



**Engineering works for Standby SRU (525 TPD) Train of IOCL, Paradip  
Refinery Project**

**Pump - Cent. Vert. (Molten Sulphur)**

**(Document No : B366-088-PA-MR-5002)**



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# MATERIAL REQUISITION (TOP SHEET)

**ITEM DESCRIPTION:** PUMP-CENT. VERT. (MOLTEN SULPHUR); Group Item Code: 04BE

**GROUP ITEM CODE:** **DESTINATION:** As per Commercial Documents

**MR CATEGORY:** II **DELIVERY PERIOD:** As per Commercial Documents

## DOCUMENT NUMBER

( Always quote the Document Number given below as reference )

<b>B366</b>	<b>088</b>	<b>PA</b>	<b>MR</b>	<b>5002</b>	<b>B</b>	<b>19/04/2021</b>	<b>80</b>	<b>42</b>
JOB NO.	UNIT/ AREA	MAIN COST CENTRE	DOC. CODE	SR. NO.	REV.	DATE	DIVN.	DEPT.
							ORIGINATOR	

## NOTES :

- 1 This page is a record of all the Revisions of this Requisition.
- 2 The nature of the Revision is briefly stated in the "Details" column below, the Requisition in its entirety shall be considered for contractual purposes.
- 3 Vendor shall note the MR category and shall submit his offer in line with the requirements included in attached 'Instructions to Bidders'.

REV.	DATE	BY	CHK.	APPD.	DETAILS
A	06/04/2021	SG	MG	TK	ISSUED FOR BIDS
B	19/04/2021	SG	MG	TK	REVISED & ISSUED FOR BIDS

**This is a system generated approved document and does not require signature.**

## Note:

Bidder to quote in BHEL format price bid only. Refer Annexure-1A,1A-I, 1B, 1B-I, page no 246 to 251. In case, the bidder furnished in any other format, the offer of the bidder may be liable for technical rejection.




**ENGINEERS INDIA LIMITED**  
**NEW DELHI**

**Project:** Standby SRU unit


**Client:** BHEL



SR. NO.	TAG NO/ ITEM CODE/ [ ID. NO. ]	DESCRIPTION	QUANTITY
01.00		Design, engineering, manufacture, procurement of materials and bought out components, assembly at shop, inspection, testing at manufacturer's works, packing & delivery of the following, including supply of all mandatory spares (note-1), commissioning spares (note-2), special tools and tackles (note-3) & documentation as per the enclosed specifications, instructions to vendors, job specification, data sheets etc. and other codes and standards attached or referred.	
➤ 01.01 <sup>A1</sup>	088-P-004 A	DEGASSING PUMPS	1 Nos
➤ 01.02 <sup>A1</sup>	088-P-004 B	DEGASSING PUMPS	1 Nos
➤ 01.03 <sup>A2</sup>	088-P-005 A	SULPHUR PIT PUMPS	1 Nos
➤ 01.04 <sup>A2</sup>	088-P-005 B	SULPHUR PIT PUMPS	1 Nos
02.00		<< DELETED >>	
03.00		<< DELETED >>	
04.00		<< DELETED >>	
05.00		Quotation of Two Years Operation and Maintenance Spares over and above mandatory spares, as per vendor recommendation (note-4).	Lot
06.00		<< DELETED >>	
07.00		<< DELETED >>	
08.00		Supervision of erection & commissioning of items specified in item 1.00 above (note-5).	
➤ 08.01 <sup>A1</sup>	{08}088-P-004 A	For Sr. No. 01.01	1 /diem rate
➤ 08.02 <sup>A1</sup>	{08}088-P-004 B	For Sr. No. 01.02	1 /diem rate
➤ 08.03 <sup>A2</sup>	{08}088-P-005 A	For Sr. No. 01.03	1 /diem rate
➤ 08.04 <sup>A2</sup>	{08}088-P-005 B	For Sr. No. 01.04	1 /diem rate
09.00		Drawings and documents as per attached Vendor Data requirement for all supplies and services covered above in Sr.Nos.1.00 to Sr.No.8.00.	Lot
10.00		<< DELETED >>	
11.00		<< DELETED >>	
12.00		<< DELETED >>	
13.00		<< DELETED >>	
14.00		<< DELETED >>	
15.00		<< DELETED >>	
16.00		<< DELETED >>	
17.00		<< DELETED >>	
18.00		Technical Loading (refer doc. # 080557C-000-JSD-0900-002)	
➤ 18.01 <sup>A1</sup>	{18}088-P-004 A	For Sr. No. 01.01	1 Nos
➤ 18.02 <sup>A1</sup>	{18}088-P-004 B	For Sr. No. 01.02	1 Nos
➤ 18.03 <sup>A2</sup>	{18}088-P-005 A	For Sr. No. 01.03	1 Nos
➤ 18.04 <sup>A2</sup>	{18}088-P-005 B	For Sr. No. 01.04	1 Nos

 <b>ENGINEERS INDIA LIMITED</b> NEW DELHI	<b>Project:</b> Standby SRU unit  <b>Client:</b> BHEL	<b>REQUISITION NO.</b>	<b>REV.</b>
		B366-088-PA-MR-5002	B

SR. NO.	TAG NO/ ITEM CODE/[ ID. NO. ]	DESCRIPTION	QUANTITY
<p>➤ Vendors shall quote prices in EIL Price Schedule except for Sr.No.9.00. Price for documentation is implied to be included in the prices quoted against Sr.No.1.00 to Sr.No.8.00</p> <p>Vendor to note that the numbers given in square '[]' and curly '{}' brackets are not for their use and meant for store purpose only. Items shall be tagged as per main equipment Tag No. only.</p> <p>Note: Bidder to note that,one fixed price is to be quoted for grouped items. The groups of items are identified by A2, A1 where A2 indicates one group and so on. Grouped items shall not be split ordered.</p>			

 <p>ENGINEERS INDIA LIMITED NEW DELHI</p>	<p>Project: Standby SRU unit</p> <p>Client: BHEL</p>	REQUISITION NO.	REV.
		B366-088-PA-MR-5002 Sheet 3 of 4	B

## LIST OF ATTACHMENTS

SL. No.	DOCUMENT TITLE	DOCUMENT NO.	REVISION			
			REV.	REV.	REV.	REV.
			DATE	DATE	DATE	DATE

In case of any subsequent revision of MR or PR, only revised sheets of the attachments listed above shall be issued alongwith the revision.

### GENERAL NOTES:

- Bidders are required to quote mandatory spares: 1 Lot for each grouped item.
- Bidders are required to submit a list of commissioning spares (as recommended by them) along with the offer, which shall be supplied along with the pump package. Any spares consumed over and above the spares supplied along with the pump package, shall be furnished by the bidder at the time of commissioning without any time / cost implication to the purchaser. Any un-used spare(s) shall be retained at purchaser's end without any cost implication. The successful vendor should make available all the commissioning spares required at site at least 4 (four) weeks prior to commissioning.
- Bidders are required to submit a list of special tools and tackles (as recommended by them) along with the offer which shall be supplied along with the pump package. If no special tools / tackles are required for normal operation and maintenance of pump package, the same shall be categorically indicated in the bid.
- Parts or assemblies normally used or consumed on the basis of scheduled maintenance, overhauls, inspections, wear, corrosion, erosion or deterioration in normal service for a period of TWO years beyond the Defect Liability Period as recommended by manufacturers of various equipment (other than commissioning and mandatory required during the Defect Liability Period). Vendors will be requested to quote for their recommended two years' operation and maintenance spares but these spares will not be considered for price evaluation.
- Bidder shall provide his services for supervision during erection & commissioning of the pump packages. Supervisory cost of 5 mandays per pump package shall be considered for purpose of commercial comparison (which the bidder may decide between days for discipline wise). Per diem rates, as quoted by the bidder, shall be the basis of payment, however the actual payment for supervision services shall be based on the actual mandays consumed at site.



**ENGINEERS INDIA LIMITED**  
NEW DELHI

**Project:** Standby SRU unit  
**Client:** BHEL

**REQUISITION NO.**

**B366-088-PA-MR-5002**

Sheet 4 of 4

**REV.**

**B**

## **SPECIAL INSTRUCTION TO BIDDERS CENTRIFUGAL PUMPS VERTICAL (MOLTEN SULPHUR)**

**PROJECT : 525 TPD STANDBY SRU PROJECT**  
**UNIT : SRU**  
**CLIENT : M/s INDIAN OIL CORPORATION LTD (IOCL)**  
**CONSULTANT : M/s ENGINEERS INDIA LTD.**  
**JOB NO. : B366**

A	01.04.2021	Issued with MR	SG	MG	TK
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

## 1.0 SCOPE

This document is intended to outline the procedures envisaged for execution of this enquiry including pre-bid & in-bid requirements.

## 2.0 SPECIAL REQUIREMENTS

2.1 This bid is intended to be without any deviations to enquiry specifications & bid evaluation will be preferred to be carried out "WITHOUT ANY POST-BID CORRESPONDENCE". Bidders must follow the following guidelines to achieve the same. Offers submitted with deviations (other than deviations which are agreed during pre-bid stage and/or technically infeasible deviations) or incomplete offers may be liable for rejection.

### 2.2 PRE-BID STAGE:

- i) Bidder's deviations / clarifications to data sheets/specifications / referred codes and standards, if any shall be discussed / finalized during the pre bid. Hence, bidder shall submit the same during pre-bid stage.
- ii) Bidder to note that only technically infeasible deviations shall be discussed during **PRE-BID STAGE** provided a suitable justification for the same is furnished. Purchaser's decision on such deviations shall be treated as **FINAL**. Deviations, which can be complied either with extra cost and or with time implications, shall not be permitted. It is in Bidder's interest to ensure that all technical deviations are sorted out in the pre-bid meeting stage only.
- iii) In case the parameters and/or scope of certain item(s) included in the MR get revised due to revision in process requirements or discussion during pre-bid meeting and/or any other reasons, an amendment / revised MR (clearly identifying the changes) shall be issued.

### 2.3 In-Bid requirement:

- i) Vendor shall necessarily furnish the following along with the bid without which the offer shall be considered incomplete and may be rejected.
  - (a) Dully filled & signed / stamped Technical Compliance Statement
  - (b) Mechanical datasheet & performance curve for each pump item in the format attached elsewhere in the enquiry document
  - (c) Signed & Stamped Scope of supply / Works
  - (d) Dully filled-in Experience Record Proforma for each pump item in the format attached elsewhere in the enquiry document
  - (e) Filled in Un-Priced priced schedule format without any alteration/comments/clarifications. The Mandatory spares, Commissioning spares and Special tools & Tackles shall be a part of base price
  - (f) List of Mandatory Spares, Commissioning Spares, and Special Tools & Tackles.
  - (g) Un-priced List of 2 years spare parts for normal operation and maintenance with quotations.
  - (h) Clarifications / deviations finalised during Pre bid stage. In principle no deviation to scope & technical requirements is acceptable. However, bidder may list only deviations to applicable codes that are specific to their design & cannot be withdrawn at any cost/time. These deviations shall be reviewed by purchaser during evaluation & Purchaser's decision shall be final in this regard.
  - (i) Bidder shall furnish in the offer, the maximum maintenance weight and minimum hook height required for the maintenance purpose so as to enable Purchaser to fix the capacity of maintenance facility, Equipment GA Drawing (Tentative)/ Preliminary Layout (Tentative) & Utilities requirements (Tentative).

## SCOPE OF SUPPLY/ WORK FOR CENTRIFUGAL PUMPS VERTICAL (MOLTEN SULPHUR)

**PROJECT** : 525 TPD STANDBY SRU PROJECT

**UNIT** : SRU

**CLIENT** : M/s INDIAN OIL CORPORATION LTD (IOCL)

**CONSULTANT** : M/s ENGINEERS INDIA LTD.

**JOB NO.** : B366

B	15.04.2021	Revised & Issued with MR	SG	MG	TK
A	01.04.2021	Issued with MR	SG	MG	TK
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

- ❖ Bidder shall furnish all equipment, drivers, auxiliary systems, instruments and controls and safety devices as per the enquiry document. Anything required over and above that is specified, for safe and satisfactory operation of the pump package shall be included by the bidder's in his scope without any cost /time implications to purchaser and mentioned in additional sheets attached to this list in the bidder's proposal.
- ❖ Bidder's scope of supply shall include but not be limited to the following for **each** pump package included in MR:

Sr. No.	Description	Specified by Purchaser & Included in Bidder's scope (Yes/No)	Remarks
<b>A</b>	<b>ROTATING</b>		
A.1	<b>PUMP</b> (Refer process datasheet, mechanical data sheets and specs. for full details)		
A.1.1	Centrifugal Pump (mounting plate, steam jackets, column pieces, steam piping & fittings) with electric motor driver complete with the following:	Yes	Type : As specified in Process datasheet & Mechanical datasheet
A.1.2	Packing for shaft sealing as per requirements specified in the MR	Yes	
A.1.3	Couplings (non-lubricated type), spacers and non-spark guards	Yes	
A.1.4	Suction Strainer at Pump suction	Yes	As per specifications of PDS & MDS
A.1.5	Cooling Water Plans including all piping and fittings.	Yes	As applicable
A.1.6	Matching companion flanges, gaskets, bolts & nuts etc. at all terminating points requiring purchaser's interface.	Yes	(For non-standard sizes/ratings)
A.1.7	All associated auxiliary piping etc., prefabricated and duly mounted on the equipment/base-plate	Yes	
A.1.8	Mounting plate	Yes	
A.1.9	FO' in corresponding pump MCF line Tag Nos.: FO-0206 & FO-0209.	Yes	Loose Supply; Refer P&ID enclosed elsewhere
<b>B</b>	<b>ELECTRICAL</b> (Refer doc. # B366-088-16-50-SP-5002)		
<b>C</b>	<b>INSTRUMENTATION</b> (Refer doc. # B366-088-16-51-SP-1005)		
<b>D</b>	<b>Spares &amp; Tools/Tackles</b> Spares for the pump package including Rotating, Electrical, Instrumentation etc		
D.1	Mandatory spares, as specified elsewhere in the enquiry document	Yes	Part of Base Price
D.2	Commissioning spares as recommended by the equipment manufacturer.	Yes	Part of Base Price
D.3	Special tools and tackles required, if any, for erection, site assembly and maintenance of each equipment of Pump package as recommended by the equipment manufacturer	Yes	Part of Base Price
D.4	Quote for vendor recommended 2 years spares parts for normal operation & maintenance for mechanical (i.e. equipment), electrical (as specified), instrumentation items ((as specified)	Yes	
<b>E</b>	<b>Inspection &amp; testing:</b>		
E.1	Shop inspection and Testing:		
E.1.1	Inspection and testing of pump package as specified in the enquiry document	Yes	
E.3	Other Shop inspection and Testing for all items under bidder's scope of supply, as specified in the inquiry document	Yes	
<b>F</b>	<b>Vendor Data &amp; Drawings</b>		
F.1	All data & drawings as specified in the enquiry document	Yes	
<b>G</b>	<b>Erection, Site testing &amp; Commissioning</b>		
G.1	Supervision of erection & commissioning for complete pump package	Yes	Per diem rate (Supervision shall be

FO with Companion Flanges

Sr. No.	Description	Specified by Purchaser & Included in Bidder's scope (Yes/No)	Remarks
			provided considering presence of Original Equipment Manufacturer (OEM) i.e. motor manufacturer in case of main motors including supply of all specialised tools & tackles / instruments required for above service.
<b>H</b>	<b>Miscellaneous</b>		
H.1	All Foundation / Anchor Bolts	<b>Yes</b>	
H.2	Additional items (including mechanical, electrical and instrumentation & controls) not specified by Purchaser but recommended by vendor for safe, smooth and efficient operation of complete Pump Train	<b>Yes</b>	Same shall be included in the base price. (Bidder to furnish separate list of such items in his proposal)



## LIST OF MANDATORY SPARES CENTRIFUGAL PUMPS VERTICAL (MOLTEN SULPHUR)

**PROJECT** : 525 TPD STANDBY SRU PROJECT

**UNIT** : SRU

**CLIENT** : M/s INDIAN OIL CORPORATION LTD (IOCL)

**CONSULTANT** : M/s ENGINEERS INDIA LTD.

**JOB NO.** : B366

For list of mandatory spares, Refer doc. # 080557C-SPL-LSTK1-001, SPARES PHILOSOPHY AND MANDATORY SPARE PARTS LIST attached elsewhere in the MR.



A	01.04.2021	Issued with MR	SG	MG	TK
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**LIST OF MANDATORY SPARES**



SL. NO	PART DESCRIPTION	QTY. REQUIRED BASED ON TOTAL NO. OF PUMPS PER ITEM					
		1	2	3	4	5	6
SPARE PARTS FOR PUMPS							
1.	Set of impellers (Full dia) with wear rings fitted)	1	1	1	1	1	1
2.	Shaft with keys	1	1	1	1	2	2
3.	Set of shaft sleeves	1	1	1	1	2	2
4.	Set of case wear rings	2	3	3	3	4	4
5.	Set of impeller wear ring	2	3	3	3	4	4
6.	Set of throat bushing	1	1	1	1	2	2
7.	Set of throttle bushing	1	1	2	2	2	2
8.	Set of gaskets	3	4	6	6	8	8
9.	Set of labyrinths – as applicable	1	1	1	1	2	2
10.	Set of oil seals – as applicable	2	2	2	2	4	4
11.	Set of constant level oiler	1	1	1	1	2	2
12.	Set of deflectors	1	1	1	1	2	2
13.	Impeller nut	1	2	2	2	2	2
14.	Set of mechanical seals (complete assembly)						
	a. With sleeve and gland plate (for cartridge seal)	1	1	1	1	1	1
	b. Without sleeve and gland plate (for non-cartridge seal)	1	1	1	1	1	1
15.	Set of mechanical seal parts:						
	a. Seal faces (stationary + rotary) *	2	3	3	3	5	5
	b. Secondary seal	2	3	4	5	7	8
	c. Gaskets/O-rings & Packings	2	4	5	5	8	8
	d. Springs and pins, screws	2	2	2	2	3	3
	*For bellow type seal, set of faces shall mean face along with bellow						

SL. NO	PART DESCRIPTION	QTY. REQUIRED BASED ON TOTAL NO. OF PUMPS PER ITEM					
		1	2	3	4	5	6
16.	Set of gland packings	2	3	3	4	4	4
17.	Set of bearing pads (if bearings are tilting pad type)						
	a. Radial bearing pads	1	1	1	1	1	1
	b. Thrust bearing pads	1	1	1	1	1	1
18.	Set of balance drum and balance sleeve insert (if provided)	1	1	1	1	1	1
19.	Set of interstage bushes	1	1	1	1	1	1
20.	Complete coupling (balanced) (only for multi-stage pumps- pumps with more than 2 stages)	1	1	1	1	2	2
21.	Flushing oil cooler in case of Plan 23	1	1	1	1	1	1
SPARE PARTS FOR ELECTRIC MOTORS FOR EACH PUMP TAG							
22.	Set of bearings (DE & NDE both)	1	1	1			
23.	Set of Terminal studs / bushing assembly	1	1	1			
	FLANGES (All flanges including blind flanges)						
24.	Gaskets	200% Extra					
25.	Bolting	10% Extra					
REMARKS:							
1) The word "Set" means the quantity required for full replacement of that part in one machine.							
2) Spare parts shall be identical in all respects to the parts fitted on the main equipment, including dimensions, material of construction and Heat treatment.							
3) Mandatory spares shall be supplied to Owner. These spares shall not be used during construction, erection or commissioning.							
4) Prices of Mandatory spares shall be included in the quoted price.							
5) Minor parts like fastening screws for wear rings, springs, washers etc. for impeller nut, retaining rings, lock washers etc. for bearings, and similar other parts shall be considered to be included along with the main part and hence not listed separately.							



Also refer doc. # 080557C-SPL-LSTK1-001 attached elsewhere in the MR.

 IndianOil	<p>IOCL PARADIP REFINERY</p> <p>SPARES PHILOSOPHY &amp; MANDATORY SPARE PARTS LIST FOR STANDBY SRU</p>	
Document no: 080557C-SPL-LSTK1-001	Rev: A	Page 1 of 37
Bidding Document Reference: 080557C/T/SRU/LSTK-1		

## SPARES PHILOSOPHY AND MANDATORY SPARE PARTS LIST

 IndianOil	<p>IOCL PARADIP REFINERY</p> <p>SPARES PHILOSOPHY &amp; MANDATORY SPARE PARTS LIST FOR STANDBY SRU</p>	
Document no: 080557C-SPL-LSTK1-001	Rev: A	Page 2 of 37
Bidding Document Reference: 080557C/T/SRU/LSTK-1		

## SPARES PHILOSPHY

 <b>IndianOil</b>	<b>IOCL PARADIP REFINERY</b>  <b>SPARES PHILOSOPHY &amp; MANDATORY SPARE PARTS LIST FOR STANDBY SRU</b>	
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## 1. CATEGORY OF SPARES:

**1.1 Commissioning Spares** - Spare parts needed to adequately cover the requirements of ~~day to day maintenance~~ and any premature failures during the period of pre-commissioning, commissioning and trial run operations.



Commissioning spares are recommended by Vendors, or requested in Material Requisitions as per experience of Owner/Consultant. The Material Requisitions shall include requirement of Commissioning spares and the same shall be procured along with main equipment / items. The price of supply shall be deemed to be inclusive of the provision of all such commissioning spares required till successful commissioning of the UNIT. The CONTRACTOR / VENDOR should make available all the commissioning spares required at site at least 4 (four) weeks prior to commissioning. Any un-used commissioning spares shall be handed over to OWNER.

**1.2 Mandatory Spare Parts** – Parts of equipment / systems/items that will be required for replacement where failure of which will be critical for continuous safe operation of the plant. The ITB / Material Requisitions shall include all Mandatory Spare Parts and clearly indicate the quantity required. These mandatory spares shall be procured along with main equipment/ systems/ items. Above-mentioned mandatory spares list defines the minimum requirement. Additional items as recommended by manufacturer if any shall also be considered.

**1.3 Two Years spares (O & M Spares)** - Parts or assemblies normally used or consumed on the basis of scheduled maintenance, overhauls, inspections, wear, corrosion, erosion or deterioration in normal service for a period of TWO years beyond the Defect Liability Period as recommended by manufacturers of various equipment (other than commissioning and mandatory required during the Defect Liability Period). Vendors will be requested to quote for their recommended two years' operation and maintenance spares but these spares will not be considered for price evaluation.

These will be selected and ordered by IOCL separately. Broad Guidelines for selection of the same include:

- Key operation and safety functions of the equipment.
- Current delivery time and transportation time to site of items not stocked.
- Possibility of damage during installation and commissioning.
- Expected normal wear and tear during first TWO years of operation.
- Service interval stated by Manufacturers maintenance policy.

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- Possible repair/exchange items.

## **2. SCOPE OF SUPPLY:**

### **2.1. COMMISSIONING SPARES**



The LSTK CONTRACTOR shall procure and supply all spare parts required during pre-commissioning and commissioning of the UNIT and various systems. The price of supply shall be deemed to be inclusive of the provision of all such commissioning spares required till successful commissioning of the UNIT. The LSTK CONTRACTOR should make available all the commissioning spares required at site at least 4 (four) weeks prior to commissioning. Any un-used commissioning spares shall be handed over to OWNER.

### **2.2. MANDATORY SPARES**

The LSTK CONTRACTOR shall within the Lumpsum Price supply all the mandatory spares as specified in ITB. The handing over of the spares will be followed through SAP system and the templates against individual category of items shall be duly filled in by the CONTRACTOR including price for each item before handing over the mandatory spares to OWNER. Methodology / Modalities to be followed for handing over of spares as per SAP system shall be provided by OWNER during Kick of Meeting.

### **2.3 TWO YEARS SPARES (O & M SPARES)**

- The LSTK CONTRACTOR shall, within 3 (three) months of finalization of all the suppliers, furnish to the PMC/ OWNER the price list for O & M spares for 2 (two) years operation beyond the Defect Liability Period as recommended by manufacturers of various equipment (other than commissioning, mandatory and O&M spares required during the Defect Liability Period).
- O & M Spares required for the uninterrupted operation of the Plant during the Defect Liability period shall be considered by LSTK CONTRACTOR. The cost of the spares shall be included in the scope of LSTK CONTRACTOR
- Price lists of these spares are intended for information purpose only and shall not be included in quoted Lumpsum Price



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### 3.2 MECHANICAL ROTARY



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SL. NO	PART DESCRIPTION	QTY. REQUIRED BASED ON TOTAL NO. OF PUMPS PER ITEM					
		1	2	3	4	5	6
	<b>SPARE PARTS FOR PUMPS</b>						
1.	Set of impellers (Full dia) with wear rings fitted)	1	1	1	1	1	1
2.	Shaft with keys	1	1	1	1	2	2
3.	Set of shaft sleeves	1	1	1	1	2	2
4.	Set of case wear rings	2	3	3	3	4	4
5.	Set of impeller wear ring	2	3	3	3	4	4
6.	Set of throat bushing	1	1	1	1	2	2
7.	Set of throttle bushing	1	1	2	2	2	2
8.	Set of gaskets	3	4	6	6	8	8
9.	Set of labyrinths – as applicable	1	1	1	1	2	2
10.	Set of oil seals – as applicable	2	2	2	2	4	4
11.	Set of constant level oiler	1	1	1	1	2	2
12.	Set of deflectors	1	1	1	1	2	2
13.	Impeller nut	1	2	2	2	2	2
14.	Set of mechanical seals (complete assembly)						
	a. With sleeve and gland plate (for cartridge seal)	1	1	1	1	1	1
	b. Without sleeve and gland plate (for non-cartridge seal)	1	1	1	1	1	1
15.	Set of mechanical seal parts:						
	a. Seal faces (stationary + rotary) *	2	3	3	3	5	5
	b. Secondary seal	2	3	4	5	7	8
	c. Gaskets/O-rings & Packings	2	4	5	5	8	8
	d. Springs and pins, screws	2	2	2	2	3	3
	*For bellow type seal, set of faces shall mean face along with bellow						

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SL. NO.	PART DESCRIPTION	QTY. REQUIRED BASED ON TOTAL NO. OF PUMPS PER ITEM					
		1	2	3	4	5	6
16.	Set of gland packings	2	3	3	4	4	4
17.	Set of bearing pads (if bearings are tilting pad type)						
	a. Radial bearing pads	1	1	1	1	1	1
	b. Thrust bearing pads	1	1	1	1	1	1
18.	Set of balance drum and balance sleeve insert (if provided)	1	1	1	1	1	1
19.	Set of interstage bushes	1	1	1	1	1	1
20.	Complete coupling (balanced) (only for multi-stage pumps- pumps with more than 2 stages)	1	1	1	1	2	2
21.	Flushing oil cooler in case of Plan 23	1	1	1	1	1	1
<b>SPARE PARTS FOR ELECTRIC MOTORS FOR EACH PUMP TAG</b>							
22.	Set of bearings (DE & NDE both)	1	1	1			
23.	Set of Terminal studs / bushing assembly	1	1	1			
	<b>FLANGES (All flanges including blind flanges)</b>						
24.	Gaskets	200% Extra					
25.	Bolting	10% Extra					

- REMARKS:**
- 1) The word **“Set”** means the quantity required for full replacement of that part in one machine.
  - 2) Spare parts shall be identical in all respects to the parts fitted on the main equipment, including dimensions, material of construction and Heat treatment.
  - 3) Mandatory spares shall be supplied to Owner. These spares shall not be used during construction, erection or commissioning.
  - 4) Prices of Mandatory spares shall be included in the quoted price.
  - 5) Minor parts like fastening screws for wear rings, springs, washers etc. for impeller nut, retaining rings, lock washers etc. for bearings, and similar other parts shall be considered to be included along with the main part and hence not listed separately.



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### 3.6 ELECTRICAL

Sr. No.	DESCRIPTION	QUANTITY
<b>1</b>	<b>Air Insulated switchgear (6.6 kV)</b>	<b>One set of spares for each switchgear</b>
1.1	Vacuum bottles	3 nos. of each type and rating
1.2	Closing coil	1 no. of each rating / type
1.3	Tripping coil	1 no. of each rating / type
1.4	Control fuses / MCB	10 nos. of each rating and type
1.5	Indication lamps covers	3 nos. of each colour
1.6	Indication lamps	20% or 3 nos. (min) - whichever is more
1.7	Pre-selection key for three position switch	1 no.
1.8	Network switches	20% of offered quantity
1.9	Protection relays	20% of offered quantity
1.10	Auxiliary relays	20% of offered quantity
1.11	CTs each type	3 nos. each
1.12	PTs each type	3 nos. each
1.13	Ammeter and volt meter	20% of offered quantity
<b>2</b>	<b>MV Switchboards - 415V (PMCC / EPMCC / MCC / EMCC / ASB / MLDB etc.)</b>	<b>One set of spares for each switchgear</b>
2.1	Closing coil	1 no. of each rating / type
2.2	Tripping coil	1 no. of each rating / type
2.3	Contactors	1 no. of each rating / type
2.4	Control transformer	20% of offered quantity
2.5	Control fuses / MCB	10 nos. of each rating and type
2.6	Indication lamps covers	3 nos. of each colour
2.7	Indication lamps	20% or 3 nos. (min) - whichever is more
2.8	Pre-selection key for three position switch	1 no.

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Sr. No.	DESCRIPTION	QUANTITY
2.9	Network switches	20% of offered quantity
2.10	Protection relays	20% of offered quantity
2.11	Auxiliary relays	20% of offered quantity
2.12	CTs each type	3 nos. each
2.13	PTs each type	3 nos. each
2.14	Ammeter and volt meter	2 nos. each
<b>3</b>	<b>PMS/ Data concentrator panel / HMI</b>	
3.1	All cards such as input & output cards, power supply cards, processor cards etc.	1 no. of each type
3.2	Ethernet switches	1 no. of each type
3.3	Control fuses / MCB	10 nos. of each type and rating
3.4	Interposing relays (if applicable)	5 nos. of each type
3.5	Transducers (if applicable)	20% of estimated quantity of each type or 1 no. (min) of each make & type - whichever is more
<b>4</b>	<b>HV Induction motors</b>	<b>One set of spares for each type and rating of motor</b>
4.1	Bearing set (DE & NDE both)	1 set
4.2	Terminal studs / bushing assembly	1 set of each type
<b>5</b>	<b>MV Induction motors (&gt; 37kW)</b>	<b>One set of spares for each type and rating of motor</b>
5.1	Bearing set (DE & NDE both)	1 set
5.2	Terminal studs / bushing assembly	1 set of each type
<b>6</b>	<b>UPS</b>	<b>One set of spares for each UPS System</b>
6.1	Thyristors/ Transistors / IGBT / Diode	1 no. of each type and rating
6.2	Control cards	1 no. of each type
6.3	Power supply cards	1 no. of each type and rating
6.4	Control fuses / MCB	20% or 1 no. (min) of each type and rating whichever is more

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Sr. No.	DESCRIPTION	QUANTITY
6.5	Power fuses / MCB	20% or 1 no. (min) of each type and rating - whichever is more
6.6	Indication lamp covers	3 nos. of each colour
6.7	Indication lamps	10% or 3 nos. (min) - whichever is more
6.8	Panel cooling fans	1 no. each rating
<b>7</b>	<b>Thyristor control panels for heaters</b>	<b>One set of spares for each panel</b>
7.1	Thyristors / transistors / IGBT/ Diode	1 no. of each type and rating
7.2	Control cards	1 no. of each type
7.3	Power supply card	1 no. of each type and rating
7.4	Control fuses / MCB	20% or 1 no. (min) of each type and rating - whichever is more
7.5	Power fuses / MCB	20% or 1 no. (min) of each type and rating - whichever is more
7.6	Indication lamp covers	3 nos. of each colour
7.7	Indication lamps	10% or 3 nos. (min) - whichever is more
7.8	Blocker diode	2 nos. of each type and rating
7.9	Contactors	10% of each type or 1 no. (min) of each rating / type – whichever is more
<b>8</b>	<b>Battery</b>	
8.1	Complete cell assembly	3 nos. of each type and rating



**REMARKS:**

1. Type-means the make, model no., type, size/length, rating, material as applicable.
2. Wherever % is identified, contractor shall supply next rounded figure.



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### 3.7 INSTRUMENTAION

Sr. No.	Description	QUANTITY
1	FIELD INSTRUMENTS	
1.1	Pressure Gauges, Differential pressure Gauge (Normal, Diaphragm type, Capillary type, Seal type)	20% (Subject to min. of 2) of each type, range, material of construction and rating.
1.2	Draft Gauges	20% (subject to minimum of 2) of each range of Draft gauge.
1.3	Temperature Gauges (Normal as well as Capillary)	20% (Subject to min. of 2) of each type, range of Temperature Gauges.
1.4	Level Gauges	A) For transparent gauges, 20% of illuminators with holder and reflector and 50% of bulbs
		B) In case of magnetic type level gauges, 20% of bi-color rollers for each gauge to be provided in addition to above.
		C) 20% subject to minimum two number of glass of each type, size along with pair of Gaskets (Cushion & Wet Gaskets ),
1.5	SMART (4-20mA & FF) Transmitters for Pressure, Flow (DP), Level(DP), Differential pressure(DP) and Temperature	10% (subject to minimum of 1) of each type, range, make and material of construction.
1.6	Valve manifolds	10% (subject to minimum of 1) of each type, size and material of construction.
1.7	Displacer Type Level Transmitters	a) Displacer and chain for each transmitters- 10% (subject to minimum of 1)
		b) 10% (subject to minimum of 1) of Head assembly (including electronics, torque tube, pull rod, gasket spindle for mechanical zero adjustment) for each type, range and make.
1.8	Servo Type Level Gauges	A) 10% or minimum one number of each type of electronic card
		B) 10% or minimum one number of each type of displacer.



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		C) 10% or minimum one number of local indicators.
1.9	Radar Level Gauges	A) 10% or minimum one number probe / antenna for each level instrument
		B) 10 % or minimum one number of electronic card of each type
		C) 2 number fuses against each instrument
1.10	Capacitance/RF type instruments	10% or minimum one number of each type of electronic cards of each type.
1.11	Temperature Element: Thermocouple	20% (subject to minimum of 2) of each type, range, length of Thermocouple with Thermo well.
1.12	RTDs	20% (subject to minimum of 2) of each length of RTD with Thermowell.
1.13	Skin & flexible and multipoint bed thermocouples, Heater skin thermocouples	10% (subject to minimum of 1) of each length & type of skin Thermocouple.
1.14	Ceramic Thermowell	10% (subject to minimum of 1) of each length & type, range
1.15	Ultrasonic Flow Meter	A) 10% or minimum one number for each type of transmitter, receiver, sensor
		B) 10 % or minimum one number of electronic card of each type
		C) 1 set of fuse against each instrument
1.16	Variable Area Flowmeter (Rotameters)	20% or minimum one no. (Complete set) for each type, size, rating and material.
1.17	Averaging Pitot Tube	10% or minimum one number for each type of Gasket, O-ring, Packing for Retract Mechanism and one no. Needle valve with each pitot tube.
1.18	Mass Flow Meter (Coriolis)	A) Power fuses 1 set of fuse for each meter
		B) 10 % of Sensor Assembly or minimum 1 one of each type.
		C) 10% or minimum one number of each type of Electronic transmitter including display assembly.



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1.19	Vortex Flow Meter and Magnetic Flow meter	A) One set of gasket and Packing for each type and Size
		B) 10% or minimum one number of each type of electronic cards
1.20	Nucleonic Level Instrument	10% or minimum one number of each type of cards for source, detector and converter.
1.21	Copper tube	10% of installed quantity of each size.
1.22	SS tube & SS tube fittings	10% of installed quantity of each size
1.23	Instrument Signal Cable (single pair/triad & multi pair/triad)	10% of installed quantity of each type and size
1.24	Thermocouple extension cable	10% of installed quantity of each type and size
1.25	Control cable and power cable	10% of installed quantity of each type and size
1.26	Optic Fibre Cable (6, 12, 24 Fibre)	10% of installed quantity of each type and size.
1.27	Earthing Cable	10% of installed quantity of each type and size.
1.28	Terminal blocks	10% of installed quantity of each size
1.29	Steam Trap	10% of installed quantity of each size
1.30	I/P Converter	10% of installed quantity
1.31	Fittings, Lugs, Nipples, Sockets, blinds, Unions	10% of installed quantity of each type and size
1.32	½", ¾", 1 " Valves used for instruments (Ball, Needle, Gate, Globe )	10% of installed quantity of each type
1.33	Mass Flow Meter (Thermal)	10% or minimum one number of sensor and electronics
1.34	Guided wave Radar Level Instrument	10% or minimum one number of full set of transmitter
1.35	Junction Box	10% or minimum one number of each type and size
1.36	Meter run	10 % for each type of fittings.
1.37	Turbine, Magnetic Flow meter	A) One set of gasket and Packing for each type and Size
		B) 10% or minimum one number of each type of electronic cards





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1.38	Target Flow Meter	10% or minimum one number of sensor and electronics
2	IN-LINE INSTRUMENTS	
2.1	Control Valves	<p>A) 10 % or minimum 1 nos of each type, size, rating of Trim set consisting of seat, seat ring, seal ring, plug with stem, cage (wherever applicable)</p> <p>B) 20% (subject to minimum of 2) of Positioners (Smart 4-20mA) with links of each type and make.</p> <p>C) 20% (subject to minimum of 2) of Diaphragm of each type</p> <p>D) 20% (subject to minimum of 2) of Air filter regulators of each make,</p> <p>E) 10% (subject to minimum of 1) of Bonnet, Gaskets, gland packings, piston O-rings, bearing &amp; liner (of butter-fly valves) for all types of valves.</p> <p>F) 10% (subject to minimum of 1) of any special accessories provided along with the control valve like boosters, position transmitters (wherever applicable), proximity switches, I/P converters, O rings of Piston actuators etc.</p>
2.2	Shutdown Valves / On-Off Valves	<p>A) 20% (subject to minimum of 2) of Air filter regulators,</p> <p>B) 10 % or minimum 1 no. of each type, size, rating of Trim set consisting of seat, seat ring / seal ring, ball/ disc with stem.</p> <p>C) 10% (subject to minimum of One number) of Seal kit consisting of O rings, gaskets, gland packing etc. against each type, size and rating of valve.</p> <p>D) 20% (subject to minimum of 1) of proximity switches,</p> <p>E) 20% (subject to minimum of 2) of solenoid valves of each type,</p>

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		F) 10% (subject to minimum of 1) of each of accessories like quick exhaust valves, volume boosters and temperature dependent fuses, O rings of Actuators etc.
2.3	Pressure control Valve (Self actuating valve)	<p>A) One number of Repair kit consisting of orifice, plug, spring, gasket, diaphragm, O-ring for each valve.</p> <p>B) 20 % or minimum 2 nos of each type, size, rating etc. of Trim set consisting of seat, seat ring / seal ring, plug with stem, cage (wherever applicable), packing material for each valve to be provided as spare.</p> <p>C) 10% (subject to minimum of 1) of accessories like quick exhaust valves and temperature dependent fuses, O rings of Actuators etc.</p>
2.4	PRDS & De-superheater unit	<p>A) 20% (subject to minimum of 2) of Positioners (Smart 4-20mA, FF) with links of each type and make.</p> <p>B) 20% (subject to minimum of 2) of Diaphragm of each type,</p> <p>C) 20% (subject to minimum of 2) of Air filter regulators of each type, make,</p> <p>D) 10% (subject to minimum of 1) of Bonnet Gaskets, gland packings, piston O-rings.</p> <p>E) 10% (subject to minimum of 1) of any special accessories provided along with the control valve like boosters, position transmitters (wherever applicable), proximity switches, I/P converters etc.</p> <p>F) 10 % or minimum 1 nos of each type, size, rating of Trim set consisting of seat, seat ring / seal ring, plug with stem, cage (wherever applicable)</p>
2.5	Butterfly valves	<p>a) 20% or minimum two set of actuator seal kits</p> <p>b) Same as that of Control valve</p>

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2.6	Saunder's Valves	20% or minimum two numbers of bottom body diaphragm
		20% (subject to minimum of 2) of Actuator diaphragms of Saunder valve of each type, size used.
2.7	Motor Operated Valves(MOVs)	A) 10 % or minimum 1 no. of each type, size, rating of Trim set consisting of seat, seat ring / seal ring, wedge/ disc with stem.  B) 10% or minimum 1 no. of electronic card for actuator.  C) 10% (subject to minimum 1 no.) of gland packing, O-rings, bearing, bonnet gaskets for each type, size and rating of valve.  D) 10% or minimum 1 no. of maintenance kit for each type, size and KW rating of motorized actuator.
2.9	Safety Relief Valves	10%(subject to minimum 1 no.) of disc for identical valves  10%(subject to minimum 1 no.) of spring for identical valves  10%(subject to minimum 1 no.) of gasket set for identical valves  20%(subject to minimum 1 no.) of expansion bellows for identical valves (Only for balanced bellows type)  10%(subject to minimum 1 no.) of Soft Good Kit for identical Main valves and Pilot Valves (Only for pilot operated type)
2.10	Rupture Disc	2 Nos. of gaskets and 3 nos. of disc for each tag.
2.11	Orifice Plates	10% or minimum 1 of blind plates of each size, rating, thickness & material of construction.
3	ANALYSERS	General philosophy for each type of Analysers shall be :10% or minimum of one of each type of electronics, display units, power supplies, fuses,

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		<p>gaskets, sensors, sensing elements, detectors, bulbs, Repair kits etc.</p> <p>10% or minimum of one of each component of sample handling system.</p> <p>Above spares philosophy is applicable for other analysers such as Oil in water, Chloride, Iron etc. which are not covered in this document.</p> <p>In addition to above general philosophy, philosophy outlined below for specific analysers shall also be referred.</p>
3.1	O2 Analyser	<p>a) Furnace Assembly – 1</p> <p>b) Thermocouple –1</p> <p>c) Sensor board –1</p> <p>d) Each type/rating of Fuses – 1 set</p> <p>e) Thermistor assembly –1</p> <p>f) Ceramic filter –1</p> <p>g) Processor card – 1</p> <p>h) Power Supply card-1</p> <p>i) Display Board-1</p> <p>j) Cell Replacement kit-1</p> <p>k) Any Other card – 1</p> <p>l) Calibration kit (Regulator for Calibration gas cylinder and calibration rotameter) - One set for each of the units where O2 Analyser is installed.</p>
3.2	Methane Analyser (Infrared )	<p>a) Rings and gasket – 2 set of each type</p> <p>b) Sensor and Detector – 1 no.</p> <p>c) Rotameter – 1no.</p> <p>d) Pressure Control Valve – 1no.</p> <p>e) Fuses – 5 sets</p>

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		f) Electronic card – 1no.
		g) Other Aux. Cards – 1 each
		h) Processor card and other electronic – 1no. Each
3.3	Moisture Analyser	a) Sensor and detector –1 no. b) Electronic card – 1 no. each type c) Fuses – 5 sets d) Flow indicator & switch – 1 no.
3.4	Hydrogen Analyser	a) Rings and gasket – 2 set of each type b) Sensor and Detector – 1 no. with each analyser c) Rotameter – 1no. d) Pressure Control Valve – 1no. e) Each type/rating of Fuses – 5 sets f) Electronic card – 1no. with each analyser g) Other Aux. Cards – 1 each
3.5	H2S Analyser	a) Cadmium lamp – 2 nos. b) Cell window – 2 nos. c) Window gasket – 10 nos. d) Air regulator – 1no. e) Seal kit for ball valve – 4nos. f) Kit-o-ring – 2 sets g) Seal kit, Air act. – 2no. h) Fuse – 5 Set each i) Relay – 1 set each j) Display Board – 1no. with each analyser K) Processor Board – 2no. l) Other Cards – 2each
3.6	CO + CO2 Analyser	a) Fuses – 1 set of each type

 IndianOil	<p>IOCL PARADIP REFINERY</p> <p>SPARES PHILOSOPHY &amp; MANDATORY SPARE PARTS LIST FOR STANDBY SRU</p>	
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		b) Ring – 2 sets of each type c) Mother board –2 nos. d) Filter assembly band pass with guard – 2 no. e) Filter – 1 set of each type f) IR/UV Lamp – 2 nos. g) Other cards – 1 each h) Detector heaters – 1 each
3.7	Sox/Nox Analyser	a) Filter of each type – 2 sets b) Critical orifice – 1 no. c) Vacuum pump / Ejector – 1 no. d) Ring set – 1 no. each e) Processor / Mother board – 2 nos. f) Display board – 2 nos. g) Optical bench – 1 no. h) Filter detector – 2 nos. i) Fuses – 1 set of each type j) Other cards –1 each k) Ozonator –1 l) Cuvette –2 nos m) chopper motor – 1 no. n) Dessican & flow sensor – 1 no. each
3.8	Chromatograph	a) Filter. – 2 sets b) Display Board –1 no. c) Processor Board –1 no. d) Chromatograph Column e) Solenoid valve - 10% subject to minimum of 1 of each type



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		f) Vaporization system if required, which includes vaporizer, thermostat, electrical tracing cable and heater etc. – 1 set
		g) Cooling system if required, which includes one cooler, flow conditioning system etc., - 1 set.
		h) Probe Filter – 2 Nos.
		i) Probe Tube – 2 Nos.
		J) Probe heater & Temp. sensors – 2 nos.
3.9	Sampling systems	<p>Following spares shall be supplied for each type, size and rating of instruments, accessories, systems:</p> <p>Complete sample kit for sample pumps inclusive of 'O'rings, Seal ring, Diaphragm etc. - 1 set</p> <p>Solenoid valve for, more than one stream application -1 no.</p> <p>Flow switch- 1 No.</p> <p>Vaporization system if required, which includes vaporizer, thermostat, electrical tracing cable and heater etc. – 1 set</p> <p>Cooling system if required, which includes one cooler, flow conditioning system etc., - 1 set.</p> <p>Sample/ Air Filter – 2 Nos.</p> <p>Probe Tube – 2 Nos.</p> <p>Probe heater &amp; Temp. sensors – 2 nos.</p> <p>Y strainer-1 no.</p> <p>Pressure Regulator-1 No.</p> <p>2, 3 way air operated valve- 1 No.</p> <p>Ball/ needle, gate valve -1 No.</p> <p>For other instrument types used in sampling systems, spares philosophy shall be as per this document.</p>



 IndianOil	<p>IOCL PARADIP REFINERY</p> <p>SPARES PHILOSOPHY &amp; MANDATORY SPARE PARTS LIST FOR STANDBY SRU</p>	
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3.10	SILICA ANALYSER	Control module- one
		Display board-10% or minimum one
		Stream selector-10% or minimum one
		Mixing chamber-10% or minimum one
		Bulb-10% or minimum one
		Pressure transmitter-10% or minimum one
		SOVs-10% or minimum 1
		Mirror-10% or minimum one
		Stirrer motor-10% or minimum one
		Cell kit and maintenance kit etc.10% or minimum two sets.
3.11	Dissolved Oxygen Analyser	a) Maintenance Kit-20% or minimum of two sets
3.12	PH & conductivity Analyser	A)10% or minimum two number of each type of sensor
		B)10% or minimum one number of full set of transmitter
3.13	Sulphur Analyser	a) Pyrolyzer Assembly – 1 no.
		b) Thermocouple - 1 no.
		c) Heater Element – 1 no.
		d) Filter – 1 no.
		e) Valve (for sample) – 1 no.
		f) O-rings – 100%
		g) Rotor – 1 no.
		h) UV lamp – 2 nos.
		i) Power supply moduel – 1 no.
4	DCS , PLC and SCADA	These spares are in addition to 20% installed spares and 20% additional space, slots for installation of future requirement. Mandatory spares shall be calculated by vendor as per philosophy outlined below The philosophy shall be applied after taking into account the installed spares.





