Additional cost saving proposal or investment for energy efficiency shall have payout period of 3.5 years. (8320 operating hrs/year).

SCOPE OF SUPPLY/WORK **ROTATING EQUIPMENT** **CAPTIVE POWER PLANT**

PROJECT : CPP-PARADIP REFINERY PROJECT
OWNER : INDIAN OIL CORPORATION LIMITED
PMC : ENGINEERS INDIA LTD.
Job No. : A011

0	24/07/09	ISSUED WITH THE BID PKG.	AK	SM
Rev. No	Date	Purpose	Prepared by	Checked & Approved by

CONTRACTOR'S SCOPE OF SUPPLY/WORK FOR ROTATING EQUIPMENT ITEMS (i.e. GTG, STG, BFW Pumps, Fuel Gas Compressors, ID/FD Fans, Large Capacity Cooling Water Pumps etc.)

Refer the bid package and also, note the following:

- 1.0 Contractor shall carry out the following activities for procurement of Rotating Equipment:
- 1.1 Contractor shall prepare the enquiry specifications/ documents for each Rotating Equipment and materials to be purchased including spare parts for erection & commissioning, insurance spares as applicable, spare parts for two-year normal operation and special tools and tackles.
- 1.2 Contractor shall fill all the required data/information in the partially filled in Equipment data sheets formats forming part of the bid package for preparation of enquiry specifications/ documents.
- 1.3 Contractor shall prepare the detailed Purchase Requisition/ specification for each Rotating Equipment Package.
- 1.4 For the finally selected equipment make and model, Contractor shall submit the following information for Owner/PMC's approval:
 - Filled in Equipment data sheets along with Performance Curves
 - Filled in Experience Record Proforma
 - Equipment Manufacturer's Latest Catalogue, General reference List and Cross Sectional Drawing for the proposed model shall also be submitted along with the above documents.
- 2.0 Contractor shall carry out the detailed review and approval of data sheets, engineering & fabrication drawings and other technical data furnished by the respective Equipment Vendors to ensure a safe, smooth and reliable operation at site.
- 3.0 Contractor shall submit to the Owner/PMC, all engineering drawings/ documents/ data as specified in "Documents/drawings for Owner/PMC review" forming part of the bid package
- 4.0 Contractor shall ensure that, all inspection and tests are conducted for all equipment at Vendor's shops/site as specified in bid package. Contractor shall also submit the schedule of witnessed tests of all rotating equipment well in advance.
- 5.0 For all rotating equipment in the subject Captive Power Plant Contractor shall ensure that all insurance spares, are ordered on equipment vendor and the same shall be supplied to the Owner along with the equipment.
- 6.0 Besides the Mandatory Spares (Insurance Spares), Contractor shall furnish a list of spares recommended by the equipment vendor for two year normal operation along with firm unit prices and ensure that the Spare parts for Two-year normal operation, if ordered by the Owner, are procured from equipment vendor and supplied to the Owner.
- 7.0 Contractor shall include all the Commissioning spares as required in the equipment vendor's scope. Contractor shall procure the same from the equipment vendors and make it available well before commissioning of Plant/Equipment. In case, any additional spares are consumed during commissioning the same to be provided by the contractor at no additional cost to the Owner
- 8.0 A list of special tools and tackles required for all rotating equipment are to be included in vendor's scope of supply. Such tools/tackles shall be supplied by the vendor and shall form part of supply by Contractor to Owner.
- 9.0 Contractor's scope shall include complete supply, transportation of equipment package from vendor's shop to site, Receipt of material at site, Handling at site and arrangement for storage at site shall be as per the requirements indicated in the Bid Document.
- 10.0 Equipment, which is transported by sea, shall have sea-worthy packing. The Contractor shall strictly follow the recommended preservation procedures during the period of storage for all equipment.

- 11.0 Contractor shall carry out the erection of each rotating equipment at the specified location on the properly designed & cast foundation as per bid document and as per the instruction of site in charge.
- 12.0 Contractor shall carry out the inter-connections at all interface points such as main process and all utility connections.
- 13.0 Contractor shall note that consumables, lubricants etc. required during erection, commissioning and performance guarantee run of Rotating Equipment shall be in Contractor's scope. A consolidated list for all rotating equipment shall be provided indicating type of lubricant, grease, oil etc. giving specifications, quantities, brand name and their Indian equivalent.
- 14.0 Contractor shall supply & install all maintenance facilities sized for handling the heaviest single piece of equipment for maintenance. The maintenance facilities like EOT cranes, chain pulley blocks and monorails for Rotating equipment shall be provided by the Contractor. Contractor shall provide sufficient space for maintenance, dismantling and platforms for maintenance.
- 15.0 Contractor shall carry out the pre-commissioning and commissioning activity at site for all Rotating Equipment.
- 16.0 Contractor shall ensure the presence of equipment manufacturer (Vendor) at site for supervision of erection and commissioning of all Rotating Equipment.
- 17.0 **As an option, bidder shall envisage design, manufacture and provision for GTG shed on all the three GTGs and drop out area along their length. This shed shall be completely steel fabricated with sheeting on top roof and sides. The side sheeting shall leave at least 3m height as free.**

The GTG shed shall have columns at a max. spacing of 10m and shall be provided with suitable EOT crane for equipment maintenance.

Bidder shall indicate a separate price for the above described shed and requisite material handling facilities.

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GENERAL									
1 Project: CPP-Paradip Refinery Project					Job No.: A011				
2 Owner: M/S IOCL					Site: Orissa, India				
3 Purchaser:					Unit: CPP Unit No.: 00				
4 Item No.:					Service: VHP BFW Pumps/ HP BFW (EXPORT) PUMPS				
5 No. Required:		Working:		Standby:		Driver Type: Working:		Standby:	
7 Applicable to <input checked="" type="checkbox"/> Proposals					<input type="checkbox"/> Purchase <input type="checkbox"/> As Built				
8 <input checked="" type="checkbox"/> Scope Option & Information Specified By Purchaser <input type="checkbox"/> Information required from and options left to vendor. Vendor to cross : the selected option									
9 Manufacturer:					Model:				
10 Driver supplied & mounted by: <input checked="" type="checkbox"/> Pump Manufacturer <input type="checkbox"/> Other									
11 Gear (If reqd.) supplied & mounted by: <input checked="" type="checkbox"/> Pump Manufacturer <input type="checkbox"/> Other									
12 Applicable Code & Standards: API 610 8 th edition along with Eng. Design Basis, EIL Standard Specification 6-41-0005, Process package									
13									
OPERATING CONDITIONDS					SITE AND UTILITY DATA				
15 <input type="checkbox"/> Capacity (m ³ /hr)					Location: <input type="checkbox"/> Indoor <input type="checkbox"/> Heated <input type="checkbox"/> Underroof				
16 Nor.: Rated: Other:					<input checked="" type="checkbox"/> Outdoor <input type="checkbox"/> Unheated <input type="checkbox"/> Grade <input type="checkbox"/> Partial Side				
17 <input type="checkbox"/> Suct. Pressure (kg/cm ² G) [Max./Rated]:					<input type="checkbox"/> Mezzanine <input type="checkbox"/> Other:				
18 <input type="checkbox"/> Discharge Pressure (kg/cm ² G):					<input type="checkbox"/> Electrical Area Classification				
19 <input type="checkbox"/> Differential Pressure (kg/cm ²):					Class Group Division				
20 <input type="checkbox"/> Differential Head (m) NPSHA (m)					<input type="checkbox"/> Winterisation Required <input checked="" type="checkbox"/> Tropicalisation Required				
21 <input type="checkbox"/> Process Variations					<input type="checkbox"/> Site Data:				
22 <input type="checkbox"/> Starting Conditions					<input type="checkbox"/> Altitude (m): <input type="checkbox"/> Barometer (kg/cm ² G):				
23 <input type="checkbox"/> Service: <input type="checkbox"/> Continuous <input type="checkbox"/> Intermittent (Start/Day)					<input type="checkbox"/> Range of Amb. Temp. (EC): Min./Max.				
24 <input type="checkbox"/> Parallel Operation Required <input type="checkbox"/> Yes <input type="checkbox"/> No					<input type="checkbox"/> Relative Humidity (%): Min./Max.				
PERFORMANCE					<input type="checkbox"/> Unusual Conditions:				
26 Proposal Curve No.					<input checked="" type="checkbox"/> Dust <input checked="" type="checkbox"/> Fumes <input checked="" type="checkbox"/> Refinery atm				
27 Visc. Correction Factor C _n / C _Q / C _H :					<input type="checkbox"/> Utility Conditions:				
28 <input type="checkbox"/> NPSH Req'd. (m) F/L Speed (rpm):					<input type="checkbox"/> Steam: Driver Heating				
29 <input checked="" type="checkbox"/> No. of Stages: ≤ 10 Efficiency (%):					<input type="checkbox"/> Press. @ EC @ EC				
30 <input type="checkbox"/> Rated BKW (+/- 0% Tol.):					<input type="checkbox"/> Press. @ EC @ EC				
31 <input type="checkbox"/> Max. BKW Rtd. Implr. (kW):									
32 <input type="checkbox"/> BKW @ MCF (C=1) (kW):									
33 <input type="checkbox"/> Recom. Driver Rating (kW):					<input type="checkbox"/> Electricity: Drivers Heating Control Shutdown				
34 <input type="checkbox"/> Max. Head @ Rated Impeller (m):					<input type="checkbox"/> Voltage				
35 <input type="checkbox"/> Capacity @ BEP (m ³ /hr):					<input type="checkbox"/> Hertz				
36 <input type="checkbox"/> Min. Cont. Flow (m ³ /hr): Stable: Thermal:					<input type="checkbox"/> Phase				
37 <input type="checkbox"/> Preferred Operating Region (m ³ /hr): To					<input type="checkbox"/> Cooling Water:				
38 <input type="checkbox"/> Allowable Operating Region (m ³ /hr): To					<input type="checkbox"/> Temp. Inlet (EC): Max. Return (EC):				
39 <input type="checkbox"/> Suction Specific Speed:					<input type="checkbox"/> Pressure: Nor. (kg/cm ² G) Design (kg/cm ² G):				
40 <input checked="" type="checkbox"/> Max. Sound Pressure Level Allowable (dBA): 85 dBA @ 1m					<input type="checkbox"/> Return: Min. (kg/cm ² G) Max. Allow.) P(kg/cm ² G):				
41 <input type="checkbox"/> Expected Sound Pressure Level (dBA):					<input type="checkbox"/> Water Source:				
42					<input type="checkbox"/> Chloride Concentration (PPM):				
CONSTRUCTION					<input type="checkbox"/> Instrument Air Pressure (kg/cm ² G):				
44 <input type="checkbox"/> PUMP TYPE:					Max. Min.				
45 <input type="checkbox"/> BB Axially Split, Multistage					LIQUID (Refer Process Package)				
46 <input type="checkbox"/> BB Radially Split, Multistage: <input type="checkbox"/> Single Casing <input type="checkbox"/> Double Casing					<input checked="" type="checkbox"/> Type/Name of Liquid: Boiler Feed Water				
47 <input type="checkbox"/> Vert. Suspended Double Casing: <input type="checkbox"/> Diffuser <input type="checkbox"/> Volute					<input type="checkbox"/> Pumping Temperature (EC):				
48 Nozzle Connections:					Normal Max. Min.				
49		Size	Rating	Facing	Position	<input type="checkbox"/> Vapour Pressure (kg/cm ² A): @ EC			
50 Suction						<input type="checkbox"/> Relative Density (Specific Gravity):			
51 Discharge						Normal Max. Min.			
52 Balance Drum						<input type="checkbox"/> Specific Heat (Cp) kJ/kgEC			
53 <input type="checkbox"/> Impeller Diameter (mm):					<input type="checkbox"/> Viscosity (cP/cst) @PT @ EC				
54 Rated:		Max.		Min.		- <input type="checkbox"/> Max. @ EC			
55 <input type="checkbox"/> Pressure Casing Connections:					<input type="checkbox"/> Corrosive/Erosive Agent:				
56		No.	Size	Type		<input type="checkbox"/> Chloride Concentration (PPM):			
57 <input checked="" type="checkbox"/> Drain						<input type="checkbox"/> H2S Concentration (PPM):			
58 <input checked="" type="checkbox"/> Vent						<input type="checkbox"/> Hazardous <input type="checkbox"/> Flammable <input type="checkbox"/> Other			
59 <input checked="" type="checkbox"/> Press. Gauge									
60 <input type="checkbox"/> Temp. Gauge									



ENGINEERS INDIA LIMITED
NEW DELHI

VHP BFW/ HP BFW (EXPORT)
CENTRIFUGAL MULTISTAGE PUMP
(Section:C-3.3)

DATA SHEET NO

A011-00-16-45-DS18

REV.

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					MATERIAL		
61					Material Class (API-610): C-6	MOC	ASTM Grades
62					Casing		
63	Press. Casing Conn. Contd.				Barrel		
64		No.	Size	Type	Inner Casing		
65	<input type="checkbox"/> Warm Up				Impeller (Suction)		
66	<input type="checkbox"/> Balance/Leak off				Impeller (Others)		
67	<input type="checkbox"/> Cylindrical Threads Required				Shaft Sleeve		
68	<input type="checkbox"/> Casing Mounting (See Separate Sheet for Vertical):				Interstage Sleeve		
69	<input checked="" type="checkbox"/> Centerline <input type="checkbox"/> Near Centerline <input type="checkbox"/> Foot				Casing Wearing Ring) H-BHN	
70	<input type="checkbox"/> Separate Mounting Plate <input type="checkbox"/> In-Line				Imp. Wearing Ring	=50 (min)	
71	<input checked="" type="checkbox"/> Casing Split <input type="checkbox"/> Axial <input type="checkbox"/> Radial				Shaft		AISI 410
72	<input type="checkbox"/> Casing Type:				Throat Bush		
73	<input type="checkbox"/> Single Volute <input type="checkbox"/> Multiple Volute <input type="checkbox"/> Diffuser				Throttle Bush		Carbon
74	<input checked="" type="checkbox"/> Between Bearings <input type="checkbox"/> Barrel				Diffuser		
75	<input type="checkbox"/> Case Pressure Rating:				Drive Shaft		
76	<input type="checkbox"/> MAWP (kg/cm ² G): @ EC				Intermediate Shaft		
77	<input type="checkbox"/> Hydrotest Pressure (kg/cm ² G):				Pump Shaft		
78	<input type="checkbox"/> Suction Press. Region must be Designed for MAWP				Bearing for Intermediate Shaft		
79	<input type="checkbox"/> Rotation (Viewed from Coupling End):				Column Pipe		
80	<input type="checkbox"/> CW <input type="checkbox"/> CCW						
81	<input checked="" type="checkbox"/> Impellers Individually Secured						
82	<input type="checkbox"/> SHAFT:						
83	<input type="checkbox"/> Shaft Dia. at Coupling Mm						
84	<input type="checkbox"/> Shaft Dia. Between Bearings Mm						
85	<input type="checkbox"/> Span Between Bearings Mm				Legends: I- Cast Iron, B- Bronze, S- Carbon Steel, C- 11-13% Chr. Stl.,		
86	<input type="checkbox"/> Span Between Brg. & Impeller Mm				h- Hardened, f- Faced, K- SS 304, L-SS 316		
87	Remark: Rotor dry, 1st wet critical & 2nd wet critical speeds				X		
88	at 100% & 200% clearance shall be indicated in the data				Y		
89	sheet.				Z		
90							
91	Couplings: Driver-Pump						
92	<input type="checkbox"/> Make:				Remarks:		
93	<input type="checkbox"/> Model:						
94	<input type="checkbox"/> Coupling Rating (kW/100 RPM):						
95	<input checked="" type="checkbox"/> Lubrication: None				1. Refer Design Spec enclosed elsewhere.		
96	<input type="checkbox"/> Limited End Float Required:						
97	<input type="checkbox"/> Spacer Length: mm						
98	<input checked="" type="checkbox"/> Service Factor: (Minimum 1.5)						
99	<input checked="" type="checkbox"/> Driver Half Coupling Mounted By:						
100	<input checked="" type="checkbox"/> Pump Mfr. <input type="checkbox"/> Driver Mfr. <input type="checkbox"/> Purchaser						
101	<input checked="" type="checkbox"/> Coupling Per API 671						
102	<input checked="" type="checkbox"/> Base Plate: Common for Pump and its driver						
103	<input type="checkbox"/> API Base Plate Number: <input type="checkbox"/> Non Grout Const.						
104	Remark:						
105							
106							
107	Bearings And Lubrication						
108	<input type="checkbox"/> Bearing Type Number:						
109	<input type="checkbox"/> Radial						
110	<input type="checkbox"/> Thrust						
111	<input type="checkbox"/> Review and Approve Thrust Bearing Size						
112	<input type="checkbox"/> Lubrication:						
113	<input type="checkbox"/> Grease <input type="checkbox"/> Flood <input type="checkbox"/> Ring Oil						
114	<input type="checkbox"/> Flinger <input type="checkbox"/> Purge Oil Mist <input type="checkbox"/> Pure Oil Mist						
115	<input type="checkbox"/> Constant Level Oilier Preference						
116	<input type="checkbox"/> Pressure Lub. System: <input type="checkbox"/> API 610 <input type="checkbox"/> API 614						
117	<input type="checkbox"/> Oil Viscosity ISO Grade						
118	<input type="checkbox"/> Oil Heater Required: <input type="checkbox"/> Electric <input type="checkbox"/> Steam						
119	<input type="checkbox"/> Oil Pressure to be greater than Coolant Press.						
120	Remarks:						



ENGINEERS INDIA LIMITED
NEW DELHI

VHP BFW/ HP BFW (EXPORT)
CENTRIFUGAL MULTISTAGE PUMP
(Section:C-3.3)

DATA SHEET NO

A011-00-16-45-DS18

REV.

0

121	MECHANICAL SEAL OR PACKING			Steam and Cooling Water Piping	
122	<input type="checkbox"/> Seal Data:		125	<input checked="" type="checkbox"/> Cooling Water Piping Plan K	
123	<input type="checkbox"/> See Attached API 682 Data Sheet		126	<input type="checkbox"/> Cooling Water Requirement (m ³ /hr):	
124	<input type="checkbox"/> Non API 682 Seal		127	Seal Jacket/Brg Hsg @ kg/cm ²	
125	<input checked="" type="checkbox"/> API Seal Code		128	Seal Heat Exchanger @ kg/cm ²	
126	<input type="checkbox"/> Seal Manufacturer		129	Quench @ kg/cm ²	
127	<input type="checkbox"/> Size and Type		130	<input type="checkbox"/> Total Cooling Water (m ³ /hr):	
128	<input type="checkbox"/> Manufacturer Code:		131	<input type="checkbox"/> Steam Piping:	
129	Seal Chamber Data		132	<input type="checkbox"/> Tubing <input type="checkbox"/> Piping	
130	<input type="checkbox"/> Temperature (EC):		133	Remark:	
131	<input type="checkbox"/> Pressure (kg/cm ² G):		134		
132	<input type="checkbox"/> Flow (m ³ /hr):		135		
133	<input type="checkbox"/> Seal Chamber Size:		136		
134	<input type="checkbox"/> Total Length (mm) <input type="checkbox"/> Clear Length (mm)		137		
135	Seal Construction:		138	Instrumentation	
136	<input checked="" type="checkbox"/> Sleeve Material: SS		139	<input checked="" type="checkbox"/> Vibration	
137	<input checked="" type="checkbox"/> Gland Material: SS		140	<input type="checkbox"/> Non Contacting (API 670) <input type="checkbox"/> Transducer	
138	<input checked="" type="checkbox"/> Aux. Seal Device: Floating Throttle Bush		141	<input type="checkbox"/> Provision for mounting only	
139	<input type="checkbox"/> Jacket Required: <input type="checkbox"/> Yes <input type="checkbox"/> No.		142	<input type="checkbox"/> Flat surface required	
140	<input checked="" type="checkbox"/> Gland Taps:		143	<input type="checkbox"/> See attached API 670 Data Sheet	
141	<input checked="" type="checkbox"/> Flush (F) <input checked="" type="checkbox"/> Drain (D)		144	<input checked="" type="checkbox"/> Monitors and Cables	
142	<input type="checkbox"/> Barrier/Buffer (F) <input type="checkbox"/> Quench (Q)		145		
143	<input type="checkbox"/> Cooling (C) <input type="checkbox"/> Lubrication (G)		146		
144	<input type="checkbox"/> Heating (H) <input type="checkbox"/> Leakage		147	Seal Fluids Requirement and Available Flush Liquid:	
145	<input type="checkbox"/> Pumped Fluid (P) <input type="checkbox"/> Balance Fluid (E)		148	Note: If flush liquid is pumpage liquid (As in flush piping	
146	<input type="checkbox"/> External Fluid Injection (X)		149	Plan 11 to 41) following flush liquid data is not required.	
147	Seal Fluids Requirement and Available Flush Liquid:		150	<input type="checkbox"/> Supply Temperature (EC)	
148	Note: If flush liquid is pumpage liquid (As in flush piping		151	Temperature and Pressure:	
149	Plan 11 to 41) following flush liquid data is not required.		152	<input checked="" type="checkbox"/> Radial Brg. Metal Temp. <input checked="" type="checkbox"/> Thrust Brg. Metal Temp.	
150	<input type="checkbox"/> Supply Temperature (EC)		153	<input type="checkbox"/> Provision for Instruments only	
151	Max. Min.		154	<input type="checkbox"/> See attached API 670 Data Sheet	
152	<input type="checkbox"/> Relative Density (Sp. Gr.) @ EC		155	<input type="checkbox"/> Temp. Gauge (With Thermowell).	
153	<input type="checkbox"/> Name of Liquid		156	Other	
154	<input type="checkbox"/> Specific Heat, cP (kJ/kgEC):		157	<input type="checkbox"/> Pressure Gauge Type	
155	<input type="checkbox"/> Vapour Press.(kg/cm ² A): @ EC		158	<input type="checkbox"/> Location	
156	<input type="checkbox"/> Hazardous <input type="checkbox"/> Flammable <input type="checkbox"/> Other		159	Remark: Temp monitor shall be as Bentley Nevada 3500 series	
157	<input type="checkbox"/> Flow Rate (m ³ /hr): Max. Min.		160	or equivalent and shall confirm to API 670.	
158	<input type="checkbox"/> Press. Regd. (kg/cm ² G): Max. Min.		161	Motor Driver: See Electrical Specification	
159	<input type="checkbox"/> Temp. Required (EC): Max. Min.		162	<input type="checkbox"/> Surface Penetration and Paint:	
160	Barrier/Buffer Fluid:		163	<input type="checkbox"/> Manufacturer's Standard	
161	<input type="checkbox"/> Supply Temp: Max. Min.		164	<input type="checkbox"/> Other (See below)	
162	<input type="checkbox"/> Relative Density (Sp Gg.) @ EC		165	Pump	
163	<input type="checkbox"/> Name of Fluid:		166	<input checked="" type="checkbox"/> Pump surface penetration:	
164	<input type="checkbox"/> Vapour Pressure (kg/cm ² A): @ EC		167	<input checked="" type="checkbox"/> Primer	
165	<input type="checkbox"/> Hazardous <input type="checkbox"/> Flammable <input type="checkbox"/> Other		168	<input checked="" type="checkbox"/> Finish Coat	
166	<input type="checkbox"/> Flow Rate(m ³ /hr): Max. Min.		169	Base Plate	
167	<input type="checkbox"/> Pressure Required (kg/cm ² G): Max. Min.		170	<input checked="" type="checkbox"/> Base Plate Surface Preparation	
168	<input type="checkbox"/> Temp. Required (EC): Max. Min.		171	<input checked="" type="checkbox"/> Primer	
169	Quench Fluid:		172	<input checked="" type="checkbox"/> Finish Coat	
170	<input type="checkbox"/> Name of Liquid:		173	Seal Flush Piping:	
171	<input type="checkbox"/> Flow Rate (m ³ /hr):		174	<input checked="" type="checkbox"/> Seal Flush Piping Plan: 23, 61	
172	Seal Flush Piping:		175	<input type="checkbox"/> Domestic <input checked="" type="checkbox"/> Export <input checked="" type="checkbox"/> Export Boxing Required	
173	<input checked="" type="checkbox"/> Seal Flush Piping Plan: 23, 61		176	<input checked="" type="checkbox"/> Out Door Storage more than 6 months	
174	<input type="checkbox"/> Tubing <input type="checkbox"/> Carbon Steel		177	Spare Rotor Assembly Packaged for:	
175	<input checked="" type="checkbox"/> Pipe <input checked="" type="checkbox"/> Stainless Steel		178	<input type="checkbox"/> Horizontal Storage <input checked="" type="checkbox"/> Vertical Storage	
176	<input type="checkbox"/> Aux. Flush Plan:		179	<input type="checkbox"/> Type of Shipping Preparation	
177	<input type="checkbox"/> Tubing <input type="checkbox"/> Carbon Steel		180	Remark:	
178	<input type="checkbox"/> Pipe <input type="checkbox"/> Stainless Steel				
179					
180					



ENGINEERS INDIA LIMITED
NEW DELHI

VHP BFW/ HP BFW (EXPORT)
CENTRIFUGAL MULTISTAGE PUMP
(Section:C-3.3)

DATA SHEET NO

A011-00-16-45-DS18

REV.

0

181 Mechanical Seal OR Packing (Contd.)			
182 <input type="checkbox"/> Piping Assembly:		<input type="checkbox"/> Weights	
183 <input type="checkbox"/> Threaded	<input type="checkbox"/> Unions	<input type="checkbox"/> Socket Welded	
184 <input type="checkbox"/> Flanged	<input type="checkbox"/> Tube Type Fitting		<input type="checkbox"/> Motor Driven:
185 <input type="checkbox"/> Pressure Switch (Plan 52/53) Type			<input type="checkbox"/> Weight of Pump (kg):
186 <input type="checkbox"/> Pressure Gauge (Plan 52/53)			<input type="checkbox"/> Weight of Base Plate (kg):
187 <input type="checkbox"/> Level Switch (Plan 52/53) Type			<input type="checkbox"/> Weight of Motor (kg):
188 <input type="checkbox"/> Level Gauge (Plan 52/53)			<input type="checkbox"/> Weight of Gear (kg):
189 <input type="checkbox"/> Temp. Indicator (Plan 21,22,23,32,41)			<input type="checkbox"/> Total Weight (kg):
190 <input type="checkbox"/> Heat Exchanger (Plan 52/53)			<input type="checkbox"/> Turbine Driven
191 Remark:			<input type="checkbox"/> Weight of Baseplate (kg):
192			<input type="checkbox"/> Weight of Turbine (kg):
193 <input type="checkbox"/> Packing Data:			<input type="checkbox"/> Weight of Gear (kg):
194 <input type="checkbox"/> Manufacturer:			<input type="checkbox"/> Total Weight (kg):
195 <input type="checkbox"/> Type:			Remark:
196 <input type="checkbox"/> Size	<input type="checkbox"/> No. of Rings		
197 <input type="checkbox"/> Packing Injection Required:			
198 <input type="checkbox"/> Flow (m ³ /hr):	@	EC	Other Purchase Requirement
199 <input type="checkbox"/> Lantern Ring:			<input type="checkbox"/> Coordination Meeting Required
200			<input type="checkbox"/> Review Foundation Drawings
201 INSPECTION AND TEST			<input type="checkbox"/> Review Piping Drawings
202 <input checked="" type="checkbox"/> Review Vendor's QA Programme			<input type="checkbox"/> Observe Piping Check
203 <input checked="" type="checkbox"/> Performance Curve Approval			<input checked="" type="checkbox"/> Observe Initial Alignment Check
204 <input checked="" type="checkbox"/> Shop Inspection			<input checked="" type="checkbox"/> Check Alignment at Operating Temp.
205 <input type="checkbox"/> Test With Substitute Seal			<input type="checkbox"/> Connection Design Approval
206	TESTS	WITNESS	<input checked="" type="checkbox"/> Hydrodynamic Thrust Bearing Size Review Required
207 <input checked="" type="checkbox"/> Hydrostatic	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Lateral Analysis Requd.
208 <input checked="" type="checkbox"/> Performance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Rotor Dynamic Balance
209 <input checked="" type="checkbox"/> NPSH (if reqd)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Mount Seal Reservoir off Base Plate
210 <input checked="" type="checkbox"/> Complete Unit Test	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Installation List in Proposal
211 <input checked="" type="checkbox"/> Sound Level Test	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Spare Rotor Vertical Storage
212 <input type="checkbox"/> Cleanliness prior to Final Assembly	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Torsional Analysis/Report
213 <input type="checkbox"/> Nozzle Load Test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Progress Report Requd.
214 <input type="checkbox"/> Brg. Hsg. Resonance Test	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Driver suitable for Pump starting with open Disc.
215 <input checked="" type="checkbox"/> Remove/Insp. Hyd.dyn. Brgs After Test:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Valve condition.
216 <input type="checkbox"/> Auxiliary Equipment Test	<input type="checkbox"/>	<input type="checkbox"/>	Remark:
217 <input type="checkbox"/> Thrust Bearing Load Verification	<input type="checkbox"/>	<input type="checkbox"/>	GENERAL REMARKS
218 <input type="checkbox"/>			2) Max. allowable Casing Working Pressure shall not be less than ____ kg/cm ² G @ ____ EC.
219 <input checked="" type="checkbox"/> Material Certificates Required			3) Down stream Design Pressure is ____ kg/cm ² G.
220 <input checked="" type="checkbox"/> Casing	<input checked="" type="checkbox"/> Impeller		4) Unitization of Pump, Gear (If Reqd.) and Driver shall be done in Pump manufacturer's shop.
221 <input checked="" type="checkbox"/> Shaft	<input type="checkbox"/> Other		5) Each pump shall be provided with Auto Re-Circulation (ARC) valve.
222 <input checked="" type="checkbox"/> Casing Repair Procedure Approval Requd.			The ARC valve body material shall Carbon Steel with Chrome steel
223 <input checked="" type="checkbox"/> Inspection Required for Connection Welds			Internals. The ARC valve shall be installed as close to the pump as
224 <input type="checkbox"/> MAG Practice	<input type="checkbox"/> Liquid Penetrant		Possible preferable on pump outlet and in a vertical position. The
225 <input checked="" type="checkbox"/> Radiographic	<input checked="" type="checkbox"/> Ultrasonic		Distance between valve inlet and pump outlet should not exceed
226 <input checked="" type="checkbox"/> Inspection Required for Casting			1.5m to prevent low frequency pulsations caused by the elasticity
227 <input checked="" type="checkbox"/> MAG Practice	<input type="checkbox"/> Liquid Penetrant		of fluid. Necessary certificates from statutory body namely IBR shall
228 <input type="checkbox"/> Radiographic	<input type="checkbox"/> Ultrasonic		Be arranged. Make of ARC valve shall be one from - Yarway Corp.,
229 <input type="checkbox"/> Additional Inspection Required for:			Schroedahl International BV, Hora valves BV, HBE Engg Inc.
230 <input type="checkbox"/> MAG Practice	<input type="checkbox"/> Liquid Penetrant		
231 <input type="checkbox"/> Radiographic	<input type="checkbox"/> Ultrasonic		
232 <input type="checkbox"/> Alternate Acceptance Criteria (See Remarks):			6) Driver Motor winding temperature monitoring shall be provided
233 <input type="checkbox"/> Hardness Test Required for			As BN 3500.
234 <input type="checkbox"/> Wetting Agent Hydrotest			
235 <input checked="" type="checkbox"/> Vendor Submit Test Procedures			
236 <input checked="" type="checkbox"/> Record Final Assembly Running clearances			
237 <input type="checkbox"/> Inspection Check List			

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ENGINEERS INDIA LIMITED
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VHP BFW/ HP BFW (EXPORT)
CENTRIFUGAL MULTISTAGE PUMP
(Section:C-3.3)

DATA SHEET NO

A011-00-16-45-DS18

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GENERAL									
1 Project: CPP-Paradip Refinery Project					Job No.: A011				
2 Owner: M/S IOCL					Site: Orissa, India				
3 Purchaser:					Unit: CPP Unit No.: 00				
4 Item No.:					Service: MP BFW (EXPORT) PUMPS				
5 No. Required:		Working:		Standby:		Driver Type: Working:		Standby:	
7 Applicable to <input checked="" type="checkbox"/> Proposals					<input type="checkbox"/> Purchase <input type="checkbox"/> As Built				
8 <input checked="" type="checkbox"/> Scope Option & Information Specified By Purchaser <input type="checkbox"/> Information required from and options left to vendor. Vendor to cross : the selected option									
9 Manufacturer:					Model:				
10 Driver supplied & mounted by: <input checked="" type="checkbox"/> Pump Manufacturer <input type="checkbox"/> Other									
11 Gear (If reqd.) supplied & mounted by: <input checked="" type="checkbox"/> Pump Manufacturer <input type="checkbox"/> Other									
12 Applicable Code & Standards: API 610 8 th edition along with Eng. Design Basis, EIL Standard Specification 6-41-0005, Process package									
13									
OPERATING CONDITIONDS					SITE AND UTILITY DATA (Refer BEDB/ Bid Pkg)				
15 <input type="checkbox"/> Capacity (m ³ /hr)					Location: <input type="checkbox"/> Indoor <input type="checkbox"/> Heated <input type="checkbox"/> Underroof				
16 Nor.: Rated: Other:					<input checked="" type="checkbox"/> Outdoor <input type="checkbox"/> Unheated <input type="checkbox"/> Grade <input type="checkbox"/> Partial Side				
17 <input type="checkbox"/> Suct. Pressure (kg/cm ² G) [Max./Rated]:					<input type="checkbox"/> Mezzanine <input type="checkbox"/> Other:				
18 <input type="checkbox"/> Discharge Pressure (kg/cm ² G):					<input type="checkbox"/> Electrical Area Classification				
19 <input type="checkbox"/> Differential Pressure (kg/cm ²):					Class Group Division				
20 <input type="checkbox"/> Differential Head (m) NPSHA (m)					<input type="checkbox"/> Winterisation Required <input checked="" type="checkbox"/> Tropicalisation Required				
21 <input type="checkbox"/> Process Variations					<input type="checkbox"/> Site Data:				
22 <input type="checkbox"/> Starting Conditions					<input type="checkbox"/> Altitude (m): <input type="checkbox"/> Barometer (kg/cm ² G):				
23 <input type="checkbox"/> Service: <input type="checkbox"/> Continuous <input type="checkbox"/> Intermittent (Start/Day)					<input type="checkbox"/> Range of Amb. Temp. (EC): Min./Max.				
24 <input type="checkbox"/> Parallel Operation Required <input type="checkbox"/> Yes <input type="checkbox"/> No					<input type="checkbox"/> Relative Humidity (%): Min./Max.				
PERFORMANCE					<input type="checkbox"/> Unusual Conditions:				
26 Proposal Curve No.					<input checked="" type="checkbox"/> Dust <input checked="" type="checkbox"/> Fumes <input checked="" type="checkbox"/> Refinery atm				
27 Visc. Correction Factor C _n / C _Q / C _H :					<input type="checkbox"/> Utility Conditions:				
28 <input type="checkbox"/> NPSH Reqd. (m) F/L Speed (rpm):					<input type="checkbox"/> Steam: Driver Heating				
29 <input type="checkbox"/> No. of Stages: Efficiency (%):					<input type="checkbox"/> Press. @ EC @ EC				
30 <input type="checkbox"/> Rated BKW (+/- 0% Tol.):					<input type="checkbox"/> Press. @ EC @ EC				
31 <input type="checkbox"/> Max. BKW Rtd. Implr. (kW):									
32 <input type="checkbox"/> BKW @ MCF (D=1) (kW):									
33 <input type="checkbox"/> Recom. Driver Rating (kW):					<input type="checkbox"/> Electricity: Drivers Heating Control Shutdown				
34 <input type="checkbox"/> Max. Head @ Rated Impeller (m):					<input type="checkbox"/> Voltage				
35 <input type="checkbox"/> Capacity @ BEP (m ³ /hr):					<input type="checkbox"/> Hertz				
36 <input type="checkbox"/> Min. Cont. Flow (m ³ /hr): Stable: Thermal:					<input type="checkbox"/> Phase				
37 <input type="checkbox"/> Preferred Operating Region (m ³ /hr): To					<input type="checkbox"/> Cooling Water:				
38 <input type="checkbox"/> Allowable Operating Region (m ³ /hr): To					<input type="checkbox"/> Temp. Inlet (EC): Max. Return (EC):				
39 <input type="checkbox"/> Suction Specific Speed:					<input type="checkbox"/> Pressure: Nor. (kg/cm ² G) Design (kg/cm ² G):				
40 <input checked="" type="checkbox"/> Max. Sound Pressure Level Allowable (dBA): 85 dBA @ 1m					<input type="checkbox"/> Return: Min. (kg/cm ² G) Max. Allow.) P(kg/cm ² G):				
41 <input type="checkbox"/> Expected Sound Pressure Level (dBA):					<input type="checkbox"/> Water Source:				
42					<input type="checkbox"/> Chloride Concentration (PPM):				
CONSTRUCTION					<input type="checkbox"/> Instrument Air Pressure (kg/cm ² G):				
44 <input type="checkbox"/> PUMP TYPE:					Max. Min.				
45 <input type="checkbox"/> BB Axially Split, Multistage					LIQUID (Refer Bid Package)				
46 <input type="checkbox"/> BB Radially Split, Multistage: <input type="checkbox"/> Single Casing <input type="checkbox"/> Double Casing					<input checked="" type="checkbox"/> Type/Name of Liquid: Boiler Feed Water				
47 <input type="checkbox"/> Vert. Suspended Double Casing: <input type="checkbox"/> Diffuser <input type="checkbox"/> Volute					<input type="checkbox"/> Pumping Temperature (EC):				
48 Nozzle Connections:					Normal Max. Min.				
49		Size	Rating	Facing	Position	<input type="checkbox"/> Vapour Pressure (kg/cm ² A): @ EC			
50 Suction						<input type="checkbox"/> Relative Density (Specific Gravity):			
51 Discharge						Normal Max. Min.			
52 Balance Drum						<input type="checkbox"/> Specific Heat (Cp) kJ/kgEC			
53 <input type="checkbox"/> Impeller Diameter (mm):					<input type="checkbox"/> Viscosity (cP/cst) @PT @ EC				
54 Rated:		Max.		Min.		- <input type="checkbox"/> Max. @ EC			
55 <input type="checkbox"/> Pressure Casing Connections:					<input type="checkbox"/> Corrosive/Erosive Agent:				
56		No.	Size	Type		<input type="checkbox"/> Chloride Concentration (PPM):			
57 <input checked="" type="checkbox"/> Drain						<input type="checkbox"/> H2S Concentration (PPM):			
58 <input checked="" type="checkbox"/> Vent						<input type="checkbox"/> Hazardous <input type="checkbox"/> Flammable <input type="checkbox"/> Other			
59 <input checked="" type="checkbox"/> Press. Gauge									
60 <input type="checkbox"/> Temp. Gauge									



ENGINEERS INDIA LIMITED
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**MP BFW (EXPORT)
CENTRIFUGAL PUMP**

(Section:C-3.3)

DATA SHEET NO

A011-00-16-45-DS21

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					MATERIAL		
61					Material Class (API-610): C-6	MOC	ASTM Grades
62					Casing		
63	Press. Casing Conn. Contd.				Barrel		
64		No.	Size	Type	Inner Casing		
65	<input type="checkbox"/> Warm Up				Impeller (Suction)		
66	<input type="checkbox"/> Balance/Leak off				Impeller (Others)		
67	<input type="checkbox"/> Cylindrical Threads Required				Shaft Sleeve		
68	<input type="checkbox"/> Casing Mounting (See Seperate Sheet for Vertical):				Interstage Sleeve		
69	<input checked="" type="checkbox"/> Centerline <input type="checkbox"/> Near Centerline <input type="checkbox"/> Foot				Casing Wearing Ring) H-BHN	
70	<input type="checkbox"/> Seperate Mounting Plate <input type="checkbox"/> In-Line				Imp. Wearing Ring	=50 (min)	
71	<input checked="" type="checkbox"/> Casing Split <input type="checkbox"/> Axial <input type="checkbox"/> Radial				Shaft		AISI 410
72	<input type="checkbox"/> Casing Type:				Throat Bush		
73	<input type="checkbox"/> Single Volute <input type="checkbox"/> Multiple Volute <input type="checkbox"/> Diffuser				Throttle Bush		Carbon
74	<input checked="" type="checkbox"/> Between Bearings <input type="checkbox"/> Barrel				Diffuser		
75	<input type="checkbox"/> Case Pressure Rating:				Drive Shaft		
76	<input type="checkbox"/> MAWP (kg/cm ² G): @ EC				Intermediate Shaft		
77	<input type="checkbox"/> Hydrotest Pressure (kg/cm ² G):				Pump Shaft		
78	<input type="checkbox"/> Suction Press. Region must be Designed for MAWP				Bearing for Intermediate Shaft		
79	<input type="checkbox"/> Rotation (Viewed from Coupling End):				Column Pipe		
80	<input type="checkbox"/> CW <input type="checkbox"/> CCW						
81	<input checked="" type="checkbox"/> Impellers Individually Secured						
82	<input type="checkbox"/> SHAFT:						
83	<input type="checkbox"/> Shaft Dia. at Coupling Mm						
84	<input type="checkbox"/> Shaft Dia. Between Bearings Mm						
85	<input type="checkbox"/> Span Between Bearings Mm				Legends: I- Cast Iron, B- Bronze, S- Carbon Steel, C- 11-13% Chr. Stl.,		
86	<input type="checkbox"/> Span Between Brg. & Impeller Mm				h- Hardened, f- Faced, K- SS 304, L-SS 316		
87	Remark: Rotor dry, 1st wet critical & 2nd wet critical speeds				X		
88	at 100% & 200% clearance shall be indicated in the data				Y		
89	sheet.				Z		
90							
91	Couplings: Driver-Pump						
92	<input type="checkbox"/> Make:				Remarks:		
93	<input type="checkbox"/> Model:						
94	<input type="checkbox"/> Coupling Rating (kW/100 RPM):						
95	<input checked="" type="checkbox"/> Lubrication: None				1. Refer Design Spec enclosed elsewhere.		
96	<input type="checkbox"/> Limited End Float Required:						
97	<input type="checkbox"/> Spacer Length: Mm						
98	<input checked="" type="checkbox"/> Service Factor: (Minimum 1.5)						
99	<input checked="" type="checkbox"/> Driver Half Coupling Mounted By:						
100	<input checked="" type="checkbox"/> Pump Mfr. <input type="checkbox"/> Driver Mfr. <input type="checkbox"/> Purchaser						
101	<input type="checkbox"/> Coupling Per API 671						
102	<input checked="" type="checkbox"/> Base Plate: Common for Pump and its driver						
103	<input type="checkbox"/> API Base Plate Number: <input type="checkbox"/> Non Grout Const.						
104	Remark:						
105							
106							
107	Bearings And Lubrication						
108	<input type="checkbox"/> Bearing Type Number:						
109	<input type="checkbox"/> Radial						
110	<input type="checkbox"/> Thrust						
111	<input type="checkbox"/> Review and Approve Thrust Bearing Size						
112	<input type="checkbox"/> Lubrication:						
113	<input type="checkbox"/> Grease <input type="checkbox"/> Flood <input type="checkbox"/> Ring Oil						
114	<input type="checkbox"/> Flinger <input type="checkbox"/> Purge Oil Mist <input type="checkbox"/> Pure Oil Mist						
115	<input type="checkbox"/> Constant Level Oilier Preference						
116	<input type="checkbox"/> Pressure Lub. System: <input type="checkbox"/> API 610 <input type="checkbox"/> API 614						
117	<input type="checkbox"/> Oil Viscosity ISO Grade						
118	<input type="checkbox"/> Oil Heater Required: <input type="checkbox"/> Electric <input type="checkbox"/> Steam						
119	<input type="checkbox"/> Oil Pressure to be greater than Coolant Press.						
120	Remarks:						



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MP BFW (EXPORT)
CENTRIFUGAL PUMP

(Section:C-3.3)

DATA SHEET NO

A011-00-16-45-DS21

REV.

0

121	MECHANICAL SEAL OR PACKING	Steam and Cooling Water Piping
122	<input type="checkbox"/> Seal Data:	<input checked="" type="checkbox"/> Cooling Water Piping Plan K
123	<input type="checkbox"/> See Attached API 682 Data Sheet	<input type="checkbox"/> Cooling Water Requirement (m ³ /hr):
124	<input type="checkbox"/> Non API 682 Seal	Seal Jacket/Brg Hsg @ kg/cm ²
125	<input checked="" type="checkbox"/> API Seal Code	Seal Heat Exchanger @ kg/cm ²
126	<input type="checkbox"/> Seal Manufacturer	Quench @ kg/cm ²
127	<input type="checkbox"/> Size and Type	<input type="checkbox"/> Total Cooling Water (m ³ /hr):
128	<input type="checkbox"/> Manufacturer Code:	<input type="checkbox"/> Steam Piping:
129	Seal Chamber Data	<input type="checkbox"/> Tubing <input type="checkbox"/> Piping
130	<input type="checkbox"/> Temperature (EC):	Remark:
131	<input type="checkbox"/> Pressure (kg/cm ² G):	
132	<input type="checkbox"/> Flow (m ³ /hr):	
133	<input type="checkbox"/> Seal Chamber Size:	
134	<input type="checkbox"/> Total Length (mm) <input type="checkbox"/> Clear Length (mm)	
135	Seal Construction:	
136	<input checked="" type="checkbox"/> Sleeve Material: SS	Instrumentation
137	<input checked="" type="checkbox"/> Gland Material: SS	<input checked="" type="checkbox"/> Vibration
138	<input checked="" type="checkbox"/> Aux. Seal Device: Floating Throttle Bush	<input type="checkbox"/> Non Contacting (API 670) <input type="checkbox"/> Transducer
139	<input type="checkbox"/> Jacket Required: <input type="checkbox"/> Yes <input type="checkbox"/> No.	<input type="checkbox"/> Provision for mounting only
140	<input checked="" type="checkbox"/> Gland Taps:	<input type="checkbox"/> Flat surface required
141	<input checked="" type="checkbox"/> Flush (F) <input checked="" type="checkbox"/> Drain (D)	<input type="checkbox"/> See attached API 670 Data Sheet
142	<input type="checkbox"/> Barrier/Buffer (F) <input type="checkbox"/> Quench (Q)	<input checked="" type="checkbox"/> Monitors and Cables
143	<input type="checkbox"/> Cooling (C) <input type="checkbox"/> Lubrication (G)	
144	<input type="checkbox"/> Heating (H) <input type="checkbox"/> Leakage	Remark: Vibration monitor shall be as Bentley Nevada 3500 series or equivalent and shall confirm to API 670.
145	<input type="checkbox"/> Pumped Fluid (P) <input type="checkbox"/> Balance Fluid (E)	
146	<input type="checkbox"/> External Fluid Injection (X)	
147	Seal Fluids Requirement and Available Flush Liquid:	
148	Note: If flush liquid is pumpage liquid (As in flush piping	
149	Plan 11 to 41) following flush liquid data is not required.	
150	<input type="checkbox"/> Supply Temperature (EC)	Temperature and Pressure:
151	Max. Min.	<input checked="" type="checkbox"/> Radial Brg. Metal Temp. <input checked="" type="checkbox"/> Thrust Brg. Metal Temp.
152	<input type="checkbox"/> Relative Density (Sp. Gr.) @ EC	<input type="checkbox"/> Provision for Instruments only
153	<input type="checkbox"/> Name of Liquid	<input type="checkbox"/> See attached API 670 Data Sheet
154	<input type="checkbox"/> Specific Heat, cP (kJ/kgEC):	<input type="checkbox"/> Temp. Gauge (With Thermowell).
155	<input type="checkbox"/> Vapour Press.(kg/cm ² A): @ EC	Other
156	<input type="checkbox"/> Hazardous <input type="checkbox"/> Flammable <input type="checkbox"/> Other	<input type="checkbox"/> Pressure Gauge Type
157	<input type="checkbox"/> Flow Rate (m ³ /hr): Max. Min.	<input type="checkbox"/> Location
158	<input type="checkbox"/> Press. Req'd. (kg/cm ² G): Max. Min.	Remark: Temp monitor shall be as Bentley Nevada 3500 series or equivalent and shall confirm to API 670.
159	<input type="checkbox"/> Temp. Required (EC): Max. Min.	Motor Driver: See Electrical Specification
160	Barrier/Buffer Fluid:	<input type="checkbox"/> Surface Penetration and Paint:
161	<input type="checkbox"/> Supply Temp: Max. Min.	<input type="checkbox"/> Manufacturer's Standard
162	<input type="checkbox"/> Relative Density (Sp Gg.) @ EC	<input type="checkbox"/> Other (See below)
163	<input type="checkbox"/> Name of Fluid:	Pump
164	<input type="checkbox"/> Vapour Pressure (kg/cm ² A): @ EC	<input checked="" type="checkbox"/> Pump surface penetration:
165	<input type="checkbox"/> Hazardous <input type="checkbox"/> Flammable <input type="checkbox"/> Other	<input checked="" type="checkbox"/> Primer
166	<input type="checkbox"/> Flow Rate(m ³ /hr): Max. Min.	<input checked="" type="checkbox"/> Finish Coat
167	<input type="checkbox"/> Pressure Required (kg/cm ² G): Max. Min.	Base Plate
168	<input type="checkbox"/> Temp. Required (EC): Max. Min.	<input checked="" type="checkbox"/> Base Plate Surface Preparation
169	Quench Fluid:	<input checked="" type="checkbox"/> Primer
170	<input type="checkbox"/> Name of Liquid:	<input checked="" type="checkbox"/> Finish Coat
171	<input type="checkbox"/> Flow Rate (m ³ /hr):	<input checked="" type="checkbox"/> Shipment
172	Seal Flush Piping:	<input type="checkbox"/> Domestic <input checked="" type="checkbox"/> Export <input checked="" type="checkbox"/> Export Boxing Required
173	<input checked="" type="checkbox"/> Seal Flush Piping Plan: 23, 61	<input checked="" type="checkbox"/> Out Door Storage more than 6 months
174	<input type="checkbox"/> Tubing <input type="checkbox"/> Carbon Steel	<input checked="" type="checkbox"/> Spare Rotor Assembly Packaged for:
175	<input checked="" type="checkbox"/> Pipe <input checked="" type="checkbox"/> Stainless Steel	<input type="checkbox"/> Horizontal Storage <input checked="" type="checkbox"/> Vertical Storage
176	<input type="checkbox"/> Aux. Flush Plan:	<input type="checkbox"/> Type of Shipping Preparation
177	<input type="checkbox"/> Tubing <input type="checkbox"/> Carbon Steel	Remark:
178	<input type="checkbox"/> Pipe <input type="checkbox"/> Stainless Steel	
179		
180		



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MP BFW (EXPORT)
CENTRIFUGAL PUMP

(Section:C-3.3)

DATA SHEET NO

A011-00-16-45-DS21

REV.