 <b>IndianOil</b>	<b>IOCL PARADIP REFINERY</b>  <b>SPARES PHILOSOPHY &amp; MANDATORY SPARE PARTS LIST FOR STANDBY SRU</b>	
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		In addition to that 20% spare space shall be considered at I/O level and Marshalling rack.
	A) Modules	<p>10% or minimum two of each hardware/module (including Controller card, IO card, Power supply card, communication cards , Field termination assemblies and any other cards/modules etc) of each type which are being used in DCS, ESD, PLC, GDS, FGS, SOE, AIMS, AMS, DON, UHN and other system oriented items .</p> <p>10 % or minimum two of all components of cabinets like Bulk power supplies(of each rating/make ), Diode Oring units(of each rating/make), Auto transfer switches, barriers, signal converters, Trip amplifiers, auxiliary modules, relays, converters, annunciator cards, fuses, fused terminals, lamps/LEDs, Push buttons, selector switches , IS mV/I Converters, IS RTD/I Converters, Alarm cards (receiver switches) etc. of each type.</p> <p>20% or minimum two of Prefabricated cable Set with connecting plugs for each type and length.</p> <p>10 % or minimum 2 nos. of RS232/485 converters, cables.</p> <p>10 % or minimum 2 nos. of Keyboard, Mouse, Track Balls</p> <p>System Cabinet Air Filter 100%</p> <p>20 % or minimum 2 nos. of Cabinet Cooling Fans of each type.</p> <p>20% or minimum two no. of each type of Fuses, MCBs, Auxiliary relays.</p> <p>10 % or minimum 2 nos. of communication system components such as hubs, switches, routers, etc.</p>
	B) Operator, Engineering console PC, Subsystem PC, Servers, monitors, Printers of each type, make, model.	20% or minimum 2 numbers of latest version to be supplied as spare for each control room

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	C) Firewall & Network switches	20% or minimum 2 numbers of latest version to be supplied as spare for each control room of each type/ model.
	D) Consumables	Consumable including  a) 20% or minimum two no. of each type of Printer cartridges/ Ribbon for all type of printers, Blank CD (RW), Other storage device as applicable (like magnetic cartridge tape, Floppy disc, Hard disk etc)  b) Printer paper for each type of printer : 25 Rims
5	OTHER ITEMS	
5.1	Pulsating dampener, Snubber, Syphon, Gauge Saver, etc.	10% (subject to minimum of 1) of each item used,
5.2	Loop powered indicators	20% (subject to minimum of 2) of Loop powered indicators used,
5.3	Solenoid Valves	20% or minimum 2 nos. of solenoid valves of each type used.
5.4	MCT Block	10% of each type of MCT Block used.
5.5	Panel mounted instruments	10% or minimum one number of each instrument
5.6	Hooter	10% (subject to minimum of 1) for each type
5.7	Beacon	10% (subject to minimum of 1) for each type
5.8	Manual Call Point	10% (subject to minimum of 1) for each type
5.9	Flame Scanner	10% subject to minimum one no. for each type
5.10	Annunciators	Power Supply Module 10% subject to minimum 1 No.of each type
		Tone Generator Card 10% subject minimum 1 No.of each type
		Flasher Module 10% subject to minimum 1 No.of each type

 <b>IndianOil</b>	<b>IOCL PARADIP REFINERY</b>  <b>SPARES PHILOSOPHY &amp; MANDATORY SPARE PARTS LIST FOR STANDBY SRU</b>	
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		I/O Module 10% subject to minimum 1 No.of each type  - Lamps 10%  - Fuses 1 dozen per Annunciator  Hooter –10% or minimum one
5.9	CCTV	Camera with Lens and zoom - 20% (subject to minimum of 2) of each type  Receiver and drive - 20% (subject to minimum of 2) of each type  Keypad including joystick - 20% (subject to minimum of 2) of each type  All type of cards/modules - 20% (subject to minimum of 2) of each type
5.10	Paging and Telephone system	Field Call Station, Master call Station, Loudspeaker, Junction box, Beacon, Acoustic Hoods, telephone set - 20% (subject to minimum of 2) of each type  All type of cards, modules - 20% (subject to minimum of 2) of each type, fuses- 10 nos. of each rating & type.
5.11	Access Control System	All type of cards, modules - 20% (subject to minimum of 2) of each type  Card Reader, Door contact, Lock, Push button, access cards - 20% (subject to minimum of 2) of each type
6	Machine Monitoring System/Condition monitoring system	A) 20 % or minimum 2 nos of each type of probes (vibration, speed, displacement etc.) and transducers, proximeter, extension cables, connector protective sleeves etc.  B) Electronic modules, cards: 10% or minimum 1 no. of each type,  C) portable, offline measurement kits : 1 set of each type used

 <b>IndianOil</b>	<b>IOCL PARADIP REFINERY</b>  <b>SPARES PHILOSOPHY &amp; MANDATORY SPARE PARTS LIST FOR STANDBY SRU</b>	
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		D) monitor units & LCD, LED display unit for local control panel : 10% or minimum 1 no. of each type,
		E) TDxNet cards : 10% or minimum 1 set of each type used
		F) One Calibration kit and one portable, offline measurement kits for vibration probes for each unit wherever vibration probes are installed.
7	Gas detection system	Sensors : 20% or minimum 2 sets of each type.
		Electronic cards, modules, display : 10% or minimum of 1 set of each type used.
8	Fire Detection and Alarm system	Sensors : 20% or minimum 2 sets of each type.
		Electronic cards, modules, display, terminal blocks : 10% or minimum of 1 set of each type used
		Glass for Break Glass Boxes / Manual Call point – 10% of each type
		Fuses , MCB – 10 nos. of each rating & type
9	Custody Transfer metering	Spares for all field instruments including transmitters, Gauges, flow meters, Control/shutdown valves, tubes fittings etc shall be as per philosophy defined in this table. Spares for system components shall be as per philosophy of DCS/PLC and SCADA defined in the table.
10	Weigh Bridges/In motion weigh bridges	20% or minimum 2 of each type of sensors (including Load cells) , each type of electronics( including display , modules for system and operator panel/station etc).
11	Package equipment-Gas Turbine	a) Control room spares in line with that of DCS/PLC  b) Field Instruments like Transmitters, Switches, vibration probes, SOVs, Control valves, analysers, thermocouples etc . in line with field instrument philosophy

 IndianOil	<p>IOCL PARADIP REFINERY</p> <p>SPARES PHILOSOPHY &amp; MANDATORY SPARE PARTS LIST FOR STANDBY SRU</p>	
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12	Package equipment-Compressors (Hydrogen, nitrogen, PSA, Air, others)	a) Control room spares in line with that of DCS/PLC  b) Field Instruments like Transmitters, Switches, condition monitoring, SOVs, Control valves, analysers, thermocouples etc .in line with field instrument philosophy
13	All other package equipments-Air driers or others	a) Control room spares in line with that of DCS/PLC  b) Field instruments like Transmitters, switches, vibration probes, SOVs, Control valves, analysers, thermocouples etc . in line with field instrument philosophy

**REMARKS:**

- Above-mentioned mandatory spares list defines the minimum requirement for each type. Contractor to select applicable to his scope of supply for this unit. Additional items as recommended by manufacturer if any shall also be considered.
- Similar philosophy shall be followed for packaged units and other items not covered in this list.
- Next rounded figure to be considered wherever % is specified. Example: For total 11 Nos. Instruments with 10%> spares basis, 2 Nos. spares shall be provided.
- The word 'TYPE' means the Make, model no., type, range, size/length, rating, material as applicable.
- The terminology used under 'Part Description' is the commonly used name of the part and may vary from manufacturer to manufacturer.
- For all type of analysers and gas chromatographs, calibration cylinders, carrier gas cylinders to be supplied for one year operation after SAT.
- Wherever complete instrument/set is considered as spare, spare quantity shall never exceed ordered/purchased quantity (for example, if ordered quantity is 1 and mandatory spares philosophy is 20% or min 2, in such cases mandatory spares quantity shall be 1 and not 2).

 		PROJECT	Standby SRU & Additional Tanks IOCL Paradip Refinery	
		CLIENT	INDIAN OIL CORPORATION LIMITED	
MECHANICAL DATA SHEET FOR DEGASSING PUMPS	Project No. 080557C001	Document No. 080557C-088-SP-0910-004	Rev. No. C	Page 1 of 2

## SULPHUR RECOVERY UNIT

UNIT : 088

### MECHANICAL DATASHEET FOR DEGASSING PUMPS

TAG NO: 088-P-004 A/B

Reference Document: Process datasheet 080557C-088-PDS-0910-004 Rev B

REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED
C	10-Jun-2020	ISSUED FOR DESIGN	RS	AA	AA	JMC
B	07-Feb-2020	ISSUED FOR DESIGN	MM	RS	AA	JMC
A	29-Nov-2019	ISSUED FOR DESIGN	MM	RS	AA	JMC

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# CENTRIFUGAL PUMP DATASHEET

DATA SHEET No.


080557C-088-SP-0910-004

Sheet: 2 of 2 REV C

Notes	Rev
A) FEED datasheet PDRP4220-8110-PS-086-0004 Rev F1 for Degassing Pumps is attached. See Annexure 1. The notes below are additional requirements / clarifications to the datasheet. General Notes of FW datasheet is replaced by General Notes in Process datasheet 080557C-088-PDS-0910-004 Rev B.	
B) Units 086 & 087 are existing SRU trains 1 & 2 respectively. This datasheet is for new SRU train (unit 088).	
C) The quantity of pumps required for unit 088 is two (2) - 1 running + 1 standby.	
D) Centrifugal pumps shall comply with API 610 - 11th Edition, Job specification 080557C-000-JSS-0910-001 and other project requirements.	
E) Domestic boxing for shipment shall be used in case of indigeneous supply. Export boxing required in case of import.	
F) Manufacturer's standard coating system can be used with the following requirements. - Colour shade (RAL), Paint type & minimum DFT shall be as specified in project specification 080557C-000-JSD-2300-001. - Finish coat for Pump : RAL 5013, Motor : RAL 5021, Baseframe : RAL 7035, for other items refer above mentioned specification	
G) Minimum Submergence test shall be conducted.	
H) Maximum discharge pressure shall be calculated based on the shut-off head for maximum diameter impeller.	
I) Statutory approvals in original such as PESO certification for electrical and instrumentation items shall be furnished.	
J) Minimum requirements of Inspection and Testing shall be as per 080557C-000-ITP-0910-001. Hydrostatic test, Performance test and Minimum Submergence test shall be witnessed.	
K) Contractor / Vendor to confirm the bearing lubrication type.	C
L) Flat surfaces for vibration measurement shall be provided at bearing housings.	
M) Note 8 of Foster Wheeler Process specification is rewritten as follows: Design pressure & temperature for steam jacketing and piping are 7 kg/cm2(a) & 190 deg C respectively. Steam piping / tubing and jackets shall be IBR certified as applicable. Steam piping and jacketing shall be given a hydrostatic test.	
N) Foster Wheeler Notes and Black & Veatch datasheet details about material of construction to be read as follows: Shaft & Shaft sleeve : SS 316/316L with nickel based alloy (COLMONOY No. 6 or equiv.) hard coating at upper stuffing box Casing : Grey cast iron Impeller : Ductile iron Steam piping / tubing material : SS 316 / 316L. Steam jacketed discharge pipe : Galvanized steel Discharge elbow : CS Steam jacketed column pieces : Galvanized steel All fasteners inside the vessel shall be SS 316. Suction strainer : SS 316L Pump support plate : CS	
O) Pit depth is specified in note 7 on page 2 / 4 of Black & Veatch datasheet. There shall be a low point sump below the pump intake nozzle. The pump to be installed inside the low sump. The low point sump shall be sized suitably by LSTK contractor for the selected pump. Pump vendor to furnish minimum submergence required for the pump. Pump shaft length to be finalized by LSTK contractor based on the sump depth, suction strainer, steam coils at the sump bottom, the vertical distance of pump mounting surface from the grade etc. Refer Process datasheet for Sulphur pit 080557C-088-PDS-1700-001.	
P) Pump mounting arrangement shall be designed by LSTK contractor and shall be sealed to prevent leakage of toxic gas from the pit vapor space to the atmosphere and to prevent leakage of air into the pit vapor space. The mounting shall be designed for vibration free operation and the pump shall be easily removable for maintenance.	
Note: The above notes ('A' to 'P') to be followed strictly. The reference of these notes are indicated in the subsequent pages.	

DOCUMENT CATEGORY		DOCUMENT REVIEW STATUS (BY CLIENT)			
(USE "X" MARK)\ <input type="checkbox"/> APPROVAL <input type="checkbox"/> REVIEW <input type="checkbox"/> INFORMATION					
0	18.03.21	ISSUED FOR ENGINEERING	SYD	RK	RK
REV	DATE	DETAILS OF REVISION	PREPARED	CHECKED	APPROVED
CLIENT	 IndianOil	INDIAN OIL CORPORATION LIMITED PARADIP REFINERY PROJECT PARADIP ODISHA			
CONSULTANT		TECHNIP ENERGIES			
PROJECT	525 TPD STANDBY SRU PROJECT IOCL PARADIP REFINERY, ODISHA, INDIA				
ESC					
	BHEL Hyderabad	NAME	SIGN	DATE	
		DRN			
		CHD			
DEPT. PE&SD.	CODE 450	APPD			
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company		<b>TITLE: PROCESS DATASHEET FOR            DEGASSING PUMPS (088-P-004 A/B)</b>			
		<b>BHEL/EIL DRG/DOC NO. B366-088-02-42-DS-1604</b>			
		<b>CUST. DRG/ DOC NO.            080557C-088-PDS-0910-004, REV. B</b>			
		<b>SHT NO. 01</b>			
		<b>NO. OF SHT. 08</b>			
		<b>REV</b>			
		<b>00</b>			



 	<b>PROJECT</b>		<b>Standby SRU &amp; Additional Tanks</b>		
	<b>CLIENT</b>		<b>IOCL Paradip Refinery</b>		
<b>PROCESS DATASHEET FOR PUMP</b>	<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-088-PDS-0910-004		<b>Rev. No.</b> B	Page 1 of 7


## SULPHUR RECOVERY UNIT (SRU) (UNIT 088)

### PROCESS DATASHEET FOR DEGASSING PUMPS (088-P-004 A/B)

B	07-02-2020	ISSUED FOR INFORMATION	SG	LK	AR	JMC
A	26-11-2019	ISSUED FOR INFORMATION	JU	LK	AR	JMC
<b>REV.</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>PREPARED</b>	<b>CHECKED</b>	<b>APPROVED</b>	<b>AUTHORIZED</b>

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 	<b>PROJECT</b>		<b>Standby SRU &amp; Additional Tanks</b>	
	<b>CLIENT</b>		<b>IOCL Paradip Refinery</b>	
<b>PROCESS DATASHEET FOR PUMP</b>	<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-088-PDS-0910-004	<b>Rev. No.</b> B	Page 2 of 7

**GENERAL NOTES:**

- A. The Licensor Basic Design Package for the SRU/TGTU consists of 3 x 50% SRU trains and 2 x 100% TGTU trains. However, at original Sulphur Recovery Unit (SRU) project sanction the redundant units (Units 088 & 090) were deferred.
- B. Indian Oil Corporation Limited (IOCL) intend to install a standby SRU train (Unit 088) of 525 TPD along with Tail Gas Incinerator (Unit 090) at the existing Paradip Refinery.
- C. Unit 088 will, as far as possible, be identical to Units 086 and 087. The equipment specification for Units 086 and 087 has therefore been issued for the same equipment service in Unit 088.
- D. The Basic Design Package (BDP) has been provided by a licensor (Black & Veatch). Bidders/vendors should not communicate with Black & Veatch directly with regard to this enquiry. Any questions or clarifications should be forwarded to Technip India Limited for resolution with the client IOCL. Note that there are specific instances where design details/specifications must be submitted to Black & Veatch for approval.

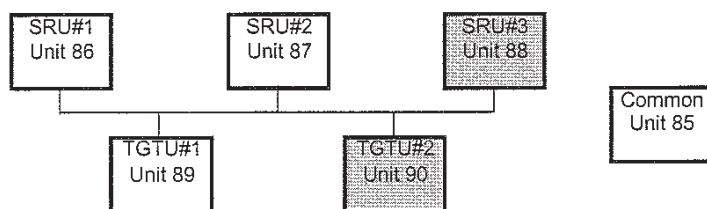
**NOTES SPECIFIC TO THE EQUIPMENT WITHIN THIS SPECIFICATION:**

- T1. Reference to Units 086 and 087 to be read as Unit 088.
- T2. Equipment quantity required is TWO.
- T3. General notes G1, G2, G3 and Notes 1 and 2 in Foster Wheeler Energy Limited's FEED stage coversheet for this equipment shall be ignored. Remaining notes in Foster Wheeler Energy Limited's FEED stage coversheet shall be followed.
- T4. Pump's shaft length shall be confirmed ~~during detailed engineering by LSTK contractor~~ based on final depth of Sulphur pit 088-SU-001.
- T5. The pump shall be installed within the respective low point sumps of Sulphur pit 088-SU-001 so that minimum submergence requirements of the pump are met.

FOSTER WHEELER ENERGY LIMITED					PROCESS SPECIFICATION	
CUSTOMERS NAME: Indian Oil Corporation Ltd (IOCL)					PROJECT No: 1-14-4200	
LOCATION: Paradip, Orissa State, India					UNIT No: SRU#1&2 UNITS : 086 & 087	
SERVICE: DEGASSING PUMPS					ITEM No: 086/087-P-004A/B	No. REQD: 4
					DOCUMENT CAT.-CLASS 1	
REV	O1	F1			DOCUMENT No. PDRP4220-8110-PS-086-0004	
DATE	16-Jul-09	27-Oct-09			SHEET 1	OF 1
ORIG. BY	JMRJ	DJL			DOCUMENT SEQUENCE No. 17792	
APP. BY	SMR	SMR				

**GENERAL NOTES. Note A**

**G1.** The Licensor Basic Design Package for the SRU/TGTU consists of 3 x 50% SRU trains and 2 x 100% TGTU trains. There being a single redundant SRU train and a single redundant TGTU train. However, at project sanction the redundant units (Units 88 & 90) were deferred as shown in grey below.






**G2.** Note that Unit 87 will, as far as possible, be identical to Unit 86. A single specification has therefore been issued to cover like for like equipment on Units 86 & 87.

**G3.** The Basic Design Package (BDP) has been provided by a licensor (Black & Veatch). Bidders/vendors should not communicate with Black & Veatch directly with regard to this enquiry. Any questions or clarifications should be forwarded to Foster Wheeler Energy Ltd for resolution with the client IOCL. Note that there are specific instances where design details/specifications must be submitted to Black & Veatch for approval.

**NOTES SPECIFIC TO THE EQUIPMENT WITHIN THIS SPECIFICATION**

Referring to the attached licensor engineering datasheet the following notes apply, taking precedence over notes stated in the Black and Veatch Specification Sheets

- Reference to unit 088 shall be ignored. **Note B**
- The quantity required is FOUR (Two for each of 086 and 087 Units) **Note C**
- The hazardous area classification is Zone 2 Group IIB Temperature Class T3 (HOLD). OISD STD-113 will be applied. 
- The differential and suction pressures should read 5.5kg/cm2 and -0.027kg/cm2.g respectively and NPSH should read 4.97m 
- The design pressure for cooling water is 8.0 kg/cm2.g not 6.5 kg/cm2.g.
- The maximum and minimum cooling water return pressures are 3.5 kg/cm2.g and 2.5kg/cm2.g respectively.
- Case and impeller material should be Cast Iron.  **Note N**
- The maximum and minimum steam pressures to drivers are 42kg/cm2.g and 38kg/cm2.g respectively. **Note M**

The normal flow & Rated flow mentioned as 12.4 m3/hr & 13.6 m3/hr respectively are the net pump capacity. The actual total capacity of the pump shall be as follows:  
Normal: 12.4 m3/hr + minimum flow of the pump  
Rated: 13.6m3/hr+minimum flow of the pump

[080557C-088-PDS-0910-004]

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PUMP DATASHEET 080557C-088-SP-0910-004 REV C

BLACK & VEATCH  
CENTRIFUGAL PUMP  
PROCESS DATA SHEET

JOB NO. 160796 ITEM NO.(S) 086/087/088-P004 A/B  
REQ / SPEC NO. 1  
PURCH ORDER NO. DATE 5/9/08  
INQUIRY NO. 0 BY VS

1 APPLICABLE TO: ☒ PROPOSALS ☐ PURCHASE ☐ AS BUILT

2 FOR Indian Oil Corporation Limited (IOCL) UNIT Sulfur Recovery Units 086, 087, 088 Note 1

3 SITE Paradip, Orissa, India SERVICE Degassing Pumps

5 NOTES: INFORMATION BELOW TO BE COMPLETED: ☐ BY PURCHASER ☐ BY MANUFACTURER ☐ BY MANUFACTURER OR PURCHASER

6 ☐ DATA SHEETS (6.1.1) REVISIONS

	ITEM NO.	ATTACHED	ITEM NO.	ATTACHED	ITEM NO.	ATTACHED	NO.	DATE	BY
8 PUMP	086-P-004 A/B	<input checked="" type="radio"/>	087-P-004 A/B	<input checked="" type="radio"/>	088-P-004 A/B	<input checked="" type="radio"/>	A	4/18/08	VS
9 MOTOR	086-PM-004 A/B	<input type="radio"/>	087-PM-004 A/B	<input type="radio"/>	088-PM-004 A/B	<input type="radio"/>	B		
10 GEAR		<input type="radio"/>		<input type="radio"/>	Note 1	<input type="radio"/>	C		
11 TURBINE		<input type="radio"/>		<input type="radio"/>		<input type="radio"/>	D		

12 APPLICABLE OVERLAY STANDARD(S): 1

13 ☒ OPERATING CONDITIONS (5.1.3) ☒ LIQUID (5.1.3)

14 CAPACITY, NORMAL 12.4 (m3/hr) RATED 13.6 (m3/hr)

15 OTHER Note (11)

17 SUCTION PRESSURE MAX./RATED 0.55 -0.07 (kg/cm2 g)

18 DISCHARGE PRESSURE Note FW4 4.92 (kg/cm2 g)

19 DIFFERENTIAL PRESSURE 4.99 (kg/cm2)

20 DIFF. HEAD 28.2 (m) NPSHA 5.36 (m)

21 PROCESS VARIATIONS (5.1.4)

22 STARTING CONDITIONS (5.1.4)

23 SERVICE: ☒ CONT. ☐ INTERMITTENT (STARTS/DAY)

24 ☐ PARALLEL OPERATION REQ'D (5.1.13)

25 ☒ SITE DATA (5.1.3)

27 LOCATION: (5.1.30)

28 ☐ INDOOR ☐ HEATED ☒ OUTDOOR ☐ UNHEATED

29 ☒ ELECTRICAL AREA CLASSIFICATION (5.1.24 / 6.1.4)

30 CL Hold GR Hold DIV Hold Note 3

31 ☐ WINTERIZATION REQ'D ☐ TROPICALIZATION REQ'D

32 SITE DATA (5.1.30)

33 ALTITUDE 4 (m) BAROMETER 1.03 (kg/cm2)

34 RANGE OF AMBIENT TEMPS: MIN/MAX. 11 / 42 (°C)

35 RELATIVE HUMIDITY: MIN / MAX 25 / 100 (%)

36 UNUSUAL CONDITIONS: (5.1.30) ☒ DUST ☐ FUMES

37 ☒ OTHER Ambient Trace H<sub>2</sub>S

38

39

40 ☐ DRIVER TYPE

41 ☒ INDUCTION MOTOR ☐ STEAM TURBINE ☐ GEAR

42 ☐ OTHER

43

44 ☐ MOTOR DRIVER (6.1.1 / 6.1.4) Note I

45 ☒ MANUFACTURER

46 (kW) (RPM)

47 FRAME ENCLOSURE

48 ☒ HORIZONTAL ☒ VERTICAL ☒ SERVICE FACTOR 1.0

49 VOLTS/PHASE/HERTZ 415 / 3 / 50

50 TYPE Squirrel Cage Induction

51 MINIMUM STARTING VOLTAGE (6.1.5)

52 INSULATION CLASS F TEMP. RISE CLASS B

53 FULL LOAD AMPS

54 LOCKED ROTOR AMPS

55 STARTING METHOD DOL

56 LUBE

58 BEARINGS (TYPE/NUMBER):

59 RADIAL Anti Friction /

60 THRUST Anti Friction /

61 VERTICAL THRUST CAPACITY

62 UP (N) DOWN (N)

63

64

65

LIQUID TYPE OR NAME Molten Sulfur

☒ HAZARDOUS ☐ FLAMMABLE ☐ (5.1.5)

MIN.	NORMAL	MAX.
	172	176.7
	0.01	
	1.77	
	131.5	197.5
	0.24	(kcal/kg°C)
		(PPM)
	350	(PPM) WET (5.2.1.12c)
		(5.12.1.9)

MIN. NORMAL MAX.

PUMPING TEMP (°C)

VAPOR PRESS. (kg/cm2)

RELATIVE DENSITY (SG)

VISCOSITY (cP)

SPECIFIC HEAT, Cp (kcal/kg°C)

☐ CHLORIDE CONCENTRATION (PPM)

☒ H<sub>2</sub>S CONCENTRATION (6.5.2.4) 350 (PPM) WET (5.2.1.12c)

CORROSIVE / EROSION AGENT (5.12.1.9)

MATERIALS Note N

☐ ANNEX H CLASS (5.12.1.1)

☒ MIN DESIGN METAL TEMP (5.12.4.1) 10 (°C)

☐ REDUCED HARDNESS MATERIALS REQ'D. (5.12.1.11)

☒ COLUMN/CASE CS IMPELLER CI

☒ CASE/IMPELLER WEAR RINGS Note 7 CI

☒ SHAFT CS

☐ DIFFUSERS

PERFORMANCE:

PROPOSAL CURVE NO. ☐ RPM

☐ IMPELLER DIA. RATED MAX. MIN. (mm)

☐ IMPELLER TYPE

☐ RATED POWER (kW) EFFICIENCY (%)

☐ MINIMUM CONTINUOUS FLOW:

THERMAL (m3/hr) STABLE (m3/hr)

☐ PREFERRED OPER. REGION TO (m3/hr)

☐ ALLOWABLE OPER. REGION TO (m3/hr)

☐ MAX HEAD @ RATED IMPELLER (m)

☐ MAX POWER @ RATED IMPELLER (HP)

☐ NPSHR AT RATED CAPACITY (m) (5.1.10)

☒ SUCTION SPECIFIC SPEED

MAX/ACTUAL / (5.1.11)

☒ MAX. SOUND PRESS. LEVEL REQ'D 85 (@ 1 m) (dBA) (5.1.16)

☒ EST MAX SOUND PRESS. LEVEL (dBA) (5.1.16)

UTILITY CONDITIONS

ELECTRICITY	VOLTAGE	PHASE	HERTZ
DRIVERS	415	3	50
HEATING			

SYSTEM VOLTAGE DIP ☐ 80% ☐ OTHER (6.1.5)

STEAM

MAX. PRESS.	MAX. TEMP.	MIN. PRESS.	MIN. TEMP.
43 kg/cm2 g	400 °C	39 kg/cm2 g	380 °C
5 kg/cm2 g	190 °C	3 kg/cm2 g	143 °C

DRIVERS

HEATING

COOLING WATER: (5.1.19) SOURCE

SUPPLY TEMP. 35 (°C) MAX. RETURN TEMP. 44 (°C)

NORM. PRESS. 5.5 (kg/cm2 g) DESIGN PRESS. 6.5 (kg/cm2 g) Note 5

MIN. RET. PRESS. 2 (kg/cm2 g) MAX. ALLOW. D.P. 0.7 kg/cm2

CHLORIDE CONCENTRATION: Note 6 Hold (PPM)



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**BLACK & VEATCH  
CENTRIFUGAL PUMP  
PROCESS DATA SHEET**

JOB NO. **160796** ITEM NO.(S) **086/087/088-P004 A/B**  
REQ / SPEC NO. **1** **Note 1**  
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INQUIRY NO **0** BY **VS**

**Note 2****Note** The quantity of pumps required for unit 088 is two (2) - 1 running + 1 standby.

- (1) Total of six (6) pumps shall be provided, two for each SRC.
- (2) Pump mounting plate, column pieces, steam jackets, steam piping and fittings shall be CS. **Note N**
- (3) Above 170°C viscosity increases rapidly. Pumps shall be able to operate with MAX. viscosity specified on page 1 of 4.
- (4) Steam temperature must stay below 170 °C to avoid high viscosity of sulfur.
- (5) Shaft sealing shall be achieved using gas tight construction with deep stuffing box and graphite impregnated packing.
- (6) Pumps shall be equipped with sufficient holes for quick draining.
- (7) Pumps shall be located inside the pit. Approximate distance from pump mounting plate to the bottom of sulfur pit **Note O** is 3.6m.
- (8) Pumps shall be furnished with suction strainer. Vendor shall take into account pressure drop across strainer.
- (9) Pumps shall be able to empty the pit down to the bottom.
- (10) Vendor shall ensure sufficient cooling of lineshaft bearings.
- (11) Pump Vendor shall provide minimum flow recirculation to allow pump to be dead headed.  
Pump capacity shown is net process capacity. Actual total capacity is minimum flow plus net process capacity.  
Vendor to set minimum flow capacity.
- (12) Vendor to take into account additional head required at impeller due to discharge column height and friction loss.

~~(13) PUMP MINIMUM FLOW CIRCULATION FO 0206 @ 6.4 M3/HR OF FLOW HAS BEEN CONSIDERED. PUMP VENDOR SHALL CONFIRM THE MINIMUM FLOW CIRCULATION IF IT EXCEEDS 6.4 M3/HR OF FLOW.~~

(13) FO 0206 shall be supplied by pump vendor and same shall be designed based on minimum flow of the pump.

## ANNEXURE 1 OF PUMP DATASHEET 080557C-088-SP-0910-004 REV C

BLACK & VEATCH  
CENTRIFUGAL PUMP  
MECHANICAL DATA SHEET

JOB NO. **160796** ITEM NO. **086/087/088-P004 A/B**  
REQ / SPEC NO. **1** **Note 1**  
PURCH ORDER NO. DATE **5/9/2008**  
INQUIRY NO. **0** BY **VS**

PAGE 3 OF 4

CONSTRUCTION		SURFACE PREPARATION AND PAINT																	
<b>ROTATION</b> (VIEWED FROM COUPLING END) <input type="checkbox"/> CW <input type="checkbox"/> CCW		<input checked="" type="checkbox"/> MANUFACTURER'S STANDARD <input type="checkbox"/> OTHER (SEE BELOW)																	
<b>PUMP TYPE: (1.3)</b>		<b>PUMP:</b> <b>Note F</b>																	
<input type="checkbox"/> VS <input type="checkbox"/> VS2 <input type="checkbox"/> VS3 <input checked="" type="checkbox"/> VS4 <input type="checkbox"/> VS5 <input type="checkbox"/> VS6 <input type="checkbox"/> VS7		<input type="checkbox"/> PUMP SURFACE PREPARATION																	
<b>CASING MOUNTING:</b> <input type="checkbox"/> SUMP COVER PLATE		<input type="checkbox"/> PRIMER																	
<input type="checkbox"/> INLINE <input checked="" type="checkbox"/> SEPARATE MOUNTING PLATE (8.3.8.3.1)		<input type="checkbox"/> FINISH COAT																	
<input type="checkbox"/> SEPARATE SOLE PLATE (8.3.8.3.3)		<b>BASEPLATE / COLUMN: (6.3.17)</b>																	
<b>CASING SPLIT:</b>		<input type="checkbox"/> BASEPLATE SURFACE PREPARATION																	
<input type="checkbox"/> AXIAL <input checked="" type="checkbox"/> RADIAL		<input type="checkbox"/> PRIMER																	
<b>CASING TYPE:</b>		<input type="checkbox"/> FINISH COAT																	
<input checked="" type="checkbox"/> SINGLE VOLUTE <input type="checkbox"/> MULTIPLE VOLUTE <input type="checkbox"/> DIFFUSER		<b>SHIPMENT: (7.4.1) <b>Note E</b></b>																	
<b>CASE PRESSURE RATING:</b>		<input type="checkbox"/> DOMESTIC <input checked="" type="checkbox"/> EXPORT <input checked="" type="checkbox"/> EXPORT BOXING REQUIRED																	
<input type="checkbox"/> MAX ALLOWABLE WORKING PRESSURE (kg/cm2)		<input checked="" type="checkbox"/> OUTDOOR STORAGE MORE THAN 6 MONTHS																	
<input type="checkbox"/> @ (°C)		<b>SPARE ROTOR ASSEMBLY PACKAGED FOR:</b>																	
<input type="checkbox"/> HYDROTEST PRESSURE (kg/cm2)		<input type="checkbox"/> HORIZONTAL STORAGE <input type="checkbox"/> VERTICAL STORAGE																	
<input type="checkbox"/> SUCTION PRESS. REGIONS MUST BE DESIGNED FOR MAWP (5.3.6)		<input type="checkbox"/> TYPE OF SHIPPING PREPARATION																	
<input type="checkbox"/> <b>NOZZLE CONNECTIONS: (5.4.2)</b>		<b>HEATING AND COOLING</b>																	
<table border="1"><thead><tr><th>SIZE</th><th>FLANGE RATING</th><th>FACING</th><th>POSITION</th></tr></thead><tbody><tr><td>SUCTION</td><td>Bell</td><td></td><td>Bottom</td></tr><tr><td>DISCHARGE</td><td>150#</td><td>RF</td><td>Top</td></tr><tr><td>BALANCE DRUM</td><td></td><td></td><td></td></tr></tbody></table>		SIZE	FLANGE RATING	FACING	POSITION	SUCTION	Bell		Bottom	DISCHARGE	150#	RF	Top	BALANCE DRUM				<input type="checkbox"/> HEATING JACKET REQ'D. (5.8.9) <input checked="" type="checkbox"/> COOLING REQ'D.	
SIZE	FLANGE RATING	FACING	POSITION																
SUCTION	Bell		Bottom																
DISCHARGE	150#	RF	Top																
BALANCE DRUM																			
<b>PRESSURE CASING AUX. CONNECTIONS: (5.4.3)</b>		<input checked="" type="checkbox"/> COOLING WATER PIPING PLAN (6.5.4.1)																	
<table border="1"><thead><tr><th>NO.</th><th>SIZE (NPS)</th><th>TYPE</th></tr></thead><tbody><tr><td><input checked="" type="checkbox"/> DRAIN</td><td></td><td></td></tr><tr><td><input type="checkbox"/> VENT</td><td></td><td></td></tr><tr><td><input type="checkbox"/> WARM-UP</td><td></td><td></td></tr><tr><td><input type="checkbox"/> BALANCE / LEAK-OFF</td><td></td><td></td></tr></tbody></table>		NO.	SIZE (NPS)	TYPE	<input checked="" type="checkbox"/> DRAIN			<input type="checkbox"/> VENT			<input type="checkbox"/> WARM-UP			<input type="checkbox"/> BALANCE / LEAK-OFF			C.W. PIPING:		
NO.	SIZE (NPS)	TYPE																	
<input checked="" type="checkbox"/> DRAIN																			
<input type="checkbox"/> VENT																			
<input type="checkbox"/> WARM-UP																			
<input type="checkbox"/> BALANCE / LEAK-OFF																			
<input type="checkbox"/> MACHINED AND STUDDED CONNECTIONS (5.4.3.8)		<input checked="" type="checkbox"/> PIPE <input checked="" type="checkbox"/> TUBING; FITTINGS																	
<input type="checkbox"/> CYLINDRICAL THREADS REQUIRED (5.4.3.3)		C.W. PIPING MATERIALS:																	
<b>ROTOR:</b>		<input checked="" type="checkbox"/> S. STEEL <input type="checkbox"/> C. STEEL <input type="checkbox"/> GALVANIZED																	
<input checked="" type="checkbox"/> COMPONENT BALANCE TO ISO 1940 G2.5 (5.9.4.4)		COOLING WATER REQUIREMENTS:																	
<input type="checkbox"/> SHRINK FIT - LIMITED MOVEMENT IMPELLERS (8.2.2.3)		<input type="checkbox"/> BEARING HOUSING (m³/h) @ (kg/cm2)																	
<b>COUPLINGS:</b>		<input type="checkbox"/> HEAT EXCHANGER (m³/h) @ (kg/cm2)																	
<input type="checkbox"/> MANUFACTURER <input checked="" type="checkbox"/> MODEL		STEAM PIPING: <input type="checkbox"/> TUBING <input type="checkbox"/> PIPE																	
<input type="checkbox"/> RATING (kW/100 RPM)		<b>BEARINGS AND LUBRICATION <b>Note K</b></b>																	
<input checked="" type="checkbox"/> SPACER LENGTH (mm) <input type="checkbox"/> SERVICE FACTOR		BEARING (TYPE/NUMBER):																	
<input checked="" type="checkbox"/> RIGID		<input type="checkbox"/> RADIAL <b>Bushing</b> /																	
<b>THROUGH COUPLINGS:</b>		<input type="checkbox"/> THRUST <b>Ball (1)</b> /																	
<input type="checkbox"/> MANUFACTURER <input checked="" type="checkbox"/> MODEL		LUBRICATION (5.11.3, 5.11.4):																	
<input type="checkbox"/> RATING (kW/100 RPM) <input type="checkbox"/> LUBE		<input checked="" type="checkbox"/> GREASE (1) <input checked="" type="checkbox"/> FLOOD <input type="checkbox"/> PURGE OIL MIST																	
<input checked="" type="checkbox"/> SPACER LENGTH (mm) <input type="checkbox"/> SERVICE FACTOR		<input checked="" type="checkbox"/> FLINGER <input type="checkbox"/> PURE OIL MIST																	
<input checked="" type="checkbox"/> RIGID		<input type="checkbox"/> CONSTANT LEVEL OILER PREFERENCE (5.10.2.2):																	
<b>DRIVER HALF COUPLING MOUNTED BY:</b>		<input checked="" type="checkbox"/> OIL VISC. ISO GRADE																	
<input checked="" type="checkbox"/> PUMP MFR. <input type="checkbox"/> DRIVER MFR. <input type="checkbox"/> PURCHASER		<input type="checkbox"/> REVIEW AND APPROVE THRUST BEARING SIZE																	
<input type="checkbox"/> COUPLING BALANCED TO ISO 1940-1 G.6.3 (6.2.3)		<input checked="" type="checkbox"/> OIL HEATER REQUIRED: <input type="checkbox"/> STEAM <input type="checkbox"/> ELECTRIC																	
<input type="checkbox"/> COUPLING PER ISO 14691 (6.2.3)		<b>INSTRUMENTATION (6.4.2)</b>																	
<input type="checkbox"/> COUPLING PER ISO 10441 (6.2.3)		<input type="checkbox"/> ACCELEROMETER (6.4.2.2)																	
<input type="checkbox"/> COUPLING PER API 671 (6.2.3)		<input type="checkbox"/> PROVISION FOR MOUNTING ONLY (5.10.2.10)																	
<input checked="" type="checkbox"/> NON SPARK COUPLING GUARD (6.2.13)		<input type="checkbox"/> FLAT SURFACE REQ'D (5.10.2.11) <b>Note L</b>																	
<input checked="" type="checkbox"/> COUPLING GUARD STANDARD		<input type="checkbox"/> PRESSURE GAUGE TYPE																	
ASME B15.1 OTHER <b>OSHA</b>		REMARKS:																	
<b>MECHANICAL SEAL:</b>		<input type="checkbox"/> <b>WEIGHTS</b>																	
<input type="checkbox"/> SEE ATTACHED ISO 21049/API 682 DATA SHEET		WEIGHT OF PUMP (kg)																	
		WEIGHT OF DRIVER (kg)																	
		WEIGHT OF GEAR (kg)																	
		WEIGHT OF BASEPLATE (kg)																	
		TOTAL WEIGHT (kg)																	





## ANNEXURE 1 OF PUMP DATASHEET 080557C-088-SP-0910-004 REV C

# BLACK & VEATCH CENTRIFUGAL PUMP MECHANICAL DATA SHEET

JOB NO. **160796** ITEM NO. **086/087/088-P004 A/B**  
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SPARE PARTS (TABLE 18)		VERTICAL PUMPS (CONT.)	
<input checked="" type="radio"/> START-UP	<input checked="" type="radio"/> NORMAL MAINTENANCE	<input type="radio"/> PUMP AND STRUCTURE DYNAMIC ANALYSIS (8.3.5)	
<input type="radio"/> SPECIFY _____		<input type="radio"/> DRAIN PIPED TO SURFACE (8.3.13.4)	
<b>OTHER PURCHASER REQUIREMENTS</b>		<b>QA INSPECTION AND TESTING <b>Note J</b></b>	
<input checked="" type="radio"/> COORDINATION MEETING REQUIRED (9.1.3)		<input type="radio"/> SHOP INSPECTION (7.1.4)	<input checked="" type="radio"/> PERFORMANCE CURVE APPROVAL
<input type="radio"/> MAXIMUM DISCHARGE PRESSURE TO INCLUDE (5.3.2)		<input checked="" type="radio"/> TEST WITH SUBSTITUTE SEAL (7.3.3.2)	
<input type="radio"/> MAX RELATIVE DENSITY		<input type="radio"/> TEST (7.3.1.2)	NON-WIT <input type="radio"/> WIT <input type="radio"/> OBSERVE <input type="radio"/>
<input type="radio"/> MAX DIA. IMPELLERS AND/OR NO OF STAGES <b>Note H</b>		<input type="radio"/> HYDROSTATIC TEST OF BOWLS	<input type="radio"/>
<input type="radio"/> OPERATION TO TRIP SPEED		AND COLUMN (8.3.13.2)	
<input type="radio"/> CONNECTION DESIGN APPROVAL (5.12.3.4)		<input checked="" type="radio"/> HYDROSTATIC (7.3.2) <b>Note M</b>	<input type="radio"/>
<input type="radio"/> TORSIONAL ANALYSIS REQUIRED (5.9.2.1)		<input checked="" type="radio"/> PERFORMANCE (7.3.3)	<input type="radio"/>
<input type="radio"/> TORSIONAL ANALYSIS REPORT (5.9.2.6)		<input type="radio"/> RETEST ON SEAL LEAKAGE (7.3.3.2d)	<input type="radio"/>
<input type="radio"/> PROGRESS REPORTS (9.3.3)		<input type="radio"/> NPSH (7.3.4.2) <b>Note G</b>	<input type="radio"/>
<input type="radio"/> OUTLINE OF PROCEDURES FOR OPTIONAL TESTS (9.3.5)		<input type="radio"/> COMPLETE UNIT TEST (7.3.4.3)	<input type="radio"/>
<input type="radio"/> ADDITIONAL DATA REQUIRING 20 YEARS RETENTION (7.2.2.1f)		<input type="radio"/> SOUND LEVEL TEST (7.3.4.4)	<input type="radio"/>
<input type="radio"/> MANIFOLD PIPING TO SINGLE CONNECTION (6.5.1.6)		<input type="radio"/> CLEANLINESS PRIOR TO	<input type="radio"/>
<input type="radio"/> <input checked="" type="checkbox"/> VENT <input checked="" type="checkbox"/> VENT <input checked="" type="checkbox"/> COOLING WATER		FINAL ASSEMBLY (7.2.2.2)	
<input checked="" type="radio"/> MOUNT SEAL RESERVOIR OFF BASEPLATE (6.5.1.4)		<input type="radio"/> NOZZLE LOAD TEST (6.3.6)	<input type="radio"/>
<input checked="" type="radio"/> FLANGES REQUIRED IN PLACE OF SOCKET WELD UNIONS (6.5.2.8)		<input type="radio"/> 4 HR. MECHANICAL RUN TEST (7.3.4.7.1)	<input type="radio"/>
<input type="radio"/> CONNECTION BOLTING <input type="radio"/> PTFE COATING <input type="radio"/> SS		<input type="radio"/> MECHANICAL RUN UNTIL OIL	<input type="radio"/>
<input type="radio"/> PAINTED <input type="radio"/> ASTM A153 GALVANIZED		TEMP. STABLE (7.3.4.7.1)	
<input checked="" type="radio"/> INSTALLATION LIST IN PROPOSAL (9.2.3L)		<input type="radio"/> 4 HR. MECHANICAL RUN AFTER	<input type="radio"/>
<input type="radio"/> <b>VERTICAL PUMPS</b>		OIL TEMP. STABLE (7.3.4.7.3)	
<input type="checkbox"/> PUMP THRUST: (+) UP (-) DOWN		<input type="radio"/> TRUE PEAK VELOCITY	<input type="radio"/>
AT MIN. FLOW _____ (N) _____ (N)		DATA (7.3.3.4.d)	
AT RATED FLOW _____ (N) _____ (N)		<input type="radio"/> RESONANCE TEST (8.3.9.2)	<input type="radio"/>
AT MAX. FLOW _____ (N) _____ (N)		<input type="radio"/> PUMP STRUCTURAL RESONANCE TEST (8.3.9.2)	
MAX THRUST _____ (N) _____ (N)		<input type="radio"/> AUXILIARY EQUIPMENT	<input type="radio"/>
<input checked="" type="radio"/> SOLEPLATE REQ'D. (8.3.8.3.3) _____ (m) X _____ (m)		TEST (7.3.4.5)	
<input checked="" type="radio"/> MOUNTING PLATE REQUIRED (8.3.9.3.1)		<input checked="" type="radio"/> CHARPY TEST (EN 13445/ASME VIII)	<input type="radio"/>
<input type="checkbox"/> SOLEPLATE THICKNESS _____ (mm)		<input checked="" type="radio"/> VENDOR KEEP REPAIR AND HT RECORDS (7.2.1.1c)	
COLUMN PIPE: <input checked="" type="checkbox"/> FLANGED <input type="checkbox"/> THREADED		<input checked="" type="radio"/> VENDOR SUBMIT TEST PROCEDURES (7.3.1.2 / 9.2.5)	
DIAMETER _____ (mm) LENGTH _____ (m)		<input type="radio"/> VENDOR SUBMIT TEST DATA WITHIN 24 HOURS (7.3.3.3e)	
GUIDE BUSHINGS		<input type="radio"/> INCLUDE PLOTTED VIBRATION SPECTRA (5.9.3.3)	
<input type="checkbox"/> NUMBER _____		<input type="radio"/> RECORD FINAL ASSEMBLY RUNNING CLEARANCES	
<input type="checkbox"/> LINE SHAFT BEARING SPACING _____ (mm)		<input type="radio"/> COMPLETION OF INSPECTION CHECK LIST (7.1.6)	
GUIDE BUSHINGS LUBE:		<input type="radio"/> MATERIAL CERTIFICATION REQUIRED (5.12.1.8)	
<input type="checkbox"/> WATER <input type="checkbox"/> OIL		<input type="radio"/> COLUMN <input type="radio"/> IMPELLER <input type="radio"/> SHAFT	
<input type="checkbox"/> GREASE <input checked="" type="checkbox"/> PUMPAGE		<input type="radio"/> OTHER _____	
LINESHAFT: <input checked="" type="checkbox"/> OPEN <input checked="" type="checkbox"/> ENCLOSED		<input checked="" type="radio"/> CASTING REPAIR PROCEDURE APPROVAL REQ'D (5.12.2.5)	
<input type="checkbox"/> LINE SHAFT DIAMETER: _____ (mm)		<input checked="" type="radio"/> INSPECTION REQUIRED FOR CONNECTION	
<input type="checkbox"/> TUBE DIAMETER: _____ (mm)		WELDS (5.12.3.4) (5.12.1.5)	
LINESHAFT COUPLING:		<input checked="" type="checkbox"/> MAG PARTICLE <input checked="" type="checkbox"/> LIQUID PENETRANT	
<input type="checkbox"/> LINE SHAFT DIAMETER: <input type="checkbox"/> SLEEVE & KEY <input type="checkbox"/> THREADED		<input checked="" type="checkbox"/> RADIOGRAPHIC <input checked="" type="checkbox"/> ULTRASONIC	
<input type="checkbox"/> SUCTION CAN THICKNESS _____ (mm)		<input checked="" type="radio"/> INSPECTION REQUIRED FOR CASTINGS (7.2.1.3) (5.12.1.5)	
<input type="checkbox"/> LENGTH _____ (m)		<input checked="" type="checkbox"/> MAG PARTICLE <input checked="" type="checkbox"/> LIQUID PENETRANT	
<input type="checkbox"/> DIAMETER _____ (m)		<input checked="" type="checkbox"/> RADIOGRAPHIC <input checked="" type="checkbox"/> ULTRASONIC	
<input checked="" type="radio"/> SUCTION STRAINER TYPE <b>Basket</b>		<input type="radio"/> HARDNESS TEST REQUIRED (7.2.2.3)	
<input type="radio"/> FLOAT & ROD <input type="radio"/> FLOAT SWITCH		<input type="radio"/> ADDITIONAL SUBSURFACE EXAMINATION (7.2.1.3)	
<input type="radio"/> IMPELLER COLLETS ACCEPTABLE (5.6.3)		FOR _____	
<input type="radio"/> HARDENED SLEEVES UNDER BEARINGS (8.3.10.5)		METHOD _____	
<b>SUMP ARRANGEMENT</b> 			
<input type="radio"/> SUMP DEPTH _____ (FT) <input type="radio"/> SUMP DIMENSION _____ (FT) <input type="radio"/> LOW LIQUID _____ (FT)		<b>Note O</b> <input type="checkbox"/> PUMP LENGTH _____ (FT) <input type="checkbox"/> SUBMERGENCE REQ'D _____ (FT) <input type="checkbox"/> CENTERLINE DISCHARGE HEIGHT _____ (FT) <input type="checkbox"/> DATUM ELEVATION _____ (FT)	

 		PROJECT	Standby SRU & Additional Tanks IOCL Paradip Refinery	
		CLIENT	INDIAN OIL CORPORATION LIMITED	
MECHANICAL DATA SHEET FOR SULPHUR PIT PUMPS	Project No. 080557C001	Document No. 080557C-088-SP-0910-005	Rev. No. C	Page 1 of 2

## SULPHUR RECOVERY UNIT

UNIT : 088

### MECHANICAL DATASHEET FOR SULPHUR PIT PUMPS

TAG NO: 088-P-005 A/B

Reference Document: Process datasheet 080557C-088-PDS-0910- 005 Rev B

REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED
C	10-Jun-2020	ISSUED FOR DESIGN	RS	AA	AA	JMC
B	7-Feb-2020	ISSUED FOR DESIGN	MM	RS	AA	JMC
A	29-Nov-2019	ISSUED FOR DESIGN	MM	RS	AA	JMC

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# CENTRIFUGAL PUMP DATASHEET



DATA SHEET No.

080557C-088-SP-0910-005

Sheet: 2 of 2 REV C

Notes	Rev
A) FEED datasheet PDRP4220-8110-PS-086-0005 Rev F1 for Sulphur Pit Pumps is attached. See Annexure 1. The notes below are additional requirements / clarifications to the datasheet. General Notes of FW datasheet is replaced by General Notes in Process datasheet 080557C-088-PDS-0910-005 Rev B.	
B) Units 086 & 087 are existing SRU trains 1 & 2 respectively. This datasheet is for new SRU train (unit 088).	
C) The quantity of pumps required for unit 088 is two (2) - 1 running + 1 standby.	
D) Centrifugal pumps shall comply with API 610 - 11th Edition, Job specification 080557C-000-JSS-0910-001 and other project requirements.	
E) Domestic boxing for shipment shall be used in case of indigeneous supply. Export boxing required in case of import.	
F) Manufacturer's standard coating system can be used with the following requirements. - Colour shade (RAL), Paint type & minimum DFT shall be as specified in project specification 080557C-000-JSD-2300-001. - Finish coat for Pump : RAL 5013, Motor : RAL 5021, Baseframe : RAL 7035, for other items refer above mentioned specification	
G) Minimum Submergence test shall be conducted.	
H) Maximum discharge pressure shall be calculated based on the shut-off head for maximum diameter impeller.	
I) Statutory approvals in original such as PESO certification for electrical and instrumentation items shall be furnished.	
J) Minimum requirements of Inspection and Testing shall be as per 080557C-000-ITP-0910-001. Hydrostatic test, Performance test and Minimum Submergence test shall be witnessed.	
K) Contractor / Vendor to confirm the bearing lubrication type.	C
L) Flat surfaces for vibration measurement shall be provided at bearing housings.	
M) Note 8 of Foster Wheeler Process specification is rewritten as follows: Design pressure & temperature for steam jacketing and piping are 7 kg/cm2(a) & 190 deg C respectively. Steam piping / tubing and jackets shall be IBR certified as applicable. Steam piping and jacketing shall be given a hydrostatic test.	
N) Foster Wheeler Notes and Black & Veatch datasheet details about material of construction to be read as follows: Shaft & shaft sleeve : SS 316/316L with nickel based alloy (COLMONOY No. 6 or equiv.) hard coating at upper stuffing box Casing : Grey cast iron Impeller : Ductile iron Steam piping / tubing material : SS 316 / 316L. Steam jacketed discharge pipe : Galvanized steel Discharge elbow : CS Steam jacketed column pieces : Galvanized steel All fasteners inside the vessel shall be SS 316. Suction strainer : SS 316L Pump support plate : CS	
O) Pit depth is specified in note 7 on page 2 / 4 of Black & Veatch datasheet. There shall be a low point sump below the pump intake nozzle. The pump to be installed inside the low sump. The low point sump shall be sized suitably by LSTK contractor for the selected pump. Pump vendor to furnish minimum submergence required for the pump. Pump shaft length to be finalized by LSTK contractor based on the sump depth, suction strainer, steam coils at the sump bottom, the vertical distance of pump mounting surface from the grade etc. Refer Process datasheet for Sulphur pit 080557C-088-PDS-1700-001.	
P) Pump mounting arrangement shall be designed by LSTK contractor and shall be sealed to prevent leakage of toxic gas from the pit vapor space to the atmosphere and to prevent leakage of air into the pit vapor space. The mounting shall be designed for vibration free operation and the pump shall be easily removable for maintenance.	
Note: The above notes ('A' to 'P') to be followed strictly. The reference of these notes are indicated in the subsequent pages.	

DOCUMENT CATEGORY		DOCUMENT REVIEW STATUS (BY CLIENT)			
(USE "X" MARK)\ <input type="checkbox"/> APPROVAL <input type="checkbox"/> REVIEW <input type="checkbox"/> INFORMATION					
0	25.03.21	ISSUED FOR ENGINEERING	SYD	RK	RK
REV	DATE	DETAILS OF REVISION	PREPARED	CHECKED	APPROVED
CLIENT	 IndianOil	INDIAN OIL CORPORATION LIMITED PARADIP REFINERY PROJECT PARADIP ODISHA			
CONSULTANT		TECHNIP ENERGIES			
PROJECT	525 TPD STANDBY SRU PROJECT IOCL PARADIP REFINERY, ODISHA, INDIA				
ESC	 ENGINEERS INDIA LIMITED				
	BHEL Hyderabad	NAME	SIGN	DATE	
		DRN			
		CHD			
DEPT. PE&SD.	CODE 450	APPD			
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company		<b>TITLE: PROCESS DATASHEET FOR            SULPHUR PIT PUMPS (088-P-005 A/B)</b>			
		<b>BHEL/EIL DRG/DOC NO. B366-088-02-42-DS-1605</b>			
		<b>CUST. DRG/ DOC NO.            080557C-088-PDS-0910-005, REV. B</b>			
		<b>SHT NO. 01</b>			
		<b>NO. OF SHT. 08</b>			<b>REV</b>  <b>0</b>

 	<b>PROJECT</b>		<b>Standby SRU &amp; Additional Tanks</b>	
	<b>CLIENT</b>		<b>IOCL Paradip Refinery</b>	
<b>PROCESS DATASHEET FOR PUMP</b>	<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-088-PDS-0910-005	<b>Rev. No.</b> B	Page 1 of 7

## SULPHUR RECOVERY UNIT (SRU)

### (UNIT 088)

## PROCESS DATASHEET

### FOR


## SULPHUR PIT PUMPS

### (088-P-005 A/B)

			<div><div><div><div></div></div></div><div>Written By</div><div>Sudanthar G. 2020.02.07 11:10:28 +05'30'</div></div>	<div><div><div><div></div></div></div><div>Checked By</div><div>Leena Krishnan 2020.02.07 17:15:06 +05'30'</div></div>	<div><div><div><div></div></div></div><div>Approved By</div><div>Ramasubramanian Arunachalam 2020.02.10 15:53:35 +05'30'</div></div>	<div><div><div><div></div></div></div><div>Authorized By</div><div>Muthukrishnan Raghav 2020.02.10 20:44:11 +05'30'</div></div>
B	07-02-2020	ISSUED FOR INFORMATION	SG	LK	AR	JMC
A	26-11-2019	ISSUED FOR INFORMATION	JU	LK	AR	JMC
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED

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 	<b>PROJECT</b>		<b>Standby SRU &amp; Additional Tanks</b>	
	<b>CLIENT</b>		<b>IOCL Paradip Refinery</b>	
<b>PROCESS DATASHEET FOR PUMP</b>	<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-088-PDS-0910-005	<b>Rev. No.</b> B	Page 2 of 7

**GENERAL NOTES:**

- A. The Licensor Basic Design Package for the SRU/TGTU consists of 3 x 50% SRU trains and 2 x 100% TGTU trains. However, at original Sulphur Recovery Unit (SRU) project sanction the redundant units (Units 088 & 090) were deferred.
- B. Indian Oil Corporation Limited (IOCL) intend to install a standby SRU train (Unit 088) of 525 TPD along with Tail Gas Incinerator (Unit 090) at the existing Paradip Refinery.
- C. Unit 088 will, as far as possible, be identical to Units 086 and 087. The equipment specification for Units 086 and 087 has therefore been issued for the same equipment service in Unit 088.
- D. The Basic Design Package (BDP) has been provided by a licensor (Black & Veatch). Bidders/vendors should not communicate with Black & Veatch directly with regard to this enquiry. Any questions or clarifications should be forwarded to Technip India Limited for resolution with the client IOCL. Note that there are specific instances where design details/specifications must be submitted to Black & Veatch for approval.

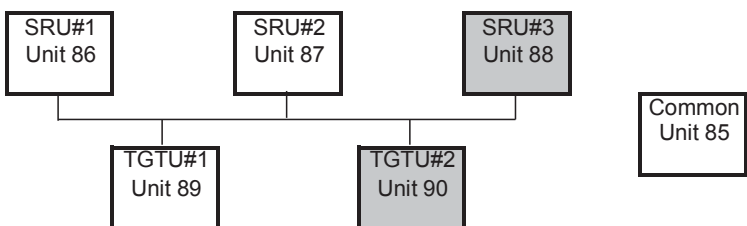
**NOTES SPECIFIC TO THE EQUIPMENT WITHIN THIS SPECIFICATION:**

- T1. Reference to Units 086 and 087 to be read as Unit 088.
- T2. Equipment quantity required is TWO.
- T3. General notes G1, G2, G3 and Notes 1 and 2 in Foster Wheeler Energy Limited's FEED stage coversheet for this equipment shall be ignored. Remaining notes in Foster Wheeler Energy Limited's FEED stage coversheet shall be followed.
- T4. The pump will be in continuous service (not intermittent) with rated flowrate of 26.76 m<sup>3</sup>/hr as mentioned in Foster Wheeler Energy Limited's FEED stage coversheet notes 9 and 10.
- T5. Pump's shaft length shall be confirmed ~~during detailed engineering by LSTK contractor~~ based on final depth of Sulphur pit 088-SU-001.
- T6. The pump shall be installed within the respective low point sumps of Sulphur pit 088-SU-001 so that minimum submergence requirements of the pump are met.

					PROCESS SPECIFICATION	
Indian Oil Corporation Ltd (IOCL)					1-14-4200	
Paradip, Orissa State, India					SRU#1&2 UNITS : 086 & 087	
SULPHUR PIT PUMPS					086/087-P-005A/B 4	
	O1	F1			PDRP4220-8110-PS-086-0005	
	5-Aug-09	12-Mar-10			1	1
	SMR	SMR			17793	
	SRB	SRB				

**GENERAL NOTES. Note A**

**G1.** The Licensor Basic Design Package for the SRU/TGTU consists of 3 x 50% SRU trains and 2 x 100% TGTU trains. There being a single redundant SRU train and a single redundant TGTU train. However, at project sanction the redundant units (Units 88 & 90) were deferred as shown in grey below.




**G2.** Note that Unit 87 will, as far as possible, be identical to Unit 86. A single specification has therefore been issued to cover like for like equipment on Units 86 & 87.

**G3.** The Basic Design Package (BDP) has been provided by a licensor (Black & Veatch). Bidders/vendors should not communicate with Black & Veatch directly with regard to this enquiry. Any questions or clarifications should be forwarded to Foster Wheeler Energy Ltd for resolution with the client IOCL. Note that there are specific instances where design details/specifications must be submitted to Black & Veatch for approval.





**NOTES SPECIFIC TO THE EQUIPMENT WITHIN THIS SPECIFICATION**

Referring to the attached licensor engineering datasheet the following notes apply, taking precedence over notes stated in the Black and Veatch Specification Sheets

- Reference to unit 088 shall be ignored. Note B
- The quantity required is FOUR (Two for each of 086 and 087 Units) Note C
- The hazardous area classification is Zone 2 Group IIB Temperature Class T3. OISD-STD-113.& IS5572 will be applied.
- Pump differential pressure should read 6.94 kg/cm<sup>2</sup> and differential head should read 39.2 m. The pump suction pressure is 0.509 kg/cm<sup>2</sup>.g (max ) / -0.043 kg/cm<sup>2</sup>.g (normal) . The pump normal discharge pressure is 6.431 kg/cm<sup>2</sup>.g. The NPSHa is 4.44m
- The design pressure for cooling water is 8.0 kg/cm<sup>2</sup>.g not 6.5 kg/cm<sup>2</sup>.g.
- The maximum and minimum cooling water return pressures are 3.5 kg/cm<sup>2</sup>.g and 2.5kg/cm<sup>2</sup>.g respectively.
- Case and Impeller material shall be cast iron. Note N
- The maximum and minimum steam pressures to  are 42kg/cm<sup>2</sup>.g and 38kg/cm<sup>2</sup>.g respectively. Note M
- The pump will operate on a continuous basis NOT intermittent
- The normal capacity of the pump shall be 24.32 m<sup>3</sup>/h. The rated capacity shall be 26.76 m<sup>3</sup>/h. These values are net of any kick back requirement.

The actual total capacity of the pump shall be as follows:  
 Normal: 24.32 m<sup>3</sup>/hr + minimum flow of the pump  
 Rated: 26.76 m<sup>3</sup>/hr+minimum flow of the pump

Bidder to take into account additional head required at impeller due to discharge column height and friction losses.

# BLACK & VEATCH CENTRIFUGAL PUMP PROCESS DATA SHEET

PAGE 1 OF 4  
JOB NO. **160796** ITEM NO.(S) **086/087/088-P005 A/B**  
REQ / SPEC NO. **7**  
PURCH ORDER NO. \_\_\_\_\_ DATE **5/9/08**  
INQUIRY NO. **0** BY **VS** *JP*

Pump flow and head, refer note 4 of page no. 57

1	APPLICABLE TO: <input checked="" type="radio"/> PROPOSALS <input type="radio"/> PURCHASE <input type="radio"/> AS BUILT															
2	FOR <b>Indian Oil Corporation Limited (IOCL)</b>					UNIT <b>Sulfur Recovery Units 086, 087, 088</b>										
3	SITE <b>Paradip, Orissa, India</b>					SERVICE <b>Sulfur Pit Pumps</b>										
5	NOTES: INFORMATION BELOW TO BE COMPLETED: <input type="radio"/> BY PURCHASER <input type="radio"/> BY MANUFACTURER <input type="radio"/> BY MANUFACTURER OR PURCHASER															
6	<input type="radio"/> DATA SHEETS (6.1.1)															
7	ITEM NO.	ATTACHED	ITEM NO.	ATTACHED	ITEM NO.	ATTACHED	NO.	DATE	BY							
8	PUMP <del>086-P-005 A/B</del>	<input checked="" type="radio"/>	<del>087-P-005 A/B</del>	<input checked="" type="radio"/>	088-P-005 A/B	<input checked="" type="radio"/>	A	4/18/08	VS							
9	MOTOR <del>086-PM-005 A/B</del>	<input type="radio"/>	<del>087-PM-005 A/B</del>	<input type="radio"/>	088-PM-005 A/B	<input type="radio"/>	B									
10	GEAR	<input type="radio"/>		<input type="radio"/>		<input type="radio"/>	C									
11	TURBINE	<input type="radio"/>		<input type="radio"/>		<input type="radio"/>	D									
12	APPLICABLE OVERLAY STANDARD(S): <b>1</b>															
13	<input checked="" type="radio"/> OPERATING CONDITIONS (5.1.3)					<input checked="" type="radio"/> LIQUID (5.1.3)										
14	CAPACITY, NORMAL <del>43.8</del> (m3/hr) RATED <del>48.1</del> (m3/hr)					LIQUID TYPE OR NAME <b>Molten Sulfur</b>										
15	OTHER <b>Note (11) FW Note 9 &amp; 10</b>					<input checked="" type="radio"/> HAZARDOUS <input type="radio"/> FLAMMABLE <input type="radio"/> (5.1.5)										
17	SUCTION PRESSURE MAX./RATED <b>0.5</b> <b>-0.03</b> (kg/cm2 g)					<table border="1"> <tr> <th>MIN.</th> <th>NORMAL</th> <th>MAX.</th> </tr> <tr> <td></td> <td></td> <td></td> </tr> </table>					MIN.	NORMAL	MAX.			
MIN.	NORMAL	MAX.														
18	DISCHARGE PRESSURE <b>6.15</b> (kg/cm2 g)					PUMPING TEMP (°C) <b>138</b> <b>172</b>										
19	DIFFERENTIAL PRESSURE <b>6.48</b> (kg/cm2 g)					VAPOR PRESS. (kg/cm2) <b>0.01</b> <b>0.07</b>										
20	DIFF. HEAD <del>34</del> (m) NPSHA <b>5.5</b> (m)					RELATIVE DENSITY (SG): <b>1.80</b> <b>1.77</b>										
21	PROCESS VARIATIONS (5.1.4)					VISCOSITY (cP) <b>12.40</b> <b>200</b>										
22	STARTING CONDITIONS (5.1.4)					SPECIFIC HEAT, Cp <b>0.24</b> (kcal/kg°C)										
23	SERVICE: <input type="radio"/> CONT. <input checked="" type="radio"/> INTERMITTENT (STARTS/DAY) <b>1-2</b>					<input type="radio"/> CHLORIDE CONCENTRATION (PPM)										
24	<input type="radio"/> PARALLEL OPERATION REQ'D (5.1.13) <b>FW Note 9</b>					<input checked="" type="radio"/> H <sub>2</sub> S CONCENTRATION (6.5.2.4) <b>10-350</b> (PPM) WET (5.2.1.12c)										
25	<input checked="" type="radio"/> SITE DATA (5.1.3)					CORROSIVE / EROSION AGENT (5.12.1.9)										
27	LOCATION: (5.1.30)					<input checked="" type="radio"/> MATERIALS <b>Note N</b>										
28	<input type="radio"/> INDOOR <input type="radio"/> HEATED <input checked="" type="radio"/> OUTDOOR <input type="radio"/> UNHEATED					<input type="radio"/> ANNEX H CLASS (5.12.1.1)										
29	<input checked="" type="radio"/> ELECTRICAL AREA CLASSIFICATION (5.1.24 / 6.1.4)					<input checked="" type="radio"/> MIN DESIGN METAL TEMP (5.12.4.1) <b>10</b> (°C)										
30	CL <b>Hold</b> GR <b>Hold</b> DIV <b>Hold</b>					<input type="radio"/> REDUCED HARDNESS MATERIALS REQ'D. (5.12.1.11)										
31	<input type="radio"/> WINTERIZATION REQ'D <input type="radio"/> TROPICALIZATION REQ'D.					<input checked="" type="radio"/> CASE/COLUMN <b>CS</b> IMPELLER <b>CI</b>										
32	SITE DATA (5.1.30)					<input checked="" type="radio"/> CASE/IMPELLER WEAR RINGS <b>CS</b>										
33	<input checked="" type="radio"/> ALTITUDE <b>4</b> (m) BAROMETER <b>1.03</b> (kg/cm2 g)					<input checked="" type="radio"/> SHAFT <b>CS</b>										
34	<input checked="" type="radio"/> RANGE OF AMBIENT TEMPS: MIN/MAX. <b>11</b> / <b>42</b> (°C)					<input type="radio"/> DIFFUSERS										
35	<input checked="" type="radio"/> RELATIVE HUMIDITY: MIN / MAX <b>25</b> / <b>100</b> (%)															
36	UNUSUAL CONDITIONS: (5.1.30) <input checked="" type="radio"/> DUST <input type="radio"/> FUMES					<input checked="" type="radio"/> PERFORMANCE:										
37	<input checked="" type="radio"/> OTHER <b>Ambient Trace H<sub>2</sub>S</b>					PROPOSAL CURVE NO. <input type="radio"/> RPM										
38						<input type="radio"/> IMPELLER DIA. RATED _____ MAX. _____ MIN. _____ (mm)										
39						<input type="radio"/> IMPELLER TYPE _____										
40	<input type="radio"/> DRIVER TYPE					<input type="radio"/> RATED POWER _____ (kW) EFFICIENCY _____ (%)										
41	<input checked="" type="radio"/> INDUCTION MOTOR <input type="radio"/> STEAM TURBINE <input type="radio"/> GEAR					<input type="radio"/> MINIMUM CONTINUOUS FLOW:										
42	<input type="radio"/> OTHER _____					THERMAL _____ (m3/hr) STABLE _____ (m3/hr)										
43						<input type="radio"/> PREFERRED OPER. REGION _____ TO _____ (m3/hr)										
44	<input type="radio"/> MOTOR DRIVER (6.1.1 / 6.1.4) <b>Note I</b>					<input type="radio"/> ALLOWABLE OPER. REGION _____ TO _____ (m3/hr)										
45	<input checked="" type="radio"/> MANUFACTURER					<input type="radio"/> MAX HEAD @ RATED IMPELLER _____ (m)										
46	<input type="radio"/> _____ (kW) <input type="radio"/> _____ (RPM)					<input type="radio"/> MAX POWER @ RATED IMPELLER _____ (HP)										
47	<input type="radio"/> FRAME <input checked="" type="radio"/> ENCLOSURE					<input type="radio"/> NPSHR AT RATED CAPACITY _____ (m) (5.1.10)										
48	<input checked="" type="radio"/> HORIZONTAL <input checked="" type="radio"/> VERTICAL <input checked="" type="radio"/> SERVICE FACTOR <b>1.0</b>					<input checked="" type="radio"/> SUCTION SPECIFIC SPEED										
49	<input checked="" type="radio"/> VOLTS/PHASE/HERTZ <b>415</b> / <b>3</b> / <b>50</b>					MAX/ACTUAL _____ / _____ (5.1.11)										
50	<input checked="" type="radio"/> TYPE <b>Squirrel Cage Induction</b>					<input checked="" type="radio"/> MAX. SOUND PRESS. LEVEL REQ'D <b>85 (@ 1 m)</b> (dBA) (5.1.16)										
51	<input type="radio"/> MINIMUM STARTING VOLTAGE (6.1.5)					<input type="radio"/> EST MAX SOUND PRESS. LEVEL _____ (dBA) (5.1.16)										
52	<input checked="" type="radio"/> INSULATION <b>CLASS F</b> <input checked="" type="radio"/> TEMP. RISE <b>CLASS B</b>					<input type="radio"/> UTILITY CONDITIONS										
53	<input type="radio"/> FULL LOAD AMPS					ELECTRICITY										
54	<input type="radio"/> LOCKED ROTOR AMPS					VOLTAGE <b>415</b> PHASE <b>3</b> HERTZ <b>50</b>										
55	<input checked="" type="radio"/> STARTING METHOD <b>DOL</b>					DRIVERS										
56	<input type="radio"/> LUBE					HEATING										
57						SYSTEM VOLTAGE DIP <input type="radio"/> 80% <input type="radio"/> OTHER _____ (6.1.5)										
58	BEARINGS (TYPE/NUMBER):					STEAM										
59	<input type="radio"/> RADIAL <b>Anti Friction</b> /					MAX. PRESS. <b>43</b> kg/cm2 g MAX. TEMP. <b>400</b> °C MIN. PRESS. <b>39</b> kg/cm2 g MIN. TEMP. <b>380</b> °C										
60	<input type="radio"/> THRUST <b>Anti Friction</b> /					DRIVERS										
61	<input type="radio"/> VERTICAL THRUST CAPACITY					HEATING										
62	UP _____ (N) DOWN _____ (N)					MAX. PRESS. <b>5</b> kg/cm2 g MAX. TEMP. <b>190</b> °C MIN. PRESS. <b>3</b> kg/cm2 g MIN. TEMP. <b>143</b> °C										
63						COOLING WATER: (5.1.19) SOURCE										
64						SUPPLY TEMP. <b>35</b> (°C) MAX. RETURN TEMP. <b>44</b> (°C)										
65						NORM. PRESS. <b>5.5</b> (kg/cm2 g) DESIGN PRESS. <b>6.5</b> (kg/cm2 g)										
						MIN. RET. PRESS <b>2</b> (kg/cm2 g) MAX. ALLOW. D.P. <b>0.7</b> kg/cm2										
						CHLORIDE CONCENTRATION: <b>Hold</b> (PPM)										



**BLACK & VEATCH  
CENTRIFUGAL PUMP  
PROCESS DATA SHEET**

PAGE **2** OF **4**  
JOB NO. **160796** ITEM NO.(S) **086/087/088-P005 A/B**  
REQ / SPEC NO. **1**  
PURCH ORDER NO. DATE **5/9/08**  
INQUIRY NO **0** BY **VS**

- 1 (1) Total of six (6) pumps shall be provided, two for each SRU. ie The quantity of pumps required for unit 088 is two (2) - 1 running + 1 standby.
- 2 (2) Pump mounting plate, column pieces, steam jackets, steam piping and fittings shall be CS. **Note N**
- 3 (3) Above 170°C viscosity increases rapidly. Pumps shall be able to operate with MAX. viscosity specified on page 1 of 4.
- 4 (4) Steam temperature must stay below 170 °C to avoid high viscosity of sulfur.
- 5 (5) Shaft sealing shall be achieved using gas tight construction with deep stuffing box and graphite impregnated packing.
- 6 (6) Pumps shall be equipped with sufficient holes for quick draining.
- 7 (7) Pumps shall be located inside the pit. Approximate distance from pump mounting plate to the bottom of sulfur pit **Note O**
- 8 is 3.3m.
- 9 (8) Pumps shall be furnished with suction strainer. Vendor shall take into account pressure drop across strainer.
- 10 (9) Pumps shall be able to empty the pit down to the bottom.
- 11 (10) Vendor shall ensure sufficient cooling of lineshaft bearings.
- 12 (11) Pump Vendor shall provide minimum flow recirculation to allow pump to be dead headed.
- 13 Pump Capacity shown is net process capacity. Actual total capacity is minimum flow plus net process capacity.
- 14 Vendor to set minimum flow capacity.
- 15 (12) Vendor to take into account additional head required at impeller due to discharge column height and friction loss.
- 16 ~~(13) Pump minimum flow circulation FO-0209 at 15.9 m<sup>3</sup>/hr @ flow has been considered. Pump vendor shall confirm the minimum~~
- 17 ~~flow circulation if it exceeds 15.9 m<sup>3</sup>/hr @ flow.~~
- 18
- 19 (13) FO 0209 shall be supplied by pump vendor and same shall be designed based on minimum flow of the pump.
- 20
- 21
- 22
- 23
- 24
- 25
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**BLACK & VEATCH  
CENTRIFUGAL PUMP  
MECHANICAL DATA SHEET**

JOB NO. **160796.0000** ITEM NO. **086/087/088-P005 A/B**  
REQ / SPEC NO. **7**  
PURCH ORDER NO. DATE **5/9/2008**  
INQUIRY NO. **0** BY **VS**

CONSTRUCTION				SURFACE PREPARATION AND PAINT			
1 <b>ROTATION</b> (VIEWED FROM COUPLING END) <input type="checkbox"/> CW <input type="checkbox"/> CCW				2 <input checked="" type="radio"/> MANUFACTURER'S STANDARD <input type="radio"/> OTHER (SEE BELOW)			
3 <b>PUMP TYPE: (1.3)</b>				3 <b>PUMP:</b> <b>Note F</b>			
4 <input checked="" type="checkbox"/> VS1 <input type="checkbox"/> VS2 <input type="checkbox"/> VS3 <input checked="" type="checkbox"/> VS4 <input type="checkbox"/> VS5 <input type="checkbox"/> VS6 <input type="checkbox"/> VS7				4 <input type="radio"/> PUMP SURFACE PREPARATION			
5 <b>CASING MOUNTING:</b> <input type="checkbox"/> SUMP COVER PLATE				5 <input checked="" type="checkbox"/> PRIMER			
6 <input type="checkbox"/> INLINE <input checked="" type="checkbox"/> SEPARATE MOUNTING PLATE (8.3.8.3.1)				6 <input type="radio"/> FINISH COAT			
7 <input type="checkbox"/> SEPARATE SOLE PLATE (8.3.8.3.3)				7 <b>BASEPLATE / COLUMN:(6.3.17)</b>			
8 <b>CASING SPLIT:</b>				8 <input type="radio"/> BASEPLATE SURFACE PREPARATION			
9 <input type="checkbox"/> AXIAL <input checked="" type="checkbox"/> RADIAL				9 <input type="radio"/> PRIMER			
10 <b>CASING TYPE:</b>				10 <input type="radio"/> FINISH COAT			
11 <input checked="" type="checkbox"/> SINGLE VOLUTE <input type="checkbox"/> MULTIPLE VOLUTE <input type="checkbox"/> DIFFUSER				11 <b>SHIPMENT: (7.4.1) Note E</b>			
12 <b>CASE PRESSURE RATING:</b>				12 <input type="radio"/> DOMESTIC <input checked="" type="radio"/> EXPORT <input checked="" type="radio"/> EXPORT BOXING REQUIRED			
13 <input type="checkbox"/> MAX ALLOWABLE WORKING PRESSURE (kg/cm2)				13 <input checked="" type="radio"/> OUTDOOR STORAGE MORE THAN 6 MONTHS			
14 @ (°C)				14 <b>SPARE ROTOR ASSEMBLY PACKAGED FOR:</b>			
15 <input type="checkbox"/> HYDROTEST PRESSURE (kg/cm2)				15 <input type="radio"/> HORIZONTAL STORAGE <input type="radio"/> VERTICAL STORAGE			
16 <input type="radio"/> SUCTION PRESS. REGIONS MUST BE DESIGNED FOR MAWP (5.3.6)				16 <input type="radio"/> TYPE OF SHIPPING PREPARATION			
17 <b>NOZZLE CONNECTIONS: (5.4.2)</b>				17 <b>HEATING AND COOLING</b>			
18				18 <input type="radio"/> HEATING JACKET REQ'D. (5.8.9) <input checked="" type="checkbox"/> COOLING REQ'D.			
19				19 <input checked="" type="checkbox"/> COOLING WATER PIPING PLAN (6.5.4.1)			
20 SUCTION				20 C.W. PIPING:			
21 DISCHARGE				21 <input checked="" type="checkbox"/> PIPE <input checked="" type="checkbox"/> TUBING; FITTINGS			
22 BALANCE DRUM				22 C.W. PIPING MATERIALS:			
23				23 <input checked="" type="checkbox"/> S. STEEL <input checked="" type="checkbox"/> C. STEEL <input checked="" type="checkbox"/> GALVANIZED			
24				24 COOLING WATER REQUIREMENTS:			
25				25 <input type="checkbox"/> BEARING HOUSING (m³/h) @ (kg/cm2)			
26				26 <input type="checkbox"/> HEAT EXCHANGER (m³/h) @ (kg/cm2)			
27				27 STEAM PIPING: <input type="radio"/> TUBING <input type="radio"/> PIPE			
28				28 <b>BEARINGS AND LUBRICATION Note K</b>			
29				29 <b>BEARING (TYPE/NUMBER):</b>			
30				30 <input type="checkbox"/> RADIAL <b>Bushing</b> /			
31				31 <input type="checkbox"/> THRUST <b>Ball (1)</b> /			
32 <b>ROTOR:</b>				32 LUBRICATION (5.11.3, 5.11.4):			
33 <input checked="" type="radio"/> COMPONENT BALANCE TO ISO 1940 G2.5 (5.9.4.4)				33 <input checked="" type="checkbox"/> GREASE (1) <input checked="" type="checkbox"/> FLOOD <input type="radio"/> PURGE OIL MIST			
34 <input type="radio"/> SHRINK FIT -LIMITED MOVEMENT IMPELLERS (8.2.2.3)				34 <input checked="" type="checkbox"/> FLINGER <input type="radio"/> PURE OIL MIST			
35 <b>COUPLINGS:</b>				35 <input type="radio"/> CONSTANT LEVEL OILER PREFERENCE (5.10.2.2):			
36 <input type="radio"/> MANUFACTURER <input checked="" type="checkbox"/> MODEL				36 <input checked="" type="checkbox"/> OIL VISC. ISO GRADE			
37 <input type="checkbox"/> RATING (kW/100 RPM)				37 <input type="radio"/> REVIEW AND APPROVE THRUST BEARING SIZE			
38 <input checked="" type="checkbox"/> SPACER LENGTH (mm) <input checked="" type="checkbox"/> SERVICE FACTOR				38 <input checked="" type="checkbox"/> OIL HEATER REQUIRED: <input type="radio"/> STEAM <input type="radio"/> ELECTRIC			
39 <input checked="" type="checkbox"/> RIGID				39 <b>INSTRUMENTATION (6.4.2)</b>			
40 <b>THROUGH COUPLINGS:</b>				40 <input type="radio"/> ACCELEROMETER (6.4.2.2)			
41 <input type="radio"/> MANUFACTURER <input checked="" type="checkbox"/> MODEL				41 <input type="radio"/> PROVISION FOR MOUNTING ONLY (5.10.2.10)			
42 <input type="checkbox"/> RATING (kW/100 RPM) <input type="radio"/> LUBE				42 <input type="radio"/> FLAT SURFACE REQ'D (5.10.2.11) <b>Note L</b>			
43 <input checked="" type="checkbox"/> SPACER LENGTH (mm) <input checked="" type="checkbox"/> SERVICE FACTOR				43 <input type="radio"/> PRESSURE GAUGE TYPE			
44 <input checked="" type="checkbox"/> RIGID				44 REMARKS:			
45 DRIVER HALF COUPLING MOUNTED BY:				45			
46 <input checked="" type="radio"/> PUMP MFR. <input type="radio"/> DRIVER MFR. <input type="radio"/> PURCHASER				46			
47 <input type="radio"/> COUPLING BALANCED TO ISO 1940-1 G.6.3 (6.2.3)				47			
48 <input type="radio"/> COUPLING PER ISO 14691(6.2.3)				48			
49 <input type="radio"/> COUPLING PER ISO 10441(6.2.3)				49			
50 <input type="radio"/> COUPLING PER API 671(6.2.3)				50			
51 <input checked="" type="radio"/> NON SPARK COUPLING GUARD (6.2.13)				51			
52 <input checked="" type="radio"/> COUPLING GUARD STANDARD				52			
53 ASME B15.1 OTHER <b>OSHA</b>				53			
54 <b>MECHANICAL SEAL:</b>				54 <input type="checkbox"/> WEIGHTS			
55 <input type="radio"/> SEE ATTACHED ISO 21049/API 682 DATA SHEET				55 WEIGHT OF PUMP (kg)			
56				56 WEIGHT OF DRIVER (kg)			
57				57 WEIGHT OF GEAR (kg)			
58				58 WEIGHT OF BASEPLATE (kg)			
59				59 TOTAL WEIGHT (kg)			
60				60			
61				61			



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JOB NO. 160796 ITEM NO. 086/087/088-P005 A/B

REQ / SPEC NO. /

PURCH ORDER NO.

DATE 5/9/2008

INQUIRY NO

0

BY

VS

# BLACK & VEATCH CENTRIFUGAL PUMP MECHANICAL DATA SHEET

SPARE PARTS (TABLE 18)		VERTICAL PUMPS (CONT.)	
<input checked="" type="radio"/> START-UP <input checked="" type="radio"/> NORMAL MAINTENANCE <input type="radio"/> SPECIFY _____		<input type="radio"/> PUMP AND STRUCTURE DYNAMIC ANALYSIS (8.3.5) <input type="radio"/> DRAIN PIPED TO SURFACE (8.3.13.4)	
OTHER PURCHASER REQUIREMENTS		QA INSPECTION AND TESTING <b>Note J</b>	
<input checked="" type="radio"/> COORDINATION MEETING REQUIRED (9.1.3) <input type="radio"/> MAXIMUM DISCHARGE PRESSURE TO INCLUDE (5.3.2) <input type="radio"/> MAX RELATIVE DENSITY <input type="radio"/> MAX DIA. IMPELLERS AND/OR NO OF STAGES <b>Note H</b> <input type="radio"/> OPERATION TO TRIP SPEED <input type="radio"/> CONNECTION DESIGN APPROVAL (5.12.3.4) <input type="radio"/> TORSIONAL ANALYSIS REQUIRED (5.9.2.1) <input type="radio"/> TORSIONAL ANALYSIS REPORT (5.9.2.6) <input type="radio"/> PROGRESS REPORTS (9.3.3) <input type="radio"/> OUTLINE OF PROCEDURES FOR OPTIONAL TESTS (9.3.5) <input type="radio"/> ADDITIONAL DATA REQUIRING 20 YEARS RETENTION (7.2.2.1f) MANIFOLD PIPING TO SINGLE CONNECTION (6.5.1.6) <input type="checkbox"/> VENT <input type="checkbox"/> VENT <input type="checkbox"/> COOLING WATER <input checked="" type="checkbox"/> MOUNT SEAL RESERVOIR OFF BASEPLATE (6.5.1.4) <input checked="" type="checkbox"/> FLANGES REQUIRED IN PLACE OF SOCKET WELD UNIONS (6.5.2.8) CONNECTION BOLTING <input type="radio"/> PTFE COATING <input type="radio"/> SS <input type="radio"/> PAINTED <input type="radio"/> ASTM A153 GALVANIZED <input checked="" type="radio"/> INSTALLATION LIST IN PROPOSAL (9.2.3L)	<input type="radio"/> SHOP INSPECTION (7.1.4) <input checked="" type="radio"/> PERFORMANCE CURVE APPROVAL <input checked="" type="checkbox"/> TEST WITH SUBSTITUTE SEAL (7.3.3.2) <input type="radio"/> TEST (7.3.1.2) NON-WIT WIT OBSERVE <input type="radio"/> HYDROSTATIC TEST OF BOWLS AND COLUMN (8.3.13.2) <input checked="" type="radio"/> HYDROSTATIC (7.3.2) <b>Note M</b> <input checked="" type="radio"/> PERFORMANCE (7.3.3) <input type="radio"/> RETEST ON SEAL LEAKAGE (7.3.3.2d) <input type="radio"/> NPSH (7.3.4.2) <b>Note G</b> <input type="radio"/> COMPLETE UNIT TEST (7.3.4.3) <input type="radio"/> SOUND LEVEL TEST (7.3.4.4) <input type="radio"/> CLEANLINESS PRIOR TO FINAL ASSEMBLY (7.2.2.2) <input type="radio"/> NOZZLE LOAD TEST (6.3.6) <input type="radio"/> 4 HR. MECHANICAL RUN TEST (7.3.4.7.1) <input type="radio"/> MECHANICAL RUN UNTIL OIL TEMP. STABLE (7.3.4.7.1) <input type="radio"/> 4 HR. MECHANICAL RUN AFTER OIL TEMP. STABLE (7.3.4.7.3) <input type="radio"/> TRUE PEAK VELOCITY DATA (7.3.3.4.d) <input type="radio"/> RESONANCE TEST (8.3.9.2) <input type="radio"/> PUMP STRUCTURAL RESONANCE TEST (8.3.9.2) <input type="radio"/> AUXILIARY EQUIPMENT TEST (7.3.4.5) <input checked="" type="checkbox"/> CHARPY TEST (EN 13445/ASME VIII) <input checked="" type="radio"/> VENDOR KEEP REPAIR AND HT RECORDS (7.2.1.1c) <input checked="" type="radio"/> VENDOR SUBMIT TEST PROCEDURES (7.3.1.2 / 9.2.5) <input type="radio"/> VENDOR SUBMIT TEST DATA WITHIN 24 HOURS (7.3.3.3e) <input type="radio"/> INCLUDE PLOTTED VIBRATION SPECTRA (5.9.3.3) <input type="radio"/> RECORD FINAL ASSEMBLY RUNNING CLEARANCES <input type="radio"/> COMPLETION OF INSPECTION CHECK LIST (7.1.6) <input type="radio"/> MATERIAL CERTIFICATION REQUIRED (5.12.1.8) <input type="radio"/> COLUMN <input type="radio"/> IMPELLER <input type="radio"/> SHAFT <input type="radio"/> OTHER <input checked="" type="radio"/> CASTING REPAIR PROCEDURE APPROVAL REQ'D (5.12.2.5) <input checked="" type="checkbox"/> INSPECTION REQUIRED FOR CONNECTION WELDS (5.12.3.4) (5.12.1.5) <input checked="" type="checkbox"/> MAG PARTICLE <input checked="" type="checkbox"/> LIQUID PENETRANT <input checked="" type="checkbox"/> RADIOGRAPHIC <input checked="" type="checkbox"/> ULTRASONIC <input checked="" type="checkbox"/> INSPECTION REQUIRED FOR CASTINGS (7.2.1.3) (5.12.1.5) <input checked="" type="checkbox"/> MAG PARTICLE <input checked="" type="checkbox"/> LIQUID PENETRANT <input checked="" type="checkbox"/> RADIOGRAPHIC <input checked="" type="checkbox"/> ULTRASONIC <input type="radio"/> HARDNESS TEST REQUIRED (7.2.2.3) <input type="radio"/> ADDITIONAL SUBSURFACE EXAMINATION (7.2.1.3) FOR _____ METHOD _____		
VERTICAL PUMPS			
<input type="checkbox"/> PUMP THRUST: (+) UP (-) DOWN AT MIN. FLOW (N) (N) AT RATED FLOW (N) (N) AT MAX. FLOW (N) (N) MAX THRUST (N) (N) <input checked="" type="checkbox"/> SOLEPLATE REQ'D. (8.3.8.3.3) (m) X (m) <input checked="" type="radio"/> MOUNTING PLATE REQUIRED (8.3.9.3.1) <input type="checkbox"/> SOLEPLATE THICKNESS (mm) COLUMN PIPE: <input checked="" type="checkbox"/> FLANGED <input type="checkbox"/> THREADED DIAMETER (mm) LENGTH (m) GUIDE BUSHINGS <input type="checkbox"/> NUMBER <input type="checkbox"/> LINE SHAFT BEARING SPACING (mm) GUIDE BUSHINGS LUBE: <input type="checkbox"/> WATER <input type="checkbox"/> OIL <input type="checkbox"/> GREASE <input checked="" type="checkbox"/> PUMPAGE LINESHAFT: <input checked="" type="checkbox"/> OPEN <input checked="" type="checkbox"/> ENCLOSED <input type="checkbox"/> LINE SHAFT DIAMETER: (mm) <input type="checkbox"/> TUBE DIAMETER: (mm) LINESHAFT COUPLING: <input type="checkbox"/> LINE SHAFT DIAMETER: <input type="checkbox"/> SLEEVE & KEY <input type="checkbox"/> THREADED <input type="checkbox"/> SUCTION CAN THICKNESS (mm) <input type="checkbox"/> LENGTH (m) <input type="checkbox"/> DIAMETER (m) <input checked="" type="radio"/> SUCTION STRAINER TYPE <b>Basket</b> <input type="radio"/> FLOAT & ROD <input type="radio"/> FLOAT SWITCH <input type="radio"/> IMPELLER COLLETS ACCEPTABLE (5.6.3) <input type="radio"/> HARDENED SLEEVES UNDER BEARINGS (8.3.10.5)			
<b>Note O</b> REFER TO HYDRAULIC INSTITUTE STANDARDS FOR DEFINITIONS			
<input type="radio"/> SUMP DEPTH (FT) <input type="radio"/> SUMP DIMENSION (FT) <input type="radio"/> LOW LIQUID (FT)		<input type="checkbox"/> PUMP LENGTH (FT) <input type="checkbox"/> SUBMERGENCE REQ'D (FT) <input type="checkbox"/> CENTERLINE DISCHARGE HEIGHT (FT) <input type="checkbox"/> DATUM ELEVATION (FT)	

1	<b>GENERAL</b>									
2	Project: <b>525 TPD STANDBY SRU PROJECT</b>					EIL Job No.: <b>B366</b>				
3	Owner: <b>M/s IOCL</b>					Site: <b>PARADIP, ODISHA</b>				
4	Purchaser: <b>M/s IOCL</b>					Unit: <b>SULPHUR RECOVERY</b>			Unit No.: <b>088</b>	
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 & Info. specified by purchaser <input type="checkbox"/> Info. Required 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	
10	<b>OPERATING CONDITIONS (Refer Licensor Datasheet attached elsewhere in the MR)</b>									
11	Liquid Type or Name:					Capacity (m <sup>3</sup> /hr): Nor/Rated/Others: (Rem. 24)				
12	<input type="checkbox"/> Hazardous <input type="checkbox"/> Flammable <input type="checkbox"/> Others					Discharge Pressure (kg/cm <sup>2</sup> ,G):				
13	Pumping Temperature (°C) (Min./Nor./Max.):					Suction Pressure: Max//Rated (kg/cm <sup>2</sup> G):				
14	Specific Gravity (Nor./Max.):					Diff. Pressure (kg/cm <sup>2</sup> ):				
15	Vap. Pressure (kg/cm <sup>2</sup> ,A):					Differential Head (m):				
16	Viscosity (cP) (Nor./Max.):					NPSH Available (m): (Rem. 23)				
17	Specific Heat (kcal/kg°C):					Process Variations:				
18	Chloride Concentration (ppm):		Corr./Eros. Agent:			Starting Conditions:				
19	H2S Concentration (ppmw):					Service: <input type="checkbox"/> Cont. <input type="checkbox"/> Intermittent (Starts/Day):				
20	<b>MANUFACTURER'S SPECIFICATIONS</b>									
21	Pump Manufacturer:					Model No.:				
22	<b>CONSTRUCTION</b>									
23	Pump Type:					Bowl Head Calculations:				
24	<input checked="" type="checkbox"/> Vertical Sump (VS4) <input type="checkbox"/> Turbine <input type="checkbox"/> Submerged Motor					Differential Head at Discharge Flange (m):				
25	<input type="checkbox"/> Vertical Double Casing					Diff. Between Minimum Submergence Level and bottom of Mounting plate (m):				
26	<input type="checkbox"/> Single Volute <input type="checkbox"/> Double Volute <input type="checkbox"/> Diffuser					Thickness of Support Plate (m):				
27	Casing Connections: <input type="checkbox"/> Vent <input type="checkbox"/> Drain <input type="checkbox"/> Gauge					Diff. Between Support Plate Level and Discharge Flange Centerline/Top of Flange (m):				
28	Line Shaft:					Friction losses in Suction Strainer:				
29	<input type="checkbox"/> Open <input checked="" type="checkbox"/> Enclosed					Friction losses in Column/Discharge Pipe:				
30	Shaft Dia. (mm):		No. of Shaft Segments:			Total (Bowl) Differential Head (m):				
31	Spacing between Shaft Guide Bushing (mm):									
32	Coupling: Make									
33	Type: <b>Flexible metallic</b>									
34	Non-spark Guard: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					<b>PERFORMANCE</b>				
35	Line Shaft Coupling Type:					Proposal Curve No.:				
36	<input type="checkbox"/> Threaded <input type="checkbox"/> Muff-Type					Visc. Corr. Factor: C <sub>E</sub> C <sub>Q</sub> C <sub>H</sub>				
37	Column Type: <input type="checkbox"/> Threaded <input checked="" type="checkbox"/> Flanged					NPSH Req'd. (Water) (m): F/L Speed (rpm):				
38	Column NB (mm):		No. of Col. Segments:			No. of stages:				
39	Nozzles	Size	ANSI Rating	Facing	Position	Efficiency (%):				
40	Suction		<b>Bell</b>		<b>Bottom</b>	Rated BkW (0% Tol.) (kW): Max. BkW Rated. Imp. (kW):				
41	Discharge		<b>150#</b>	<b>RF</b>	<b>Top</b>	BKW @ MCF(ρ=1.0):				
42	Imp.N (mm) Max:		Rated:		Min:		Type: <b>Closed</b>		Normal Shaft Power (kW): (Rem. 22)	
43	Guide		Material:		No.				Normal Absorbed Power @ motor terminal (kW): (Rem. 22)	
44	Guide Bushing Lubrication:					Rec. Driver Rating (kW): Max. head rated imp.(m):				
45	<input checked="" type="checkbox"/> Pumpage / Self <input type="checkbox"/> Oil <input type="checkbox"/> Other					Cap @ BEP(m <sup>3</sup> /hr):				
46	<input checked="" type="checkbox"/> No Pre-lubrication Required					MCF (m <sup>3</sup> /hr): Stable Thermal (Rem. 24)				
47	Driver Half cplg. mtd. by: <input checked="" type="checkbox"/> Pump Mfr. <input type="checkbox"/> Others					M.A.W.P @ 15°C/P.T./Design Temp.(kg/cm <sup>2</sup> ,G):				
48	Packing: <b>Yes</b> (Remark-16)		Size:		No. of rings:		Hydrostatic Test pressure (kg/cm <sup>2</sup> ,G):			
49	Mech. Seal: Make					Rotation facing coupling end: <input type="checkbox"/> CW <input type="checkbox"/> CCW				
50	Model:		API Code:			Seal flush/ Quench plan:		Material:		
51	Mounting Plate: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		Fnd. Bolts: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No				C.W. Plan:		Material:	
52	Mtg Plate <input type="checkbox"/> Yes <input type="checkbox"/> No		Mntg. Bolts: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No				Ext. seal flush fluid:		LPM: @ kg/cm <sup>2</sup> G/°C	
53	Motor Mtg Stool: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No						Seal Barrier fluid:		LPM: @ kg/cm <sup>2</sup> G/°C	
54	Balancing <input type="checkbox"/> Yes <input type="checkbox"/> No						Ext. quench fluid:		LPM: @ kg/cm <sup>2</sup> G/°C	
55	Suction Strainer: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		Material: SS316				C.W. Reqmt.		LPM: @ kg/cm <sup>2</sup> G/°C	
56	Type: Basket		Mesh Size:			Thrust (kg) Up:		Max. Min.		
57	Mounting Channel: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					Thrust (kg) Down:		Max. Min.		
58	<b>WEIGHT DATA:</b>									
59	Weight of the Pump (kg):					Weight of the Mounting. Stool (kg):				
60	Weight of the Mounting. Plate (kg):					Weight of the Driver (kg):				
61	Total Weight of the Pump Unit (kg):									

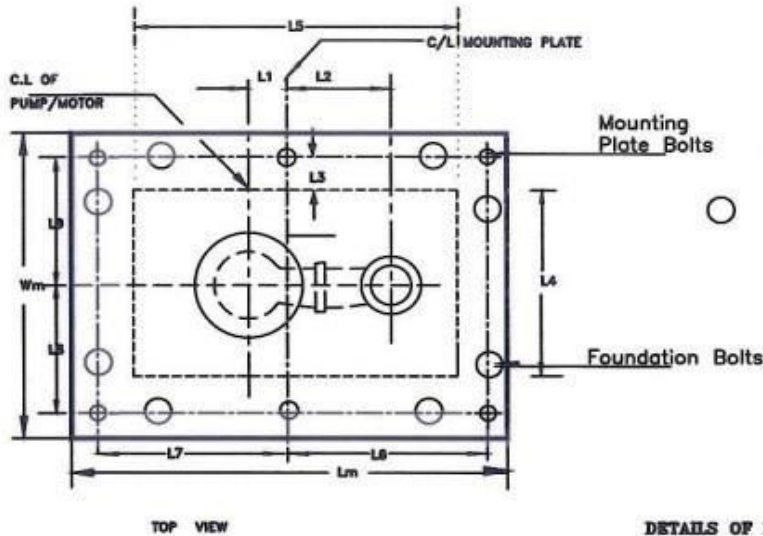
62						
63	INSPECTION & TESTS (EACH PUMP) [Refer doc. # 080557C-000-ITP-0910-001]					
64		Witness	Observe		Witness	Observe
65	■ Shop Test / Inspection	<input type="checkbox"/>	<input type="checkbox"/>	■ Minimum submergence test ■ Mandatory	<input type="checkbox"/>	<input type="checkbox"/>
66	■ Material Certificates	<input type="checkbox"/>	<input type="checkbox"/>	■ Dismantle Inspection & Reassembly after Test	<input type="checkbox"/>	<input type="checkbox"/>
67	■ Hydrostatic	<input type="checkbox"/>	<input type="checkbox"/>	■ Unitisation/Dimensional Check	<input type="checkbox"/>	<input type="checkbox"/>
68	■ Performance/Sound Level	<input type="checkbox"/>	<input type="checkbox"/>	■ Check for dirn. of rotation of pump & driver	<input type="checkbox"/>	<input type="checkbox"/>
69	Materials Class (API 610):					
70	Materials: (Remark-15)	MOC	ASTM Grades	AUXILIARY PIPING INTERFACE CONNECTIONS		
71	Casing (External)			(All interface conn. shall be termntd. with a flng. block valves)		
72	Impeller				Size	Rating(ANSI)
73	Inner Case parts			Lantern Ring Inlet/Outlet		Facing
74	Sleeve Packed / Stuffing Box			Ext. flush fluid Inlet/Outlet		
75	Sleeve Seal			Seal Quench fluid Inlet		
76	Casing wear ring	ΔH-BHN		Seal pot vent/ drain		
77	Impeller wear ring	50(Min.)		Casing vent/ drain		
78	Shaft Driver			C.W Inlet/ Outlet		
79	Shaft Intermediate			Base plate drain (only flanged)		
80	Shaft Pump					
81	Column / Column Flange			Steam Inlet/Outlet for Jacket		
82	Mounting Plate					
83	Discharge Pipe					
84	Throttle Bush					
85						
86	Legend: I-Cast Iron; B-Bronze; S-Carbon Steel; C-11 to 13% Chr Stl; h-Hardened; f-Faced; K-SS 304; L(s)-SS 316L; X-AISI 410, A-Alloy 20					
87	L-SS 316					
88	<input type="checkbox"/> Driver suitable for Pump starting with open Discharge Valve condition.					
89	Applicable Specification: API Std. 610, 11 <sup>th</sup> Edition along with Licensor Specifications attached elsewhere in MR					
90	REMARKS:- 1) Maximum allowable casing working pressure shall not be less than ___ kg/cm <sup>2</sup> .g @ ___ °C.					
91	Down Stream Design Pressure is ___ kg/cm <sup>2</sup> .g. The same shall not be exceeded in any circumstance including that at shutoff (considering.					
92	maximum suction pressure).					
93	2) This pump item shall be installed in sulphur pit. Refer sulphur pit datasheet for sulphur pit details. 300 mm approx. slab thickness shall be considered for pump sizing. Exact slab thickness will be informed during detailed engg. Stage.					
94	3) Any internal recirculation/guide bushing lubrication flow (Δ) required by the pump vendor shall be added to the rated flow. The additional flow (Δ) shall be clearly indicated in the data sheet and shall be used for driver sizing.					
95	4) Performance / Characteristics curves of the pumps shall be furnished by the bidder along with proposal.					
96	5) Pump casing, suction column and discharge pipe shall be steam jacketed. LP steam (refer site & utility data for operating / design					
97	conditions) shall be supplied by purchaser at single in / out point. Mechanical Design pressure & temperature of the jacket shall be					
98	at-least equal to LP steam return header design pressure & temperature.					
99	6) Unitization of pump & driver shall be done in the pump manufacturer's shop.					
100	7) Pump vendor shall furnish the Dimensional Details as per page 4 of 4 of pump data sheet along with proposal.					
101	8) Mounting plate shall be of rectangular shape as shown at page 4 of 4 sketch.					
102	9) Discharge line size is to be steam jacketed.					
103	10) The pump minimum submergence shall be kept below the pit bottom so that pump shall be able to evacuate the pit up to the bottom / floor					
104	level.					
105	11) Material certificates shall be furnished for at least the following components: Casing, Impeller, Shaft, Casing & Impeller wear rings,					
106	Column pipe and Mounting plate.					
107	12) Vendor shall furnish a recommended layout drawing/sketch showing the two pumps (A&B) and recommended distance between them					
108	keeping in view of maintenance/operation of the pumps along with the proposal.					
109	13) Bidder to take a note of clause 6.12.1 of API 610 11 <sup>th</sup> edition and confirm compliance to the same.					
110	14) Manufacturer to ensure sufficient cooling of bearings.					
111	15) Material:- Refer Note-N of Licensor MDS.					
112	16) Shaft sealing shall be achieved using gas tight construction with deep stuffing box & graphite impregnated packing.					
113	17) Pump to have sufficient holes for quick draining.					
114	18) Note that the Installation length of pump may undergo a change by +/- 0.75 M. This change may occur during detail engineering (i.e. post order Stage). All technical changes i.e. change of impeller / driver rating etc. as required to accommodate the changed operating conditions due to change in setting length shall be complied by vendor at that stage without any price/time implication.					
115	19) Pump vendor to confirm to meet vibration levels of API 610-11 <sup>th</sup> edition. Categorical confirmation for the same shall be provided in offer.					
116	20) Pump Vendor to confirm to meet Noise level of 85dBA @1m. Vendor to note that the above specified noise limit shall be guaranteed at site by the vendor. In case, supplied equipment is not meeting the above requirements at site, necessary modification, insulation etc shall be in the vendor's scope of supply without any cost and time implication to purchaser.					
117	21) Pump Vendor shall supply companion flanges along with nuts, bolts, gaskets for non-standard sizes/ rating mismatch.					
118	22) Absorbed power (at motor terminal, including motor efficiency, coupling losses etc.) shall be guaranteed with 0% positive tolerance for					



119	pumps running on normal capacity (i.e process normal flow + pump MCF) at rated differential head (as indicated in respective Licensor
120	Datasheet) and the same shall not exceed 12 kW for pump item # 088-P-004 A/B & 24 kW for pump item # 088-P-005 A/B. Pump vendor to
121	furnish motor efficiency and mechanical losses like losses in coupling etc. to arrive at pump shaft power at normal capacity & rated differential
122	head as stated above. This shaft power shall also be guaranteed with 0% positive tolerance and the same shall be verified during shop
123	performance testing. For details, refer Loading & Penalty criteria (Doc. No. 080557C-000-JSD-0900-002) included elsewhere in the MR.
124	23) NPSH indicated on respective PDS is reported at Bottom of Pit.
125	24) MCF indicated in notes of respective licensor datasheet is for reference only. Since continuous by-pass through 'FO' requirement is there,
126	Pump shall be selected for Capacity # (Process Rated Capacity + Pump MCF) @ Rated Differential Head. 'FO' in corresponding pump MCF
127	line shall be in vendor's scope of supply.
128	25) Pump Mounting Channel (between the pump mounting plate and grout (30mm thick min.) is to be provided by vendor. The channel shall
129	be ISMC-100, duly primer coated. The material of the same shall be of CS.
130	26) Mounting plate with gaskets & fasteners shall be supplied by vendor.
131	27) This is a typical datasheet. Vendor to fill this datasheet for each of the quoted pump item (Item Nos. 088-P-004 A/B &
132	088-P-005 A/B) respectively.