0

181 Mechanical Seal OR Packing (Contd.)			
182 <input type="checkbox"/> Piping Assembly:		<input type="checkbox"/> Weights	
183 <input type="checkbox"/> Threaded	<input type="checkbox"/> Unions	<input type="checkbox"/> Socket Welded	
184 <input type="checkbox"/> Flanged	<input type="checkbox"/> Tube Type Fitting		<input type="checkbox"/> Motor Driven:
185 <input type="checkbox"/> Pressure Switch (Plan 52/53) Type			<input type="checkbox"/> Weight of Pump (kg):
186 <input type="checkbox"/> Pressure Gauge (Plan 52/53)			<input type="checkbox"/> Weight of Base Plate (kg):
187 <input type="checkbox"/> Level Switch (Plan 52/53) Type			<input type="checkbox"/> Weight of Motor (kg):
188 <input type="checkbox"/> Level Gauge (Plan 52/53)			<input type="checkbox"/> Weight of Gear (kg):
189 <input type="checkbox"/> Temp. Indicator (Plan 21,22,23,32,41)			<input type="checkbox"/> Total Weight (kg):
190 <input type="checkbox"/> Heat Exchanger (Plan 52/53)			<input type="checkbox"/> Turbine Driven
191 Remark:			<input type="checkbox"/> Weight of Baseplate (kg):
192			<input type="checkbox"/> Weight of Turbine (kg):
193 <input type="checkbox"/> Packing Data:			<input type="checkbox"/> Weight of Gear (kg):
194 <input type="checkbox"/> Manufacturer:			<input type="checkbox"/> Total Weight (kg):
195 <input type="checkbox"/> Type:			Remark:
196 <input type="checkbox"/> Size	<input type="checkbox"/> No. of Rings		
197 <input type="checkbox"/> Packing Injection Required:			
198 <input type="checkbox"/> Flow (m ³ /hr):	@	EC	Other Purchase Requirement
199 <input type="checkbox"/> Lantern Ring:			<input type="checkbox"/> Coordination Meeting Required
200			<input type="checkbox"/> Review Foundation Drawings
201 INSPECTION AND TEST			<input type="checkbox"/> Review Piping Drawings
202 <input checked="" type="checkbox"/> Review Vendor's QA Programme			<input type="checkbox"/> Observe Piping Check
203 <input checked="" type="checkbox"/> Performance Curve Approval			<input checked="" type="checkbox"/> Observe Initial Alignment Check
204 <input checked="" type="checkbox"/> Shop Inspection			<input checked="" type="checkbox"/> Check Alignment at Operating Temp.
205 <input type="checkbox"/> Test With Substitute Seal			<input type="checkbox"/> Connection Design Approval
206	TESTS	WITNESS	<input type="checkbox"/> Hydrodynamic Thrust Bearing Size Review Required
207 <input checked="" type="checkbox"/> Hydrostatic	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Lateral Analysis Requd.
208 <input checked="" type="checkbox"/> Performance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Rotor Dynamic Balance
209 <input checked="" type="checkbox"/> NPSH (if reqd)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Mount Seal Reservoir off Base Plate
210 <input checked="" type="checkbox"/> Complete Unit Test	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Installation List in Proposal
211 <input checked="" type="checkbox"/> Sound Level Test	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Spare Rotor Vertical Storage
212 <input type="checkbox"/> Cleanliness prior to Final Assembly	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Torsional Analysis/Report
213 <input type="checkbox"/> Nozzle Load Test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Progress Report Requd.
214 <input type="checkbox"/> Brg. Hsg. Resonance Test	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Driver suitable for Pump starting with open Disc.
215 <input checked="" type="checkbox"/> Remove/Insp. Hyd.dyn. Brgs After Test:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Valve condition.
216 <input type="checkbox"/> Auxiliary Equipment Test	<input type="checkbox"/>	<input type="checkbox"/>	Remark:
217 <input type="checkbox"/> Thrust Bearing Load Verification	<input type="checkbox"/>	<input type="checkbox"/>	GENERAL REMARKS
218 <input type="checkbox"/>			2) Max. allowable Casing Working Pressure shall not be less than ____ kg/cm ² G @ ____ EC.
219 <input checked="" type="checkbox"/> Material Certificates Required			3) Down stream Design Pressure is ____ kg/cm ² G.
220 <input checked="" type="checkbox"/> Casing	<input checked="" type="checkbox"/> Impeller		4) Unitization of Pump, Gear (If Reqd.) and Driver shall be done in Pump manufacturer's shop.
221 <input checked="" type="checkbox"/> Shaft	<input type="checkbox"/> Other		5) Each pump shall be provided with Auto Re-Circulation (ARC) valve.
222 <input checked="" type="checkbox"/> Casing Repair Procedure Approval Reqd.			The ARC valve body material shall Carbon Steel with Chrome steel Internals. The ARC valve shall be installed as close to the pump as Possible preferable on pump outlet and in a vertical position. The Distance between valve inlet and pump outlet should not exceed 1.5m to prevent low frequency pulsations caused by the elasticity of fluid. Necessary certificates from statutory body namely IBR shall Be arranged. Make of ARC valve shall be one from - Yarway Corp., Schroedahl International BV, Hora valves BV, HBE Engg Inc.
223 <input checked="" type="checkbox"/> Inspection Required for Connection Welds			
224 <input type="checkbox"/> MAG Practice	<input type="checkbox"/> Liquid Penetrant		
225 <input checked="" type="checkbox"/> Radiographic	<input checked="" type="checkbox"/> Ultrasonic		
226 <input checked="" type="checkbox"/> Inspection Required for Casting			
227 <input checked="" type="checkbox"/> MAG Practice	<input type="checkbox"/> Liquid Penetrant		
228 <input type="checkbox"/> Radiographic	<input type="checkbox"/> Ultrasonic		
229 <input type="checkbox"/> Additional Inspection Required for:			
230 <input type="checkbox"/> MAG Practice	<input type="checkbox"/> Liquid Penetrant		
231 <input type="checkbox"/> Radiographic	<input type="checkbox"/> Ultrasonic		
232 <input type="checkbox"/> Alternate Acceptance Criteria (See Remarks):			6) Driver Motor winding temperature monitoring shall be provided As BN 3500.
233 <input type="checkbox"/> Hardness Test Required for			
234 <input type="checkbox"/> Wetting Agent Hydrotest			
235 <input checked="" type="checkbox"/> Vendor Submit Test Procedures			
236 <input checked="" type="checkbox"/> Record Final Assembly Running clearances			
237 <input type="checkbox"/> Inspection Check List			

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DATE	REV	JOB ENGINEER	REV. & APPROVED BY



ENGINEERS INDIA LIMITED
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**MP BFW (EXPORT)
CENTRIFUGAL PUMP**

(Section:C-3.3)

DATA SHEET NO

A011-00-16-45-DS21

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GENERAL										
1										
2	Project: CPP-Paradip Refinery Project					Job No.: A011				
3	Owner: M/s IOCL					Site: Orissa, India				
4	Purchaser:					Unit: CPP		Unit No: 00		
5	Item No.:					Service:				
6	No. Reqd.:		Working		Standby		Parallel Operation Required:		<input type="checkbox"/> Yes <input type="checkbox"/> No	
7	Applicable to <input checked="" type="checkbox"/> Proposal <input type="checkbox"/> Purchase					<input type="checkbox"/> As Built				
8	<input checked="" type="checkbox"/> Scope option & Information specified by purchaser <input type="checkbox"/> Information Reqd. from & option left to vendor. Vendor to cross <input checked="" type="checkbox"/> the selected option.									
9	Driver: Working		Standby		Driver Supplied & Mounted By: <input checked="" type="checkbox"/> Pump Mfr. <input type="checkbox"/> Other					
OPERATING CONDITIONS										
11	Liquid Handled					Capacity (m ³ /hr): Min/Nor/Rated:				
12	Pumping Temp. (°C):		Normal		Max.		Discharge Pressure (kg/cm ² ,A):			
13	Specific Gravity at P.T./15°C:					Suction Pressure: Nor./ Max. (kg/cm ² ,A):				
14	Vapour Pressure at P.T. (kg/cm ² ,A):					Diff. Pressure (kg/cm ²) @ Rated Capacity:				
15	Viscosity at P.T. (cP/cst):		Corr./Eros. By:			Diff. Head (m) @ Rated Capacity:				
16	Solids in suspension		<input type="checkbox"/> Yes <input type="checkbox"/> No		Size: %		NPSH Available (m):			
MANUFACTURERS SPECIFICATIONS										
17	Pump Manufacturer:					Model No.:				
CONSTRUCTION					PERFORMANCE					
20	Casing Mounting: <input checked="" type="checkbox"/> Centerline <input type="checkbox"/> Foot <input type="checkbox"/> Inline					Proposal Curve No.				
21	Casing Split: <input type="checkbox"/> Axial <input type="checkbox"/> Radial					Visc. Corr. Factor: C ₀ C ₁ C _H				
22	Type: <input type="checkbox"/> Single Volute <input type="checkbox"/> Double Volute <input type="checkbox"/> Diffuser					NPSH Reqd. (Water) (m):		F/L Speed (rpm):		
23	Casing Connection: <input checked="" type="checkbox"/> Vent <input checked="" type="checkbox"/> Drain <input type="checkbox"/> Gauge					No. of stages:		Efficiency (%):		
24	Nozzles		Size		ANSI Rating		Facing		Position	
25	Suction									
26	Discharge									
27	Imp. N (mm)		Max:		Rated:		Min:		Type:	
28	Brg.: Type/No. Radial:		Thrust:		Lub: Oil		M.A.W.P @ 15°C/P.T./Design Temp.(kg/cm ² ,G):			
29	Cplg.: Make/Type:		Fleximet ^l w spacer		Nonspark Guard		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		Hydrostatic Test pressure (kg/cm ² ,G):	
30	Driver Half cplg. Mounted by: <input checked="" type="checkbox"/> Pump Mfr. <input type="checkbox"/> Others					Rotation facing coupling end: <input type="checkbox"/> CW <input type="checkbox"/> CCW				
31	Packing Type:		Size:		No. of rings:		Seal flush/ Quench plan:		Material :	
32	Mech. Seal:		Model:		API Code :		Ext. seal flush fluid:		LPM: @ kg/cm ² G/ EC	
33	Base Plate Drain Rim Type :		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		Fdn. Bolts:		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		Seal Barrier fluid:	
34	Throat Bush:		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		Matl.:		Bal. Device:		<input type="checkbox"/> Yes <input type="checkbox"/> No	
35	Materials (API-610 Matl. Class):				MOC		ASTM Grades		C.W. Plan :	
36	I - Cast Iron		Casing						Weight(kg): Pump+Base+Coupling:	
37	B - Bronze		Impeller						Driver:	
39	S - Carbon Steel		Inner Case parts						AUXILIARY PIPING INTERFACE CONNECTIONS	
(All interface conn. shall be termntd. with a flng. block valves)										
40	C - 11-13% Chr. Stl.		Sleeve Packed						Size Rating(ANSI) Facin	
41	h - Hardened		Sleeve Seal						Lantern Ring Inlet/Outlet	
42	f - Faced		Casing ring		H-BHN				Ext. Seal flush fluid Inlet/Outlet	
43	K - SS 304		Impeller ring		50(min)				Seal Quench fluid Inlet	
44	L - SS 316		Shaft						Seal pot vent/ drain	
45	X		Throttle Bush						Casing vent/ drain	
46	Y		Throat Bush						C.W Inlet/ Outlet	
47	Z		Balance Drum						Base plate drain (only flanged)	
48	<input type="checkbox"/> Driver suitable for Pump starting with open Disc. Valve condition.					Casing steam jacket				
INSPECTION & TESTS (EACH PUMP)										
50			Witness		Observe				Witness Observe	
51	<input checked="" type="checkbox"/> Shop Test / Inspection		<input type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/> NPSH As Reqd. <input checked="" type="checkbox"/> Per Spec. <input type="checkbox"/> Mandatory		<input checked="" type="checkbox"/> <input type="checkbox"/>	
52	<input checked="" type="checkbox"/> Material Certificates		<input type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/> Dismantle Insp. & Re-assembly after Test		<input checked="" type="checkbox"/> <input type="checkbox"/>	
53	<input checked="" type="checkbox"/> Hydrostatic		<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/> Nitritisation/Dimensional Check		<input checked="" type="checkbox"/> <input type="checkbox"/>	
54	<input checked="" type="checkbox"/> Performance/Sound Level		<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/> Check for direction of rotation of pump & driver.		<input checked="" type="checkbox"/> <input type="checkbox"/>	
55	Applicable Specification: API Std. 610, 8th Edition, alongwith EIL Std. Spec.No. 6-41-0005									
56	REMARKS:- 1) Max. allowable casing working pressure shall not be less than ___ kg/cm ² G @ ___ °C.									
57	2) Down Stream Design Pressure is ___ kg/cm ² g.									
58	3) Accessories and Instrumentation shall be as per EIL approved vendors only.									
59	4) Unitisation of Pump and Driver shall be done in pump manufacturer's shop.									
60										

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**CENTRIFUGAL PUMP
(HORIZONTAL SPECIAL PURPOSE
PROCESS)
(Section:C-3.3)**

DATA SHEET NO.

A011-00-16-45-DS30

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GENERAL										
1										
2	Project: CPP-Paradip Refinery Project				Job No.: A011					
3	Owner: M/s IOCL				Site: Orissa, India					
4	Purchaser :				Unit: CPP		Unit No.: 00			
5	No. Required:	Working:	Standby:	Driven Equipment: VHP BFW/HP BFW (EXPORT) Pumps						
6	Applicable to	<input checked="" type="checkbox"/> Proposal	<input type="checkbox"/> Purchase	<input type="checkbox"/> As-Built						
7	Note: <input checked="" type="checkbox"/> Scope Option & Information specified by Purchaser <input type="checkbox"/> Information required from & options left to vendor Vendor to cross [:] the selected Option									
8	Manufacturer:				Model:					
APPLICABLE CODES & STANDARDS										
10	API Standard 611, Standard Specification 6-43-0042 and Engineering Design Basis									
11	OPERATING CONDITIONS				PERFORMANCE					
12	Operating Point	Power (kW)	Speed (RPM)	Operating Point / Steam Condition		No. of Hand Valves Open		Steam Rate, kg/kW-hr		
13										
14	Normal			Rated BkW of Driven Equip. / (Normal						
15	(Rated BkW of									
16	Driven Equip.)			Rated BkW (Turbine Rating) / Normal						
17	Rated BkW									
18	(Turbine Rating)			Rated BkW (Turbine Rating) /						
19	Other									
20	SITE / INSTALLATIONS DATA (Refer BEDB/ Bid Pkg)			Min. Inlet, Max. Exhaust						
21	Application (Spared, Unspared) :			CONSTRUCTION FEATURES						
22	<input type="checkbox"/> Wide Speed Range <input type="checkbox"/> Rapid start			Turbine Type		<input checked="" type="checkbox"/> Horiz. <input type="checkbox"/> Vertical				
23	<input type="checkbox"/> Slow Roll Required <input checked="" type="checkbox"/> Hand Valves Req.			<input type="checkbox"/> No of Stages		Wheel Dia.(mm)				
24	<input checked="" type="checkbox"/> Duty: <input checked="" type="checkbox"/> Continuous <input type="checkbox"/> Standby			Rotor <input type="checkbox"/> Builtup Up <input type="checkbox"/> Solid <input type="checkbox"/> Overhung <input checked="" type="checkbox"/> Between Brgs.						
25	<input type="checkbox"/> Unattended Auto Start			Blading		<input type="checkbox"/> 2 Row <input type="checkbox"/> 3 Row <input type="checkbox"/> Re-entry				
26	Location <input type="checkbox"/> Indoor <input checked="" type="checkbox"/> Outdoor			Casing Split <input type="checkbox"/> Axial <input type="checkbox"/> Radial						
27	<input type="checkbox"/> Heated <input checked="" type="checkbox"/> Unheated <input type="checkbox"/> Underroof <input checked="" type="checkbox"/> W/o Roof			Casing Support <input checked="" type="checkbox"/> Centerline <input type="checkbox"/> Foot						
28	Ambient Temp. EC Min. Max.			<input checked="" type="checkbox"/> Vert. Jackscrews						
29	Unusual Conditions <input checked="" type="checkbox"/> Dust <input type="checkbox"/> Salt Atm. <input checked="" type="checkbox"/> Refinery atm			Vert. Turbine Flange <input type="checkbox"/> NEMA "P" base <input type="checkbox"/> Others						
30	Elect. Area Class Group: Div.			Trip Valve		<input type="checkbox"/> Integral <input checked="" type="checkbox"/> Separate				
31	<input type="checkbox"/> Non-Hazardous			Interstage Seals		<input type="checkbox"/> Labyrinth <input type="checkbox"/> Carbon				
32	Control Power V Ph. Hz.			End Seals		<input type="checkbox"/> Carbon Ring, No./Box				
33	Aux. Motor V Ph. Hz.					<input type="checkbox"/> Labyrinth <input type="checkbox"/> Material				
34	Allow. Sound Press Level 85 dBA @ 1 M			<input type="checkbox"/> Mechanical <input type="checkbox"/> Mfr:						
35	UTILITY DATA (Refer Basic Engg. Design Basis/ Bid Pkg)			<input type="checkbox"/> Type Radial Bearings <input type="checkbox"/> Type Thrust Bearing						
36	Cooling Water : Press. kg/cm ² g) P. kg/cm ²			<input type="checkbox"/> Cal. thrust Load: kg/cm ² <input type="checkbox"/> Brq's Mfr. ultimate Rating						
37	Flow, m ³ /h) T, EC			Thrust Collar <input type="checkbox"/> Replaceable <input type="checkbox"/> Integral <input type="checkbox"/> None						
38	Remarks :			<input checked="" type="checkbox"/> Turbine Suitable for autostart without warmup						
39				<input checked="" type="checkbox"/> Lube Oil Viscosity ISO Grade :						
40	STEAM CONDITIONS (Refer BEDB/Bid pkg)			Lubrication <input checked="" type="checkbox"/> Ring Oiled <input type="checkbox"/> Pressure <input type="checkbox"/> Grease						
41	STEAM	MIN	NORMAL	MAX	DESIGN	Oil Mist <input type="checkbox"/> Purge Oil Mist <input type="checkbox"/> Pure Oil Mist				
42						<input checked="" type="checkbox"/> Brq. Housing Oil Type:				
43	Inlet Press (kg/cm ² g)					<input checked="" type="checkbox"/> CASING DESIGN		INLET	OUTLET	
44	Inlet Temp. (EC)					Max. Allow. Press.(kg/cm ² G)				
45	Exhaust Press (kg/cm ² g)					Max. Allow. Temp., EC				
46	<input type="checkbox"/> Steam Containments			Hydro Test Press(kg/cm ² G)						
47	Remarks :			CONNECTIONS						
48	TURBINE DATA					Size	Rating	Facing	Position	Mating
49	<input type="checkbox"/> Allow Speed, RPM Max.: Min.:									
50	<input type="checkbox"/> Max. Cont. Speed, RPM					Inlet				
51	<input type="checkbox"/> Trip Speed, RPM			Blade Tip Vel., (mm/s)		Exhaust				
52	<input type="checkbox"/> First Critical Speed, RPM					Drains				
53	Exh. Temp. EC Normal No Load			STEAM CONTROL						
54	<input type="checkbox"/> Potential Max. Power, KW			Governor Type <input checked="" type="checkbox"/> Hydr. <input type="checkbox"/> Oil Relay <input type="checkbox"/> Other						
55	<input type="checkbox"/> Max. Nozzle Steam Flow, kg/hr			NEMA Class : A						
56	Rotation Facing Governor End <input type="checkbox"/> CCW <input type="checkbox"/> CW			Speed Changer <input checked="" type="checkbox"/> Manual <input type="checkbox"/> Pneum <input type="checkbox"/> Elect.						
57	<input type="checkbox"/> Driven Equipment Thrust (Vertical Turbine)			Mfr. : Woodward or eqv. Model						
58	<input checked="" type="checkbox"/> Water Piping Furn. By <input checked="" type="checkbox"/> Vendor <input type="checkbox"/> Others			Controlled Variable		Operating Range		Controlled Signal		
59	<input type="checkbox"/> Oil Piping Furn. By <input type="checkbox"/> Vendor <input type="checkbox"/> Others			Speed		To rpm		To kg/cm ² /mA		
60	Remarks :					To rpm		To kg/cm ² /mA		



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STEAM TURBINE GENERAL PURPOSE

(Section: C-3.3)

DATA SHEET NO

A011-00-16-45-DS20

REV.

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61	MATERIALS (Refer API611)							ACCESSORY EQUIPMENT BY VENDOR				
62	<input type="checkbox"/> High Pressure Casing							<input checked="" type="checkbox"/> Remote Trip <input checked="" type="checkbox"/> Solenoid <input checked="" type="checkbox"/> Remote Start <input checked="" type="checkbox"/> Solenoid				
63	<input type="checkbox"/> Exhaust Casing							<input type="checkbox"/> Vacuum Breaker <input type="checkbox"/> Automatic steam sealing System				
64	<input type="checkbox"/> Nozzles							<input type="checkbox"/> Gland Vacuum Device <input type="checkbox"/> Water Eductor <input type="checkbox"/> Steam Ejector				
65	<input type="checkbox"/> Blading							<input checked="" type="checkbox"/> Sentinel Warning Valve				
66	<input type="checkbox"/> Wheels							<input checked="" type="checkbox"/> Insulation Type <input type="checkbox"/> Metal Insulation Cover				
67	<input type="checkbox"/> Shaft <input checked="" type="checkbox"/> Shaft Coating Under Packing: <input type="checkbox"/> Material							<input checked="" type="checkbox"/> Tachometer Type				
68	Application Method <input type="checkbox"/> Thickness							Mfr.:		Model :		
69	<input checked="" type="checkbox"/> Gov. Valve Trim SS <input checked="" type="checkbox"/> Inlet Strainer SS							Mounted By :		<input checked="" type="checkbox"/> Thermal Relief Valves		
70	<input type="checkbox"/> Coupling Spacer Hubs <input type="checkbox"/> Diaphragm							<input type="checkbox"/> Shut off valves for Shut Down Sensors				
71	COUPLINGS							<input checked="" type="checkbox"/> Local Gauge Board With Following Pressure Gauges:				
72			Turbine- Driven				<input checked="" type="checkbox"/> Throttle Steam <input type="checkbox"/> First Stage					
73			Equipment				<input checked="" type="checkbox"/> Nozzle Rating <input checked="" type="checkbox"/> Exhaust					
74	Manufacturer							<input type="checkbox"/> Liquid Filled Type Gauges				
75	Model							<input type="checkbox"/> Instrument Panel(Local) <input type="checkbox"/> Base Mount				
76	Rating (kW / 100 RPM)							<input type="checkbox"/> Safety Switches & Control Devices by Vendor				
77	Lubrications Non Lube							<input type="checkbox"/> Blow of piping with silencer <input type="checkbox"/> Auto Drain Traps				
78	Limited End Float							EXTERNAL LUBE OIL SYSTEM				
79	Spacer Length							<input type="checkbox"/> Circulating <input type="checkbox"/> Pressure				
80	Service Factor							Vendor System as per API 611 for:		<input type="checkbox"/> Turbine		
81	Turbine Vendor Mounts half							<input type="checkbox"/> Other				
82	Coupling							Oil System To be:		<input type="checkbox"/> Console Type		
83	Dynamic Balance : <input type="checkbox"/> AGMA Class 8 <input type="checkbox"/> Other							<input type="checkbox"/> Mounted On Baseplate				
84	Turbine Shaft: <input type="checkbox"/> Taper <input type="checkbox"/> Straight <input type="checkbox"/> Hydr. Fit Hub							Oil System To Include Following Equipment:				
85	ENGINEERING REQUIREMENTS							<input type="checkbox"/> Standby Oil Pump: <input type="checkbox"/> Type Driver				
86	<input type="checkbox"/> Supply Engr. Data For Lateral/Torsional Analyses							<input type="checkbox"/> Low Oil Pressure Alarm Switch				
87	<input checked="" type="checkbox"/> Calcs. AND/OR Data For Separation Margin							<input type="checkbox"/> Low Oil Pressure Trip Switch				
88	<input type="checkbox"/> Train Torsional Vibration Analysis							<input type="checkbox"/> Heater <input type="checkbox"/> Electric <input type="checkbox"/> Steam				
89	<input checked="" type="checkbox"/> Residual Unbalance Check							<input type="checkbox"/> Oil Drain Site Flow Indicators <input type="checkbox"/> Hand operated standby pump				
90	<input type="checkbox"/> Electrical And Mechanical							Bearing metal temp. sensors/monitors for <input type="checkbox"/> Radial brgs <input type="checkbox"/> Thrust				
91	<input type="checkbox"/> Gears, When Furnished, Shall Conform To							VIBRATION AND POSITION DETECTORS				
92			<input type="checkbox"/> API-677		<input type="checkbox"/> Other		<input type="checkbox"/> Furnish Provisions For Mounting Non-Contacting					
93			Integral Gear Type:		<input type="checkbox"/> Single Helical		Vibration Probes					
94			<input type="checkbox"/> Double Helical		<input type="checkbox"/> Epicyclic		<input type="checkbox"/> Furn. Axial Position Probes <input type="checkbox"/> No. Of Probes					
95	<input type="checkbox"/> Submit Campbell And Goodman Diagrams							<input type="checkbox"/> Mfr. <input type="checkbox"/> Model				
96	Remarks:							<input type="checkbox"/> Furn. Radial Probes <input type="checkbox"/> No. Of Probes Per Bearing				
97	INSPECTION & TESTING							<input type="checkbox"/> Mfr. <input type="checkbox"/> Model				
98	<input type="checkbox"/> 100% Ultrasonic Inspect. After Rough Machining							<input type="checkbox"/> Furn. Vel/Acc Transducers <input type="checkbox"/> No. Per Bearing				
99	<input type="checkbox"/> Special NDT Inspection Of Following Parts:							<input type="checkbox"/> Mfr. <input type="checkbox"/> Model				
100	Casting Surface Inspection		<input type="checkbox"/> MSS SP-55 <input type="checkbox"/> Other				Vib./Axial Monitors:		Turbine Vendor Equipme	Driven Equipment	Purcha	
101	<input type="checkbox"/> Weld Inspection		<input type="checkbox"/> Special Inspection				Furnished By		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
102	COMPONENT	MAG.	DYE	RADIO	ULTRA	OBS	WIT	Mounted By		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
103		PART.	PENET	GRAPHIC TEST	TEST			MOUNTING PLATES				
104	<input type="checkbox"/> T & T Valve	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Type:		<input checked="" type="checkbox"/> Base Plate <input type="checkbox"/> Sole Plate		
105	<input type="checkbox"/> STM Chest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Furn. By:		<input type="checkbox"/> Turbine Vendor <input checked="" type="checkbox"/> Driven Eqpt Vendor		
106	<input type="checkbox"/> Casing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Equip. To Be Mounted:		<input checked="" type="checkbox"/> Turbine <input type="checkbox"/> Gear <input checked="" type="checkbox"/> Pump <input type="checkbox"/> Generator		
107	<input type="checkbox"/> Piping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> UngROUTed Baseplate <input type="checkbox"/> Suitable for Column Mounting				
108	<input type="checkbox"/> Rotor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Turbine Vendor Furnishes Subplates				
109		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	WEIGHTS (kg)				
110	TESTS			Required	Witnessed	Observed	<input type="checkbox"/> Turbine : <input type="checkbox"/> Rotor :					
111	Hydrostatic			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Turbine upper half casing : <input type="checkbox"/> Baseplate :					
112	Mech. Run			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> T&T valve :					
113	Bearing Oil Flow			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Max. maintainance weight : <input type="checkbox"/> Misc:					
114	Performance			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Total shipping weight :					
115	Complete unit			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PREPARATION FOR SHIPMENT					
116	Gear			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Turbine Auxiliary Equipment And Spare Rotor Prepared For:					
117	Sound Level			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Domestic Shipment <input checked="" type="checkbox"/> Export Shipment					
118	Aux. Equipment			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Turbine Prepared For Extended Storage 6 Months					
119	Dynamic Balancing of rotor			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Spare Rotor Prepared For Extended Storage Months					
120												



ENGINEERS INDIA LIMITED
NEW DELHI

**STEAM TURBINE
GENERAL PURPOSE**

(Section: C-3.3)

DATA SHEET NO

A011-00-16-45-DS20

REV.

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121	Remarks :
122	1. The turbine shall be designed to develop 110% of the maximum power reqd. for any of the specified operation of the driven equipment
123	With minimum steam inlet conditions and maximum steam exhaust conditions .
124	2. No gearbox between pump and turbine should be used.
125	3. BEDB = Basic Engineering Design Basis.
126	
127	

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Date	Rev	Job Engineer	Rev. & Approved By



ENGINEERS INDIA LIMITED
NEW DELHI

**STEAM TURBINE
GENERAL PURPOSE**

(Section: C-3.3)

DATA SHEET NO

A011-00-16-45-DS20

REV.

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**PARADIP REFINERY PROJECT
PROJECT SPECIFICATION**



**PIPING MATERIAL SPECIFICATION
PIPE CLASS : A2AW**

**3210-8230-SP-0001
PAGE : 1 OF 7
REV : A1**

PIPE CLASS : A2AW DESIGN CODE : ASME B31.3

RATING, FLANGE FACE : 150, RF/FF STRESS RELIEF : NO

MATERIAL : CARBON STEEL VALVE PACKING : GROUP B

CORROSION ALLOWANCE : 3.0 MM FABRICATION : 3210-8440-SP-0018

SPECIAL REQUIREMENT : - PMI : -

PAINTING : 3210-8440-SP-0006

TEMPERATURE (Deg.C) AND PRESSURE (Kg/cm2 g) RATING

TEMP.	0	38	50	65	100
PRESS.	10.5	10.5	10.5	10.5	10.5

SERVICE

UTILITY – NON CORROSIVE WATER SERVICE (CATEGORY “D” FLUID) :
A/G COOLING WATER

SIZE RANGE AND PIPE WALL THICKNESS (MM) TABLE

NPS	½”	¾”	1”	1 ½”	2”	3”	4”	6”	8”	10”
SCHEDULE	160	160	160	160	80	STD	STD	STD	-	-
THICKNESS	4.78	5.56	6.35	7.14	5.54	5.49	6.02	7.11	8	8

NPS	12”	14”	16”	18”	20”	24”	26”	28”	30”	32”
SCHEDULE	-	-	-	-	-	-	-	-	-	-
THICKNESS	8	8	8	8	10	10	12	12	12	12

NPS	34”	36”	38”	40”	42”	44”	46”	48”	52”	56”
SCHEDULE	-	-	-	-	-	-	-	-	-	-
THICKNESS	12	12	12	12	12	12	12	12	12	14

NPS	60”	64”	68”	72”	76”	80”	110”
SCHEDULE	-	-	-	-	-	-	-
THICKNESS	14	14	16	16	16	16	21



PARADIP REFINERY PROJECT
PROJECT SPECIFICATION



PIPING MATERIAL SPECIFICATION
PIPE CLASS : A2AW

3210-8230-SP-0001
PAGE : 3 OF 7
REV : A1

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
PIPE						
	½"	1 ½"	PE, SEAMLESS	B36.10	ASTM A106 GR.B	
	2"	6"	BE, SEAMLESS	B36.10	ASTM A106 GR.B	
	8"	110"	BE, WELDED	-	IS 3589 GR.FE410	
NIPPLE	½"	1 ½"	ENDS AS REQUIRED, SEAMLESS, SCH 160	B36.19	ASTM A106 GR.B	
FITTINGS						
	½"	1 ½"	CL.6000, FORGED, SW	B16.11	ASTM A105N	
	2"	6"	WROUGHT, SEAMLESS, BW	B16.9	ASTM A234 GR.WPB-S	
	8"	24"	WROUGHT, WELDED, BW	B16.9	ASTM A234 GR.WPB-W	
	26"	110"	FABRICATED FROM PIPE	-	IS 3589 GR.FE410	N, P
THD. CAP	½"	1 ½"	CL.3000, FORGED	B16.11	ASTM A105N	
PLUG	½"	1 ½"	ROUND HEAD TYPE	B16.11	ASTM A105N	26
BRANCHES						
TEE	½"	1 ½"	CL.6000, FORGED , SW	B16.11	ASTM A105N	
SOCKOLET	½"	1 ½"	CL.6000, FORGED , SW	MSS SP-97	ASTM A105N	
TEE	2"	6"	WROUGHT, SEAMLESS, BW	B16.9	ASTM A234 GR.WPB-S	
TEE	8"	48"	WROUGHT, WELDED, BW	B16.9	ASTM A234 GR.WPB-W	
	52"	110"	SET-IN BRANCH. CHECK FOR REINFORCEMENT	-	IS 3589 GR. FE410	H
THREDOLET	½"	1 ½"	CL.6000, FORGED	MSS SP-97	ASTM A105N	26
FLANGES						
SW	½"	1 ½"	CL.150, RF	B16.5	ASTM A105N	
SLIP-ON	2"	24"	CL.150, RF	B16.5	ASTM A105N	20



PARADIP REFINERY PROJECT
PROJECT SPECIFICATION



PIPING MATERIAL SPECIFICATION
PIPE CLASS : A2AW

3210-8230-SP-0001
PAGE : 4 OF 7
REV : A1

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
FLANGES						
SLIP-ON	26"	80"	HUB FLANGES, FF	AWWA C207 CL-D	ASTM A105N	19, 20
BLIND	½"	24"	CL.150, RF	B16.5	ASTM A105N	
BLIND	26"	80"	FF	AWWA C207 CL-D	ASTM A285 GR.C	
LINE BLINDS						
	½"	8"	CL.150, SPECTACLE BLIND	B16.48	ASTM A105N	
	10"	24"	CL.150, SPADE & SPACER	B16.48	ASTM A105N	
	26"	80"	SPADE & SPACER TO SUIT AWWA C207 CL-D FLANGES	-	ASTM A285 GR.C	J
GASKETS						
	½"	24"	CL.150, FLAT RING, 2 MM THK.	B16.21 / B16.5	SYNTHETIC FIBRE WITH OIL RESISTANT BINDER	
	26"	80"	FULL FACE, 6 MM THK.	AWWA C207 CL-D	RUBBER WITH STEEL INSERT	
BOLTS						
	½"	24"	STUD BOLT C/W 2 HEAVY HEX. NUTS	B18.2. 1/ B18.2. 2	STUD: ASTM A193 GR. B7 NUT: ASTM A194 GR. 2H	
	26"	80"	STUD BOLT C/W 2 HEAVY HEX. NUTS	B18.2. 1/ B18.2. 2	STUD: ASTM A307 GR. B NUT: ASTM A563 GR. B	
VALVES						
GATE	½"	1 ½"	CL.800, SW, SOLID WEDGE, OS & Y, BOLTED BONNET	API 602	BODY :ASTM A105N TRIM : 8 (API 602) (13CR / HF)	
GATE	2"	2"	CL.150, RF FLGD., FLEXIBLE WEDGE, OS & Y, BOLTED BONNET	API 600	BODY : ASTM A216 GR.WCB TRIM : 8 (API 600) (13CR / HF)	





PARADIP REFINERY PROJECT
PROJECT SPECIFICATION





PIPING MATERIAL SPECIFICATION
PIPE CLASS : A2AW

3210-8230-SP-0001
PAGE : 5 OF 7
REV : A1

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
VALVES						
GLOBE	½"	1 ½"	CL.800, SW, SWIVEL PLUG DISC, OS &Y, BOLTED BONNET	BS EN 15761	BODY : ASTM A105N TRIM : 8 (API 602) (13CR / HF)	
GLOBE	2"	16"	CL.150, RF FLGD, SWIVEL PLUG DISC, OS & Y, BOLTED BONNET	BS 1873	BODY: ASTM A216 GR.WCB TRIM : 8 (API 600) (13CR / HF)	
CHECK	½"	1 ½"	CL.800, SW, PISTON TYPE, BOLTED COVER	BS EN 15761	BODY : ASTM A105N TRIM : 8 (API 602) (13CR / HF)	54
CHECK	8"	24"	CL.150, DUAL PLATE, TYPE A, LUG TYPE TO SUIT B16.5 RF FLANGES	API 594	BODY : ASTM A536 GR.60-40- 18 SEAT : NITRILE RUBBER DISC : ALUMINIUM BRONZE	56
CHECK	26"	48"	CL.150, DUAL PLATE, TYPE A, FF DOUBLE FLGD TO SUIT AWWA C207 CL-D FLANGES	API 594	BODY : ASTM A536 GR.60-40- 18 SEAT : NITRILE RUBBER DISC : ALUMINIUM BRONZE	56
BUTTERFLY	6"	24"	CL.150, RF, LUG TYPE TO SUIT B16.5 FLANGES	API 609, CAT.A	BODY : ASTM A536 GR.60-40- 18, SEAT : NBR DISC : ASTM A536 GR.60-40- 18, EPOXY COATED	
BUTTERFLY	26"	60"	CL.150, FF, DOUBLE FLANGED TO AWWA C207 CL-D	API 609, CAT.A	BODY : ASTM A536 GR.60-40- 18 SEAT : NBR DISC : ASTM A536 GR.60-40- 18, EPOXY COATED	
STRAINERS						
Y-TYPE	½"	1 ½"	FORGED, CL.800, SW, W/NPT (M) BLOW-OFF CONNECTION, 0.033" PERFORATION	-	BODY : ASTM A105N STRAINER : SS304	
T-TYPE	2"	6"	CL. 150, BW	-	BODY : ASTM A ASTM A234 GR. WPB FLANGE : ASTM A105N STRAINER : SS304	101

 IndianOil	PARADIP REFINERY PROJECT PROJECT SPECIFICATION		 3210-8230-SP-0001 PAGE : 6 OF 7 REV : A1
	PIPING MATERIAL SPECIFICATION PIPE CLASS : A2AW		

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
STRAINERS						
T-TYPE	8"	24"	CL. 150, BW	-	BODY : ASTM A ASTM A234 GR. WPB-W FLANGE : ASTM A105N STRAINER : SS304	101
TEMPORARY	2"	24"	CONE TYPE C/W SPACER TO SUIT ASME B16.5 FLANGES	-	STRAINER : SS304 SPACER : ASTM A515 GR.70	87

 IndianOil	PARADIP REFINERY PROJECT PROJECT SPECIFICATION		 3210-8230-SP-0001 PAGE : 7 OF 7 REV : A1
	PIPING MATERIAL SPECIFICATION PIPE CLASS : A2AW		

STANDARD PIPING ASSEMBLIES



VENTS, DRAINS AND INSTRUMENT CONNECTIONS (REFER TO DRAWING 3210-8230-SP-0008 FOR PIPING STANDARD HOOK-UPS)									
HEADER	1½"	2" & UP	1½"	2" & UP	1½"	2" & UP	3"	4" & UP	
	VENT / DRAIN VALVED		VENT HYDROSTATIC		PRESSURE CONNECTION		TEMPERATURE CONNECTION		ORIFICE
ASSL'Y NO.	D01	D02	H01	H02	P01	P02	T01	T02	F01

DESIGN NOTES

- A. BRACE ALL NIPPLES AND BRANCHES ON ALL MAJOR ROTATING EQUIPMENT.
- B. FOR PIPE SIZES 2" AND SMALLER IN VIBRATION SERVICE WHERE BRACING CANNOT BE EFFECTIVELY PROVIDED, NIPPLES WITH SCHEDULE XXS SHALL BE INSTALLED.
- H. BRANCHES >48"NB SHALL BE CALCULATED IN ACCORDANCE WITH ASME B31.3.
- J. REFER PROJECT STANDARD 3210-8230-54-0022 FOR DIMENSIONS. THICKNESS OF SPADES & SPACER >24"NB MAY BE CALCULATED BASED ON LINE DESIGN CONDITIONS TO ECONOMISE ON THICKNESS. SPADES & SPACERS WITH THE DEVIATION IN THICKNESS FROM THE PROJECT STANDARD SHALL BE TREATED AS SPECIALITY ITEM.
- N. USE 5-PIECE 90 DEG. MITER FOR SIZES FROM 12" UPTO 80" NB. 45 DEG. MITER SHALL REQUIRE TWO PIECE LESS. REFER PROJECT STANDARD DRAWING 3210-8230-54-0050.
- P. LENGTH OF CONICAL REDUCER UPTO 48"NB SHALL BE ACCORDING TO ASME B16.9. REFER PROJECT STANDARD DRAWING (3210-8230-54-0052) FOR DIMENSIONS OF CONICAL REDUCER ABOVE 48"NB. FOR ALL OTHER PIPE FITTINGS ABOVE 48"NB, DIMENSIONS ACCORDING TO AWWA C208 MAY BE FOLLOWED.

GENERAL NOTES

- 1. THE MIN. LINE SIZE IN THIS CLASS IS ¾" NB. SIZE ½" NB IS INCLUDED FOR INSTRUMENT CONNECTIONS ONLY.
- 2. ALL BUTT-WELDED COMPONENT THICKNESSES SHALL MATCH THE PIPE THICKNESS.
- 3. REDUCING TEES MAY ONLY BE USED WHERE DEFINED IN THE BRANCH CONNECTION TABLES.
- 19. AWWA C207 CL.D FLANGES SHALL BE HUB TYPE.
- 20. SLIP-ON FLANGES SHALL BE USED WITH PIPE SPOOLS.
- 26. USE FOR NON VALVED HYDROSTATIC TEST VENTS.
- 54. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION ONLY WITH COVER UP.
- 56. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION WITH HINGE PIN VERTICAL OR IN VERTICAL POSTION WITH UPWARD FLOW.
- 61. FOR NON STANDARD VALVE TYPES REFER TO P&ID.
- 87. REFER PROJECT STANDARD 3210-8230-54-0023.
- 101. REFER PROJECT STANDARD 3210-8230-54-0053, 3210-8230-54-0054, 3210-8230-54-0055.