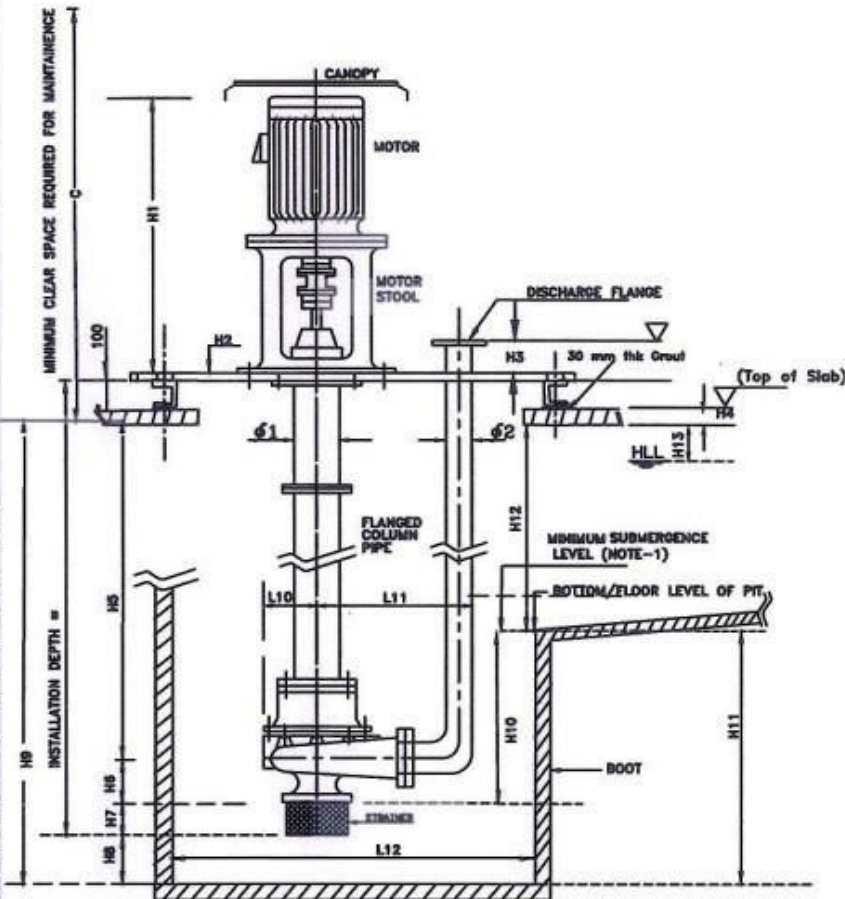


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TOP VIEW

DETAILS OF FDN. BOLTS (No.xDia.x L): \_\_\_\_\_



VENDOR SHALL FURNISH FOLLOWING  
DIMENSIONS IN MM.

S.NO	DESCRIPTION	DIMENSIONS(mm)
1.	$L_m \times W_m$	
2	$\phi 1$	
3	$\phi 2$	
4	L1	
5	L2	
6	L3	100 mm (min)
7	L4	
8	L5	
9	L6	
10	L7	
11	L8	
12	L9	
13	L10	
14	L11	
15	H1	
16	H2	45 mm (min)
17	H3	150 mm (min)
18	H4	
19	H5	
20	H6	
21	H7	
22	H8	
23	H9	
24	H10	
25	H11	
26	H12	
27	H13	
28	L12	
29	C	

INSTALLATION DEPTH =  $H5+H6+H7+H4+100$  = \_\_\_\_\_ mm (Including 30 mm thk Grout)  
 MINIMUM SUBMERGENCE LEVEL = H10 = \_\_\_\_\_ mm  
 CLEARANCE FROM BOTTOM = H8 = \_\_\_\_\_ mm  
 DIFFERENCE BETWEEN MIN. SUBM. LEVEL TO PUMP DISCH. FLANGE =  $H5+H6+H3+100-H10$  = \_\_\_\_\_ mm

NOTES:

- 1) MINIMUM SUBMERGENCE SHALL BE WITHIN THE BOOT TO ENSURE COMPLETE DRAINAGE OF THE PIT
- 2) Please also refer GA Drawing of Sulphur Pit ( ) as attached with MR.



ENGINEERS INDIA LIMITED  
NEW DELHI

FILE NO-BE -106 RO.DWG



PUMP-CENTRIFUGAL VERTICAL  
(Pit Mounted)

DRAWING NO.

REV.

A



 	<b>PROJECT</b>		<b>Standby SRU &amp; Additional Tanks</b>		
	<b>CLIENT</b>		<b>INDIAN OIL CORPORATION LIMITED</b>		
<b>PROCESS DATASHEET FOR SULPHUR PIT</b>	<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-088-PDS-1700-001		<b>Rev. No.</b> B	Page 1 of 11


## SULPHUR RECOVERY UNIT (SRU) (UNIT 088)

### PROCESS DATASHEET FOR SULPHUR PIT (088-SU-001)

B	07-02-2020	ISSUED FOR INFORMATION	SG	LK	AR	JMC
A	26-11-2019	ISSUED FOR INFORMATION	JU	LK	AR	JMC
<b>REV.</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>PREPARED</b>	<b>CHECKED</b>	<b>APPROVED</b>	<b>AUTHORIZED</b>

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 	<b>PROJECT</b>		<b>Standby SRU &amp; Additional Tanks</b>	
	<b>CLIENT</b>		<b>IOCL Paradip Refinery</b>	
<b>PROCESS DATASHEET SULPHUR PIT</b>	<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-088-PDS-1700-001	<b>Rev. No.</b> B	Page 2 of 11


#### GENERAL NOTES:

- A. The Licensor Basic Design Package for the SRU/TGTU consists of 3 x 50% SRU trains and 2 x 100% TGTU trains. However, at original Sulphur Recovery Unit (SRU) project sanction the redundant units (Units 088 & 090) were deferred.
- B. Indian Oil Corporation Limited (IOCL) intend to install a standby SRU train (Unit 088) of 525 TPD along with Tail Gas Incinerator (Unit 090) at the existing Paradip Refinery.
- C. Unit 088 will, as far as possible, be identical to Units 086 and 087. The equipment specification for Units 086 and 087 has therefore been issued for the same equipment service in Unit 088.
- D. The Basic Design Package (BDP) has been provided by a licensor (Black & Veatch). Bidders/vendors should not communicate with Black & Veatch directly with regard to this enquiry. Any questions or clarifications should be forwarded to Technip India Limited for resolution with the client IOCL. Note that there are specific instances where design details/specifications must be submitted to Black & Veatch for approval.

#### NOTES SPECIFIC TO THE EQUIPMENT WITHIN THIS SPECIFICATION:

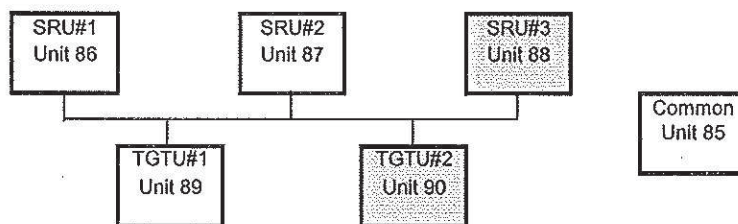
- T1. Reference to Units 086 and 087 to be read as Unit 088.
- T2. Equipment quantity required is ONE.
- T3. General notes G1, G2, G3 and Notes 1 and 2 in Foster Wheeler Energy Limited's FEED stage coversheet for this equipment shall be ignored. Remaining notes in Foster Wheeler Energy Limited's FEED stage coversheet shall be followed.
- T4. Sulphur pit pumps 088-P-005 A/B are in continuous operation.
- T5. Height of vapor space above Liquid Sulphur high liquid level and height above dividing wall shall be confirmed and increased as required ~~by LSTK contractor during detailed engineering~~ based on civil design of sump. No reduction in sump depth is allowed.
- T6. Sulphur pit pumps' ( 088-P-004 AB and 088-P-005-AB) shaft length shall be confirmed ~~during detailed engineering by LSTK contractor~~ based on final depth of Sulphur pit 088-SU-001.
- T7. Sulphur pit pumps ( 088-P-004 AB and 088-P-005-AB) shall be installed within the respective low point sumps of Sulphur pit 088-SU-001 so that minimum submergence requirements of the pumps are met.



 FOSTER WHEELER ENERGY LIMITED				PROCESS SPECIFICATION	
CUSTOMERS NAME: Indian Oil Corporation Ltd (IOCL)				PROJECT No: PDRP	
LOCATION: Paradip, Orissa State, India				UNIT No: SRU#1&2 UNITS : 86 & 87	
SERVICE: SULPHUR PIT				ITEM No: 086/087-SU-001 No. REQD: 2	
				DOCUMENT CAT.-CLASS 1	
REV	O1	F1		DOCUMENT No. PDRP4220-8110-PS-086-0027	
DATE	16-Jul-09	20-Oct-09		SHEET 1 OF 1	
ORIG. BY	JMRJ	DJL		DOCUMENT SEQUENCE No. 17760	
APP. BY	SMR	SMR			

**GENERAL NOTES.**

G1. The Licensor Basic Design Package for the SRU/TGTU consists of 3 x 50% SRU trains and 2 x 100% TGTU trains. There being a single redundant SRU train and a single redundant TGTU train. However, at project sanction the redundant units (Units 88 & 90) were deferred as shown in grey below.



G2. Note that Unit 87 will, as far as possible, be identical to Unit 86. A single specification has therefore been issued to cover like for like equipment on Units 86 & 87.

G3. The Basic Design Package (BDP) has been provided by a licensor (Black & Veatch). Bidders/vendors should not communicate with Black & Veatch directly with regard to this enquiry. Any questions or clarifications should be forwarded to Foster Wheeler Energy Ltd for resolution with the client IOCL. Note that there are specific instances where design details/specifications must be submitted to Black & Veatch for approval.

**NOTES SPECIFIC TO THE EQUIPMENT WITHIN THIS SPECIFICATION**

Referring to the attached licensor engineering datasheet the following notes apply, taking precedence over notes stated in the Black and Veatch Specification Sheets

- Reference to unit 088 shall be ignored.
- The number required is TWO.
- The material of construction for vertical sections of the steam coil should read 304L SS not 316L SS.



**BLACK & VEATCH**  
**Sulfur Pit Data Sheet**

Client:	<b>Indian Oil Corporation Ltd (IOCL)</b>	Job No.	<b>160796.1000</b>
Project:	<b>Paradip Refinery Project</b>	Req No.	
Location:	<b>Paradip, Orissa State, India</b>	By:	<b>MB/DAO</b>
Item No:	<b>086-SU-001, 087-SU-001, 088-SU-001 Note 1</b>	Page:	<b>1 of 8</b>
Service:	<b>Sulfur Pit, Unit 086, Unit 087 &amp; Unit 088</b>	Quantity	<b>Three (3) Note 2</b>

## 1.0 DESCRIPTION

The Sulfur Pit is a below grade, all concrete storage pit. The design liquid sulfur production rate is based on the Design case, which produces 525 MTPD liquid sulfur per SRU train or 1050 MTPD total. One Sulfur Pit is required for each of the **three** Note 2 Sulfur Recovery Units- Unit 086, Unit 087 & Unit 088. The Sulfur pit has two compartments - the 1<sup>st</sup> Compartment for Rundown sulfur and the 2<sup>nd</sup> compartment for the final product sulfur. The two compartments are adjacent to each other, with an internal concrete wall separating each compartment.

The Rundown Chamber receives all molten sulfur that flows by gravity from the 1<sup>st</sup>, 2<sup>nd</sup> and Final Sulfur Condensers in the SRU. The combined sulfur in this section of the pit comes in at 172°C and is undegassed. The undegassed sulfur can have up to 350 ppmwt of dissolved H<sub>2</sub>S. The undegassed sulfur contained in the Rundown chamber flows to the Degassing Pumps (086/087/088-P-004A/B) which are mounted in a sump. The sulfur is then pumped to the Sulfur Cooler (086/087/088-E-009) where the sulfur is cooled to 138°C. From the Sulfur Cooler it flows to the Degassing Contactor (086/087/088-C-001) where it is sparged with air and is also contacted with Claus Catalyst to promote the removal of H<sub>2</sub>S from the sulfur. The cooled, degassed sulfur then gravity flows from the Degassing Contactor back to the Product Chamber. The Rundown Chamber has been sized for a residence time of approximately 12 hours.

The Product Chamber receives cooled, degassed sulfur from the Degassing Contactor. The Product Chamber provides a 24 hour residence time to hold the sulfur for transfer to the OSBL Sulfur Storage Tanks. The Sulfur Pit Pumps are mounted in a sump located in the Product Chamber. These pumps serve to transfer the degassed molten sulfur to the Sulfur Storage Tank. The pumps are operated intermittently based on the sulfur level in the Product Chamber.

Both the Rundown and Product Chambers shall contain Steam Coils designed to maintain a 127°C minimum pit (molten sulfur) temperature in the event of an SRU shutdown. Reference Paragraph 8.0 for steam coil details. All coils shall consist of vertical risers for steam supply and condensate return for each individual horizontal coil.

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<b>Approved/Date</b>		DAO 09-May-08		



**BLACK & VEATCH**  
**Sulfur Pit Data Sheet**

Client:	<b>Indian Oil Corporation Ltd (IOCL)</b>	Job No.	<b>160796.1000</b>
Project:	<b>Paradip Refinery Project</b>	Req No.	
Location:	<b>Paradip, Orissa State, India</b>	By:	<b>MB/DAO</b>
Item No:	<b>086-SU-001, 087-SU-001, 088-SU-001</b> Note 1	Page:	<b>2 of 8</b>
Service:	<b>Sulfur Pit, Unit 086, Unit 087 &amp; Unit 088</b>	Quantity	<b>Three (3)</b> Note 2

## 2.0 SIZING

Please see sketch on page 6. The overall inside dimensions of the Sulfur Pit are given below.

### A. Dimensions (Inside)

#### 1st Compartment (Rundown Chamber):

3.2 m deep  
7.0 m wide (inside wall-to-wall)  
7.5 m long (inside wall-to-wall)

#### 2nd Compartment (Product Chamber):

3.2 m deep  
7.0 m wide (inside wall-to-wall)  
15.0 m long (inside wall-to-wall)

Note: Dimensions are approximate, to be confirmed by Civil Designer to include concrete thicknesses and floor sloping. Depth is referenced from the inside top of the pit which is 300 mm above grade. The depth at the dividing wall is noted, which results in a pit depth of 3.125 m to 3.350 m.

### B. Volume

1st Compartment (Rundown Chamber)	Actual Volume:	166 m <sup>3</sup>
	Working Volume:	147 m <sup>3</sup>
	Storage:	12.0 hours
2nd Compartment (Product Chamber)	Actual Volume:	360 m <sup>3</sup>
	Working Volume:	295 m <sup>3</sup>
	Storage:	24.0 hours

## 3.0 MATERIALS OF CONSTRUCTION

- 3.1 Concrete used for the sulfur pit walls, slab, and roof shall be watertight.
- 3.2 Use sulfate resistant Portland ASTM C-150 Type V cement with tricalcium aluminate (C3A) content less than 6 percent or equivalent.
- 3.3 Use acid resistant aggregate of silica rock such as found in quartz, mica, and feldspar. Do not use sedimentary rock such as limestone or aggregate. The maximum

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**BLACK & VEATCH**  
**Sulfur Pit Data Sheet**

Client:	<b>Indian Oil Corporation Ltd (IOCL)</b>	Job No.	<b>160796.1000</b>
Project:	<b>Paradip Refinery Project</b>	Req No.	
Location:	<b>Paradip, Orissa State, India</b>	By:	<b>MB/DAO</b>
Item No:	<b>086-SU-001, 087-SU-001, 088-SU-001 Note 1</b>	Page:	<b>3 of 8</b>
Service:	<b>Sulfur Pit, Unit 086, Unit 087 &amp; Unit 088</b>	Quantity	<b>Three (3) Note 2</b>

aggregate size should not exceed 20 mm. Test for cleanliness, soundness, and grading in accordance with ASTM C33.

- 3.4 Provide a minimum 75 mm concrete cover to protect the reinforcing from corrosion.
- 3.5 Reinforce concrete according to American Concrete Institute's (ACI) crack control method for water retaining structures.
- 3.6 Use minimum 4000 psi concrete compressive strength (at 28 days) with  $6 \pm 1$  percent air content.
- 3.7 Use aluminum water stops with protective coating at all construction and control joints.
- 3.8 Minimize the number of form ties.
- 3.9 Use water-reducing, set-retarding admixtures and low slump concrete to decrease drying shrinkage cracking of the concrete. Admixtures must not reduce concrete sulfate resistance, and calcium chloride should not be used.
- 3.10 Vibrate concrete to fill all voids and assure uniform consistency throughout. Ensure that concrete seals tightly against all nozzles and items penetrating the concrete.
- 3.11 Provide adequate moisture and temperature control of concrete during curing to decrease plastic shrinkage cracking. After the concrete is in place, evaporation must be controlled for 24 hours to insure that adequate water is available for proper cement hydration. Concrete surfaces should be kept wet or sealed for at least seven days after placement, and during this time the concrete must be kept at a minimum temperature of 10°C. Forms must remain in place until concrete has cured seven days.
- 3.12 The backfill operation can not begin until the sulfur pit roof (reinforced concrete) has been poured and cured.
- 3.13 Direct surface water away from the pit. The uppermost 300 mm of backfill shall be compacted impervious clay soil.
- 3.14 Fill joints with G.E. Silicone G;E. SCS 2000 "SILPRUF" with sprayed primer G.E. SCP 3165 applied as per manufacturer's specifications.

#### **4.0 INSULATION**

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**BLACK & VEATCH**  
**Sulfur Pit Data Sheet**

Client:	<b>Indian Oil Corporation Ltd (IOCL)</b>	Job No.	<b>160796.1000</b>
Project:	<b>Paradip Refinery Project</b>	Req No.	
Location:	<b>Paradip, Orissa State, India</b>	By:	<b>MB/DAO</b>
Item No:	<b>086-SU-001, 087-SU-001, 088-SU-001</b> Note 1	Page:	<b>4 of 8</b>
Service:	<b>Sulfur Pit, Unit 086, Unit 087 &amp; Unit 088</b>	Quantity	<b>Three (3)</b> Note 2

50 mm Foamglass insulation (as manufactured by the Pittsburg Corning Corp or approved equal) should be applied externally to the pit walls above and below grade to reduce heat loss and to protect the water proofing. The same thickness should be applied externally to the pit floor, primarily to protect the water proofing.

### **5.0 WATER PROOFING**

The concrete base and walls are water proofed by applying 3 layers of Pittcote 300 coated over PC Fabric 79 over the Foamglass insulation.

### **6.0 PIT FLOOR**

The pit floor must be over-excavated to allow depth to install a 150 mm thick seal slab, water proofing layers, 50 mm of Foam Glass insulation followed by a 50 mm seal slab prior to pouring the reinforced concrete slab that will be the sulfur pit floor.

### **7.0 CONCRETE WALLS**

Final details for the concrete walls will need to be resolved ~~in Detailed Engineering~~. It is necessary to maintain 75 mm clearance between the interior surface of the concrete wall and the outside of the reinforcing bars.

### **8.0 STEAM COILS**

Removable steam pipe coils (50mm) should be provided on the pit floor of each compartment to maintain a minimum molten sulfur temperature of 127°C. Steam coils must be laid out in sections that can be removed through the roof access hatches. Piping for the in-pit vertical sections of the coils should be 50 mm Schedule 80, 316L stainless steel pipe. Piping for the horizontal steam coils should be 50 mm Schedule 80 carbon steel pipe (pipe specification 3CAJA). The steam coils should use Low Pressure Saturated Steam (4.0 kg/cm<sup>2</sup>g) as the heat source. The design conditions of the steam are 240°C and 7 kg/cm<sup>2</sup>g. Pipe joints inside the sulfur pit are all welded. Note 3

Steam Coils shall be installed to be removable from each long side of the Sulfur Pit. Each coil section shall consist of a gate valve at the steam supply header, the steam supply downcomer, multiple horizontal "U" loops across the width of the Sulfur Pit floor of the particular chamber, then a condensate return riser to a dedicated steam trap station located alongside the Sulfur Pit. The entire floor of the sulfur pit, including the sump area to be covered by coils. The steam supply and condensate return line is to pass through a 100 mm 316 stainless steel sleeve embedded in the Sulfur Pit roof.

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**BLACK & VEATCH**  
**Sulfur Pit Data Sheet**

Client:	<b>Indian Oil Corporation Ltd (IOCL)</b>	Job No.	<b>160796.1000</b>
Project:	<b>Paradip Refinery Project</b>	Req No.	
Location:	<b>Paradip, Orissa State, India</b>	By:	<b>MB/DAO</b>
Item No:	<b>086-SU-001, 087-SU-001, 088-SU-001</b> Note 1	Page:	<b>5 of 8</b>
Service:	<b>Sulfur Pit, Unit 086, Unit 087 &amp; Unit 088</b>	Quantity	<b>Three (3)</b> Note 2

## 9.0 PIT VAPOR SPACE SWEEP AIR PROVISIONS

The Sulfur Pit vapor space will accumulate evolved  $H_2S$  from the raw molten Sulfur. Without purging this vapor space, explosive concentrations of  $H_2S$  could potentially form. Therefore, a fresh ambient air intake pipe should be provided on the outlet end of the pit. On the opposite end of the pit, a suction pipe should be provided as the inlet to the Sulfur Pit Ejectors. During normal operation, the Sulfur Pit Ejectors use low pressure steam as a motive fluid to draw fresh air through the pit and exhaust the steam and vapors to the Incinerator for oxidation of all sulfur compounds to  $SO_2$ . The pit must be sealed tightly to avoid air leaks into the pit, which would reduce the sweep air inlet flow.

## 10.0 PIT ACCESS

Concrete Sulfur Pit Access Hatches, 1.2 m x 1.2 m, should be provided integral with the Sulfur Pit roof. There should be one hatch on each compartment. The concrete hatches should be gasketed to lie freely over the pit opening without physical bolting; Garlock Gylon Style 3500 gaskets should be used. A walkway should be provided for accessing pit nozzles to prevent personnel from walking on the concrete pit roof.

## 11.0 SULFUR PUMPS

There will be a total of four vertical sulfur pumps in the Sulfur Pit. There will be two Degassing Pumps, 086/087/088-P-004A/B in the 1<sup>st</sup> Compartment Rundown Chamber and two Sulfur Pit Pumps, 086/087/088-P-005A/B in the 2<sup>nd</sup> Compartment Product Chamber. The floor of the compartment should have a 1% slope down to the side where the pumps are located. Each pump must be securely mounted for operation, but easily removed for maintenance. ~~There should be a low point sump below the pump intake nozzle to allow the pump intake nozzle to be installed at the same level as the sulfur pit floor.~~ The low point sump should be sized for the pumps selected during detailed design.

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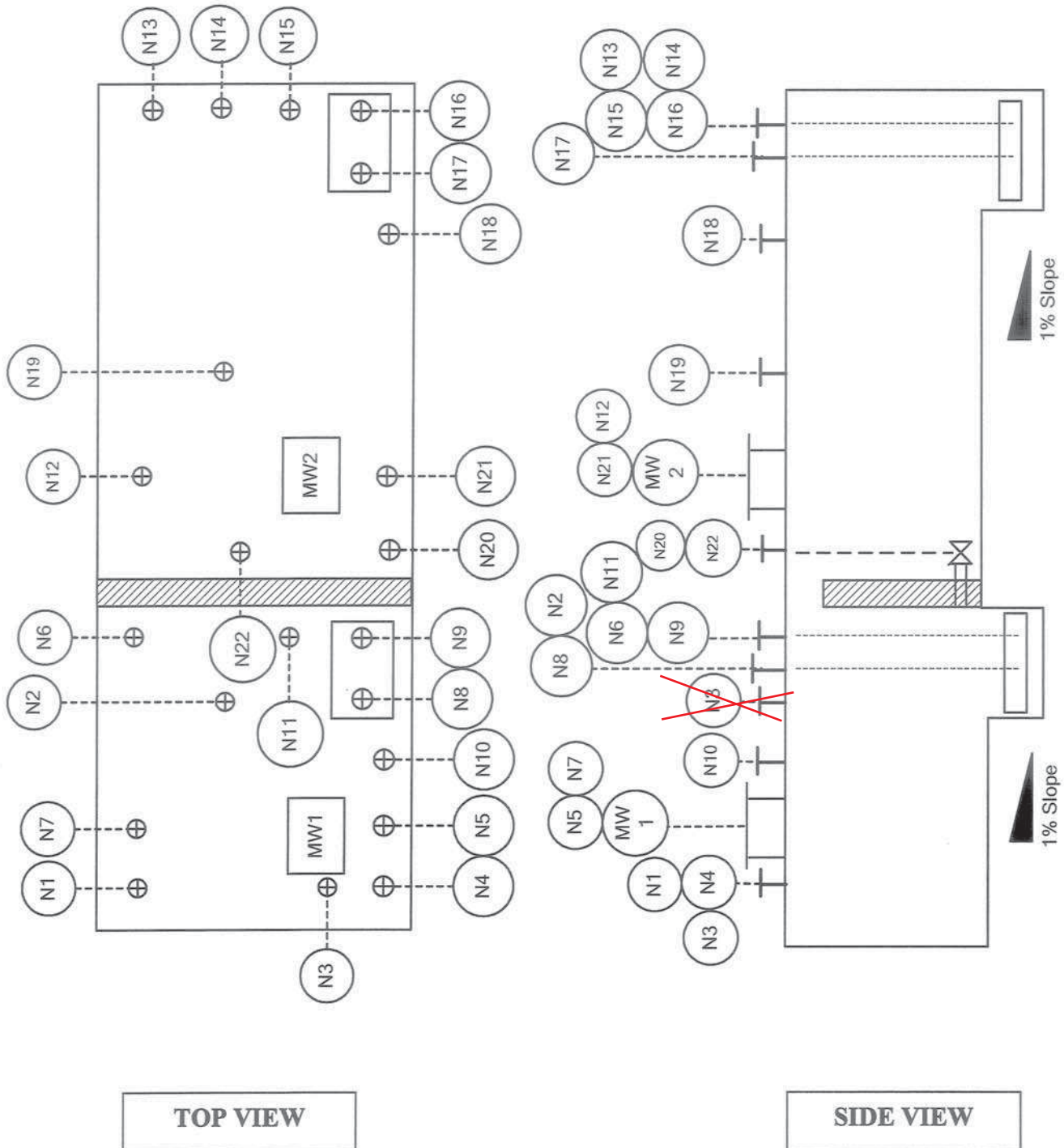


# **BLACK & VEATCH** Sulfur Pit Data Sheet

Client: **Indian Oil Corporation Ltd (IOCL)**  
 Project: **Paradip Refinery Project**  
 Location: **Paradip, Orissa State, India**  
 Item No: **086-SU-001, 087-SU-001, 088-SU-001** Note 1  
 Service: **Sulfur Pit, Unit 086, Unit 087 & Unit 088**

Job No. **160796.1000**  
 Req No.  
 By: **MB/DAO**  
 Page: **6 of 8**  
 Quantity **Three (3)** Note 2

## **12.0 GENERAL ARRANGEMENT**



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<b>Engineer/Date</b>	MB/DAO 05-Apr-08	MB 09-May-08		
<b>Approved/Date</b>		DAO 09-May-08		

## BLACK & VEATCH

### Sulfur Pit Data Sheet

Client:	Indian Oil Corporation Ltd (IOCL)	Job No.	160796.1000
Project:	Paradip Refinery Project	Req No.	
Location:	Paradip, Orissa State, India	By:	MB/DAO
Item No:	086-SU-001, 087-SU-001, 088-SU-001 Note 1	Page:	7 of 8
Service:	Sulfur Pit, Unit 086, Unit 087 & Unit 088	Quantity	Three (3) Note 2

### 13.0 SUMMARY OF SULFUR PIT WALLS AND ROOF PENETRATIONS

All penetrations must be sealed to prevent leakage of toxic gas from the pit vapor space to the atmosphere and to prevent leakage of air into the pit vapor space. Unless stated otherwise, all penetration piping shall be carbon steel with a 3.0 mm corrosion allowance. A complete list of penetrations is provided below.

Mark	No.	Size	Rating	Type	Description	Notes
<b>1<sup>st</sup> Compartment – Rundown Chamber</b>						
N1	1	200x250, Note 6	150#	RF	Liquid Sulfur Inlet	1, 2, 3, 4
N2	1	50 <del>CL300</del> 150#	150#	RF	Temperature Instrument	1, 8
N3	1	200x250, Note 6	150#	RF	Pit Sweep Ejector Suction	1,2
N4	1	50, Note 6	150#	RF	Condensate from Heating Coils	1, 10
N5	1	50, Note 6	150#	RF	Steam to Heating Coils	1, 10
N6	1	50x80, Note 6	150#	RF	Sulfur Deg Pump Min Flow Bypass	1,2,4,5
N7	1	80x100, Note 6	150#	RF	Drain from Degassing Contactor	1,2,4
N8	1	Note 7	150#	Note 7	Degassing Pump 086/087/088-P004A	1,2
N9	1	600 Note 7 <del>CL300</del> 150#	150#	Note 7	Degassing Pump 086/087/088-P004B	1,2
N10	1	150x200, Note 6	150#	RF	Level Instrument	1, 2, 8
N11	1	100x150, Note 6	150#	RF	Spill Over From Product Chamber	1,2, 4
MW1	1	1200x1200	Note 9	Note 9	Access Hatch	1, 9, 12
<b>2<sup>nd</sup> Compartment – Product Chamber</b>						
N12	1	200x250, Note 6	150#	RF	Sulfur from Degassing Contactor	1,2,3,4
N13	1	200x250, Note 6	150#	RF	Sweep Air Intake	1, 2
N14	1	80, Note 6 <del>CL300</del> 150#	150#	RF	Snuffing Steam Connection	1, 2
N15	1	150x200, Note 6	150#	RF	Level Transmitter	1,2,8
N16	1	Note 7	150#	Note 7	Sulfur Pit Pump 086/087/088-P-005A	1, 2
N17	1	Note 7	150#	Note 7	Sulfur Pit Pump 086/087/088-P-005B	1, 2
N18	1	50x80, Note 6	150#	RF	Sulfur Pit Pump Min. Flow Bypass	1, 2, 4, 5
N19	1	50 <del>CL300</del> 150#	150#	RF	Temperature Instrument	1, 8
N20	1	50, Note 6	150#	RF	Steam to Heating Coils	1, 10
N21	1	40, Note 6	150#	RF	Condensate from Heating Coils	1, 10
N22	1	Note 11	150#	RF	Access for Handwheel	1
MW2	1	1200x1200	Note 9	Note 9	Access Hatch	1, 9, 12

### Notes to Penetrations Schedule

1. General notes for all nozzles, access ways and openings.
  - a. Any nozzles that penetrate the interface between the vapor and liquid to be 316L SS. Note 3

Revision	A	0		
Engineer/Date	MB/DAO 05-Apr-08	MB 09-May-08		
Approved/Date		DAO 09-May-08		



**BLACK & VEATCH**  
**Sulfur Pit Data Sheet**

Client:	<b>Indian Oil Corporation Ltd (IOCL)</b>	Job No.	<b>160796.1000</b>
Project:	<b>Paradip Refinery Project</b>	Req No.	
Location:	<b>Paradip, Orissa State, India</b>	By:	<b>MB/DAO</b>
Item No:	<b>086-SU-001, 087-SU-001, 088-SU-001</b> Note 1	Page:	<b>8 of 8</b>
Service:	<b>Sulfur Pit, Unit 086, Unit 087 &amp; Unit 088</b>	Quantity	<b>Three (3)</b> Note 2

- b. Ensure all nozzles and openings are sealed tight to avoid leakage into or out of the sulfur pit.
2. There are two nozzles on this installation. The inner nozzle is steam jacketed and the size is shown. The outer nozzle, which holds the inner nozzle assembly, is located on the sulfur pit and is not jacketed. A steam supply and condensate return must be provided for all inner nozzles.
3. Look box to be installed on top of inlet nozzle. The look box should be designed for safe and convenient observation of the liquid sulfur.
4. Downcomer pipe required to be routed below low liquid level, at 150mm above the sulfur pit floor. Downcomer pipe to be jacketed.
5. Pump minimum flow bypass may be deleted by detailed designer if pump vendor provides internal minimum flow bypass.
6. Size shown reflects the size of the internal nozzle to which piping will connect. The actual size of the nozzle required on the sulfur pit will be larger, because the sulfur pit nozzle must allow for the removal of the internal nozzle and piping inside the pit for maintenance. The size of the nozzle on the sulfur pit to be determined by detailed designer.
7. Nozzle size and type by pump vendor to be determined ~~during detailed design~~.
8. Ensure that instrument details are compatible with nozzle size and sulfur pit configuration ~~during detailed design~~.
9. Size of rectangular access way to be confirmed during detailed design. Size must be adequate to allow installation and maintenance of sulfur pit internals. Access way to be constructed such that it can be sealed tightly.
10. Number of steam/condensate connections to be determined ~~during detailed design~~.
11. Access to be provided for hand wheel operation of 80 mm drain valve located on the separation wall between the rundown and product compartments. Size of access way to be confirmed ~~during detailed design~~. Size must be adequate to allow steam/condensate connections to/from steam jacketed valve at bottom of pit.
12. Access way to be equipped with a 50 mm gauge hatch.

<b>Revision</b>	A	0		
<b>Engineer/Date</b>	MB/DAO 05-Apr-08	MB 09-May-08		
<b>Approved/Date</b>		DAO 09-May-08		



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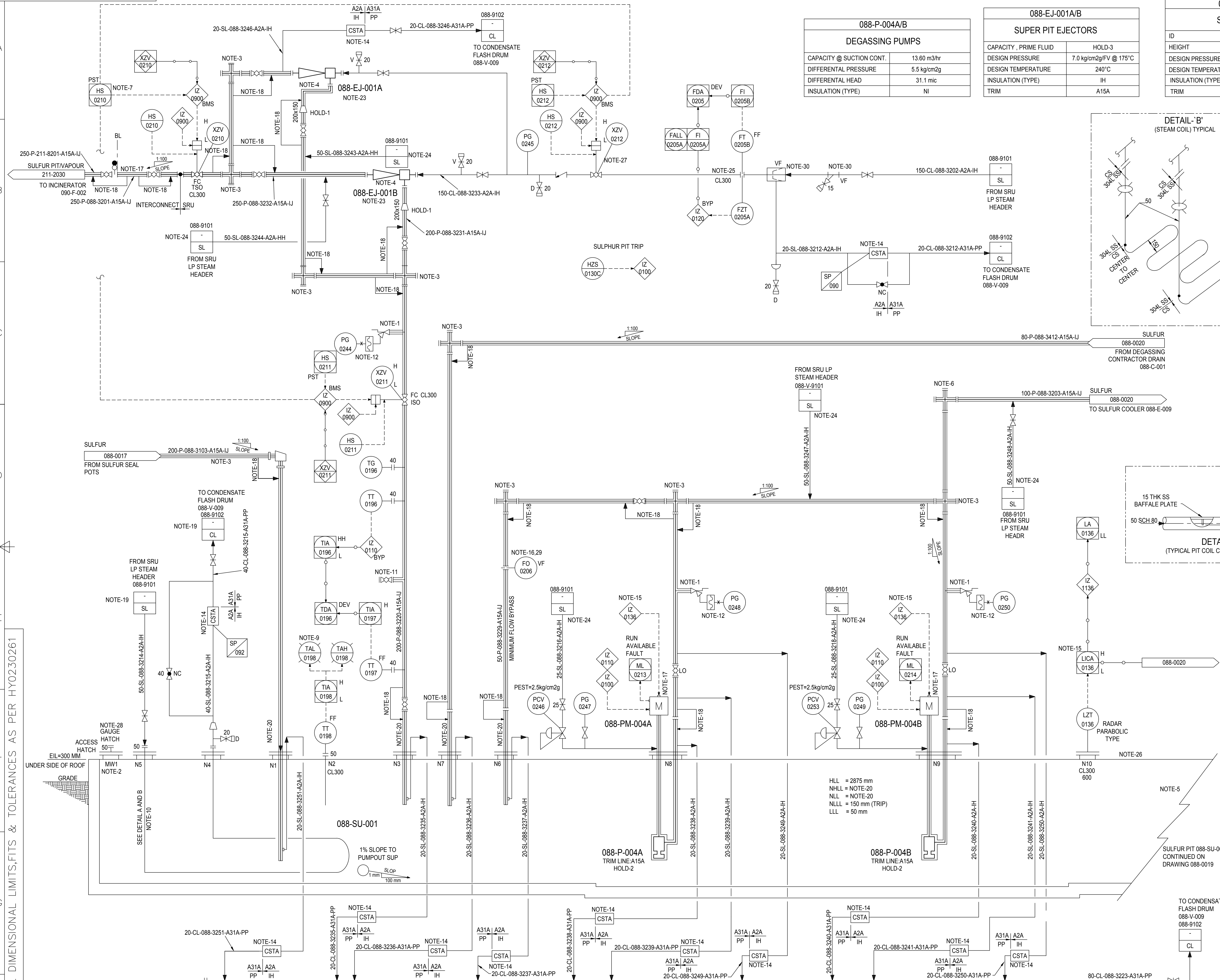
GENERAL DIMENSIONAL LIMITS, FITS &amp; TOLERANCES AS PER HY0230261

INVENTORY NO

SIGN. AND DATE

REF. DRG. NO.

COMPUTER FILE NAME



## GENERAL NOTES :

- FOR STANDARD SYMBOLS, DETAILS AND LEGEND SHEETS SEE DRAWINGS B366-02-42-0090-0005.
- FOR SAMPLE STATION DETAILS SEE DRAWING B366-02-42-0090-0001.
- FOR PUMP SEAL PLAN DETAILS SEE DRAWING B366-02-42-0090-0002.
- THIS DRAWING HAS BEEN DEVELOPED BASED ON REFERENCE DRAWING NO. PDRP4220-8110-25-088-0018, REV AX.

## NOTES :

- STEAM JACKET VALVE.
- ACCESS HATCH TO BE EQUIPPED WITH 50MM GAUGE NOZZLE SIZE ACCESS HATCH LARGE ENOUGH TO ACCOMMODATE TEMPERATURE SULFUR PUMP.
- CROSSES TO BE USED AT ALL CHANGES IN DIRECTION ON JACKETED PIPING. ALLOW CLEARANCE AT ALL JACKETED CROSSES FOR RODOUT IN BOTH DIRECTION.
- LOCATE EJECTORS AT HIGH POINT.
- SULFUR PIT IS A TWO COMPARTMENT PIT SEPARATED BY AN INTERNAL BAFFLE.
- CS SECTION TO BE SUBMERGED AT ALL TIMES.
- SIS SWITCH IS USED TO INITIATE VALVE SEQUENCING TO LINE UP SULPHUR PIT EJECTOR DISCHARGE TO THE INCINERATOR.
- ALL INSTRUMENT TAG NUMBER SHALL BE PREFIXED BY UNIT NUMBER '088'.
- PROCESS CRITICAL ALARM.
- RISER MATERIAL OF CONSTRUCTION TO BE 304LSS. NUMBER OF COILS TO BE DETERMINED DURING DETAILED ENGINEERING.
- SWEEP AIR INTAKE DURING EJECTOR OUTAGE LOCATE AT MINIMUM SAFE ELEVATION. JACKET VALVE.
- PRESSURE TAP/SAMPLE POINT WITH STRAHMAN PISTON TYPE VALVE.
- DELETED.
- STEAM TRAPS TO BE OF COMPACT TYPE ASSEMBLY.
- INTERLOCK TRIPS PUMPS ON LOW LIQUID LEVEL.
- MOUNT FO-0206 IN VERTICAL, IN ORDER TO FREE DRAIN.
- REMOVABLE SPOOL.
- JUMP OVER SECTIONS FOR STEAM ACROSS JACKETED FITTINGS.
- PROVISIONAL STEAM SUPPLY/CONDENSATE RETURN.
- NHLL AND NLL TO BE DETERMINING DURING OPERATION.
- SULPHUR PIT INSULATED WITH 50MM FROM GLASS.
- SULFUR PIT 3.2M (D) x 7.0M(W) x 2.5M (L).
- 088-EJ-001A/B IS STEAM JACKET.
- NUMBER OF STEAM CONNECTIONS FOR JACKETED PIPEWORK TO BE CONFIRMED.
- REFER TO PDDP-8550-SP-0013 FOR UPSTREAM AND DOWNSTREAM STRAIGHT RUNS OF PIPE.
- LID OF SULFUR PIT IS CONCRETE.
- CLOSED LIMIT SWITCH HAS BMS FUNCTION OPEN AND CLOSED LIMIT SWITCHES TO BE CONNECTED DIRECT TO THE ESD (BMS) SYSTEM WITH SERIAL REPEAT TO DCS.
- CHANNED WEIGHTED COVER TO BE FIXED AT ACCESS HATCH TO ACT AS PRESSURE RELIEF PANEL.
- FO-0206 TO BE PROVIDED BY PUMP VENDOR.
- TO A PART OF EJECTOR VENDOR SCOPE OF SUPPLY.

HOLD LIST		
S. NO.	HOLD	DUE TO
1.	INLET NOZZLE FLANGE SIZE	TO BE CONFIRMED BY EJECTOR VENDOR
2.	PUMP NOZZLE, DRIVER, VENT & DRAIN	BY ENGG.
3.	SULPHUR PIT EJECTOR CAPACITY	TO BE CONFIRMED BY EJECTOR VENDOR

DOCUMENT CATEGORY	DOCUMENT REVIEW STATUS (BY CLIENT)
(USE "X" MARK)	
<input type="checkbox"/> APPROVAL	
<input type="checkbox"/> REVIEW	
<input type="checkbox"/> INFORMATION	

CLIENT	INDIAN OIL CORPORATION LIMITED PARADIP REFINERY PROJECT PARADIP, ORISSA
--------	---

CONSULTANT	TECHNIP ENERGIES
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PROJECT	525 TPD STANDBY SRU PROJECT IOCL PARADIP REFINERY, ODISHA, INDIA
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ENGINEERS INDIA LIMITED  
NEW DELHIBHARAT HEAVY ELECTRICALS LTD.  
HYDERABADDEPT. PE&SD  
CODE 450TITLE  
P&IDs FOR  
SULPHUR PIT RUNDOWN CHAMBER

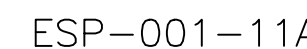
SHT. No 01

NAME	SIGN.	DATE	NO. OF VAR.
DRN.			
CHD.			
APPD.			