	PARADIP REFINERY PROJECT PROJECT SPECIFICATION	 3210-8230-SP-0001 PAGE : 1 OF 6 REV : A1
	PIPING MATERIAL SPECIFICATION PIPE CLASS : D2AG	

PIPE CLASS : D2AG **DESIGN CODE : ASME B31.1**
RATING, FLANGE FACE : 600, RF **STRESS RELIEF : ASME B31.1**
MATERIAL : KILLED C.S. **VALVE PACKING : GROUP A**
CORROSION ALLOWANCE : 3.0 MM **FABRICATION : 3210-8440-SP-0018**
SPECIAL REQUIREMENT : POWER PIPING, PMI : -
IBR SERVICE. PAINTING : 3210-8440-SP-0006

TEMPERATURE (Deg.C) AND PRESSURE (Kg/cm² g) RATING (FOR ½" NB THROUGH 8" NB)

TEMP.	-29	38	93	149	204	260	316	343	371	399
PRESS.	104.05	104.05	95.62	92.10	88.94	84.72	79.80	77.34	74.53	71.36

TEMP.	427
PRESS.	58.00



SERVICE

UTILITY – POWER PIPING, IBR SERVICE:
 HP BOILER FEED WATER,



SIZE RANGE AND PIPE WALL THICKNESS (MM) TABLE

NPS	½"	¾"	1"	1 ½"	2"	3"	4"	6"	8"	10"
SCHEDULE	160	160	160	160	160	160	120	120	100	-
THICKNESS	4.78	5.56	6.35	7.14	8.74	11.13	11.13	14.27	15.09	CALC



NPS	12"	14"	16"	18"	20"	24"
SCHEDULE	-	-	-	-	-	-
THICKNESS	CALC	CALC	CALC	CALC	CALC	CALC

 IndianOil	PARADIP REFINERY PROJECT PROJECT SPECIFICATION	 3210-8230-SP-0001 PAGE : 3 OF 6 REV : A1
	PIPING MATERIAL SPECIFICATION PIPE CLASS : D2AG	

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
PIPE						
	½"	1 ½"	PE, SEAMLESS	B36.10	ASTM A106 GR.B	
	2"	24"	BE, SEAMLESS	B36.10	ASTM A106 GR.B	
NIPPLE	½"	1 ½"	ENDS AS REQUIRED, SEAMLESS, SCH XXS	B36.10	ASTM A106 GR.B	
FITTINGS						
	½"	1 ½"	CL.6000, FORGED, SW	B16.11	ASTM A105N	
	2"	24"	WROUGHT, SEAMLESS, BW	B16.9	ASTM A234 GR.WPB-S	
THD. CAP	½"	1 ½"	CL.3000, FORGED	B16.11	ASTM A105N	25
BRANCHES						
TEE	½"	1 ½"	CL.6000, FORGED, SW	B16.11	ASTM A105N	
TEE	2"	24"	WROUGHT, SEAMLESS, BW	B16.9	ASTM A234 GR.WPB-S	
SOCKOLET	½"	1 ½"	CL.6000, FORGED, SW	MSS SP-97	ASTM A105N	
FLANGES						
SOCKET WELD	½"	1 ½"	CL.600, RF	B16.5	ASTM A105N	
WELDNECK	2"	24"	CL.600, RF	B16.5	ASTM A105N	
BLIND	½"	24"	CL.600, RF	B16.5	ASTM A105N	
ORIFICE	1"	24"	CL.600, RF	B16.36	ASTM A105N	
LINE BLINDS						
	½"	8"	CL.600, SPECTACLE BLIND	B16.48	ASTM A515 GR.70	
	10"	24"	CL.600, SPADE & SPACER	B16.48	ASTM A515 GR.70	
GASKETS						
	½"	24"	CL.600, SPIRAL WOUND, 4.5 MM THK.	B16.20 / B16.5	SP. WINDING + INNER RING : SS316, FILLER : GRAPHITE, OUTER RING :CS 3MM THK	

 IndianOil	PARADIP REFINERY PROJECT PROJECT SPECIFICATION	 3210-8230-SP-0001 PAGE : 4 OF 6 REV : A1
	PIPING MATERIAL SPECIFICATION PIPE CLASS : D2AG	

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
BOLTS						
	½"	24"	STUD BOLT C/W 2 HEAVY HEX. NUTS	B18.2. 1/ B18.2. 2	STUD: ASTM A193 GR. B7 NUT: ASTM A194 GR. 2H	
VALVES						
GATE	½"	1 ½"	CL.800, SW, SOLID WEDGE, OS & Y, BOLTED BONNET	API 602	BODY :ASTM A105N TRIM : 5 (API 602) (HF)	
GATE	2"	24"	CL.600, RF FLGD., FLEXIBLE WEDGE, OS & Y, BOLTED BONNET	API 600	BODY : ASTM A216 GR.WCB TRIM : 5 (API 600) (HF)	
GLOBE	½"	1 ½"	CL.800, SW, SWIVEL PLUG DISC, OS &Y, BOLTED BONNET	BS EN ISO 15761	BODY : ASTM A105N TRIM : 5 (API 602) (HF)	
GLOBE	2"	12"	CL.600, RF FLGD, SWIVEL PLUG DISC, OS & Y, BOLTED BONNET	BS 1873	BODY : ASTM A216 GR.WCB TRIM : 5(API 600) (HF)	
CHECK	½"	1 ½"	CL.800, SW, PISTON TYPE, BOLTED COVER	BS EN ISO 15761	BODY : ASTM A105N TRIM : 5 (API 602) (HF)	54
CHECK	10"	24"	CL.600, DUAL PLATE, TYPE A, RF DOUBLE FLGD TO B16.5	API 594	BODY : ASTM A216 GR.WCB TRIM : 5 (API 594) (HF)	56, 57
CHECK	2"	24"	CL.600, RF FLGD, SWING TYPE, BOLTED COVER	BS 1868	BODY : ASTM A216 GR.WCB TRIM : 5 (API 600) (HF)	55, 57
STRAINERS						
Y-TYPE	½"	1 ½"	FORGED, CL.800, SW, W/NPT (M) BLOW-OFF CONNECTION, 0.033" PERFORATION	-	BODY : ASTM A105N STRAINER : SS304	
T-TYPE	2"	24"	CL. 600, BW	-	BODY : ASTM A ASTM A234 GR. WPB FLANGE : ASTM A105N STRAINER : SS304	101
TEMPORARY	2"	24"	CONE TYPE C/W SPACER TO SUIT ASME B16.5 FLANGES	-	STRAINER : SS304 SPACER : ASTM A515 GR.70	87

	PARADIP REFINERY PROJECT PROJECT SPECIFICATION	 3210-8230-SP-0001 PAGE : 5 OF 6 REV : A1
	PIPING MATERIAL SPECIFICATION PIPE CLASS : D2AG	

STANDARD PIPING ASSEMBLIES



VENTS, DRAINS AND INSTRUMENT CONNECTIONS (REFER TO DRAWING 3210-8230-SP-0008 FOR PIPING STANDARD HOOK-UPS)									
HEADER	1½"	2" & UP	1½"	2" & UP	1½"	2" & UP	3"	4" & UP	
	VENT / DRAIN VALVED		VENT HYDROSTATIC		PRESSURE CONNECTION		TEMPERATURE CONNECTION		ORIFICE
ASSL'Y NO.	D01/V01	D02/V02	H03	H04	P01	P02	T01	T02	F01

DESIGN NOTES

- A. BRACE ALL NIPPLES AND BRANCHES ON ALL MAJOR ROTATING EQUIPMENT.
- B. FOR PIPE SIZES 2" AND SMALLER IN VIBRATION SERVICE WHERE BRACING CANNOT BE EFFECTIVELY PROVIDED, NIPPLES WITH SCHEDULE XXS SHALL BE INSTALLED.
- G. WHERE 'CALC' IS SHOWN, THE PIPE THICKNESS SHALL BE CALCULATED IN ACCORDANCE WITH PARA 3.4 OF PIPING MATERIAL SPECIFICATION. THE MIN. THICKNESS SHALL NOT BE LESS THAN 12.7MM

GENERAL NOTES

1. THE MIN. LINE SIZE IN THIS CLASS IS ¾" NB. SIZE ½" NB IS INCLUDED FOR INSTRUMENT CONNECTIONS ONLY.
2. ALL BUTT-WELDED COMPONENT THICKNESSES SHALL MATCH THE PIPE THICKNESS.
3. REDUCING TEES MAY ONLY BE USED WHERE DEFINED IN THE BRANCH CONNECTION TABLES.
4. ALL BUTT-WELDS SHALL BE 100% RADIOGRAPHED.
11. CARBON CONTENT SHALL NOT EXCEED 0.25% FOR ALL PIPES, FITTINGS AND FLANGES ETC. THAT MAY REQUIRE WELDING. MOREOVER, FOR FLANGES THE SULPHUR AND PHOSPHOROUS SHALL ALSO BE LIMITED TO 0.05% EACH.
12. ALL PIPES, FITTINGS, VALVES, FLANGES, TRAPS, STRAINERS AND OTHER SPECIAL PARTS SHALL BE TESTED AND TEST CERTIFICATE IN FORM IIIA FOR PIPE AND FORM IIIC FOR OTHERS SHALL BE REQUIRED DULY COUNTERSIGNED BY IBR AUTHORITY OR ITS APPROVED REPRESENTATIVE.
25. THREADED JOINTS ARE PERMITTED ONLY AT THE OUTLET OF VENT AND DRAIN VALVES.
27. USE FLANGE AND BLIND FLANGE FOR NON-VALVED HYDROSTATIC TEST VENTS.
28. CONSIDER CONTROLLED BOLT TIGHTENING OF FLANGED JOINTS ACCORDING TO PROJECT STANDARD 3210-8440-SP-0011
54. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION ONLY WITH COVER UP.
55. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION WITH COVER UP OR IN VERTICAL POSITION WITH UPWARD FLOW.
56. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION WITH HINGE PIN VERTICAL OR IN VERTICAL POSTION WITH UPWARD FLOW.
57. DUAL PLATE CHECK VALVE IS PREFRRD OPTION.
61. FOR NON STANDARD VALVE TYPES REFER TO P&ID.
87. REFER PROJECT STANDARD 3210-8230-54-0023.

 IndianOil	PARADIP REFINERY PROJECT PROJECT SPECIFICATION		 3210-8230-SP-0001 PAGE : 6 OF 6 REV : A1
	PIPING MATERIAL SPECIFICATION PIPE CLASS : D2AG		

101. REFER PROJECT STANDARD 3210-8230-54-0053, 3210-8230-54-0054, 3210-8230-54-0055.



PARADIP REFINERY PROJECT
PROJECT SPECIFICATION



PIPING MATERIAL SPECIFICATION
PIPE CLASS : A1AG

3210-8230-SP-0001
PAGE : 1 OF 7
REV : A1

PIPE CLASS : **A1AG** DESIGN CODE : ASME B31.1
RATING, FLANGE FACE : 150, RF STRESS RELIEF : ASME B31.1
MATERIAL : KILLED CS VALVE PACKING : GROUP A
CORROSION ALLOWANCE : 1.5 MM FABRICATION : 3210-8440-SP-0018
SPECIAL REQUIREMENT : POWER PIPING, PMI : -
IBR SERVICE PAINTING : 3210-8440-SP-0006

TEMPERATURE (Deg.C) AND PRESSURE (Kg/cm² g) RATING

TEMP.	-29	38	93	149	204	260	316	343	371	399
PRESS.	20.04	20.04	18.28	16.17	14.06	11.95	9.84	8.79	7.73	6.68

TEMP.	427
PRESS.	5.62

SERVICE

UTILITY- POWER PIPING, IBR SERVICE :
LOW PRESSURE STEAM

SIZE RANGE AND PIPE WALL THICKNESS (MM) TABLE

NPS	½"	¾"	1"	1 ½"	2"	3"	4"	6"	8"	10"
SCHEDULE	160	160	XS	XS	XS	STD	STD	STD	STD	STD
THICKNESS	4.78	5.56	4.55	5.08	5.54	5.49	6.02	7.11	8.18	9.27

NPS	12"	14"	16"	18"	20"	24"
SCHEDULE	STD	STD	STD	STD	STD	STD
THICKNESS	9.53	9.53	9.53	9.53	9.53	9.53



PARADIP REFINERY PROJECT PROJECT SPECIFICATION



PIPING MATERIAL SPECIFICATION PIPE CLASS : A1AG

3210-8230-SP-0001
PAGE : 3 OF 7
REV : A1

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
PIPE						
	½"	1 ½"	PE, SEAMLESS	B36.10	ASTM A106 GR.B	
	2"	24"	BE, SEAMLESS	B36.10	ASTM A106 GR.B	
NIPPLE	½"	1 ½"	ENDS AS REQUIRED, SEAMLESS, SCH XXS	B36.10	ASTM A106 GR.B	
FITTINGS						
	½"	¾"	CL.6000, FORGED, SW	B16.11	ASTM A105N	
	1"	1 ½"	CL.3000, FORGED, SW	B16.11	ASTM A105N	
	2"	24"	WROUGHT, SEAMLESS, BW	B16.9	ASTM A234 GR.WPB-S	
THD. CAP	½"	1 ½"	CL.3000, FORGED	B16.11	ASTM A105N	25
BRANCHES						
TEE	½"	¾"	CL.6000, FORGED, SW	B16.11	ASTM A105N	
TEE	1"	1 ½"	CL.3000, FORGED, SW	B16.11	ASTM A105N	
TEE	2"	24"	WROUGHT, SEAMLESS, BW	B16.9	ASTM A234 GR.WPB-S	
SOCKOLET	½"	¾"	CL.6000, FORGED, SW	MSS SP-97	ASTM A105N	
SOCKOLET	1"	1 ½"	CL.3000, FORGED, SW	MSS SP-97	ASTM A105N	
FLANGES						
SOCKET WELD	½"	1 ½"	CL.150, RF	B16.5	ASTM A105N	
WELDNECK	2"	24"	CL.150, RF	B16.5	ASTM A105N	
BLIND	½"	24"	CL.150, RF	B16.5	ASTM A105N	
ORIFICE	1"	24"	CL.300, RF	B16.36	ASTM A105N	



PARADIP REFINERY PROJECT PROJECT SPECIFICATION



PIPING MATERIAL SPECIFICATION PIPE CLASS : A1AG

3210-8230-SP-0001
PAGE : 4 OF 7
REV : A1

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
LINE BLINDS						
	½"	8"	CL.150, SPECTACLE BLIND	B16.48	ASTM A515 GR.70	
	10"	24"	CL.150, SPADE & SPACER	B16.48	ASTM A515 GR.70	
GASKETS						
	½"	24"	CL.150, TANGED INSERT GASKET, 2 MM THK.	B16.20 / B16.5	FILLER : EXPANDED GRAPHITE, INSERT : ASTM A240 TYPE 316	
	½"	24"	CL.300, SPIRAL WOUND, 4.5MM THK.	B16.20 / B16.5	SP. WINDING + INNER RING : SS316, FILLER : GRAPHITE, OUTER RING :CS 3MM THK	
BOLTS						
	½"	24"	STUD BOLT C/W 2 HEAVY HEX. NUTS	B18.2. 1/ B18.2. 2	STUD: ASTM A193 GR. B7 NUT: ASTM A194 GR. 2H	
VALVES						
PISTON	½"	1"	CL.800, SW, GLANDLESS PISTON VALVE	MFR STD	BODY : ASTM A105 TRIM : STAINLESS STEEL PISTON WITH SS REINFORCED GRAPHITE SEALS	69
GATE	½"	1 ½"	CL.800, SW, SOLID WEDGE, OS & Y, BOLTED BONNET	API 602	BODY :ASTM A105N TRIM : 5 (API 602) (HF)	
GATE	2"	24"	CL.150, RF FLGD., FLEXIBLE WEDGE, OS & Y, BOLTED BONNET	API 600	BODY : ASTM A216 GR.WCB TRIM : 5 (API 600) (HF)	
GLOBE	½"	1 ½"	CL.800, SW, SWIVEL PLUG DISC, OS & Y, BOLTED BONNET	BS EN ISO 15761	BODY : ASTM A105N TRIM : 5 (API 602) (HF)	
GLOBE	2"	16"	CL.150, RF FLGD, SWIVEL PLUG DISC, OS & Y, BOLTED BONNET	BS 1873	BODY: ASTM A216 GR.WCB TRIM : 5 (API 600) (HF)	
CHECK	½"	1 ½"	CL.800, SW, PISTON TYPE, BOLTED COVER	BS EN ISO 15761	BODY : ASTM A105N TRIM : 5 (API 602) (HF)	54
CHECK	8"	24"	CL.150, DUAL PLATE, TYPE A, RF DOUBLE FLGD TO B16.5	API 594	BODY : ASTM A216 GR.WCB TRIM : 5 (API 594) (HF)	56, 57





PARADIP REFINERY PROJECT
PROJECT SPECIFICATION



PIPING MATERIAL SPECIFICATION
PIPE CLASS : A1AG

3210-8230-SP-0001
PAGE : 5 OF 7
REV : A1

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
VALVES						
CHECK	2"	24"	CL.150, RF FLGD, SWING TYPE, BOLTED COVER	BS 1868	BODY : ASTM A216 GR.WCB TRIM : 5 (API 600) (HF)	55, 57
STRAINERS						
Y-TYPE	½"	1 ½"	FORGED, CL.800, SW, W/NPT (M) BLOW-OFF CONNECTION, 0.033" PERFORATION	-	BODY : ASTM A105N STRAINER : SS304	
TEMPORARY	2"	24"	CONE TYPE C/W SPACER TO SUIT ASME B16.5 FLANGES	-	STRAINER : SS304 SPACER : ASTM A515 GR.70	87
STEAM TRAPS						
	½"	1 ½"	CL.150, RF FLGD, THERMODYNAMIC TYPE WITH IN-BUILT STRAINER	-	BODY : ASTM A105N INTERNALS : STAINLESS STEEL	

 IndianOil	PARADIP REFINERY PROJECT PROJECT SPECIFICATION	 3210-8230-SP-0001 PAGE : 6 OF 7 REV : A1
	PIPING MATERIAL SPECIFICATION PIPE CLASS : A1AG	

STANDARD PIPING ASSEMBLIES



VENTS, DRAINS AND INSTRUMENT CONNECTIONS (REFER TO DRAWING 3210-8230-SP-0008 FOR PIPING STANDARD HOOK-UPS)									
HEADER	1½"	2" & UP	1½"	2" & UP	1½"	2" & UP	3"	4" & UP	
	VENT / DRAIN VALVED		VENT HYDROSTATIC		PRESSURE CONNECTION		TEMPERATURE CONNECTION		ORIFICE
ASSL'Y NO.	D01/V01	D02/V02	H03	H04	P01	P02	T01	T02	F01

DESIGN NOTES

- A. BRACE ALL NIPPLES AND BRANCHES ON ALL MAJOR ROTATING EQUIPMENT.
- B. FOR PIPE SIZES 2" AND SMALLER IN VIBRATION SERVICE WHERE BRACING CANNOT BE EFFECTIVELY PROVIDED, NIPPLES WITH SCHEDULE XXS SHALL BE INSTALLED.
- K. STIFFENER RINGS, IF NEEDED SHALL BE PROVIDED IN ACCORDANCE WITH ASME SEC.VIII, DIV.I FOR FULL VACUUM CONDITION.

GENERAL NOTES

- 1. THE MIN. LINE SIZE IN THIS CLASS IS ¾" NB.SIZE ½" NB IS INCLUDED FOR INSTRUMENT CONNECTIONS ONLY.
- 2. ALL BUTT-WELDED COMPONENT THICKNESSES SHALL MATCH THE PIPE THICKNESS.
- 3. REDUCING TEES MAY ONLY BE USED WHERE DEFINED IN THE BRANCH CONNECTION TABLES.
- 4. ALL BUTT-WELDS SHALL BE 100% RADIOGRAPHED.
- 11. CARBON CONTENT SHALL NOT EXCEED 0.25% FOR ALL PIPES, FITTINGS AND FLANGES ETC. THAT MAY REQUIRE WELDING. MOREOVER, FOR FLANGES THE SULPHUR AND PHOSPHOROUS SHALL ALSO BE LIMITED TO 0.05% EACH.
- 12. ALL PIPES, FITTINGS, VALVES, FLANGES, TRAPS, STRAINERS AND OTHER SPECIAL PARTS SHALL BE TESTED AND TEST CERTIFICATE IN FORM IIIA FOR PIPE AND FORM IIIC FOR OTHERS SHALL BE REQUIRED DULY COUNTERSIGNED BY IBR AUTHORITY OR ITS APPROVED REPRESENTATIVE.
- 25. THREADED JOINTS ARE PERMITTED ONLY AT THE OUTLET OF VENT AND DRAIN VALVES.
- 27. USE FLANGE AND BLIND FLANGE FOR NON-VALVED HYDROSTATIC TEST VENTS.
- 28. CONSIDER CONTROLLED BOLT TIGHTENING OF FLANGED JOINTS ACCORDING TO PROJECT STANDARD 3210-8440-SP-0011
- 54. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION ONLY WITH COVER UP.
- 55. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION WITH COVER UP OR IN VERTICAL POSITION WITH UPWARD FLOW.
- 56. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION WITH HINGE PIN VERTICAL OR IN VERTICAL POSTION WITH UPWARD FLOW.
- 57. DUAL PLATE CHECK VALVE IS PREFRRED OPTION.
- 61. FOR NON STANDARD VALVE TYPES REFER TO P&ID.
- 69. USE FOR LP STEAM MANIFOLDS, CONDENSATE RECOVERY MANIFOLDS AND ISOLATION VALVES FOR ALL STEAM TRAPS.

 IndianOil	PARADIP REFINERY PROJECT PROJECT SPECIFICATION	 3210-8230-SP-0001 PAGE : 7 OF 7 REV : A1
	PIPING MATERIAL SPECIFICATION PIPE CLASS : A1AG	

87. REFER PROJECT STANDARD 3210-8230-54-0023.



PARADIP REFINERY PROJECT
PROJECT SPECIFICATION



PIPING MATERIAL SPECIFICATION
PIPE CLASS : B1AS

3210-8230-SP-0001
PAGE : 1 OF 6
REV : A1

PIPE CLASS : **B1AS** DESIGN CODE : IBR
RATING, FLANGE FACE : 300, RF STRESS RELIEF : IBR
MATERIAL : KILLED CS VALVE PACKING : GROUP A
CORROSION ALLOWANCE : 1.5 MM FABRICATION : 3210-8440-SP-0018
SPECIAL REQUIREMENT : IBR SERVICE PMI : -
PAINTING : 3210-8440-SP-0006

TEMPERATURE (Deg.C) AND PRESSURE (Kg/cm² g) RATING

TEMP.	-29	38	93	149	204	260	316	343	371	399
PRESS.	52.03	52.03	47.81	46.05	44.64	42.54	40.07	38.67	37.26	35.51

TEMP.	427
PRESS.	28.83

SERVICE

UTILITY- IBR SERVICE:
MEDIUM PRESSURE STEAM, BLOW DOWN STEAM

SIZE RANGE AND PIPE WALL THICKNESS (MM) TABLE

NPS	½"	¾"	1"	1 ½"	2"	3"	4"	6"	8"	10"
SCHEDULE	160	160	XS	XS	XS	STD	STD	STD	STD	STD
THICKNESS	4.78	5.56	4.55	5.08	5.54	5.49	6.02	7.11	8.18	9.27

NPS	12"	14"	16"	18"	20"	24"
SCHEDULE	40	40	40	40	40	40
THICKNESS	10.31	11.13	12.7	14.27	15.09	17.48



PARADIP REFINERY PROJECT
PROJECT SPECIFICATION



PIPING MATERIAL SPECIFICATION
PIPE CLASS : B1AS

3210-8230-SP-0001
PAGE : 3 OF 6
REV : A1

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
PIPE						
	½"	1 ½"	PE, SEAMLESS	B36.10	ASTM A106 GR.B	
	2"	24"	BE, SEAMLESS	B36.10	ASTM A106 GR.B	
NIPPLE	½"	1 ½"	ENDS AS REQUIRED, SEAMLESS, SCH XXS	B36.10	ASTM A106 GR.B	
FITTINGS						
	½"	¾"	CL.6000, FORGED, SW	B16.11	ASTM A105N	
	1"	1 ½"	CL.3000, FORGED, SW	B16.11	ASTM A105N	
	2"	24"	WROUGHT, SEAMLESS, BW	B16.9	ASTM A234 GR.WPB-S	
THD. CAP	½"	1 ½"	CL.3000, FORGED	B16.11	ASTM A105N	25
BRANCHES						
TEE	½"	¾"	CL.6000, FORGED, SW	B16.11	ASTM A105N	
TEE	1"	1 ½"	CL.3000, FORGED, SW	B16.11	ASTM A105N	
TEE	2"	24"	WROUGHT, SEAMLESS, BW	B16.9	ASTM A234 GR.WPB-S	
SOCKOLET	½"	¾"	CL.6000, FORGED, SW	MSS SP-97	ASTM A105N	
SOCKOLET	1"	1 ½"	CL.3000, FORGED, SW	MSS SP-97	ASTM A105N	
FLANGES						
SOCKET WELD	½"	1 ½"	CL.300, RF	B16.5	ASTM A105N	
WELDNECK	2"	24"	CL.300, RF	B16.5	ASTM A105N	
BLIND	½"	24"	CL.300, RF	B16.5	ASTM A105N	
ORIFICE	1"	24"	CL.300, RF	B16.36	ASTM A105N	
LINE BLINDS						
	½"	8"	CL.300, SPECTACLE BLIND	B16.48	ASTM A515 GR.70	
	10"	24"	CL.300, SPADE & SPACER	B16.48	ASTM A515 GR.70	





PARADIP REFINERY PROJECT
PROJECT SPECIFICATION





PIPING MATERIAL SPECIFICATION
PIPE CLASS : B1AS

3210-8230-SP-0001
PAGE : 4 OF 6
REV : A1

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
GASKETS						
	½"	24"	CL.300, SPIRAL WOUND, 4.5MM THK.	B16.20 / B16.5	SP. WINDING + INNER RING : SS316, FILLER : GRAPHITE, OUTER RING :CS 3MM THK	
BOLTS						
	½"	24"	STUD BOLT C/W 2 HEAVY HEX. NUTS	B18.2. 1/ B18.2. 2	STUD: ASTM A193 GR. B7 NUT: ASTM A194 GR. 2H	
VALVES						
GATE	½"	1 ½"	CL.800, SW, SOLID WEDGE, OS & Y, BOLTED BONNET	API 602	BODY :ASTM A105N TRIM : 5 (API 602) (HF)	
GATE	2"	24"	CL.300, RF FLGD., FLEXIBLE WEDGE, OS & Y, BOLTED BONNET	API 600	BODY : ASTM A216 GR.WCB TRIM : 5 (API 600) (HF)	
GLOBE	½"	1 ½"	CL.800, SW, SWIVEL PLUG DISC, OS &Y, BOLTED BONNET	BS EN ISO 15761	BODY : ASTM A105N TRIM : 5 (API 602) (HF)	
GLOBE	2"	12"	CL.300, RF FLGD, SWIVEL PLUG DISC, OS & Y, BOLTED BONNET	BS 1873	BODY: ASTM A216 GR.WCB TRIM : 5 (API 600) (HF)	
CHECK	½"	1 ½"	CL.800, SW, PISTON TYPE, BOLTED COVER	BS EN ISO 15761	BODY : ASTM A105N TRIM : 5 (API 602) (HF)	54
CHECK	12"	24"	CL.300, DUAL PLATE, TYPE A, RF DOUBLE FLGD TO B16.5	API 594	BODY : ASTM A216 GR.WCB TRIM : 5 (API 594) (HF)	56, 57
CHECK	2"	24"	CL.300, RF FLGD, SWING TYPE, BOLTED COVER	BS 1868	BODY : ASTM A216 GR.WCB TRIM : 5 (API 600) (HF)	55, 57
STRAINERS						
Y-TYPE	½"	1 ½"	FORGED, CL.800, SW, W/NPT (M) BLOW-OFF CONNECTION, 0.033" PERFORATION	-	BODY : ASTM A105N STRAINER : SS304	
TEMPORARY	2"	24"	CONE TYPE C/W SPACER TO SUIT ASME B16.5 FLANGES	-	STRAINER : SS304 SPACER : ASTM A515 GR.70	87

 IndianOil	PARADIP REFINERY PROJECT PROJECT SPECIFICATION		 3210-8230-SP-0001 PAGE : 5 OF 6 REV : A1
	PIPING MATERIAL SPECIFICATION PIPE CLASS : B1AS		

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
STEAM TRAPS						
	½"	1 ½"	CL.300, RF FLGD, THERMODYNAMIC TYPE WITH IN-BUILT STRAINER	-	BODY : ASTM A105N INTERNALS : STAINLESS STEEL	

 IndianOil	PARADIP REFINERY PROJECT PROJECT SPECIFICATION	 3210-8230-SP-0001 PAGE : 6 OF 6 REV : A1
	PIPING MATERIAL SPECIFICATION PIPE CLASS : B1AS	

STANDARD PIPING ASSEMBLIES



VENTS, DRAINS AND INSTRUMENT CONNECTIONS (REFER TO DRAWING 3210-8230-SP-0008 FOR PIPING STANDARD HOOK-UPS)									
HEADER	1½"	2" & UP	1½"	2" & UP	1½"	2" & UP	3"	4" & UP	
	VENT / DRAIN VALVED		VENT HYDROSTATIC		PRESSURE CONNECTION		TEMPERATURE CONNECTION		ORIFICE
ASSL'Y NO.	D01/V01	D02/V02	H03	H04	P01	P02	T01	T02	F01

DESIGN NOTES

- A. BRACE ALL NIPPLES AND BRANCHES ON ALL MAJOR ROTATING EQUIPMENT.
- B. FOR PIPE SIZES 2" AND SMALLER IN VIBRATION SERVICE WHERE BRACING CANNOT BE EFFECTIVELY PROVIDED, NIPPLES WITH SCHEDULE XXS SHALL BE INSTALLED.
- K. STIFFENER RINGS, IF NEEDED SHALL BE PROVIDED IN ACCORDANCE WITH ASME SEC.VIII, DIV.I FOR FULL VACUUM CONDITION.
- Q. PIPE WALL THICKNESS CALCULATION IS BASED ON ASME POWER PIPING CODE B31.1.

GENERAL NOTES

- 1. THE MIN. LINE SIZE IN THIS CLASS IS ¾" NB.SIZE ½" NB IS INCLUDED FOR INSTRUMENT CONNECTIONS ONLY.
- 2. ALL BUTT-WELDED COMPONENT THICKNESSES SHALL MATCH THE PIPE THICKNESS.
- 3. REDUCING TEES MAY ONLY BE USED WHERE DEFINED IN THE BRANCH CONNECTION TABLES.
- 11. CARBON CONTENT SHALL NOT EXCEED 0.25% FOR ALL PIPES, FITTINGS AND FLANGES ETC. THAT MAY REQUIRE WELDING. MOREOVER, FOR FLANGES THE SULPHUR AND PHOSPHOROUS SHALL ALSO BE LIMITED TO 0.05% EACH.
- 12. ALL PIPES, FITTINGS, VALVES, FLANGES, TRAPS, STRAINERS AND OTHER SPECIAL PARTS SHALL BE TESTED AND TEST CERTIFICATE IN FORM IIIA FOR PIPE AND FORM IIIC FOR OTHERS SHALL BE REQUIRED DULY COUNTERSIGNED BY IBR AUTHORITY OR ITS APPROVED REPRESENTATIVE.
- 25. THREADED JOINTS ARE PERMITTED ONLY AT THE OUTLET OF VENT AND DRAIN VALVES.
- 27. USE FLANGE AND BLIND FLANGE FOR NON-VALVED HYDROSTATIC TEST VENTS.
- 28. CONSIDER CONTROLLED BOLT TIGHTENING OF FLANGED JOINTS ACCORDING TO PROJECT STANDARD 3210-8440-SP-0011
- 54. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION ONLY WITH COVER UP.
- 55. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION WITH COVER UP OR IN VERTICAL POSITION WITH UPWARD FLOW.
- 56. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION WITH HINGE PIN VERTICAL OR IN VERTICAL POSTION WITH UPWARD FLOW.
- 57. DUAL PLATE CHECK VALVE IS PREFRRED OPTION.
- 61. FOR NON STANDARD VALVE TYPES REFER TO P&ID.
- 87. REFER PROJECT STANDARD 3210-8230-54-0023.

 IndianOil	PARADIP REFINERY PROJECT PROJECT SPECIFICATION	 3210-8230-SP-0001 PAGE : 1 OF 6 REV : A1
	PIPING MATERIAL SPECIFICATION PIPE CLASS : A1LD	

PIPE CLASS	:	A1LD	DESIGN CODE	:	ASME B31.3
RATING, FLANGE FACE	:	150, RF	STRESS RELIEF	:	NO
MATERIAL	:	SS 316L	VALVE PACKING	:	GROUP A
CORROSION ALLOWANCE	:	1.5 MM	FABRICATION	:	3210-8440-SP-0018
SPECIAL REQUIREMENT	:	-	PMI	:	3210-8440-SP-0016
			PAINTING	:	3210-8440-SP-0006

TEMPERATURE (Deg.C) AND PRESSURE (Kg/cm2 g) RATING (FOR ½"NB THROUGH 4"NB)

TEMP.	-29	38	93	149	204
PRESS.	16.17	16.17	13.71	12.30	11.25

SERVICE

UTILITY - HYDROCARBON :
LUBRICATING OIL, SEAL OIL

SIZE RANGE AND PIPE WALL THICKNESS (MM) TABLE

NPS	½"	¾"	1"	1 ½"	2"	3"	4"	6"	8"	10"
SCHEDULE	80S	80S	80S	80S	80S	40S	40S	-	-	-
THICKNESS	3.73	3.91	4.55	5.08	5.54	5.49	6.02	CALC	CALC	CALC

NPS	12"
SCHEDULE	-
THICKNESS	CALC



PARADIP REFINERY PROJECT
PROJECT SPECIFICATION



PIPING MATERIAL SPECIFICATION
PIPE CLASS : A1LD

3210-8230-SP-0001
PAGE : 3 OF 6
REV : A1

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
PIPE						
	½"	1 ½"	PE, SEAMLESS	B36.19	ASTM A312 TP316L	
	2"	8"	BE, SEAMLESS	B36.19	ASTM A312 TP316L	
	10"	12"	BE, WELDED	B36.19	ASTM A358 GR.316L CL 1	
NIPPLE	½"	1 ½"	ENDS AS REQUIRED, SEAMLESS, SCH 80S	B36.19	ASTM A312 TP316L	
FITTINGS						
	½"	1 ½"	CL.3000, FORGED, SW	B16.11	ASTM A182 GR. F316L	
	2"	8"	WROUGHT, SEAMLESS, BW	B16.9	ASTM A403 GR. WP316L - S	
	10"	12"	WROUGHT, WELDED, BW	B16.9	ASTM A403 GR. WP316L - WX	
THD. CAP	½"	1 ½"	CL.3000, FORGED	B16.11	ASTM A182 GR.F316L	25
BRANCHES						
TEE	½"	1 ½"	CL.3000, FORGED , SW	B16.11	ASTM A182 GR. F316L	
TEE	2"	8"	WROUGHT, SEAMLESS, BW	B16.9	ASTM A403 GR. WP316 - S	
TEE	10"	12"	WROUGHT, WELDED, BW	B16.9	ASTM A403 GR. WP316L - WX	
SOCKOLET	½"	1 ½"	CL.3000, FORGED , SW	MSS SP-97	ASTM A182 GR. F316L	
FLANGES						
SW	½"	1 ½"	CL.150, RF	B16.5	ASTM A182 GR. F316L	
WELDNECK	2"	12"	CL.150, RF	B16.5	ASTM A182 GR. F316L	
BLIND	½"	12"	CL.150, RF	B16.5	ASTM A182 GR. F316	
ORIFICE	1"	12"	CL.300, RF	B16.36	ASTM A182 GR. F316L	
LINE BLINDS						
	½"	8"	CL.150, SPECTACLE BLIND	B16.48	ASTM A240 GR. 316	
	10"	12"	CL.150, SPADE & SPACER	B16.48	ASTM A240 GR. 316	



PARADIP REFINERY PROJECT
PROJECT SPECIFICATION



PIPING MATERIAL SPECIFICATION
PIPE CLASS : A1LD

3210-8230-SP-0001
PAGE : 4 OF 6
REV : A1

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
GASKETS						
	½"	12"	CL.150, TANGED INSERT GASKET, 2 MM THK	B16.20 / B16.5	FILLER : EXPANDED GRAPHITE, INSERT : ASTM A240 TYPE 316	
	½"	12"	CL.300, SPIRAL WOUND, 4.5 MM THK	B16.20 / B16.5	SP. WINDING + INNER RING : SS316, FILLER : GRAPHITE, OUTER RING :CS 3MM THK	
BOLTS						
	½"	12"	STUD BOLT C/W 2 HEAVY HEX. NUTS	B18.2. 1/ B18.2. 2	STUD: ASTM A193 GR. B7 NUT: ASTM A194 GR. 2H	
VALVES						
BALL	½"	4"	CL.150, RF FLGD, FLOATING BALL, REDUCED PORT, FIRESAFE	API 608	BODY : ASTM A182 GR.F316 / ASTM A351 GR. CF8M BALL: ASTM A351 GR. CF8M SEAT : RTFE	58, 59, 60
BALL	6"	12"	CL.150, RF FLGD, TRUNNION MOUNTED BALL, REDUCED PORT, FIRESAFE	API 608	BODY : ASTM A351 GR. CF8M BALL: ASTM A351 GR. CF8M SEAT : RTFE	58, 59, 60
CHECK	½"	1 ½"	CL.800, SW, PISTON TYPE, BOLTED COVER	BS EN 15761	BODY :ASTM A182 GR. F316L TRIM : 12 (API 602) (SS316/HF)	54
CHECK	8"	12"	CL.150, DUAL PLATE, TYPE A, RF DOUBLE FLGD TO B16.5	API 594	BODY : ASTM A 351 GR.CF8M TRIM : 12 (API 594) (SS316/HF)	56, 57
CHECK	2"	12"	CL.150, RF FLGD, SWING TYPE, BOLTED COVER	BS 1868	BODY : ASTM A 351 GR.CF8M TRIM : 12 (API 600) (SS316/HF)	55, 57
BUTTERFLY	6"	12"	CL.150, RF DOUBLE FLGD TO B16.5, FIRE SAFE TO API 607	API 609, CAT.B	BODY : ASTM A351 GR. CF8M DISC : SS 316 SEAT: FLURO-CARBON ELASTOMER	60





PARADIP REFINERY PROJECT
PROJECT SPECIFICATION



PIPING MATERIAL SPECIFICATION
PIPE CLASS : A1LD

3210-8230-SP-0001
PAGE : 5 OF 6
REV : A1

ELEMENT NAME	NPS (INCH)		DESCRIPTION	MFG. STD.	MATERIAL STD.	NOTES
	FROM	TO				
STRAINERS						
Y-TYPE	½"	1 ½"	FORGED, CL.800, SW, W/NPT (M) BLOW-OFF CONNECTION, 0.033" PERFORATION	-	BODY : ASTM A182 GR. F316L STRAINER : SS316	
T-TYPE	2"	8"	CL. 150, BW	-	BODY : ASTM A403 GR. WP316L - S FLANGE : ASTM A182 GR. F316L STRAINER : SS316	101
T-TYPE	10"	12"	CL. 150, BW	-	BODY : ASTM A403 GR. WP316L - W FLANGE : ASTM A182 GR. F316L STRAINER : SS316	101
TEMPORARY	2"	12"	CONE TYPE C/W SPACER TO SUIT ASME B16.5 FLANGES	-	STRAINER : SS304 SPACER : ASTM A240 GR.316	87

 IndianOil	PARADIP REFINERY PROJECT PROJECT SPECIFICATION	 3210-8230-SP-0001 PAGE : 6 OF 6 REV : A1
	PIPING MATERIAL SPECIFICATION PIPE CLASS : A1LD	

STANDARD PIPING ASSEMBLIES

VENTS, DRAINS AND INSTRUMENT CONNECTIONS (REFER TO DRAWING 3210-8230-SP-0008 FOR PIPING STANDARD HOOK-UPS)									
HEADER	1½"	2" & UP	1½"	2" & UP	1½"	2" & UP	3"	4" & UP	
	VENT / DRAIN VALVED ##		VENT HYDROSTATIC		PRESSURE CONNECTION ##		TEMPERATURE CONNECTION		ORIFICE ##
ASSL'Y NO.	D01/V01	D02/V02	H03	H04	P01	P02	T01	T02	F01

USE FLANGED BALL VALVES

DESIGN NOTES

- A. BRACE ALL NIPPLES AND BRANCHES ON ALL MAJOR ROTATING EQUIPMENT.
- G. WHERE 'CALC' IS SHOWN, THE PIPE THICKNESS SHALL BE CALCULATED IN ACCORDANCE WITH PARA 3.4 OF PIPING MATERIAL SPECIFICATION. THE MIN. THICKNESS SHALL NOT BE LESS THAN SCHEDULE 10S.

GENERAL NOTES

1. THE MIN. LINE SIZE IN THIS CLASS IS ¾" NB. SIZE ½" NB IS INCLUDED FOR INSTRUMENT CONNECTIONS ONLY.
2. ALL BUTT-WELDED COMPONENT THICKNESSES SHALL MATCH THE PIPE THICKNESS.
3. REDUCING TEES MAY ONLY BE USED WHERE DEFINED IN THE BRANCH CONNECTION TABLES.
27. USE FLANGE AND BLIND FLANGE FOR NON-VALVED HYDROSTATIC TEST VENTS.
28. CONSIDER CONTROLLED BOLT TIGHTENING OF FLANGED JOINTS ACCORDING TO PROJECT STANDARD 3210-8440-SP-0011
54. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION ONLY WITH COVER UP.
55. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION WITH COVER UP OR IN VERTICAL POSITION WITH UPWARD FLOW.
56. THESE CHECK VALVES SHALL BE INSTALLED IN HORIZONTAL POSITION WITH HINGE PIN VERTICAL OR IN VERTICAL POSITION WITH UPWARD FLOW.
57. DUAL PLATE CHECK VALVE IS PREFERRED OPTION.
58. THE USE OF SOFT SEATED BALL VALVES IS RESTRICTED TO MAX. DESIGN TEMPERATURE OF 204°C.
59. FULL PORT VALVES SHALL BE USED IF INDICATED ON THE P&ID.
60. ABOVE 121°C SERVICE, DERATE VALVE ACCORDING TO MANUFACTURER'S PRESSURE / TEMPERATURE TABLE.
61. FOR NON STANDARD VALVE TYPES REFER TO P&ID.
62. USE OF WAFER TYPE AND LUG TYPE BODY FOR THE BUTTERFLY VALVES IS NOT PERMITTED.
87. REFER PROJECT STANDARD 3210-8230-54-0023.
101. REFER PROJECT STANDARD 3210-8230-54-0053, 3210-8230-54-0054, 3210-8230-54-0055.

JOB SPECIFICATION FOR SHOP & FIELD PAINTING SMMS DEPARTMENT CAPTIVE POWER PLANT

PROJECT : PARADIP REFINERY

OWNER : INDIAN OIL CORPORATION LIMITED (IOCL)

PMC : ENGINEERS INDIA LTD.

JOB NO. : A011

0	28-07-2009	ISSUED AS JOB SPECIFICATION BY SMMS DEPARTMENT	AS	DR.DNW	RC
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

Abbreviations:

AS	:	Alloy Steel
CS	:	Carbon Steel
LTCS	:	Low Temperature Carbon Steel
MS	:	Mild Steel
SS	:	Stainless Steel
GI	:	Galvanized Iron
DFT	:	Dry Film Thickness
WFT	:	Wet Film Thickness
DM	:	De-mineralized
ID	:	Internal Diameter
OD	:	Outside Diameter
NB	:	Nominal Bore
RCC	:	Reinforced Cement Concrete
IRN	:	Inspection Release Note

CONTENTS

SL. NO	DESCRIPTION	PAGE NO.
1.0	General	4
2.0	Scope	4
3.0	Reference Codes & Standards	6
4.0	Equipment	6
5.0	Surface Preparation, Shop Primer, Coating Application & Repair and Documentation	7
6.0	Paint Materials	16
7.0	Paint Systems	21
8.0	Paint System for Corrosive Environment-Offsite Areas (Excluding Cooling Tower Area & DM Plant Area)	24
9.0	Paint System for Corrosive Environment-Unit Areas	25
10.0	Paint System for Highly Corrosive Environment-Unit & Offsite Areas of the Plant with Corrosive Fumes like HCL, H ₂ SO ₄ , Water Impingement, Salty Water, Chloride & Water Mist, DM Plant Area, Cooling Tower Area	26
11.0	Paint System for Carbon Steel and Low Alloy Steel Storage Tanks (External)- All Areas (Units & Offsites)	27
12.0	Paint System for Carbon Steel and Low Alloy Steel Storage Tanks (Internal); All Areas (Units & Offsites)	28
13.0	Coating System for External Side of Underground Carbon Steel Plant Piping and Underground Tanks in All Areas	30
14.0	Painting Under Insulation All Environments/All Areas (Units & Offsites)	31
15.0	Internal Protection of Carbon Steel Coolers/ Condensers.	32
16.0	Field Painting System for GI Towers/Non-Ferrous Tube Sheet	32
17.0	Shop and Field Painting system for ETP	33
18.0	Storage	34
19.0	Colour Code for Piping	34
20.0	Identification of Vessels, Piping etc.	43
21.0	Painting for Civil Defence Requirements	43
22.0	Inspection and Testing	43
23.0	Guarantee	45
24.0	Qualification Criteria of Painting Contractor	45
25.0	Procedure for Approval of New Paint Manufacturers	45
	Annexure-I – List of Recommended Manufacturers	47
	Annexure-II – List of Recommended Manufacturers' Products	48

1.0 GENERAL

- 1.1 These technical specifications shall be applicable for the work covered by the contract, and without prejudice to the provisions of various codes of practice, standard specifications etc. It is understood that contractor shall carry out the work in all respects with the best quality of materials and workmanship and in accordance with the best engineering practice and instructions of Engineer-In-Charge.
- 1.2 Wherever it is stated in the specification that a specific material is to be supplied or a specific work is to be done, it shall be deemed that the same shall be supplied or carried out by the contractor.

Any deviation from this standard without written deviation permit from appropriate authority will result in rejection of job.

2.0 SCOPE

- 2.1 Scope of work covered in the specification shall include, without being limited to the following.
- 2.1.1 This specification defines the requirements for surface preparation, selection and application of primers and paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, external & internal protection of storage tanks for all services, MS Chimney with & without Refractory lining, MS Chimney with insulation and without insulation and Flare lines etc. The items listed in the heading of tables of paint systems is indicative only, however, the contractor is fully responsible for carrying out all the necessary painting, coating and lining on external and internal surfaces as per the tender requirement.

2.2 Extent of Work

- 2.2.1 The following surfaces and materials shall require shop, pre-erection and field painting:
- All uninsulated C.S. & A.S. equipment like columns, vessels, drums, storage tanks(both external & internal surfaces), heat exchangers, pumps, compressors, electrical panels and motors etc.
 - All uninsulated carbon and low alloy piping, fittings and valves (including painting of identification marks), furnace ducts and stacks.
 - All items contained in a package unit as necessary.
 - All structural steel work, pipe, structural steel supports, walkways, handrails, ladders, platforms etc.
 - Flare lines, external surfaces of MS chimney with and without refractory lining and internal surfaces of MS chimney without refractory lining. MS chimney with insulation and without un-insulation.
 - Identification colour bands on all piping as required including insulated aluminium clad, galvanised, SS and nonferrous piping.

- g. Identification lettering/ numbering on all painted surfaces of equipment/piping insulated aluminium clad, galvanized, SS and non-ferrous piping
- h. Marking / identification signs on painted surfaces of equipment/piping including hazardous service.
- i. Supply of all primers, paints and all other materials required for painting (other than Owner supplied materials)
- j. Over insulation surface of equipments and pipes wherever required.
- k. Painting under insulation for carbon steel, alloy steel and stainless steel as specified.
- l. Painting of pre-erection/fabrication and Shop primer.
- m. Repair work of damaged pre-erection/ fabrication and shop primer and weld joints in the field/site before and after erection as required.
- n. All CS Piping, equipments, storage tanks and internal surfaces of RCC tanks in **ETP plant.**

2.2.2 The following surfaces and materials shall not require painting in general. However, if there is any specific requirement by the owner, the same shall be painted as per the relevant specifications:

- a. Uninsulated austenitic stainless steel.
- b. Plastic and/or plastic coated materials
- c. Non-ferrous materials like aluminum.

2.3 Documents

2.3.1 The contractor shall perform the work in accordance with the following documents issued to him for execution of work.

- a. Bill of quantities for piping, equipment, machinery and structures etc.
- b. Piping Line List.
- c. Painting specifications including special civil defence requirements.

2.4 Unless otherwise instructed, final painting on pre-erection/ shop primed pipes and equipments shall be painted in the field, only after the mechanical completion, testing on systems are completed as well as after completion of steam purging wherever required.

2.5 Changes and deviations required for any specific job due to clients requirement or otherwise shall be referred to EIL for deviation permit.

3.0 REFERENCE CODES & STANDARDS

3.1 Without prejudice to the provision of Clause 1.1 above and the detailed specifications of the contract, latest editions of the following codes and standards are applicable for the work covered by this contract.

IS-5	:	Colour coding.
RAL DUTCH	:	International Standard for colour shade (Dutch Standard)
IS-101	:	Methods of test for ready mixed paints and enamels.
IS-2379	:	Indian Standard for Pipe line identification-colour code.
ASTM-Vol 6.01 & 6.03:		American standard test methods for Paints and Coatings.
ASA A 13.1-1981:		Scheme for identification of piping systems: American National Standards Institution.

3.2 Surface Preparation Standards

The latest editions of any of the following standards shall be followed for surface preparation:

3.2.1 ISO 8501-1 / SIS-05 59 00: ISO standard for Preparation of steel substrates before application of paints and related products. This standard contains photographs of the various standards on four different degrees of rusted steel and as such is preferable for inspection purpose by the Engineer-In-Charge.

3.2.2 Steel Structures Painting Council, U.S.A. (Surface Preparation Specifications (SSPC-SP).

3.2.3 National Association of Corrosion Engineers, U.S.A., (NACE).

3.2.4 Various International Standards equivalent to Swedish Standard for surface preparations are given in Table-I.

3.3 The contractor shall arrange, at his own cost, to keep a set of latest edition of above standards and codes at site.

3.4 The paint manufacturer's instructions shall be followed as far as practicable at all times for best results. Particular attention shall be paid to the following:

- Instructions for storage to avoid exposure as well as extremes of temperature.
- Surface preparation prior to painting shall be followed as per Table 8.0 to 16.0 of this standard shall be followed.
- Mixing and thinning.
- Application of paints and recommended limit on time intervals in between coats.

4.0 EQUIPMENT

4.1 All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning and all equipments, scaffolding materials, shot & grit blasting equipments & air compressors etc. required to be used shall be suitable for the work and all in good order and shall be

arranged by the contractor at site and in sufficient quantity. The manufacturer's test certificates / data sheets for all the above items shall be reviewed by Engineer-in-charge at site before start of work.

- 4.2 Mechanical mixer shall be used for paint mixing operations in case of two pack systems except that the Engineer-In-Charge may allow the hand mixing of small quantities at his discretion in case of specific requirement for touch up work only.

5.0 SURFACE PREPARATION, SHOP PRIMER COATING APPLICATION & REPAIR AND DOCUMENTATION

5.1 General

- 5.1.1 In order to achieve the maximum durability, one or more of following methods of surface preparation shall be followed, depending on condition of surface to be painted and as instructed by Engineer-In-Charge. Adhesion of the paint film to surface depends largely on the degree of cleanliness of the metal surface. Proper surface preparation contributes more to the success of the paint protective system.

- a. Manual or hand tool cleaning.
- b. Mechanical or power tool cleaning.
- c. Blast cleaning.

- 5.1.2 Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. Unless otherwise specified, surface preparation shall be done as per provisions of relevant tables given elsewhere in this specification. The minimum acceptable standard in case of manual or hand tool cleaning shall be St. 2 or equivalent, in case of mechanical or power tool cleaning it shall be St. 3 or equivalent, in case of blast cleaning it shall be Sa 2-1/2 as per Swedish Standard SIS-055900(latest edition) or SSPC-SP or ISO 8501-01. Blast cleaning shall be Sa 3 as per Swedish Standard in case of highly corrosive environment.

Remove all other contaminants, oil, grease etc. by use of an aromatic solvent prior to surface cleaning.

- 5.1.3 Blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceed 85%. In case of internal coating of storage tanks, De-humidifiers shall be used to control the humidity levels during rainy season, if painting is to be carried out during the no rain days in case of exigency of project schedule with prior permission of Engineer-in-charge of OWNER/EIL
- 5.1.4 Irrespective of the method of surface preparation, the first coat of primer must be applied by airless spray/ air assisted conventional spray if recommended by the paint manufacturer on dry surface. This should be done immediately and in any case within 4 hours of cleaning of surface. However, at times of unfavorable weather conditions, the Engineer-In-Charge shall have the liberty to control the time period, at his sole discretion and/or to insist on re-cleaning, as may be required, before primer application is taken up. In general, during unfavorable weather conditions, blasting and painting shall be avoided as far as practicable.

- 5.1.5 The external surface of R.C.C. chimney to be painted shall be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed by scrubbing with soft wire brush. Acid etching with 10-15% HCL solution for about 15 minutes shall be carried and surface must be thoroughly washed with water to remove acid & loose particles and then dried completely before application of paint.

5.2 Procedure of Surface Preparation :

5.2.1 Air Blast Cleaning with abrasives

The surfaces shall be blast cleaned using one of the abrasives like copper slag, Al_2O_3 particles, chilled cast iron or malleable iron and steel at pressure of $7kg/cm^2$ at a appropriate distance and angle depending of nozzle size maintaining constant velocity and pressure. Chilled cast iron, malleable iron and steel shall be in the form of shot or grit of size with appropriate size of G42 grade (maximum) and S250 grade size of steel shots (maximum) to obtain a desired surface profile of 35-50 microns trough to peak or specified profile in case of steel and malleable iron . The combination of steel grits and shots shall be normally in the ratio of 3 : 1. The quality of abrasives shall be free from contaminants and impurities and shall meet the requirements of SSPC AB1. Compressed air shall be free from moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the materials for liners. Nozzles orifice may vary from 3/16" to 3/4". On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic luster. Primer/first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bad weather without adequate protection or when there is dew on the metal, which is to be cleaned. Surface profile shall be uniform to provide good key to the paint adhesion (i.e. 35 to 50 microns). If possible vacuum collector shall be installed for collecting the abrasives and recycling.

5.2.2 Mechanical or Power Tool Cleaning

Power tool cleaning shall be done by mechanical striking tools, chipping hammers, grinding wheels or rotating steel wire- brushes. Excessive burnish of surface shall be avoided as it can reduce paint adhesion. On completion of cleaning, the detached rust mill scale etc. shall be removed by clean rags and /or washed by water or steam and thoroughly dried with compressed air jet before application of paint.

5.2.3 Manual or hand tool cleaning

Manual or hand tool cleaning is used only where safety problems limit the application of other surface preparation procedure and hence does not appear in the tables of paint systems.

Hand tool cleaning normally consists of the following:

- a. Hand de-scaling and/or hammering
- b. Hand scraping
- c. Hand wire brushing

Rust, mill scale spatters, old coatings and other foreign matter, shall be removed by hammering, scrapping tools, emery paper cleaning, wire brushing or combination of the

above methods. On completion of cleaning, loose material shall be removed from the surface by clean rags and the surface shall be brushed, swept, dusted and blow off with compressed air/steam to remove all loose matter. Finally the surface may be washed with water and dried for effective cleaning.

5.3 Non-Compatible shop coat primer

The paint system followed for Shop coating of structures/equipments etc., shall be mentioned in IRN. The compatibility of finishing coat should be confirmed from the paint manufacturer. In the event of use of primer such as zinc Rich epoxy, inorganic zinc silicate etc. as shop coat, the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer-in-Charge.

5.4 Shop coated (coated with Primer & finishing coat) equipment should not be repainted unless paint is damaged. Repair shall be carried out as per Table 7.2 of paint systems depending upon compatibility of paint.

5.5 Shop primed equipment and surfaces will only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer should be completely removed before application of selected paint system for particular environment.

5.6 For Package units/equipment, shop primer should be as per the paint system given in this specification. However, manufacturer's standard can be followed after review.

5.7 Coating Procedure and Application

5.7.1 Surface shall not be coated in rain, wind or in environment where injurious airborne elements exists, when the steel surface temperature is less than 5°F above dew point when the relative humidity is greater than 85% or when the temperature is below 40°F and when the ambient/substrate temp is below the paint manufacturer's recommended temperature of application and curing. De-humidifier equipment shall be used to control RH and Dew point. The paint application shall not be done when the wind speed exceeds 20KM per hour.

5.7.2 Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hrs the same day.

5.7.3 To the maximum extent practicable, each coat of material shall be applied as a continuous film uniform thickness free of probes. Any spots or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.

5.7.4 Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer instruction shall be followed for inter coat interval.

5.7.5 When the successive coat of the same colour have been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate complete coverage of the surface. The tinting material shall be compatible with the material and not detrimental to its service life and shall be recommended by the original paint manufacturer.

5.7.6 Air spray application shall be in accordance with the following:

- a. The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied, and shall be equipped with suitable pressure regulators and gauges. The air caps, nozzles, and needles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.
- b. Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.
- c. **Ingredients shall be kept properly mixed in the spray pots or containers during application by continuous mechanical agitation.**
- d. The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The pressure on the material in the pot shall be adjusted when necessary for changes in elevation of the gun above the pot. The atomizing air pressure at the gun shall be high enough to properly atomize the paint but not so high as to cause excessive fogging of paint, excessive evaporation of solvent, or less by over spray
- e. Spray equipment shall be kept sufficiently clean so that dirt, dried paint, and other foreign materials are not deposited in the paint film.

Any solvents left in the equipment shall be completely removed before applying paint to the surface being painted.

- f. Paint shall be applied in a uniform layer, with overlapping at the edge of the spray pattern. The spray patterns shall be adjusted so that the paint is deposited uniformly. During application, the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke.
- g. All runs and sags shall be brushed out immediately or the paint shall be removed and the surface repainted.
- h. Areas inaccessible to the spray gun shall be painted by brush; if not accessible by brush, daubers or sheepskins shall be used.
- i. All nameplates, manufacturer's identification tags, machined surfaces, instrument glass, finished flange faces, control valve items and similar items shall be masked to prohibit coating deposition. If these surfaces are coated, the component shall be cleaned and resorted to its original condition.

- j. Edges of structural shapes and irregular coated surfaces shall be coated first and an extra pass made later.
- k. If spray gun shows choking, immediately de-choking procedure shall be followed.

5.7.7 Airless spray application shall be in accordance with the following procedure: as per steel structure paint Manual Vol.1 & Vol.2 by SSPC, USA, Air less spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor is used to operate a pump to produce pressures of 1000 to 6000 psi. paint is delivered to the spray gun at this pressure through a single hose within the gun, a single paint stream is divided into separate streams, which are forced through a small orifice resulting in atomization of paint without the use of air. This results in more rapid coverage with less over spray. Airless spray usually is faster, cleaner, more economical and easier to use than conventional air spray.

Airless spray equipment is mounted on wheels, and paint is aspirated in a hose that sucks paint from any container, including drums. The unit shall have in built agitator that keep the paint uniformly mixed during the spraying. The unit shall consist of in built strainer. Usually very small quantity of thinning is required before spray. In case of high build epoxy coating (two pack). 30:1 pump ratio and 0.020-0.023" tip size will provide a good spray pattern. Ideally fluid hoses should not be less than 3/8" ID and not longer than 50 ft to obtain optimum results.

In case of gun choking, de-choking steps shall be followed immediately.

5.7.8 Brush application of paint shall be in accordance with the following:

- a. Brushes shall be of a style and quality that will enable proper application of paint.
- b. Round or oval brushes are most suitable for rivets, bolts, irregular surface, and rough or pitted steel. Wide flat brushes are suitable for large flat areas, but they shall not have width over five inches.
- c. Paint shall be applied into all corners.
- d. Any runs or sags shall be brushed out.
- e. There shall be a minimum of brush marks left in the applied paint.
- f. Surfaces not accessible to brushes shall be painted by spray, doublers, or sheepkin.

5.7.9 Manual application by sling (where 6 O' clock position of pipe is not approachable)

A canvas strip (alternatively a tinplate strip) about 450 mm wide and 1.5m long is hold under the pipe by two men holding this sling move it up and down and walk slowly forward while fresh coating is poured on the pipe and they manipulate the sling so that an even coating is obtained all round the bottom. This work shall be done very carefully and by experienced personnel. There shall not be any formation of "Whiskers" and holes in the coating. The coating film shall be inspected by mirror.

- 5.7.10 For each coat the painter should know the WFT corresponding to the specified DFT and standardize the paint application technique to achieve the desired WFT. This has to be ensured in the qualification trial.

5.8 Drying of coated surfaces

- 5.8.1 No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or mixing is faulty.
- 5.8.2 No paint shall be force dried under conditions which will cause checking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.
- 5.8.3 No drier shall be added to a paint on the job unless specifically called for in the manufacturer's specification for the paint.
- 5.8.4 Paint shall be protected from rain, condensation, contamination, snow and freezing until dry to the fullest extent practicable.

5.9 Repair of damaged paint surface

- 5.9.1 Where paint has been damaged in handling and in transportation, the repair of damaged coating of pre-erection / fabrication and Shop primer shall be done as given below and as per the Table 7.2 of this specification.
- 5.9.2 Repair of damaged inorganic zinc silicate primer after erection / welding in the design temperature of -90°C to 550°C.

Surface Preparation: Quickly remove the primer from damaged area by mechanical scraping and emery paper conforming to SSPC-SP-3 to expose the white metal. Blast clean the surface, if possible. Feather the primed surface over the intact adjacent surface surrounding the damaged area by emery paper.

Primer coating: One coat of F-9 shall be applied wherever damaged was observed on pre-erection pre fabrication / shop primer of inorganic zinc silicate coating (F-9). F-9 shall not be applied if damaged area is not more than 5x5 cm.

5.10 Paint Application

- 5.10.1 Shop priming/pre-erection priming with F9 or F12 shall be done only on blasted surface (SSPC-SP-10)
- 5.10.2 Shop priming/ pre-erection priming with F9 or F12 shall be done only with airless spray.
- 5.10.3 For large flat surface field painting shall be done by airless spray otherwise brush can be used.

5.10.4 Assessment of painting requirement

The paint system to be applied for a specific job shall be arrived at sequentially as given below:

- Identify the environment from area classification details and chose the appropriate table.
- Identify the design temperature from the technical documents
- Identify the specific field paint system and surface preparation requirement from the above identified table and temperature range.
- Identify the shop priming requirement from Table 7.1 based on compatibility of the above paint system.
- Identify the need of repair of shop primer and execute as per Table 7.2.

5.11 Documentation

- 5.11.1 A written quality plan with procedure for qualification trials and for the actual work.
- 5.11.2 Daily progress report with details of weather conditions, particular of applications, no of coats and type of materials applied, anomalies, progress of work versus program.
- 5.11.3 Results of measurement of temperatures relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.
- 5.11.4 Particulars of surface preparation and paint application during trials and during the work.
- 5.11.5 Details of non-compliance, rejects and repairs.
- 5.11.6 Type of testing equipments and calibration.
- 5.11.7 Code and batch numbers of paint materials used.

TABLE-1 (FOR CLAUSE 5.0)
SURFACE PREPARATION STANDARDS

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
1	Manual or hand tool cleaning Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, standing and wire brushing. Surface should have a faint metallic sheen	ST.2	SSPC-SP-2	--	This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.
2	Mechanical or power tool cleaning Removal of loose rust loose mill scale and loose paint to degree specified by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.	ST.3	SSPC-SP-3	--	
3	Dry abrasive Blast cleaning There are four common grades of blast cleaning				
3.1	White metal Blast cleaning to white metal cleanliness. Removal of all visible rust. Mill scale, paint & foreign matter 100% cleanliness with desired surface profile.	SA 3	SSPC-SP-5	NACE#1	Where extremely clean surface can be expected for prolong life of paint system.
3.2	Near white metal Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of	SA 2½	SSPC-SP-10	NACE#2	The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
	all visible residues with desired surface profile.				silicate paints, also for conventional paint systems used under fairly corrosive conditions to obtain desired life of paint system.
3.3	Commercial Blast Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.	SA 2	SSPC-SP-6	NACE # 3	For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.
3.4	Brush-off Blast Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint & foreign matter. Surface profile is not so important	SA 1	SSPC-SP-7	NACE # 4	

6.0 PAINT MATERIALS

Paint manufacturers shall furnish the characteristics of all paints materials on original printed literature, alongwith the test certificate for all specified characteristics given in this specification. All the paint materials shall be of first quality and conform to the following general characteristics as per the tables 6.1, 6.2, 6.3 and 6.4.

PAINT MATERIALS

TABLE No. 6.1 PRIMERS

SI. No.	DESCRIPTION	P-2	P-4	P-6	P-7
1	Technical name	Chlorinated rubber Zinc Phosphate primer.	Etch primer/wash primer	Epoxy zinc phosphate primer	ZINGA synthetic zinc primer
2	Type and composition	Single pack, air drying chlorinated rubber based medium plasticised with unsaponifiable plasticizer, pigmented with zinc phosphate.	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.	Two component polyamine cured epoxy resin medium, pigmented with zinc phosphate.	One pack Synthetic Resin based zinc primer containing 96% of electrolytic zinc dust of 99.995% purity.
3	Volume Solids (minimum)	40%.	7-8%	40%	37%
4	DFT (Dry Film thickness) per coat (minimum)	30-40μ	8-10μ	40-50μ	40-50μ
5	Theoretical covering capacity in M ² /coat/ litre (minimum)	8-10	8-10	8-10	4m ² /kg
6	Weight per litre in kgs/litre (minimum)	1.3	1.2	1.4	2.67 kg at 15°C
7	Touch dry at 30°C (minimum)	30 minutes	2 hrs.	After 30 min.	10 minutes
8	Hard dry at 30°C (maximum.)	24 hrs.	24 hrs.	24 hrs.	24 hrs.
9	Overcoating interval	Min.: 8 hrs	Min: 4-6 hrs.	Min.:8hrs.	Min.:4 hrs
10	Pot life at 30°C for two component paints (minimum)	Not Applicable	Not applicable	6 - 8 hrs.	Unlimited
11	Temperature (Resistance (minimum)	60 °C	NA	80°C	100°C.

PAINT MATERIALS

TABLE No. 6.2 FINISH PAINTS

Sl. No	DESCRIPTION	F-2	F-3	F-6A/B	F-7
1	Technical name	Acrylic Polyurethane finish paint	Chlorinated rubber based finish paint	Epoxy-High Build finish paint.	High build coaltar epoxy coating.
2	Type and composition	Two-pack aliphatic isocynate cured acrylic finish paint.	Single pack plasticised chlorinated rubber based medium with chemical and weather resistant pigments.	F6A: Two-pack polyamine cured epoxy resin medium suitably pigmented. F6B: polyamide cured epoxy resin medium suitably pigmented	Two pack polyamide cured epoxy resin blended with coaltar medium, suitably pigmented
3	Volume Solids (minimum.)	40%.	40%	62%	65%
4	DFT (Dry Film thickness) per coat (minimum)	30-40μ	30-40μ	100-125μ	100-125μ
5	Theoritical covering capacity in M ² /coat/litre (minimum)	10-13	8-10	5-6	5.2-6.5
6	Weight per liter in kgs/litre(minimum)	1.3	1.2	1.4	1.5
7	Touch dry at 30°C	1 hr.	30 minutes.	3 hrs.	4 hrs.
8	Hard dry at 30°C (max) Full cure at 30°C (for immersion/ high temperature service)	16 hrs 5 days	8 hrs NA	16 hrs 5 days	48 hrs. 5 days
9	Over-coating interval at 30 °C	Min.: 12 hrs.	Min.: Overnight	Min.: Overnight Max.: 5 days	Min.: 24 hrs Max.: 5 days.
10	Pot life (approx.) at 30°C for two component paints (minimum)	6-8 hrs.	Not applicable	4-6 hrs	4-6 hrs.
11	Temperature Resistance (minimum)	80 °C	60 °C	80°C	125°C.

PAINT MATERIALS

TABLE No. 6.3 FINISH PAINTS

Sl. No	DESCRIPTION	F-8	F-9	F-11	F-12
1	Technical name	Self priming type surface tolerant high build epoxy coating (complete rust control coating).	Inorganic zinc silicate coating	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C dry temp.	Heat resistant silicone Aluminium paint suitable upto 500°C dry temp.
2	Type & composition	Two pack epoxy resin based suitable pigmented and capable of adhering to manually prepared surface and old coating.	A two pack air drying self curing solvent based inorganic zinc silicate coating with minimum 80% zinc content on dry film. The final cure of the dry film shall pass the MEK rub test.	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C.	Single pack silicone resin based medium with Aluminium flakes.
3	Volume Solids (minimum)	72%.	60%	25%	20%
4	DFT (Dry Film thickness) per coat (minimum)	100-125μ	65-75μ	20-25μ	20-25μ
5	Theoretical covering capacity in M ² /coat/ litre (minimum)	6.0-7.2	8-9	10-12	8-10
6	Weight per liter in kgs/litre (minimum)	1.4	2.3	1.2	1.1
7	Touch dry at 30°C (maximum)	3 hrs.	30 minutes.	3 hrs.	30 minutes.
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temperature service)	24 hrs 5days	24 hrs NA	24 hrs NA	24 hrs NA
9	Over-coating interval	Min.: 10 hrs	Min.: 12 hrs.at 20°C & 50% RH	Min.: 24 hrs	Min.: 24 hrs
10	Pot life at 30°C for two component paints (minimum.)	90 minutes.	4-6 hrs.	Not applicable	Not applicable
11	Temperature Resistance (min)	80 °C	400 °C	250°C	500°C.

PAINT MATERIALS
TABLE No. 6.4 FINISH PAINTS

Sl. No	DESCRIPTION	F-14	F-15	F-16	F-17
1	Technical name	Polyamine cured coal tar epoxy	Two-component Epoxy phenolic coating cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint)	Ambient temperature curing Poly Siloxane coating/High build cold applied inorganic copolymer based aluminium coating suitable for under insulation coating of CS and SS piping for high temperature service.	Two component solvent free type high build epoxy phenolic/ novalac epoxy phenolic coating cured with Polyamine adduct hardner system
2	Type & composition	Specially formulated polyamine cured coal tar epoxy suitable for application under insulation	Two pack ambient temperature curing epoxy phenolic coating system suitable for application under insulation of CS/SS piping	Amercoat 738 from Ameron Products, USA/ Berger 938 from Berger Paints Ltd., or Intertherm 751 CSA from Akzo Nobel coating. Note: 6	Two component solvent free type high build epoxy phenolic/ novalac epoxy phenolic coating cured with Polyamine adduct hardner system
3	Volume Solids (minimum)	70%	65%	60%	98-100 %
4	DFT (Dry Film thickness) per coat (minimum)	125 µm	75-100 µm	75-100 µm	125- 150 µm
5	Theoretical covering capacity in M ² /coat/ litre (minimum)	5.5	6.5- 8.5	6.0- 8.0	6.5 - 8
6	Weight per liter in kgs/litre (mix paint) (minimum)	1.5	1.7	1.3	1.7
7	Touch dry at 30°C (maximum)	4 hrs	2 hrs	1 hr	2 hrs
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temp. service)	24 hrs 168 hrs (7 days)	24 hrs 168 hrs (7 days)	16 hrs -	24 hrs 168 hrs (7 days)
9	Over-coating interval	Min. 6 hrs Max.5 days	Min. 36 hrs Max.21 days	Min.16 hrs Max. Not applicable	Min. 16 hrs Max.21 days

10	Pot life at 30°C for two component paints (minimum.)	4 hrs	1.5 hrs	1 hr	1 hr
11	Temperature Resistance (min)	-45°C to 125°C under insulation	-45°C to 150°C under insulation (Note: 5)	Up to 400 deg. C for CS & SS surfaces under insulation	-45°C to 150°C for immersion service

NOTES (for tables 6.1 to 6.4):

- Covering capacity and DFT depends on method of application. Covering capacity specified above are theoretical. Allowing the losses during application, min specified DFT should be maintained.
- All primers and finish coats should be cold cured and air drying unless otherwise specified.
- All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured. In case of conflict between this specification and manufacturer's recommendation, the same shall be clarified through SMMS.
- Technical data sheets for all paints shall be supplied at the time of submission of quotations.
- F-15: Two-component Epoxy phenolic coating cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint) suitable upto 225°C (Intertherm 228 from M/s Akzo Nobel Coatings & Sealants, Bangalore). For all other companies, the temperature resistance shall be a maximum of 150°C.
- F-16: Ambient temperature curing epoxy poly siloxane Coating or high build cold applied inorganic co-polymer based aluminium coating.

'Amercoat 738' from Ameron Products USA/Kansai Nerolac Paints Ltd. Mumbai, suitable upto 400°C for CS surfaces and 600°C for SS surfaces.

'Berger 938' from Berger Paints Ltd Kolkata, suitable upto 400°C for CS & SS surfaces.

'Intertherm 751' from Akzo Nobel Coatings and Sealants Pvt Ltd, Bangalore, Inorganic co-polymer cold applied Aluminium spray coating suitable upto 400°C of CS & SS surfaces.

6.5 List of recommended Manufactures

The paints shall conform to the specifications given above and best quality in their products range of manufacturers listed in Annexure-I.

7.0 PAINT SYSTEMS

The paint system should be selected based on the areas classified inside the plant as given below. The Geographical corrosive and highly corrosive conditions of a plant located in Coastal and Marine area, Highly Corrosive conditions inside a plant and Industrial Corrosive Environment are taken care in the specifications in total.

ENVIRONMENT/AREA CLASSIFICATION

- **Corrosive Environment-Offsite areas** (excluding Cooling Tower area, DM-plant)
- **Corrosive Environment-Unit areas**
- **Highly Corrosive Environment-Unit & Offsite areas** of a plant with corrosive fumes like HCl, H₂SO₄, Water impingement, Salty water, Chloride and water mist, Cooling Tower areas, DM Plant area.

Notes:

1. Painting systems (Primers, Finish Paints etc) based upon Area classification/ Environments (Corrosive / Highly Corrosive) / Applications are tabulated in Tables 8.0 to 16.0.
2. Primers & Finish paints covered in Tables 8.0 to 16.0 are listed in Table 7.1.
3. Repair of Pre-Erection/Pre-Fabrication & Shop priming after erection/ welding shall be done as per Table 7.2.

TABLE 7.1: LIST OF PRIMERS & FINISH COATS COVERED IN TABLE NOS. 8.0 - 16.0

<u>PRIMERS</u>	
P-2	Chlorinated rubber zinc Phosphate Primer
P-4	Etch Primer/Wash Primer
P-6	Two component Epoxy Zinc Phosphate Primer cured with polyamine hardner
P-7	Single pack, synthetic resin based `ZINGA' zinc primer containing 96% of electrolytic zinc dust in dry film.
<u>FINISH COATS/PAINTS</u>	
F-2	Two component Acrylic – Polyurethane finish paint
F-3	Chlorinated Rubber finish paint
F-6A	High Build Epoxy finish coating cured with polyamine hardner
F-6B	High Build Epoxy finish coating cured with polyamide hardner
F-7	High build Coal Tar epoxy coating cured with polyamine hardner
F-8	Self priming surface Tolerant High Build epoxy coating. cured with polyamine hardner
F-9	Two component Inorganic Zinc Silicate coating
F-11	Heat resistant synthetic medium based Aluminium paint
F-12	Two component Heat resistant Silicone Aluminium paint.
F-14	Specially formulated coaltar epoxy coating. cured with polyamine hardner
F-15	Two component Epoxy phenolic coating cured with Polyamine adduct hardner system
F-16	Engineered Epoxy poly Siloxane Coating or high build cold applied inorganic co-polymer based aluminium coating
F-17	Two component solvent free type high build epoxy phenolic/novalac epoxy phenolic coating cured with Polyamine adduct hardner system

**TABLE 7.2 REPAIR OF PRE-ERECTION/PRE-FABRICATION & SHOP PRIMING AFTER
ERECTION/WELDING** for all insulated and un-insulated CS, LTCS & low allow
steel items in all environments. (refer clauses 5.4, 5.5 & 5.9)

Sl. No.	Design Temp. in °C	Surface Preparation	Paint System	Total DFT in Microns (min.)	Remarks
7.1	-40 to 150 for structures, hand rails and Gratings only	SSPC-SP-3	1 coat of F-9 or 2 coats of P-7 @ 40μ DFT/coat	65-75 (F-9) or 80 (P-7)	For few isolated damaged areas of more than 5x5 CM
7.2	-90 to 400	SSPC-SP-3	1 coat of F-9	65-75	-DO-
7.3	401 to 550	SSPC-SP-3	1 coat of F-12	20	-DO-

NOTES:

- 1 The application and repair of pre-erection/pre-fabrication & Shop Priming given in above tables shall be done for all the items to be painted. In case the damages of primer are severe and spread on large areas, the Engineer-in-Charge may decide to advise re-blasting and priming again if required.
- 2 The pre-fabrication primer P-7, 'ZINGA' primer is recommended as alternative repair primer to F-9 for Structures, Hand Rails and Gratings only. F-9 shall be used for all other areas.

TABLE 8.0 PAINT SYSTEM FOR CORROSIVE ENVIRONMENT-OFFSITE AREAS (excluding Cooling Tower area & DM Plant area) for external surfaces of Un-insulated Structures, Piping, Equipments, Pumps, Vessels etc (Note-1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
8.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/coat	None	None	65-75	No over-coating to be done on
8.2	-14 to 60	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/coat	1 coat of P-2 @ 40μ DFT/ coat	2 coats of F-3 @ 40μ DFT/coat ; (2x40=80)	185	F-9 as it will lead to mud cracking.
8.3	61 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/coat	1 coat of P-6 @ 40μ DFT/ coat	1 coat of F-6B @ 100μ DFT/coat + 1 coat of F-2 @ 40μ DFT/coat; (100+40=140)	245	F-3 paint shall contain pure chlorinated rubber, not modified.
8.4	81 to 250	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/coat	None	3 coats of F-11 @ 20μ DFT/coat; (3x20=60)	125	F-12 shall be ambient temperature curing type
8.5	251 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/coat	None	2 coats of F-12 @ 20μ DFT/coat (2x20=40) or 1 coat of F-16 @ 50 μ DFT/coat.	105-115 or 115-125	Flare lines shall be painted as per Table 9.0.
8.6	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20μ DFT/coat	None	2 coats of F-12 @ 20μ DFT/coat (2x20=40)	60	

NOTES

- 1 The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
- 2 For external surfaces of MS chimney with/without refractory lining and for internal surfaces of MS chimney without refractory lining 8.3, 8.4 & 8.5 shall be followed.
- 3 For external surfaces of RCC chimney: 2 coats of F-6 @ 100μ DFT/coat to obtain 2x100=200μ DFT shall be applied after making surface preparation as per guidelines in 5.1.5.

- 4 If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2
- 5 In case of Paint systems as per SI Nos 8.5 and 8.6, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in Clause 18.0.

TABLE 9.0 PAINT SYSTEM FOR CORROSIVE ENVIRONMENT-UNIT AREAS

for external surfaces of Un-insulated Structures, Piping, Equipments, Columns, Towers, Vessels, Pumps, Compressors, Blowers etc(Note1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
9.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @65-75µDFT/coat	None	None	65-75	No over-coating to be done on
9.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	1 coat of P-6 @ 40µ DFT/ coat	1 coat of F-6A @ 100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat; (100+40=140)	245-255	F-9 as it will lead to mud cracking.
9.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat (2x20=40) or 1 coat of F-16 @50 µ DFT/coat.	105-115 or 115-125	F-12 shall be ambient temperature curing type
9.4	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat (2x20=40)	60	

NOTES:

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
2. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and

priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.

- In case of paint systems as per SI Nos 9.3 and 9.4, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in clause 18.0.

TABLE 10.0 PAINT SYSTEM FOR HIGHLY CORROSIVE ENVIRONMENT- UNIT & OFFSITE AREAS OF THE PLANT with corrosive fumes like HCl, H₂SO₄, Water Impingement, Salty Water, Chloride & Water Mist, DM Plant Area, Cooling Tower Area for external surfaces of Un-insulated Structures, Piping, Equipments, Towers, Columns, Vessels, Pumps, Compressors, Blowers etc(Note-1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
10.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking. F-12 shall be ambient temperature curing type
10.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	1 coat of P-6 @ 40µ DFT/ coat	2 coat of F-6A @ 100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat; (2x100+40=240)	345-355	
10.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat 2x20=40 or 1 coat of F-16 @ 50µ DFT/coat.	105-115 or 115-125	
10.4	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat; (2x20=40)	60	

NOTES:

- The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
- If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and

priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.

3. In case of paint systems as per SI Nos 10.3 and 10.4, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in clause 18.0.

TABLE 11.0 PAINT SYSTEM FOR CARBON STEEL AND LOW ALLOY STEEL STORAGE TANKS (EXTERNAL)
All areas (Units & Offsites)

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
11.1	All external surfaces of shell, internal surfaces of shell above maximum liquid level exposed to atmosphere, wind girders, appurtenances, roof tops of all above ground tank including top side of floating roof of open tank as well as covered floating roof tank and associated structural works, rolling and stationary ladders, spiral stairways, hand rails for all environments for crude oil, LDO, HSD, ATF, Kerosene, Gasolene, motor spirit, DM water, firewater, raw water, potable water, acids, alkalis, solvents and chemicals etc.					
11.1.1	-14 to 80	SSPC-SP-10;	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat ; (65/75+40=105/115)	2 coats of F-6A @ 100µ DFT /coat + 1 coat of F-2 @ 40µ DFT/ coat; (2x100+40=240)	345-355	F-6 should be suitable for occasional water immersion
11.1.2	81 TO 150	SSPC-SP-10;	1 coat of F-15 primer @ 80µ DFT/ coat + 1 coat of F-15 intermediate coat @ 80µ DFT/coat ; (80+80=160)	1 coat of F-15 finish coat @80µ DFT/ coat + 1coat of F-2 @ 40µ DFT/ coat; (80+40=120)	280	
11.1.3	151TO 500	SSPC-SP-10;	1 coat of F-9 @ 65-75µ DFT/ coat	2 coats of F-12 @ 20µ DFT/coat; (2x20=40) or 1 coat of F-16 @ 50µ DFT/coat	105-115 OR 115-125	F-12 shall be ambient temperature curing type
11.2	External surfaces of bottom plate (soil side) for all storage tanks.					
11.2.1	-14 TO 80	SSPC-SP-10;	1 coat of F-9 @ 65-75µ DFT/ coat	3 coats of F-7@ 100µ DFT/coat (3x100=300)	365-375	F-7 should be suitable for immersion service of the products given
11.2.2	81 TO 150	SSPC-SP-10;	1 coat of F-15 primer @ 80µ DFT/ coat + 1 coat of F-15 intermediate coat @ 80µ DFT/coat ; (80+80=160)	1 coat of F-15 finish coat @ 80µ DFT/ coat	240	

NOTES

1. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2

**TABLE 12.0 PAINT SYSTEMS FOR CARBON STEEL AND LOW ALLOY STEEL
STORAGE TANKS (INTERNAL)
All Areas (Units & Offsites)**

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
12.1	Underside of floating roof, internal surface of cone roof, bottom plate, bottom course up to 1meter height, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel, ladders, supports for storing crude oil, LDO, HSD and Gas Oil (Excluding white oil products)					
12.1.1	-14 to 80	SSPC-SP-10	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat ; (65/75+40=105/115)	2 Coats of F-6A @ 100µ DFT/coat; (2x100=200)	305-315	Note-2
12.2	Inside of bare shell of floating roof tanks and cone roof tanks for items mentioned in 12.1					
12.2.1	-14 TO 80	SSPC-SP-10	1coat of Phosphating treatment with phosphating chemical @ 10 M²/Litre of coverage	1coat of Phosphating treatment with phosphating chemical @ 10 M²/Litre of coverage	2 coats	DFT need not be measured reconciliation of Chemical used shall be done (Note : 4)
12.3	Floating / Cone roof tanks for petroleum products such as ATF, Gasoline, Naptha, Kerosene, Motor spirit, inside of bottom plate, bottom course upto 4 meters height inside shell, underside of floating roof and shell above maximum liquid level, oil side surfaces of deck plates, oil side surfaces of pontoons, support structures and ladders etc.					
12.3.1	-14 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75µ DFT/coat	3 coats of F-6A @ 100µ DFT/ coat; (3x100=300)	365-375	Note-2
12.4	Inside of Bare shell of floating/cone roof tanks for products mentioned in 12.3.					
12.4.1	-14 to 80	SSPC-SP-10	1 Coat of F-9 @ 65-75µ DFT/Coat	None	65-75	
12.5	Internal protection of fixed roof type storage tanks for potable water: Inside of shell, under side of roof and roof structure inside surface, bottom plate and structural steel works, ladders, walkways, platforms etc.					
12.5.1	-14 to 80	SSPC-SP-10	2 Coats of P-6 @ 40µ DFT/coat; (2x40=80)	2 Coats of F-6B @ 100µ DFT/ Coat; (2x100=200)	280	Note-2
12.6	D.M. (De-mineralized water) and hydrochloric acid (HCL): Internal shell, bottom plate & all accessories					

12.6 .1	-14 to 60	SSPC-SP-10	None	Natural Rubber lining as per SMMS specifications 6-06-204	4.5MM	For DM tanks without steam blanketing
12.6 .2	61 to150	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	1 coat of F-15 intermediate coat @ 80μ DFT/coat + 1 coat of F-15 finish coat @ 80μ DFT/ coat; (80+80=160)	240	For DM tanks with steam blanketing
12.7	EG(Ethylene Glycol) tanks (internal shell, bottom plate roof and all accessories)					
12.7 .1	All	SSPC-SP-10	None	3 coats of vinyl chloride co-polymer Amercoat 23 @ 75μ /Coat ; (3x75=225)	225	
12.8	Inside pontoon and inside of double deck of all floating roofs.					
12.8 .1	-14 to 80	SSPC-SP-3	1 coat of F-8 @ 100μ DFT/coat	1 coat of F-8 @ 100μ DFT/coat	200	
12.9	Internal surfaces of wet slop, amine, sour water , water draw off storage tanks					
12.9 .1	-14 TO 80	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	1 coat of F-15 intermediate coat @ 80μ DFT/coat + 1 coat of F-15 finish coat @ 80μ DFT/ coat; (80+80=160)	240	
12.1 0	Underside of floating roof, internal surface of cone roof, bottom plate, bottom course up to 4meter height, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel, ladders, supports for storing Vacuum Residue, Fuel oil , dry slop and other high temperature hydrocarbon liquids.					
12.1 0.1	81 TO 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	1 coat of F-17 intermediate coat @ 125μ DFT/coat + 1 coat of F-17 finish coat @125μ DFT/ coat; (125+125=250)	375	Note:3
12.1 1	Inside of Bare shell of floating/cone roof tanks for products mentioned in 12.10					
12.1 1.1	81 TO 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	None	125	

NOTES

1. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and

priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.

2. F-6A/F6B should be suitable for immersion service of the products given.
3. This system can be used where maximum operating temperature is below 150°C and design temperature is upto 200°C. Cases of operating temperature > 150°C **are not covered in this spec, such cases shall be covered in the job specifications.**
4. The phosphating chemical shall be applied on blast cleaned surface inside the shell of carbon steel storage tanks at the time of erection. Incase, any corrosion is observed at the time of commissioning, 2 coats of the phosphating chemical shall be applied at the discretion of Engineer-in-charge.

TABLE 13.0 COATING SYSTEM FOR EXTERNAL SIDE OF UNDERGROUND CARBON STEEL PLANT PIPING AND UNDERGROUND TANKS IN ALL AREAS

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
13.1	Underground carbon steel plant piping (Yard/ Over the Ditch Corrosion protection Coating)					
13.1.1	25 to 65	SSPC-SP-10	1 coat of synthetic fast drying primer 25 @μ DFT/ coat	1 layer of coaltar tape coating @ 2mm +1 coat of synthetic fast drying primer 25 @μ DFT/ coat +1 layer of coal tar tape coating @ 2mm /layer as per EIL Standard Spec.No 6-79-0011	4 mm	
13.2	Carbon steel plant piping (underground).					
13.2.1	66 to 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	1 coat of F-17 intermediate coat @ 125μ DFT/coat + 1 coat of F-17 finish coat @125μ DFT/ coat; (125+125=250)	375	
13.2.2	151 to 400	SSPC-SP-10	1 coat of F-16 primer @ 125μ DFT/ coat	1 coat of F-16 finish coat @125μ DFT/ coat	250	
13.3	External side of un-insulated underground storage tanks:					
13.3.1	-40 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75μ DFT/ coat	3 coats of F-7 @ 100μ DFT/coat (3x100=300)	365-375	
13.3.2	81 to 150	SSPC-SP-10	1 coat of F-17 primer @ 125μ DFT/ coat	1 coat of F-17 intermediate coat @ 125μ DFT/coat + 1 coat of F-17 finish coat @125μ DFT/ coat; (125+125=250)	375	
13.3.2	151 to 400	SSPC-SP-10	1 coat of F-16 primer @ 125μ DFT/ coat	1 coat of F-16 finish coat @125μ DFT/ coat	250	

TABLE 14.0 PAINTING UNDER INSULATION (ALL ENVIRONMENTS)

All areas (Units & Offsites) for insulated Piping, Storage Tanks, Equipments etc (Note-1); (For Carbon Steel, LTCS, Low Alloy Steel & Stainless Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
14.1	Insulated carbon steel, LTCS and low allow steel Piping, Storage Tanks, Equipment etc					
14.1.1	-45 to 125	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-14 @ 125µ DFT/coat; (2x125=250) or 3 coats of F-15 @ 80µ DFT/coat ; (3x80=240)	315-325 or 305-315	No over-coating to be done on F-9 as it will lead to mud cracking. F-12 shall be ambient temperature curing type
14.1.2	126-400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	3 coats of F-12 @ 20µ DFT/coat; (3x20=60) or 1 coat F-16 @ 60 µ DFT/coat	125 – 135	
14.2	Insulated stainless steel including Alloy-20 piping (Note:2)					
14.2.1	Below 0°C to all minus temperature	Aluminium sheeting with aluminium foil and “Chloride free mineral sealant coating barium chromate” shall be applied.				If the piping & equipments are already erected than surface shall be prepared by cleaning with emery paper and wash/flush with chloride free DM water followed by wiping with organic solvent
14.2.2	0 to 125	SSPC-SP-10 (15-25µ surface profile) 1 coat of F-14 @ 125µ DFT/coat	None	1 coats of F-14 @ 125µ DFT/coat;	250	
	0 to 125 (alternate)	SSPC-SP-10 (15-25µ surface profile) 1 coat of F-15@ 80µ DFT/coat	None	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat; (80+80=160)	240	
14.2.3	121 to 400	SSPC-SP-10; 1 coat of F-16@ 125 µ DFT/coat	None	1 coat of F-16@ 125 µ DFT/coat	250	
14.2.4	401 to 600	SSPC-SP-10; 1 coat of Amercoat 738 @ 125µ DFT/coat	None	1 coat of Amercoat 738 @ 125µ DFT/coat	250	Only Amercoat 738 is suitable for

14.2.5	Cyclic service (-)196 to 480 excepting (-)45 to 120	SSPC-SP-10 1 coat of Amercoat 738 @ 125μ DFT/coat	None	1 coat of Amercoat 738 @ 125μ DFT/coat	250	the temperature of 600 deg.C and cyclic temperature.
14.3	No painting is required for insulated monel, incoloy and nickel lines.					

NOTES

1. Refer Notes 1 & 4 of Table 8.0.
2. The blast cleaning abrasives for SS and Alloy steel surfaces shall be SS grits/shots or Aluminium oxide grits/shots.
3. For SS surfaces with cyclic temperature of -45 to 125 deg.C, both 14.2.1 & 14.2.2 are applicable.

TABLE 15.0 INTERNAL PROTECTION OF CARBON STEEL COOLERS / CONDENSERS

Water boxes, channels, partition plates, end covers and tube sheets etc.

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
15.1	Upto 65	SSPC-SP-10; 1 coat of P-6 @ 40μ DFT/coat	None	2 coats of F-7 @ 125μ DFT/coat; (2x125=250)	290	For CS surfaces
15.2	Upto 65	SSPC-SP-3; 1 coat of P-4 @8- 10μ DFT/ coat+ 1coat of P-6 @ 40μ DFT/coat.	None	2 coats of F-7 @ 125μ DFT/coat; (2x125=250)	300	(Non ferrous and brass tube sheets)

TABLE 16.0 PAINTING SYSTEM FOR GI TOWERS/NON-FERROUS TUBE SHEET

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
16.1	Upto 65	SSPS-SP-3	1 coat of P-4 @8-10μ DFT/ coat + 1 coat of P-6 @ 40μ DFT/coat	2 coats of F-2 @ 40μ DFT/coat; (2x40=80)	130	Shade as per defence requirements
16.2	Upto 65	SSPS-SP-3	1 coat of P-4 @ 8μ DFT/coat.+ 1 coat of P-6 @ 40μ DFT/coat.	2 coats of F-7 @ 125μ DFT/coat; (2x125=250)	300	(Non ferrous and brass tube sheets)

17.0 SHOP & FIELD PAINTING SYSTEM FOR EFFLUENT TREATMENT PLANT

Sl. No.	Design Temperature in °C	Surface Preparation	Paint System		Total DFT in Microns (min.)	Remarks
			Primer	Finish Paint		
17.1	-14 to 80(for C.S./M.S. items): Screens, Walk way bridges, Baffles, Dual media filters(external) Vertical pumps, piping in treated effluent sump and pump house, external side lining of Slop oil MS tank	SSPS-SP-10	1 coat of F-9 @ 65-75μ DFT/coat	3 coats of F-6A @100μ DFT/coat 3x100=300	365	
17.2	-14 to 80(CS/MS Items) for Vertical pump and piping in, Bio-sludge sump and pump, Filter feed sump and pump, Process sump, Sanitary sump; Transfer sump, Sludge, MS Slop oil tank internal, scrapping mechanism in Clarifier, Screw pump	SSPS-SP-10	1 coat of F-9 @ 65-75μ DFT/coat.	2 coats of F-6A @100μ DFT/coat	265	
17.3	-14 to 80 deg.C :All R.C.C. surfaces such as tanks, structures, drains etc.) in Process sump, TPI separator (Process and Oil), Aeration Tank, Transfer sump etc.	Blast cleaning to SSPC-SP guide lines and Acid etching with 10-15% Hcl acid followed by thorough water washing.	As per SMMS-EIL specification for Epoxy screed lining No.6-06-209 (latest Revision)	As per SMMS-EIL specifications for Epoxy screed lining as per 6-06-209 (latest Revision)	3mm	Epoxy screed lining shall be used as per specific instructions from Engineer-in-Charge at site.
17.4	Upto 60 deg. C C.S./M.S Dual media filters (Internal), Chemical dosing tanks(internal such as DAP, Urea	SSPC-SP-10	-	Rubber Lining as per SMMS-EIL Spec. 6-06-204 Rev.4 (Latest revision)	4.5mm	

18.0 STORAGE

- 18.1 All paints and painting materials shall be stored only in rooms to be arranged by contractor and approved by Engineer-in-charge for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent building. A signboard bearing the word "PAINT STORAGE – NO NAKED LIGHT – HIGHLY INFLAMABLE" shall be clearly displayed outside. Manufacturer's recommendation shall be followed for storage of paint materials.

19.0 PIPING COLOUR CODE:

The following colour coding system has been made based on international standards like ASME/ ANSI, BS and Indian Standard.

19.1 IDENTIFICATION

The system of colour coding consists of a ground colour and secondary colour bands superimposed over the ground colour. The ground colour identifies the basic nature of the service and secondary colour band over the ground colour distinguishes the particular service. The ground colour shall be applied over the entire length of the un-insulated pipes. For insulated lines ground colour shall be provided as per specified length and interval to identify the basic nature of service and secondary colour bands to be painted on these specified length to identify the particular service. Above colour code is applicable for both unit and offsite pipelines.

- 19.1.1 The following ground colour designation for identification of basic classification of various important services shall be followed:

Post Office Red	- Fire protection materials
Off White/Aluminium	- Steam (all pressures)
Canary Yellow	- Chemicals and dangerous materials
Dark Admiralty Grey	- Crude oil, lube oil
Orange	- Volatile petroleum products (motor spirit and lighter)
Oxide red	- Non-volatile petroleum products (kerosene and heavier, including waxy distillates and diesel, gas oil)
Black	- Residual oils, still bottoms, slop oils and asphalts, fuel oil
Sky blue	- Water (all purities and temperatures)
Sea green	- Air and its components and Freon

- 19.1.2 Secondary colours: The narrow bands presenting the secondary colour which identifies the specific service, may be applied by painting or preferably by use of adhesive plastic tapes of the specific colour.

19.2 COLOUR BANDS AND IDENTIFICATION LETTERING

- 19.2.1 The following specifications of colour bands shall be followed for identifying the piping contents, size and location of bands & letters. The bandwidth and size of letters in legends will depend to some extent upon the pipe diameter. Either white or black letters are selected to provide maximum contrast to the band colour. Bands usually are 50 mm

wide and regardless of band width, are spaced 25 mm apart when two bands are employed

Table 1.0: Colour bands and size of lettering for piping:

Outside diameter of pipe or covering in mm	Width of colour bands in mm	Size of legend letters in mm
19 to 32	200	13
38 to 51	200	19
64 to 150	300	32
200 to 250	600	64
Over 250	800	89

In addition, ground colour as per specified length should be provided on insulated piping for easy identification of nature of fluid, on which the colour bands should be painted for identification of each service. The length of the ground colour should be 3 times the width of normal band or 2 meters, whichever is suitable depending on the length of the pipe.

Size of letters stenciled/ written for equipment shall be as given below:

Column and vessel : 150 mm (Height)
Pump, compressor and other machinery : 50 mm (Height)

In addition, the contents of the pipe and/or direction of flow may be further indicated by arrows and legend. If a hazard is involved it must be identified clearly by legend.

19.2.2 Colour bands: The location and size of bands, as recommended, when used, shall be applied to the pipe:

- On both sides of the valves, tees and other fittings of importance.
- Where the pipe enters and emerges from walls and where it emerges from road & walkway overpasses, unit battery limits.
- At uniform intervals along long sections of the pipe.
- Adjacent to tanks, vessels, and pumps.

19.2.2 For piping, writing of name of service and direction of flow for all the lines shall be done at following locations:

19.2.3 The letters will be in black on pipes painted with light shade colours and white on pipes painted with dark shade colours to give good contrast.

19.2.4 Only writing of service name shall be done on stainless steel lines. Precautions should be taken while painting by using low chloride content painting to avoid any damage to the stainless steel pipes. It is preferable to use adhesive plastic tapes to protect stainless steel pipes.

19.2.5 Colour band specification:

- a) Unit Area: Bands at intervals of 6.0 meters.
Offsite Area: Bands at intervals of 10.0 meters.

- b) Each pipe segment will have minimum one band indication, irrespective of length.
- c) The bands shall also be displayed near walkways, both sides of culverts, tanks dykes, tanks, vessels, suction and discharge of pumps/ compressors, unit battery limit, near valves of line, etc.

19.3 For alloy steel/ stainless steel pipes and fittings in stores/ fabrication yard, color band (Minimum ½" wide) should be applied along the complete length of pipe, bends/ tees, side-curved surface (on thickness) of flanges as well as valves as per the metallurgy.