REV. 00

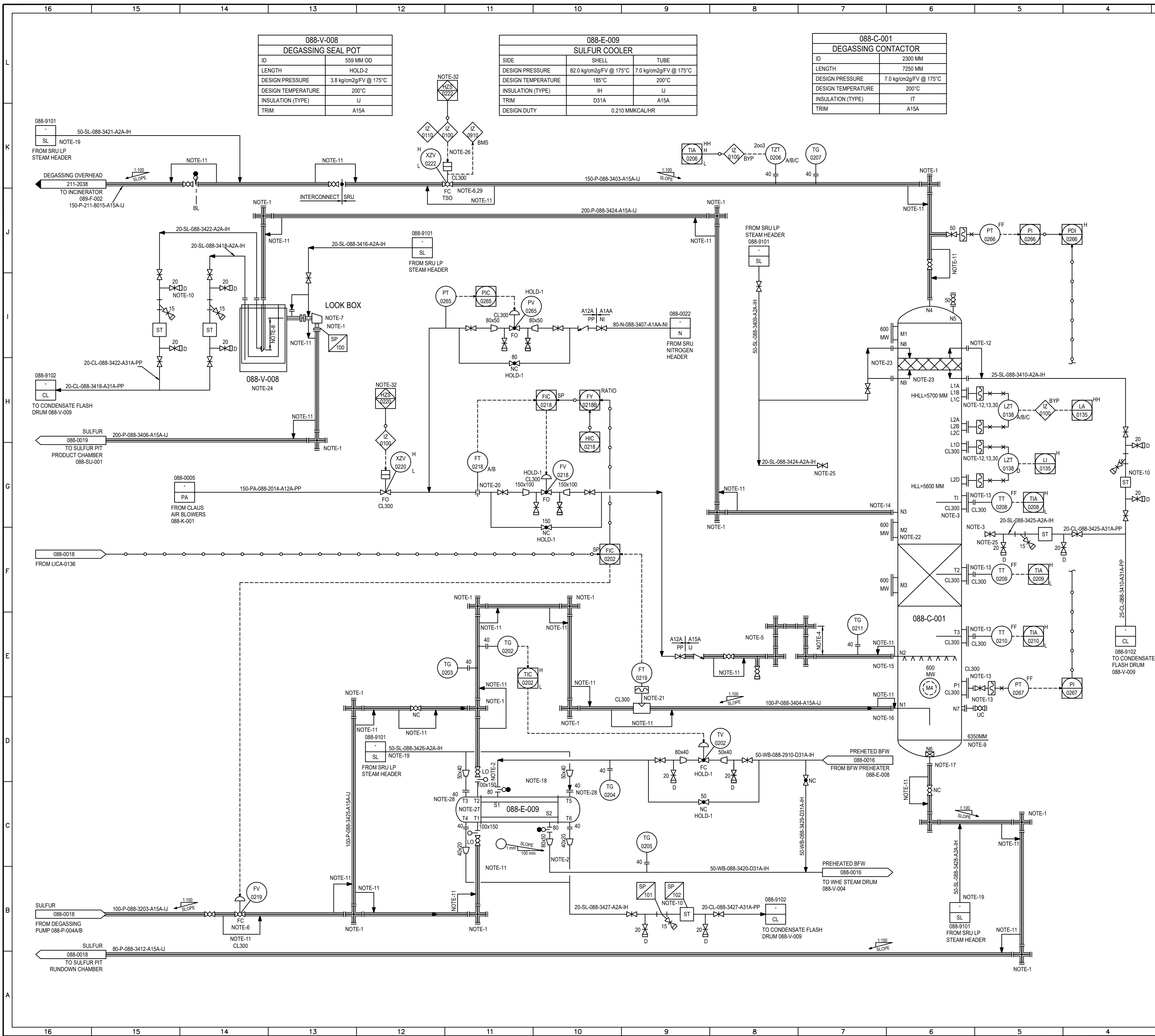
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- FOR SAMPLE STATION DETAILS SEE DRAWING 080557C-085-PID-0021-0001.
- FOR PUMP SEAL PLAN DETAILS SEE DRAWING 080557C-085-PID-0021-0002.
- THIS DRAWING HAS BEEN DEVELOPED BASED ON LICENSOR P&ID DRG. NUMBER D01-1634.

#### NOTES :

- CROSSES TO BE USED AT ALL CHANGES IN DIRECTION ON JACKETED PIPING. ALLOW CLEARANCE AT ALL JACKETED CROSSES FOR RODOUT IN BOTH DIRECTIONS.
- STEAM JACKETED VALVE.
- EXTERIOR STEAM PLAT COILS ON ENTIRE MAIN BODY OF VESSEL.
- TOP OF SEAL LOOP TO BE HIGHER THAN CONTRACTOR OVERHEAD VAPOUR NOZZLE.
- MINIMUM 15M OF JACKETED PIPE FOR HEATING AIR STEAM.
- LP STEAM JACKETED PLUG VALVE.
- PROVISIONS REQUIRED TO ROD LOOK BOX. LIDS ON LOOK BOXES TO BE DESIGNED TO PREVENT RAIN WATER INTRUSION. LOOK BOX TO BE SAFE AND PRACTICAL FOR OPERATOR USE.
- SULFUR SEAL POT DEPTH TO BE SET BY MAXIMUM CLAUS AIR BLOWER DISCHARGE PRESSURE AT LOW AMBIENT TEMPERATURE PLUS DESIGN MARGIN.
- PROVIDE ADEQUATE ELEVATION ABOVE TOP OF SULFUR PIT TO ALLOW FOR FREE DRAINING OF SULFUR.
- STEAM TRAPS TO BE OF COMPACT TYPE ASSEMBLY.
- JUMP OVER SECTION FOR STEAM ACROSS JACKETED FITTINGS.
- ADDITIONAL 2 SETS (4 Nos) OF LEVEL TRANSMITTER NOZZLES L3A/B & L4A/B ALONG WITH 2 TRANSMITTER (DIAPHRAGM SEAL DIP TYPE) TO BE INCLUDED FOR 2003 VOTING.
- NOZZLE IS 50MM x 80MM (JACKETED).
- NOZZLE IS 200MM x 250MM (JACKETED).
- NOZZLE IS 150MM x 200MM (JACKETED).
- NOZZLE IS 100MM x 150MM (JACKETED).
- NOZZLE IS 80MM x 100MM (JACKETED).
- 088-E-009 BOTH CHANNELS TO BE STEAM JACKETED.
- NUMBER OF STEAM CONNECTIONS FOR JACKETED PIPE WORK TO BE CONFIRMED.
- REFER TO PDRP-8550-SP-0013 FOR UPSTREAM AND DOWNSTREAM STRAIGHT RUNS OF PIPE.
- REFER TO PDRP-8550-SP-0013 FOR UPSTREAM AND DOWNSTREAM STRAIGHT RUNS OF PIPE.
- MANWAY USED FOR CATALYST LOADING.
- NOZZLES N8 & N9 ARE DEMISTER STEAM INLET AND OUTLET.
- CAPACITY OF 088-V-008 IS 21889 KG/HR.
- HEATING SUPPLY AND RETURN TO 12-OFF NOZZLE JACKETS AND PLATE COILS.
- CLOSED LIMIT SWITCH HAS BMS FUNCTION. OPEN & CLOSED LIMIT SWITCHES TO BE CONNECTED DIRECT TO THE ESD (BMS) SYSTEM WITH SERIAL REPEAT TO DCS.
- NOZZLES T1 & T2 ARE STEAM JACKETED NOZZLES.
- NOZZLES T3/T4 /T5/T6 CONNECTED TO EXTERNAL JACKETS ON EXCHANGER CHANNELS.
- XZV-0222 TO BE SUPPLIED BY TEAM 2 AND MODELED BY TEAM 4. VALVE TO BE LOCATED HIGH POINT OF BATTERY LIMIT PLATFORM.
- LEVEL TRANSMITTER(DIP TYPE WITH DIAPHRAGM SEAL) SHALL BE PROVIDED INSTEAD OF LEVEL SWITCHES LSH-0138 & LSH-0138 NOZZLE L1 & L2 SHALL BE REPLACED BY L1A/B & L2A/B.
- ALL INSTRUMENT TAG NUMBER SHALL BE PREFIXED BY UNIT NUMBER '088'.
- VALVE RESET BY ESD SCREEN PUSH BUTTON.

HOLD LIST		
S. NO.	HOLD	DUE TO
1.	CONTROL VALVE SIZE/BYPASS VALVE SIZE	BY ENGG.
2.	SEAL POT DEPTH	BY ENGG.

A	19.02.21	ISSUED FOR COMMENTS	BSR	SYD	RK	RK
संख्या	तिथि	संशोधन	ड्रॉ	द्वारा	जाँच	अनुमोदित
No.	DATE	REVISIONS	DRN	BY	CHKD	APPD.

**इंजिनियर्स इंडिया लिमिटेड**  
(भारत सरकार का उद्यम)

**ENGINEERS INDIA LIMITED**  
(A Govt. of India Undertaking)

**Bharat Heavy Electricals Limited**  
Powering Progress, Brightening Lives Touching Every Indian Home

**BLACK & VEATCH CORPORATION**

**इंडियन ऑयल कॉर्पोरेशन लिमिटेड**  
**INDIAN OIL CORPORATION LIMITED**  
**PARADIP REFINERY PROJECT**  
**PARADIP, ORISSA**

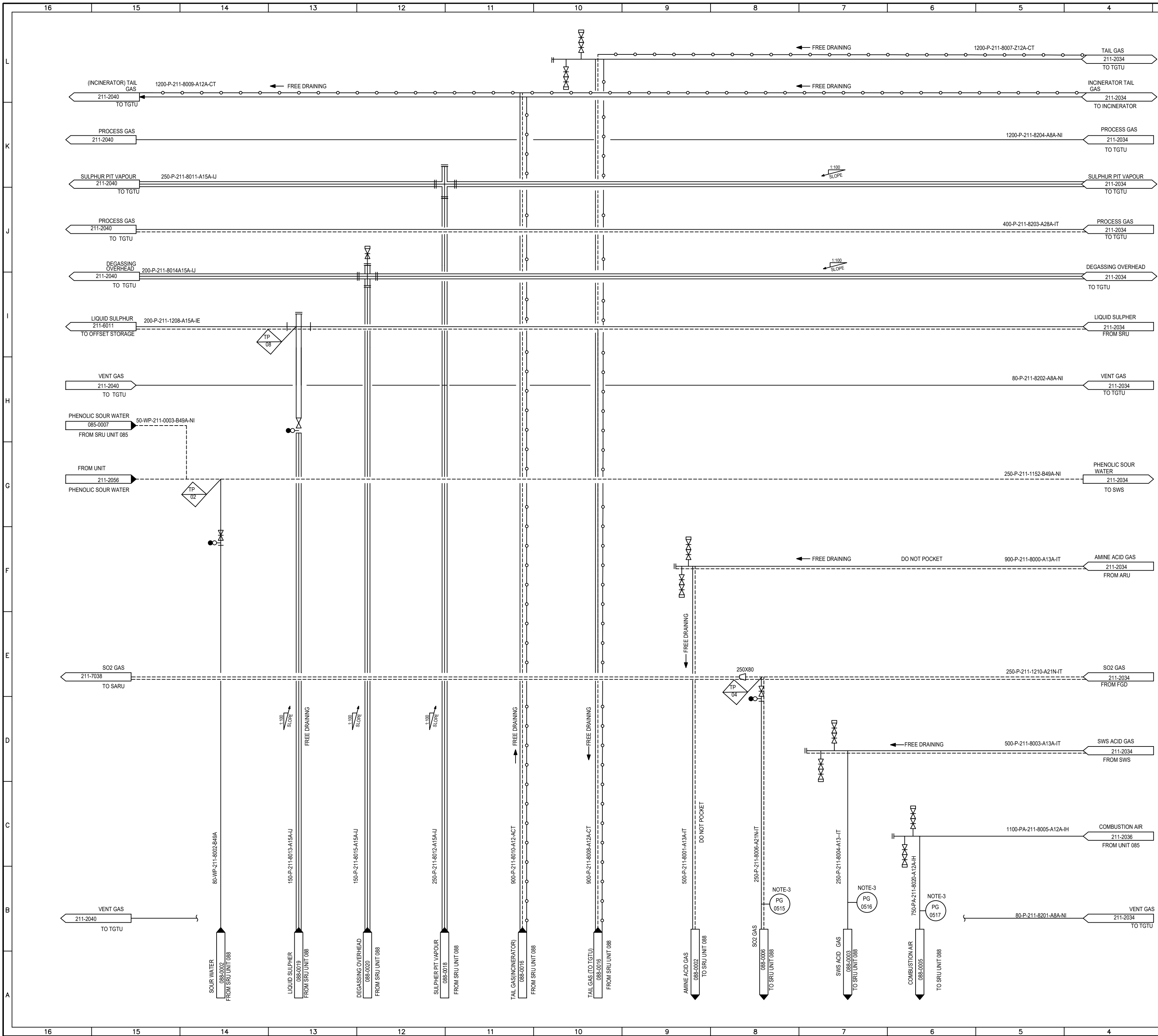
पाइपिंग रण्ड इंस्ट्रुमेंटेशन डायग्राम  
**PIPING AND INSTRUMENTATION DIAGRAM**  
**SRU TRAIN-3**  
**DEGASSING COOLER AND CONTACTOR**

अनुमाप	कार्य संख्या	विभाग	अनुभाग	इकाई	आरेख संख्या	रैंको
SCALE	JOB NO.	DEPT.	SECTN.	UNIT	DWG. No.	REV.
B366	02	42	088	0020	A	

EL-0241-502-REV-0-A

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- FOR SAMPLE STATION DETAILS SEE DRAWING B366-02-42-0021-0001.
- FOR PUMP SEAL PLAN DETAILS SEE DRAWING B366-02-42-0021-0002.
- REFER OVERALL KEY PLAN DRAWING INDICATING THE NODE LOCATION PDRP4200-8230-02-600-0001
- THIS DRAWING HAS BEEN DEVELOPED BASED ON REFERENCE DRAWING NO. PDRP4240-275-8110-25-211-2038, REV ZX.


NOTES :

- VENTS AND DRAINS TO BE ADDED AT HIGH AND LOW POINT OF PIPING TO CONFIRM LOCATION
- PIPERACK STEEL TO BE DEFLECTED PRIOR TO ADDITION OF PIPEWORK, SPECIFICALLY FOR SPANS OF 12M OR GREATER
- PG TO BE READABLE FROM BATTERY LIMIT PLATFORM





LEGEND :

- EXISTING  
— NEW

A 03.03.21		ISSUED FOR COMMENTS		KISHAN	SYD	RK	RK
संख्या No.	तिथि DATE	संशोधन REVISIONS		ड्रा DRN	द्वारा BY	जाँच CHKD	अनुमोदित APPD.
इंजिनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम)				ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)			
बी एच ई एल BHEL				Bharat Heavy Electricals Limited Powering Progress, Brightening Lives Touching Every Indian Home			
B & V CORPORATION				BLACK & VEATCH CORPORATION			
इंडियन ऑयल				इंडियन ऑयल कॉर्पोरेशन लिमिटेड INDIAN OIL CORPORATION LIMITED PARADIP REFINERY PROJECT PARADIP, ORISSA			
पाइपिंग रण्ड इंस्ट्रुमेंटेशन डायग्राम PIPING AND INSTRUMENTATION DIAGRAM INTERCONNECTING PIPE RACK SRU NODE 7							
अनुमाप SCALE	कार्य संख्या JOB NO.	विभाग DEPT.	अनुभाग SECTN.	इकाई UNIT	आरेख संख्या DWG. No.	रैंडो REV.	
1:1	B366	02	42	211	2038	A	

 		PROJECT	Standby SRU & Additional Tanks	
			IOCL Paradip Refinery	
		CLIENT	INDIAN OIL CORPORATION LIMITED	
JOB SPECIFICATION FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS	Project No. 080557C001	Document No. 080557C-000-JSS-0910-001	Rev. No. B	Page 1 of 24

## JOB SPECIFICATION FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS

			 <small>Shankar Ramasubramanian 2020.06.11 15:24:42 +05'30'</small>	 <small>Anandan Ananthapadmanaban 2020.06.11 17:52:28 +05'30'</small>	 <small>Anandan Ananthapadmanaban 2020.06.11 17:52:49 +05'30'</small>	 <small>Morischristopher Jesumarian 2020.06.12 00:05:10 +05'30'</small>
B	10-Jun-2020	REISSUED FOR DESIGN	RS	AA	AA	JMC
A	15-Nov-2019	ISSUED FOR DESIGN	KS	RS	AA	JMC
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED

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 		PROJECT	Standby SRU & Additional Tanks	
			IOCL Paradip Refinery	
		CLIENT	INDIAN OIL CORPORATION	
JOB SPECIFICATION FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS	Project No. 080557C001	Document No. 080557C-000- JSS-0910-001	Rev. No. B	Page 2 of 24

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 		<b>PROJECT</b>	<b>Standby SRU &amp; Additional Tanks</b> <b>IOCL Paradip Refinery</b>	
		<b>CLIENT</b>	<b>INDIAN OIL CORPORATION</b>	
<b>JOB SPECIFICATION FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS</b>	<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-000-JSS-0910-001	<b>Rev. No.</b> B	Page 3 of 24

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 		<b>PROJECT</b>	<b>Standby SRU &amp; Additional Tanks</b>	
		<b>CLIENT</b>	<b>IOCL Paradip Refinery</b>	
<b>JOB SPECIFICATION FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS</b>	<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-000-JSS-0910-001	<b>Rev. No.</b> B	Page 4 of 24

## 1. **INTRODUCTION:**

**INDIAN OIL CORPORATION LIMITED (IOCL)** has awarded Fax of Acceptance (FOA) dated 29<sup>th</sup> August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

## 2. **DEFINITIONS:**

<b>Abbreviation</b>	<b>Definition /Expanded form</b>
IOCL/ CLIENT	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit

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 		<b>PROJECT</b>  <b>Standby SRU &amp; Additional Tanks</b>  <b>IOCL Paradip Refinery</b>	
		<b>CLIENT</b>	<b>INDIAN OIL CORPORATION</b>
<b>JOB SPECIFICATION FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS</b>	<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-000-JSS-0910-001	<b>Rev. No.</b> B
		Page 5 of 24	

### 3. SCOPE

This specification covers the minimum requirements for the Design, Engineering, Materials, Fabrication, Expediting, Inspection & testing, Painting, packing & forwarding of Centrifugal Pumps complying to API 610 – 11<sup>th</sup> edition.

Any deviations from this specification are not acceptable, unless a written approval of such deviations from OWNER/PMC is obtained.

### 4. ORDER OF PRECEDENCE

In case of conflict between documents, the following order of precedence shall govern:

- Local Regulatory and Statutory Requirement.
- Local Codes and Standards (for pumps it is not applicable)
- Licensor Requirements (if applicable)
- Engineering Standards and Specifications
- International Codes and Standards

Any conflicting requirements shall be referred to CONTRACTOR, for clarification and resolution in writing before proceeding with design and fabrication of the affected part. Generally, in case of conflict between requirements most stringent requirement shall be applied.

### 5. EQUIPMENT QUALIFICATION CRITERIA

- 5.1 The vendor for the complete unit shall be an established manufacturer and he shall also be the manufacturer of the proposed equipment having adequate engineering, manufacturing & testing facilities for the same.
- 5.2 The vendor shall have engineered, packaged, tested and supplied at least TWO identical or validly similar packages in terms of type 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) , machine, driver, sealing system etc from the proposed plant and at least ONE of these shall have successfully operated in the field for at least 8000 hours without any major problem as on the date of issue of invitation to bid. The vendor shall include reference list in the proposal.
- 5.3 For large water injection or similar duty pumps where the pressure containment parts are cast in alloy

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materials the experience criteria above shall be verified also by references for the proposed foundry.

- 5.4 The vendor besides satisfying the requirements of above clauses shall also be the packager of the Complete system proposed and shall have the single point responsibility for the entire package.

## **6. POWER LOADING**

- 6.1 Power loading shall be applied for continuous operating driven equipment during the evaluation of vendor's quotations as per Loading Criteria for Rotating Equipment 080557C-000-JSD-0900-002. The price loading shall be in terms of the excess cost of electrical power consumption for motor driven equipment over the competing bidders. The same shall be calculated as per the procedure given in the above specification. The penalty shall be applied upon the performance test of the supplied equipment, if it is found that the power is in excess than the vendor's guaranteed value. The same shall be calculated as per the procedure given in Loading criteria specification.

## **7. BASIC DESIGN**

### **7.1 GENERAL**

- 7.1.1 **Design Life:** All equipment shall be designed for a minimum service life of 20 years and at least 3 years uninterrupted operation under normal operating conditions. This requirement excludes specialized components requiring periodic maintenance and replacement.
- 7.1.2 Installation of all Equipment's shall be as per Guidelines in API 686 – Recommended Practice for Machinery Installation and Installation design as a minimum requirement. LSTK contractors can suitably develop specific requirement if required based on vendor recommendations
- 7.1.3 Equipment along with the drivers shall be procured from the respective driven eqpt. manufacturers as skid mounted units with all accessories, auxiliaries along with auxiliary piping.
- 7.1.4 For overhung and between bearing centerline supported pumps, dismantling of rotor assembly shall be possible without disturbing casing piping.
- 7.1.5 Horizontal pumps shall be centerline mounted.
- 7.1.6 Two stage pumps and double suction single stage pumps shall be of in-between bearing type of construction only. Pump rated flow exceeding 1000 M3/Hr., only "Between Bearing Type" pumps shall be selected. Maximum number of stages shall not exceed 10 for horizontal pumps.
- 7.1.7 Maximum impeller diameter of overhung pumps operating at 2800 rpm and higher, shall be limited to 380 mm.

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- 7.1.8 Fabricated impellers are not acceptable.
- 7.1.9 The shaft shall be capable of safely transmitting the rated driver power when the pump is fitted with the maximum impeller diameter and operating with water (i.e. SG of 1.0)
- 7.1.10 Individual components like impeller, balancing drum, and similar rotating components shall be dynamically balanced to grade G1.0 of ISO 1940. However, the complete assembly to be balanced to grade G2.5 of ISO 1940.
- 7.1.11 Impeller of multistage pumps shall also be positively locked against axial movement in the direction opposite to normal hydraulic thrust.
- 7.1.12 The suction regions shall be designed for the same MAWP as the discharge section. This is applicable for all pumps.
- 7.1.13 Renewable wear rings (if used) shall be held in place by means of press fit with locking pins or screws. Tack welding shall not be considered as an option. The casing wear ring shall be harder by minimum difference of 50 BHN.
- 7.1.14 Pumps handling slurry or fluids containing abrasive solids shall be provided with wear rings equipped for injection of clean flushing liquid to prevent the ingress of abrasive particles.
- 7.1.15 All connections that are less than or equal to DN 40(1 ½") shall be gusseted.
- 7.1.16 Casing Vent and drain connections shall be provided with isolation valves (gate type) and blind flanges. For self-venting pumps, casing vent connection is not applicable.
- 7.1.17 Except for Seal glands, connections into process pressure containing components shall not be threaded.
- 7.1.18 Pumps with constant speed driver shall be capable of at least 5% head increase at rated conditions and pump speed specified on the performance curve by installing new impeller. Similarly, it shall also be possible to achieve a 5% head decrease by installing a new impeller which shall be in no case less than the minimum diameter for the pump casing. The pump shall be preferably of back pull out design type.
- 7.1.19 The maximum discharge pressure shall be the addition of maximum Suction pressure and the maximum

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differential pressure (including the allowable positive performance tolerance) the pump is able to develop when operating with the maximum diameter impeller at the rated speed and specified maximum relative density (specific gravity). For variable speed driven pumps: at 105 percent of rated speed.

- 7.1.20 When the specific gravity of the fluid being pumped is less than 1, at the pumping temperature, Vendor shall ensure that the pump and its accessories shall be able to operate without deterioration during the performance test with water. Performance test at reduced speed shall require prior approval from Owner/PMC.
- 7.1.21 Pumps that handle liquids more viscous than water shall have their performance corrected in accordance with the Centrifugal Pump Section of the Hydraulic Institute Standards. Bidder / vendor has to confirm that all viscosity correction factors as mentioned against each model are firm and are guaranteed figures.
- 7.1.22 The pressure casing shall be designed to at least 42.2 kg/cm<sup>2</sup> g and have a corrosion allowance of 3 mm. For the vertical VS4 type pumps with cast iron casing, the pump casing shall be designed to meet the maximum discharge pressure calculated on the basis of this specification.
- 7.1.23 For pump's pressure casing shall be suitable to withstand twice the forces and moments in Table 5 of API 610, 11th Edition applied simultaneously to the pump through each nozzle with internal pressure and without distortion that would impair operation of the Pump or seal. For pumps operating at above 200°C, the casing shall be suitable to withstand the loads that are four times Table 5 values.
- 7.1.24 Pump nozzle flanges shall be accordance with ASME B16.5. The vendor shall consider while offering their model that the velocity of fluid in the suction nozzle is limited to 4.5 m/sec.
- 7.1.25 Inducers shall not be used except for Sundyne or equivalent type of pumps. When inducers cannot be avoided vendor shall clearly document the reason for the same and the design of inducer shall be such that it does not create pulsations at part load operation and obtain approval from the OWNER.
- 7.1.26 Discharge orifice shall not be used as a means of providing a continuous rise to shutoff. If required, it has to be stated in the proposal and Owner/PMC approval needs to be taken.
- 7.1.27 Minimum continuous stable flow shall be indicated in the proposal. Meeting minimum flow requirements with orifice arrangement / bypass is not acceptable unless mentioned otherwise in the datasheet or tender document.
- 7.1.28 Pumps for high head, low flow duties (falling outside the range of two stage pumps without continuous

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bypass) shall be Sundyne or equivalent type. Seal less canned motor pump sets shall be considered for clean liquids.

- 7.1.29 Whenever pump capacity control is through LIC or LIC/FIC cascade or has a fail closed control valve on pump discharge or process minimum capacity is less than pump MCF, necessary flow instruments in pump discharge along with pump bypass back to suction vessel with control valve for pump protection shall be provided. However, when continuous Bypass of pump MCF is envisaged bypass from pump discharge back to suction vessel with restriction orifice sized for pump MCF instead of control valve shall be provided.
- 7.1.30 The maximum permissible running clearances shall not be less than twice the running clearances as specified in API 610.
- 7.1.31 No cast Iron pressure containing parts shall be used for hydrocarbon service.
- 7.1.32 Welded or brazed repairs of iron castings are not acceptable.
- 7.1.33 Weld procedures for all major repair welding on pressure containing parts shall be submitted to IOCL for approval prior to commencement of the repair work.
- 7.1.34 Integral impeller wear rings shall not be used, unless approved by Owner/ PMC.
- 7.1.35 In case of vertical pumps, column & bowl assembly joints shall be flanged.
- 7.1.36 Asbestos shall not be used in any form.
- 7.1.37 INTERCHANGEABILITY: As far as possible pumps & mechanical seals and couplings shall be of identical make so that minimum levels of inventory can be maintained and maximum interchangeability/ standardization can be achieved.
- 7.1.38 Multistage Pumps:
- Balance piston or balance drum shall necessarily be provided for design 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 connected to pump suction within the pump confines or to suction vessel (as recommended by pump vendor).

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- The balance line shall be provided with pressure gauge and pressure relief valve. In case balance line is located inside the barrel, it is not possible to mount the instrument, the same shall not be provided.
- INTERCHANGEABILITY: As far as possible pumps & mechanical seals and couplings shall be of identical make so that minimum levels of inventory can be maintained and maximum interchangeability/ standardization can be achieved.
- Casing Vent and drain connection will be provided with isolation valves (gate type) and blind flanges.

## 7.2 PERFORMANCE

- 7.2.1 In case of parallel operation and/or auto-start operation with open discharge valve, NPSH margin shall be positive for the operating range of the pump including end of curve.
- 7.2.2 NPSH margins for pumps shall be minimum 0.6 m at rated flow. For High energy pumps defined by API 610 Cl 6.1.15, the minimum NPSH margin at rated flow shall be 1.5 m.
- 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. NPSH test shall be performed in case difference between NPSH available and NPSH required is less than or equal to 1.0 Mtr at Rated flow.
- 7.2.3 Pumps that have stable head/capacity curves (continuous head rise to shut-off) are required with a minimum shut-off head of 110% but not exceeding 120% of the head at the rated capacity.
- 7.2.4 In parallel operation, duty point on each curve shall match within 2%
- 7.2.5 Pumps with suction specific speed greater than 12,780 (m<sup>3</sup>/h, m, rpm) at the best efficiency point for the maximum diameter impeller is not acceptable unless approved by OWNER.
- 7.2.6 Best efficiency point shall preferably lie between the rated point and the normal point. However, in no case the rated point shall be beyond 110% of the BEP of the rated impeller. And in no case shall the normal flow be less than 70% of BEP of the rated impeller, unless otherwise mentioned specifically in the pump datasheet.
- 7.2.7 For vertical pumps, the specified head shall be measured at the discharge flange at pump mounting level. Pumps shall be suitable to develop specified discharge head in addition to the column losses and vertical distance, between minimum liquid level in the sump tank and centerline of discharge flange. Pump vendor shall indicate total head to be developed by the pump in the offer.
- 7.2.8 Power calculations shall be with maximum specific gravity.

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### 7.3 BEARING AND BEARING HOUSINGS

- 7.3.1 Bearings and bearing housings shall be arranged/designed for hydrocarbon oil lubrication. The bearing housing of oil lubricated non-pressure-fed bearing shall be equipped with sump indicator / sight glass and constant level “Oiler” and with isolation valve to facilitate removal in running pump. For VS4 type pumps, Grease lubrication can be provided if Proven Track Record (PTR) is available and it meets the specified L<sub>10</sub> bearing life. Provision shall be made for re-greasing the bearings in service and for the effective discharge of old or excess grease.
- 7.3.2 Bearing housing shall be equipped with suitable replaceable non-contact type bearing isolators (Inpro or equiv.) where shaft passes through the housing. Bearing isolators shall be provided on either side of the bearing housing.
- 7.3.3 Bearing housing drain opening shall be provided with a magnetic drain plug.
- 7.3.4 All pumps shall be provided with plugged connection for oil mist lubrication for future use.
- 7.3.5 Rolling element bearings shall have bearing life (L<sub>10</sub>h) in accordance with API standards. Bearing cooling shall not be considered in achieving the required L<sub>10</sub> life.
- 7.3.6 For pumping temperatures below 200°C, the pump shall be designed to operate continuously without the use of cooling liquid. The need for bearing housing cooling shall be determined by vendor and the method shall be agreed upon by the purchaser. Water cooling shall be considered for pumping temperature equal or above 260°C. When shaft mounted bearing cooling air fan is required, then it shall be of metal using non-sparking material.
- 7.3.7 All rolling element bearings shall have metal rolling element cages.
- 7.3.8 In addition to any installed vibration equipment specified, a flat surface at least 25 mm in diameter shall be supplied for the location of magnetic based vibration measuring equipment. These shall be located on or as near as practicable to the bearing.
- 7.3.9 Flinger or oil rings shall not be used for pumps with variable speed drivers unless approved by the client.
- 7.3.10 Oil mist shall not be visible from the bearing housing breathers.

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7.3.11 In vertical pumps (VS type), guide bushings shall be suitable for dry running during start up and shut down.

#### 7.4 MECHANICAL SEALS

7.4.1 Mechanical Seal for pumps shall be cartridge type, shall comply to API-682 and shall be category 2. Seal systems shall be in accordance with API 682.

7.4.2 All mechanical seals shall be designed for bi-directional rotation.

7.4.3 Pumps shall be provided with mechanical seals (except clean cold water service which can be provided with gland packing).

7.4.4 In general, Tank/Pit mounted vertical pumps (process service) shall be provided with dry running vapour seals. In case of handling hazardous or toxic fluids this vapour seal shall be nitrogen buffered. For vertical pumps handling molten sulphur, gas tight construction with deep stuffing box and graphite impregnated packing shall be provided.

7.4.5 Seal manufacturers specific recommendation shall be obtained and submitted along with the proposal.

7.4.6 Mechanical Seals shall be imported either in fully assembled condition OR the critical components shall be imported by Indian seal manufacturers from their respective principals and the seals shall be assembled and tested in the indigenous facilities of these seal manufacturers. Qualification test results of each seal shall be furnished during detail engineering for review.

7.4.7 Mechanical seals shall have a vent connection on the stuffing box or flush piping with an isolation valve to ensure fluid at the seal face before start-up.

7.4.8 All seal vents shall be routed to closed system ie. to flare.

7.4.9 Only balanced cartridge type mechanical seal shall be used. Single seals shall be used in all cases except for hazardous or flammable fluids or dirty service as identified in the datasheets. Suitable seal flushing plans as identified in the datasheets shall also be provided.

7.4.10 For seal flushing plans, piping material shall be of Stainless Steel. For cooling water plans, piping material shall be carbon steel.

7.4.11 Pumps for vacuum service or having operating temperature of 176°C and above shall be provided with

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stationary metal-bellows seals.

- 7.4.12 Vendor shall provide all instrumentation requirements for API seal plan as per API 682. Switches are not acceptable. Only transmitters are acceptable. For critical pumps, Seal Plan trip instruments and transmitters shall be with 2oo3 logic and shall utilize 4-20 mA with HART protocol.
- 7.4.13 Fluids containing toxic, carcinogenic & corrosive fluids require seals that have enhanced safety features like tandem seals, double/dual seals etc. Dual seals shall be applied for following services or if specified in the datasheet:
- Liquids containing hydrogen sulphide in concentrations above 600Mg/Kg
  - Liquids consisting of or containing lethal substances. Examples of lethal substances include but not limited to: HF acid, Phenol, concentrated Sulphuric or Nitric acid.
  - Hydrocarbon services of butane (C4) or lighter, LPG, NGL, Naphtha, liquid gas etc.
  - Liquids consisting of or containing very toxic substances like Benzene, Toluene, MEK, Ethylene oxide etc.
  - Services involving solid contaminants
  - Services involving liquids at or above auto ignition temperature
- 7.4.14 Mechanical seal API plan 54 is not acceptable unless approved by the OWNER.
- 7.4.15 Pumps handling non-congealing liquids at temperatures 200°C and above shall be provided with API seal flushing plan 23 or 32 where single mechanical seals are provided. Cooler shall not be provided in seal flushing system where seal is flushed by congealing liquid.
- 7.4.16 For congealing service, the stuffing box shall be jacketed with LP or MP steam to ensure fluid inside seal does not congeal.
- 7.4.17 For pumps provided with flushing Plan 21 and 23. Temperature Indicator shall be provided in the flushing line.
- 7.4.18 All cooling water piping header size for hot water pumps shall be 25 mm NB (min). Instead of series connection separate connection for all circuits shall be provided. For cleaning purpose flange with blind is to be provided at the dead end.
- 7.4.19 For all API cooling water piping plans a sight flow glass (Ball type flow indicator) shall be provided in the individual outlet lines.

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7.4.20 For horizontal pumps seal system and interconnecting piping shall be mounted on the base plate of pump.

7.4.21 For Vertical pumps seal system shall be provided in separate mounting plate.

7.4.22 Self-sintered silicon carbide (SSSiC) seal faces shall be provided for Caustic service and hydrofluoric acid service.

7.4.23 Double Mechanical seal shall be suitable for reverse pressure (i.e., the equipment is sealed whatever the barrier liquid pressure and stuffing box pressure).

## 7.5 LUBE OIL SYSTEM

7.5.1 When applicable, lube oil system shall be General Purpose oil system as specified in API 610-11<sup>th</sup> Edition. The following minimum requirements shall apply:

7.5.2 Filter outlet housing as well as downstream piping shall be in stainless steel material.

7.5.3 When a separate oil reservoir is provided, the reservoir shall be sized for a retention time of 3 minutes minimum and suitable to recover all piping oil capacity. Top of the reservoir shall be sloped to avoid accumulation of liquid or dirt.

7.5.4 Unless otherwise specified, Oil coolers shall be water-cooled shell and tube type with removable bundle as per TEMA 'C'.

7.5.5 In case of oil coolers, the oil-side operating pressure shall be higher than water- side operating pressure except for cases where this is not feasible.

## 8. ACCESSORIES

### 8.1 DRIVER

8.1.1 Electric Motor power for Pumps with auto-start or parallel operation shall not be less than the maximum 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.

8.1.2 The maximum power requirement of the driven equipment shall be determined at the driver coupling and shall include all transmission losses.

8.1.3 The driver and auxiliaries shall be suitable for operation in the area classification specified in the equipment datasheet. Where applicable, PESO certification in original for electrical items and

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Instruments shall be provided to OWNER / PMC.

- 8.1.4 The motor nameplate rating for applications where the specific gravity of pumped fluid is less than 1.0 shall not be less than the BKW of pump at minimum continuous stable flow with clean cold water of sp. gravity 1.0.
- 8.1.5 Motors for pumps with Open valve start-up shall be capable of accelerating the pump to rated speed assuming maximum power at 80 % supply voltage. The separation between the motor and pump speed torque curve shall never be less than 10% of the rated torque.
- 8.1.6 For all vertical pumps, the vendor shall supply, shop mount, align and be responsible for all vertical drive components (including motor, gear and couplings). Vendor's responsibilities shall cover freedom from harmful effects of torsional and/or lateral critical speeds and vibrations of the complete structural assembly of the pump.
- 8.1.7 For VFD application, Vendor should check that lateral and torsional critical speeds do not occur in the entire pump operating range.
- 8.1.8 Steam turbine drivers shall be in accordance with API 611 or API 612 based on the criticality of the driven equipment and availability of standby pump. The steam turbine drivers shall be sized to deliver 110% of the pump rated power or the maximum power at end-of curve operation with rated impeller for Auto-start/ parallel operation, whichever is higher. The turbine shall be sized considering minimum inlet and maximum exhaust steam conditions.

## 8.2 COUPLING AND GUARDS

- 8.2.1 Unless otherwise specified, all couplings required for multistage pump (more than two stages) with driver rating greater than 160 kW or for pumps driven by Special Purpose steam turbine (API 612) shall conform to API 671.
- 8.2.2 Coupling shall have a minimum service factor of 1.5 over the driver rating. For steam turbine driven pumps and diesel engine driven pumps, minimum service factor of coupling shall be 1.25 and 3.0 respectively.
- 8.2.3 Coupling shall meet the balancing requirements of ISO 1940-1 grade G6.3. Couplings for speeds over 3600 rpm or when specified in the pump datasheet, the dynamic balancing grade shall be G2.5.
- 8.2.4 For all types of coupling except for close coupled machines, it shall be possible to remove the half couplings or coupling hubs in-situ without moving driving or driven equipment.

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8.2.5 Non-lubricated Flexible metallic multi disc or diaphragm type coupling with spacer shall be provided. The multidisc/diaphragm shall be of stainless steel material. For vertical VS4 type pumps with gland packing as shaft seals, non-spacer type coupling can be provided.

8.2.6 Coupling guard shall be removable, perforated and of non-sparking material. Guard shall be fabricated from 18 SWG (MIN), Aluminum sheet 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. The guard for pumps/motors should have proper and convenient arrangement for vibration readings. Guards shall be designed to minimize the potential heating caused by windage. It shall be securely attached to the baseplate, a fixed support or adjacent fixed parts of the machinery.

### 8.3 BASEPLATES

8.3.1 Drive train components regardless of weight shall have traverse and longitudinal alignment positioning screws. Jackscrews shall be provided for components heavier than 225 kg.

8.3.2 When shims are to be used for equipment alignment only Stainless Steel shall be used.

8.3.3 Pump, Drive, seal system, supporting arrangement and the Auxiliary component shall be mounted on a single skid as per API guidelines. Any projections outside skid edge is not acceptable.

8.3.4 The baseplate shall be rigid construction and fabricated out of standard steel sections. The minimum height of the section shall be as under:

Pump with motor rating upto	Min section height
7.5 kW	ISM 100
45 kW	ISM 150
75 kW	ISM 200
Above 75 kW	ISM 250

8.3.5 Motor side of the baseframe shall be capable of accommodating next higher frame size of the proposed motor.

8.3.6 Unless otherwise specified, baseplates shall have drain pan for containing and collecting oil or process leakages from the pump and shall be constructed of welded structural steel. Drain connection shall be provided as per API standard for customer hook-up. All welds shall be fully continuous.



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- 8.3.7 Lifting devices and their attachment welds shall be designed to comply with the local rules and regulations. As a minimum requirement on the design, the following shall be applicable:
- For the design of the lug (in view of material stresses during lifting) as impact factor of 1.5 on the lifting weight shall be applied.
  - For the attachment welds an impact factor of 2.0 on the lifting weight shall be applied.
- 8.3.8 Unless otherwise specified, baseplates shall be designed for grouting and shall have at least one lipped grouting hole per each bulkhead section and appropriately located vents. The baseplate bottom shall be coated with a suitable coating system compatible with the grouting material. If specified, the rigidity of the base plate and pedestal assembly shall be increased, in case the baseplate shall be mounted without grouting.
- 8.3.9 The selection and application of grout to be discussed and finalized by LSTK contractor with vendors and the same to be documented suitably before the commencement construction.
- 8.3.10 All critical equipment intended to be mounted directly on foundation, without base plate and having flat mounted surface shall be grouted using epoxy grouting or as recommended by vendor. Epoxy grouting to be carried out in the technical supervision of grouting material manufacturer
- 8.3.11 Splices in primary beams are not acceptable.
- 8.3.12 For vertical pumps installed on sumps, a separate soleplate shall be provided. For pumps installed in tanks or vessels the vendor shall include the supply of fixing bolts (inc. 10% overage) and the sole / mounting plate gaskets.
- 8.4 SUCTION STRAINERS**
- 8.4.1 Vertical pumps taking suction from sump / vessel shall be furnished with corrosion resistant suction strainer. Perforation / mesh size shall be suitable for proper operation of pump. Free flow area of the strainer shall be minimum 2.5 times the area of equivalent suction nozzle area.
- 8.5 ELECTRICAL**
- 8.5.1 Earthing within the skid shall be considered in Vendor scope. Minimum two (2) earthing lugs located at diagonal opposite sides of each unit.
- 8.5.2 In general, the cable trays within the skid upto battery limit shall be supplied by vendor with necessary supports.

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		<b>CLIENT</b>	<b>IOCL Paradip Refinery</b>	
<b>JOB SPECIFICATION FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS</b>	<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-000-JSS-0910-001	<b>Rev. No.</b> B	Page 18 of 24

8.5.3 MV/ HV induction motors shall be as per specification 080557C-000-JSS-1691-001/1692-001.

8.5.4 Electrical heaters shall be fitted in a stainless-steel shell (well) to allow for removal without draining the heated fluid.

8.5.5 Electric motors shall be provided with GI canopy for protection from rain water, when installed outdoor without shelter.

## 8.6 INSTRUMENTATION AND CONTROL

8.6.1 Instruments supplied by vendors shall be compliant to project specification of Instrumentation for Packages units (080557C-000-JSS-1515-001).

8.6.2 Instrumentation tagging shall be as per Instrument numbering and identification (080557C-000-JSD-1540-003).

8.6.3 All field instrumentation shall be securely mounted so that they are not affected by vibration, are properly visible during normal operation and are easily accessible for maintenance.

8.6.4 Rain cum Sun shade Canopy made of corrosion resistant material shall be provided for all electronic instrumentation, Local control panels and junction boxes housing electronic components, exposed to direct sun rays.

8.6.5 Instrument mounting/ hook-up shall allow instrument venting and drainage for calibration and isolation for replacement without draining the equipment.

8.6.6 Machine protection and condition monitoring system and instruments shall be supplied, installed and tested in accordance with API 670.

8.6.7 Machine and Condition Monitoring system shall be in accordance with 080557C-000-JSS-1514-003, API 670 and pump datasheet.

8.6.8 When maximum power at rated impeller is equal to or greater than 1000 kW and/or the driver rating is 1000 kW or above, accelerometer vibration probes and bearing temperature detectors for bearing housing along with cable & skid mounted junction box shall be supplied.

## 8.7 PIPING AND APPURTENANCES

8.7.1 All customer tie-in connections shall terminate at skid edge with a flanged connection in accordance with ASME B16.5.

8.7.2 Cast iron shall not be used for auxiliary connections.

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- 8.7.3 Thermal Safety valve shall be provided on the cooling water or condensate return lines, upstream of any isolation valve.
- 8.7.4 Piping components (including valves, check valves etc) on flammable and/ or hazardous fluids shall be fire safe (external tie rod are not allowed).
- 8.7.5 Screwed piping into mechanical seal glands shall be straight and provided with lap joint flanges at the connection with seal system piping.
- 8.7.6 Flange fasteners on stainless steel piping shall be stainless steel.
- 8.7.7 Flanges are required instead of socket welded unions for all auxiliary process fluid piping.
- 8.8 NAMEPLATE AND TAGGING**
- 8.8.1 All equipment and components including electrical and instruments accessories shall be identified with a stainless-steel nameplate in English language. The units as in pump datasheets shall be followed.
- 8.8.2 All the nameplates, warning signboards, containing advices or other basic safety instructions, to be placed on the outside of the equipment and/or on confined parts, doors and emergency push buttons, shall be supplied by Vendor and written in English.
- 8.8.3 Rotation arrows shall be cast in or indicated in stainless steel plate permanently attached to rotating machinery with pins of the same material.
- 8.9 PAINTING & INSULATION**
- 8.9.1 Equipment and piping shall be painted and color coded in compliance with the project specification 080557C-000-JSD-2300-001. Vendor can propose their standard painting procedure provided it complies with the minimum requirements of the specification, including (but not limited to) surface preparation, type of products to be used, minimum thickness and inspection. The following is the color shade requirement for main items:  
Pumps: Cobalt blue RAL – 5013  
Electric motors: Bluish Green RAL 5021  
Baseplate & structural supports: Light Grey RAL 7035  
Dangerous or exposed parts of Machinery: Orange – RAL 2008
- 8.9.2 No surfaces of parts of pumps are to be painted until the inspection is completed.
- 8.9.3 Where the equipment or piping are to be insulated for personnel protection or Heat conservation, vendor shall provide insulation materials and fixing accessories as loose supply which will be installed at site by others.
- 8.9.4 Insulation shall be as per Project specification 080557C-000-JSD-2200-001.
- 8.9.5 Where insulation is required to be removed for inspection or maintenance, removable insulation blanket shall be provided.
- 8.9.6 Vendor shall indicate in the drawings and datasheets the equipment and piping to be insulated.

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## 9. **HEALTH, SAFETY AND ENVIRONMENT**

- 9.1 HSE is the primary commitment of PMC and OWNER. Design studies, material supply and construction activities must be delivered to comply with all HSE aspects of the project. SUPPLIER shall demonstrate his own HSE commitment.
- 9.2 SUPPLIER must ensure that the design, fabrication and testing of his equipment doesn't endanger the health and security of his own employees, employees of erection CONTRACTOR and future operator of the plant. In addition, all possible efforts must be made in order to minimize the environmental impact of his activities.
- 9.3 If SUPPLIER needs additional design data in order to meet these requirements, PMC will provide the information upon SUPPLIER written request.
- 9.4 All required precautions for the work to proceed safely without interruption (health, safety and environment) during site erection must be taken into account.
- 9.5 SUPPLIER shall provide any necessary recommendation for installation, operation and maintenance in order to ensure a safe erection and operation of his equipment.
- 9.6 Equipment noise level (Driver + Driven equipment train + auxiliaries) shall not exceed 85 dBA when measured at One-meter distance from the equipment skid in any direction. This requirement is not applicable for equipment having infrequent operation. Where expected noise level exceeds above limit, the equipment supplier shall provide noise attenuation device such as noise enclosure or blanket / silencer to reduce the noise level to within 85 dBA.
- 9.7 Personnel protection insulation shall be provided for accessible surfaces with temperatures of 60°C and above. Guard shall be provided to protect personnel from accidental contact in case the surface cannot be insulated for heat transfer reason.
- 9.8 All electrical components & installations, instruments shall be suitable for the electrical area classification and grouping in which the equipment is installed.
- 9.9 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 cooling or steam jacket).

## 10. **INSPECTION AND TESTING**

### 10.1 **GENERAL**

- 10.1.1 The minimum Inspection and Testing requirements are specified in the Inspection and Test Plan 080557C-000-ITP-0910-001.
- 10.1.2 Prior to start of test, manufacturer shall furnish the certificate of latest calibration of driver and measuring instruments for review by Owner/PMC/ Contractor Inspector.

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10.1.3 Material Certificate shall be as a minimum meet the requirements of BS EN10204 3.1B for pressure containment / rotating parts and BS EN 10204 2.1 for other components.

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

## 10.2 INSPECTION

10.2.1 All personnel performing Non-Destructive Testing (NDT) must be adequately qualified. Qualification Record shall be available at Vendor's Shop before test.

10.2.2 All pressure retaining welds shall be subject to the following requirements:

- All pressure retaining welds shall be subject to 100% radiographic examination.
- Auxiliary connections shall be examined by either magnetic particle or liquid penetration.

10.2.3 For equipment requiring post weld heat treatment, final NDT of welds shall be carried out after heat treatment.

10.2.4 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 the hardness of wear rings.
- A check for good workmanship and finish throughout.

## 10.3 TESTING

10.3.1 The following tests shall be witnessed:

- Hydrostatic (For all pressure containing parts including auxiliaries). Jacket test pressure shall be 1.5 times the design pressure of the connecting piping. The chloride content of the liquid shall not exceed 30 mg/kg (i.e. 30 ppm).