19.4 In case of camouflaging requirements of civil defence or any other location requirements, the same shall be followed accordingly.

19.5 The specification for application of the complete Piping identification colour code, including base and bands colours, are presented in the following table confirming to RAL colour shades of Dutch Standard:

RECOMMENDED RAL COLOR CODE FOR PAINTING OF PIPING AND EQUIPMENTS

SR. No.	SERVICE	RECOMMENDED COLOR FOR PAINT SYSTEM	RAL COLOR CODE			
			BASE COLOR		BAND COLOR	
HYDROCARBON LINES (UNINSULATED)						
1	CRUDE SOUR	Dark Admiralty grey with 1 orange band	7012		2011	
2	CRUDE SWEET	Dark Admiralty grey with 1 red band	7012		3001	
3	LUBE OILS	Dark Admiralty grey with 1 green band	7012		6010	
4	FLARE LINES	Heat Resistant Aluminium	9006			
	LPG	Orange with 1 oxide red band	2011		3009	
6	PROPYLENE	Orange with 2 blue bands	2011		5013	
7	NAPHTHA	Orange with 1 green band	2011		6010	
8	M.S.	Orange with 1 dark admiralty grey band	2011		7012	
9	AV.GASOLINE (96 RON)	Orange with 1 band each of green, white and red bands	2011	6010	9010	3001
	GASOLINE (regular, leaded)	Orange with 1 black band	2011		9005	
11	GASOLINE (premium, leaded)	Orange with 1 blue band	2011		5013	
12	GASOLINE (white)	Orange with 1 white band	2011		9010	

13	GASOLINE (Aviation 100/130)	Orange with 1 red band	2011	3001
14	GASOLINE (Aviation 115/145)	Orange with 1 purple band	2011	4006
	N-PENTANE	Orange with 2 blue bands	2011	5013
16	DIESEL OIL (White)	Oxide red with 1 white band	3009	9010
17	DIESEL OIL (Black)	Oxide red with 1 yellow band	3009	1023
18	KEROSENE	Oxide red with 1 green band	3009	6010
19	HY.KEROSENE	Oxide red with 2 green bands	3009	6010
	DISULFIDE OIL (EX- MEROX)	Oxide red with 1 black band	3009	9005
21	M.T.O	Oxide red with 3 green bands	3009	6010
22	DHPPA	Oxide red with 2 white bands	3009	9010
23	FLUSHING OIL	Oxide red with 2 black bands	3009	9005
24	LAB FS	Oxide red with 2 dark admiralty grey bands	3009	7012
	LAB RS	Oxide red with 3 dark admiralty grey bands	3009	7012
26	LAB (Off. Spec)	Oxide red with 1 light grey band	3009	7035
27	N-PARAFFIN	Oxide red with 1-blue band	3009	5013
28	HEAVY ALKYLATE	Oxide red with red band	3009	3001

29	BLOW DOWN, VAPOR LINE	Off white / Aluminum with 1- Brown band	9006	8004
30	BLOWDOWN	Off white / Aluminum with 2 brown bands	9006	8004
31	A.T.F.	Leaf brown with 1 white band	8003	9010
32	TOULENE	Leaf brown with 1 yellow band	8003	1023
33	BENZENE	Leaf brown with 1 green band	8003	6010
34	LAB PRODUCT	Leaf brown with 1 blue band	8003	5013
35	FUEL OIL	Black with 1 yellow band	9005	1023
36	FULE OIL (Aromatic rich)	Black with 2 yellow bands	9005	1023
37	ASPHALT	Black with 1 white band	9005	9010

38	SLOP AND WASTE OILS	Black with 1 orange band	9005	2011
39	SLOP AROMATICS	Black with 2 orange bands	9005	2011
CHEMICAL LINES				
40	TRI-SODIUM PHOSPHATE	Canary yellow with 1 violet band	1012	5000

41	CAUSTIC SODA	Canary yellow with 1 black band	1012	9005
42	SODIUM CHLORIDE	Canary yellow with 1 white band	1012	9010
43	AMMONIA	Canary yellow with 1 blue band	1012	5013
44	CORROSION INHIBITOR	Canary yellow with 1 Aluminum band	1012	9006
45	HEXAMETA PHOSPHATE	Canary yellow with 2 black bands	1012	9005
46	ACID LINES	Golden Yellow with 1 red band	1004	3001
47	RICH AMINE	Canary yellow with 2 blue bands	1012	5013
48	LEAN AMINE	Canary yellow with 3 blue bands	1012	5013
49	SOLVENT	Canary yellow with 1 green band	1012	6010
50	LCS	Canary yellow with 1 smoke grey	1012	7031

WATER LINES

51	RAW WATER	Sky blue with 1 black band	5015	9005
52	INDUSTRIAL WATER	Sky blue with 2 signal red band	5015	3001
53	TREATED WATER	Sky blue with 1 oxide red band	5015	3009
54	DRINKING WATER	Sky blue with 1 green band	5015	6010
55	COOLING WATER	Sky blue with 1 light brown band	5015	1011
56	SERVICE WATER	Sky blue with 1 signal red brown	5015	3001
57	TEMPERED WATER	Sky blue with 2 green bands	5015	6010
58	DM WATER	Sky blue with 1 aluminum band	5015	9006
59	DM WATER ABOVE 150°F	Sky blue with 2 black bands	5015	9005
60	SOUR WATER	Sky blue with 2 pearl white bands	5015	1013
61	STRIPPED WATER	Sky blue with 2 blue bands	5015	5013

62	ETP TREATED WATER	Sky blue with 2 oxide red bands	5015	3009
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FIRE PROTECTION SYSTEM (ABOVE GROUND)

63	FIRE WATER FOAM & EXTINGUISHERS	Post office red	3002
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AIR & OTHER GAS LINES (UNINSULATED)

64	SERVICE AIR	Yellow green with 1 signal red band	6018	3001
65	INSTRUMENT AIR	Yellow green with 1 black band	6018	9005
66	NITROGEN	Yellow green with 1 orange band	6018	2011
67	FREON	Yellow green with 1 yellow band	6018	1023
68	CHLORINE	Canary yellow with 1 oxide band	1012	3009

69	SO2	Canary yellow with 2 white bands	1012	9010
70	H2S	Orange with 2 red oxide bands	2011	3009
71	GAS (Fuel)	Orange with 1 aluminum band	2011	9006

72	GAS (Sour)	Orange with 2 aluminum bands	2011	9006
73	GAS (Sweet)	Orange with 2 signal red band	2011	3001
74	HYDROGEN	Orange with 1 light green band	2011	6021

STEAM AND CONDENSATE LINES (UNINSULATED)

75	HP STEAM	Off white / Aluminum with 1 yellow band	9006	1023
76	MP STEAM	Off white / Aluminum with 1 red band	9006	3001
77	MLP STEAM	Off white / Aluminum with 1 orange band	9006	2011
78	LP STEAM	Off white / Aluminum with 1 light green band	9006	6021
79	CONDENSATE	Sky blue with 1 white band	5015	9010
80	CONDENSATE ABOVE 150°F	Sky blue with 3 oxide red band	5015	3009
81	BFW	Sky blue with 2 red bands	5015	3001

Note: For all insulated steam lines, the colour coding shall be follow as given for un-insulated lines with the specified length of color bands.

INSULATED HYDROCARBON PIPING				
82	IFO SUPPLY	1Black ground colour with 1 yellow band in centre	9005	1023
83	IFO RETURN	Black ground colour with 1 green band in centre	9005	6010
84	HPS	Black ground colour with 1 red band in centre	9005	3001
85	BITUMEN	Black ground colour with 2 red bands in centre	9005	3001

86	CLO	Black ground colour with 1 brown band in centre	9005	8004
87	VB TAR	Black ground colour with 2 brown bands in centre	9005	8004
88	VR AM (BITUMEN / VBU FEED)	1 Black ground colour with 1 blue band in centre	9005	5013
89	VR BH	1 Black ground colour with 2 blue bands in centre	9005	5013

90	VAC. SLOP	1 Black ground colour with 1 white band in centre	9005	9010
91	SLOP	1 Black ground colour with 1 orange band in centre	9005	2011
92	CRUDE SWEET	1 Dark admiralty grey ground colour with 1 red band in centre	7012	3001
93	CRUDE OUR	1 Dark admiralty grey ground colour with 1 orange band in centre	7012	2011
94	VGO / HCU	1 Oxide red ground colour with 2 steel grey bands in centre	3009	7011
95	OHCU BOTOM / FCCU FEED	1 Oxide red ground colour with 2 steel grey bands in centre	3009	7011

UNINSULATED EQUIPMENTS, TANKS AND STRUCTURES			
96	HEATER STRUCTURE	Steel grey	7011
97	HEATER CASING	Heat resistant aluminium	9006
98	VESSELS & COLUMNS	Aluminium	9006
99	HYDROGEN BULLETS	Pink	3014
100	LPG VESSELS	Oxide red	3009
101	SO2 VESSEL	Canary yellow	1012
102	HEAT EXCHANGER	Heat resistant aluminium	9006
103	FO TANK AND HOT TANKS	Black	9005
104	ALL OTHER TANKS	Aluminum / Off white	9006
105	CAUSTIC / AMINE / ACID TANKS	Golden yellow	1004
106	SOUR WATER	Sky Blue	5015
107	OUTER SURFACE IN BOILER HOUSE	Heat resistant aluminum	9006
108	COMPRESSORS AND BLOWERS	Dark admiralty grey	7012
109	PUMPS	Navy blue	5014
110	Electrical Equipment – Indore	Pebbel grey	7032
111	Electrical Equipment - Outdoor	Blue grey	7031
112	HAND RAILING	Fluorescent yellow	1026
113	STAIRCASE, LADDER AND WALKWAYS	Black	9005
114	LOAD LIFTING EQUIPMENT AND MONORAILS ETC	Leaf brown	8003

115	GENERAL STRUCTURE	Dark grey	7031
116	LOCAL PANEL FACE	Opaline green	6026
117	PANEL REAR SURFACE, FRAME WORK & MOUNTING PLATES	Pale cream	9001
118	MONORAIL	Signal red	3001
PIPES AND FITTINGS OF ALLOY STEEL AND SS MATERIAL IN STORE			
119	IBR	Signal red	3001
120	9Cr-1Mo	Verdigris green	6021
121	5Cr-0.5Mo	Satin blue	5012
1 22	21/4Cr-1 Mo	Aircraft yellow	1026
123	11/4Cr-½ Mo	Traffic Yellow	1023
124	SS-304	Dark blue grey	5008
125	SS-316	Dark violet	4005
126	SS-321	Navy blue	5014
SAFETY COLOUR SCHEMES			
127	DANGEROUS OBSTRUCTION	Black and alert orange band	9005 2008
128	DANGEROUS OR EXPOSED PARTS OF MACHINERY	Alert orange	2008

RAL COLOR CODING FOR PETROCHEMICAL COMPLEX

Sr. No.	SERVICE	RECOMMENDED COLOR FOR PAINT SYSTEM	RAL COLOR CODE	
			BASE COLOR	BAND COLOR
REFINERY PRODUCTS				
1	NATURAL GAS	Orange with 3 Oxide red bands	2011	3009
2	PROPANE	Orange with 3 Blue band	2011	5013
3	METHANE	Orange with 1 Brown band	2011	8004
4	CYCLOHEXANE	Orange with 1 Pearl night blue band	2011	5026
5	n-HEXANE	Orange with 1 Pearl green bend	2011	6035
6	ETHANE	Orange with 4 Blue bands	2011	5013
7	BLENDED FUEL OIL	Black with 3 Yellow bands	9005	1023

8	ETHYLENE OXIDE	Orange with 3 Green bands	2011	6010
9	POLYMER PELLETS & SLURRY	Brown beige with 1 white bands	1011	9010
10	HDPE PELLETS	Brown beige with 2 white bands	1011	9010
11	WAX	Oxide Red with 1 Pastel Green Band	3009	6019
12	GLYCOL	Canary yellow with 1 Pearl gentian blue	1012	5025
13	BUTADIENE < 15%	Orange with 1 band Pastel Green band	2011	6019
14	BUTADIENE 5 - 95%	Orange with 2 Pastel Green bands	2011	6019
15	BUTADIENE > 95%	Orange with 3 Pastel Green bands	2011	6019
16	ALDEHYDE SOLUTION	Sky blue with 1 orange band	5015	2011
17	OCTENE-1	Orange with 1 Blue, 1 Black and 1 Blue band	20 11	5013 90 05
18	ETHYLENE	Orange with 2 Blue bands + 1 Black band	2011	5013 9005
19	PROPYLENE	Orange with 2 Oxford blue bands	2011	5013
20	BUTENE -1	Orange with 2 Red band	2011	3001
21	HEXANE	Orange with 2 White bands	2011	9010
22	MEG	Canary yellow with 1 Blue lilac band	1012	4005
23	DEG	Canary yellow with 2 Blue lilac band	1012	4005
24	TEG	Canary yellow with 3 Blue lilac band	1012	4005
25	POLYGLYCOL	Canary yellow with 3 Green band	1012	6010
26	GLYCOL / WATER SOLUTION	Canary yellow with 1 Sky blue band	1023	5015
27	DTA	Canary yellow with 2 Green band	1012	6010
28	OXYGEN	Yellow green with 1 Blue band	6018	5013
29	CYCLE GAS SYSTEM	Oxide red with 2 Purple band	3009	4006
CHEMICALS				
29	ISOPRENYL ALUMINUM	Canary yellow with 1 copper brown bands	1012	8004
30	MAGNESIUM ETHYLATE	Canary yellow with 2 copper brown bands	1012	8004
31	TITANIUM TETRA CHLORIDE	Canary yellow with 1 chocolate brown band	1012	8017
32	SULPHURIC ACID	Golden Yellow with 3 red bands	1004	3001

33	CALCIUM HYDROXIDE	Canary yellow with 3 black bands	1012	9005
34	SODIUM CHLORIDE	Canary yellow with 1 white band	1012	9010
35	FERRIC CHLORIDE	Canary Yellow with 3 red oxide bands	1012	3009
36	SODIUM BI SULFIDE	Canary yellow with 3 white bands	1012	9010

37	CHLORINE DIOXIDE	Canary yellow with 1 orange band	1012		2011
38	HYDRAZINE	Canary yellow with 3 blue bands	1012		5013
39	CARBON DIOXIDE	Orange with 4 Aluminum bands	2011		9006
40	CARBON MONOXIDE	Orange with 3 Aluminum bands	2011		9006
41	TEAL	Dark admiralty grey with 2 white bands	7012		9010
42	LIQUID PEROXIDE	Canary yellow with 1 red and 1 blue band	1023	3001	5013
43	CATALYST LINE	Canary yellow with 2 Red band	1023		3001
44	CO-CATALYST LINE	Canary yellow with 3 Red band	1023		3001
45	EO / WATER SOLUTION	Sky blue with 3 Green bands	5015		6010

46	BCWS / BCSWR	Sky blue with 1 Brown Biege band	5015	1011
WATER				
47	CYCLE WATER-LEAN	Sky blue with 2 blue lilac bands	5015	4005
48	CYCLE WATER-RICH	Sky blue with 3 blue lilac bands	5015	4005
49	JACKET WATER	Sky blue with 3 black bands	5015	9005
50	JACKET WATER-BIOCIDE	Sky blue with 2 aluminum bands	5015	9006
51	JACKET WATER-CORROSION INHIBITOR	Sky blue with 3 aluminum bands	5015	9006
52	CHLORINATED WATER	Sky blue with 1 green band	5015	6010
53	BACK FLUSH WATER	Sky blue with 3 signal red bands	5015	3001
54	CUTTING WATER	Sky blue with 1 orange band	5015	2011
55	REFRIGERATED WATER	Sky blue with 2 violet blue bands	5015	5000
56	WASTE WATER	Sky blue with 2 Signal red bands	5015	3001
INTERMEDIATES				
57	MOTHER LIQUOR SOLUTION	Orange with 3 pebble grey bands	2011	7032

58	ADDITIVES SOLUTION	Pearl green with 2 white band	6035	9010
59	DEACTIVATORS	Pearl green with 2 orange band	6035	2011
60	OFF GAS	Pearl green with 2 yellow band	6035	1023
61	OFF GAS PLUS POLYMER	Pearl green with 2 Aluminum bands	6035	9006
62	RA SOLUTION	Pearl green with 2 oxide red bands	6035	3009
63	DONOR	Pearl green with 2 black bands	6035	9005
STEAM				
64	VHP	Offwhite / Aluminium with 2 yellow band	9006	1023
65	MHP STEAM (20 KG / CM2 G)	Off white / Aluminium with 3 yellow bands	9006	1023
66	OTHER PROCESS LINES e.g. PROCESS STEAM, PROCESS CONDENSATE, PROCESS VENTS.	Light grey with 1Traffic yellow band	7035	1023
67	DECOKING AIR	Yellow Green with 1 Terrabrown band	6018	8028
68	RPG	Orange with 1 Yellow Green band	2011	6018
69	C6-C8 CUT	Orange with 1 terrabrown band	2011	8028
70	C4 MIX	Orange with 1 peral black berry band	2011	4012
71	C9+ CUT / FLUX OIL	Orange with 2 grey Beige band	2011	1019
72	C4 PURGE / C4 MIX	Orange with 2 peral black berry	2011	4012
73	C9 CUT	Orange with 1 grey beige	2011	1019
74	C7-C8 CUT	Orange with 2 terra Brown band	2011	8028
75	C3	Orange with 1 Sky blue band	2011	5015
76	PP RECYCLE	Orange with 1 water blue	2011	5021
77	PLANT AIR	Yellow green with 1 peral light grey	6018	9022
78	AROMATIC	Black with 1 water blue	9005	5021
79	LIGHT DISTILLATION	Orange with 1 Solman pink band	2011	3022
80	C9+	Orange with 3 grey beige	2011	1019
81	OWS-OIL WATER SEWER	Sky blue with 1 band of salmon orange	5015	2012
82	CRWS-CONTAMINATED RAIN WATER SEWER	Sky blue with 2 bands of salmon orange	5015	2012
83	CRYOGENIC TANK (RCC)	Orange	2011	

20.0 IDENTIFICATION OF VESSELS, PIPING ETC.

20.1 Equipment number shall be stencilled in black or white on each vessel, column, equipment & machinery (insulated or uninsulated) after painting. Line number in black

or white shall be stencilled on all the pipe lines of more than one location as directed by Engineer-In-Charge, Size of letter printed shall be as below :

Column & Vessels	-	150mm (high)
Pump, compressor & other machinery	-	50mm (high)
Piping	-	40-150 mm

20.2 Identification of storage tanks:

The storage tanks shall be marked as detailed in the drawing.

21.0 PAINTING FOR CIVIL DEFENCE REQUIREMENTS

21.1 Following items shall be painted for camouflaging if required by the client.

- a. All Columns
- b. All tanks in Offsites
- c. Large Vessels
- d. Spheres

21.2 Two coats of selected finishing paint as per defence requirement shall be applied in a particular pattern as per 20.3 and as per the instructions of Engineer-In-Charge.

21.3 Method of Camouflaging

21.3.1 Disruptive painting for camouflaging shall be done in three colours in the ratio of 5:3:2 (all matt finish).

Dark Green	Light Green	Dark Medium Brown
5:	3:	2

21.3.2 The patches should be asymmetrical and irregular.

21.3.3 The patches should be inclined at 30° to 60° to the horizontal.

21.3.4 The patches should be continuous where two surfaces meet at an angle.

21.3.5 The patches should not coincide with corners.

21.3.6 Slits and holes shall be painted in dark shades.

21.3.7 Width of patches should be 1 to 2 meters.

22.0 INSPECTION AND TESTING

22.1 All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable.

22.2. Engineer-In-Charge at his discretion, may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batch-wise test of wet paints for physical & chemical analysis as per clause 24.4 of relevant ASTM test method. All costs there shall be borne by the contractor.

The contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The Engineer-in-Charge shall have the right to test wet samples of paint at random for quality of same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.

- 22.3 The painting work shall be subject to inspection by Engineer-In-Charge at all times. In particular, following stage-wise inspection will be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection are as follows:

- (a) Surface preparation
- (b) Primer application
- (c) Each coat of paint

In addition to above, record should include type of shop primer already applied on equipment e.g. Red oxide zinc chromate or zinc chromate or Red lead primer etc.

Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of Engineer-In-Charge before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work, contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (D F T)) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to owner, the extra coat should have prior approval of Engineer-in-charge.

22.4 **Primer Application**

After surface preparation, the primer should be applied to cover the crevices, corners, sharp edges etc. in the presence of inspector nominated by Engineer-In-Charge.

- 22.5 The shades of successive coats should be slightly different in colour in order to ensure application of individual coats, the thickness of each coat and complete coverage should be checked as per provision of this specification. This should be approved by Engineer-In-Charge before application of successive coats.

- 22.6 The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting. Holiday detectors and pinhole detector and protector whenever required for checking in case of immersion conditions.

- 22.7 Prior to application of paints on surfaces of chimneys, the thickness of the individual coat shall be checked by application of each coat of same paint on M.S.test panel. The thickness of paint on test panels shall be determined by using gauge such as 'Elkometer'. The thickness of each coat shall be checked as per provision of this specification. This shall be approved by Engineer-In-Charge before application of paints on surface of chimney.

- 22.8 At the discretion of Engineer-In-Charge, the paint manufacturer must provide the expert technical service at site as and when required. This service should be free of cost and without any obligation to the owner, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations. The contractor is responsible to arrange the same.
- 22.9 Final inspection shall include measurement of paint dry film thickness, Adhesion, Holiday detection check of finish and workmanship. The thickness should be measured at as many points/ locations as decided by Engineer-In-Charge and shall be within + 10% of the dry film thickness, specified in the specifications.
- 22.10 The contractor shall arrange for spot checking of paint materials for Sp.gr., glow time (ford cup) and spreading rate.

23.0 GUARANTEE

- 23.1 The contractor shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein/to be provided during execution of work.

24.0 QUALIFICATION CRITERIA OF PAINTING CONTRACTOR/SUB-CONTRACTOR

Painting contractor who is awarded any job for EIL, Projects under this standard must have necessary equipments, machinery, tools and tackles for surface preparation, paint application and inspection. The contractor must have qualified, trained and experienced surface preparator, paint applicator, inspector and supervisors. The contractor supervisor, inspector, surface preparator and paint applicator must be conversant with the standards referred in this specification.

25.0 PROCEDURE FOR APPROVAL OF NEW COATING MATERIALS AND MANUFACTURERS

Following procedure is recommended to be followed for approval of new manufacturers.

- 25.2 The manufacturer should arrange testing of the coating materials as per the list of tests given in para 24.4 below from one of the reputed Government laboratories.
- 25.2 Samples of coating materials should be submitted to the Govt. laboratory in sealed containers with batch no. and test certificate on regular format of manufacturer's testing laboratory. The sampling shall be certified and sealed by a certifying agency.
- 25.2 All test panels should be prepared by Govt. testing agency coloured photographs of test panels should be taken before and after the test and should be enclosed alongwith test report.

Sample batch no. and manufacturer's test certificate should be enclosed alongwith the report. Test report must contain details of observation and rusting if any, as per the testing code. Suggested Government laboratories are:

IICT, Hyderabad
HBTI, Kanpur
DMSRDE, Kanpur
IIT, Mumbai
BIS Laboratories
UICT, Matunga, Mumbai
RITES, Kolkata
PDIL, Sindri
NTH, Kolkata

- 25.2 Manufacturers should intimate the company, details of sample submitted for testing, name of Govt. testing agency, date, contact personnel of the govt. testing agency. At the end of the test the manufacturer should submit the test reports to the company for approval. The manufacturer(s) shall be qualified based on the results of these tests and other assessment and the company's decision in this regard shall be final and binding on the manufacturer.

Test required for evaluation of acceptance of coating materials for onshore application.

<u>Test</u>	<u>ASTM Test Method</u>
Density	D 1475
Dipping properties	D 823
Film characteristics	
Drying time	D 1640
Flexibility	D 1737/D 522
Hardness	D 3363
Adhesion	D 2197
Abrasion resistance	D 968/ D 1044
DFT/coat	AS PER SSPC GUIDELINES
Storage Stability	D 1849
Resistance to	
Humidity for 2000 hrs.	D 2247
Salt spray 2000 hrs	B 117
Accelerated Weathering	D 822
% Zn in Dry film for Inorganic Zinc	G 53
Silicate primer	

- 25.2 Coating systems for panel test shall be decided after discussion with EIL.
- 25.2 Clause No. 24.0 is for approval prior to award of the contract. In case any agency proposes for any fresh approval after award of work, the same shall have no time implications upon the contract.

ANNEXURE-I

LIST OF RECOMMENDED MANUFACTURERS

Indian Vendors

1. Asian Paints (I) Ltd., Mumbai
2. Berger paints Ltd., Kolkata
3. Kansai Nerolac Paints Ltd., Mumbai (including Ameron, USA Products).
4. Chugoku Marine Paints Pvt. Ltd., Mumbai
5. Shalimar Paints Ltd., Kolkata
6. Sigma Kalon Marine and Protective Coatings(India) Pvt Ltd, Mumbai.
7. CDC Carboline Ltd., Chennai
8. Premier products Ltd., Mumbai
9. Coromandel Paints & Chemicals Ltd., Visakhapatnam
10. Anupam Enterprises, Kolkata
11. Grand Polycoats, Vadodara
12. Bombay Paints Ltd., Mumbai
13. Akzo Nobel Coatings and Sealants Pvt. Ltd., Bangalore
14. Cipy Polyurethanes Pvt. Ltd., Pune
15. Gunjan Paints Ltd., Ahmedabad
16. Advance Paints Ltd., Mumbai
17. VCM Polyurethane Paints (for polyurethane paints only)
18. Jotun Paints India Pvt Ltd, Chennai(Singapore)
19. Paladin Paints and Chemicals , Mumbai
20. Chembond Chemicals Pvt Ltd , Navi Mumbai
21. Aashish Coating Technologies Pvt. Ltd, Vadodara/Mumbai

Foreign Vendors

1. Sigma Kalon Protective Coatings, Singapore
2. Ameron, USA
3. Kansai Paints, Japan
4. Hempel Paints, USA
5. Valspar Corporation, USA
6. Akzo Nobel/International Coatings, UK
7. Jotun Paints, Singapore

The following are approved for specific materials only.

- 1.0 Mark-chem Incorporated, Mumbai (for phosphating chemicals only).
- 2.0 ChemTreat India Ltd.(for Phosphating Chemical and glass flake filled coatings of M/s Atlas Chemicals Corporation, USA).
- 3.0 Carolina equipment and supply Co., USA.
- 4.0 Zinga Metall(Rozenstraat 4-Industrial Zone)-9810 EKE-Belgium, Indian Agent-Newkem, Mumbai-14 (for cold spray zinc coating)

ANNEXURE-II

LIST OF RECOMMENDED MANUFACTURERS' PRODUCTS

Sl. No	Manufacturers Name	P2 Chlorinated Rubber Zinc Ph Primer	P4 Etch Primer/ Wash Primer	P6 Epoxy Zinc Ph. Primer	F9 Inorganic Zinc Silicate Primer/ Coating
1	ASIAN PAINTS (I) LTD.	ASIOCHLOR HB.ZN.PH.PRIMER RO PC 168	APCONYL WP636 (PC335)	APCODUR HB.ZP. PC433	APCOSIL 605
2	BERGER PAINTS LTD.	LINOSOL HIGH BUILD ZP PRIMER	BISON WASH PRIMER	EPILUX 610 HB PRIMER	ZINC ANODE 304 MZS
3	AMERON PRODUCTS	-	AMERCOAT 178	AMERCOAT 71/ 385P	DIMETCOTE-9FT
4	CHEMBOND CHEMICALS	KEMCHLOR 201	KEMGALVA GRIP A1	KEMOXY 301	KEMGUARD 501
5	SHALIMAR PAINTS LTD	CHLOROKOTE ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ETCH PRIMER	EPIGUARD ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ZILIKATE
6	SIGMA KALON INDIA PVT LTD,	SIGMA NUCOL UNICOAT 7321	SIGMA ETCH PRIMER (7185)	SIGMA COVER 256 (7412)	SIGMAZINC-158
7	CDC CARBOLINE LTD.	-	-	CARBOLINE 893	CARBOZINC 11
8	PREMIER PRODUCTS LTD.	-	-	P-15/3A U-16/92	U17/92 ETHYL SILICATE INORGANIC ZINC
9	CORAMANDEL PAINTS & CHEMICALS LTD.	COROCLORE CR HB.ZN.PH PRIMER	CPC WASH PRIMER	COROPEX EPOXY ZN.PH. HIGH BILD PRIMER	CPC INORGANIC ZINC SILICATE PRIMER
10	ANUPAM ENTERPRISES	ANUCHLOR ZP PRIMER	ANUPRIME-291	ANUPAM ANLICOR A-EZP-500	ANUZINC 2001 TP
11	GRAND POLYCOATS	GP CHLOROPRIME 601	GP PRIME 401	-	GP PRIME 402
12	BOMBAY PAINTS LTD.	PENTA CHLOR HB PRIMER 8632	PENTOLITE WASH PRIMER 8520	PENTADUR PRIMER 8530	ZINC-O-SIL 75
13	HEMPEL MARINE PAINTS	HEMPA TEX HIGHBUILD 4633	-	HEMPEL'S SHOP PRIMER E1530	GALVASOL 1570
14	AASHISH COATING TECH-				

	NOLOGIES				
15	AKZO NOBEL PAINTS	-	-	INTERGARD 251	INTERZINC 12/22
16	PALADIN PAINTS	VEGCHLOR HB PRIMER 1143	VEGWASH PRIMER 1181	VEGPOX 1241ZP	THERMOSIL1 362 ZINC
17	VCM POLYURETHAN E PAINTS				
18	JOTUN PAINTS		JOTA ETCH TWO PACK WASH PRIMER	EPOXY CQ SPECIAL ZINC PHOSPHATE PRIMER	RESIST-86
19	KCC PRODUCTS (KOREA)				EZ 180(N)
20.	CHUGOKU MARINE PAINTS PVT. LTD.	-	-	CAMIDECK PRIMER	GALBONS HB
21.	KANSAI NEROLAC PAINTS LTD.	NEROLAC HB CR ZINC PHOSPHATE PRIMER	NEROLAC ETCH PRIMER	NEROLAC EPOXY ZINC PHOSPHATE PRIMER	NEROSIL 118

LIST OF RECOMMENDED MANUFACTURERS PRODUCTS (Cont. ...)

Sl. No	Manufacturers Name	F2 Acrylic- Polyurethane Finish Paint	F3 Chlorinated Rubber Finish Paint	F6A/B High Build Epoxy Finish Paint	F7 High Build Coal Tar Epoxy Coating
1	ASIAN PAINTS (I) LTD.	APCOTHANE CF676 (PC 1109)	ASIOCHLOR CF 621 (PC 319)	APCODUR HB COATING PC 1262	APCODUR CF 651/655(PC 131/471)
2	BERGER PAINTS LTD.	BERGER ACRYLIC PU FINISH	LINOSOL CHLORINATED RUBBER HB COATING	EPLIUX 04 AND 78 HB EPOXY COATING	EPILUX 555
3	AMERON	AMERCOAT 450GL	AMERCOAT 515	AMERCOAT 383 HS	AMERCOAT 78HB
4	CHEMBOND CHEMCIALS	KEMTHANE 411	KEMCHLOR 211	KEMOXY 324	KEMOXY 314
5	SHALIMAR PAINTS LTD	SHALITHANE FINISH	CHLORKOTE HB FINISH	EPIGARD TL FINISH POLYAMINE/ POLYAMIDE	BIPIGARD CTE ZL BLACK HB COAL TAR EPOXY COATING
6	SIGMA COATINGS.	SIGMADUR GLOSS (7528)	SIGMA NUCOL FINISH 7308	SIGMA GUARD 720	SIGMACOVER 300 (7472)
7	CDC CARBOLINE LTD.	CARBOLINE 132	-	CARBOLINE 191	CARBO-MASTIC-14
8	PREMIER PRODUCTS LTD.	U3/92 POLYURETHANE	CR-71, CR FINISH PAINT	42B/4A HIGH BUILD EPOXY	350/3A, COAL TAR EPOXY COATING
9	CORAMANDEL PAINTS & CHEMICALS LTD.	COROTHANE SUPER PU FINISH	COROCLORE CR FINISHING	COROPEX EPOXY HB COATING	COROPEX EPOXY COAL TAR COATING
10	ANUPAM ENTERPRISES	ANUTHANE ENAMEL	ANUCHLOR HB ENAMEL	DURACOAT-6000	COROGUARD
11	GRAND POLYCOATS	GP BOND 141	GP CHLOROGAURD 631	GP GUARD HP234	POLYGUARD CE
12	BOMBAY PAINTS LTD.	PENTATHANE FP 4510	PENTACHLOR FB 4635	PENTADUR HB 5540/5520	PENTADUR COALTAR EPOXY 8518/6518
13.	HEMPEL MARINE PAINTS	-	HEMPATEX HIBUILD 4633	HEMPADUR HIGH BUILD 5520	HEMPADUR 1510
14.	AASHISH COATING TECH	GA 1110 PU-UB		GA701 HB	
15	AKZO NOBEL COAITNGS	INTERTHANE 990	-	INTERGARD 966 / 410	INTERTUF 262 (TAR FREE TYPE)

16	PALADIN PAINTS	VEGTHANE (ALIPHATIC)	VEGCHLOR FP3140	VEGEPOX 3245/3562	VEGEPOX 4265
17	VCM POLYURETHA NE PAINTS	PIPCOTHANE ALIPHATIC POLYURETHANE FINISH PAINT			
18	JOTUN PAINTS	HARDTOP XP		PENGUARD HB	JOTAGUARD 85
19	KCC PRODUCTS (KOREA)			KOEPOX TOPCOAT HB ET 5740	EH 173
20.	CHUKOGU MARINE PAINTS PVT LTD.	UNY MARINE	-	EPICON MARINE FINISH HB	BISCON HB 2001/ACHB
21.	KANSAI NEROLAC PAINTS	NEROTHANE ENAMEL	NEROLAC HB CHLORINATED RUBBER ENAMEL	NEROPOXY HB 262/6061	NEROLAC EPOXY COAL TAR POLYAMINE/P OLYAMIDE CURED.

LIST OF RECOMMENDED MANUFACTURERS PRODUCTS (cont. ...)

Sl. No.	Manufacturers Name	F8 Epoxy Mastic Coating Surface Tolerant	F-11 Heat Resistant Synthetic Medium Aluminium Paint	F-12 Heat Resistant Silicone Aluminium Paint	F-15 Two Pack Ambient Temperature Curing Epoxy Phenolic Coating
1	ASIAN PAINTS (I) LTD.	APCODOR CF 640	ASIAN HR ALUMINIUM PAINT (PC 300)	HR SILICONE ALUMINIUM PAINT (PC 189)	
2	BERGER PAINTS LTD.	PROTECTO MASTIC	FERROTOL HR ALUMINIUM PAINT	LUMEROS HR SILICONE AL. PAINT(HR/143)	BERGER EPOXY PHENOLIC COATING
3	AMERON	AMERLOCK 400		AMERCOAT 878	
4	CHEMBOND CHEMICALS	KEMGUARD 555	KEMGUARD 250HR	-	-
5	SHALIMAR PAINTS LTD	EPIPLUS 556	HEAT RESISTING LUSTROL ALUMINIUM	LUSTOTHERM HS SILICONE ALUMINIUM	EPIGARD TL 543 HS FINISH
6	SIGMA COATINGS.	SIGMA COVER 630 (7428)	HIGH TEMPERATURE RESISTANT EPOXY SYSTEM UPTO 200°C	SIGMATHERM 540/SUPER THERMOVIT 600	SIGMA PHENGUARD 930 SYSTEM
7	CDC CARBOLINE LTD.	CARBO MASTIC-15	CARBOLINE 1248	CARBOLINE 4674	
8	PREMIER PRODUCTS LTD.	BH EPOXY MASTIC 150B/150A			
9	CORAMANDEL PAINTS & CHEMICALS LTD.	-	SILVOTOL HR ALUMINIUM PAINT	CPC SILICONE HR ALUMINIUM PAINT	
10	ANUPAM ENTERPRISES	ANU-MASTIC-102	-	ANUPAM HEAT GUARD.	
11	GRAND POLYCOATS	GP PRIME GUARD 235	-	-	
12	BOMBAY PAINTS LTD.	PENTADUR MASTIC 5515	KANGAROO HHR ALUMINIUM 4950	PENTHOLITE HRR ALUMINIUM 4951	
13.	HEMPEL MARINE PAINTS	HEMPDUR 1708			
14	AASHISH COATING TECH	GA700SPE	-	-	-

15	AKZO NOBEL COATINGS	INTERSEAL 670HS	INTERTHERM 891	INTERTHERM 50	INTERTHERM 228
16	PALADIN PAINTS	VEGEPOX MASTIC 2285	VEG HR AL PAINT	VEG HHR AL PAINT 600 DEG C	
17	VCM POLYURETHANE PAINTS	-	-	-	-
18	JOTUN PAINTS	PRIMASTIC UNIVERSAL	JOTUN AL PAINT HR 250 DEG.C	SOLVELITT AL SILICONE PAINT	TANKGUARD STORAGE
19	KCC PRODUCTS (KOREA)	EH 4158H		QT 606	
20.	CHUKOGU J&N LTD.	UMEGUARD MT/SX			
21.	KANSAI NEROLAC PAINTS LTD.	NEROMASTIC 400	NEROTHERM 250	NEROTHERM 538	

Note : This list is subject to revision based on fresh approval/ re-approval/ deletion.

उपकेन्द्रीय पम्पों के लिए मानक विनिर्देश विशिष्ट प्रयोजन प्रक्रिया पम्प

STANDARD SPECIFICATION FOR CENTRIFUGAL PUMPS (SPECIAL PURPOSE PROCESS SERVICE)

2	02.11.07	REVISED & ISSUED AS STANDARD SPECIFICATION	NK	DB	RK	VC
1	04.09.02	REVISED & ISSUED AS STANDARD SPECIFICATION	KNJ	KDS	VJN	GRR
0	15.12.97	ISSUED AS STANDARD SPECIFICATION	KNJ	KDS	SKG	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	

Abbreviations:

ANSI	:	American National Standards Institute
ASTM	:	American Society for Testing and Materials
BIS	:	Bureau of Indian Standards
EQC	:	Equipment Qualification Criteria
GA	:	General Arrangement
ISA	:	Instruments Society of America
MAWP	:	Maximum Allowable Working Pressure
MCF	:	Minimum Continuous Flow
MCR	:	Maximum Continuous Rating
NPSH	:	Net Positive Suction Head
NPSHA	:	Net Positive Suction Head Available
NPSHR	:	Net Positive Suction Head Required
P&ID	:	Piping and Instrumentation Diagram
PTR	:	Proven Track Record
VDR	:	Vendor Data Requirements

Rotating Equipment Standards Committee

Convenor: Mr Ravinder Kumar

Members: Mr V.K.Malhotra
Mr A.K.Nijhawan
Mr. Dinesh Bhatia
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Mr Nalin Kumar
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CONTENTS

	Page No.
1.0 SCOPE.....	4
SECTION 1 - GENERAL	5
1.1 Scope.....	5
1.2 Alternative Designs	5
1.3 Conflicting Requirements	5
1.6 Equipment Qualification Criteria	5
SECTION 2 - BASIC DESIGN	7
2.1 General	7
2.2 Pressure Casings.....	8
2.3 Nozzle & Pressure Casing Connections	8
2.6 Wear Rings And Running Clearances	9
2.7 Mechanical Shaft Seals	9
2.8 Dynamics	9
2.9 Bearings & Bearing Housings.....	9
2.11 Materials.....	9
SECTION 3 - ACCESSORIES	9
3.1 Driver	9
3.2 Couplings & Guards.....	10
3.3 Baseplates	10
3.4 Instrumentation	11
3.5 Piping & Appurtenances.....	11
SECTION 4 - INSPECTION TESTING AND PREPARATION FOR SHIPMENT	11
4.1 General	11
4.2 Inspection	11
4.3 Testing	12
4.4 Preparation For Shipment	14
SECTION 5 - SPECIFIC PUMP TYPES.....	14
5.1 Single Stage Overhung Pump	14
5.2 Between Bearing Pumps	14
5.3 Vertically Suspended Pumps.....	15
SECTION 6 - VENDOR'S DATA.....	15
6.1 General	15
6.2 Proposals	16
6.3 Contract Data	16
APPENDIX C - STUFFING BOXES FOR PACKING	22

1.0 SCOPE

- i. This specification together with the attendant Data Sheets and other specifications/attachments to inquiry / order defines the minimum requirements for vertical and horizontal centrifugal pumps including pumps running in reverse direction as hydraulic power recovery turbines and their accessories / auxiliaries for use in the petroleum, heavy duty chemical, pipeline and gas industry services.
- ii. Vendor shall make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.

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

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

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

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

- iv Except as modified herein, the centrifugal pumps shall be designed, manufactured, tested and supplied strictly in accordance with the **API Standard 610 - Centrifugal Pumps for Petroleum, Heavy Duty Chemical, and Gas Industry Services , Eighth Edition, August 1995.**

- v Except for new paragraphs, the number and title of the paragraphs in this specification correspond to the respective sections and paragraphs of the above standard. Paragraphs not addressed in this specification shall be strictly in accordance to **API Standard 610, 8th Edition, August 1995** requirements.

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

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

SECTION 1 - GENERAL

1.1 Scope (Substitution)

- 1.1.1 The entire paragraph is substituted by paragraph 1.0 hereinabove, excepting the note contained in the para.

1.2 Alternative Designs (Deleted)

1.3 Conflicting Requirements (Substitution)

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

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

1.5.1 (Modification)

The editions of referenced publication that are in effect at the time of inquiry or at a date specified in the inquiry documents shall be applicable.

1.6 Equipment Qualification Criteria (New)

- 1.6.1 Unless otherwise specified elsewhere, the Equipment Qualification Criteria (EQC) specified vide para 1.6.2 thru 1.6.5 of this specification shall be applied for acceptance of the offered pump model.

- 1.6.2 The vendor shall be an established manufacturer of API-610 centrifugal pumps and having adequate engineering, manufacturing and testing facilities for pumps.

- 1.6.3 a) The pump model offered shall be from the existing pump model series in 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# 1.6.3 b) below.

b) Pumps shall be identical or validly similar in terms of Power rating, Hydraulic Performance (including NPSHR), Inlet flow, Differential Head, Operating Pressure & Temperature, Pumping Liquid, Speed, Number & Type of Impellers, Mechanical Design, Materials, Bearing span (applicable for between bearing pumps), Column Length (applicable for vertically suspended pumps) etc. as compared to at least TWO UNITS of the proposed model designed, manufactured, tested and supplied from the proposed manufacturing plant in the last fifteen years and at least ONE of these units shall have successfully operated in the field for at least 8000 hours individually without any major problem as on the date of issue of inquiry.

- 1.6.4 In case the vendor is a licensee / member of a group company and does not meet on his own, the experience criteria of clause# 1.6.3 b), the vendor can substitute the references of his Collaborator (licensor) / another member of the group company, who shall also be

a regular manufacturer of the proposed pump model, provided the following conditions are met by the vendor.

- 1.6.4.1 The vendor shall be a regular & established manufacturer of API 610 centrifugal pumps and shall have supplied smaller & larger sizes of pump models of the same series, from the proposed manufacturing plant and proves to the satisfaction of the purchaser that the vendor does possess the manufacturing & testing facilities for the offered pump model.
- 1.6.4.2 The vendor's collaborator (licensor) / the member of group company whose references are being used to establish proven track record of the proposed pump model, meets the criteria as per 1.6.3.
- 1.6.4.3 The vendor's license agreement is valid and continues to remain valid till, at least TWO years after the delivery of the pumps.
- 1.6.4.4 The vendor imports as a minimum the following critical components (including components required for spare parts) from his Collaborator (licensor)/Group Company/Collaborator's 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 manufacturing plant.
- 1.6.4.5 The vendor shall have adequate testing facilities and shall carry out all the inspection and tests as specified in the inquiry/order at the proposed manufacturing plant (except for tests specified in 1.6.4.4 above, i.e. dynamic balancing & hydrostatic test) from where the vendor intends to supply the proposed pump model.
- 1.6.4.6 The vendor shall indicate the details of such arrangement in the proposal.
- 1.6.5 In case the vendor does not possess the manufacturing experience of the proposed two stage between bearing pumps & multistage pumps at the vendor's own manufacturing plant as per Clause 1.6.3 and 1.6.4 above, the vendor may propose to supply the complete package with bare 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 vendor meets the following criteria:
- 1.6.5.1 The vendor shall be a regular & established manufacturer of API 610 centrifugal pumps and shall be a licensee / member of group company from where the bare pump is proposed to be sourced.
- 1.6.5.2 a) The vendor's license agreement is valid and continues to remain valid till, at least TWO years after the delivery of the pumps.
- b) In case of member of group company, 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.
- 1.6.5.3 The pump being sourced shall meet the Equipment Qualification Criteria as detailed in clauses 1.6.2 and 1.6.3.

- 1.6.5.4 The vendor shall have engineered, packaged, tested (performance test, string test etc.) and supplied at least TWO identical or validly similar pumping units in terms of construction (axially or radially split), size of pumps (flow, head and power), lubrication system, sealing system and type of drive from the proposed shop in the last fifteen years and at least ONE of these units shall have successfully operated in the field for at least 8000 hours individually without any major problem as on the date of issue of inquiry.
- 1.6.5.5 The vendor shall have adequate testing facilities and shall carry out all the inspection and tests as specified in the inquiry/order and out of these tests, following tests as a minimum shall be carried out at the proposed manufacturing plant from where the vendor intends to supply the complete pumping unit i.e. pump, driver, gear box, lubrication system, sealing system, base plate, instrumentation and controls:
- A witnessed performance test as per clause 4.3.3
 - A witnessed NPSHR test as per clause 4.3.4.1 when specified in the inquiry /order or when the difference between NPSHA and NPSHR is less than or equal to one (1) meter.
 - Dismantle inspection and reassembly, after the running test (witnessed)
 - String test, when specified (witnessed)
 - Sound level test (witnessed)
- Hydrostatic test as per para 4.3.2 shall be witnessed type at the shop of the pump manufacturer i.e. the shop from where the intended bare multistage pump is sourced. This test shall be witnessed by a third party inspector, which shall be arranged by the vendor at his own expenses. The vendor shall furnish the test certificate for the same for approval.
- 1.6.5.6 The vendor shall indicate details of such arrangement in the proposal.
- 1.6.6 **PROVEN TRACK RECORD (PTR)**
The vendor shall complete the Experience Record Proforma's enclosed with the inquiry document to amply prove that the offered pumps meet the EQC for technical acceptance. Special attention is drawn to applications involving high suction pressure, high/low operating temperature and low NPSHR. The vendor shall also identify the imported components against each specific reference in the PTR. The vendor may furnish additional information to justify that the EQC is being met. In addition, manufacturer's catalogue and general reference list for Centrifugal Pumps shall also be furnished along with the proposal.

SECTION 2 - BASIC DESIGN

2.1 General

2.1.8 (Addition)

Pumps where difference between NPSHA and NPSHR from quoted minimum flow to rated flow is less than 0.6 meter are not acceptable. The said NPSHR value shall correspond to the maximum value of NPSHR from rated flow down to the recommended minimum continuous stable flow specified by the vendor.

Pumps fitted with inducers for reducing NPSHR are not acceptable.

2.1.10 (Addition)

Refer Performance Correction Chart of Hydraulic Institute Standard. Correction factors as applicable shall be indicated by the manufacturer on the filled-in data sheet.