- Performance

Pump shall be operated at the shop at the rated speed and capacity. At least five data points shall be taken at shut-off, minimum continuous stable flow, minimum flow, rated flow and 110% of rated flow for complete test data including head, capacity, NPSHR and power.

- NPSH (In case difference between NPSHA and NPSHR is less than or equal to 1.0m or when specified in the job specification)
- Dismantling inspection and reassembly after the running test, which shall include examination of mechanical seals, close clearance parts and measurement of running clearances. In case of multistage pumps having hydrodynamic bearings, the bearing shall be removed inspected and reassembled.

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- Vibration measurement and Sound level test (During Performance Test).
- Check for direction of rotation of pump & driver.
- UT of shaft & Radiography of casing

10.3.2 The tolerance for guaranteed characteristics shall be as under:

- Rated head: Zero negative tolerance
- Shutoff Head: Zero negative tolerance. Positive tolerance permitted as long as shutoff head does not exceed 120% of rated head.
- Min. Submergence required / NPSHr: Zero Positive tolerance
- Rated BkW: Zero Positive tolerance (However, pumps may be accepted upto 104% of Guaranteed BkW subject to penalties as defined in Loading Criteria 080557C-000-JSD-0900-002.
- Shop driver shall be used for testing and the rating of the driver shall not exceed 150% of the power that may be consumed while running at duty point with Water or full valve open conditions, whichever is higher. This is applicable only for LV motors.

10.3.3 Pump shall be run on the test stand until oil temperature stabilization has been achieved.

10.3.4 The mechanical and performance test can be combined.

10.3.5 Any filing, grinding or other reworking of impellers to meet the guaranteed performance shall be described in the test report and parts manual in sufficient detail to permit re-ordering new impellers similarly reworked.

## 11. **PREPARATION FOR SHIPMENT AND ON-SITE STORAGE**

11.1 Packing and preservation shall conform to Packing, Marking and Shipping Instructions.

11.2 The equipment shall be suitably prepared for the type of shipment, type and duration of storage defined in relevant procedure, including the following specific requirements:

- If necessary, mechanical seals and other high sensitive sub-components shall be dismantled by Manufacturer after test and packed separately in complete enclosed wooden boxes. VENDOR shall clearly state in the proposal the concerned components, and include in its quotation the required additional operations (dismantling, separate packing)
- Equipment surfaces made from corrosion resistant materials shall be prevented from rust on the inside. This shall be done either by placing moisture absorbing materials, inside the equipment, or by applying a nitrogen blanket inside the equipment. In case equipment is filled with nitrogen, warning signs shall be provided at every nozzle connection or inspection opening.
- Stainless steel components shall be passivated before packing. VENDOR will submit his procedure for review



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- Blocking of the rotors when necessary.
- Separate, loose, and spare parts shall be completely boxed. All pieces of equipment and spare parts shall be identified by item number on the inside and the outside of the packing

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

## 12. **SPARE PARTS AND SPECIAL TOOLS**

SUPPLIER shall quote for Commissioning spares, Mandatory spares, Operation & Maintenance spares and Special tools. SUPPLIER shall submit Spare Parts Interchangeability Report.

### 12.1 **PRE-COMMISSIONING, COMMISSIONING AND START-UP SPARES**

Spares for pre-commissioning, commissioning and start-up shall be supplied by the VENDOR as part of main order. Spares parts list with part numbers is to be furnished in the project prescribed format by the VENDOR.

Spare parts for commissioning and start -up shall include following as a minimum.

- One complete set of gaskets.

### 12.2 **MANDATORY SPARES**

Mandatory spares shall be procured along with the main equipment. Minimum Mandatory Spares requirement is included in the tender.

### 12.3 **OPERATION & MAINTENANCE SPARE PARTS**

The total price quoted shall also include cost of Operation & Maintenance (O & M) Spares required during the Defect Liability Period. The CONTRACTOR shall, within 3 (three) months of his finalization of all the suppliers, furnish to the OWNER the current price list for O & M spares for 2 (two) years operation beyond the Defect Liability Period as recommended by manufacturers of various equipment to enable the OWNER to procure these spares

### 12.4 **SPECIAL TOOLS**

VENDOR shall suggest the requirement and quantity of the special tools and tackles required for installation and maintenance.

Special tools if required shall be supplied by the VENDOR.



## 13. **GUARANTEES**

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Vendor shall guarantee the mechanical behaviour (vibration, noise, bearing temperatures etc.) and the performance of the equipment to be in accordance with the requirements of the specifications, the datasheets and applicable standards in particular

- Performances: refer to the equipment datasheet operating conditions
- Power consumption: shall be guarantee power. Refer to Equipment datasheet. For additional power consumed, Penalty as per Loading Criteria 080557C-000-JSD-0900-002 shall be applied.
- Utility Consumption (Cooling water, Nitrogen, Instrument Air, Steam ...)





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# ENGINEERING DESIGN BASIS FOR ROTATING EQUIPMENT

			 <b>Written By</b> Shankar Ramasubramanian 2020.06.11 15:25:27 46296	 <b>Checked By</b> Arundan Ananthapadmanaban 2020.06.11 17:54:17 +05'30'	 <b>Approved By</b> Arundan Ananthapadmanaban 2020.06.11 17:54:17 +05'30'	 <b>Authorized By</b> Muralidharan Ananthapadmanaban 2020.06.11 18:01:53 +05'30'
B	10-Jun-2020	REISSUED FOR DESIGN	RS	AA	AA	JMC
A	15-Nov-2019	ISSUED FOR DESIGN	KS	RS	AA	JMC
<b>REV.</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>PREPARED</b>	<b>CHECKED</b>	<b>APPROVED</b>	<b>AUTHORIZED</b>

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## 1. Introduction:



**INDIAN OIL CORPORATION LIMITED (IOCL)** has awarded Fax of Acceptance (FOA) dated 29<sup>th</sup> August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

## 2. Definitions & Abbreviations

Abbreviation	Definition /Expanded form
IOCL/ CLIENT	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit

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### 3. Design Philosophy

#### 3.1. Scope

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

Electrical items, Instrumentation & Controls, Piping, Pressure Vessels, Mechanical Equipment, Heat exchangers etc. associated with rotating equipment shall comply with the design requirements as given in the respective specifications forming part of the bid package / inquiry.

#### 3.2. Conflicts And Deviations

If conflicting statements exist within this document or between this document and Design Basis, other applicable specifications, Standard Drawings, Industry standards, codes, etc., it shall be brought to Owner's / PMC notice for clarification and proper approval shall be obtained before implementation. Decision of Owner / PMC shall be final.

In case of contradiction between licensor specification, design basis and JSS, it has to be brought to the notice of Owner/PMC and Decision of Owner/PMC shall be binding on Contractor/Vendor.

In general, order of precedence of the documents shall be as follows,

- Local Regulatory and Statutory Requirement.
- Local Codes and Standards (for pumps not applicable)
- Licensor Requirements (if applicable)
- Engineering Standards and Specifications
- International Codes and Standards

#### 3.3. Referenced Standards



Equipment Data Sheets, P&ID's, Licensor's specification, Job specifications, Inspection and Test Plans and Standards/Codes along with the requirements specified in this Design Basis, shall be the basis of design, selection, manufacture, inspection/testing of the equipment. For design aspects not specifically covered herein, the design shall be based on good engineering practices. The latest edition of following standards are referred and applicable for the equipment as enlisted.

- Centrifugal Pumps for Special Purpose Process Services - API Std. 610 – 11<sup>th</sup> Edition
- Centrifugal Pumps for Water service – ISO 5199 Edition 2002 – Class II
- Centrifugal Fans – Fired Heaters for General Refinery Service API Std. 560 – 5<sup>th</sup> Edition
- Pressure Lubrication, Shaft sealing and Oil control Systems – API Std. 614-5<sup>th</sup> Edition
- Shaft sealing for centrifugal & rotary pumps- API Std. 682 – 4<sup>th</sup> Edition
- Special Purpose couplings – API 671 4<sup>th</sup> Edition

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- Vibration, Axial Position & Bearing Temp. Monitoring Systems- API Std. 670 – 5th Edition
- Bearing-ABMA
- Mechanical Vibrations - Balancing quality requirements of rotating rigid rotors- ISO 1940
- Pressure vessels ASME Section VIII
- TEMA Std for Heat Exchangers

### 3.4. POWER LOADING

- 3.4.1 The power loading is to be done only for the equipment whose power consumption can be verified during testing of equipment at vendor's works such as Centrifugal Pumps, Centrifugal Compressor, and Centrifugal Fans etc.,
- 3.4.2 The power consumption of driven equipment only to be considered for evaluating energy consumption and power loading purpose.
- 3.4.3 Power loading shall be applied on continuous operating units only and not on standby units. Power loading should not be done for equipment operating on intermittent basis.
- 3.4.4 The offer of vendor to be loaded by Net Present Value of the excess energy consumption (over the vendor having least energy consumption) for five years period starting from one year after delivery.
- 3.4.5 Power Loading Criteria shall be as defined in document 080557C-000-JSD-0900-002.

### 3.5. Equipment Selection and Sizing Criteria

- 3.5.1. Selection of Rotating Equipment shall be based upon the following considerations:
- Suitability for the specified duty conditions
  - Standard Models under vendor's regular range of manufacture
  - Proven Track record in similar service as specified under acceptance criterion
  - Compliance to specified codes and standards.
- 3.5.2. Unless otherwise specified in the process package, the sizing of blowers, air compressors shall be based on maximum site coincident ambient temperature and relative humidity.
- 3.5.3. Allowable working pressure & temperature of the rotating equipment shall be greater than the higher of design pressure & temperature specified in

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- the equipment data sheet (if any)
- the licensor's/engineering specifications, codes & standards.

- 3.5.4. 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/maximum continuous speed.
- 3.5.5. The equipment (including auxiliaries) shall be designed and constructed for a minimum service life of 20 years and at least 3 years of uninterrupted operation.
- 3.5.6. Rolling element bearings shall have bearing life ( $L_{10h}$ ) in accordance with respective equipment standards as specified in the equipment datasheets.

### 3.6. Equipment Sparing Philosophy

The Equipment Sparing philosophy shall be as specified in the Process Design basis.

### 3.7. Equipment Qualification Criteria



- 3.7.1. The vendor for the complete unit shall be an established manufacturer and he shall also be the manufacturer of the proposed equipment having adequate engineering, manufacturing & testing facilities for the same.
- 3.7.2. The vendor shall have engineered, packaged, tested and supplied at least TWO identical or validly similar packages in terms of type of machine, driver, sealing system etc from the proposed plant and at least ONE of these shall have successfully operated in the field for at least 8000 hours without any major problem as on the date of issue of invitation to bid.
- 3.7.3. The vendor besides satisfying the requirements of clauses 3.7.1 & 3.7.2 above shall also be the packager of the complete system proposed and shall have the single point responsibility for the entire package. Seal make/model shall be from the regular manufacturing range of seal manufacturer and shall be field proven for similar services, pressures and speeds.

### 3.8. Equipment Suppliers

The equipment supplier shall be one from the approved list of vendors.

### 3.9. Associated Accessories and Auxiliary Systems

- 3.9.1. Vendor shall furnish all rotating equipment, along with drivers, auxiliary systems, instrumentation and control systems, all necessary electrical and safety devices as applicable or required for safe and reliable operation of the unit

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- 3.9.2. Vendor in his scope of supply and work shall also include the hardware required over and above what is specified, for safe and satisfactory operation of the equipment package.
- 3.9.3. LSTK contractor shall provide the foundation bolts for all Rotating equipment and its auxiliaries except where special foundation bolts are required in which case the vendor shall supply the special bolts.
- 3.9.4. The companion flanges along with gaskets and bolts shall be supplied by the vendors for the non-standard battery limit flanges.
- 3.9.5. Motors, electrical/instrument components and electrical/instrument installations shall be suitable for the area classification specified by the EPCM consultant and shall meet the requirements as defined in the electrical/instrument specification attached with the relevant sections of the bid package /order.

### 3.10. Sealing System Selection Criteria

#### 3.10.1. Centrifugal Pumps

- 3.10.1.1. Unless otherwise specified in the datasheet, all pumps shall be provided with mechanical seals.
- 3.10.1.2. In general Tank / Pit mounted vertical pumps (process service) shall be provided with dry running vapour seals. In case of handling hazardous or toxic fluids this vapour seal shall be nitrogen buffered. For vertical pumps handling molten Sulphur, gas tight construction with deep stuffing box and graphite impregnated packing shall be provided.

#### 3.10.2. Centrifugal Fans



- 3.10.2.1. Centrifugal fans (for gas service) shall be provided with Dry Gas Seals except for services (like Air, N2 etc.) where normally labyrinths shall be used for sealing.
- 3.10.2.2. Dry gas seal and sealing skid comprising of dry gas seal filters, valves and instrumentation etc. shall be procured from Dry Gas seal supplier only.
- 3.10.2.3. Gas installation grouting
- 3.10.2.4. Package system for drying and filtering the process buffer gas to the dry gas seal shall be provided.

### 3.11. Drive Arrangement

- 3.11.1. All equipment shall be either directly driven or driven through gear box. However, belt driven arrangement may be used for smaller equipment as per guide lines of relevant API standard. (eg. Belt drive may be used for centrifugal fans / blowers less than 75 kW.)
- 3.11.2. V-Belt drive arrangement may be provided, where it is permitted by the applicable Job Specification of a rotating equipment.
- 3.11.3. V-belts used for equipment located in hazardous area i.e. Div. I or Div.II (NEC) area (Zone I or Zone 2 (IEC) area) shall be non-conducting type and shall be certified suitable for the area classification.

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### 3.12. Couplings & Coupling Guards

- 3.12.1. Unless otherwise specified, Couplings shall be of metallic, non-lubricated, flexible element type (i.e. either diaphragm or discs) with spacer, for all equipment. For vertical VS4 type pumps with gland packing as shaft seals, non-spacer type coupling can be provided. All coupling models shall be selected for a minimum service factor of 1.5.
- 3.12.2. Couplings for the following equipment or if specified in the datasheet shall conform to API Standard 671:
- Centrifugal compressors (API 617)
  - Special purpose Steam Turbines (API Std. 612)
  - Rotary Screw Compressors (API Std. 619)
  - Multi-stage (greater than two stages) centrifugal pumps with driver rating greater than 160 kW.
- 3.12.3. Couplings as per manufacturer's standard may be supplied for the following equipment:
- Reciprocating compressors
  - Packaged Integrally Geared Centrifugal Air Compressors
  - Packaged Rotary Compressors (Screw type for Plant & Instrument Air Service)
  - Diesel / Gas Engine driven equipment.

The couplings for the above equipment shall however comply to the requirements of the equipment standards as applicable.

- 3.12.4. Universal type coupling (hook joint) shall be used for coupling diesel engine and the vertical water pumps.
- 3.12.5. Coupling guard shall be removable, perforated and of non-sparking material. Guard shall be fabricated from 18 SWG (MIN), Aluminum sheet 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. The guard for pumps/motors should have proper and convenient arrangement for vibration readings. Guards shall be designed to minimize the potential heating caused by windage. It shall be securely attached to the baseplate, a fixed support or adjacent fixed parts of the machinery. Centrifugal compressors coupling guards may have vendor standard features.

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### 3.13. Equipment Layout

- 3.13.1. When designing the layout of the equipment package due consideration shall be given for easy accessibility to all the items for maintenance and operational requirements. Access shall be provided to all equipment and any area requiring maintenance. The equipment shall be designed so that all maintenance can be carried out with the minimum special facilities / tools.
- 3.13.2. All equipment and piping shall be neatly arranged on the skid where possible to ensure that they do not obstruct maintenance operation. The package vendor shall ensure that the most effective layout, assuring adequate access for maintenance is achieved within the package.
- 3.13.3. All pump components and accessories like seal plan connections and supporting arrangement shall be within the equipment baseframe as per API guidelines.
- 3.13.4. All nozzle sizes up to 2" shall be provided with 2 nos of stiffener at 90 deg apart.

### 3.14. Allowable Noise Level

- 3.14.1. Equipment noise level (Driver + Driven equipment train + auxiliaries) shall not exceed 85 dBA when measured at One-meter distance from the equipment skid in any direction. This requirement is not applicable for equipment having infrequent operation such as diesel engine driven fire water pump package. Where expected noise level exceeds above limit, the equipment supplier shall provide noise attenuation device such as noise enclosure or blanket / silencer to reduce the noise level to within 85 dBA. Acoustic hoods shall not be used for any equipment excepting for DG sets (rating upto 1000 kVA), gas turbines, rotary compressors & roots blowers.



### 3.15. Installation Criteria

#### 3.15.1. General

- 3.15.1.1. Installation of all Equipment's shall be as per Guidelines in API 686 – Recommended Practice for Machinery Installation and Installation design as a minimum requirement. LSTK contractors can suitably develop specific requirement if required based on vendor recommendations.
- 3.15.1.2. All rotating equipment shall be suitable for outdoor installation and shall be installed on ground floor (ie. On finished floor level). No equipment shelter is envisaged.
- 3.15.1.3. The selection and application of grout to be discussed and finalized by LSTK contractor with vendors and the same to be documented suitably before the commencement construction.
- 3.15.1.4. All critical equipment intended to be mounted directly on foundation, without base plate and having flat mounted surface shall be grouted using epoxy grouting or as recommended by vendor. Epoxy grouting to be carried out in the technical supervision of grouting material manufacturer.

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3.15.1.5. All rotating equipment base plates shall have jacking provision for leveling and screws for alignment.

3.15.1.6. Only Stainless Steel shims shall be used for equipment alignment.

#### TYPICAL GROUTING INSTALLATION OF BASEPLATE

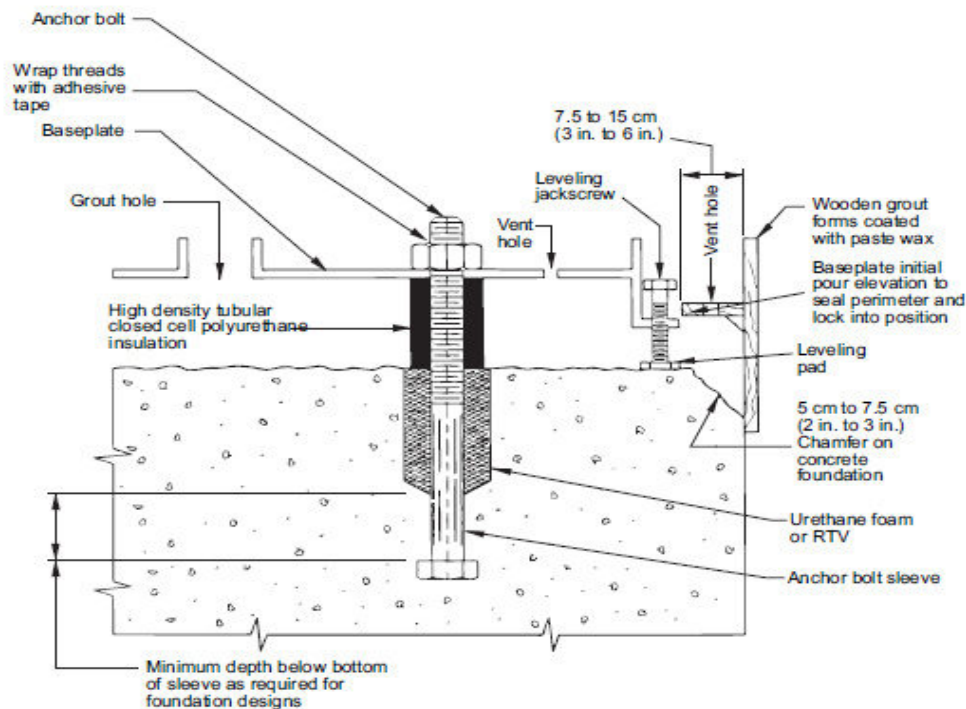




Figure G.1—Typical Grouting Installation of Baseplates for Pumps and General-purpose Equipment



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### TYPICAL GROUTING INSTALLATION OF SOLEPLATES

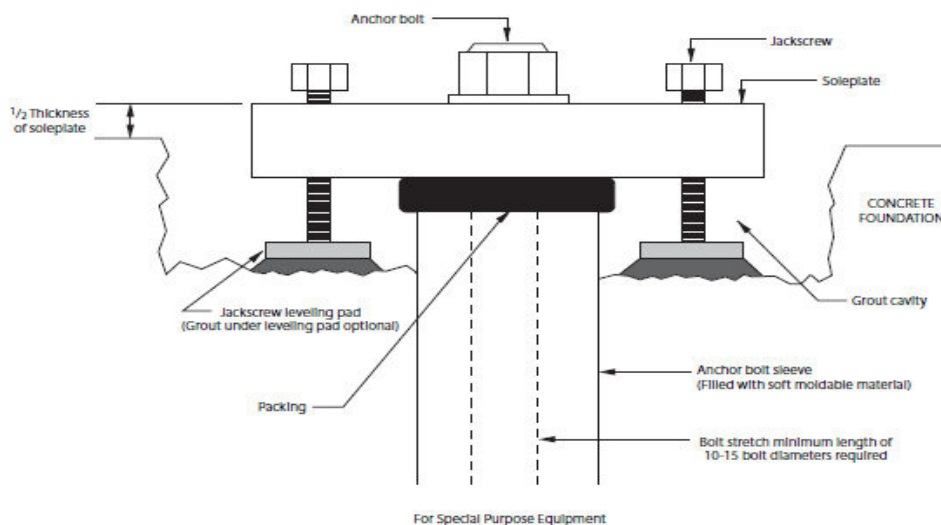


Figure F.1—Typical Grouting Installation of Soleplates

### 3.15.2. Pumps

- 3.15.2.1. All pumps shall be suitable for outdoor installation. No equipment shelter is envisaged. Electric motors shall be protected from rain by a canopy. Instruments and instrument panels shall be protected by rain hoods/shades.
- 3.15.2.2. If pump is located inside a pump house, necessary hoist and chain pulley block arrangement to be provided for maintenance.
- 3.15.2.3. The selection and application of grout to be discussed and finalized by LSTK contractor with vendors and the same to be documented suitably before the commencement construction.

### 3.16. Maintenance Facilities

#### 3.16.1. Pumps



- 3.16.1.1. All pumps not open to sky with motor rating > 75 kW shall be provided with monorail. No monorails shall normally be provided for pumps outside the rack. Sufficient space below rack shall be available for pump maintenance. All OSBL pumps shall be grouped (to the possible extent) and to be provide with monorail and chain pulley arrangement.

#### 3.16.2. Centrifugal Fans

For centrifugal fans that are located outdoor sufficient space to be provided in the layout for mobile crane movement. For the units inside a shelter, suitable hoist and chain pulley arrangement shall be provided.

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### 3.17. Heat Exchangers

#### 3.17.1. Lube Oil Coolers



- 3.17.1.1. Unless otherwise specified, Oil coolers shall be water-cooled shell and tube type with removable bundle as per TEMA 'C'.
- 3.17.1.2. For shell and tube exchangers of AES type, test ring and test flange shall be provided.
- 3.17.1.3. In case of oil coolers, the oil-side operating pressure shall be higher than water- side operating pressure except for cases where this is not feasible.

### 3.18. Safety

- 3.18.1. Equipment design and engineering shall incorporate adequate safety features (as per applicable specifications of respective equipment as well as Health, Safety and Environment Codes & Standards applicable for the subject project) to provide protection to operating personnel, equipment and environment.
- 3.18.2. All electrical components & installations, instruments shall be suitable for the electrical area classification and grouping in which the equipment is installed. All the field Instruments and accessories shall be suitable for area classifications as specified in relevant Instrument specifications.
- 3.18.3. Personnel protection insulation shall be provided for accessible surfaces with temperatures of 60°C and above. Guard shall be provided to protect personnel from accidental contact in case the surface cannot be insulated for heat transfer reason.
- 3.18.4. 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 cooling jacket).
- 3.18.5. Allowable Noise level shall be maximum 85 dBA at 1 m from equipment.

### 3.19. Inspection And Testing

- 3.19.1. Inspection and test specified in the bid package shall be carried out by the Equipment Vendor at his works. The Third party inspector shall conduct inspection and witness tests of all equipment at vendor's works and furnish inspection and test reports to the owner / PMC.
- 3.19.2. The Vendor shall notify to owner/TPI of all inspection and tests at least four weeks before the scheduled date of inspection and test and reconfirm the same at least one week before the date of inspection and testing.

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### 3.20. Vendor Documentation

- 3.20.1. As a minimum, vendors shall furnish vendor documentation as per the guidelines mentioned in the respective Job specifications. The following aspects shall be taken care of by Contractor/Vendor.
- 3.20.2. The vendors shall provide information on allowable nozzle loads of all process inlets/outlet nozzles of equipment.
- 3.20.3. The equipment GA drawings shall show the list of drawings related to the equipment.
- 3.20.4. The vendor shall furnish all approved drawings and certificates approved by Statutory authorities such as IBR, PESO (CCoE) etc and the original documents shall be handed over to owner through PMC.
- 3.20.5. All part drawings of compressors including proprietary shall to be provided.
- 3.20.6. All vendor fabrication drawings of all parts shall be provided.
- 3.20.7. All bought out and proprietary items information, documents and drawings shall be handed over to owner.

### 3.21. Equipment Storage

- 3.21.1. All rotating equipment shall be packed for an outside storage period of at least 12 months.

### 3.22. Oils and Lubricants

- 3.22.1. Initial fill of oils and lubricants, sealing fluid and other consumables for start-up and commissioning shall be purchased from the vendor.
- 3.22.2. The equipment vendors shall recommend suitable lubricating oils from popular brands in India and are available in India, including from the owner's (IOCL) brand.
- 3.22.3. Lubrication chart consolidating the lubricant requirements for all equipment in the plant shall be prepared by the contractor as per the template which will be provided to the successful bidder. Contractor shall hand over the lubricant chart to the owner through PMC.

## 4. Special Requirements

### 4.1. Centrifugal Fans / FD Fans

- 4.1.1. Centrifugal Fans shall comply with the requirement of API standard as specified in the tender and the technical specifications/datasheets.

### 4.2. Centrifugal Pumps (Special Purpose Process)



#### 4.2.1. Equipment Qualification Criteria

- 4.2.1.1. The offered pump model shall meet the following minimum service and manufacturing experience requirements:

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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.

- 4.2.2. Centrifugal pumps shall comply with the requirement of API 610, except wherever modified in the technical specifications. Centrifugal pumps shall also comply with the requirements of Job Specification 080557C-000-JSS-0910-001.
- 4.2.3. Maximum discharge pressure is the maximum possible suction pressure specified plus the maximum differential pressure that the pump is able to develop when operating with the maximum specific gravity specified at pumping temperature and with maximum diameter impeller.
- 4.2.4. Irrespective of pump operating parameters, all pump components shall be designed for operation with maximum impeller diameter except for coupling, impeller and motor. It means in order to achieve higher operating parameters in future, with a higher impeller only coupling and motor are to be replaced and nothing else. Therefore, the maximum allowable working pressure at pumping temperature has to be more than the maximum discharge pressure, corresponding to shutoff head at maximum impeller diameter and maximum suction pressure as indicated in the datasheet. And hydrostatic pressure has to be 1.5 times the maximum allowable working pressure at pumping temperature.
- 4.2.5. Two stage pumps shall be of in-between bearing types.
  - 4.2.5.1. Pump rated flow exceeding 1000 M3/Hr., only "Between Bearing Type" pumps shall be selected. Maximum number of stages shall not exceed 10 for horizontal pumps.
- 4.2.6. Horizontal pumps shall be centerline mounted.
- 4.2.7. Inducers shall not be used except for Sundyne or equivalent type of pumps.
- 4.2.8. Pumps for high head, low flow duties (falling outside the range of two stage pumps without continuous bypass) shall be Sundyne or equivalent type. Sealless canned motor pumpsets as per API 685 latest edition shall be considered for clean liquids.
- 4.2.9. For high flow/high power pumps as defined in 6.1.15 of API 610-11<sup>th</sup> Edition, the NPSH margin shall be minimum 1.5 m. For all other Pumps Minimum NPSH margin of 0.6 m is required.



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- 4.2.10. In case of pump operating at the end of curve, positive NPSH margin shall be available at the end of curve.
- 4.2.11. Pumps that have stable head/capacity curves (continuous head rise to shut-off) are required. When parallel operation is specified, the head shall be at least 12 percent of the head at rated capacity.
- 4.2.12. The maximum permissible running clearances shall not be less than twice the running clearances as specified in API 610.
- 4.2.13. Impeller of multistage pumps shall also be positively locked against axial movement in the direction opposite to normal hydraulic thrust.
- 4.2.14. Mechanical Seal for pumps shall be cartridge type and conform to API-682.
- 4.2.15. Pumps shall be provided with mechanical seals (except clean cold water service which shall be provided with gland packing). For services involving solid contaminants, hazardous/toxic services, light hydrocarbons such as LPG, NGL, Naphtha, liquid gases and services involving liquids at or above auto ignition temp., dual mechanical seal shall be used.
- 4.2.16. Pumps for vacuum service or having operating temperature of 200°C and above shall be provided with stationary metal-bellows seals.
- 4.2.17. Sealing Plan:  
 Seal plans shall be in accordance with API 682.  
 All seal vents shall be routed to closed system ie. to flare.  
 For critical pumps, Seal Plan instruments and transmitters shall be with 2oo3 logic.  
 As per OISD 125 fluids containing toxic, carcinogenic & corrosive fluids require seals that have enhanced safety features like tandem seals, double/dual seals etc. Dual seals shall be applied for following services:-
- Liquids containing hydrogen sulphide in concentrations above 600Mg/Kg.
  - Liquids consisting of or containing lethal substances. Examples of lethal substances include but not limited to: HF acid, Phenol, concentrated Sulphuric or Nitric acid.
  - Hydrocarbon services of butane (C4) or lighter.
  - Liquids consisting of or containing very toxic substances like Benzene, Toluene, MEK, Ethylene oxide etc.
- 4.2.18. Pumps handling non-congealing liquids at temperatures 200°C and above shall be provided with API seal flushing plan 23 or 32 where single mechanical seals are provided.
- 4.2.19. Cooler shall not be provided in seal flushing system where seal is flushed by congealing liquid.
- 4.2.20. For pumps provided with flushing Plan 21 and 23. Temperature Indicator shall be provided in the flushing line.
- 4.2.21. For all API cooling water piping plans a sight flow glass shall be provided in the outlet lines.

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- 4.2.22. In case Multistage pumps require force feed lubrication, the same shall conform to API-610, 11th edition.
- 4.2.23. The Instruments shall be suitable for the specified area classification and shall be from approved vendors (specified elsewhere in the bid package).
- 4.2.24. 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.
- 4.2.25. The motor nameplate rating for applications where the specific gravity of pumped fluid is less than 1.0 shall not be less than the BkW of pump at minimum continuous stable flow with clean cold water of sp. gravity 1.0.
- 4.2.26. Pumps that handle liquids more viscous than water shall have their performance corrected in accordance with the Centrifugal Pump Section of the Hydraulic Institute Standards.
- 4.2.27. The coupling service factor shall not be less than 1.5 over the driver rating as a minimum.
- 4.2.28. INTERCHANGEABILITY: As far as possible pumps & mechanical seals and couplings shall be of identical make so that minimum levels of inventory can be maintained and maximum interchangeability/ standardization can be achieved.
- 4.2.29. Whenever pump capacity control is through LIC or LIC/FIC cascade or has a fail closed control valve on pump discharge or process minimum capacity is less than pump MCF, necessary flow instruments in pump discharge along with pump bypass back to suction vessel with control valve for pump protection shall be provided.
- 4.2.30. Equipment along with the drivers shall be procured from the respective driven eqpt. manufacturers as skid mounted units with all accessories, auxiliaries along with auxiliary piping.
- 4.2.31. Replaceable non-contact type Bearing isolators (Inpro or eq.) shall be provided on either side of the bearing housing. Magnetic drain plug shall be provided for all centrifugal pumps bearing housings.
- 4.2.32. Pump nozzle flanges shall be accordance with ASME B16.5.
- 4.2.33. For seal flushing plans, piping material shall be of Stainless Steel. For cooling water plans, piping material shall be carbon steel.
- 4.2.34. All pumps shall be provided with plugged connection for oil mist lubrication for future use.
- 4.2.35. No cast Iron pressure containing parts shall be used for hydrocarbon service.
- 4.2.36. Whenever pumps are to be provided with Automatic Recirculation (ARC) valve, the same should be included in pump vendor's scope of supply.
- 4.2.37. Inspection and Testing (For Each Pump)

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4.2.37.1. Type 3.1 Material Certificates for the following parts are required. Compliance certificate required for other parts.

- Casing, wear rings, Impeller, shaft and shaft sleeve.

4.2.37.1.1. 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:

4.2.37.1.2. - A measurement of the actual running clearances throughout the pump.

- A check of the hardness of wear rings.
- A check for good workmanship and finish throughout.

4.2.37.2. The following tests shall be performed as per approved Inspection Test Plan :

- UT of shaft & Radiography of casing
- Dynamic Balancing of Rotating elements (As per quality G2.5 of ISO 1940).
- Hydrostatic test (For all pressure containing parts including auxiliaries)
- Performance test
- NPSH test (In case difference between NPSHA and NPSHR is less than or equal to 1.0m)
- Dismantling inspection and reassembly after the running test, which shall include examination of mechanical seals, close clearance parts and measurement of running clearances. In case of multistage pumps having hydrodynamic bearings, the bearing shall be removed inspected and reassembled.
- Sound level test (During Performance Test).



### 4.3. Centrifugal Pumps (General Service)

#### 4.3.1. EQUIPMENT QUALIFICATION CRITERIA

4.3.1.1. The pump model offered shall be from the existing regular manufacturing range of the pump manufacturer. The mechanical as well as the hydraulic performance (including NPSHR) for the complete range of operation of the offered model shall have been established in the shop test. The offered pump model shall meet the following minimum service and manufacturing experience requirements.

Pumps shall be identical or validly similar in terms of Power rating, Hydraulic Performance (including NPSHR), Inlet flow, Differential Head, 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 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 overhaul as on the date of issue of invitation to bid.



4.3.2. Pumps shall comply to ISO 5199 – 2002 Class II and requirements in the technical specifications and datasheets. Pumps shall meet the requirements of 080557C-000-JSS-0910-002.

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- 4.3.3. Pumps with constant speed drivers shall be capable of atleast 5 percent head increase at rated condition and pump rated speed by replacing with a new impeller or impellers. Offered impeller shall in no case be less than the minimum diameter impeller.
- 4.3.4. Horizontal pumps of the close-coupled, the two stage overhung, or the single stage double suction overhung, type shall not be furnished.
- 4.3.5. Pumps where difference between NPSHA and NPSHR is 0.6 meter or less are not acceptable. The said NPSHR value shall correspond to the maximum value of NPSHR from rated flow down to the recommended minimum stable flow specified by the vendor.
- 4.3.6. Pumps that have stable head/capacity curves (continuous head rise to shut-off) are preferred for all applications and are required when parallel operation is specified. When parallel operation is specified, the head rise shall be at least 12 percent of the head at rated capacity.
- 4.3.7. Vertical pumps & motors that could be damaged due to reverse rotation shall be provided with non-reverse ratchet or suitable device to prevent reverse rotation.
- 4.3.8. Vertical pumps shall have sufficient clearance from bottom of sump to avoid choking.
- 4.3.9. Vertical pumps shall be provided with monorail and chain pulley block arrangement.
- 4.3.10. Vertical pump intermediate shaft bearing shall be self lubricated type or cooling shall be from discharge piping, however bearing shall not be run dry till it gets lubrication from discharge.
- 4.3.11. Negative suction pumps shall be self priming pumps and seal less pumps for ease in maintenance.
- 4.3.12. Impellers shall be cast as one piece.
- 4.3.13. Shaft shall be provided with sleeves under the mechanical seal. Sleeves shall be locked to the shaft. The material of sleeve shall be 12 percent chrome steel (hardened). Where the size of pump makes the use of shaft sleeve impracticable, the shaft shall be constructed of 12 percent chrome steel (hardened). For vertical pumps, shaft material shall be 12 percent chrome steel.
- 4.3.14. The following vibration limits shall be applied at rated speed and at flow of  $\pm 10$  percent of rated flow.
- 4.3.15. Horizontal pumps  
Unfiltered vibration velocity for horizontal pumps upto 3000 rpm with antifriction bearing or sleeve bearings when measured at the bearing housing in horizontal or vertical direction shall not exceed 7.6 mm/sec (0.3 inch/sec).
- 4.3.16. Vertical Pumps  
Unfiltered vibration velocity for vertical pumps with antifriction and or sleeve bearings when measured at the top bearing housing of pump or top bearing housing of motor or mounting flange for measuring points upto 3 meters above the mounting base shall not exceed the following limit:  
Pumps greater than 1500 rpm (Peak to Peak) = 10.1 mm/sec (0.4inch/sec)  
Pumps upto & including 1500 rpm (Peak to Peak) = 8.9 mm/sec (0.35inch/sec)  
Vertical pumps that could be damaged by reverse rotation shall be provided with a non reverse ratchet.

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4.3.17. Pumps for Fire Water Application shall also meet the following additional requirements:

- Pumps shall be direct-coupled except in the case of engine-driven vertical turbine pumps wherein gear drives shall be used.
- Pumps shall be capable of furnishing not less than 150 percent of rated capacity at a head not less than 65 percent of the rated head. Shut off head shall not exceed 120 percent of rated head in horizontal pumps and 140 percent in the case of vertical turbine pumps. Difference between NPSHA and NPSHR at 150 percent of the duty point shall not be less than 0.5 meters.

For Diesel engine drivers, the net continuous site power available after considering the deration due to site condition and power losses, due to other parasitic loads and engine driven auxiliaries shall be higher of the following two values:

- (a) 20 percent in excess of the maximum BKW (including +4% tolerance) required to drive the pump at rated condition.
- (b) Maximum BKW rated impeller as indicated by the manufacturer in the pump data sheets.

4.3.18. Electrical motor drivers as per (IEC/IS) shall be rated for continuous duty (Duty type SI) whereas motor as per American Standards shall be designed to operate at a service factor of 1.0. Rating shall not be less than the following unless higher rating is dictated by the Note 1.

Motor Name plate Rating	Motor MCR (% of Pump Rated BKW inclusive of +4% tolerance)
Less than 22 kW:	To suit maximum BKW indicated on pump data sheet or 125% of rated pump BKW, whichever is higher.
22 kW -55kW:	115% of rated pump BKW.
Higher than 55kW:	110% of rated pump BKW.

Note:



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

#### 4.3.19. Inspection And Testing

Refer Centrifugal Pumps (Special Purpose Process).

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## 5. Special Tools/Tackles

- 5.1. 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. Special fixtures and laser alignment kit shall be given due consideration during finalization of special tools.

## 6. Site Installation, Precommissioning, Commissioning

- 6.1. Site installation of Blower/ Turbine/ Compressor to be carried out at site under the supervision of OEM.
- 6.2. Pre-commissioning/ commissioning of rotary equipment to be carried out under the guidance of experts from OEM at site.



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## ANNEXURE A

### SPARES

#### A.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. Commissioning spares shall include also gaskets, o-rings etc. Any commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor.

#### A.2 MANDATORY SPARES





Mandatory spares, as specified in the tender shall be procured along with the main equipment. Spare rotors where supplied shall be boxed in a metal containers for vertical storage and purged with inert gas.

#### A.3 OPERATION AND MAINTENANCE SPARE PARTS

Operation and Maintenance Spare parts shall be recommended by the equipment manufacturer. The spare parts required for normal operation during Defect Liability Period shall be in CONTRACTOR scope. The CONTRACTOR shall obtain quotation for Two year operation spare parts required beyond Defect liability period and forward the same to the OWNER /PMC for review and order appropriately. For pumps in EPCM scope, the operation and maintenance spares shall be arranged by PMC/OWNER.



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## POWER LOADING CRITERIA FOR ROTATING EQUIPMENT

			 <b>Written By</b>	 <b>Checked By</b>	 <b>Approved By</b>	 <b>Authorized By</b>
A	15-Nov-2019	ISSUED FOR DESIGN	KS	RS	AA	JMC
<b>REV.</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>PREPARED</b>	<b>CHECKED</b>	<b>APPROVED</b>	<b>AUTHORIZED</b>

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## 1. INTRODUCTION



**INDIAN OIL CORPORATION LIMITED (IOCL)** has awarded Fax of Acceptance (FOA) dated 29<sup>th</sup> August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

## 2. DEFINITIONS & ABBREVIATIONS

Abbreviation	Definition /Expanded form
IOCL/ CLIENT	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit

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### 3. **POWER LOADING**

It is the intention to minimise the utility consumptions. To meet this requirement, LSTK Contractors/Vendors are requested to offer their most efficient equipment for the specified duty.

This Specification includes the criteria for the financial loading and penalty to be applied on the less energy efficient equipments quoted / supplied by the LSTK Contractors/Vendors.

The loading shall be applied during the evaluation of the Vendor's quotations. The price loading shall be in terms of the excess cost of electrical power consumption for motor driven equipment over the competing bidders.

The penalty will be applied upon the performance test. The penalty shall be applied on the supplied equipment if it is found that the power is in excess than the Vendor's guaranteed values.

#### 3.1 **Scope**

- 3.1.1 The power loading is to be done for rotating equipments like centrifugal pumps, centrifugal compressors and Centrifugal fans etc., whose power consumption can be verified during testing of equipment at vendor's works.
- 3.1.2 The power consumption of driven equipment only to be considered for evaluating energy consumption and power loading purpose.
- 3.1.3 Power loading shall be applied on continuous operating units only and not on standby units. Power loading should not be done for equipment operating on intermittent basis.
- 3.1.4 The guaranteed power shall be at the operating point specified on the equipment data sheet.
- 3.1.5 For centrifugal pumps and fans this is normally at the rated conditions. For centrifugal and axial compressors this is normally at the normal operating point.
- 3.1.6 The offer of vendor to be loaded by Net Present Value of the excess energy consumption (over the vendor having least energy consumption) for five years period starting from one year after delivery.

#### 3.2 **Total Cost**


The total cost of an item number (including all working & standby units) for evaluation purpose =  $C1+C2+C3$

Where

C1 = Capital cost of an item number including all working & standby units (including cost of commissioning spares and special tools if any)

C2 = Cost of Mandatory/Capital Spares, wherever mandatory/Capital spares are specified.



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C3 = Differential operating cost

**Note: BKW shall be read as power consumed at motor terminal**

### 3.3 Differential operating cost C3 is defined as under:

$$C3 \text{ (Rupees)} = N_{op} \times \{(BKW_E - BKW_R)\} \times C_P \times 8000 \times D_F$$

Where,

$N_{op}$  = Number of Operating Units

$BKW_E$  = Guaranteed shaft power (kW) for pump quoted by the bidder under evaluation

$BKW_R$  = Lowest Guaranteed shaft power (kW) for pump (amongst all the technically acceptable bidders)

$C_P$  = Cost of energy in Rupees per kWh (INR 7.78 per kWhr) (to be confirmed)

$D_F$  = Discounting factor to arrive at Net Present Value (NPV) based on number of years as defined below:

### 3.4 Discounting Factor (DF) is defined as under:

$$n = k+1$$

$$D_F = \sum_{n=2} [1 \div \{1 + (R/100)\}^n]$$

where,

k = Number of operating years for which loading is to be done as specified ie. 5 years

R = Percentage rate of interest 12% (to be confirmed)

$D_F$  = 3.2186 (to be confirmed)

### 3.5 Limitations

The maximum loading to be applied however shall not exceed 10% of the total Capital cost (C1).



## 4. PENALTY CRITERIA

During performance test at the vendor's works, in case the pump fails to meet the guaranteed value, the following to be followed:

During performance tests, if BKW consumed by the pump exceed the stipulated guaranteed value by more than 4 % the subject pump gets rejected.

However, for excess power (Kw) consumed over and above guaranteed BKW upto a maximum of 4 % of guaranteed BKW, the vendor shall be penalized for extra energy consumption for each pump exceeding the guaranteed power during shop performance, as defined hereunder:

The penalty shall be worked out on the basis of differential operating cost (PP) as under:

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$$PP \text{ (in Rupees)} = (BKW_T - BKW_G) \times C_P \times 8000 \times D_F$$

Where,

BKWT = Shaft Power as obtained from shop test value of pump BKW (corrected to pumping fluid)

BKWG = Guaranteed shaft power of the pump furnish by bidder in BKW with zero percent positive tolerance including error in instruments and measurement, at rated point specified in the datasheet.

The maximum penalty to be charged for non conformance to guaranteed values during the shop performance test of all pumps of an item number put together (ie all working & standby units) shall not be exceeded 10% of the total capital cost C1 + C2. This penalty shall be applicable independently of any penalty specified elsewhere in the tender.

## SITE & UTILITY DATA

**PROJECT** : 525 TPD STANDBY SRU PROJECT

**UNIT** : SRU

**CLIENT** : M/s INDIAN OIL CORPORATION LTD (IOCL)

**CONSULTANT** : M/s ENGINEERS INDIA LTD.

**JOB NO.** : B366

A	01.04.2021	Issued with MR	SG	MG	TK
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

## 1 Project Description

1.1 Client: Indian Oil Corporation Limited – (IOCL)

1.2 Plant Name: Paradip Refinery Project (PDRP)

1.3 Plant Location:

Country : India  
State : Orissa  
District : Jagatsinghpur  
Town/City : Abhaychandrapur, Paradip

Geographic bearing of site : 20° 15' 20" latitude  
: 86° 36' 00" longitude

Site altitude : Minimum 3.91 m above Indian mean sea level (IMSL) which corresponds to the site recorded flood level

1.4 Project Type

This is a grass root Refinery project.

1.5 Units:

The Refinery is comprised of the following Units;

Atmospheric Vacuum Distillation, Naphtha Hydrotreaters, CCR Reformer, LPG Treating, ATF Treater, Diesel Hydrotreater, VGO Hydrotreater, Fluid Catalytic Cracker, Propylene Recovery, Delayed Coker, Alkylation, Butane Isomerisation, Hydrogen Generation, Amine, Sour Water Stripper, Sulphur Recovery, Spent Acid Regeneration, Flue Gas Desulphurisation, FCC Light Naphtha Treatment, FCC LPG Treatment, Straight Run LPG Treatment, Utilities, Offsites

1.6 The system of measurements shall be Metric as follows:

UNITS OF MEASUREMENT		
Parameter	Preferred Unit	Alternative
Area	m <sup>2</sup>	mm <sup>2</sup>
Composition - Gas or Vapor	vol% or mol%	ppmv
Composition - Liquid	wf%	ppmw
Enthalpy, Entropy	kcal/kg	
Flow (gas)	Nm <sup>3</sup> /hr	kg/hr
Flow (liquid)	m <sup>3</sup> /hr	kg/hr (for < 1TPH), TPH (for > 1TPH)
Flow (steam)	kg/hr	
Force	N	
Fouling resistance	m <sup>2</sup> hr °C / kcal	

### 3 Climatic Data

#### 3.1 Wind

##### 3.1.1 Wind Velocity

Average velocity	
- Summer	37 – 45 km/hr
- Winter	15 – 25 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



### 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 <sup>2</sup> .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.)  
SO<sub>2</sub>: 16.6 micro gm (maximum)

- e) Exposure to conductive or corrosive dusts  
(carbon, iron oxide ammonium nitrates or phosphates, etc.)  
NO<sub>x</sub>: 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.) SO<sub>2</sub>  
and NO<sub>x</sub> 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

ANNEXURE-I

UTILITY CONDITIONS AT VENDOR BATTERY LIMIT

S.No.	Describe	Parameter	Minimum	Normal	Maximum	Design
1	HP Steam	Pressure Kg/cm <sup>2</sup> (g)			42.0	46/FV
		Temp, Deg C			400	427
2	LP Steam	Pressure Kg/cm <sup>2</sup> (g)	3.0	3.7	5.0	7.0/FV
		Temp, Deg C	146	175	190	240
3	HP Boiler Feed Water	Pressure Kg/cm <sup>2</sup> (g)	58.0	58.0	60.0	82.0
		Temp, Deg C	105	105	116	150
4	Instrument Air(Note-1)	Pressure Kg/cm <sup>2</sup> (g)	4.2	7.0	8.0	10.5
		Temp, Deg C	ambient	40	50	65
5	Nitrogen	Pressure Kg/cm <sup>2</sup> (g)	3.0	8.0	8.3	10.5
		Temp, Deg C	20	amb	amb	65
6	Fuel gas	Pressure Kg/cm <sup>2</sup> (g)	2.5	3.9	4.2	6.0
		Temp, Deg C	Amb	40	55	65
7	Service Water	Pressure Kg/cm <sup>2</sup> (g)	4.0	6.0	8.0	10.5
		Temp, Deg C	Amb	Amb	Amb	65
8	Cooling Water	Supply Pressure Kg/cm <sup>2</sup> (g)	4	4.5	5.0	8.0
		Return Pressure Kg/cm <sup>2</sup> (g)	3	3.5	4.0	8.0
		Supply Temp Deg C		35	35	65
		Return Temp Deg C		44	44	65
9	Demineralised Water	Pressure Kg/cm <sup>2</sup> (g)	4.0	5.5	6.0	10.0
		Temp, Deg C		Amb	Amb	65

Note 1-Actuator shall be designed for minimum instrument air pressure of 3.5 kg/cm<sup>2</sup> (g).