- 2.1.12 (Addition)
Vendor shall indicate "Preferred Operating Range" and "Allowable Operating Range" on the characteristic curve.
- 2.1.14 (Substitution)
The maximum permissible sound level shall not exceed 88 dBA measured at one (1) meter from the complete pump unit, when measured in any direction & from any point of any equipment surface located on the equipment skid, for the recommended range of operation.
- 2.1.20 (Modification)
Maximum inlet temperature 33°C, maximum temperature rise 17°C, fouling factor water side 0.0004 m²h°C/kcal, maximum allowable working pressure 8 kg/cm²g.
- 2.1.29 (Modification)
Unless otherwise specified, equipment shall be designed to be suitable for outdoor installation without a roof.
- 2.1.30 (New)
For balancing axial thrust in multi-stage pumps, only the following arrangements shall be used:
- Opposed arrangements of impellers.
- A balancing piston
- 2.1.31 (New)
For rated flows exceeding 1000 m³/Hr, only "Between Bearing Type" pump shall be supplied.
- 2.2 **Pressure Casings**
- 2.2.4 (Modification)
Regions of double-casing and horizontal multistage pumps (pumps with three or more stages) that are subject only to suction pressure shall also be designed for the maximum allowable working pressure.
- 2.2.8 (Substitution)
The pump's pressure casing shall be suitable to withstand twice the forces and moments in Table 2-1A (2-1B) applied simultaneously to the pump through each nozzle, plus internal pressure, without distortion that would impair operation of the pump or seal.
- Note: Vendor to note that the above criteria shall be used for design of purchaser's associated piping system.
- 2.3 **Nozzle & Pressure Casing Connections**
- 2.3.3.10 (Addition)
Casing shall be provided with drain connection with nipple, threaded and seal welded and provided with a socket welded gate valve terminated at edge of the base plate. Gate valve shall be of 800# rating with material of construction (MOC) equal or superior to the pump casing. For multistage pumps with more than one drain point, block valves at each drain point shall be provided and the piping shall be terminated at edge of the base plate with a flange. Unless made self venting design, vent connections shall also be provided with a nipple, threaded and seal welded and terminated with a gate valve.

Pressure gauge connection shall not be provided unless specifically required in the inquiry. Nipples shall meet the requirements of 2.3.3.5 & 2.3.3.6.

2.6 Wear Rings And Running Clearances

2.6.3 (Modification)

The sentence "Other methods including tack welds, requires purchaser's approval" stands deleted.

2.6.4.1 (Addition)

Vendor shall also furnish in the proposal the maximum permissible running clearances which in no case shall be less than twice the running clearances as specified in this clause.

2.7 Mechanical Shaft Seals

2.7.3.19 (Modification)

For the applicable flushing and cooling plans, the vendor shall also include in his scope of supply, all items marked with an asterisks (*) and shown as optional items in Appendix D - Mechanical Seal and Piping Schematics along-with all other specified/required items.

2.8 Dynamics

2.8.2.6 (Modification)

The words "when specified" stand deleted.

2.9 Bearings & Bearing Housings

2.9.2.9 (Modification)

Requirement of oil heaters for bearing oil shall be as per vendor's standard practice and shall be provided by the vendor when the ambient or operating temperature dictates.

2.9.2.13 (New)

Bearing housing shall be equipped with magnetic drain plug.

2.11 Materials

2.11.1.1 (Modification)

The material of construction of pump parts shall be in accordance with the data sheet.

2.11.1.7 (Modification)

The words 'when specified' stand deleted.

2.11.2.5 (Modification)

The words "when specified" stand deleted.

2.11.3.5.6 (Modification)

Radiographic inspection of nozzle welds is required.

SECTION 3 - ACCESSORIES

3.1 Driver

3.1.4 (Modification)

Electric motor drivers shall have a maximum continuous rating (MCR) (i.e. service factor equal to 1) not lower than the following:

Motor Name plate Rating

Upto 22 kW

Motor MCR (% of Pump Rated BKW)

To suit maximum BKW indicated on pump data sheet or 125% of rated pump BKW, whichever is higher.

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

Note:

- Over and above the requirements specified in Table 3-1 and the above modifications, the motor nameplate rating for pumps under parallel operation shall not be less than the max. BKW indicated on pump data sheet (Power at End of the curve for the rated impeller) and the pump motors shall be suitable for start-up under open discharge valve condition.
- The motor nameplate rating for applications where the specific gravity of pumped fluid is less than 1.0 shall either be 100% of the BKW of pump at minimum continuous stable flow with clean cold water of sp. gravity 1.0 or shall have the specified margin as per this clause, whichever is greater.

3.2 Couplings & Guards

3.2.2 (Addition)

The coupling service factor shall not be less than 1.5 over the driver rating.

3.2.12 (Addition)

Coupling guard shall be non-sparking 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.

3.2.13 (New)

Unless otherwise specified, all couplings required for multistage pump package(s) shall conform to API standard 671 where either the driver rating is greater than 500 kW or the maximum continuous speed is greater than 3800 rpm. In case of gear box driven multistage pump units, both low speed and high speed couplings shall conform to API standard 671, even if the lower speed happens to be less than or equal to 3800 rpm.

3.3 Baseplates

3.3.6 (Modification)

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

3.3.20 (Modification)

Anchor bolts & suitable washers shall be furnished by the pump manufacturer.

3.3.21 (New)

Pumps in corrosive service shall have provision to collect and drain the leakage from mechanical seal or packing, through a drip pan of metallurgy equivalent or superior to pump casing. Leakages from drip pan shall be piped to baseplate with a flanged

connection for onward disposal by purchaser. Where the design of bearing prohibits provision of drip pan, the material of bearing bracket shall be suitable for the corrosive service.

3.4 Instrumentation

3.4.3.1 (Modification)

The words 'when specified' stand deleted.

3.4.3.2 (Modification)

The words 'when specified' stand deleted.

3.5 Piping & Appurtenances

3.5.2.4 (Addition)

Auxiliary process fluid piping material shall be SS-316 as a minimum.

3.5.2.10.1 (Modification)

Flanges are required in places of socket welded unions.

3.5.2.11 (New)

Material for seal flushing liquid cooler shall be as under:

Tube or Coil : Type 316 stainless steel or Monel.

Casing (or Shell) : Carbon Steel.

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

3.5.4.3 (Modification)

Sight flow indicator shall have ball or flag for easy verification of water flowing through pipes. Thermal Relief valves in each isolatable CW circuit shall also be provided.

SECTION 4 - INSPECTION TESTING AND PREPARATION FOR SHIPMENT

4.1 General

4.1.5 (Addition)

Prior to start of test, manufacturer shall furnish the certificate of latest calibration / re-calibration of driver and measuring instruments.

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

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

4.2 Inspection

4.2.1.3 (Substitution)

The minimum material inspection requirement for pressure containing casings shall be as per the following inspection category:

Inspection category	Inspection requirement	Remarks
CATEGORY A	Visual inspection and Magnetic Particle or Liquid Penetrant	A1. Liquid penetrant inspection shall be

Inspection category	Inspection requirement	Remarks
	inspection of following components as a minimum: - Nozzle weld - Butt welds on pressure containing components - Fillet welds on pressure containing components. - Shaft Radiographic or ultrasonic inspection of the following as a minimum: - Nozzle weld - Butt welds on pressure containing components.	performed only when specified magnetic particle inspection is not feasible. A2. Magnetic particle or liquid Penetrant inspection shall be carried out in accordance with table 13. A3. Ultrasonic inspection shall be carried out when radiography is not feasible. Radiography or ultrasonic inspection shall be carried out in accordance with table 13.
CATEGORY B	Visual inspection and Magnetic Particle or Liquid Penetrant inspection of following components as a minimum: - Nozzle weld - Butt welds on pressure containing components - Fillet welds on pressure containing components. - Shaft	B1. Liquid penetrant inspection shall be performed only when specified magnetic particle inspection is not feasible. B2. Magnetic particle or liquid penetrant inspection shall be carried out in accordance with table 13.
CATEGORY C	As per vendor's standard Quality Assurance Plan	
<p>Note: Category A: This category is applicable for services with process design pressure above 70 kg/cm²g or process design temperature below -29°C or above 300°C.</p> <p>Category B: This category is applicable for services within the design pressure and temperature range other than covered under category A above and category C below.</p> <p>Category C: This category is applicable for carbon steel and cast iron for services with process design pressure up to 40 kg/cm²g and design temperature from 0°C to 150°C.</p>		

4.2.3.3 (New)

Inspection shall also include dimensional check of pump, driver and auxiliaries (if any) duly mounted on the base plate, in accordance with certified general assembly drawing. This will include all main pump dimensions, base plate dimensions, location of foundation bolt holes, size/position/rating of flanges, coupling guard arrangement, verification of the required material certificates and their traceability to the respective components. In addition, following checks shall also be carried out:

- A measurement of the actual running clearances throughout the pump.
- A check of compliance report for wear ring(s) hardness.
- A check for good workmanship and finish throughout.

4.3 Testing

4.3.1.1 (Addition)

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

1. A witnessed hydrostatic test as per 4.3.2.
2. A witnessed performance test as per 4.3.3.
3. A witnessed NPSHR test as per 4.3.4.1 when specified in the material requisition or when the difference between NPSHA and NPSHR is less or equal to one (1) meter.
4. Shop Inspection per 4.1.4.1.
5. Dismantling inspection and reassembly, after the running test (witnessed).
6. Dynamic balancing of rotating assembly (impeller only; in case of single & two stage pumps) (observed).
7. Sound level test (witnessed).

4.3.3.2.5 (New)

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

4.3.3.3.2 (Addition)

During the performance test, rise in temperature of bearing oil shall be measured and results recorded on the test log.

4.3.3.3.3 (Modification)

The tolerances for guaranteed characteristics stand modified as under:

Rated Head : Zero negative tolerance @ rated flow rate & rated speed
Shut-off Head : Following criteria shall apply:

a) Positive tolerance permitted as long as maximum shutoff pressure corresponding to shut-off head (as observed during the shop performance test) and the maximum suction pressure (as specified on pump data sheet), does not exceed the downstream design pressure (as specified on pump data sheet).

b) Negative tolerance (as per Table 4-2 of API Std. 610, 8th edition) may be permitted only if test curve still shows rising characteristics.

c) Negative tolerance is not permitted for pumps required for pumps under parallel operation.

[Note: Generally shutoff head should be limited within 120% of rated head.]”

NPSHR : Zero positive tolerance.

Rated BKW : Zero positive tolerance. (However, pumps may be accepted up-to 104% of guaranteed BKW subject to Penalties as defined elsewhere.

4.3.3.4.1 (Addition)

Decision regarding trimming of impellers to meet the tolerances on differential head shall be taken only thereafter.

4.3.3.5 (New)

During the performance test, the equipment shall be checked for its sound level at minimum flow, at rated flow, at flow at best efficiency point and at 120% BEP flow.

The maximum allowable value shall not exceed 88 dBA measured at one (1) meter from pump surface or as specified in data sheet whichever is lower. During the performance test, the pump shall be run for a minimum duration of continuous four hours.

Where complete unit test is specified, vendor is required to demonstrate the noise levels within the maximum permissible sound level for the complete unit.

Recorded noise levels shall be taken for reference only & not for final acceptance or rejection.

4.4 Preparation For Shipment

4.4.7 (New)

Unless otherwise specified, 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 operation and maintenance manuals.

SECTION 5 - SPECIFIC PUMP TYPES

5.1 Single Stage Overhung Pump

5.1.1.3 (New)

Unless otherwise specified, overhung pumps for rated flow exceeding 1000 m³/ Hr are not acceptable.

5.2 Between Bearing Pumps

5.2.2.4 (New)

Maximum number of stages shall not exceed 10 for horizontal pumps.

5.2.5.2.2 (Addition)

Thrust collar shall be replaceable.

5.2.6.2.a (Modification)

Except in case of shaft driven pumps, if a positive displacement type of oil pump is supplied, a separate relief valve (not integral with the pump) shall be provided. The relief valve shall not be used for pressure regulation. Horizontal oil pumps shall not be installed on top of the oil reservoir.

5.2.6.2.b (Modification)

The oil side operating pressure shall be higher than the water side operating pressure to prevent contamination of oil in case of cooler failure.

5.2.6.2.e (Addition)

Filters shall be equipped with continuous flow switch over valve and equalising line.

5.2.6.2.k (Addition)

Oil system shall have drain rim or pan to catch oil spills.

5.2.6.2.l (Addition)

All the instrumentation shall be supplied by the pump manufacturer. However, make, type and specification shall be approved by purchaser.

- 5.2.6.3 (Modification)
Unless otherwise specified, heating element shall not be provided. However, if in the opinion of vendor such arrangement is required (especially in view of the lowest ambient temperature prevailing at job site), the same shall be supplied by the pump manufacturer with specific approval of the purchaser.
- 5.2.8.5 (Modification)
The words "when specified" stand deleted.
- 5.2.9.2 (Modification)
The words "when specified" stand deleted.
- 5.3 **Vertically Suspended Pumps**
- 5.3.1.2 (Addition)
Bowls and columns shall be flanged and bolted.
- 5.3.2.3 (Addition)
Multi-piece vertical pump line shaft shall not be joined by threaded couplings.
- 5.3.5.2 (Modification)
Pump thrust shall not be transferred to driver motor. Vertical pumps shall be provided with their own thrust bearing to carry rotor weight and pump generated axial forces.
- Thrust bearing shall be positively locked on the pump shaft (shouldered shaft) and the bearing housing.
- 5.3.5.4 (New)
For self lubrication pumps, guide bushing shall be suitable for dry running during start-up.
- 5.3.7.1.2 (Modification)
For vertical pumps, not provided with non-reverse ratchet, vendor shall describe the precaution taken, to prevent damage due to reverse rotation.
- 5.3.9.7 (Modification)
The words "when specified" stand deleted.
- 5.3.12.6 (Modification)
The words "when specified" stand deleted.

SECTION 6 - VENDOR'S DATA

- 6.1 **General**
- 6.1.3 **Co-ordination meeting** (Substitution)
When specified, a co-ordination meeting shall be held at Purchaser's office, preferably within 4 weeks of order.
An agenda shall be prepared for this meeting and would include the following points related to technical aspects:
- Any clarifications required by the vendor on purchaser's order.
 - Vendor Data Index & Schedule.

- c) Vendor Data Review/approval modalities.
- d) Sub-vendor lists proposed by vendor.
- e) Utility requirements.
- f) Preliminary General Arrangement & layout drawings & purchaser's interface drawings.

6.2 Proposals (Substitution)

The vendor's proposals shall as a minimum include the following:

- a) All data sheets, drawings and documents listed under "PRINTS WITH QUOTE" in the enclosed Vendor Data Requirement Form.
- b) Vendor's confirmation/comments on post-order Vendor Data Requirements (Type of Documents, no. of prints and date needed) indicated in Vendor Data Requirement forms data sheets and specs.
- c) List of recommended commissioning spares included in the offer.
- d) List of mandatory spares (where specified by the purchaser) included in the offer.
- e) List of Spare Parts For Two Years Normal Operation
This list shall be made separately for each items including auxiliaries and drivers in the form of a table & shall show:
 - i) Part name, description and number.
 - ii) Quantity installed in one unit.
 - iii) Quantity recommended per unit for 2 years normal operation.
 - iv) Quantity recommended for number of units of an item as specified in the inquiry.
 - v) Quantity recommended as insurance for the number of units of an item specified in the inquiry.
- f) An itemised list of special tools included in the offer.
- g) Any start-up, shutdown or operating restrictions required to protect the integrity of the equipment.
- h) Any limitations of vendor's test-facility to carryout the specified tests.
- i) A specific statement that the scope of supply, the offered equipment/systems and all its components are in strict accordance with the data sheets, job specifications, this specifications and all other attachments, except for specific deviations as listed in the proposal.

6.3 Contract Data (Substitution)

6.3.1 General

6.3.1.1 Drawings and data as required after purchase order has been specified in Vendor Data Requirement. Vendor to note that the drawing/document descriptions/titles as given in the Vendor Data Requirement are generic in nature. It is possible that against one drawing / document specified there are several drawings to be furnished by the vendor or vice versa.

6.3.1.2 Vendor shall complete & forward a document "Vendor Data Index & Schedule" to the purchaser (Destination & contact person as per order).

This document shall list out in consolidated form all drawings and documents required by purchaser (As specified in Data Sheets, Specifications and Vendor Data Requirement forms enclosed with the order).

Against each drawing/document vendor shall indicate the vendor's drawing numbers, titles, Rev. No., category (whether for information or approval) and schedule of submission.

This shall be the first document to be submitted by vendor within two weeks of order.

6.3.1.3 All transmittal letters (covers), drawings and data shall have a title block (in addition to vendor's standard title block) which shall as a minimum contain the following contract information:

- i) Purchaser's and Consultant's Corporate Name
- ii) Project Name.
- iii) Equipment Name and Item No.
- iv) Purchase Order No.
- v) Purchase Requisition No.

Title Block on drawings shall be placed on the lower right hand corner.

6.3.1.4 All vendor data/drawings/documents shall be in English Language and in Metric Systems.

6.3.1.5 Data specified in the VDR is the minimum requirements of Purchaser. Any additional document/data required or requested by Purchaser for engineering or construction shall also be made available by the vendor.

6.3.1.6 Whether or not specified the vendor shall furnish the following, before shipment:

- As built running clearances and when applicable; thrust bearing, radial bearing and seal running clearances.
- A supplementary list of spare parts other than those included in his original proposal. The supplementary list shall include recommended spare parts, cross-sectional or assembly type drawings, parts numbers, materials, prices and delivery period. The vendor shall forward this supplementary list to the purchaser promptly after receipt of the reviewed drawings and in time to permit order and delivery of parts before field start-up.
- A parts list for all equipment supplied. The list shall include pattern, stock, or production drawing numbers and materials of construction. The list shall completely identify each part so that the purchaser may determine the interchangeability of the parts with other equipment furnished by the same manufacturer. Standard purchased items shall be identified by the original manufacturer's name and part number.
- At least 8 weeks before shipment, the vendor shall submit his preservation, packaging and shipping procedures to the purchaser's for his review.

6.3.2 Drawings

6.3.2.1 The number of prints and/or reproducible required and the times within which these are to be submitted by vendor are specified in Purchaser's inquiry/order.

6.3.2.2 The purchaser's review of the vendor's drawings shall not constitute permission to deviate from any requirements in the purchase order/specifications unless specifically agreed upon in writing. After the drawings have been reviewed, the vendor shall furnish certified copies in the quantity specified. All drawings must be clearly legible and shall be folded to 216 mm x 279 mm size. All transparencies shall be rolled.

6.3.3 Technical Data

6.3.3.1 General Arrangement Drawing

A general arrangement drawing shall contain as a minimum, the following information:

- i) Outline dimensions (minimum three views) (All principal dimensions).
- ii) Allowable forces and moments on suction and discharge nozzles.

- iii) Location (in all three planes), size, type, rating and identification of all purchaser's interface connections including those of vents, drains, lubricating oil, sealing fluid, cooling water, steam & Electrical/Instrumentation.
- iv) Direction of rotation viewing from the driving end.
- v) Weight of each assembly/component.
- vi) The weight & location of center of gravity of the heaviest assembly/ components that must be handled for erection.
- vii) Identification and weight, dimensions of the heaviest assembly / subassembly / component required to be handled for maintenance.
- viii) Maintenance clearances and dismantling clearances.
- ix) Speeds of Driven Equipment and Driver with Driver rating. Location of driver terminal box (in case of Electric Motor Driver).
- x) Layout of auxiliary equipment and operating platform, as applicable.
- xi) Make, Type and Size of couplings and the location of guards and their coverage.
- xii) A list of reference drawings if any.
- xiii) A list of any special weather-protection and climatic features.

6.3.3.2 Foundation Drawings

A foundation drawing shall indicate complete information required for foundation design by purchaser including the following:

- i) Foundation bolt sizes, pipe sleeve details, pocket sizes and locations.
- ii) Grouting thickness and other necessary technical details.
- iii) Static weight of each skid/independently grouted item and location of center of gravity of each of such skid/items in all three planes.
- iv) Weight distribution for each bolt/subsole plate location and total static weight.
- v) Dynamic loading caused due to various items grouted independently.
- vi) The direction and magnitude of unbalance forces and moments generated by each such item at the worst operating condition and short circuit moments of motor drivers.
- vii) GD^2 value of each item resolved to driver speed.
- viii) Maximum permissible amplitude of vibration on the foundation at base level.
- ix) Total mass of rotating parts.
- x) Suggested dynamic factor and ratio of foundation weight to weight of skid/equipment as per vendor experience.

6.3.3.3 Layout Drawing (For multi-skid packages)

This drawing shall include at-least the following information:

- i) Layout of all skid/equipment and their auxiliaries, vessels, control panels, exchangers etc. Vendor shall furnish an optimised layout (considering the space allocated, site wind conditions, area classification, the type of equipment located in the vicinity etc.) indicating elevation and dimension of skids/equipment.
- ii) Minimum spacing required between the various skids / equipment and between the skids and the walls / columns / roof for an easy accessibility and maintenance.
- iii) Layout for water piping, trenches for water piping, cable tray/trenches layout.
- iv) Piping arrangement and piping support arrangement/location for piping in vendor's scope.
- v) Layout for auxiliary equipment and operating platform details.
- vi) Specification for crane/mono rail (including suggested mono rail layout) recommended for maintenance and height of the lifting hook from the centreline of equipment.

6.3.3.4 Field Alignment Diagram

The diagram shall indicate the relative displacement to be kept between the centrelines of various equipments at the time of installation, so that under normal running conditions the equipments get fully aligned. This relative displacement should be decided on the basis of centreline temperature rise data of driver, gear box/transmission system, driven equipment.

6.3.3.5 Heat Exchanger Drawings

Heat exchanger drawing and data shall include heat and mass balance data, details of provisions for separating and withdrawing the condensate, construction details, cross sections & general arrangement drawings of heat exchangers, vendor's recommendations regarding provision for support and piping expansion.

6.3.3.6 P&I Diagrams (with Bill of Materials)

Vendor shall supply P&I Diagrams along with Bill of Materials of each system in the vendor's scope of supply or specified in the order. P&I Diagram shall indicate the system details, location of various auxiliaries, instruments, controls and safety devices as required. Line sizes, piping class, valve sizes and class shall be clearly marked on the P&ID. Vendor's scope and purchaser's scope shall be clearly demarcated. Each item shall be identified by an item No./item tag no., which shall correspond to the item no. shown on the bill of materials. The bill of materials shall include items number, normal value, set value, range, quantity per unit, make and other specifications as applicable. Legends adopted shall be indicated either at the bottom of drawing or on a separate drawing. The legends shall be as per ISA 5.1.

6.3.3.7 Cross-sectional Drawing with Bill of Materials

The vendor shall supply cross-sectional or assembly type drawings for all equipment furnished showing all parts, design assembly and running clearances, and balancing data required for erection and maintenance. Each part shall be numbered which shall correspond to the part number on the bill of materials. The bill of materials shall include the part no., name of component, materials quantity installed per unit & sizes where applicable (say for bolts, nuts, rings, gaskets etc.). All bought-out items shall also be indicated with make and brief specifications.

A separate cross-sectional drawing showing installation and setting dimensions for the seals shall be furnished.

6.3.3.8 Performance Characteristic Curves

6.3.3.8.1 The vendor shall provide complete performance curves to encompass the map of operations, with any limitations indicated thereon.

6.3.3.8.2 All curves submitted prior to final performance testing shall be marked "PREDICTED". Any set of curves resulting from a test shall be marked "TESTED".

6.3.3.8.3 Certified test curves and data shall be submitted within 15 days after testing and shall include head, power recalculated to the proper specific gravity and efficiency plotted against capacity. If applicable, viscosity corrections shall be indicated. If NPSHR test is specified, the water NPSHR curve (drawn up-to minimum continuous flow) shall also be included. The curve sheet shall include the maximum and minimum diameters of the impeller design supplied, the eye area of the first stage impeller, the identification number of the impeller or impellers and the pump serial number.

6.3.3.9 Data Sheet

The Vendor shall provide completely filled in data sheets, first for "As Purchased" and then for "As Built". This shall be done by the vendor correcting and filling out the data sheets and submitting copies to the purchaser.

6.3.3.10 Installation Manual

The vendor shall provide sufficient written instructions, including a cross-reference list of all drawings, to enable the purchaser to correctly install, operate and maintain all the equipment. It shall include any special information required for proper installation that is not on the drawings, special alignment or grouting procedures, utility specifications (including quantity) and all installation data. It shall also contain the following information:

6.3.3.10.1 Instructions for erecting, piping, aligning (including the expected thermally induced shaft centreline shift between normal site ambient temperature position and that at normal equipment operating temperature).

6.3.3.10.2 A description of rigging procedures, including the lifting of the assembled equipment, and methods of disassembly, repair, adjustment, inspection and reassembly of the equipment and auxiliaries.

6.3.3.10.3 Pre-commissioning/commissioning/functional test procedures and acceptance criterion.

6.3.3.11 Operation and Maintenance Manual

This shall provide sufficient written instructions and data to enable purchaser to correctly operate and maintain the equipment ordered. It shall include a section to cover special instructions for operation at extreme environmental and/or extreme operating conditions. The following shall be included in this manual:

6.3.3.11.1 Instructions covering start-up, normal shutdown, emergency shutdown, operating limits and routine operational procedures.

- (a) A description of equipment construction features and the functioning of component parts or systems (such as control, lubrication, sealing systems etc.).
- (b) Outline and sectional drawings, schematics and illustrative sketches in sufficient details to identify all parts and clearly show the operation of all equipment and components and the methods of inspection and repair. Standardised sectional drawings are acceptable only if they represent the actual construction of the equipment.

6.3.3.11.2 The following maintenance information:

- (a) Maximum and minimum bearing, labyrinth and seal clearances including any other clearance between moving and stationary parts of the equipment affecting proper running and maintenance of the equipment.
- (b) Instructions for measuring and adjusting cold clearances, shaft run-out, concentricity etc.
- (c) Rotor float allowance.
- (d) Interference fits on parts that are required to be removed or replaced for maintenance of normally consumable spares.
- (e) Balancing tolerances.
- (f) Lubricating schedules indicating recommended grades of oil, their properties, replacement period etc.
- (g) Normal maintenance procedure.
- (h) Preventive maintenance schedules and criterion for replacement of parts.
- (i) Trouble - shooting procedures.

6.3.3.11.3 The following reassembly information:

- (a) Bolting sequence and torque values for all bolts affecting equipment performance/integrity/safety.
- (b) Reassembly sequences together with required inspection checks.
- (c) Adjustment procedures to achieve required positions, clearances, float and so forth.
- (d) Detailed procedures for pre-operational checks, including settings and adjustments.
- (e) Seals and coupling installation procedures.
- (f) Parts list indicating cross-sectional drawings of various assemblies and sub-assemblies, part numbers, materials of construction (ASTM) etc. to facilitate identification of parts and for procurement of spares.

6.3.3.12 Technical Data Manual / Mechanical Catalogue

6.3.3.12.1 Technical data manual / mechanical catalogue is a compilation of "as built" drawings and data, manufacturing and test records, installation, operating and maintenance instructions.

6.3.3.12.2 Not later than two weeks after successful completion of all specified tests, the vendor shall furnish the required number of technical data manual / mechanical catalogues for the equipment, any auxiliaries and instruments that the vendor is providing. The technical data manual / mechanical catalogue shall include the following documents as a minimum:

- a) All drawings and data as listed in the vendor data index & schedule. (For drawings, where purchaser's approval is required, the final certified drawings shall be attached.) Sections of technical data manual / mechanical catalogue shall be organised in a manner that data and drawings related to one subject are grouped together such as Mechanical, Electrical, Instrumentation etc.
- b) All manufacturing, inspection and test data and records.

6.3.3.12.3 Following information shall also be included in the Technical data manual / mechanical catalogue:

- (a) Storage instructions for storing and preserving the equipment (including driver and all the auxiliary units) at the plant site before installation of the same.
- (b) Instructions for preserving the equipment after it has been installed. This is particularly required in cases where a long time gap is expected between equipment installations and commissioning.
- (c) Field performance test procedures and acceptance criterion.

6.3.3.12.4 Technical data manual / mechanical catalogue shall be in hard board folder(s) of size 265 mm x 315 mm (10½" x 12½") and shall not be more than 90 mm thickness; it may be of several volumes and each volume shall have a volume number, index of volumes & index of contents of that particular volume.

6.3.3.12.5 Title sheet (Top sheet) of each volume of technical data manual / mechanical catalogue shall contain the contract information as defined under 5.2.1.2 besides the volume number.

6.3.3.12.6 In case order contains more than one item, separate dedicated mechanical catalogues shall be submitted for each item.

6.3.3.12.7 Two (2) sets of Final / "As Built" drawings & documents shall also be submitted as electronic files on secondary storage media (i.e. CD-ROM / DVD-ROM disk).

APPENDIX C - STUFFING BOXES FOR PACKING

C.2 (Addition)

Cooling jackets shall be provided on stuffing boxes of packed pumps when either of the following condition is specified:

1. Fluid temperature is equal to or above 120°C
2. The vapour pressure is equal or above 0.7 kg/cm² abs. (0.69 bar abs.)

C.7 (Modification)

Pump packing shall be supplied duly installed on the pump.

सामान्य प्रयोजन स्टीम टर्बाइनो के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR GENERAL PURPOSE STEAM TURBINES

1	13.05.08	REAFFIRMED & ISSUED AS STANDARD SPECIFICATION	JSD	NK	VKM	VC
0	24.07.03	ISSUED AS STANDARD SPECIFICATION (Superseding EIL Spec. 6-41-0042 Rev.1)	NK	KDS	RK	SKG
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

EQC	:	Equipment Qualification Criteria
ISA	:	Instrument Society of America
P&ID	:	Piping & Instrumentation Diagram
PTR	:	Proven Track Record
VDR	:	Vendor Data Requirements

Rotating Equipment Standards Committee

Convenor: Mr V K Malhotra

Members: Mr A.K.Nijhawan
Mr Dinesh Bhatia
Mr Sanjay Mazumdar
Mr Nalin Kumar
Mr Anukul Mandal
Mr SP Singh
Mr Tarun Kumar
Mr S Kaul (Proj.)

CONTENTS

	Page No.
1.0 SCOPE	4
1 SCOPE	5
1.1 PURPOSE (Modification)	5
1.2 ALTERNATIVE DESIGNS (Deleted)	5
1.3 CONFLICTING REQUIREMENTS (Substitution)	5
1.4 EQUIPMENT QUALIFICATION CRITERIA (New)	5
2 REFERENCES	6
2.1 REFERENCED PUBLICATIONS	6
4 BASIC DESIGN	6
4.1 GENERAL	6
4.2 PRESSURE CASINGS	6
4.4 CASING CONNECTIONS	7
4.8 DYNAMICS	7
4.10 LUBRICATION	7
4.12 NAMEPLATES AND ROTATION ARROWS	7
5 ACCESSORIES	7
5.4 CONTROLS AND INSTRUMENTATION	8
6 INSPECTION AND TESTING	8
6.1 GENERAL	8
6.2 INSPECTION	8
6.3 TESTING	8
6.4 PREPARATION FOR SHIPMENT	8
7 VENDOR'S DATA	8
7.1 GENERAL	8
7.2 PROPOSALS (Substitution)	8
7.3 CONTRACT DATA (Substitution)	9

1.0 SCOPE

- (i) This specification together with attendant data sheets and other specifications/attachments to the inquiry/order covers the minimum requirements for General-Purpose Steam Turbines. These requirements include basic design, materials, related lubrication systems, controls, auxiliary equipment and accessories.
- (ii) Vendor shall make all possible efforts to comply strictly to the requirements of this specification and other specifications/attachments to inquiry/order. In case deviations are considered essential by the vendor (after exhausting all possible efforts) these shall be separately listed in the vendor's proposal under separate section titled as "List of deviations/exceptions to the inquiry document". Deviation shall be listed separately for each document with cross-reference to Page No./Section/Clause No./Para etc. of the respective document supported with proper reasons for the deviation for purchaser's consideration. Any deviation not listed under the above section, even if reflected in any other portion of the proposal shall not be considered applicable. No deviations or exceptions shall be permitted without the written approval of the Purchaser.
- (iii) Compliance with this Specification shall not relieve the vendor of the responsibility of furnishing equipment and accessories /auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions. In case the vendor considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, he shall recommend the same along with reasons in a separate section along with his proposal and include the same in his scope of supply.
- (iv) Except as modified herein, the general purpose steam turbines and their auxiliaries shall be designed, fabricated, tested and supplied strictly in accordance with the **API Standard - 611, Fourth Edition, June 1997, "General Purpose Steam Turbines for Refinery Services"**. All requirements specified in the following paragraphs are additions, modifications or substitution (as noted in parenthesis) to above standard and appear in the alphabetical or numerical order as followed in the above Standard.
- (v) Except for new paragraph, the number and title of the paragraphs in this Specification correspond to the respective sections and paragraphs of the above standard. Paragraphs not addressed in this specification shall be strictly in accordance to **API Standard 611, Fourth Edition, June 1997**. The word in parenthesis following the number or title of a paragraph indicates the following:

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

1 SCOPE

1.1 PURPOSE (Modification)

The entire paragraph excepting "NOTE" and paragraph 1.1.1 is substituted by paragraph 1.0 above.

1.2 ALTERNATIVE DESIGNS (Deleted)

1.3 CONFLICTING REQUIREMENTS (Substitution)

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

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

1.4 EQUIPMENT QUALIFICATION CRITERIA (New)

1.4.1 Unless otherwise specified elsewhere, the Equipment Qualification Criteria (EQC) specified vide para 1.4.2 to 1.4.5 of this specification shall be applied for acceptance of the offered steam turbine model and its manufacturer.

1.4.2 The vendor shall be an established General-Purpose Steam Turbines manufacturer having adequate engineering, manufacturing and testing facilities for the same.

1.4.3 The Steam Turbine model offered shall be from regular manufacturing range of the vendor.

1.4.4 Steam turbines shall be identical in frame size (Model Number) and validly similar in Power rating, Rated Speed, Steam Flow, Steam Inlet Conditions, Steam Exhaust Conditions, Roto-dynamics, Bearing Span, Mechanical Design and Materials as compared to at least TWO units designed, manufactured, tested and supplied from the proposed manufacturing plant in the last fifteen years and at least ONE of these units shall have successfully operated in the field for minimum 8000 hours without any major problem.

As an alternative, vendor may show to the satisfaction of the purchaser that the equipment offered is comprised of modules such as Inlet Module, Middle Module & Exhaust Modules each of which individually satisfies the requirement specified above.

1.4.5 Proven Track Record

The vendor shall complete the Experience Record Proformas as enclosed in the inquiry specification to amply prove that the Equipments offered meet the EQC for technical acceptance. Vendor may furnish additional information to justify that the EQC is being met. In addition, manufacturer's catalogue and general reference list for all the above equipments shall also be furnished alongwith the proposal.

2 REFERENCES

2.1 REFERENCED PUBLICATIONS

2.1.2 (Substitution)

Vendor shall take all the measures to comply with any state or local codes, statutory regulations, ordinances or rules that are applicable to the equipment.

4 BASIC DESIGN

4.1 GENERAL

4.1.11.1 (Substitution)

Unless otherwise specified, cooling water system shall be designed for the following condition:

Velocity over heat exchanger surface	:	1.5 - 2.5 m/sec.
Maximum Allowable Working Pressure	:	$\geq 8.0 \text{ kg/cm}^2\text{g}$
Test Pressure	:	$\geq 12.0 \text{ kg/cm}^2\text{g}$
Maximum Pressure Drop	:	$1.0 \text{ kg/cm}^2\text{g}$
Maximum Inlet Temperature	:	33°C
Maximum Outlet Temperature	:	45°C
Maximum Temperature Rise	:	12°C
Fouling Factor on Water Side	:	$0.0004 \text{ m}^2 \text{ hr}^\circ\text{C/kcal}$
Shell Side Corrosion allowance	:	3.2 mm

Provision shall be made for complete venting and draining of the system.

4.1.12 (Modification)

Unless otherwise specified, the maximum sound pressure level of the turbine shall not exceed 88 dBA measured at 1 meter from the equipment surface for the recommended range of operation.

4.1.13 (Modification)

Motors, electrical/instrument components and electrical/instrument installations shall be suitable for the area classification specified by the purchaser, and shall meet the requirements as defined in the electrical/instrument specification attached with the inquiry /order.

4.1.15 (Substitution)

Unless otherwise specified, the vendor shall develop the arrangement of the equipment including piping & auxiliaries. The arrangement shall provide adequate areas and safe access for operation and maintenance.

4.2 PRESSURE CASINGS

4.2.7.1 (Substitution)

On all turbines, the vendor shall provide automatic draining system.

4.2.13 (Modification)

The words 'when specified' stand deleted.

4.4 CASING CONNECTIONS

- 4.4.6.5 (Modification)
The words 'when specified' stand deleted.

4.8 DYNAMICS

- 4.8.4.2 (Modification)
The words 'when specified' stand deleted.

4.10 LUBRICATION

- 4.10.3 (Modification)
Unless otherwise specified, oil grade/characteristics shall be as recommended by the vendor.

- 4.10.6.9 (Modification)
The words 'when specified by the purchaser or required by the vendor' stand deleted.

- 4.10.6.10 (Modification)
The words 'when specified' stand deleted.

- 4.10.6.11 (Modification)
The words 'when specified' stand deleted.

- 4.10.6.12 (Modification)
The words 'when specified' stand deleted.

- 4.10.8 (Modification)
Substitute 'when required as per the vendor's recommendation' in place of 'when specified'.

4.12 NAMEPLATES AND ROTATION ARROWS

- 4.12.3 (Modification)
MKS and/or SI units are to be shown.

5 ACCESSORIES

5.3 MOUNTING PLATES

5.3.1 General

- 5.3.1.1 (Modification)
Unless otherwise specified, the equipment shall be furnished with base plate.

- 5.3.1.2.10 (Substitution)
Anchor bolts shall be furnished by the vendor.

- 5.3.2.3 (Modification)
The words 'when specified' stand deleted.

- 5.2.3.8 (Modification)
Where required, sub-sole plates shall be provided by the vendor.

5.4 CONTROLS AND INSTRUMENTATION

5.4.4.7.3 (Modification)

The words 'when specified' stand deleted.

5.4.5.2 (Modification)

The words 'when specified' stand deleted.

6 INSPECTION AND TESTING

6.1 GENERAL

6.1.5 (Modification)

The vendor shall notify the purchaser not less than 4 weeks before the date of schedule testing and reconfirm the same at least one week before the firm test date.

6.2 INSPECTION

6.2.1.3 (Substitution)

The vendor shall list in the proposal, the parts (and the type of examination) that shall be subjected for surface and sub-surface examination as per vendor's standard practice for the subject equipment.

6.3 TESTING

6.3.1.2 (Substitution)

Notice period shall be as per paragraph 6.1.5 above.

6.3.3.1.2 (Modification)

The words 'when specified' stand deleted.

6.4 PREPARATION FOR SHIPMENT

6.4.1 (Modification)

The preparation shall be suitable for at least 18 months of outdoor storage from the time of shipment unless specified otherwise in the inquiry or order. If any extra precaution is to be taken by the Purchaser for storage beyond 18 months the same shall be explicitly indicated in the operation and maintenance manuals.

7 VENDOR'S DATA

7.1 GENERAL

7.1.1 (Modification)

The information to be furnished by the vendor is specified in 7.2, 7.3 and purchaser's Vendor Data Requirements as included in the inquiry document. Vendor shall complete and forward the document "Vendor Data Index and Schedule" to the purchaser. (Destination and Contact person as per order).

7.2 PROPOSALS (Substitution)

7.2.1 General

The vendor's proposals shall, as a minimum, include the following:

- a. All data sheets, drawings and documents listed under "PRINTS WITH QUOTE" in the Vendor Data Requirement Form enclosed with the inquiry.
- b. Vendor's confirmation/comments on post-order Vendor Data Requirements (Type of Documents, no. of prints and date needed) indicated in Vendor Data Requirement forms, data sheets and specs.
- c. List of recommended commissioning spares included in the offer.
- d. List of mandatory spares (where specified by the purchaser) included in the offer.
- e. List of Spare Parts for Two Years Normal Operation
This list shall be made separately for each items including auxiliaries and drivers in the form of a table & shall show
 - i) Part name, description and number.
 - ii) Quantity installed in one unit.
 - iii) Quantity recommended per unit for 2 years normal operation.
 - iv) Quantity recommended for number of units of an item as specified in the inquiry.
 - v) Quantity recommended as insurance for the number of units of an item specified in the inquiry.
- f. An itemised list of special tools included in the offer.
- g. Any start-up, shutdown or operating restrictions required to protect the integrity of the equipment.
- h. Any limitations of vendor's test-facility to carryout the specified tests.
- i. A specific statement that the scope of supply, the offered equipment/systems and all its components are in strict accordance with the data sheets, job specifications, this specifications and all other attachments, except for specific deviations as listed in the proposal.

Unless a specific deviation/exception is taken by the vendor at the time of submitting the proposal, it will be understood that final equipment/system shall be designed, fabricated tested and supplied strictly in accordance with Purchaser's specified requirements as covered in the inquiry or order.

7.3 CONTRACT DATA (Substitution)

7.3.1 General

7.3.1.1 Drawings and data as required after purchase order has been specified in Vendor Data Requirement. Vendor to note that the drawing/document descriptions/titles as given in the Vendor Data Requirement are generic in nature. It is possible that against one drawing/document specified, there are several drawings to be furnished by the vendor or vice versa. Vendor shall complete & forward a document titled as "Vendor Drawing Schedule" to the purchaser (Destination & contact person as per order). This document shall list out in consolidated form all drawings and documents required by purchaser (As specified in Data Sheets, Specifications and Vendor Data Requirement forms enclosed with the order). Against each drawing/document vendor shall indicate the vendor's drawing number, title, Rev. No., category (whether for information or approval) and schedule of submission. This shall be the first document to be submitted by vendor within two weeks of order.

7.3.1.2 All transmittal letters (covers), drawings and data shall have a title block (in addition to vendor's standard title block) which shall as a minimum contain the following contract information:

- i) Purchaser's and Consultant's Corporate Name
- ii) Project Name.
- iii) Equipment Name and Item No.
- iv) Purchase Order No.

v) Purchase Requisition No.

Title Block on drawings shall be placed on the lower right hand corner.

7.3.1.3 All vendor data/drawings/documents shall be in English Language and in Metric Systems.

7.3.1.4 Data specified in the VDR is the minimum requirements of Purchaser. Any additional document/data required or requested by Purchaser for engineering or construction shall also be made available by the vendor.

7.3.1.5 Whether or not specified the vendor shall furnish the following, before shipment:

- As built running clearances and when applicable; thrust bearing, radial bearing and seal running clearances.
- A supplementary list of spare parts other than those included in his original proposal. The supplementary list shall include recommended spare parts, cross-sectional or assembly type drawings, parts numbers, materials, prices and delivery period. The vendor shall forward this supplementary list to the purchaser promptly after receipt of the reviewed drawings and in time to permit order and delivery of parts before field start-up.
- A parts list for all equipment supplied. This list shall include pattern, stock, or production drawing numbers and materials of construction. The list shall completely identify each part so that the purchaser may determine the interchangeability of the parts with other equipment furnished by the same manufacturer. Standard purchased items shall be identified by the original manufacturer's name and part number.
- At least 8 weeks before shipment, the vendor shall submit equipment preservation, packaging and shipping procedures to the purchaser for review.

7.3.2 Drawings

7.3.2.1 The number of prints and/or reproducible required and the times within which these are to be submitted by vendor are specified in Purchaser's inquiry/order.

7.3.2.2 The purchaser's review of the vendor's drawings shall not constitute permission to deviate from any requirements in the purchase order/specifications unless specifically agreed upon in writing. After the drawings have been reviewed, the vendor shall furnish certified copies in the quantity specified. All drawings must be clearly legible and shall be folded to 216 mm x 279 mm size. All transparencies shall be rolled.

7.3.2.3 Drawings/documents with following titles shall contain as a minimum the following information:

a) General Arrangement Drawing

A general arrangement drawing shall indicate:

- Outline dimensions (minimum three views) (All principal dimensions).
- Allowable forces and moments on suction and discharge nozzles.
- Location (in all three planes), size, type, rating and identification of all purchaser's interface connections including those of vents, drains lubricating oil, sealing fluid, cooling water, steam & Electrical/Instrumentation.
- Direction of rotation, viewing from the driving end.
- Weight of each assembly/component.
- The weight & location of center of gravity of the heaviest assembly/components that must be handled for erection.
- Identification, weight and dimensions of the heaviest equipment assembly / subassembly / component required to be handled for maintenance.

- Maintenance clearances and dismantling clearances.
- Speeds of Driven Equipment and Driver with Driver rating. Location of driver terminal box (in case of Electric motor Driver).
- Layout of auxiliary equipment and operating platform.
- Make, Type and Size of couplings and the location of guards and their coverage.
- A list of reference drawings if any.
- A list of any special weather-protection and climatic features.
- Equipment furnished (loose) by the vendor for mounting by the purchaser.

b) Foundation Drawings

A foundation drawing shall indicate complete information required for foundation design by purchaser including the following:

- Foundation bolt sizes, pipe sleeve details, pocket sizes and locations.
- Grouting thickness and other necessary technical details.
- Static weight of each skid/independently grouted item and location of center of gravity of each of such skid/items in all three planes.
- Weight distribution for each bolt/subsole plate location and total static weight.
- Dynamic loading caused due to various items grouted independently.
- The direction and magnitude of unbalance forces and moments generated by each such item at the worst operating condition and short circuit moments of motor drivers/generators.
- GD^2 value of each item resolved to driver speed.
- Maximum permissible amplitude of vibration on the foundation at base level.
- Total mass of rotating parts.
- Suggested dynamic factor and ratio of foundation weight to weight of skid/equipment as per vendor experience.

c) Layout Drawing (For multi-skid packages)

This drawing shall include atleast the following:

- Layout of all skid/equipment and their auxiliaries, vessels, control panels, exchangers etc. Vendor shall furnish an optimised layout (considering the space allocated, site wind conditions, area classification, the type of equipment located in the vicinity etc.) indicating elevation and dimension of skids/equipment.
- Minimum spacing required between the various skids/equipment and between the skids and the walls/columns/roof for an easy accessibility and maintenance.
- Layout for water piping, trenches for water piping, cable tray/trenches layout.
- Piping arrangement and piping support arrangement/location for piping in vendor's scope.
- Layout for auxiliary equipment and operating platform details.
- Specification for crane/mono rail (including suggested mono rail layout) recommended for maintenance and height of the lifting hook from the centerline of equipment.

d) Field Alignment Diagram

The diagram shall indicate the relative displacement to be kept between the centerlines of various equipments at the time of installation, so that under normal running conditions the equipments get fully aligned. This relative displacement should be decided on the basis of centerline temperature rise data of driver, gear box/transmission system, driven equipment.

e) Heat Exchanger Drawings

Heat exchanger drawing and data shall include heat and mass balance data, details of provisions for separating and withdrawing the condensate, construction details, cross sections & general arrangement drawings of heat exchangers, vendors recommendations regarding provision for support and piping expansion.

7.3.2.4 P&I Diagrams (with Bill of Materials)

Vendor shall supply P&I Diagrams along with Bill of Materials of each system in the

vendor's scope of supply or specified in the order. P&I Diagram shall indicate the system details, location of various auxiliaries, instruments, controls and safety devices as required. Line sizes, piping class, valve sizes and class shall be clearly marked on the P&ID. Vendor's scope and purchaser's scope shall be clearly demarcated. Each item shall be identified by an item No./item tag no., which shall correspond to the item no. shown on the bill of materials. The bill of materials shall include items number, normal value, set value, range, quantity per unit, make and other specifications as applicable. Legends adopted shall be indicated either at the bottom of drawing or on a separate drawing. The legends shall be as per ISA.

7.3.2.5 Cross-sectional Drawing with Bill of Materials

The vendor shall supply cross-sectional or assembly type drawings for all equipment furnished showing all parts, design assembly and running clearances, and balancing data required for erection and maintenance. Each part shall be numbered which shall correspond to the part number on the bill of materials. The bill of materials shall include the part no., name of component, materials quantity installed per unit & sizes where applicable (say for bolts, nuts, rings, gaskets etc.). All boughtout items shall also be indicated with make and brief specifications.

A separate cross-sectional drawing showing installation and setting dimensions for the seals shall be furnished.

7.3.3 Curves

The vendor shall provide the following performance curves:

- a. Steam Flow versus Power for various settings of the hand-valve or valves when the turbines are operating at normal speed.
- b. For multi-stage turbines, first stage pressure versus steam flow, when the turbines are operating at normal speed and normal steam conditions.