EXPERIENCE RECORD PROFORMA  
CENTRIFUGAL PUMP (VERTICAL)

**EXPERIENCE RECORD - CENTRIFUGAL PUMP (VERTICAL)**

ITEM. :

ITEM NUMBER. :

VENDOR :

Note: Bidders to furnish all required documents as per Pre Qualification Criteria of NIT

**INSTRUCTIONS TO BIDDERS :**

1. This proforma duly filled in shall be submitted for each item separately, alongwith the bid.
2. Since the information requested in this proforma will be utilised to assess provenness of offered model, it is in the interest of the equipment manufacturer to pick up those cases out of total list of references which most closely match with the offered model. The equipment manufacturer shall also ensure that each & every information asked for is furnished and the same is correct and complete in all respects. **Incorrect information furnished in this proforma shall render the bid liable for rejection.**
3. While furnishing the materials, where asked for, the equipment manufacturer shall furnish ASTM equivalents also.
4. For the referred installations, the equipment manufacturer shall indicate the name of the person (alongwith his address, telephone no., fax no./email-id etc.) who may be contacted by the Purchaser / his representative, if felt necessary.
5. The equipment manufacturer shall also furnish along with the bid his standard reference list for the offered equipment model manufactured and supplied by him.
6. The equipment manufacturer shall clarify the meaning of each letter / digit used in the model designation below:

**Description of Model designation system :**

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			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
1	<b>GENERAL</b>					
1.1	Cross reference to manufacturer's Standard Reference list	----				
1.2	Make					
1.3	Model Number					
1.4	Number of units supplied					
1.5	Type of driver (Electric Motor / Steam Turbine / Gas Turbine / IC Engine)	Electric Motor				
1.6	Driver rated kW / Speed(rpm)					
1.7	Edition of API Std - 610 to which the pump conforms	API Std - 610				
1.8	Shop where pump is designed, manufactured, packaged, tested & supplied with address					
2	<b>OPERATING CONDITIONS</b>					
2.1	Fluid handled					
2.2	Fluid temperature (Min / Max) °C					
2.3	Capacity (m³/hr)					
2.4	Maximum Suction pressure (kg/cm²,g)					
2.5	Differential Head, Rated (m)					
2.6	Differential Pressure, Rated (kg/cm²)					
2.7	Minimum Submergence Required (mm)					
2.8	Setting depth (mm) (distance between bottom face of the mounting flange and first stage impeller suction eye)					
2.9	Efficiency					
2.10	BKW, Rated					
2.11	Minimum Continuous Stable Flow, (m³/hr)					



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			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
2.12	Rated Speed					
2.13	Speed range for variable speed drive					
2.14	MAWP casing (kg/cm <sup>2</sup> G) @ 15°C @ pumping temperature					
3	<b>CONSTRUCTION</b>					
3.1	Type of Pump Discharge (discharge through column / separate discharge )					
3.2	Type of line shaft (open / close)	Open				
3.3	Line shaft lubrication (pumping medium / separate lubricant)					
3.4	Start-up pre-lubrication required (yes / no)					
3.5	No. of stages (single / two)					
3.6	Impeller diameter - Rated/ Maximum / Minimum (mm)					
3.7	Whether the proposed model and reference models have identical hydraulic design (for impeller / diffuser / volute)					
3.8	Sealing Element (packing / mechanical seal)					
3.9	Type of mechanical seal (Single / Double)					
3.10	API Sealing Plan No.					
3.11	API Cooling Plan					
4	<b>MATERIAL OF CONSTRUCTION</b>					
4.1	API - 610 Material Code					
4.2	Casing					
4.3	Impellers					
4.4	Line Shaft					

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			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
4.5	Column					
4.6	Line Shaft bearing					
5	<b>OTHER INFORMATION ON INSTALLATIONS</b>					
5.1	Date of supply of entire unit					
5.2	Date of commissioning of entire unit					
5.3	No. of operating hours completed as on the date of issue of material requisition					
5.4	Major Problems encountered					
5.5	Name of plant					
5.6	Purchaser's Name and Address					
	Name (Company / Organization)					
	Name of Contact Person					
	Address					
	Telephone No.					
	Fax No.					
	email-id					

**TECHNICAL COMPLIANCE STATEMENT**  
(TO BE SIGNED BY VENDOR'S PRINCIPAL CORPORATE LEVEL SIGNATORY ON  
COMPANY LETTERHEAD)

I, ON BEHALF OF M/s \_\_\_\_\_ CONFIRM THAT THE  
PROPOSAL OF \_\_\_\_\_ QUOTED BY M/s \_\_\_\_\_  
FOR **525 TPD STANDBY SRU PROJECT OF M/S INDIAN OIL CORPORATION**  
**LIMITED PARADIP REFINERY** AGAINST MATERIAL REQUISITION  
/TENDER/PACKAGE No. ----- IS IN TOTAL

COMPLIANCE TO THE FOLLOWING

- A. SCOPE OF SUPPLY AND WORK
- B. PROCESS DATA SHEETS
- C. MECHANICAL DATA SHEETS
- D. BATTERY LIMIT/INTERFACE REQUIREMENTS
- E. TECHNICAL AMENDMENT IF APPLICABLE
- F. ANY OTHER DOCUMENT ATTACHED AS PART OF MR

**AS WELL AS ALL THE TECHNICAL SPECIFICATION AND NO DEVIATION,  
VARIATION OR RESERVATION WHATSOEVER HAS BEEN MENTIONED IN THE  
TECHNICAL OFFER.** IT IS FURTHER AGREED THAT THE TECHNICAL DETAILS  
FURNISHED IN OUR OFFER WILL BE REVIEWED BY EIL/IOCL DURING DETAILED  
ENGINEERING STAGE AFTER ORDER AND ANY CHANGE REQUIRED TO MEET  
THE REQUIREMENTS OF ENQUIRY SCOPE AND SPECIFICATION INCLUDING  
AMENDMENT(S) (IF ANY) WILL BE INCORPORATED BY US WITHOUT ANY PRICE  
AND TIME IMPLICATION.

(SIGNATURE WITH SEAL)

### DEVIATIONS TO TECHNICAL SPECIFICATIONS

**PROJECT** : 525 TPD STANDBY SRU PROJECT

**UNIT** : SRU

**CLIENT** : M/s INDIAN OIL CORPORATION LTD (IOCL)

**CONSULTANT** : M/s ENGINEERS INDIA LTD.

**JOB NO.** : B366

**NAME OF THE VENDOR** :

**VENDOR'S REF. NO.** :

#### NOTES:

1. Bidder shall note that only those deviations to specified standards & codes (if any), shall be permitted which are technically infeasible to be met, provided suitable justification for the same is furnished. Deviations, which can be complied with extra cost and or time implication, shall not be permitted.
2. Any deviations/deletions/corrections made elsewhere in the body of the bidder's proposal will not be taken cognisance of and all such deviations shall be deemed to have been withdrawn by the bidder.

TITLE OF THE DOCUMENT:

DOCUMENT NO.:

[illegible]





## UTILITY REQUIREMENTS





[illegible]







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## JOB SPECIFICATION FOR MV INDUCTION MOTORS

			 <small>Written By</small> <small>Nataraj Murthy Vallappan</small> <small>2019.11.26 11:54:36</small> <small>+05:30'</small>	 <small>Checked By</small> <small>Gopi Chellappa</small> <small>2019.11.26 11:54:36</small> <small>+05:30'</small>	 <small>Approved By</small> <small>Velmangam Shanmugam</small> <small>2019.11.26 18:24:08 +05:30'</small>	 <small>Authorized By</small> <small>Jasumarian</small> <small>2019.11.29 19:59:18</small> <small>+05:30'</small>
A	26.11.2019	ISSUED FOR DESIGN	NM	CG	SV	JMC
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED

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 <b>TechnipFMC</b>	 IndianOil	<b>PROJECT</b>	<b>Standby SRU &amp; Additional Tanks</b>		
			<b>IOCL- Paradip Refinery</b>		
		<b>CLIENT</b>	<b>INDIAN OIL CORPORATION LIMITED</b>		
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## 1. INTRODUCTION

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29<sup>th</sup> August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

## 2. DEFINITIONS



Wherever used in this procedure, the following words shall have the meaning as given hereunder;

Abbreviation	Definition
IOCL / CLIENT / OWNER	Indian Oil Corporation Limited
PMC / CONSULTANT	Technip India Limited
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
VENDOR	Any third party supplying the equipment / materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
SITE	Indicates Paradip Refinery in Paradip, Odisha State, India
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related

## 3. GENERAL

### 3.1 Scope

This specification together with other documents specified in Section 3.3, covers the minimum requirements to be followed for the design, material selection, manufacturing, inspection, shop testing, packing and supply of MV squirrel cage induction motors.

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### 3.2 Specifications

3.2.1 This Job specification for supply shall be read in conjunction with relevant data sheet.

3.2.2 If any conflict arises among the documents, the order of precedence of documents shall be as follows:



- Statutory regulations.
- Data Sheet
- Scope of Supply
- Job specification for supply

3.2.3 Manufacturer must declare in the offer any exception and / or deviation from the job specification for supply. The lack of any declaration and / or deviation will be considered as full compliance with the job specification for supply.

### 3.3 Standards

3.3.1 The MV Induction motors shall comply with the latest editions of following standards.

IS 5	Colours for ready mixed paints and enamels
IS 325	Three phase induction motors
IS 1231	Dimensions of three phase, foot mounted induction motors
IS 1271	Thermal evaluation and classification of electrical insulation
IS 2223	Dimension of flange mounted AC Induction motors
IS 2253	Dimensions for type of construction and mounting arrangement of rotating electrical machines
IS 2254	Dimension of vertical shaft motors for pumps
IS 2968	Dimension of slide rails for Electric Motors
IS 4029	Guide for testing three phase induction motors
IS 4889	Methods of determination of efficiency of rotating electrical machines
IS 6362	Methods of cooling for electrical machines
IS 7816	Guide for testing insulation resistance of rotating machines
IS 8223	Dimension and output ratings for foot mounted rotating electrical machines



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IS 8789	Values of performance characteristic for three phase induction motors
IS 9283	Motors for submersible pump sets
IS 12065	Permissible limits of noise level for rotating electrical machines
IS 12066	Three Phase Induction Motors for Machine Tools
IS 12075	Mechanical vibration of rotating Electrical Machines
IS 12615	Energy efficient Induction Motors - Three Phase Squirrel Cage
IS 13529	Guide on effects of unbalanced voltages on the performance of three phase cage induction motors
IS 13555	Guide for selection and application of three phase induction motors for different types of driven equipment
IS 14222	Impulse voltage with-stand levels for rotating electrical machines with form-wound stator coil.
IS 14568	Dimensions and output series for rotating electrical machines, frame members 355 to 1000 and flange numbers 1180 to 2360
IS 15999	Rotating Electrical Machines, Part 2: Method of Tests, Section 1: Standard Methods for Determining Losses and Efficiency from Tests
IS / IEC 60034	Rotating Electrical Machines
IEC 60072	Dimensions and Output Series for Rotating Electrical Machines
IS / IEC 60079	Electrical Apparatus for Explosive Gas Atmospheres (All parts)
IS / IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 60738	Thermistor -directly heated positive temperature co-efficient
IS / IEC 61241	Electrical apparatus for use in the presence of combustible dust

The motors shall comply with the provisions of CEA regulations and other statutory regulations currently in force in the country.

### 3.4 Abbreviations

AC	-	Alternating current
BASEEFA	-	British Approval Service for Electrical Equipment in Flammable Atmospheres
CT	-	Current Transformer

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CEA	-	Central Electricity Authority
CIMFR	-	Central Institute of Mines and Fuel Research
DC	-	Direct Current
EMC	-	Electromagnetic compatibility
FM	-	Factory Mutual
IS	-	Indian Standards
IEC	-	International Electrotechnical Commission
IEEE	-	Institute of Electrical & Electronics Engineers
IP	-	Ingress Protection
MV	-	Medium Voltage
HV	-	High Voltage
LCIE	-	Laboratoire Central des Industries Eletriques
RPM	-	Revolutions Per Minute
THD	-	Total Harmonic Distortion
UL	-	Underwriter's Laboratories
VSD	-	Variable Speed Drive

### 3.5 Manufacturer's Responsibility

- 3.5.1 Manufacturer shall not make assumptions to replace information not furnished by contractor. Manufacturer is required to obtain necessary information from contractor / purchaser. Any and all claims arising from lack of knowledge of required information will be rejected by contractor.
- 3.5.2 It shall be the manufacturer's responsibility to furnish all items essential for the safe and satisfactory operation of the MV Induction Motors, notwithstanding the inclusion or omission of same from this specification or the associated requisition and its data sheets or the purchase order.

### 3.6 Certification

- 3.6.1 The hazardous area motors and associated equipment shall have test certificates issued by recognized independent test house (CIMFR / BASEEFA / LCIE / UL / FM / ATEX or equivalent). All indigenous motors shall confirm to Indian Standards and shall be certified by Indian testing agencies.

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- 3.6.2 All motors (indigenous & imported) shall also have valid statutory approvals as applicable for the specified location from PESO / CCoE or any other applicable statutory authority. All indigenous flameproof motors shall have valid BIS license and marking as required by statutory authorities.

#### 4. **DESIGN**

##### 4.1 **Ambient Conditions**

- 4.1.1 The MV induction motors shall be suitable for outdoor installation with typical atmosphere of chemical plant or refinery (dusty, marine and corrosive). The on-site service conditions are coastal, tropical and corrosive. The equipment (including auxiliaries) shall be suitable for unsheltered outdoor operation, unless indicated otherwise.
- 4.1.2 The ambient condition to be considered shall be those specified in the data sheet. If not specifically mentioned therein, then maximum ambient temperature of 43°C and an altitude not exceeding 1000M above mean sea level shall be taken into consideration.

##### 4.2 **Power Supply System Features**

- 4.2.1 Motors shall be capable of providing its rated output at specified power supply system of rated voltage and frequency with variation indicated in the data sheet.
- 4.2.2 The MV motor shall operate satisfactorily with the total harmonic distortion of up to 5% in the input power supply.

##### 4.3 **Mechanical Driven Machine**



- 4.3.1 Induction motors will generally be used to drive pumps, blowers, agitators, compressors and other constant-speed operated equipment.
- 4.3.2 Motor shall satisfy the speed-torque requirements of the driven equipment over its entire starting and operating range.
- 4.3.3 Special operating conditions will be individually considered and motor shall comply with the requirements of the driven equipment. Such conditions shall include frequent starting of fans under cold and hot air temperatures and variable or multi speed operation.

##### 4.4 **General Design Requirements**

Rated output of the motors shall be in accordance with relevant standards. Motor shall be designed for continuous running operation at rated power.

Unless specified otherwise, duty service type shall be S1 (Continuous Duty) according to relevant standards.

Motor shall be sized by the driven equipment vendor.

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The equipment (including auxiliaries) covered by this specification shall be designed and constructed for a minimum service life of 20 years and at least 3 years of uninterrupted operation.

Motors up to 160 kW shall be powered at 415V, 3Ph 50 Hz. Motors over 160 kW up to 4.0 MW shall be powered at 6.6 kV, 3 Ph, 50 Hz. Motors over 4.0 MW shall be powered at 11 kV, 3 Ph, 50 Hz.

The equipment vendor, at the time of quotation is required to supply a speed / torque curve showing;

- The driven equipment torque requirement.
- The motor torque at 80% of rated voltage.
- The motor torque at 100% of rated voltage.

#### 4.4.1 Starting Characteristic

4.4.1.1 Unless specified otherwise in data sheet, the motors shall be suitable for Direct on Line (DOL) Starting.

4.4.1.2 Unless otherwise specified, all motors shall be suitable for starting under specified load conditions with 75% of the rated voltage.

4.4.1.3 Motor shall be designed for reacceleration under full load after a momentary loss of voltage with the residual voltage being 100% and in phase opposition to the applied voltage.

4.4.1.4 Number of sequential starts: At any voltage between 75% to 100% rated voltages, motors shall be capable of starting as per following:



Sl. No	Starts	Minimum number of consecutive starts
1	No. of Consecutive starts-ups with the motor initially at maximum ambient temperature (Under cold condition)	3
2	No. of Consecutive starts-ups with initial temperature at full load operating level (Under hot condition).	2

4.4.1.5 Another starting sequence of two successive starts shall be allowed after a cooling period of 30 minutes at standstill.

#### 4.4.2 Performance

4.4.2.1 Thermal Withstand Time: Minimum locked rotor thermal withstand time at rated voltage shall be 10 seconds under cold conditions and 8 seconds under hot conditions. The starting time of the motor shall be less than the hot thermal withstand time by at least 2 sec. (time  $t_E$  in case of increased safety motors) to permit application of conventional bimetal relays or thermal release against locked rotor and overload conditions.



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4.4.2.2 Motor Starting Torque: The starting & minimum torque of the motor shall be compatible with the speed-torque curve of the driven equipment under specified operating conditions. For heavy-duty drive such as blowers, crusher etc. high starting torque motors shall be required. In case the characteristics of the driven equipment are not available while selecting the motor, minimum starting torque shall be 110% of the rated value for motors up to 75 kW and shall be 90% of the rated value for motors above 75 kW.

4.4.2.3 Pull out torque: Pull out torque at the rated voltage shall not be less than 175% of the rated load torque with no negative tolerance. Unless otherwise agreed, the pull out torque shall not exceed 300% of the rated load torque. In case of pulsating loads (e.g. reciprocating compressor) the minimum value of the pull out torque at 75% of the rated voltage shall be more than the peak value of pulsating torque and the current pulsation shall be limited to 40%.

#### 4.4.3 Starting current

4.4.3.1 Unless specified otherwise, the starting current for MV motor shall not be greater than 6 times the rated current, subject to tolerances as per relevant standards.

#### 4.4.4 Temperature Rise

4.4.4.1 The total temperature of the stator winding under full load running condition shall not exceed the values permissible for the specified insulation class. For increased safety motors, the temperature shall be 10°C less than for normal motors.

4.4.4.2 Unless until specified in data sheet, the Temperature Class for the motors used in the hazardous area shall be rated for Temperature Class T3.

4.4.4.3 For starting and locked rotor conditions stipulated the maximum temperature in the rotor shall not exceed 200°C or as permissible for the temperature class of hazardous gases / vapours present in the area whichever is lower.

#### 4.4.5 Vibrations



4.4.5.1 The motor vibration measured at the bearings must not exceed the limits specified in relevant standards.

#### 4.4.6 Noise level

4.4.6.1 Motor permissible noise levels shall not exceed the stipulation laid down in relevant standards.

#### 4.4.7 Direction of Rotation

4.4.7.1 The motors shall be suitable for either direction of rotation unless until specified in data sheet. In case of unidirectional motor, the direction of rotation for which the motor is designed shall be permanently indicated by means of an arrow. Directional arrow should be manufactured from

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corrosion resistant material. When a motor is provided with bi-directional fans, a double-headed arrow should be provided.

#### 4.4.8 Critical Speeds

4.4.8.1 The first actual critical speed of stiff rotors shall not be lower than 125% of the synchronous speed. For flexible rotors, this shall be between 60% and 80% of the synchronous speed. The second actual critical speed shall be above 125% of the synchronous speed.

#### 4.4.9 Performance Curves

4.4.9.1 The manufacturer shall submit performance curves of motors along with the offer.

#### 4.4.10 Variable speed drive motors:

4.4.10.1 For motors fed by variable speed drive, the manufacturer shall take care of additional requirements in motor for safe operation. Winding insulation shall be designed to withstand high level of dv/dt for inverter operation. The manufacture shall clearly indicate the level of inter-turn insulation provided.

4.4.10.2 The motor shall be suitable for the current wave forms produced by power supply including harmonics generated by drive. The motor shall be designed to operate continuously at any speed over the range (1-100%) of rated speed or as specified in data sheet.

4.4.10.3 All motors operating on VSDs / VFDs shall have embedded temperature detectors / thermistors for winding with thermistor relay which will trip the motor in case the temperature of winding exceeds the permissible limits.

4.4.10.4 All MV motor including & above 75 KW shall be provided with PTC thermistors.



4.4.10.5 In classified area, in case of Ex e type VFD driven motors, combined testing shall be done with job VFD for one motor of each rating. In case of Ex d motors, type test certificates for combined testing conducted on similar drive shall be furnished. Provision for tripping the motor in case the temperature rise exceeds the permissible limits shall be provided for all VFD driven motors.

4.4.10.6 VSD operated motors shall be designed to withstand voltage spikes for at least 1 sec.

4.4.10.7 For VSD operated motors, 2/3 logic shall be provided for tripping from temperature detectors / thermistors.

## 5. CONSTRUCTION AND FABRICATION

Motors for outdoor use shall be suitable for installation and satisfactory operation without any protective shelter. Motor casing shall be provided with a suitable drain for removal of condensed moisture except in case of flameproof motors. Vertical motors with downward shaft shall be provided with fully covering canopies. Vertical motors with upward shaft e.g. on fin-fan coolers, shall be

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adequately protected (such as cowls/canopies) against ingress of water standing still for long period of time.

## 5.1 Enclosure and Motor Housing / Casing



- 5.1.1 The degree of protection for motor enclosures and terminal boxes including bearing housing shall be IP 55, unless otherwise specified. Outdoor motors shall be provided with canopy.
- 5.1.2 Motors for use in safe areas shall be industrial type meeting the specified ambient conditions, starting and operating requirements.
- 5.1.3 Motors for use in hazardous area (Zone 1 & 2) shall have type of protection as specified in the data sheet and shall meet the requirements of the relevant standards.
- 5.1.4 Products that are toxic to the environment or that are considered potential carcinogens shall not be used.
- 5.1.5 The use of hygroscopic materials should be avoided. The materials used shall be selected to prevent contact corrosion.
- 5.1.6 Transport units heavier than 25 kg shall have eyebolts, lugs or extension pieces clearly identifiable to be used for hoisting. Eyebolts shall not be part of the equipment type of protection.
- 5.1.7 Motors weighing over 600 kg shall have jacking bolts or facilities to lift the motor with the aid of a mechanical jacking device to facilitate the alignment of the motor with the driven equipment.
- 5.1.8 Motors shall be provided with external earthing facilities. The earthing facility shall be clearly marked with the appropriate symbol.
- 5.1.9 All external hardware shall be of rust proof material or protected against corrosion.
- 5.1.10 All internal and external metallic parts, which may come into contact with cooling air, shall be of corrosion resistant material or appropriately treated to resist the corrosive agents which may be present in the atmosphere.
- 5.1.11 Unless otherwise agreed, motor shall have standard frame size for output ratings as stipulated in relevant standards.
- 5.1.12 Energy efficient motors IE2 shall be used for MV application

## 5.2 Stator Frame

- 5.2.1 All motor frames and bearing end-shields shall be constructed of ferrous metals.
- 5.2.2 Motor frames made of aluminium alloy are not acceptable.
- 5.2.3 Motor frame including bearing supports shall have sufficient strength and rigidity to avoid distortion or increased vibration as a result of external mechanical forces, e.g. tightening of fixing bolts.

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- 5.2.4 Castings shall be sound and free of shrink holes, cracks, scale or other similar injurious defects. Surface of castings shall be cleaned by shot blast, pickling or other standard methods.

### 5.3 Windings



- 5.3.1 Unless otherwise specified in the data sheet motors shall be provided with class 'B' insulation as a minimum. In case of motors with class 'F' insulation the permissible temperature rise as measured by resistance method above the specified ambient temperature shall be limited to those specified in the applicable standards for class 'B' insulation. The insulation shall have tropical and Anti-fungus treatment. The winding shall preferably be vacuum impregnated.

Alternately the winding shall be varnished, baked and treated with epoxy gel for operating satisfactorily in humid and corrosive atmosphere.

- 5.3.2 Winding shall be adequately braced to prevent any relative movement during operation. In this respect, particular care shall be taken for the stator windings of direct-on-line starting squirrel cage motors. Insulation shall be provided between coils of different phases lie together. Core laminations must be capable of withstanding burnout for rewind at 400°C without damage or loosening.
- 5.3.3 The windings shall have their leads accessible in the terminal box to allow star or delta connections.
- 5.3.4 In case of, motors driving equipment with pulsating loads, special care shall be taken for the joints of rotor bars and end rings to avoid premature failures due to induced fatigue stresses.
- 5.3.5 The windings shall be connected in delta, however, for motors rated 2.2 kW and below, star connection may be accepted.
- 5.3.6 All motors shall be with six terminals and suitable links to connect them in star or in delta except for motors rated up to and including 2.2 kW which may be accepted with three terminals.
- 5.3.7 Anti-loosening, anti-vibration type of terminals shall be provided in case of increased safety (Ex-e) and non-sparking (Ex-n) motors.

### 5.4 Terminal Boxes

- 5.4.1 Terminal box shall be sturdy with ample space for connecting the cable or cables as indicated on the Scope of supply / data sheet. Terminal box cover shall be provided with handles to facilitate easy removal, however for terminal box covers weighing less than 5 kg, terminal box covers without handles can be accepted.
- 5.4.2 All the motors shall be equipped with terminal boxes of cast iron or steel. The design of the terminal box shall be such as to prevent small parts from dropping into the motor housing.
- 5.4.3 Unless otherwise stated in the scope of supply / datasheet, the terminal boxes shall be located on the right-hand side as viewed from the driving (coupling) end. For hazardous area motor, top



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mounted terminal box is also acceptable, in case manufacturer has only top mounted certified design. It shall be possible to rotate the terminal box in steps of 90° to allow cable entry from any direction

- 5.4.4 An adequately sized earthing terminal or bolt shall be provided, inside the terminal box, for connecting the 4th core of specified size of cable. The earthing facility shall be clearly marked with the appropriate symbol.
- 5.4.5 The terminal box shall be provided with crimp type tinned copper cable lugs and cable entries with suitable cable glands, corresponding to the number and sizes of cables, as per the data sheet.
- 5.4.6 Nickel-plated brass double compression type suitable cable glands shall be supplied along with the motor for all cables (like power, space heater, etc).
- 5.4.7 Gland plates to be used for single core cables shall be made of non-magnetic material.
- 5.4.8 All accessories provided and fixed on to the motor shall confirm to the hazardous area classification and the environmental conditions wherever required and as specified in data sheet.
- 5.4.9 Terminal box shall be capable of withstanding internal short circuit conditions without danger to personnel or plant from the emission of hot gases or flame or due to excessive distortion or damage to the terminal enclosure.
- 5.4.10 Separate terminal box shall be provided for anti-condensation heaters.
- 5.4.11 Separate terminal box shall be provided for WTD / BTM, if WTD / BTM requirement is specified in data sheet.
- 5.4.12 Appropriate phase markings as per relevant standards shall be provided inside terminal box. The marking shall be non-removable and indelible.

## 5.5 Bushings and Terminals

- 5.5.1 Phase marking on the terminals shall be as per relevant standards.
- 5.5.2 Terminal marking of auxiliary cable connections shall be in accordance with the relevant motor wiring diagrams.
- 5.5.3 Terminal blocks should be made of synthetic resin. The use of porcelain is not allowed.
- 5.5.4 Terminal connections shall be constructed in such ways that direct contact between screws, bolts or nuts and the conductor is avoided. Connections shall be secured against loosening by providing anti-loosening type bolts.

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## 5.6 Rotor

- 5.6.1 The rotor shall be of squirrel cage type, unless otherwise specified. The shaft shall be made of one-piece, heat-treated steel. Welding on finished shafts is not allowed. Shafts and/or spiders subjected to welding, shall be post-weld stress relieved.
- 5.6.2 Rotors of all motors shall be dynamically balanced at nominal speed with half the key (HK) fitted in the key way(s). The shaft-end should be permanently marked with the indication 'HK'.
- 5.6.3 If metal is to be removed to achieve dynamic or static balance it shall be removed in a manner that maintains the structural integrity of the rotor and does not result in harmful or distorted hot spots.
- 5.6.4 Motors shall be provided with a single shaft extension with key-way & full key. Motor shaft shall be sized to withstand 10 times the rated torque.



## 5.7 Fans and Cooling

- 5.7.1 All motors shall be self-ventilated, fan cooled confirming to relevant standards. Fans shall be corrosion resistant or appropriately protected.
- 5.7.2 The external fans shall be of non-corroding material or shall be treated with a corrosion resistant coating.
- 5.7.3 The flow of cooling air shall be in the direction of the driven equipment.
- 5.7.4 Motors fitted with unidirectional fans shall be provided with an arrow of permanent nature, indicating the direction of rotation. Indication by means of a painted or adhesive arrow is not acceptable.
- 5.7.5 Fan shall be suitable for motor rotation in either direction without affecting the performance of the motor. If this is not possible for large outputs, it shall be possible to reverse the fan without affecting the balancing of the motor.
- 5.7.6 Fans for the motors used in the hazardous area (Zone 1 & 2) shall be manufactured from anti-static non-sparking material. If manufactured from non-metallic material, it shall be painted with an electrically conducting paint, to prevent accumulation of static charge.

## 5.8 Coupling

- 5.8.1 The coupling design shall be based on the maximum transient torque that can be expected at the coupling in case of a two or three-phase short-circuit at the motor terminals.
- 5.8.2 All motors shall be suitable for being coupled to the driven equipment through flexible coupling, unless otherwise specified. Where rigid coupling is specified, the motor shaft shall have the desired class of accuracy.
- 5.8.3 For all vertical flange mounted motors, the limitations on shaft extension, run out, perpendicular and eccentricity as required by the driven machine supplier, shall be complied with by the motor supplier.



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5.8.4 If the motor is to be coupled to centrifugal pump or compressor requiring fluctuating torque, the motor supplier shall ensure that the inertia of the driving and the driven machine assembly shall be such that the variation in the armature current shall not exceed + 66% of the rated current while delivering full load.

5.8.5 Wherever the belt drive is specified the motor supplier shall ensure the shaft extension and the bearings are suitable for the duty specified and supply the slide rails unless otherwise specified.

## 5.9 Bearings

5.9.1 Motors shall be equipped with grease lubricated ball or roller bearing. Bearing shall be so chosen to provide a minimum L-10 rating life of 5 years (40, 000 Hours) at rated operating condition.

5.9.2 Re-greasing shall be possible and grease relieves valve proposed for large motors to be installed in a high temperature environment.

5.9.3 Bearings shall be protected against contamination, loss of lubricant and to prevent intrusion of fine dust and sand particles.

5.9.4 The bearing shall be adequate to absorb axial thrust produced by motor itself or due to shaft expansion.



5.9.5 Motors designed to handle external thrust from the pump shall be supplied with a thrust bearing at non-driving end (NDE).

5.9.6 As far as vertical motors are concerned, the bearing shall withstand the thrusts of both driven machine and motor itself. Vertical motors driving direct-coupled pumps shall have the thrust bearing at the non-drive end (NDE).

5.9.7 In cases such as pumps for hot liquids where the driven machine operates at high temperatures, bearings shall be cooled by a shaft-mounted fan. This shall ensure efficient ventilation of the bearing and disperse the heat transmitted from the driven object by conduction or convection.

5.9.8 Bearings shall be capable of grease injection from outside without removal of covers with motors in the running conditions. The bearing boxes shall be provided with necessary features to prevent loss of grease or entry of dust or moisture e.g. labyrinth seal. Where grease nipples are provided, these shall be associated, wherever necessary, with appropriately located relief devices, which ensure passage of grease through the bearing. Pre-lubricated sealed bearings may be considered provided a full guarantee is given for 4 to 5 years of trouble free service without the necessity of re-lubrication.

5.9.9 Rotor of motors equipped with roller bearings shall be secured during transport to avoid damage to the bearings.

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## 5.10 Earth terminals

5.10.1 Two earth terminals located preferably on diametrically opposite points shall be provided for each motor. Unless otherwise specified, the size of each earth stud shall be as given below:

<u>Motor Rating</u>	<u>Stud size</u>
Up to and including 3.7 KW	6mm
5.5KW to 30 KW	10mm
Above 37 KW	12mm

Necessary nuts and spring washers shall be provided for earth connection.

## 5.11 Accessories

Following accessories shall be provided in the motors as specified in the Scope of supply / data sheet.



5.11.1 Anti-condensation heaters: - Unless otherwise specified in the data sheet, all motors rated 30 kW and above shall be provided anti-condensation heaters suitable for 240V 1 Ph AC power supply. The same shall be sized and located so as to prevent condensation of moisture during shutdown periods. Motor rated below 30 kW shall be provided with anti-condensation heater, if specifically specified in the Scope of supply / data sheet. The windings of all motors rated below 30 kW shall be guaranteed for use and for standing idle in the environmental conditions indicated without the use of anti condensation heaters.

Motors meant for humid location such as cooling tower fans, sump pump motors etc. shall be provided with space heaters irrespective of the motor rating in the data sheet. The heater shall remain permanently "ON" when the motor is not in service and as such shall not cause damage to the windings. For motors installed in hazardous area, the heaters shall conform to the provisions of applicable standard and temperature classification specified in the motor data sheet.

A warning label (Warning - Circuit May Be Live) with indelible red inscription shall be provided on the motor to indicate that the heater supply shall be isolated before carrying out any work on the motor.

5.11.2 Name / Rating plates: -

- The name / rating plates shall be in English and any other language specified in project data sheet.
- The name / rating plates shall be manufactured from stainless steel (Series 300) with letters embossed on them.
- The name / rating plates shall contain all the required details as per relevant standards and in addition shall indicate the following: -

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- The description and code No. of motor.
- Degree of protection of enclosure.
- Temp. rise of winding under running condition.
- Designation of bearing.
- Recommended type of lubricant and interval of lubrication.
- Weight.

iv. In addition to the motor name / rating plate, a separate number plate for motor tag no shall be fixed in a readily visible position. This number shall be as per the motor data sheets.

- 5.11.3 Flameproof / Increased safety / type “n” motors shall have additional name plate containing relevant particulars in accordance with relevant standards.
- 5.11.4 All motors except for fractional horsepower motors shall be provided with lifting hooks of adequate capacity.
- 5.11.5 Motors shall have corrosion resistant guard screens on all ventilation openings.
- 5.11.6 When tropicalisation treatment is specified, all internal parts which are subject to attack by moisture, fungus or insects shall be treated with polyurethane or equivalent coating and fungicides to inhibit such attacks. Corrosion resistant materials and moisture resistant insulation shall be provided.

## 5.12 Spares

The details of mandatory spare requirements along with recommended quantity are listed below.



Description	One set of spares for each rating & type
Bearing set (DE & NDE both)	1 set
Terminal studs / bushing assembly	1 set of each type

Commissioning spares and two-year normal operation & maintenance spares shall be supplied with the main equipment. Item wise list of recommended spares by vendor, shall be furnished for approval.

Any other spare parts not specified, but required, shall also be quoted along with the offer by respective vendor.

## 5.13 Painting

Internal & external parts of the casing and all metal parts likely to come in contact with the surrounding air shall be protected with acid-alkali resistant epoxy paint that will resist the particular ambient conditions. The paint shade shall be as specified in data sheet.

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## 6. INSPECTIONS AND TESTING

### 6.1 Fabrication and quality control plan and inspections

Inspection and testing activities shall be defined by the Manufacturer on the Fabrication and quality control/assurance plan based on the minimum requirements established on Inspection and Test Plan (ITP).

During the manufacturing period, the MV Induction motors could be subject to inspection (if specified/ agreed in Inspection Test Plan), to ascertain that only quality raw material is used, by inspectors appointed by Owner (Purchaser).

The Manufacturer shall allow free access of workshop to the inspector, shall give all information required and shall make available all copies of internal orders to other sub suppliers.

The manufacturer shall give at least 2 weeks' advance notice to the owner (purchaser), regarding the date of testing to enable him / his representative to witness the testing.

### 6.2 Test Procedure



The tests shall be carried out in Manufacturer workshop at his care and expense. Even in case Owner (Purchaser) waives to witness the tests the manufacturer shall draw up the certificate of the tests carried out containing a full report and all the results and the measures of the tests.

The tests shall be carried out in accordance with the requirements of relevant standards and of the Inspection and Test Plan.

- 6.3 Soft feet check : Before the mechanical run test, motor "soft feet" shall be checked. Micrometer reading shall not exceed 0.02 mm during this verification. This check shall be carried out at each motor foot, with the other feet in tight condition. "Soft feet" checking shall be performed after the motor alignment and shimming were completed and motor was fixed to the test base securely.






## 7. PACKING

The motor shall be properly packed to safeguard against weather conditions and handling during transit. The equipment may be stored outdoor for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains / high ambient temperature, unless otherwise agreed.



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## 8. VENDOR DOCUMENTATION

Vendor shall submit the drawings and documents as listed in “Vendor Documentation Schedule” / “Supply Requisition (SR)” attached to the Material Requisition for contractor / owner’s approval prior to manufacturing.

				 Written By:  Checked By:  Design Checked By:  Approved By:  Authorized By:			
A	26.11.2019	ISSUED FOR DESIGN		NM	CG	SV	JMC
REV	DATE	DESCRIPTION		WRITTEN	CHECKED	APPROVED	AUTHORIZED

 		<b>DATA SHEET MEDIUM VOLTAGE INDUCTION MOTOR - HAZARDOUS AREA</b>					
<b>PROJECT :</b> STANDBY SRU + ADDITIONAL TANKS, IOCL - PARADIP REFINERY <b>CLIENT :</b> INDIAN OIL CORPORATION LIMITED		<b>PROJECT N°:</b> 080557C001	<b>UNIT:</b> 000	<b>DOCT. CODE:</b> SP 1691	<b>SERIAL N°:</b> 002	<b>REV:</b> A	<b>SHEET:</b> 1 of 1

TO BE COMPLETED BY PURCHASER & DRIVEN MACHINE SUPPLIER	1	ITEM TAG:		QUANTITY:		MR	
	2	General specification: 080557C-000-JSS-1691-001		Standards, codes:			
	3	Supplier:		Manufacturer:			
	4						
	5	<b>ENVIRONMENTAL CONDITIONS</b>					
	6	Installation (indoor/outdoor) / Environment type		Outdoor		Humid and corrosive - Refinery	
	7	Maximum ambient temperature		42.4 °C			
	8	Minimum ambient temperature		11.3 °C			
	9	Design ambient temperature		43 °C			
	10	Altitude/Maximum relative Humidity		3.91 m above Indian mean sea level (IMSL)		95 %	
	11	Hazardous area classification		As per Driven Equipment Data sheet			
	12						
	13	<b>DRIVEN MACHINE DATA</b>					
	14	Manufacturer/Machine Type (fan, pump, compressor,...)					
	15	Maxi shaft power / Shaft power at operating point				kW	
	16	Coupling type / To be designed for restarting		Yes <input type="checkbox"/> No <input type="checkbox"/>			
	17	Thrust (vertical) Up/Down		Up kg Down kg			
	18	Driven Machine Inertia (GD <sup>2</sup> )				kg.m <sup>2</sup>	
	19	Brake torque curve / Required starting, brake torque				N.m	
	20						
TO BE COMPLETED BY MANUFACTURER	21	<b>MOTOR GENERAL CHARACTERISTICS</b>					
	22	Rated power/ Poles number		kW/N°:			
	23	Voltage/Frequency and its variation/Phases		415 ± 6% V/50 ± 3% Hz/N°:		3	
	24	System short circuit level		50/65 kA		1 Sec	
	25	Service condition - Duty type (S1, S2,...)		S1			
	26	Mounting (IM1001,3001,3011,1011,...)					
	27	Protection degree: Enclosure / terminal box		IP: 55		IP: 55	
	28	Protection Ex(n), Ex(d), Ex(e):		Ex d for Zone 1 and Ex e for Zone 2 (see note-1)			
	29	Zone/ Gas group (IIB,...) / Temperature class (T3,...)		As per Driven Equipment Data sheet			
	30	Enclosure cooling (fan cooled, air to air, air to water,...)		Fan cooled			
	31	Starting Method (loaded, unloaded / DOL, soft start,...)		DOL (see note-2)			
	32	Starting voltage (full, reduced x%) / Max. voltage drop at starting		75%			
	33	Nb of consecutive starts within 1 hour		Cold 3 Hot 2			
	34	Efficiency class		IE2			
	35	Thermal insulation / Max Temperature Rise		Class F		Class B	
	36	Direction of Rotation (looking from motor coupling)		CW <input type="checkbox"/> CCW <input type="checkbox"/> Bidirectionnal <input checked="" type="checkbox"/>			
	37	Position of Main / Auxiliary terminal box		Main : RHS from coupling end		Auxiliary:	
	38	Terminal Box Short Circuit Withstand Current/Time		50 / 65 kA		0.25 Sec	
	39	Cable Type and Size on main terminal box		Cu/Al cond. XLPE Insul, Armoured		Size mm <sup>2</sup>	
	40	Terminal boxes provided with cable glands		Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			
41	Painting (Mfr standard,... / color)		Mfr standard				
42	Noise Level at 1 m		As per standards dB(A)				
43							
44							
TO BE COMPLETED BY MANUFACTURER	45	<b>MOTOR MANUFACTURER'S DATA</b>					
	46	Manufacturer type / Frame Size /					
	47	Winding Connection (star, delta)/Nb terminals brought out		Delta		N°: 6	
	48	Full Load Speed		rpm			
	49	BkW at full load/ kW at end of curve					
	50	Rated Current / No load current / Locked Rotor Current		A		A	
	51	Starting Time (% of Voltage) at full load / Time te for Ex e motor		100%: s		80%: s	
	52	Allowable Locked Rotor withstand Time at 80%/100% voltage		Cold: s		Hot: s	
	53	Thermal Time Constant		Cooling: s		Heating: s	
	54	Efficiency		4/4 %		3/4 %	
	55	Power Factor		4/4		3/4	
	56	Locked Rotor Power Factor					
	57	Full load Torque				N.m	
	58	Starting/Pull Up/Breakdown Torque		L %		PU %	
	59	Rotor Motor Inertia (GD <sup>2</sup> )				kg.m <sup>2</sup>	
	60	Bearing Type (Drive End/Non Drive End)		DE:		NDE:	
	61	Lubrication Type/Interval		hours			
	62	Anticondensation heaters (power / voltage) 30 kW and above		Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		kW 240 V	
	63	Thermister (make/type/quantity)					
	64	Shaft voltage					
65	Critical speed						
66	Ground lug size		mm <sup>2</sup>				
67	Motor Weight		kg				
68	Canopy		For Outdoor Motors				
69	Certifying authority / certificate Nr						
70							
TO BE COMPLETED BY MANUFACTURER	<b>Notes:</b>						
	1	All Electrical motors of following category shall be Flame Proof type. i. Handling flammable material ii. Located in pump house/compressor house associated with hydrocarbon storage/tankage area iii. Located in loading & unloading gantries iv. Requiring frequent start stop applications					
	2	Starting current shall be limited to 6 times the rated current subject to tolerance.					
	3	Motors driven by VFD shall have following additional features. a) Winding insulation designed to withstand high level of dv/dt for inverter operation. b) Shall run at any speed over the range (1-100%) of rated speed. c) Shall have winding RTD for temperature indication/ tripping. d) Shall have combined test certificates with VFD.					
	4	All MV motor including & above 75 kW shall be provided with PTC thermistors.					

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# ANNEXURE

## SCOPE OF WORK AND JOB SPECIFICATIONS (ELECTRICAL)

### FOR

## PUMPS- CENTRIFUGAL VERTICAL (B366-088-PA-MR-5002)

**PROJECT :** STANDBY SRU PROJECT

**OWNER :** M/s IOCL, PARADIP

**PMC :** ENGINEERS INDIA LTD.

**JOB NO :** B366

A	05.04.2021	ISSUED WITH MR	GCS	AR	SV
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

## 1.0 GENERAL

- 1.1 The specification defines the basic requirements of the electrical works in vendor's scope for the centrifugal pumps for STANDBY SRU Project of M/s IOCL at Paradip. This job specification shall be read in conjunction with referred specifications, data sheets and documents attached with the Material Requisition. In case of any conflict amongst various documents enclosed with MR, the most stringent requirement shall govern and Owner/EIL decision in this regards shall be final.
- 1.2 The equipment shall conform to this specification, enclosed data sheets and standard specifications.

## 2.0 SCOPE

Vendor's scope, shall include sizing, design, engineering, manufacturing, supply, testing at manufacturer's works, packing and delivery at site of electrical equipment including supply of all commissioning spares, special tools & tackles and quotation for two years recommended spares as per the specifications and data sheets enclosed with the requisition. The major electrical equipments involved are:-

Sr. No.	Description	Specified by Purchaser & Included in Vendor's scope (Yes/No)	Remarks
1	All MV motors as per enclosed data sheet	Yes	
2	Any other miscellaneous electrical loads (Heaters, etc. if required)	Yes	
3	Double compression type nickel plated brass FLP Cable glands with PVC shrouds and lugs.	Yes	
4	Commissioning spares for the motors as required	Yes	
5	Mandatory spares as per specification	Yes	

Vendor shall supply cable glands and bimetallic lugs having Al barrel & tinned Cu palm (for Aluminum Cables) and tinned Cu lugs (for Copper cables) for equipment supplied by them. For outdoor equipment, double compression type Nickel plated brass FLP cable glands shall be supplied.

## 2.1 EXCLUSIONS

- 2.1.1 Supply of power supply feeder (415V) for motors, other misc. electrical loads.
- 2.1.2 Supply and laying of all power and control cables from field to Substation.

## 3.0 UTILIZATION VOLTAGE

Utilization voltage for motor, anti-condensation heaters based on their ratings shall be as listed below:

- |     |                           |   |                 |
|-----|---------------------------|---|-----------------|
| a.) | Motors rated above 160kW  | : | 6.6 KV $\pm$ 6% |
| b.) | Motors rated upto 160kW   | : | 415V $\pm$ 6%   |
| c.) | Anti-condensation heaters | : | 240V $\pm$ 6%   |

## 4.0 SPECIAL REQUIREMENTS

- 4.1 Motors shall fulfill the following requirements:-
- 4.1.1 MV motors (<1100V) for DOL start shall conform to attached specification and MV Motor data sheet.
- 4.1.2 Motors shall not have dual winding.

- 4.1.3 The enclosure type / area classification for motors and their auxiliaries shall be as listed below:

Sr. No.	Tag No.	Enclosure Type	Area Classification
1.	088-P-004 A/B	Ex-d / Ex-de	Zone-2, IIA/IIB, Temp. Class T3
2.	088-P-005 A/B	Ex-d / Ex-de	Zone-2, IIA/IIB, Temp. Class T3

- 4.2 All the motors with enclosure protection Ex-d/de shall meet the requirements of IS/IEC 60079.
- 4.3 Exact cable sizes of power and control cables shall be finalised during detailed engineering. Provisions, as required in Vendor's equipment for termination of the same, shall be made accordingly without any cost & time implications to Owner.
- 4.4 All electrical equipment for use in hazardous areas shall be certified by CIMFR, ATEX, BASEEFA or equivalent independent testing agency for the service & the area in which it can be used and shall have a valid statutory approval of CCOE/PESO and copies of the same (CCOE/PESO) shall be furnished during detailed engineering stage which is mandatory as per local rules/regulations
- 4.5 Cable glands to be supplied with the motor shall be of flameproof Ex-d type suitable for use in Zone-2, Gas group IIA/IIB, Temp class T3 and shall meet all the requirement of IS/IEC-60079.
- 4.6 Vendor to note that, if there is any requirement of emergency electrical power for the auxiliary equipments supplied with the main motor/pump, same shall be highlighted at the bid stage only.

## 5.0 SPARES

For requirements of commissioning spares, mandatory spares and two year recommended spares for all electrical equipments, refer Doc. No. 080557C-SPL-LSTK1-001 attached with MR.

## 6.0 MAKES OF EQUIPMENT AND COMPONENTS

S.NO	EQUIPMENT	COUNTRY
	<b>MOTORS-INDUCTION-MV (FLAMEPROOF)</b>	
1	ABB INDIA LTD	INDIA
2	BHARAT BIJLEE LIMITED	INDIA
3	CEMP	INTERNATIONAL
4	CG POWER AND INDUSTRIAL SOLUTIONS LTD	INDIA
5	KIRLOSKAR ELECTRIC LTD	INDIA
6	LAXMI HYDRAULICS PVT LIMITED	INDIA
7	MARATHON ELCTRIC MOTOR LIMITED	INDIA
8	SIEMENS LIMITED	INDIA
	<b>MOTORS-IMPORTED</b>	
1	ABB	INDIA / INTERNATIONAL
2	CEMP SRL	INDIA / INTERNATIONAL
3	GE NERGY POWER CONVERSION FRANCE SAS	INDIA / INTERNATIONAL
4	GENERAL ELECTRIC CANADA	INDIA / INTERNATIONAL
5	HITACHI LIMITED	INDIA / INTERNATIONAL
6	HYUNDAI HEAVY INDUSTRIES CO. LTD	INTERNATIONAL
7	JEUMONT SA/ FRAMATONE ANP	INTERNATIONAL
8	LLOYD DYNAMOWERKE GMBH	INTERNATIONAL
9	LOHER GMBH	INTERNATIONAL
10	NIDEC ASI SPA	INTERNATIONAL

11	SIEMENS AG	INTERNATIONAL
12	TOSHIBA CORPORATION	INDIA / INTERNATIONAL
13	WEG EQUIPAMENTOS ELECTRICOS SA	INDIA / INTERNATIONAL
14	WEGEURO – INDUSTRIA ELECTRICA SA	INTERNATIONAL

- 6.1 List of approved vendors for major Electrical equipment/components is as mentioned above.
- 6.2 Additional makes of imported items shall be subject to Owner/EIL's approval during detailed engineering.
- 6.3 Vendor may procure material from any of the listed vendors. However current validity and range of approval as per enlistment letter, workload, stability and solvency need to be verified by the vendor before placement of order.