7.3.4 Installation, Operation, Maintenance and Technical Data Manuals (Modification)

7.3.4.1 Technical Data Manual is a compilation of "As Built" drawings and data, manufacturing and test records, installation, operating and maintenance instructions.

7.3.4.2 Not later than two weeks after successful completion of all specified tests, the vendor shall furnish the required number of Technical Data Manuals for the equipment, any auxiliaries and instruments that the vendor is providing. The Technical Data Manual shall include the following documents as a minimum:

- (i) All drawings and data as listed in the vendor data index & schedule. (For drawings, where purchaser's approval is required, the final certified drawings shall be attached.)

Sections shall be organised in a manner that data & drawings related to one subject is grouped together such as Mechanical, Electrical, Instrumentation etc.

- (ii) All manufacturing, inspection and test data and records.

- (iii) Installation Manual

The vendor shall provide sufficient written instructions, including a cross-reference list of all drawings, to enable the purchaser to correctly install the equipment and prepare the equipment for start-up. It shall include any special information required for proper installation that is not on the drawings, special alignment or grouting procedures, utility specifications (including quantity) and all installation data. It shall also contain the following information:

- a) Instructions for erecting, piping, aligning (including the expected thermally induced shaft centerline shift between normal site ambient temperature position and that at normal equipment operating temperature).
- b) A description of rigging procedures, including the lifting of the assembled

equipment, and methods of disassembly, repair, adjustment, inspection and reassembly of the equipment and auxiliaries.

- c) Pre-commissioning / commissioning / functional test procedures and acceptance criterion.
- d) Lube and Seal oil, Seal Gas/Purge Gas recommendations.
- (iv) Operation and Maintenance Manual
This manual shall provide sufficient written instructions and data to enable purchaser to correctly operate and maintain the equipment ordered. It shall include a section to cover special instructions for operation at extreme environmental and/or extreme operating conditions. The following shall be included in this manual:
 - a) Instructions covering start-up, normal shutdown, emergency shutdown, operating limits and routine operational procedures.
 - b) A description of equipment construction features and the functioning of component parts or systems (such as control, lubrication, sealing systems etc.).
 - c) Outline and sectional drawings, schematics and illustrative sketches in sufficient details to identify all parts and clearly show the operation of all equipment and components and the methods of inspection and repair. Standardised sectional drawings are acceptable only if they represent the actual construction of the equipment.
 - d) The following maintenance information:
 - Maximum and minimum bearing, labyrinth and seal clearances including any other clearance between moving and stationary parts of the equipment affecting proper running and maintenance of the equipment.
 - Instructions for measuring and adjusting cold clearances, shaft runout, concentricity etc.
 - Rotor float allowance.
 - Interference fits on parts that are required to be removed or replaced for maintenance of normally consumable spares.
 - Balancing tolerances.
 - Lubricating schedules indicating recommended grades of oil, their properties, replacement period etc.
 - Normal maintenance procedure including disassembly procedures.
 - Preventive maintenance schedules and criterion for replacement of parts.
 - Trouble-shooting procedures.
 - e) The following reassembly information:
 - Bolting sequence and torque values for all bolts affecting equipment performance/integrity/safety.
 - Reassembly sequences together with required inspection checks.
 - Adjustment procedures to achieve required positions, clearances, float and so forth.
 - Detailed procedures for pre-operational checks, including settings and adjustments.
 - Seals and coupling installation procedures.
 - Parts list indicating cross-sectional drawings of various assemblies and sub-assemblies, part numbers, materials of construction (ASTM grades) etc. to facilitate identification of parts and for procurement of spares.
- (v) Following information shall also be included in the Technical Data Manual :
 - a) Storage instructions for storing and preserving the equipment (including driver and all the auxiliary units) at the plant site before installation of the same.
 - b) Instructions for preserving the equipment after it has been installed. This is particularly required in cases where a long time gap is expected between equipment installation and commissioning.

c) Field performance test procedures and acceptance criterion.

- 7.3.4.3 Technical Data Manual shall be in Hard board folder(s) of size 265 mm x 315 mm and shall not be more than 90 mm thick; it may be of several volumes and each volume shall have a volume number, index of volumes & index of contents of that particular volume.
- 7.3.4.4 Title sheet (Top sheet) of each volume of Technical Data Manual shall contain the contract information as defined under clause 7.3.1.2 besides the volume number.
- 7.3.4.5 In case order contains more than one item, separate dedicated Technical Data Manuals shall be submitted for each item.



TECHNICAL SPECIFICATIONS

SPECN. NO.:

PE-TS-353-100-N001

MISCELLANEOUS PUMPS

VOLUME:

IIB

SECTION:

C2

REV. NO.

0

DATE:

10.07.2010

SECTION C2

INSTRUMENTATION SPECIFICATION

1 GENERAL Specification of C&I

1.1.1 Scope

- 1.1.2 This specification together with the attachments covers the design, engineering, supply, factory inspection and testing, field testing and calibration, installation and commissioning of instrumentation and control systems for its successful operation.
- 1.1.3 The detailed scope of work, specific job requirements, design basis, exclusions, deviations, additions etc. are indicated elsewhere in the document.
- 1.1.4 This specification provides only the qualitative specifications of commonly used instruments and systems, but by no means covers the specification of each and every item covered in the bid document. Instruments specification for those items not covered in this specification shall be submitted by the bidder for approval.
- 1.1.5 Contractor shall be fully responsible for design, material selection, sizing and proper selection of the instruments and systems being supplied by them. Any approval or comment on any document or guideline issued to contractor before or after placement of contract or during execution of the contract shall not absolve the contractor of their contractual obligations and responsibility with regards to completeness, proper selection, satisfactory operation and easy maintenance of the unit.
- 1.1.6 All equipments supplied shall be of field proven quality both with respect to design and materials. Prototype instruments or instruments of an experimental nature shall not be offered or supplied. In general, all instruments offered by contractor shall have a well proven performance record of operating satisfactorily in the hydrocarbon industry like refinery, petrochemical, gas processing etc. for a minimum of 4000 running hours. No instrument requiring special maintenance or operating facilities shall be offered or supplied as far as possible.
- 1.1.7 In the event of any conflict between this specifications, data sheets, related standards, codes etc., the contractor shall refer the matter to the purchase/purchaser's representative for clarification and only after obtaining the same should proceed with the manufacture /engineering of the item in question.

1.1.8 Bids

- 1.1.9 Bidder shall clearly define the operational philosophy suggested by them, in line with requirements specified in the tender specifications. Bidder shall also clearly indicate the provision of control panels, and control systems required for their sub packages offered by them.
- 1.1.10 Bidder shall provide the following information along with their offer as a minimum:

- a) Compliance statement as given in bid document
- b) Configuration diagram and details of the offered control systems
- c) Details of special instruments and control systems if any.
- d) List of deviations, if any, from bid package clause number wise with reasons thereof, wherever applicable.

1.2.3 Information like Instrument list and typical specifications if enclosed by bidder in their bid, shall be retained for information only and shall not be referred by bidder as contractual agreement. No implication shall be admissible on the basis of these documents. Contractor shall submit details only after the finalization of P&ID (Piping and Instrument Diagram).

1.2.4 In addition to mandatory spares and consumable spares indicated elsewhere in the tender document, bidder shall also quote for two years operational spares for all the instruments and control systems including those required for sub packages being offered by them.

1.3 **Applicable national/international standards.**

1.3.1 Design and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

AGA	American Gas Association, Gas Measurement Committee
-	Report No.3 - National Gas Fluid Measurement- Orifice Metering of Natural Gas.
-	Report No.7 - Measurement of Gas by Turbine Meters.
ANSI/ASME	American National Standards Institute/ American Society of Mechanical Engineers.
B 1.20.1	Pipe Threads.
B 16.47	Steel Pipe Flanges and Flanged Fittings.
B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges.
ANSI/FCI	American National Standards Institute/Fluid Controls Institute
70.2	Control valve seat leakage classification.
API	American Petroleum Institute
RP 520	Sizing, selection and installation of pressure relieving system in refineries.
	Part-I - Sizing and selection
	Part-II - Installation
RP 521	Guide for pressure relieving and depressurising systems.
RP 526	Flanged steel safety relief valves.
RP 527	Seat tightness of pressure relief valves .
MPMS	Manual of Petroleum Measurement Standards.
RP 551	Process Measurement Instrumentation.
	Part 1 - Process Control and Instrumentation.

RP 552	Transmission Systems
S 1101	Measurement of Petroleum liquid hydrocarbon by Positive Displacement meter.
S 2000	Venting Atmospheric and low pressure storage tank.
S 2534	Measurement of liquid hydrocarbons by turbine meter systems.
S 670	Vibration, Axial-Position and Bearing-Temperature Monitoring Systems.
ASME	American Society of Mechanical Engineers. <ul style="list-style-type: none"> - Boiler and Pressure codes (Section I and VIII) - Unfired Pressure Vessels.
ASTM	American Society for Tests and Materials.
BS	British Standards <ul style="list-style-type: none"> BS-1042 Measurement of fluid flow in closed conduits. BS-4368 Compression coupling for tubes. BS-4800 Colours for ready mixed paint. BS-5308Part-2 Specification for PVC insulated cables. BS-6364 Specification for valves for cryogenic service. BS-7244 Flame Arrestors for general use
DIN-43760	Temperature vs Resistance curves for RTDs.
DIN-19234	Electrical Distance Sensors; DC interface for Distance Sensor and Signal Convertor.
IBR	Indian Boiler Regulations.
IEC	International Electrotechnical Commission. <ul style="list-style-type: none"> IEC 79 Electrical Apparatus for Explosive Gas atmosphere. IEC 85 Thermal Evaluation and Classification of Electrical Insulation. IEC-332 Test on bunched wires or cables. Part 3 Cat.A IEC 529 Classification of degree of protection provided by enclosures. IEC 534-2 Industrial Process Control Valves-Flow capacity. IEC 584-2 Thermocouples - Tolerances IEC 60584-3 Thermocouples extension and compensating cables, tolerances and identification system.

IS	Indian Standard
IS-5	Colours for ready mixed paints.
IS-319	Specification for free cutting Brass bars, rods and sections
IS-1239	Mild steel tubes, tubulars and other wrought steel fittings.
IS-1271	Specification of Thermal Evaluation and Classification of Electrical Insulation.
IS-1554-	PVC insulated (heavy duty) electric cables-working Part I
	Voltage upto and including 1100 V.
IS-2074	Ready mixed paints, air drying, red oxide- zinc chrome.
IS-2147	Degree of Protection provided by enclosures for low voltage switch gear and control gear.
IS-2148	Flame proof enclosures for electrical apparatus.
IS-3624	Specification for pressure and vacuum gauges
IS-5831	PVC insulation and sheath of electric cables.
IS-7358	Specifications for Thermocouples
ISA	Instrument Society of America.
S-5.2	Binary logic diagrams for process operations.
S-7.3	Quality standard for instrument air.
S-75.01	Flow equations for sizing control valves.
ISO 5167	Measurement of fluid flow by means of orifice plates, nozzles and venturi tubes inserted in circular cross-section conduits.
NACE	National Association of Corrosion Engineers - MR-01-75.
NEC	National Electric Code.
NFPA	National Fire Protection Association.
NFPA-496	Purged and pressurized enclosures for electrical equipment.
OSHA	Occupational Safety and Health Authority.

1.4 Sub Vendor List (for Instruments and Accessories) EIL sub-vendor list is to be followed for instrumentation item. The list provided are for make only and not for model number. It is contractor's responsibility to select correct model number to suit the requirements and has requisite proven track record. It may be possible that make and / or model number of some instruments are identified in licensor's process package or in P&IDs, in such cases licensor process package or P&ID shall be guiding. In case for certain instruments vendor list is not included, suggested vendor list will have to be got approved from the purchaser/purchaser's representative.

1.4.3.5 Instrument sizing calculations, selection requirements Instrument sizing calculations provide information regarding sizing (as per standards specified elsewhere in this document), type, selection and

other related information.

1.4.3.6 Utility Requirements This document lists out the following information regarding utilities required by the contractor:

- a) List of utilities required i.e. Power (UPS, Non UPS), Instrument air, Cooling water, Steam for tracing, Nitrogen etc.
- b) Location and estimated/actual requirement at each location. The requirement shall be listed as minimum/normal/maximum.
- c) In case of AC power, the In-rush current with duration and power factor shall also be indicated for each location.

1.4.3.7 Nozzle Elevation Drawings for Level Instruments These drawings represent the nozzle elevation, nozzle sizes and rating, requirement of standpipes, type of level instrument etc. for all the vessels, columns, exchangers and tanks.

1.4.3.9 Functional Schematics (FS) Functional Schematics details out the functionality of all the loops shown on the P&ID including their correlation. The schematic shows all the hardware necessary to configure a loop including their physical location, their interconnection and important software blocks as applicable to make a loop complete. Similar loops may be combined under the same functional schematic.

1.4.3.10 Logic Diagrams Logic diagram is a logic representation of process interlock and shutdown system and details out the functionality, in a schematic form, based on either process cause and effect table shown on the P&ID or in a separate write-up. The schematic shall be prepared based on ISA S5.2 - ♦Binary Logic Diagrams for Process Operations♦ and shall show the physical location of Input/Output devices, their interconnection with functional blocks, bench status of all electrical devices etc. The schematic shall also be supplemented with operational requirements like startup and process bypasses, reset and shut down push buttons, selector switches, status lamp etc.

1.4.3.11 Instrument Loop drawings Each loop shall have a separate Instrument Loop drawing which shall show each component from field device to final receiver including physical location, initiating device, its terminal number, junction box with its terminal number, cable number with pair number/polarity, receiver instrument terminals/cabinet terminals, system functional blocks of loop in simplified manner (without configuration details).

1.4.3.20 Instrument Cable Schedule The instrument cable schedule shall show all instrument and power cables required for complete instrumentation. The document shall show, tag number, cable number, type, length and size of cables, type of junction box, identity of local panel, control room panel/cabinet location etc.

2 DESIGN PHILOSOPHY

2.1 Instrumentation shall be complete in every respect and liberal to the extent of providing data on all operations and variables sufficient for the safe, efficient and easy operation, start up and shut down of the plant.

2.2 The design and installation of instruments shall be generally in accordance with ISA/API recommended practices and other applicable standards like BIS, IBR etc. Material specifications and practices shall, in general, conform to appropriate ASTM or equivalent standards. All standards and code of practices referred to herein shall be of the latest edition prior to the date of purchaser's enquiry.

2.3 All instruments and equipments shall be suitable for use in a hot, humid and tropical industrial climate in which corrosive gases and/or chemicals may be present. As a minimum, all instruments and enclosures in field shall be dust proof and weatherproof to IP-66 as per IEC529/IS-2147 and secure against the ingress of fumes, dampness, insects and vermin. All external surfaces shall be suitably treated to provide protection against corrosive plant atmosphere.

2.4 Instrument Requirements for classified area:

2.4.1 a) All electronic/electrical instruments and equipments shall be suitable for area classification as per IEC codes and shall be tested by any recognised authority like BASEEFA, FM, PTB, CMRI etc. and shall be certified by CCE.

b) Certified Intrinsically Safe (IS) equipment as per IEC-79-11 shall be used, in general, in hazardous area. In case intrinsically safe equipment is not available, flameproof enclosures as per IEC-79.01 may be considered.

c) Junction boxes and accessories required for flameproof instruments shall also be certified flameproof.

d) All non flameproof panels and cabinets installed in classified area shall be purged as per requirements specified in NFPA-496, as a minimum.

e) Other type of protection as specified in IEC-79 shall not be used.

2.4.2 Statutory Approvals

a) Contractor shall be responsible for obtaining all statutory approvals, as applicable for all instruments and control systems.

b) In addition, equipments/instruments/systems located in the hazardous area shall be certified by the local statutory authorities for their use in the area of their installation. In general following certification shall be given:

For all intrinsically safe/explosion proof/flameproof equipments/ instruments/systems or equipments with any other type of protection allowable as per this package which are manufactured abroad and certified by any statutory authority like BASEEFA, FM, UL, PTB, LCIE etc. should also have the approval of Chief Controller of Explosives (CCE), Nagpur.

For all flame proof equipments manufactured locally (indigenously), the testing shall be carried out by any of the approved test house like CMRI/ERTL etc. The equipment shall in addition bear the valid approval from Chief Controller of Explosives, Nagpur and a valid BIS license.

For all intrinsically safe equipment manufactured locally (indigenously), the testing shall be carried out by any of the approved test house like CMRI/ERTL etc. The equipment shall in addition bear the valid approval from Chief Controller of Explosives, Nagpur.

c) Approvals other than above shall neither be offered nor these will be acceptable.

2.5 Sizing for control valves and safety valves is contractor's responsibility. It is contractor's responsibility to supply the items as per approved sizes. For orifice, the sizing shall be carried out by contractor and in case due to these sizing the line sizes need to be increased or decreased the same shall be carried out by the contractor as part of his contract. The type of flow instruments shall be decided by the contractor based on technical specifications and shall be approved by the purchaser/purchaser's representative. In general type as indicated in P&ID/by licensor shall be followed.

2.6 Following units of measurement shall be applicable, unless indicated specifically otherwise;

Flow	Liquid :	m ³ /h
	Steam :	kg/h
	Gas and Vapour :	Nm ³ /h
Pressure/Vacuum	Gauge :	kg/cm ² mm of H ₂ O
	Vacuum :	kg/cm ² mm of H ₂ O
	Temperature :	°C
	Level :	%
	Analysis :	% ppm
	Conductivity :	μS (micro siemens)
	Viscosity :	mPa.s (cP)

2.9 Ranges for instruments shall be selected in general, such that in normal process operation the indication is between 40% to 60% of span for linear and 60% to 80% of span for square root inputs.

2.10 Ranges for process switches shall be selected, in general, such that the set point falls preferably in the middle 30% of full adjustable range i.e. the set point shall fall between 35% and 65% of adjustable range.

2.12 Field mounted direct actuated flow and temperature switches shall not be used. Instead, receiver switch/trip amplifier shall be used along with flow element/temperature element. Whenever specified in job specification, flow and temperature transmitters may be directly connected to control system to achieve switch action.

2.13 Intrinsically Safe System Requirements

Following points must be considered while designing an intrinsically safe system:-

- a) All intrinsic safety barriers shall be active isolating type only and shall have isolation between input, output and power supply.
- b) Barriers must be selected based on entity concept. Cable parameters shall also be considered while matching entity parameters.
- c) The signal transfer accuracy of barrier shall be at least equal to or better than the transmitter selected.
- d) Each instrument in the hazardous area and the intrinsic barrier shall be certified for intrinsic safety by a statutory authority.
- e) Each input and output in a loop shall have separate barrier. No barrier shall be shared between two loops or input/outputs.
- f) Any intrinsically safe loop requiring any device to be connected in the hazardous side permanently or temporarily shall also be intrinsically safe.
- g) Configuration tools whenever required for any intrinsically safe item which forms part of the intrinsically safe item shall also be certified intrinsically safe.
- h) Universal barrier with programmable capability shall be used for temperature inputs i.e. for thermocouple /RTD inputs.
- i) It is desirable to use one make of barrier for entire plant. The series shall be of MTL / P&F or equivalent reputed makes.

2.14 Power Supplies and their Distribution

a) Following power supply voltage levels shall be used, unless otherwise specified:

For Instruments, Control Systems, Analyzers	110 V AC \pm 10%(UPS) 50 Hz \pm 3 Hz
Solenoid Valves, Relays, lamps	110 V AC \pm 10%(UPS)
Input interrogation voltage	110 V AC \pm 10%(UPS)
Panel/cabinets lighting	240 V AC \pm 10%

Any voltage level other than 110VAC UPS (including 24 V DC) if required for powering any subsystem, input interrogation, relays and lamps etc same shall be generated by the bidder using dual redundant power packs (110 V AC to 24 V DC convertor).

b) All instruments, control systems (PLC and DCS) and analyser system shall be able to operate at the following power supply specification :

Voltage level :	110 V AC \pm 10%
Frequency :	50 Hz \pm 3 Hz
Switch over time :	5 mili seconds.

c) Power feeders if specifically indicated, shall be supplied to the bidder at only one location. All further distribution within the package shall be taken care of by the bidder.

d) Instrument power circuits shall be individually protected from fault with the help of fuses. Power supply to the individual instrument shall be disconnected with the help of Double Pole Single Throw (DPST) switch and protected with the help of fuses. Miniature circuit breakers (MCB's) may be selected in place of switch fuse unit in case protection is provided for overload protection.

2.15 Alarm Philosophy

a) Adequate alarms shall be provided to give audible and visual warning of any process and machine malfunction in the package.

b) All trips shall have a pre-trip warning alarm in addition to alarm at the trip condition.

c) All package alarms including pre-trip warning alarms and trip alarms (shutdown alarms) shall be annunciated on the local panel. First out alarm sequence as per F3A as per ISA shall be provided, whenever required.

d) All rotating equipments shall have the status indication provided on the local panel wherever applicable.

e) Wherever printer is provided, all alarms shall be printed as and when they appear, in the sequence of their occurrence.

f) Common pre-warning alarm and common trip alarm contacts for the sub packages shall be provided for remote annunciation. Additional alarm contacts shall be provided when specified.

g) Fail-safe type with normally closed alarm contacts shall be used.

2.16 All line or equipment mounted instruments like control valves, pressure relief valves, thermowells, orifice flanges, level instruments and analyser instruments etc., installed on pipes and vessels under IBR service shall be certified by IBR or their authorised representative.

2.17 Location of process connections shall be from the side or from the top of the process equipment but not from the bottom. This requirement is applicable to both pipes and vessels. The location of lower side connection when necessary, shall be high enough inside vessel to prevent plugging due to dirt or other suspended solids. In addition, the connections shall be short, vertical or horizontal and without any pockets. Material of construction of instruments shall be as per the material selection guide lines, provided with this specification. And any specific requirement of material of construction by purchaser/purchaser's representative during detail engineering shall be complied by contractor without any time/cost implications. In any case vendor to ensure that the selected material is consistent with temperature, pressure, corrosion conditions and other process requirements. In case where suitable material of construction is not feasible/possible, diaphragm seal shall be considered.

2.18 All process switches shall be provided with sealed micro switch contacts rated for the specified

application. Contacts shall be Single Pole Double Throw (SPDT) type unless otherwise specified. Contacts used in intrinsically safe applications shall be gold plated.

2.19 Instrument Connections

2.19.1 The connections of instruments installed on vessels, tanks, standpipes and piping shall be as per following EIL Standards, unless otherwise specified in licensors's package. a) 7-52-0001 Instrument Connections on Vessels and tanks. b) 7-52-0002 Instrument connection on Piping. c) For clad vessel minimum connection size shall be 3".

2.19.2 Pneumatic instrument connections for signal and air supply shall be 1/4" NPT(F).

2.19.3 Electrical cable entry connection shall be 1/2" NPT(F). Suitable cable gland shall be used.

2.19.4 End connections shall meet the following, unless, otherwise specified;

a) Threaded end connection shall be NPT as per ANSI/ASME B1.20.1.

b) Flanged end connection shall be as per ANSI/ASME B16.5.

c) Flange face finish shall be per paragraphs 6.4.4.1, 6.4.4.2 and 6.4.4.3 of ANSI/ ASME B 16.5. The face finish wherever specified in data sheets shall have serration as follows:

Serrated :	250 to 500 AARH
125 AARH :	125 to 200 AARH
63 AARH :	32 to 63 AARH

d) Grooves of ring type joint flanges shall be octagonal as per ANSI/ASME B 16.20

2.20 Air supply for the instruments at pressure specified elsewhere shall be made available to the contractor at the battery limit of the unit wherever specified in the job specification. Contractor shall be responsible for further distribution within the Unit.

2.21.2 Signal Interface Philosophy

2.21.2.1 Direct signals from field to control room

a) All signals from field to main control room/ Control Equipment Room (CER) shall be terminated in the junctions boxes located at appropriate locations in the field.

Separate junction boxes shall be used for the following type of signals:

- Intrinsically Safe Analog Inputs/Outputs (4-20 mA)
- Non Intrinsically Safe Analog Inputs/Outputs (4-20 mA)
- Intrinsically Safe Thermocouple Inputs
- Intrinsically Safe RTD Inputs
- Intrinsically Safe contact Inputs
- Non Intrinsically Safe contact Inputs.
- Non Intrinsically Safe contact Outputs.

b) All pulsed signals or serial signals shall be routed directly to control room(s) without the use of intermediate junction boxes, in general. In case, where single cable length is a problem, intermediate junction boxes can be used, however in all such case, same junction box shall not share signals from two or more device.

c) Whenever multi drop serial communication is adopted, intermediate junction boxes may be used for multi dropping purpose only.

2.22 Instrument Cables

2.22.1 Multi cables between junction boxes and main control room (MCR) / or satellite room or any other control room shall be as per following philosophy unless specified otherwise:

- a) Signals (4-20 mA or switch contact): 6/12 pair individually and over all shielded (screened) and armoured, twisted, 0.5 mm² conductor.
 - b) Thermocouple: 6/12 pair thermocouple extension cable (20 AWG)
 - c) RTD: 8 Triad 1.5 mm² conductor.
 - d) Solenoid valves (24 V DC): 6/12 Pair shielded, armoured, 1.5 mm² conductor.
- Higher conductor size shall be selected to limit the voltage drop within the specified limit.

2.22.2 The colour of outer sheath, inner sheath and individual core for each type of cable shall be as mentioned below unless specified otherwise:

Type of cable	Signal type	Outer sheath	Conductor Insulation
			+ve -ve
a) Signal	IS	blue	blue * Black *
	Non IS	black	blue * Black *
b) Control / Power		black	red Black
c) Alarm	IS / Non IS	black	white Black
d) T/C Extension cable	IS	As per IEC 60584-3	

* Triad cable shall have blue, black and brown colour.

2.23 Junction Boxes

2.23.1 Junction boxes shall be used for interconnection in the field wherever necessary as per para 2.21.2. Analog signals (4 - 20 mA), switch contacts, temperature elements, LEL detectors, intrinsically safe, non intrinsically safe and low voltage contact signals shall be segregated in the separate junction boxes. Separate junction box shall also be used for signals and contacts connected to PLC, DCS or and other system.

2.23.2 The junction box shall be suitable for the type of signal and type of multicore cables used as indicated in para 2.21.7. Unless otherwise specified, contractor must use the following type of junction boxes:

For all intrinsically safe signals :	Weatherproof junction boxes
For all input/output connected : to explosion proof/flameproof instruments	Explosion proof/flameproof junction boxes

2.23.3 The junction boxes shall have cable entries suitable for the multi and single cables used. 20 % addition cable entries must be provided. Unused entries shall be plugged.

2.23.4 The junction boxes shall have terminals suitable for the cable wire size and shall preferably be of Phoenix or equivalent make.

All junction boxes used in intrinsically safe service shall be sky blue in colour while those in non-intrinsically safe service shall be painted gray.

2.23.5 The multi cable entry for 6 pair Junction Box (JB) shall be 1" NPTF and for 12 pair / 8 triad

junction box, it shall be 1 1/2" NPTF. Each junction box shall be provided with 2 multicable entries with one plugged with weatherproof, flameproof plug as required. Multicable entries shall be from the bottom whereas 1 pair/triad from the side.

2.24 Philosophy of Junction Box and Cabling

i) Overhead ducts shall be used for routing multicables in the unit and upto control room unless specified otherwise. This main duct shall be routed over the pipe rack with suitable accessible location.

ii) Contractor shall provide continuous channel for support of the overhead duct and the same shall be suitable for a load considering 100% filling of the duct by cables. However as a good engineering practice duct shall be sized considering 60% occupancy of the duct by cables. For ladder and angle trays contractor shall provide support at a minimum interval of 1.5 m.

iii) In duct 4-20 mA signal cables, alarm cables, thermocouple cables and RTD cables can run together in one compartment. The control and power (110 V DC) shall run in other compartment. The middle compartment shall be kept vacant. It shall be used for plant communication cable where specified.

2.27 Requirement for instrument in steam service

2.27.1 All in-line instruments such as control valve, thermowell, orifice flanges, pressure relief valves, all types of level instruments and any other in-line instrument shall be provided with IBR form III C certificate.

2.27.2 All pressure relieving devices shall be designed in accordance with ASME code for 'Boilers and Pressure Vessels', API-521 and Indian Boiler Regulations. In case of valves as per IBR, the same shall be to regulation no. 294 with 5% over pressure and regulation no. 295 with 5% blow down and shall be provided with the following certificates.

i) IBR form-IIIC certificate of manufacture and test of boiler mountings and fittings.

ii) Type test certificate from IBR authority as per regulation no. 293 and Appendix-L of IBR for the valve series supplied.

iii) Radiography of all castings shall be as per piping material specification.

2.27.3 The discharge capacity of pressure relief valves as in (a) above shall be calculated as per IBR regulation no. 293 a, b and c.

2.27.4 Detailed requirement of Pressure Relief Valve is given else where in this specification.

2.27.5 Installation item like syphon, condensate chambers, impulse pipe and pipe fittings connected with IBR lines shall have IBR form III C certification.

2.28 All instruments shall have internal terminal block for cable termination. Flying leads are not acceptable.

2.29 Diaphragm seal instruments with capillary shall be used for congealing, and various services, where plugging of element may occur or where suitable material is not available in highly corrosive services. In these cases the flange material shall be in accordance with piping classes. Spacer ring shall be provided along with vent and drawing. Capillary shall be minimum AISI 316 SS with AISI 304 SS armouring. Seal fluid shall be suitable for the temperature.

2.30 Temperature extension of suitable length shall be provided in the impulse line of the instrument installation where process fluid temperature is higher than the maximum withstanding temperature of the instrument.

2.31 The in-line instruments on fully jacketed lines shall also be jacketed.

2.32 Interlock and Shutdown System shall be an independent system with its own dedicated primary element except for flow. In which case common flow element with separate transmitter shall be used. However separate element with trip amplifier shall be used for temperature. In no case the initiating contacts shall be derived from indicators, controllers, recorders, scanners, alarm annunciator or any such instrument.

2.33 The interlock & shutdown system shall be designed fail safe and shall meet the following requirements, as a minimum :-

- a) All initiating contacts shall be close under normal conditions and shall open under abnormal conditions.
- b) All relays and solenoid valves shall be energised under normal conditions and shall de-energise under abnormal conditions.
- c) Emergency shut down switch contacts shall be wired in series with the final actuating device to ensure positive shutdown.
- d) If desired, because of operational or maintenance requirements, adequate trip by-pass facilities are to be provided with warning lights to indicate that the trip has been bypassed. Trip bypass alarms shall be provided in local on local panel as well as in remote location. All such by-pass switches shall be key-operated type.

2.34 The interlock & shutdown system shall be designed using electromagnetic relays unless specified otherwise and shall be located locally or remotely as per the operational requirements. The system shall meet the following requirements as a minimum;

- a) The electromagnetic relays shall be low power continuously rated type and shall have LED for status indication.
- b) The relays shall be plug-in-type and their plug-in-bases shall have screwed terminals for interconnection. Lug type soldered connection shall not be acceptable.
- c) Each relay shall have three numbers of 'NO'(normally open) and three number of 'NC'(normally closed) contacts, as a minimum each suitable to drive the connected load. Out of these, one 'NO' and one 'NC' contacts shall not be used.
- d) Each shutdown/interlock logic shall be individually protected using separate switchfuse unit and shall have a lamp for indicating power healthy status.

2.35 Each shutdown circuit and solenoid valve shall be provided with a switch-fuse unit separately. Programmable Logic Controller (PLC) whenever used for interlock and shutdown, shall be located in environmentally controlled remote control room or satellite rack room. This shall meet the following minimum requirements:

- a) PLC shall have dual redundant or triple redundant as specified in job specification. Redundancy for I/O's/Power Supply/Communication network shall be provided as per selected configuration.
- b) The software shall include the operating system and application program. The application program shall include software for performing functions like interlock and shutdown logic, programming/program modification, documentation etc. Two copies of application program and two set of licensed system software shall be supplied.
- c) The system shall be supplied with programming tools and related accessories.
- d) No two shutdown circuits shall be shared by same I/O module, unless specified otherwise.

e) For detailed PLC specifications refer standard specification for PLC 6-52-0040/standard specification for DCS 6-52-0055.

f) TUV approval, wherever required shall be specified in the job specification.

2.36 Contractor shall provide four sets of back up configuration in floppy media. The drawings should be in AutoCAD (latest version) and all documents in electronic media in addition to hard copy/reproducibles as a part of project requirement.

2.37 Unit rate of all items/modules and hardware shall be indicated by contractor for any future addition/deletion for system related items. This price shall include all engineering charges, installation, software charges etc. related to the effected addition/deletion.

2.38 All necessary furniture required for mounting consoles, printers, CRT's, video copier etc. shall be provided by the contractor.

3 SPARES PHILOSOPHY

3.1 Mandatory Spares

Mandatory spares for instrumentation and control system shall be provided as below unless otherwise specified in the job specification:

a) **10%** spare instruments or minimum one of each range, type and material of construction (except for control valves, pressure relief valves, displacer type instruments, level gauges, flowmeters, analysers and special instruments)

b) **5%** or minimum one module for all control systems (DCS/PLC/ESD etc.)

3.2 2-years operational spares

Unless otherwise specified in the job specifications, all spares for 2 years of operation like gaskets, O-rings, diaphragms etc. as required for all instruments for two years of trouble free operation shall be provided.

3.3 Commissioning spares

Any kind of spares required for start-up & commissioning shall be provided.

3.4 Consumable Spares

Consumable spares for a minimum of one year duration after acceptance and shall include chart paper, printer paper, ink, cartridges, floppies etc required for recorders, printers and hard copier units, unless otherwise specified elsewhere.

4 GENERAL REQUIREMENT OF INSTRUMENTS

4.1 Instrument Concept

4.1.1 Major instrumentation shall be electronic type with final control elements as pneumatic.

4.1.2 Electronic Instruments

a) All electronic instruments requiring separate power supply, shall generally operate on 110 V 50 Hz. Instruments operating at 24 V DC shall also be acceptable.

b) Electronic transmitters shall generally be two wire type. These shall have transmission/output signal of 4-20 mA DC and shall be capable of delivering rated current into external load of at least 600 Ω when powered with 24 V DC nominal voltage.

c) Smart transmitter when selected, shall be used in analog output mode. Digital integration shall be avoided unless specified otherwise.

d) All receiver instruments shall be microprocessor based and shall operate on voltage input of 0.25 to 1.25 V, 1 to 5 V, or 0 to 10 V DC, in general.

e) The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC - 801.

4.1.3 Pneumatic instruments whenever used shall operate on air supply of 1.4 kg/cm²g and shall have transmission and output signal of 0.2 to 1.0 kg/cm²g.

4.1.4 Instrument air quality shall be as per ISA-S7.3 and free from corrosive, hazardous and toxic contaminants.

4.2 Panel Board Instruments:

4.2.1 Panel board instruments shall generally be multibin subminiature 6" x 3", except recorders, which shall preferably be 6" x 6". Instruments like microprocessor based recorders, temperature scanners etc., shall be as per manufacturer standards.

4.2.2 Panel board instruments shall have the following graduations, in general;

Differential pressure : 0 to 10 square root

flow meters Variable area : 1 to 10 linear
flow meters

Pressure : Direct Reading

Level : 0 to 100 Linear

Temperature : Direct Reading.

Multiplying factors for flow scales shall be specified on manufacturer's name plate.

Recorder charts shall be dual graduated, in general, in 0 to 10 square root and in 0 to 100 linear.

4.2.3 Subminiature recorders shall have 100 mm strip chart with chart speed of 25 mm/h. Microprocessor based recorders shall have strip chart of 250 mm approx. and chart speed of 50 mm/h with a provision to change speed at site.

4.2.4 Annunciators, in general, shall be solid state type with plug in modules, in a cabinet with back lighted engraved windows and integral power supply. Alarm logic module shall be single channel type. In case multi-input alarm module are selected, only one channel shall be used. Intrinsically safe annunciator circuit, when used, shall have power supply unit in a safe area. Annunciator alarm sequence shall be as

per F3A of ISA. The design of the alarm annunciator system shall be such that transient alarms of less than 330 milliseconds duration shall be automatically rejected.

4.3 Control Panel

4.3.1 All control panels shall be supplied in pre-tubed/pre-wired conditioned and shall be completely tested at manufacturer's works prior to dispatch.

4.3.2 Control panels shall be free standing type and fabricated preferably from 3 mm thick cold rolled steel sheet. If the same is not available, 4 mm thick hot rolled steel sheet shall be used. Angle iron frame work shall use a minimum section of 50 x 50 x 4 mm angle. The finish shall include sand blasting, grinding, chemical cleaning, surface finishing by suitable filler and two coats of high grade lacquer with wet sanding between coats. Two coats of paint in panel colour shall be given for non-glossy high stain finish. Panel face final colour can be any of the following shades as per to IS-5:

Opaline green : ISC No.- 275

Light Admiralty Grey : ISC No.- 697

Sky blue : ISC No.- 101

Panel rear surface, frame work and mounting plates shall have a finish colour of pale cream to IS-5 ISC No.- 352 or Beige to IS-5 ISC No.-388. A final coat of paint shall be given at site. Equivalent colour shade according to BS/RAL are also acceptable.

4.3.3 Control panel shall be open back with each section of typically 2100 mm high, 1200 mm wide and 800 mm deep, when mounted inside the control room on 100 mm channel base covering wall to wall, else these shall be totally enclosed cubicle type. The panel width may be increased if necessary.

4.3.4 Enclosed cubicle panels shall have removable hinged doors, generally at the side or back for easy maintenance and accessibility of the instruments. Doors shall be double leaved type with handle and shall be provided with lock and key. Adequate illumination shall be provided inside the panel. All light fittings shall be suitable for 230 V, 50 Hz AC.

4.3.5 No process fluid of any kind, except instrument air shall enter the control panel. Also power supply greater than 230 V shall not enter the local panel.

4.3.6 All cable entries to the local panel shall be from panel bottom only using cable glands of adequate size. Cable gland plate thickness shall be a minimum of 3 mm cold rolled cold annealed (CRCA) as a minimum. All unused cable entries must be plugged

4.3.7 Space heater shall be provided where condensation is expected.

4.3.8 The design of control panel shall incorporate provision for expansion by installing adequate spare capacity. Each panel shall be designed to accommodate the following additional equipment, as a minimum;

- a) 20% of panel front/inside mounted instruments including lamps, push buttons, switches, relays etc.
- b) 20% additional power feeders each provided with switch fuse assembly.
- c) 20% additional spare windows in alarm annunciators.
- d) 20% spare cable entry points.

4.3.9 Panel layout shall be designed considering ease of operation. No push button or hand switch shall be located below 600 mm. Instrument Mounting heights, in general, shall be as follows:-

a) Miniature and subminiature instruments (3 rows)	Bottom row	1100 mm
	Middle row	1350 mm
	Top row	1600 mm

b) Annunciators - 1950 mm

c) Electric push buttons/ - 700 mm
Switches, lamps etc.

4.3.10 The internal panel layout shall be designed considering proper approach for instruments, terminals and other accessories for maintenance, easy removal and online calibration. No instrument, terminals, power distribution box etc shall be mounted on the panel side plates inside the panel.

4.3.11 All lamps, status as well as alarm, shall be provided with lamp test facility. One single lamp test push button shall be used for each panel.

4.3.12 Colour Scheme

a) Status Lamps

On/Open/Permissive :	Green
Off/Close/Emergency :	Red

b) Alarms

Normal/Pre-trip alarms :	White
Shutdown alarms :	Red

c) Push/Pull buttons

On/Open :	Green
Off/Close :	Red
Emergency shut-down (ESD) : (Push-button with cover/ Mushroom push button)	Red

4.3.13 Panel Piping and Tubing

4.3.13.1 The instrument air header shall be adequately sized with brass packless isolation valves and shall be complete with suitable dual filter-cum-air reducing station.

4.3.13.2 Panel tubing from the bulk head to the panel instruments and instrument air supply to the panel instruments shall be of 6 mm x 1 mm polyethylene tubing.

4.3.13.3 The tubing shall be laid in plastic slotted ducts. Panel air header and tube fittings shall be of brass, suitably protected against corrosion.

4.3.13.4 Shut off valves shall be installed in all branch lines taking off the transmission and output signal. Each tube shall be identified at both the terminating ends.

4.3.14 Panel Wiring

4.3.14.1 Open terminals shall generally be avoided. Terminal strips shall be of 'Phoenix/Klippon/Elmex or equivalent type and shall preferably be mounted in an enclosure. Fused terminal may be used wherever necessary.

4.3.14.2 A minimum of 1 mm² multi stranded PVC insulated copper conductor shall be used in general. All wiring shall be laid in the PVC troughs. No trough shall be more than 70% full.

4.3.14.3 Wires carrying measurement signals associated with thermocouples, resistance thermometers, pH instruments and other low level signals shall be routed in separate troughs/wire ways and not alongwith power cables. Power wiring and control wiring shall be separated by not less than 150 mm. The crossing, if unavoidable, shall be as close to right angles as possible.

4.3.14.4 Extension cables/wires shall be used for all thermocouple inputs. These wires shall be routed in separate troughs/wire-ways.

4.3.14.5 All intrinsically safe wires shall be routed in separate wire ways from non-intrinsically safe and power wiring. Intrinsically safe wiring and terminals shall be light blue in colour and shall be separated from non-intrinsically safe terminals atleast by 50 mm.

4.3.14.6 All incoming power feeders shall be terminated on separate terminals suitable for the incoming feeder size. These shall be located at the bottom of the panel and shall be suitably covered for protection against accidental shorting and for human safety.

4.3.14.7 Following design philosophy shall be followed while deciding the internal layout of panels, as a minimum:-

a) Distance between terminal strip and : side of the panel upto 50 terminals	100 mm (min.)+ trough width
b) Distance between two adjacent terminal : strips	100 mm (min.)+trough width
c) Distance between gland plate and : bottom of the strip	300 mm (min.)
d) Distance of terminal strip : from instrument/trough/panel top	100 mm (min.)

4.4 Local Control Panel

4.4.1 Local control panel for the package units shall be installed within the battery limit of the package considering operational and maintenance requirements and accessibility. In case of skid mounted packages, panel shall be located away from the skid. In case local control panel is housed outdoor i.e. not in a local control room, it shall be designed to meet IP-55 requirements. In addition, panel must be provided with a rain cum sun shade canopy/shed.

4.4.2 Local control panel/panels shall be totally enclosed cubicles. Panel sizing shall be carried out based on equipment being installed keeping in view the maintenance clearances and easiness. Although the panel dimensions shall be guided by the actual requirements, typical dimensions of 2100 mm operational (height) x 1200 mm (width) x 1000 mm (depth) shall be kept in mind while finalising the panel size. In any case, vendor shall not proceed with panel manufacturing before getting prior approval from the purchaser.

4.4.3 Local control panels located in the hazardous area shall be either purged type or flameproof Exd as specified in the job specification. In case pressurised panels are specified the same shall be purged and pressurised as per NFPA-496 requirements to render space within the panel non hazardous. For panels located in IEC Zone 2 hazardous area type Z purging shall be used with a purge fail alarm in main control room. In case, panels are located in Zone-1, the power shall be cut-off on pressurisation X-purge requirement of NFPA-496.

An alarm shall be provided on local panel and a contact shall be provided for remote annunciation, whenever the panel pressurisation falls below 2.5 mm of H₂O. A protective device to protect the panel from over pressure must be provided.

4.4.4 Panel pressurisation with start-up panel purging scheme shall be fully automatic however it shall be started manually from a push button. Solenoid valves and differential pressure switch required for panel purging shall be flameproof, however other items like relays, switches/pushbuttons, timers etc. shall be located in a flameproof housing. Other items like valves, restriction orifice plates, dual filter regulators, pressure gauges, variable area flowmeters etc required for pressurisation, shall also be located in the non-pressurised section of the panel.

4.4.5 It shall be possible to switch off incoming power to panel from panel front. All such power on/off switches shall be flameproof type. In addition, all those devices and terminals which can not be powered off from on/off switches shall also be located inside flameproof enclosures.

4.4.6 All hinges, screws and other non-painted metallic parts shall be of stainless steel material.

4.4.7 All other requirements as specified in clause 4.3 of this specification shall also be applicable for local control panels.

4.5 Local Gauge Board

4.5.1 Local gauge board shall be used to install skid mounted instruments like pressure gauges, temperature gauges, process switch and transmitters.

4.5.2 Location of local gauge boards, when provided, shall be decided to allow easy access at the rear and front for all instruments and accessories for maintenance and operation.

4.5.3 Gauge board shall be constructed from 3 mm cold rolled cold annealed steel sheet with other necessary steel supporting structure and shall be painted sky blue shade No. ISC-101 as per IS-5.

4.5.4 Local gauge board shall be supplied with all instruments installed and completely in tubed /wired condition before shipment.

4.5.5 All pressure gauges shall be provided with block and bleed valves securely fastened. Identification tags shall be securely fastened for easy identification.

4.6 Temperature Instruments

4.6.1 Thermowells

a) All temperature elements shall be provided with Thermowells fabricated out of bar stock of minimum SS 304, in general. Other materials like SS 316/SS 316L, SS310, Inconel, Incolloy etc shall be selected based on the process pressure, temperature and service conditions. Thermowell flange material shall be selected as per piping specifications, in general. However for lines where post weld heat treatment is called for in piping specifications, the thermowell flange material shall be selected same as thermowell material.

For proper selection of material of construction _Material Selection Guide Line_clause 11.0 of this specification shall be referred. Contractor shall be responsible to select proper material based on the process conditions including pressure, temperature, sulphur contents etc.

b) Thermowell design shall be as per EIL standard 7-52-0035 upto ANSI 600# including for packages /sub-packages. For thermowells above ANSI 600# rating, contractor may use their own proven design(s) recommended by various manufacturers suitable for the specified pressure-temperature conditions. The thermowell design shall ensure no air gap between the tip of the element and thermowell to minimise measurement lag.

c) Contractor shall carry out the vibration analysis of all thermowells as per PTC codes where line velocity exceeds 6 m/s for liquids and 120 m/s for vapours /gases. In case the thermowell design fails vibration analysis, an alternate design may be used by the contractor. All such design along with calculations shall be submitted for purchaser's review.

d) Immersion length of thermowells shall be selected as follows:

Line Size	Immersion length
upto 6"	280 mm
From 8"	onwards 320 mm
Vessels / columns	400 mm

This immersion length is based on thermowell nozzle length of 200 mm (between flange face and inner wall of pipe). In special applications, where thermowell nozzle sizes are larger or where temperature is to

be measured at any specific location, vendor shall decide the immersion length based on the actual requirements.

- e) Any pipe line size less than 4" nominal bore shall be blown to 4" size to install thermowell.
- f) For immersion lengths larger than 500 mm, like those in fired heaters, built up thermowell design shall be used. In all such cases, all welded joints shall undergo 100 % radiography testing. For joints where radiography is not possible dye penetration test may be carried out.

4.6.2 Temperature Gauges

- a) Local temperature gauges shall be liquid/vapour/gas filled type in general and shall be manufactured as per relevant SAMA Class. Bimetallic gauges shall be considered if required as per licensor package or specified in job specification. The temperature bulb shall be of SS 316 construction as a minimum.
- b) All local temperature gauges shall have 150 mm dial size with adjustable head. The bulb size shall be selected to suit the thermowell.
- c) All gauges shall be of heavy duty weatherproof construction
- d) Temperature gauges shall have accuracy of $\pm 1\%$ URV (upper range value).
- e) Bimetallic temperature and direct filled system gauges shall be avoided where excessive vibrations are encountered, such as compressors. Only filled type with capillary extension shall be used in such applications. Capillary tubing shall be minimum of SS304 with stainless steel flexible armouring, having PVC covering over armour.
- f) It shall be possible to adjust gauge stem length by using adjustable gland with union. All such fittings shall be suitable for 1/2" NPTF connection to suit thermowell.

4.6.3 Temperature Elements

- a) For remote temperature indication/recording/control/switch etc., thermocouples or resistance temperature detector (RTD) shall be used depending on the process requirements. Elements shall be spring loaded, mineral insulated and shall have SS 316 sheath as minimum.
- b) The design of thermocouple assemblies shall be as per EIL Standard 7-52-0036 i.e. Thermocouple /RTD assembly with thermowell and shall allow online replacement of temperature element. The element head shall be screwed-in type and weatherproof to IP-56 as a minimum. For thermocouple assembly, the terminals shall be color coded as per element color code.
- c) Thermocouples shall be magnesium oxide (MgO) filled ungrounded type, unless specified otherwise. Thermocouple characteristics shall be as per IEC-584-2/IS-7358. The type of thermocouple shall be selected based on operating temperature conditions. Following guidelines shall be followed in general unless specified otherwise:-

Copper-Constantan (ISA-Type-T) :	(-) 200 to 200_C
Chromel-Constantan (ISA-Type-E) :	200 to 600_C
Chromel-Alumel (ISA-Type-K) :	600 to 1200_C
PlatinumRhodium-Platinum (ISA Type-S) :	1200 to 1600_C

- d) Thermocouple wire size shall be 18 AWG for single and 20 AWG for double thermocouple for most of the applications, in general. However following guidelines shall be followed for selecting single thermocouple wire size as a minimum.

Type	8 AWG	14 AWG 18 AWG	24 AWG
T	-	> 371_C For all other	-

E	> 871_C	> 649_C For all other -	temperatures
K	> 1260_C	> 1093_C	temperatures For all other -
S	-	-	temperatures - < 1482_C

e) The design of thermocouple assemblies shall be such that replacement on line is possible.

f) RTD (Resistance Temperature Detector) shall be platinum element 3 wire type with 100 Ω resistance at 0_C calibrated as per IEC 751/DIN 43760. RTD shall be used within a temperature range of -200 to 650_C.

g) RTD shall generally be selected for applications requiring low temperature measurement with comparatively shorter temperature span requiring accuracies of the order of 0.25% or better.

h) Twin element sensors, if used, shall have two separate cable entries.

i) The special thermocouples such as reactor thermocouples, reactor / vessel skin thermocouples etc shall be designed by contractor based on specifications/details provided elsewhere in the contract document.

j) Heater tube skin thermocouple, where applicable, assembly shall meet the heater design requirements and shall be provided with expansion loops. The sheath material shall be selected based on temperature and sulphur content and shall be as per API recommendation.

4.6.4 Temperature Transmitter

a) Unless specified otherwise, temperature transmitters, shall be panel/rack mounted type only and shall be located in control room/satellite rack room. In case, field mounted transmitters are specified, separate field mounted transmitters shall be used, head mounted transmitters shall be avoided.

b) Temperature transmitters shall have a built-in linearising function to produce an output linear to temperature range.

c) Field mounted temperature transmitters shall be smart type with HART protocol having an accuracy of +/- 0.1 % of URV. The other features of smart transmitters shall be same as those covered under field transmitters.

d) Burn out protection must be provided with temperature transmitters and other temperature input devices. Upscale or downscale protection shall be decided based on the application to ensure failsafe operation.

4.7 Pressure Instruments

4.7.1 Pressure Gauges

a) Pressure gauge dial shall be white, non rusting plastic with black figures. Pointers shall have external micrometer adjustment for gauge zero adjustment.

b) Pressure gauges shall be weatherproof with dial size of 150 mm and shall have features like screwed bezels, externally adjustable zero, over range protection and blowout discs. Pressure gauge sensing element shall be of SS316 and movement of SS304, as a minimum. The design of pressure gauges shall confirm to IS-3624.

- c) Pressure gauges shall have an accuracy of $\pm 1\%$ of URV as a minimum. Differential pressures gauges may have an accuracy of $\pm 2\%$ of URV.
- d) Over range protector and pulsation dampener, whenever used, shall be of SS304, as a minimum. Pulsation dampeners shall be used for all pulsating services. These shall be floating pin type, externally mounted and externally adjustable.
- e) All pressure gauges with maximum operating pressure exceeding 60 kg/cm²g and gauges in toxic service shall be solid front type.
- f) Process connection shall normally be 1/2" NPTM bottom, except for diaphragm seal where 1" flanged connection shall be used in general.
- g) Cases shall normally be cast aluminium alloy or black phenol and weatherproof to IP-55 as per IEC-529/IS-2147. Blow-out discs shall be provided for all gauges.
- h) Ranges shall be so specified that the gauge normally operates in the middle third of the scale and shall conform to IS-3624 standard dials, wherever possible.
- i) Diaphragm seal pressure gauge with capillary shall be used for congealing and viscous services, i.e where plugging of the element may occur or where suitable material is not available in highly corrosive service. Direct mounted, filled type gauges or mechanical linked gauges (schaffer diaphragm type) shall be avoided for any mild to heavy vibrating service.
- j) Receiver pressure gauges for local transmitter output indication shall have 100 mm dial with stainless steel element and 1/4" NPTM instrument connection.
- k) Shatterproof glass shall be provided for pressure, receiver or draft gauges.

4.7.2 Pressure Switches

- a) Pressure switches shall have either diaphragm or bellow type of process element with SS316 material of construction as a minimum. Switch type shall be sealed micro type with contact rating suitable for specific application. Pressure switch design with Reed type switches shall not be selected.
- b) Pressure switches shall be blind type with 1/2 NPTF process connection and shall be operative in full specified range. The switch differential shall be selected as per operating conditions, it shall be less than 60% of difference between set value and operating value.
- c) Pressure switches shall have repeatability of $\pm 0.5\%$ of URV, as a minimum.
- d) Receiver pressure switches shall have SS316 bellows as measuring element with 1/4" NPTF connection.
- e) Over range protection and pulsation damper requirements and design shall be as per above clause.
- f) Requirements, design and selection of diaphragm seal (chemical seal) for pressure switches shall be as per clause 4.7.1(i).

4.8 Level Instruments

4.8.1 Level gauges

- a) All gauge glasses shall be steel armoured reflex or transparent type with body and cover material of forged carbon steel as a minimum and shall have tempered borosilicate glass with asbestos or other suitable gasket. Transparent type of gauges shall be provided with integral illuminators operating at 230 V

50 Hz supply and suitable for electrical area classification specified. All gauge glasses must have a rating equal to or more than the vessel design pressure and temperature.

b) Reflex type shall be used for clean and colourless liquids, for liquid level interface. For low temperature, low boiling point service, large chamber type will be used. Transparent type will be used on acid, caustic, dirty or viscous, coloured liquids and liquid interface. Transparent type with Mica or Kel-F shields shall be used for treated water, boiler and condensate services, and for corrosive liquids, which will attack glass. Tubular gauge glasses shall not be used, in general. They may be used for non-hazardous services at ambient temperature and low pressures.

c) Large chamber gauges with frost shields shall be provided for cold services below 0°C. Heating jacket shall be provided for viscous liquids.

d) All gauges shall have top and bottom chamber connections, unless otherwise specified. In addition each gauge shall be provided with ball check valves and pipe union.

e) The visible range of level gauge shall be selected to cover the complete operating level as well as measuring range of the other level instruments provided for the same purpose. In general, the visible length of the level gauges shall be selected from the following: -

Visible length, mm	Centre to Centre Length, mm
220	470
470	720
720	970
980	1230

In any case, the maximum visibility length shall not exceed 1500 mm for a single gauge. Multiple gauges with overlapping range shall be used for such cases.

f) Gauge glass cocks shall be forged off-set type with an integral ball check and back seating stem. Primary isolation valves are normally required in addition to the gauge glass cocks, except on vented tanks containing harmless liquids. Where the process fluid tends to foul the cocks internals and create plugging or where leakage is a problem, gauge valve may be eliminated. On low temperature service, with liquids having very high vapour pressure at ambient temperature, safety valve shall be provided at the vent connection of the gauge glass.

g) For level gauging in very viscous liquids, liquids with crystals, sour services and pressure above 600# toxic services, float operated magnetic gauges with 2" flanged end connections shall be used.

h) Bicolor type level gauges shall be used for steam drums.

4.8.2 Level Transmitter

a) External displacer type instruments with side-side connections and rotatable head, shall normally be used for level measurement upto 1219 mm. Side-bottom connections are preferred where RJ flanges are required. Internal displacer type of level transmitters shall be avoided unless application necessitates its use.

b) All displacer type of level transmitters shall be of torque tube type with torque tube material of inconel, as a minimum.

c) In general, displacer type instruments shall be used with displacer lengths of 356 mm, 813 mm and 1219 mm. For interface level measurement, displacer type instruments shall only be used.

4.8.3 Level Switch

- a) Level switches shall generally be external ball float type with flanged head. External displacer type level switches can be considered for lighter fluids where specific gravity is less than 0.5. Internal float/displacer type level switches shall only be used if external ball float/displacer type is not possible, like in viscous services and in underground tanks/vessels.
- b) Multifloat / displacer level switches shall be avoided in process service.
- c) Switch shall be sealed micro type with contact rating suitable for the specific application. Level switches with Reed switch shall not be used.
- d) Level switch shall be furnished with SPDT contacts with adjustable differential, unless otherwise specified.

4.8.4 Tank Level Instruments

4.8.4.1 a) Mechanical float type gauge shall be used for atmosphere tanks where level measurement accuracy requirement is of the order of ± 2 mm. Liquid seal chamber shall be used where tank contents are toxic or tank is blanketed.

b) Servo type gauges shall be used for level measurement of pressurized tanks/vessels/spheres requiring remote signal transmission and better level measurement accuracies. Level/data transmission signal to remote control room shall be digital only. Servo type instruments shall have 6" process connection with 12" diameter still well.

c) The tank side indicator for both types of gauges shall have hoisting facility. All tank level gauges shall have side mounted indicator-counter type for mechanical float type and solid state digital for servo controlled level gauge.

d) The wetted material like float, displacer, tape, wire etc. shall generally be SS316.

e) The accessories for servo-controlled level gauge shall include calibration chamber and isolation ball valves for pressurised tanks. Isolation ball valve size shall be same as equipment nozzle size.

4.8.4.2 Whenever specified, averaging tank temperature element shall be provided. The temperature elements shall be RTD. Number of temperature elements shall be as per ASTM D 1066. The temperature element shall be connected to corresponding gauge head and shall be intrinsically safe.

4.8.4.3 Radar type tank gauges shall be used for storage tanks handling viscous fluids or as specified in job specification.

4.8.4.4 All tank gauges shall be supplied with power ON-OFF switch mounted at grade level. Separate cable entries shall be provided for signal and power in the gauge head/tank side indicator/ONOFF switch as applicable.

4.8.4.5 Other Special type of level instruments like radar, ultrasonic, hydrostatic, nucleonic, capacitance, conductivity type shall be used as necessitated by application requirements.

4.8.4.6 For high pressure steam drum application conductivity type (hydrostatic or equivalent) level instrument shall be preferred.

4.8.5 For solid level measurement, type of instrument shall be ultrasonic/radio frequency/ electromechanical /capitance/nucleonic. The actual type selection shall be carried out based on the provenness of the selected type for the similar type of application.

4.9 Flow Instruments

4.9.1 Orifice Plates

a) Flow measurement shall normally be carried out using thin square edged concentric orifice plate mounted between a pair of weld neck flanges of minimum 300 # ANSI rating for line size 2" and above. Flange taps shall be used for line sizes upto 14" while D-D/2 taps shall be used for line sizes 16" and above. For line sizes 1-1/2" and below for conical entrance orifices corner taps shall be used. Contractor to check fouling of tapping point with respect to welding of flange. In case of fouling, flange tap shall only be used. The material of the orifice plates shall be normally SS316, as a minimum. Quadrant edge or quarter circle orifice plates shall be used when lower Reynolds number does not permit the use of squared edge orifices as per codes. Conical entrance type of orifice plates shall preferably be used for very highly viscous liquids upto throat Reynolds number of 250. These shall be fabricated as per BS 1042 Part 1.

b) Vent and Drain holes shall be provided in orifice plates, wherever necessary.

c) Sizing of orifice plate shall be carried out in accordance with ISO-5167. Other sizing methods like AGA Report No.3, BS-1042, 'Flow measurement-Engineering Handbook' by R.W. Miller shall be used when specified.

d) Orifice plates shall be fabricated in accordance with EIL standard 7-52-0041 'Orifice Plates and Flanges Dimensional Details'.

e) Differential range for orifice meter shall normally be 2500 mm of H₂O dry calibration. Other preferred ranges are 500, 1250, 5000 and 10000 mm of H₂O. However the selected value shall be less than the allowable pressure drop mentioned in the process data sheet.

f) Upstream and downstream straight length shall be provided based on maximum d/D ratio of 0.75, in general. Where it is difficult to meet this requirement, the actual d/D ratio can be considered for reducing the straight length as permitted by the codes. The recommended practice shall be as per API-MPMS, Recommended Practices and AGA Report No.3. Flow straighteners should be considered, where straight runs are difficult to achieve otherwise.

g) Meter taps shall be horizontal for liquids, condensible vapours and steam. The taps shall be on top for gas, non-condensable vapour, or liquids which boil at or below the maximum design ambient temperature at operating pressure. Where piping clearances are a factor, taps may be located upto 45 deg above the horizontal centre line for condensible vapour, liquid and steam. The taps may be located upto 60_ from vertical for gas and non condensible vapour. For 45 deg installation both the tapping point nipples are 4" long. For horizontal tappings on liquid condensible vapour and steam service they shall be 4" long for one tapping and 6" long for the other.

h) At least one pair of tapping shall be provided for each orifice flange. Where more than one transmitters are used, separate pair of tappings shall be provided for each orifice flange for each instrument for installation of each instrument separately.

4.9.2 Variable area flow meters shall be as per ISA-RP 16.1, 16.2, 16.3, 16.4, 16.5 and 16.6 and shall be used for viscous or corrosive services or where rangeability in flow precludes the use of an orifice. Metal tube variable area flow meters shall be used for all process fluids. External devices for indicating or transmitting shall be magnetically coupled to the float or extension. Glass tube variable area flow meters shall be used for low pressure utility services for local indication and where line size is 1-1/2" or less. Glass tube variable area flow meters shall not be used if outlet line is connected to a line or vessel containing hazardous or toxic fluid unless a check valve is installed at the downstream side of variable area flow meters.

4.9.3 Turbine and positive displacement meters or mass flow meters shall be used for accurate flow integration for custody transfer etc. Whenever PD meter is selected, these shall be double casing type with inner casing of SS 316 as a minimum. Whenever turbine meter is selected, it shall have SS 316 turbine with tungsten carbide bearings. Pulser and the transmitter selected shall be compatible and should have a proven combination reference.

4.9.4 For flow measurement in lines less than 2", integral flow transmitters shall be selected. The integral flow assembly shall be supplied as an integral assembly consisting of upstream and downstream straight pipes, integral orifice of SS 316 (as a minimum) and transmitter installed along with manifold. Material of construction of all elements except for end flanges which shall be as per piping specifications, upstream and downstream pipes shall be honed from inside to achieve smooth surface. Integral orifice meters, when used, shall be installed with block and bypass valves. Orifice meters with metering runs may also be used for lines less than 2".

4.9.5 Magnetic type flow meters shall be used for electrically conductive slurry or corrosive services and shall be installed with line size bypass, with block and clean out valves, at the lowest point in piping to ensure that meter run is always liquid filled. Grounding rings shall be used whenever required.

4.9.6 Target meters shall be considered for highly viscous hydrocarbon streams such as asphalt, tar, polymers etc.

4.9.7 Vortex meter shall be considered where high rangeability is the prime requirement. Ultrasonic flow measurement shall be considered where non-intrusive flow measuring is required.

4.9.8 Averaging pitot tube shall be considered for low pressure loss, high velocity steam, large diameter lines and air ducts. This shall be installed on 1-1/2" size nozzle for small lines and 3" for large lines or lines with high velocity. The average pitot tube shall be of SS 316 material as a minimum, shall be provided with end support, whenever required. Retraction arrangement with ball valves shall be provided for each average pitot tube installation.

4.9.9 Differential Pressure type flow transmitter shall meet all the requirements specified for field transmitters in this specification.

4.10 Field Transmitters

4.10.1 Field transmitters for flow, pressure, differential pressure and level applications shall be yoke mounted smart type unless specified otherwise. These transmitters shall be certified intrinsically safe, in general, with 2 wire system having 4 - 20 mA DC output with superimposed digital signal having simultaneous analog and digital communication. Communication protocol shall be HART only.

4.10.2 Transmitters shall be provided with external zero adjustment and shall have integral vent/drain.

4.10.3 All transmitters shall be provided with integral intrinsically safe output meter. Intrinsically safe remote output meter shall only be provided, if specified in the P&IDs or in the job specifications. All output meters shall provide digital LCD display.

4.10.4 The transmitter shall be microprocessor based and it shall incorporate a non-volatile memory which shall store complete configuration data of transmitter. All necessary signal conversions, including conversion to produce output with the required protocol shall be carried out in the transmitter electronics.

4.10.5 Transmitter shall also run complete diagnostic routine. In the event of detection of failure, the output shall be driven to predefined value.

4.10.6 Temperature sensors shall be provided to compensate for process temperature and ambient temperature variations.

4.10.7 The transmitter shall be able to assure an accuracy of $\pm 0.1\%$ of span for a rangeability of 1:10, unless otherwise specified in the job specification. The accuracy shall include the combined effect of linearity, hysteresis and repeatability.

4.10.8 The response time of smart transmitters shall commensurate with process. It shall be equal or better than the half of the scan time of control loop specified elsewhere in the bid package.

4.10.9 HART protocol of latest version shall be used and shall be suitable for HART maintenance system with corner stone software or equivalent with the following features as minimum:

a) It shall allow multi masters (two for example, primary and secondary) for configuration, calibration, diagnosis and maintenance. The primary could be control system or host computer and the secondary could be the hand held communicator or a maintenance computer.

b) It shall be capable of implementing universal commands. It must be possible to communicate all the commands of HART maintenance system to field transmitters and smart transmitters shall be selected accordingly.

4.10.10 Unless recommended otherwise by compressor manufacturer, field transmitters used in antisurge control loop shall be non-smart and flameproof type. The flameproof transmitters shall have their calibration adjustment from out side without any need to remove the cover.

4.10.11 Retrofit type of smart transmitters are not acceptable.

4.10.12 Diaphragm seal element with capillary shall be used for congealing, corrosive and highly viscous services.

4.10.13 Field communicator

It shall be possible to perform routine configuration, calibration, display process variable, diagnostics etc. from a hand held portable calibrator which can be connected at any location in the transmitter loop. It shall be possible to perform all the above functions on line. The loop function shall remain unaffected while communication is going on between transmitter and the field communicator. No output interruption should occur.

Field communicator shall meet the following requirements.

a) They shall be battery powered with replaceable and rechargeable batteries. Recharger power supply shall be 230 V AC $\pm 10\%$, 50 Hz ± 3 Hz.

b) It shall be possible to connect the communicator at any of the following places for purpose of digital communication:

i) Marshalling cabinet serving the transmitter, in safe area, control room.

ii) Junction box serving the transmitter, in hazardous area, field.

iii) Directly at the transmitter, in hazardous area, field.

Plug in type connections shall be provided with field communicator. Necessary interconnection cable and any other accessories required for connection shall be supplied by vendor.

c) Offered communicator shall be dustproof, certified intrinsically safe and suitable for outdoor location. Carrying case shall be supplied with each communicator.

4.11 Vibration and Axial Displacement Monitoring

4.11.1 Vibration and axial displacement monitoring system shall be based on non-contacting type sensing probe, unless otherwise specified.

4.11.2 Vibration and displacement monitoring system shall be as per API-670 . The extent and type of monitoring shall be as defined elsewhere. However, contractor shall furnish any additional requirements for monitoring deemed essential by them with reasons. Two probes at 90 degrees apart for each location shall be provided and connected to same dual channel monitor for vibration monitoring.

4.11.3 The sensing probe shall be accessible for adjustment, repair and replacement without dismantling the machine.

4.11.4 Vibration and displacement monitoring system shall be Bently Nevada 3500 series or equivalent. Monitoring instruments shall be located in control room unless otherwise specified.

4.11.5 System shall provide continuous 4-20 mA DC isolated output for each channel of measurement for remote indication and potential free contacts for alarm/shutdown setting.

4.11.6 Monitors shall be with maximum four(4) channel type and shall meet the following specifications as a minimum:-

a) Each channel shall have two independent alarm levels one for pre trip alarm and one for each trip, settable continuously over measurement range. Two relay contacts for each pre trip alarm and trip alarm per channel shall be provided.

b) Broken sensor failure detection without causing shut down.

c) LED status indication to show health status of the monitor, bypass status and communication status of the monitor.

4.12 Speed Monitoring

4.12.1 Speed monitoring system shall be based on non-contacting type sensing probe, unless otherwise specified.

4.12.2 Speed monitoring system shall be as per API-670 . The extent and type of monitoring shall be as defined elsewhere. However, contractor shall furnish any additional requirements for monitoring deemed essential by them with reasons. Two probes at 90 degrees apart for each location shall be provided and connected to same dual channel monitor for vibration monitoring.

4.12.3 The sensing probe shall be accessible for adjustment, repair and replacement without dismantling the machine.

4.12.4 Speed monitoring system shall be Bently Nevada 3500 series or equivalent. Monitoring instruments shall be located in control room unless otherwise specified.

4.12.5 System shall provide continuous 4-20 mA DC isolated output for each channel of measurement for remote indication and potential free contacts for alarm/shutdown setting.

4.12.6 Monitors shall be with dual channel type and shall meet the following specifications as a minimum :-

a) Each channel shall have two independent alarm levels one for pre trip alarm and one for each trip, settable continuously over measurement range. Two relay contacts for each pre trip alarm and trip alarm per channel shall be provided.

- b) Broken sensor failure detection without causing shut down.
- c) LED status indication to show health status of the monitor, bypass status and communication status of the monitor.

4.13 Bearing and Winding Temperature Monitoring

4.13.1 In general, bearing temperature shall be measured at the points which are under maximum loading.

4.13.2 Sensor shall be three wire RTD element of platinum having 100 Ω resistance at 0°C. Calibration shall be to DIN 43760 standards.

4.13.3 The temperature sensor, cables, terminal heads, junction boxes etc. should be capable of withstanding the mechanical vibration and environment of a rotating machinery atmosphere.

4.13.4 Bearing and Winding temperature shall be monitored by means of a temperature monitor. The temperature monitors shall be located in control room and shall meet following requirements :-

- a) Accept RTD inputs (platinum, 100 Ω at 0°C calibrated to DIN 43760 standards).
 - b) Continuous six channel monitoring with each channel input from one RTD.
 - c) Each channel shall have two independent alarm levels one for pre-trip alarm and one for trip alarm, settable continuously over measurement range.
 - d) Broken sensor failure detection without causing shut down.
 - e) LED status indication to show health status of the monitor, bypass status and communication status of the monitor.
 - f) Analog output 4-20 mA DC isolated signals shall be provided for each channel for remote indication.
- 4.13.5 Separate temperature monitors shall be provided for motor winding and bearings temperature monitoring.

4.14 Key Phasor

4.14.1 Key phasor system shall be provided by vendor for performing analysis of vibration signals to determine machine malfunctions. It shall consist of a proximity probe and transmitter, extension cable, mounted etc. and other accessories to make the system complete. Vendor shall provide necessary reference on the shaft to determine one-per-turn occurrence.

4.15 Accumulator of Lube Oil System

4.15.1 If accumulators are used with nitrogen for lube oil dampening at the desired pressure to meet the system requirement the following instrumentation with the accumulator to be provided by vendor:

- a) Accumulator shall have charge kit with isolation valves and connection hoses.
- b) Standard Nitrogen cylinders available in India are at pressure of 140 kg/cm²g with standard connection sizes. Vendor shall provide the complete regulator system with protection for charging nitrogen from nitrogen cylinder to accumulator at the desired pressure. Regulator shall be suitable for the inlet pressure variation of 140 to 150 kg/cm²g while charging with suitable inlet connection to match the Nitrogen

cylinder connection. Regulator system shall have pressure indicator, regulator, relief valve, needle valve etc. as a minimum. Material of construction shall be stainless steel.

4.15.2 The compressor loading-unloading scheme for reciprocating compressors shall be provided as per the minimum requirements specified in the job specifications. Manual as well as automatic schemes shall be provided per steps as per machine requirement.

4.15.3 Emergency switch shall be provided in the local panel/field. All such switches shall have a protective cover to avoid inadvertent shutdown.

4.15.4 Vendor shall provide the following common alarms in control room:

a) Common machine pre-trip alarms.

b) Common machine trip alarm.

4.15.5 Vibration, axial displacement, speed, temperature monitoring system shall be provided with serial link output for connectivity to plant DCS. The serial link shall also be provided for machine diagnostic software running on separate whenever specified in job specification.

4.16 Pressure Relief Valves and Rupture Discs

4.16.1 Pressure Relief Valves

4.16.1.1 In case, ASME section I valves are supplied, it shall have the certificate from ASME laboratories.

4.16.1.2 Pressure relief valves shall be full nozzle full lift type except for thermal relief valves.

4.16.1.3 Conventional valves shall be specified for constant back pressure while bellows seal type valves shall be specified for variable back pressure more than 10% of set pressure. Pilot operated pressure relief valves shall be used for special services and where set pressure is closer than 10% of the operating pressure, in general.

4.16.1.4 Lifting lever shall be specified for steam and air service. Open bonnet shall be used for steam service.

4.16.1.5 The percentage accumulation in case of pressure relief valves/safety valves shall be as follows:

a) Steam Service

- ASME SEC I	3%
- IBR (Before steam let-down station)	5%
- IBR (Distribution & utilities) and ASME Section VIII	10%

b) Gas, Vapour or liquid except in (c) & (d) below 10%

c) Liquid for thermal Relief 25%

d) Fire exposure on unfired vessels 21%

4.16.1.6 3/4" x 1" threaded (NPT) modified nozzle type valves with typically 0.38 cm_ orifice size shall be specified for thermal relief.

4.16.1.7 The body material shall, as a minimum, be as per piping specifications. Nozzle and disc material shall be SS316 as a minimum with machined stainless steel guide and spindle. Whenever semi nozzle designs are unavoidable, body material shall be atleast same as nozzle material.

4.16.1.8 The spring material of pressure relief valves shall be as follows unless otherwise necessary because of process conditions ;

- 29_C to 250_C :	Zinc/nickel plated carbon steel.
above 250_C :	Tungsten alloy steel.
below - 29_C :	Stainless steel 316

4.16.1.9 Flanged connection shall be for standard sizes 1" or larger. Minimum flange rating shall be 150 # ANSI.

4.16.1.10 Where permissible, threaded connections shall be used on sizes 3/4" and below.

4.16.1.11 Pilot operated pressure relief valves shall have remote sense facility for pilot valve. Internal sensing for pilot shall be avoided as far as possible.

4.16.1.12 The pressure relief valves shall be type tested for capacity with 5% blowdown as per ASME sec VIII UG-131 and the actual blowdown of individual valves shall meet the process requirement. Contractor shall furnish the type test certificate for the same.

4.16.1.13 Test gag shall be provided for all pressure relief valves.

4.16.2 Rupture Disc

4.16.2.1 Rupture discs shall be reverse buckling type, in general and shall be supplied in pre-torqued holder assembly which shall fit inside the inner diameter of the bolt circle of standard ASME flanges. Disc material shall be compatible with the vessel contents and shall be consistent with the bursting requirements.


4.16.2.2 Following shall be taken care when rupture disc is used upstream of the pressure relief valve:


(a) Derating factor of 0.9 shall be used for capacity sizing.


(b) A tell-tale assembly consisting of pressure switch, pressure gauge and excess flow check valve shall be provided to indicate leakage/rupture downstream of the rupture disc.

4.16.2.3 Manufacturing tolerance of the rupture disc shall be decided by contractor based on operating pressures. However when rupture disc is used in combination with pressure relief valve, zero manufacturing range shall be selected.

4.16.2.4 For each rupture disc four(1+3spare) discs shall be provided.

	TECHNICAL SPECIFICATIONS SPECIAL PROCESS HORIZONTAL PUMPS	SPECN. NO.:	PE-TS-353-100-N001		
		VOLUME:	IIB	SECTION:	D
		REV. NO.	0	DATE:	10.07.2010
<div>SECTION D</div> <div>STANDARD TECHNICAL SPECIFICATIONS</div> <div>STANDARD TECHNICAL SPECIFICATIONS FOR PUMPS</div>					

	DATA SHEET - A					SPECIFICATION NO.: PE-TS- 353-100 - N001		
	SPECIAL PROCESS HORIZONTAL PUMPS					REV. NO.:00	DATE : 08/07/2010	
	CPP - PARADIP REFINERY PROJECT					VOLUME : II B	SECTION : D	
Sl. No.	Description	HP FEED WATER EXPORT PUMPS- MOTOR DRIVEN	HP FEED WATER EXPORT PUMPS- TURBINE DRIVEN	MP FEED WATER EXPORT PUMPS- MOTOR DRIVEN	MP FEED WATER EXPORT PUMPS- TURBINE DRIVEN	CONDENSATE TRANSFER PUMPS - TURBINE DRIVEN	CONDENSATE TRANSFER PUMPS - MOTOR DRIVEN	HRSG MAKE-UP TRANSFER PUMPS - MOTOR DRIVEN
		HORIZONTAL PUMPS GROUP - I				HORIZONTAL PUMPS GROUP - II		
1.1	Variant No.	01	02	03	04	05	06	07
1.2	KKS code							
1.3	Number of Pumps	Two (1W + 1S)	One (1W)	Two (1W + 1S)	One (1W)	One (1W)	Two (1W + 1S)	Three (2W + 1S)
1.4	Parallel operation	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.5	Drive	Motor	Steam Turbine	Motor	Steam Turbine	Steam Turbine	Motor	Motor
1.6	Direct drive	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.7	Drive included in Pump supplier scope	No	Yes	No	Yes	Yes	No	No
1.8	Auto Start facility	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.9	Motor designed for end of the curve operation with discharge valve open	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2.1	Pump type	Horizontal, Centrifugal, Multistage, Barrel Casing				Horizontal, Centrifugal , Axially split one and two stage between bearing pumps or radially split one and two stage between bearing pumps or Multistage, Barrel Casing pumps.		
	Pump Standard	API 610, 8th edition, EIL: 6-41-0005, (Centrifugal, Special Purpose Process Service)				API 610, 8 th edition, EIL: 6-41-0005, (Centrifugal, Special Purpose Process Service)		
	Steam Turbine standard	NA	General Purpose steam turbines, API Std 611(gen), 4 th edition	NA	General Purpose steam turbines, API Std 611(gen), 4 th edition	General Purpose steam turbines, API Std 611(gen), 4 th edition	NA	NA
	Gear Box standard (if applicable)	NA	NA	NA	NA	NA	NA	NA
	Vibration & Temperature Monitoring System Std. (if applicable)	API 670 Note : Bidder to provide provision for installing purchaser probes for vibration monitoring system. Instrumentation for measuring bearing temp. to be provided for generating Alarm and Trip interlocks						
	LO System Standard (if applicable)	API 614				API 614		
	Coupling Standard	API 671				API 671		
2.2	Mechanical Seal Standard	API 682				API 682		
2.3	Liquid handled	Boiler Feed Water				Steam Condensate Water		
2.4	Liquid Temperature/Design Temperature	145 DegC / 160 DegC				64.3 DegC / 75 DegC		
2.5	Density of water	921.384 Kg/cu.m				980.890 Kg/cu.m		
2.6	Design Pump Capacity	235 CubM/hr	235 CubM/hr	125 CubM/hr	125 CubM/hr	600 Cu.m/hr	600 Cu.m/hr	395 Cu.m/hr
2.7	Design Pump Differential Head	805 MLC	805 MLC	420 MLC	420 MLC	140 MLC	140 MLC	165 MLC
2.8	Max. Limit on shut-off head corresponding to pump TDH at 51.5 Hz.	120% of rated head						
2.9	Available Pressure on Suction side of BFP	4.758Kg/cm2(a)	4.758Kg/cm2(a)	4.758Kg/cm2(a)	4.758Kg/cm2(a)	4.736Kg/cm2(a)	4.736Kg/cm2(a)	4.736Kg/cm2(a)
2.10	NPSHA at pump suction flange	5.659 MLC	5.659 MLC	5.659 MLC	5.659 MLC	5.423 MLC	5.423 MLC	5.423 MLC
2.11	NPSHR shall be ltd to	4.359 MLC	4.359 MLC	4.359 MLC	4.359 MLC	4.123 MLC	4.123 MLC	4.123 MLC
2.12	Motor Rating	Continuous motor rating (at 50 degC ambient) for all pumps shall be at least 10% above the max. power requirement at any condition of the entire characterstic curve of the pump (viz. end of curve) or 15% extra at the design point whichever is maximum.						
3.1	Max allowable pressure drop in ARC valve	1 Kg/Sqcm				1 Kg/Sqcm		

	DATA SHEET - A					SPECIFICATION NO.: PE-TS- 353-100 - N001		
	SPECIAL PROCESS HORIZONTAL PUMPS					REV. NO.:00	DATE : 08/07/2010	
	CPP - PARADIP REFINERY PROJECT					VOLUME : II B	SECTION : D	
Sl. No.	Description	HP FEED WATER EXPORT PUMPS- MOTOR DRIVEN	HP FEED WATER EXPORT PUMPS- TURBINE DRIVEN	MP FEED WATER EXPORT PUMPS- MOTOR DRIVEN	MP FEED WATER EXPORT PUMPS- TURBINE DRIVEN	CONDENSATE TRANSFER PUMPS - TURBINE DRIVEN	CONDENSATE TRANSFER PUMPS - MOTOR DRIVEN	HRSG MAKE-UP TRANSFER PUMPS - MOTOR DRIVEN
		HORIZONTAL PUMPS GROUP - I				HORIZONTAL PUMPS GROUP - II		
3.2	Strainer type	"T" type				"T" type		
3.3	Free flow area of strainer element	8 times the inlet pipe area				8 times the inlet pipe area		
3.4	Max allowable pressure drop in suction strainer 50% clogged condition	0.2 Kg/Sqcm	0.2 Kg/Sqcm	0.2 Kg/Sqcm	0.2 Kg/Sqcm	0.15 Kg/Sqcm	0.15 Kg/Sqcm	0.15 Kg/Sqcm
3.5	Operating/Plant performance guarantee condition- Pump Capacity	235 CubM/hr	235 CubM/hr	125 CubM/hr	125 CubM/hr	600 Cu.m/hr	600 Cu.m/hr	395 Cu.m/hr
3.6	Operating/Plant perf guarantee condition- Pump Differential Head	805 MLC	805 MLC	420 MLC	420 MLC	140 MLC	140 MLC	165 MLC
3.7	Capability condition-I-Pump Capacity	211 CubM/hr	211 CubM/hr	112 CubM/hr	112 CubM/hr	546 CubM/hr	546 CubM/hr	357 CubM/hr
3.8	Capability condition-I-Pump Differential Head	698 MLC	698 MLC	363 MLC	363 MLC	123 MLC	123 MLC	148 MLC
3.9	Capability condition-II-Pump Capacity	218 CubM/hr	218 CubM/hr	115 CubM/hr	115 CubM/hr	563 CubM/hr	563 CubM/hr	368 CubM/hr
3.10	Capability condition-II-Pump Differential Head	742 MLC	742 MLC	385 MLC	385 MLC	131 MLC	131 MLC	158 MLC
3.11	Permissible tolerance in rated capacity & TDH	No negative tolerance						
3.12	Noise Level	85 DBA at 1 m distance, in any direction, for pump				85 DBA at 1 m distance, in any direction, for pump		
4.1	Strainer Suction Size	8"-A1AG # 150 RF 219.1x6.35 A106 GrB	8"-A1AG # 150 RF 219.1x6.35 A106 GrB	6"-A1AG # 150 RF 168.3X7.11 A106 GrB	6"-A1AG # 150 RF 168.3X7.11 A106 GrB	14"-A1AG # 150 RF 355.6x9.53 A106 GrB	14"-A1AG # 150 RF 355.6x9.53 A106 GrB	10"-A1AG # 150 RF 273.1x6.35 A106 GrB
4.2	ARC Valve Discharge Size	6"-D2AG # 600 RF 168.3X13.49 A106 GrC	6"-D2AG # 600 RF 168.3X13.49 A106 GrC	4"-D2AG # 600 RF 114.3X 6.02 A106 GrB	4"-D2AG # 600 RF 114.3X 6.02 A106 GrB	10"-A1AG # 150 RF 273.1x6.35 A106 GrB	10"-A1AG # 150 RF 273.1x6.35 A106 GrB	8"-A1AG # 150 RF 219.1x6.35 A106 GrB
4.3	ARC Valve Recirculation Size	3"-D2AG # 600 RF 88.9X11.13 A106 GrC	3"-D2AG # 600 RF 88.9X11.13 A106 GrC	2"-D2AG # 600 RF 60.3X5.54 A106 GrB	2"-D2AG # 600 RF 60.3X5.54 A106 GrB	6"-A1AG # 150 RF 168.3X7.11 A106 GrB	6"-A1AG # 150 RF 168.3X7.11 A106 GrB	4"-A1AG # 150 RF 114.3X6.02 A106 GrB
4.4	Balance Leak off Size	1.5"-A1AG # 150 RF 48.3X5.08 A106 GrB	1.5"-A1AG # 150 RF 48.3X5.08 A106 GrB	1.5"-A1AG # 150 RF 48.3X5.08 A106 GrB	1.5"-A1AG # 150 RF 48.3X5.08 A106 GrB	NA	NA	NA
4.5	Cooling water inlet & outlet-pump/ Gear box/Turbine Gland Steam Condensate System Size	100NB A2AW #150RF Cooling Water shall be provided at one T.P further distribution shall be by Pump Vendor	200NB A2AW #150RF Cooling Water shall be provided at one T.P further distribution shall be by Pump Vendor	100NB A2AW #150RF Cooling Water shall be provided at one T.P further distribution shall be by Pump Vendor	200NB A2AW #150RF Cooling Water shall be provided at one T.P further distribution shall be by Pump Vendor	200NB-A2AW #150RF Cooling Water shall be provided at one T.P. further distribution shall be by pump vendor	65NB-A2AW #150RF Cooling Water shall be provided at one T.P. further distribution shall be by pump vendor	65NB-A2AW #150RF Cooling Water shall be provided at one T.P. further distribution shall be by pump vendor
4.6	Steam inlet Size	NA	3"-D1ES # 600 RF 88.9x5.49	N/A	2"-D1ES # 600 RF 60.3X5.54	3"-D1ES # 600 RF 88.9x5.49	N/A	N/A
4.7	Steam exhaust Size	NA	6"-B1AS # 300 RF 168.3x7.11	N/A	3"-B1AS # 300 RF 88.9X5.49	4"-B1AS # 300 RF 114.3x6.02	N/A	N/A
5	MATERIAL OF CONSTRUCTION							
5.1	Pumps	Material of construction of the pumps shall be as per material class C-6 of API-610, with AISI410 shaft & barrel of 12% chrome steel. Please refer EIL data sheets enclosed, for material of construction of individual components like ARC valve, seals etc.				Material of construction of the pumps shall be as per material class C-6 of API-610, with AISI410 shaft.		
5.2	Base plate	MS fabricated				MS fabricated		
5.3	Suction strainer casing	Carbon Steel (A 106 Gr B)				Carbon Steel (A 106 Gr B)		
5.4	Suction strainer internals	SS 316/SS 304				SS 316/SS 304		
5.5	ARC Valve	CS body and SS internals				CS body and SS internals		
6.1	Pump Efficiency	73%		71%		72%		

DATA SHEET - A						SPECIFICATION NO.: PE-TS- 353-100 - N001		
SPECIAL PROCESS HORIZONTAL PUMPS						REV. NO.:00	DATE : 08/07/2010	
CPP - PARADIP REFINERY PROJECT						VOLUME : II B	SECTION : D	
Sl. No.	Description	HP FEED WATER EXPORT PUMPS- MOTOR DRIVEN	HP FEED WATER EXPORT PUMPS- TURBINE DRIVEN	MP FEED WATER EXPORT PUMPS- MOTOR DRIVEN	MP FEED WATER EXPORT PUMPS- TURBINE DRIVEN	CONDENSATE TRANSFER PUMPS - TURBINE DRIVEN	CONDENSATE TRANSFER PUMPS - MOTOR DRIVEN	HRSG MAKE-UP TRANSFER PUMPS - MOTOR DRIVEN
		HORIZONTAL PUMPS GROUP - I				HORIZONTAL PUMPS GROUP - II		
6.2	Motor Efficiency	92%	NA	92%	NA	NA	92%	92%
7	MANDATORY SPARES							
7.1	Mechanical seals (DE+NDE)	1 set		1 set		1 set		1 set
7.2	Pump element assembly including dynamically balanced rotor & stationary hydraulic parts (Only for multi-stage centrifugal barrel type pumps) OR dynamically balanced rotor (Only for multi-stage centrifugal axial split type pumps) (See Note 3)	1 set		1 set		1 set		1 set
8	Bid Evaluation							
8.1	Bid Evaluation Rate (Pumps with Drive Motor)	@ Rs 1.85 lac per KW						
8.2	Bid Evaluation Rate (Pumps with Drive Turbine)	@ 3.5 lac per 1% increase in the specific steam consumption with respect to the bidder having lowest specific steam consumption						
Notes :								
1	The above pumps shall be rated & guaranteed for the Design Parameters, and shall be cross-checked to satisfy the Normal Operating Parameters & Capability Parameters, indicated above.							
2	Cooling water supply to various accessories shall be confirmed by the bidder. Some of the accessories may not be applicable. Bidder to confirm.							
3	Element consists of assembled rotor plus stationary hydraulic parts [diffuser(s) or volute(s)].							
8	STEAM DATA (FOR STEAM TURBINE)							
8.1	Type of turbine	Horizontal, Back pressure				Horizontal, Back pressure		
8.2	Steam turbine standard	API 611, 4th edition				API 611, 4th edition		
8.3	Steam condition at turbine inlet							
	Description	Design / Normal	Minimum		Maximum		Mechanical Design	
	Inlet pressure (HP Steam)	44 Kg/Sqcm (g)	38 Kg/Sqcm (g)		48 Kg/Sqcm (g)		50 Kg/Sqcm (g)	
	Inlet Temperature (HP Steam)	395 DegC	375 DegC		415 DegC		427 DegC	
	Exhaust pressure (MP Steam)	17 Kg/Sqcm (g)	15 Kg/Sqcm (g)		17.5 Kg/Sqcm (g)		18 Kg/Sqcm (g)	
	Exhaust Temperature (MP Steam)	Bidder to Provide	Bidder to Provide		Bidder to Provide		Bidder to Provide	
8.4	Steam header conditions							
	Description	Design / Normal	Minimum		Maximum		Mechanical Design	
	Pressure (MP Steam)	17 Kg/Sqcm (g)	15 Kg/Sqcm (g)		17.5 Kg/Sqcm (g)		18 Kg/Sqcm (g)	
	Temperature (MP Steam)	305 DegC	290 DegC		334 DegC		350 DegC	



TITLE:
**TECHNICAL SPECIFICATION FOR
SPECIAL PROCESS HORIZONTAL PUMPS**

DATASHEET C

SPECIFICATION NO. PE-TS-353-100-N001

VOLUME II B

SECTION D

REV. NO. 0 DATE 10.07.2010

SHEET 1 OF 3

1.00.0 DRAWINGS, DATA AND MANUALS

Sl no.	Description	Remarks	For Approval /Review by CUSTOMER /BHEL No. of Sets Required.	Final copies- after approval No. of Sets - Required
1	P&IDs, Data Sheets, G.A & other Drgs. , Catalogue information etc.	Required with technical bid & also required during doc. submission after placement of order	12	12
2	QAP & Shop Testing Procedure Documents	1) Approval from BHEL required 2) Submission along with the Engg. Docs.	12	12
3	Site Erection, Testing & Commissioning Procedure documents	1) Approval from CUSTOMER/BHEL required 2) Submission along with the Engg. Docs.	3	12
4	"As -Built" Drawings & Documents	Submission within three weeks -after commissioning at site	0	12
5	Compact Disc (CD) –MDL, All drawings, Documents, Data sheets,all applicable Catalogues (Scanned) , BOM & all items covered in the O&M Manuals & the "As-built" Drgs.	To submit along with the submission of "As-built" drgs. & docs.	0	3

2.00.0 Notes :

2.01.0 BHEL will furnish their approvals / comments within 15 days after submission of drawings/ documents.

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

- The identification details of the equipment like BHEL PO NO., Vendor's Sl. No., Vendors contact address with tel., fax details.
- The description of the equipment.
- Final Data sheets and Drawings of the equipment as per the list mentioned in this specification.
- O&M Manuals of the equipment.
- Recommended 2 years operational spares.
- Test reports.

2.03.0 The erection documentation shall consist of

- All drawings/documents,
- O&M instructions of pump, motor, instruments, ARC valve, etc.
- all such drawings/documents, not submitted for review, but essential for erection/commissioning, e.g. cooling plan, flushing plan, assembly drawings, etc.



TITLE:
TECHNICAL SPECIFICATION FOR
SPECIAL PROCESS HORIZONTAL PUMPS

DATASHEET C

SPECIFICATION NO. PE-TS-353-100-N001			
VOLUME II B			
SECTION D			
REV. NO.	0	DATE	10.07.2010
SHEET 2 OF 3			

- master document list
- site despatchable B.O.M.
- any special safety/erection/commissioning requirements, vendor would like to specify.

3.00.0 VENDOR DATA REQUIREMENTS (DETAILED LIST)

S.No	DESCRIPTION	AFTER AWARD OF CONTRACT					
		FOR INFORMATION		FOR APPROVAL		FINAL SUBMISSION	
		No. of Copies	No. of weeks	No. of Copies	No. of weeks	No. of Copies	No. of weeks
1.	Data sheets for pumps (To be furnished separately for BHEL & Customer)	-	-	12	2	12	8
2.	Pump performance curves	-	-	12	2	12	8
3.	General Arrangement Drawing of Pump& Turbine/Motor Assembly including foundation details & loading data (static & dynamic)	-	-	12	2	12	8
4.	Electric load & Utility consumption requirements (viz. Cooling water, steam consumption etc)	12	2	-	-	12	8
5.	Pump speed torque curve	12	2	-	-	12	8
6.	Pump CS Drawing with part list	-	-	12	2	12	8
7.	P&ID with part list	-	-	12	2	12	8
8.	Mechanical seal drawing	-	-	12	2	12	8
9.	Coupling Drawing	-	-	12	2	12	8
10.	Strainer Drawing	-	-	12	2	12	8
11.	ARC Valve Data sheet & GA, CS.	-	-	12	2	12	8
12.	Sequential interlocking write-up	-	-	12	2	12	8
13.	Logic diagram	-	-	12	2	12	8
14.	Painting Specification	-	-	12	2	12	8
15.	Allowable forces & Moments	12	2	-	-	12	8
16.	Initial displacement of nozzles	12	2	-	-	12	8
17.	Instrument schedule	12	2	-	-	12	8
18.	Data sheets for instruments	12	2	-	-	12	8
19.	GA & BOM of Local GB.	12	2	-	-	12	8
20.	JB data sheet & wiring drawing	12	2	-	-	12	8
21.	Lubrication Schedule	12	2	-	-	12	8
22.	List of special tools & tackles	12	2	-	-	12	8
23.	LO System drawings like data sheets, GA, P&ID, Instrument data sheets (If applicable)	-	-	12	4	12	8
24.	VMS drawings like BOM, data sheets, housing, wiring etc. (If applicable)	-	-	12	4	12	8
25.	Acoustic hood drawings (If applicable)	-	-	12	4	12	8
26.	Quality Plan	-	-	12	4	12	8
27.	Performance test procedure	-	-	12	4	12	8
28.	Verification, Inspection & Test certificates as per QP of BHEL	-	-	12	24	12	28



TITLE:
**TECHNICAL SPECIFICATION FOR
SPECIAL PROCESS HORIZONTAL PUMPS**

DATASHEET C

SPECIFICATION NO. PE-TS-353-100-N001

VOLUME II B

SECTION D

REV. NO. 0 **DATE 10.07.2010**

SHEET 3 OF 3

29.	O & M Manuals	-	-	2	24	12	28
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NOTES:

1. All drawings & documents shall be submitted in both hard & soft copy.
2. All Drawings & Documents shall be made available in soft copy in a CD along with O & M manuals.
3. Purchaser's review shall not relieve the contractor of his obligations to meet specifications, Applicable codes and standards