## 7.0 ATTACHMENTS

Sr. No.	Document Title	Document No.	Rev.
1.	Data Sheet –MV Induction Motors	080557C-000-SP-1691-002	A
2.	Data Sheet – Load Data Format	B366-999-16-50-DS-1002	A
3.	Vendor Data Requirement	B366-088-16-50-VR-5001	A
4.	Specification for MV Induction Motors	080557C-000-JSS-1691-001	A

## ELECTRICAL LOAD DATA

### NOTES: -

1. Vendor shall fill the details of all electrical power consumer loads, which are included in the scope of this MR/Tender and submit with the offer.

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### MOTOR

S.NO	TAG NO.	SERVICE	Make	Type of enclosure	Applicable standard for hazardous area application	Motor Kw	Duty (continuous/in termittent)	No. of poles	Type designation for cooling



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### OTHER ELECTRICAL LOADS

S.NO	TAG NO.	SERVICE	Make	Type of enclosure	Applicable standard for hazardous area application	Rated KW	Duty (continuous /intermittent)	Voltage

**JOB SPECIFICATION AND SCOPE OF WORK OF**  
**INSTRUMENTATION FOR**  
**VERTICAL CENTRIFUGAL PUMPS**  
**(Tag Nos. 088-P-004 A/B, 088-P-005 A/B)**  
**FOR**  
**STANDBY SRU PROJECT**  
**IOCL – PARADIP**

**MR No.: B366-088-PA-MR-5002**

A	15.04.2021	ISSUED FOR BIDS	VK	JJ	AR
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

## **1.0 GENERAL**

- 1.1 The purpose of this specification is to define general requirements and philosophy of instrumentation as per API-682.
- 1.2 This specification along with attached standards and relevant part of this requisition covers the design, engineering, supply and testing of Instrumentation with all accessories and materials.
- 1.3 If there is any conflict between this specification, data sheets, related standard, code etc. Bidder shall refer the matter to Purchaser for clarification and only after obtaining the same should proceed further.

## **2.0 SCOPE OF SUPPLY AND WORK**

Bidder's scope of instrumentation supply and work shall include the following as a minimum:

- a) Supply of all instruments as per this requisition and any other vendor furnished instruments as per specifications.
- b) Design, Engineering and procurement of instruments.
- c) Submission of filled in data sheets for all instruments along with sizing calculations for restriction orifice. Bidder shall also indicate make and model numbers of the offered instruments. Data sheets shall be submitted for review/approval with one set of technical catalogues of offered instruments with model decoding details.

## **3.0 DESIGN PHILOSOPHY AND TECHNICAL REQUIREMENTS**

- 3.1 The procurement of all instruments shall be strictly from the manufacturers listed in Purchaser's approved vendor list attached elsewhere in this requisition.
- 3.2 S.S. tag plates shall be provided for all the instruments.
- 3.3 Typical (skeleton / blank) instrument data sheets for each type of instruments will be provide after the placement of the order. Vendor shall furnish filled in data sheet for each tag after sizing, range selection, material selection etc. These data sheets shall be reviewed by Purchaser after placement of order. Proper selection of instruments, materials etc. shall be Vendor's responsibility. Any necessary change required later for meeting the specification shall be done by the Vendor without any price or delivery implications. While filling the instruments data sheets, the following shall be taken care:
  - a) All the relevant data shall be filled in. If any point is not applicable then N/A shall be indicated.
  - b) Make and model number of the offered instruments shall be indicated with model decoding details for offered instrument, without model no, data sheet shall not be reviewed.
  - c) Vendor seal with signature shall be provided and Pump Vendor shall ensure the correctness of the process data.Instruments tag numbers /data sheet numbers shall be indicated.

### 3.4 Restriction Orifice Plates

- a) Vendor's scope includes following 2 nos. restriction orifices as a minimum:
  - > 088-FO-0206
  - > 088-FO-0209
- b) Vendor shall follow Job Specifications for Flow Elements (Document No. 080557C-000-JSS-1546-001) attached with the requisition for the design of the restriction orifice plates.
- c) Plate material shall be SS316L as a minimum. These restriction orifice plates shall be suitable for installation on fully jacketed lines as mentioned below.
- d) If single RO plate design is considered as per Job Specifications for Flow Elements (Document No. 080557C-000-JSS-1546-001), restriction orifice plates shall be designed for flange with 2 inch, 150# Bolt Center Dia. with process dia. of 1 inch.
- e) If Multi-stage restriction orifice plates are being considered by Vendor as per Job Specifications for Flow Elements (Document No. 080557C-000-JSS-1546-001), then Vendor shall consider the end flanges with 2 inch, 300# Bolt Center Dia with process dia. of 1 inch. Multi-stage restriction orifice plates shall be complete with prefabricated spool piece with end connection flanges with following metallurgy:
  - > Spool piece material shall be ASTM A106 Gr.B
  - > Flange material shall be ASTM A105N as per ASME B16.5.
- f) Each Restriction Orifice Plate shall have an integral handle, which shall, upon assembly with flanges, extend to a distance of 50 mm beyond flange edge with following information punched on it:
  - > Tag Number.
  - > Nominal pipe size in inches and rating in psi.
  - > Material of plate

### 3.5 Mandatory spares:

Vendor to supply following mandatory spares as a minimum:

Orifice Plates: 10% or minimum 1 of blind plates of each size, rating, thickness & material of construction.

- 3.6 Package Vendor shall generate and submit all instrument specifications, datasheets using SPI Ver 2016. SPI datasheet format (i.e. ".ISF") for each type of instruments will be provided during detail engineering. These data sheets can be edited in "External Editor Software". Vendor shall submit the final approved datasheet in "ISF" format in form of soft file (CD) as part of VDR during detail engineering.

### 4.0 TAG NUMBERING

- 4.1 Instrumentation symbol shall follow latest edition of ISA standard S 5.1.
- 4.2 All Vendor-supplied instruments shall have Tag No. as per the format indicated below. Numerical no. for all the instruments shall be unique i.e. without any repetition of tag no. for same type of instrument.

<u>Unit No.</u>	<u>Instrument Type</u>	<u>Numerical No.</u>
AAA	BBBB	CCDD
AAA	= Unit Number (Refer pump tag list)	
BBBB	= Refer ISA S 5.1	
CC	= Last two digit of P&ID no.	
DD	= Instrument serial number (To be allotted during detail engineering.)	

## 5.0 INSPECTION:

All instruments shall undergo inspection as per the criteria mentioned elsewhere.

## 6.0 Miscellaneous requirement:





- a. Softcopy of all instrumentation documentation shall be submitted in editable format for loading into Purchaser's Documentation Node. Vendor to ensure that all' final as-built instrumentation documentation are submitted as separate volume / section.
- b. Any Instrument loose supplied items are to be packed separately instead of packing the same with other mechanical items while shipping to site.

### **LIST OF DOCUMENTS (INSTRUMENTATION)**

S. No.	DOCUMENT NAME	DOCUMENT NO.
1	JOB SPECIFICATION AND SCOPE OF WORK FOR INSTRUMENTATION FOR CENTRIFUGAL VERTICAL PUMPS (GPP)	B366-088-16-51-SP-1005
2	VENDOR DATA REQUIREMENTS	B366-088-16-51-VDR-1005
3	JOB SPECIFICATIONS FOR FLOW ELEMENTS	080557C-000-JSS-1546-001
4	ORIFICE PLATES, FLANGES AND THERMOWELL DIMENSIONAL DETAILS	080557C-000-STC-1580-005

 	<b>PROJECT</b>		<b>Standby SRU &amp; Additional Tanks</b>	
	<b>CLIENT</b>		<b>IOCL Paradip Refinery</b>	
<b>JOB SPECIFICATIONS FOR FLOW ELEMENTS</b>	<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-000-JSS-1546-001	<b>Rev. No.</b> B	Page 1 of 20



## JOB SPECIFICATIONS FOR FLOW ELEMENTS

			 <small>Rathinakannan Chinmoyam 2019.11.27 11:17:53 +05'30'</small>	 <small>Shyam Sundar Kanthulurajan 2019.11.27 12:07:27 +05'30'</small>	 <small>Ernam Sankaranarayanan 2019.11.27 12:36:29 +05'30'</small>	 <small>Morischdispher Jousuratan 2019.11.29 20:06:16 +05'30'</small>
B	25.11.2019	ISSUED FOR DESIGN	CRK	KRS	SS	JMC
A	11.11.2019	ISSUED FOR DESIGN	CRK	KRS	SS	JMC
<b>REV.</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>PREPARED</b>	<b>CHECKED</b>	<b>APPROVED</b>	<b>AUTHORIZED</b>

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## 1. INTRODUCTION:



**INDIAN OIL CORPORATION LIMITED (IOCL)** has awarded Fax of Acceptance (FOA) dated 29<sup>th</sup> August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

## 2. DEFINITIONS & ABBREVIATIONS

Abbreviation	Definition /Expanded form
IOCL/ CLIENT	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related

### 1. TECHNICAL ABBREVIATIONS

AARH      Arithmetic Average Root Height

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BIS	Bureau of Indian Society
CCOE	Chief Controller Of Explosives
CMRI	Control Mining Research Institute
FF	Foundation Fieldbus
HART	Highway Addressable Remote Transducer
NACE	National Institute of Chemical Engineers
NPS	Nominal Pipe Size
NPT	National Pipe Threads
OSHA	Occupational Safety and Health Authority
PESO	Petroleum and Explosives Safety Organisation
PTFE	Poly Tetra Fluoro Ethylene

## 2. CONFLICTS AND DEVIATIONS

If conflicting statements exist within this document or between this document and Design Basis, other applicable specifications, Standard Drawings, Industry standards, codes, etc., it shall be brought to Owner's / PMC notice for clarification and proper approval shall be obtained before implementation. Decision of Owner / PMC shall be final.

In case of contradiction between licensor specification, design basis and JSS, it has to be brought to the notice of Owner/PMC and Decision of Owner/PMC shall be binding on Contractor/Vendor.



In general, order of priority of the documents shall be as follows,

- Local regulatory and statutory requirement.
- Licensor Requirements (as applicable)
- Project specification and datasheets, wherever applicable.
- This specification and relevant equipment/system specification.
- Codes and standard.



## 3. REFERENCE NATIONAL / INTERNATIONAL STANDARDS

Design and terminology shall comply, as a minimum, with the latest edition of following codes, standard practices and publications:

ANSI/ASME	American National Standard Institute/American Society of Mechanical Engineer.
B 1.20.1	Pipe Threads, General Purpose (Inch)
B 16.5	Pipe Flanges and Flanged Fittings NPS½ through NPS24
B 16.20	Metallic Gaskets for Pipe Flanges, Ring Joint, Spiral wound and Jacketed.

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	B 16.36 / B16.36a	Orifice Flanges
	B 16.47	Large Diameter Steel Flanges NPS 26 through NPS 60 Metric/Inch Standard
AGA	Report No 3 Part 1:	American Gas Association Orifice metering of natural gas and other related hydrocarbon fluids. General equations and uncertainty guidelines
ASME		American Society of Mechanical Engineers
ASME MFC 14M		Measurement of Fluid Flow Using Small Bore Precision Orifice Meters
ASME MFC-SC17		Basic Design geometries for multiport averaging pitot - primary elements
EN 10204		Inspection Documents for Metallic Products.
IBR		Indian Boiler Regulation.
IEC 60079		Electrical Apparatus for Explosive Gas Atmosphere.
IEC 60529		Degree of Protection Provided by Enclosures.
IEC-61000-4		Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment
IS-2148		Flame proof enclosures for electrical apparatus for explosive Gas Atmospheres – Flame proof Enclosures 'd'
ISO 5167-1		Measurement of fluid flow by means of Pressure Differential Devices inserted in circular cross-section conduits running full-Part 1: General Principles and Requirements
ISO 5167-2		Measurement of fluid flow by means of Pressure Differential Devices inserted in circular cross-section conduits running full using Pressure Differential Devices-Part 2: Orifice Plates
ISO 5167-3		Measurement of fluid flow by means of Pressure Differential Devices in circular cross-section conduits running full using Pressure Differential Devices-Part 3: Nozzles and Venturi nozzles
ISO 5167-4		Measurement of fluid flow by means of Pressure Differential Devices in circular cross-section conduits running full using Pressure Differential Devices-Part 4: Venturi tubes
ISO-5168		Measurement of fluid flow-estimation of uncertainty of a flow-rate measurement. - Flow Measurements Engineering Handbook by R.W. Miller - Principles and Practice of Flow Meter Engineering by L.K.Spink

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ISO/TR 15377	Measurement of fluid flow by means of pressure differential devices, guidelines for specification of nozzles & orifice plates beyond the scope of ISO 5167-1.
NACE MR0175/ISO 15156	Petroleum, Petrochemical and Natural gas Industries-Material for Use in H <sub>2</sub> S containing environments in Oil and Gas Production
NACE MR0103	Petroleum, Petrochemical and Natural gas Industries-Metallic materials resistant to Sulphide Stress cracking in corrosive Petroleum refining environments
OSHA	Occupational safety and health hazard
ITK-XXX	Interoperability Test Kit (Latest version).
FF-940	Foundation Fieldbus Specification.



#### 4. REFERENCE DOCUMENTS

080557C-000-JSS-1553-001	Job Specifications for Electronic Field Transmitters
080557C-000-JSD-1540-001	Design Basis – Instrumentation Tanks
080557C-088-JSD-1540-002	Design Basis – Instrumentation
080557C-000-ITP-1500-001	Inspection and Test Plan for Instrumentation
080557C-000-JSD-1300-002	Piping Material Specification
080557C-000-SP-1500-001	Data sheet formats (typical) for Instrumentation Items
080557C-000-STC-1590-001	Installation Standards
080557C-000-STC-1580-005	Orifice plates, flanges and thermowell dimensional details

#### 5. GENERAL REQUIREMENTS



- 1) Flow Elements design, manufacturing and testing shall be complete in all respects for the safe, efficient and easy operation, start up and shutdown of the units.
- 2) Material of construction of the instrument parts shall withstand the corrosive and other adverse influence of medium and its service conditions. Suitable protection against vibration, pulsation, erosion, corrosion etc. shall be provided without sacrificing consistent accuracy and reliability.
- 3) All the Flow elements in Hydrogen Service shall be certified for use in Hydrogen service by the manufacturer specifically with respect to Hydrogen Diffusion. All the Instruments in NACE service shall meet specific material requirements like hardness, radiography, material requirements and material testing requirements as per ISO 15156. For specific requirements requiring PWHT, Ultrasonic test, Radiography etc., piping material specification shall be referred.
- 4) The Flow elements used on pipe under IBR services shall be certified by IBR or IBR authorized



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representative. IBR design code shall be governed by Regulation 294 and regulation 295 of IBR and tested and certified by IBR as per Appendix 'L' of IBR.

- 5) Contractor shall supply the specified flow element complete with all the fittings and accessories required for the specified installation type. (e.g. fixed, extractable, supported to one end or at both ends, etc.)
- 6) Contractor shall provide minimum straight length requirement for upstream and downstream without sacrificing consistent accuracy and reliability as per recommendation and ISO 5167.
- 7) Unless otherwise specified, flow element flanges shall be fabricated in accordance with the standards mentioned in the specification. Minimum pressure rating for the flanges shall be 300lbs.
- 8) Unless otherwise specified, the following shall govern:
  - a. Threaded end connections shall be to NPT as per ANSI/ASME B1.20.1.
  - b. Flanged end connections shall be as per ANSI/ASME B 16.5/ B16.36 / B 16.47.
  - c. Flange face finish shall be as per clauses 6.4.4.1, 6.4.4.2 and 6.4.4.3 of ANSI/ASME B16.5. The face finish as specified in data sheets shall be as follows:
    - i. 125 AARH : 125 TO 200 AARH
    - ii. 63 AARH : 32 to 63 AARH
- 9) All electronics shall be suitable for use for specified site climatic conditions and industrial environment in which corrosive gases and / or chemicals may be present. As a minimum, all instruments in field shall be dust proof and weather proof to IP-66 as per IEC-60529/ 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 atmospheres.
- 10) Foundation Fieldbus shall be applied for all DCS open loops
- 11) Conventional 4-20 mA (HART) shall be applied to all other DCS loops, all ESD Signals, all Fire & Gas signals and for all Package Instruments.
- 12) For HART signals, the preferred method of protection shall be Intrinsic Safety using galvanic isolators (3 port active isolating type). The isolators shall have status indicating LED's. Dual channel devices shall not be used for conventional signals.
- 13) For the FF implementation, the field instruments shall generally be certified intrinsically safe suitable for the hazardous area. The FF topology shall use the High Power Trunk (HPT) design, which combines different safety techniques to allow high power on the trunk and intrinsically safe or energy limited output on the spurs. The HPT approach meets the intrinsically safe EEx ia FISCO requirement at the field device level and uses increased safety techniques (EEx e) for the trunk.
- 14) All ESD Instruments shall be SIL-2 certified. Contractor must furnish certified values of failure rates, probability of failure detection and test intervals for safety integrity level analysis. In addition to this, Contractor shall furnish SIL certification from any statutory body like TUV, FMEDA as per IEC 61508.
- 15) The meter electronics shall be protected against transients induced by lightning and power supply surges. Transient protection of electronics shall preferably be provided in the terminal block. The transient protection shall meet the requirements specified in IEC-60587. In case of external, same shall be Exd certified and plugged in Transmitter body. Universal type Transient protection device shall be provided.
- 16) Flying leads shall not be acceptable for terminations.
- 17) Instrument systems shall be designed to avoid interaction between associated electrical circuits. Spurious

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signals that cause interference shall be suppressed, preferably at source.

- 18) Special tools, jigs and fixtures, which are necessary to carry out maintenance activities shall be supplied.
- 19) All custody transfer meters shall be calibrated by FCRI with accuracy required for custody transfer metering. Master meters shall be considered for accuracy checking of mass flow meters in case of custody transfer.
- 20) For the measurement of cooling water flow, Magnetic flow meter/Ultrasonic Flow meters shall be used. To avoid any problem of water ingress in electronics of the flow meters, installation of these flow meters shall be above ground. To achieve this, the portion of the CW lines is to be brought above grade level. For extra ordinary cases, instrument with remote electronics and suitable IP class shall be used for installing in the pit with weatherproof canopy/covers and maintenance access.
- 21) Hydrocarbon volume/mass measurement for Custody transfer shall be by Multi-path Ultrasonic flow meter or Coriolis Mass flow meter.
- 22) Magnetic flow meters shall be used for cooling water service which shall be insertion type.
- 23) For hydrocarbon and high pressure steam service, unused holes in orifice flange should be plugged and seal welded. Used holes from where the tapping is taken should also be welded.
- 24) Mass flow meter shall be preferred over orifice flow measurement where higher accuracy requirements for flow measurements exists like Heater fuel lines and product run-down lines and shall have provisions for density measurement & compensation.

## **6. AREA CLASSIFICATION (Integral Orifice with Transmitter)**

The plant area is hazardous classified as Zone 1, Group IIA & IIB, and Temperature Class T3. Following certificates are required

- 1) Certificate from statutory authority like BASEFFA, FM, PTB, ATEX and CENELEC etc. for items of foreign origin and from CMRI, ERTL etc. for items of Indian origin are required and shall be submitted. Also, Indigenous Flameproof equipment shall comply with BIS requirement.
- 2) Flow meter & other accessories shall be Intrinsically safe design, with electrical certification Ex'ia' and ingress protection class shall be IP-66.
- 3) Approval certificates are required from CCOE / PESO for items to be installed in India, irrespective of country of origin.
- 4) Materials in contact with Plant Atmosphere shall be corrosion resistant.
- 5) For electronic transmitter details, refer Job Specifications for Electronic Field Transmitters (080557C-000-JSS-1553-001)

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## 7. DESIGN AND CONSTRUCTION

### 7.1. Orifice Plate and Flange assembly

- Flow measurement by orifice plate shall normally be carried out using thin square edge concentric orifice plate. The plate shall be mounted between a pair of weld neck flanges, with a rating ANSI 300lbs minimum for line size 2" and above. Flange taps orifice shall generally be used for line sizes 2" to including 14". Above 14" line size, D-D/2 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. Integral orifice assembly with transmitter or meter run without transmitter shall be used for line sizes 1 1/2" or below as per ASME MFC 14M and tapping type shall be corner taps..
- The material of construction for orifice plates shall be SS316, as a minimum. Where this material is unsuitable for the service because of corrosion or erosion, an alloy shall be chosen whose corrosion allowance is equal and better than line material.
- Quadrant edge or quarter circle orifice plates shall be used for lower Reynolds number (below 10000), high viscous fluid, and for application does not permit to use squared edge orifices as per codes., Conical entrance type of orifice plates shall preferably be used for very highly viscous liquids up to throat Reynolds number of 250.
- Concentric orifice plates shall not be recommended for multi-phase fluids in horizontal lines because the secondary phase can build up around the upstream edge of the plate. In extreme cases, this can clog the opening, or it can change the flow pattern, creating measurement error. Eccentric and segmental orifice plates are better suited for such applications. Concentric orifices are still preferred for multi-phase flows in vertical lines because accumulation of material is less likely and the sizing data for these plates is more reliable.
- Segmental orifice plates shall be used when solids are entrained in a gas or liquid with entrained gasses and gasses with condensed liquid.
- Eccentric orifice shall be recommended for dirty fluid service or slurries.
- Vent and drain holes shall be provided in orifice plates, wherever necessary. Vent and Drain hole is a small hole which is provided in the upper region (for liquid service) lower region (for Gas service) of orifice plate. Vent hole is required in liquid flow service where gas entrainment may occur, drain hole is required in gas flow service where liquid entrainment may occur. The diameter of the vent and drain hole as per 080557C-000-STD-1580-005.
- Drain hole is not recommended in dirty fluid service or slurries as the hole could be plugged.
- Sizing of orifice plates shall be carried out in accordance with ISO-5167.
- Differential range for orifice meter shall normally be 2500 mm of H<sub>2</sub>O dry calibration. Other preferred ranges are 1250, 3750 and 5000 mm of H<sub>2</sub>O. Beta Ratio limits for orifice plates shall be as per ISO 5167 with the The values of 'beta' shall be between 0.3 and 0.7. For high accuracy measurement a Beta ratio of 0.56 is preferred
- Orifice assemblies having ring-type joint flanges shall be provided with a plate carrying holder. Plate holder hardness shall be as per specification.

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12. Meter taps shall be horizontal for liquids, condensable vapours and steam. The taps shall be on top for gas, non-condensable vapour or liquids.
13. Instrument tapping connections shall be 1/2" NPT (F) up to 600# pressure rating. For corrosive and congealing service and for services above 600#; instrument tapping connections shall be 3/4" NPT(F). Maximum schedule of impulse pipes and associated fittings to be used in general is schedule 160. Higher schedules may be used with the concurrence of PMC/ owner. For orifices used for critical flow measurement and for flows used for unit mass balance, the tappings should be drawn min 45 deg upwards to avoid choking.
14. Individual taps on the orifice flange shall be provided for individual transmitter (in case of 2oo3 logic requirement, three transmitters with independent taps on orifice shall be used. In such case, three set of taps shall be provided in orifice assembly).
15. All the Orifice flanges shall have 4 sets of tapping. For hydrocarbon and high pressure steam service Un used holes in orifice should be plugged and seal welded. Used holes from where the tapping is taken should also be welded. Steam tracing is to be considered in viscous services and for capillary transmitters, steam tracing to be considered up to flange.
16. In case of DP type flow with 2oo3 logic with separate transmitter for Indication / control in DCS, four sets of tap shall be provided in orifice assembly.
17. Where more than one transmitter is used, separate pair of tapping shall be provided for installation of each instrument separately. No branching from a single tapping shall be designed. Orifice flanges shall be in accordance with the ANSI B16.36, ANSI B16.36a.
18. Upstream and downstream straight length shall be 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 and AGA-3. Flow straighteners should be considered, where straight runs are difficult to achieve otherwise.
19. Type of flow straightner (tube or vane type etc.) shall be as recommended by Contractor considering the metering application. The straightening element shall be made out of a thin walled tube or light gauge metal vane. However, the design shall be rugged enough to resist the forward thrust due to high flows. For tube type flow straighteners, the length to diameter ratio of each tube shall be at least 10: 1. The element shall have smooth leading and trailing edges.
20. The area of the orifice plate in contact with the gasket shall have the same surface roughness specified for the flanges set.
21. The upstream face of the orifice plate shall have a roughness criterion  $Ra < 10-4d$  within a circle of diameter not less than D and which is concentric with the orifice. In all cases, the roughness of the upstream face of the orifice plate shall not be such that it affects the edge sharpness measurement. If, under working conditions, the plate does not fulfil the specified conditions, it shall be repolished or cleaned to a diameter of at least D.
22. Thickness of Orifice plate shall be as per 080557C-000-STD-1590-005.
23. Orifice plate shall be provided with Tab handle, which is welded on the orifice plate and engraved with following information on the upstream of the tab handle:
  - Tag number,
  - Diameter (mm) of orifice,

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- Nominal pipe size (in.),
- ANSI flange rating, materials,
- DP Range and meter Flow Range
- “UPSTREAM” (or “UP”).

- Meter Run: For line sizes 1-1/2” and below, prefabricated meter runs (conical entrance orifices, corner taps) shall meet the requirements of ISO5167 additional  $\pm 0.5\%$  uncertainty. ISO 5167 requirements shall also apply to dimensions, surface finish, tolerances, and straightening vanes e.g: internal pipe finish/welds shall be ground flush on the entries to inline flowmeters. Sizing shall be as per ASME MFC-14M. The meter run, plate and carrier ring shall be manufactured from 316 stainless steel unless compatibility with the flowing medium requires a higher alloy.
- Orifice plate bores shall be calculated so that the maximum flow is below full scale and normal flow is at approximately 70 to 80% of full scale. All flow calculations shall confirm to the requirements of ISO 5167. Base conditions shall be referenced to 1.03 Bara and 15.6°C.
- Rangeability of orifice plate shall be 3:1 normally and 5:1 for non-critical services.
- Instrument tapping connection shall be 1/2” NPT(F) for normal service and 3/4” NPT(F) tapping for congealing, viscous and high pressure, steam services. Tapping connection shall be screwed and seal welding.
- Closed- couple installation is preferred for high viscous services, or hydrocarbons containing water.

## **7.2. Restriction Orifice Plate**

- Restriction Orifice plate shall be designed according to ISO 5167. Restriction orifice shall be single or multiple steps depending on the required  $\Delta p$  reduction. Detailed sizing and dimensional drawing for all Multi-stage restriction orifice shall be furnished.
- The pressure drop across a single restriction orifice should not exceed 50% of inlet pressure.
- Unless otherwise specified, restriction orifice plates shall be concentric square edge type
- All Restriction orifice plates and carrier construction materials shall be in accordance with Piping Material specification and shall be 316 stainless steel as a minimum.
- Each restriction orifice plate shall have an integral handle, which upon assembly shall extend by minimum of 50mm beyond flange edge.
- Where the restriction orifice plate is to be mounted between ring-type joint flanges, plate shall be supplied with a plate-carrying holder.
- Where multi-stage restriction orifice plate assembly considered based on process condition, Multistage device shall be supplied as a complete assembly with orifice plates, spool piece and flanges duly welded. The orifice plate design shall be either of the concentric or eccentric type. The number of stages of orifice plates shall be calculated based upon the process condition.
- In multi-element restriction orifice installations, the plates are placed approximately one pipe diameter from one another in order to prevent pressure recovery between the plates.
- In addition, the following guideline shall be considered:

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- Special care shall be taken for high pressure drops to limit the noise level or where a risk of cavitation / vibration could occur,
- Special design should be required such as Multi-stages orifice.

10. The noise limit for all restriction orifice plates, operating under normal operation, on a continuous basis, shall be 85 dB (A) Sound Pressure Level at 1 metre from the downstream or upstream from the orifice plate flange and at 1 metre from the outer wall of the pipe.

11. As a minimum bore diameter shall not be less than 3mm.

### 7.3. Venturi Tube

1. Venturi tube shall be selected where system requires Low pressure drops, slurries, dirty fluids and non-viscous fluids application.
2. The venturi tube shall be a "Classical" venturi tube as defined in ISO 5167 Part-4. Beta ratio shall be within the limits as defined in ISO 5167.
3. Venturi tube material (throat, divergent and convergent section), flange material shall be as per Piping material specification.
4. Venturi - "As Cast" convergent section shall be considered for use for pipe diameter between 100 & 800 mm with beta ratio shall be as per ISO 5167 for high pressure application.
5. Venturi - "Machined" convergent section shall be considered for use for pipe diameter between 50 & 250 mm with beta ratio shall be as per ISO 5167 for general service application.
6. Venturi - "Rough welded sheet Iron" convergent section shall be considered for use for pipe diameter between 200 & 1200 mm with beta ratio shall be as per ISO 5167 for air duct application.
7. The divergent section of the venturi shall have an included angle of 7° to 8° in order to minimize the permanent pressure loss. And convergent section shall be 21° +/- 1°
8. Venturi meter pipe internal, concentricity, etc., shall conform to the requirement of ISO 5167.
9. For the liquid, steam or condensable vapour lines taps shall be horizontal and for gas application taps shall be vertical on top. The number of tapping for the venturi/ piezometric ring tube shall be as indicated in the specification sheet. Other aspects of the pressure tapping shall be as in accordance with ISO 5167.
10. Venturi tubes, with square or rectangular cross section for air duct service, shall be manufactured with appropriate thickness. Material shall be as per datasheet.
11. Unless otherwise specified on Data Sheet, the differential pressure taps shall be ½" NPT threaded.
12. The following information shall be stamped on the outside of the venturi tube:
  - Tag Number
  - Upstream side or flow direction
  - Throat diameter



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- Material of construction
- Meter (flow) range & DP range

#### **7.4. Flow Nozzle**

1. As a minimum requirement, ISO 5167 standard shall be complied with for all Flow Nozzles. ASME PTC 6 shall be complied with for specific Flow nozzles (if any) with high accuracy requirements.
2. The Flow nozzles shall be of long radius, weld in type (suitable for welding with the associated branch pipe). The design and manufacture of the flow nozzles shall be as per ISO 5167. Beta ratio shall be calculated based on process condition and same shall be validated for suitability of the selected design for the specified application. Vent holes, if required for the specified duty shall be located at the top and drain holes at the bottom of the nozzle.
3. The Flow nozzles shall be constructed of stainless steel type SS 316 unless specified in datasheet.
4. The Flow nozzles shall be supplied as complete assemblies, along with duly machined branch pipes, having proper end connection for welding on to the associated pipe at site. Welding shall be done as per the relevant ANSI practice in line with the main piping.
5. Each flow nozzle assembly shall be provided with minimum three pairs of pressure tapping complete with associated root valves, suitable for the service conditions. D & D/2 pressure tapping shall be provided on the branch pipe.
6. Extra pressure tapping (other than the three-tapping's mentioned above) shall be provided in case to case basis for a specific project (if required).
7. Unless otherwise specified, the differential pressure taps shall be ½" NPT threaded.
8. Associated accessories for this extra tapping like root valve, nipple and expander shall be considered.
9. Each flow nozzle assembly shall also be provided with a suitable nameplate, with tag number and duty.
10. Marking: Each flow element assembly shall be identified with the following information:
  - Tag Number
  - Service
  - Element Material
  - Beta ratio
  - Line size & thickness
  - Direction of flow

#### **7.5. Averaging Pitot Tube / Annubar**

1. Averaging pitot tube shall be considered for low pressure loss, high velocity steam, large diameter lines and air ducts. Annubar should not be used in water applications
2. The flow sensor shall be a continuous averaging velocity head producing type of pitot tube with four or more equal annubar sensing ports or continuous slots to suit line velocity profile. The sensor shall also incorporate a rear port for the measurement of line static pressure.

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3. The sensor shall be designed to provide a non-clog design and shall be able to provide a uniform flow pattern around the sensor to ensure accurate differential pressure consistently.
4. Unless otherwise specified, averaging pitot tube shall be of flanged construction with process flange connection shall be of 3" size. The average pitot tube shall be of SS 316 material as a, shall be provided with end support wherever required.
5. Contractor shall provide a special weldolet along with weld neck flange with inner diameter to suit the outer diameter of averaging pitot tube. The material and rating of weldolet and flange shall be as per Piping specification.
6. Clean out plugs shall be provided as standard with all averaging pitot tubes.
7. Insert - Retraction arrangement with 3" size full port ball valves shall be provided for the averaging pitot tube installation.
8. The insert retract mechanism shall be hand crank type allow on line removal and insertion of the average pitot tube under full pressure condition within the line. Gear operated insert-retract mechanism shall be provided when required.
9. Material of construction of the instrument parts shall withstand the corrosive and other adverse influence of medium and its service conditions. Suitable protection against vibration, pulsation, erosion, corrosion etc. shall be provided without sacrificing consistent accuracy and reliability.
10. The packing gland material shall be PTFE for process temperature up to 200°C. For higher process temperatures, grafoil or graphite shall be used as gland packing material. Use of gland packing material of asbestos or asbestos bearing materials is prohibited.
11. Contractor shall perform vibration analysis for each averaging pitot tube element for the indicated flow conditions to ensure that the quoted averaging pitot tube is of sufficient thickness and strength to withstand the vibration effects created due to karman vortex shedding in the fluid stream.
12. The free end of the average pitot tube shall be pressure supported at the pipe wall. However, for the large pipe sizes and where vibration analysis recommends the requirement of end support or where specifically indicated in the purchaser's datasheet, the end support/weld cap support shall be provided.
13. Performance of averaging pitot tube shall have the accuracy inclusive of repeatability and hysteresis shall be  $\pm 1\%$  of actual value and Repeatability shall be  $\pm 0.1\%$  of actual value.
14. Unless otherwise specified on Specification Sheets, the pressure taps shall be 1/2" threaded NPT. The isolation valves with 316 Stainless Steel construction shall be provided for each pressure tap.
15. Averaging pitot tube shall have a stainless-steel nameplate, permanently attached with following data. Manufacturer's name, Instrument type and size, Model and serial numbers, Operating condition, e.g., pressure, Instrument range & the specified instrument Tag nos.

#### **7.6. Elbow Meter**

1. Elbow meter shall be used for flow measurement for Slurry service.
2. Elbow meters operate on the principle that when liquid travels in a circular path, centrifugal force is exerted along the outer edges. Thus, when liquid flows through a pipe elbow, the force on the elbow's

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interior surface is proportional to the density of the liquid times the square of its velocity. In addition, the force is inversely proportional to the elbow's radius.

3. Any 90° pipe elbow can serve as a liquid flowmeter. All that is required is the placement of two small holes in the elbow's midpoint (45° angle for a 90° Elbow) for piezometer taps. Pressure-sensing lines can be attached to the taps.
4. Material of construction shall be as per piping specification.
5. Elbow meter shall have a stainless-steel nameplate, permanently attached with following data Manufacturer's name, Instrument type and size, Model and serial numbers, Operating condition, e.g., pressure, Instrument range & the specified instrument Tag nos.

## 8. SPECIAL INSTRUCTIONS

Selection of the correct model numbers for the flow elements shall be entirely the responsibility of the Contractor, if any discrepancies are found between model numbers and specifications of offered devices at any stage after placement of LOI/order, same shall be rectified by Contractor without any price and time implications.

Unused electrical cable entries shall be plugged with recessed head screw in full compliance with the applicable explosion proof classification and ingress protection level of the respective component.

### 8.1. NDE & NDT Requirements

Flow element body and flanges shall be subject to NDE/NDT in accordance with ASME B16.34. Piping specification shall be followed for NDE requirement like Radiography (RT), Ultrasonic Testing/magnetic Particle Testing (MT), Dye Penetration Test etc.

### 8.2. PMI Requirements

PMI shall be performed for alloy metal parts as per approved Positive Material Identification Procedure.

### 8.3. Sour and HIC service / NACE Requirements

In case of Sour and HIC service, the valve materials must meet the specific requirements hardness, radiography and other testing requirements, as per NACE MR-0103 latest edition.

### 8.4. Hydrogen Service Requirement

Flow element used in Hydrogen Service must be certified for the use in Hydrogen service, specifically Hydrogen diffusion problems. Reference list, along-with performance feedback shall be furnished.

For hydrogen service the flow meter shall meet all the material and testing requirements such as Helium leak test etc.

### 8.5. Indian Boiler Regulation (IBR) Requirements

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For applications involving Steam, the manufacturer must furnish the IBR form IIIC certification duly approved by IBR authority.

### 8.6. Painting Requirement

External surfaces preparation and painting system shall be suitable for the specified conditions. The painting colour shall be as per datasheet

### 8.7. PTR Requirement

Supplied Flow elements shall be rugged in design and must be well proven in the hydrocarbon industry. Proto type design or equipment's of experimental nature or design undergoing testing etc. shall not be acceptable. Following criteria must be applied before selecting the flow element.

"The Flow elements as being offered/supplied should have been operating satisfactorily in a hydrocarbon industry like refinery, petrochemical and gas processing plant under similar process conditions for at least 8000 hours from the bid opening."

Contractor shall furnish reference list along-with with performance feedback in support of the above requirement.

## 9. NAMEPLATE

Each flow element shall have a stainless-steel nameplate attached firmly to it at a visible place, furnishing the following information:

- Tag number as per data sheets.
- Manufacturer's model number and serial number.
- Manufacturer's name/trade mark.
- Nominal end connection size in inches and rating in lbs (#) and material.
- Flow element material.
- Area classification in which the equipment can be used (For Electronic transmitter).
- Enclosure type (For Electronic transmitter)
- DP Range and Flow meter range and unit of measurement of flow.


The specified instrument identification numbers or Tag number shall be provided with a corrosion resistant metal identification plate attached to the element body by means of rivets or screws which do not affect the pressure retaining capabilities.

A warning label (white letters on red background) shall be provided on each terminal box cover, engraved with the following warning (as applicable):

"This terminal box may contain supplies several sources. All the supplies must be isolated before removing the cover." Within the terminal compartment, all terminals shall be clearly identified.

## 10. INSPECTION AND TESTING

- Testing and inspection for all items shall be carried out as per approved factory testing procedures.

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- 2) Unless otherwise specified, Owner/Consultant reserves the right to test and inspect all the items at the manufacturer's works, in line with inspection test plan for flow element.
- 3) Contractor shall submit following test certificates and test reports:
  - a) Material test certificate as per clause 3.1B of EN10204.
  - b) Certificate from statutory body for intrinsic safety and explosion proof enclosures.
  - c) Type test certificate for weatherproof enclosures.
  - d) Certificate of radiography/X-ray for weld joints, wherever specified. Dye penetration check shall also be carried out for all weld joints.
  - e) Hydrostatic test reports as per clause 12.1 of this specification.
  - f) Flow calibration and performance test report including calibration factors for each element as per clause 12.2 of this specification.
  - g) Capability of smart and field bus based transmitters to accept multimasters for configuration, calibration, diagnostics and maintenance (as applicable).
  - h) Configuration, calibration and diagnostics check through hand held configurator / field bus tester for smart / field bus based instruments (as applicable).
  - i) Configuration, calibration and diagnostics check through field bus configurator for field bus based instruments (as applicable)
  - j) Dimensional test report for each flow element.
- 4) The Flow elements and its components shall be suitable for the design pressure and temperature conditions indicated in the data sheet. Indigenous make, Flow elements shall be calibrated at NABL Accredited Lab like FCRI, Palakkad in India and the calibration of Flow elements shall be certified by Third Party Agencies like EIL/Lloyds/BV. However, imported make Flow elements shall be calibrated at the respective foreign Bidder's works, duly accredited by the respective country's well known Accreditation authority like PTB, SGS etc. and the same shall be certified by well-known third party agencies like SGS, LRIS, and DNV etc.
- 5) A 5 year rate contract to be firmed up with vendor for calibration of MFMs at FCRI (including transportation from/to Owner's site to/ from FCRI) and stamping of custody transfer meters.
- 6) The complete Instrument shall be tested at factory to demonstrate proper functioning and inspection release note shall be obtained from purchaser/client.

#### **10.1. Hydrostatic Test**

Each Flow elements shall be subjected to hydrostatic test at test pressure equal to 1.5 times the maximum allowable working pressure at ambient temperature in accordance with ANSI B 16.34. There shall not be any visible leakage during the test.

#### **10.2. Calibration**


Each Flow elements shall be calibrated with the fluid for which it is expected to be used. Else Contractor must indicate;

- a. Fluid used for calibration
- b. The correction factor / adjustment required for the actual process fluid.

#### **10.3. Witness Inspection**

All Flow elements shall be offered for pre-dispatch inspection, for the following as a minimum:

- a. Physical dimensional verification and workmanship.
- b. Hydrostatic test as per clause 12.1 of this specification on representative sample.

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- c. Performance testing including establishing accuracy and repeatability over the entire range and calibration testing, on the representative samples.
- d. Capability of smart and field bus based transmitters to accept multimasters for configuration, calibration, diagnostics and maintenance.
- e. Configuration, calibration and diagnostics check through hand held configurator / field bus tester for smart / field bus based instruments.
- f. Configuration, calibration and diagnostics check through field bus configurator for field bus based instruments.
- g. Review of all certificates and test reports as indicated in clause 12 of this specification.

In the event when witness inspection is not carried out by purchaser, the tests shall be any way completed by the Contractor and the documents for the same shall be submitted to purchaser for scrutiny.

## 11. SPARE

For Spare Philosophy for Instrumentation items, refer Mandatory spare part list attached in the ITB documents.

## 12. SHIPPING

1. It is the responsibility of the contractor to ensure that the equipment is adequately protected and packed to meet the shipping and delivery requirements. The equipment may be stored outdoor for long period before installation. Packing shall be suitable for outdoor storage in the area with heavy rains and high ambient temperature.
2. Machined surface which may be exposed to the atmosphere in the transit and subsequent storage shall be properly protected with an easily removeable rust preventing coating of the proper consistency applied by the manufacturer, but not until inspection.
3. All threaded and flanged openings shall be suitably protected to prevent entry of foreign material. Temporary plugs used should be readily distinguishable from permanent metal plugs.
4. The flow elements and its accessories shall be packed separately.
5. Each individual carton or box shall be marked with the flow element tag numbers on the top and side of the carton.
6. Flow elements shall be packed as per vendor recommended 'Packing & Storage Procedure'. The flow elements and the accessories shall all be tagged properly. Vendor shall furnish above procedure for contractor's information for Site Storage.

## 13. DOCUMENTATION

Following are the drawings and documents required to be submitted for the Flow elements, as a minimum:

1. Data sheets for each flow element.
2. Dimensional Drawings of flow element with weight.
3. Curves for flow measurement vs. accuracy and rangeability.
4. Maximum and minimum supply voltage required for the instrument to function within the stated performance characteristics. (as applicable)
5. Reference list with proven track record (for 8000 hrs. in operation)



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6. Dimensions of clearance space required for maintenance work
7. Lifting Instruction
8. Wiring diagram including terminal numbers and cable type (as applicable)
9. Copy of type test certificates.
10. Copy of the test certificates for all tests.
11. Installation procedure.
12. Calibration and maintenance procedure including replacement of its parts/internals wherever it is applicable
13. Minimum straight length requirement for upstream and downstream

All the documents shall be A4 or A3 size only; all the document prints larger than A4 shall be folded to A4 size with identification data visible at the bottom right.

All the documents submitted shall be checked & approved by Contractor, unchecked document will be returned un-reviewed & Contractor will be responsible for the delay.



Any revision to a document after its first submission shall be clearly identified on the documents in the revision box at the right bottom.

All the documents submitted shall be clearly marked with following information: -





TechnipFMC India Ltd Project No. – 080557C001  
 Enquiry reference Material Requisition no. & item no. And equipment identification tag no.  
 Contractor's Job No., Document no. and revision no.

#### **14. GUARANTEE AND WARRANTY**

1. Contractor shall warranty the supply against defective materials, design and workmanship.
2. Contractor shall guarantee the performance of the flow element at site, for the specified time specified elsewhere.
3. Equipment performance shall be guaranteed in accordance with requirements of applicable specifications and codes at conditions indicated in relevant specification.
4. If the stated performances are not achieved, Contractor shall, at his own expenses, make necessary repairs, modifications and replacements to the supply to enable the performance to be achieved.

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## ORIFICE PLATES, FLANGES AND THERMOWELL DIMENSIONAL DETAILS

			 <small>Geetanjali Subramanian Paradip 2020.06.11 18:28:28 +05'30'</small>	 <small>Shyam Sunder Kumar 2020.06.11 18:37:18 +05'30'</small>	 <small>Suman Sarikatsanayakam 2020.06.11 12:03:07 +05'30'</small>	 <small>Mukundkishor Jaiswal 2020.06.12 00:25:08 +05'30'</small>
B	11-06-2020	ISSUED FOR DESIGN	SGR	KRS	SS	JMC
A	14-11-2019	ISSUED FOR DESIGN	CRK	KRS	SS	JMC
<b>REV.</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>PREPARED</b>	<b>CHECKED</b>	<b>APPROVED</b>	<b>AUTHORIZED</b>

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 	<b>PROJECT</b>		<b>Standby SRU &amp; Additional Tanks</b>	
	<b>CLIENT</b>		<b>IOCL Paradip Refinery</b>	
<b>ORIFICE PLATES FLANGES AND THERMOWELL DIMENSIONAL DETAILS</b>		<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-000-STC-1580-005	<b>Rev. No.</b> B
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## 1. INTRODUCTION:

**INDIAN OIL CORPORATION LIMITED (IOCL)** has awarded Fax of Acceptance (FOA) dated 29<sup>th</sup> August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

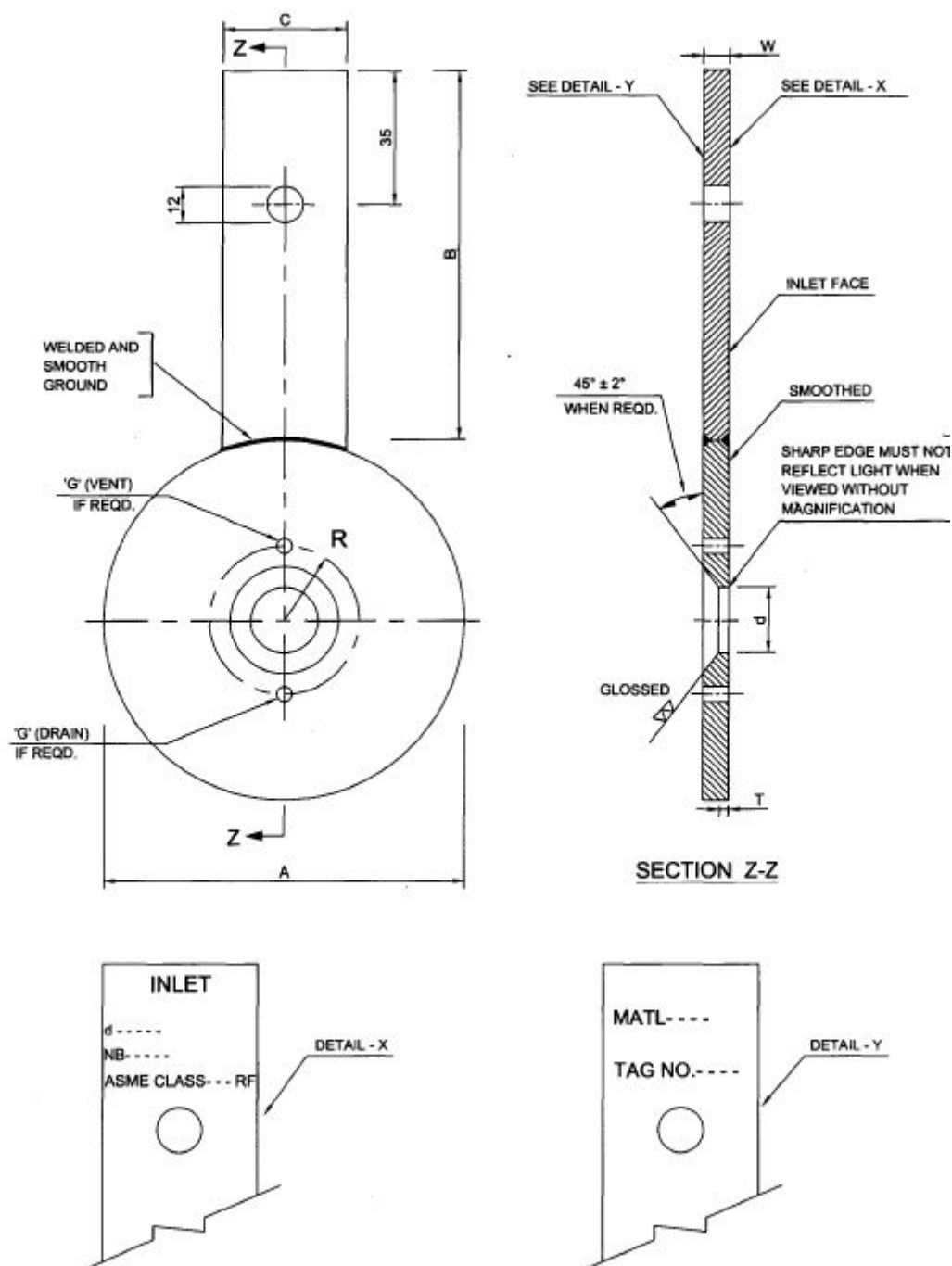
## 2. DEFINITIONS & ABBREVIATIONS

Abbreviation	Definition /Expanded form
IOCL/ CLIENT	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
UNIT	Indicates any portion of the project to be built which can be Process related or Utilities/Offsites related

		PROJECT	Standby SRU & Additional Tanks		
		CLIENT	INDIAN OIL CORPORATION LIMITED		
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### 3. ORIFICE PLATES AND FLANGES DIMENSIONAL DETAILS

#### 3.1 CONCENTRIC SQUARE EDGED ORIFICE PLATE

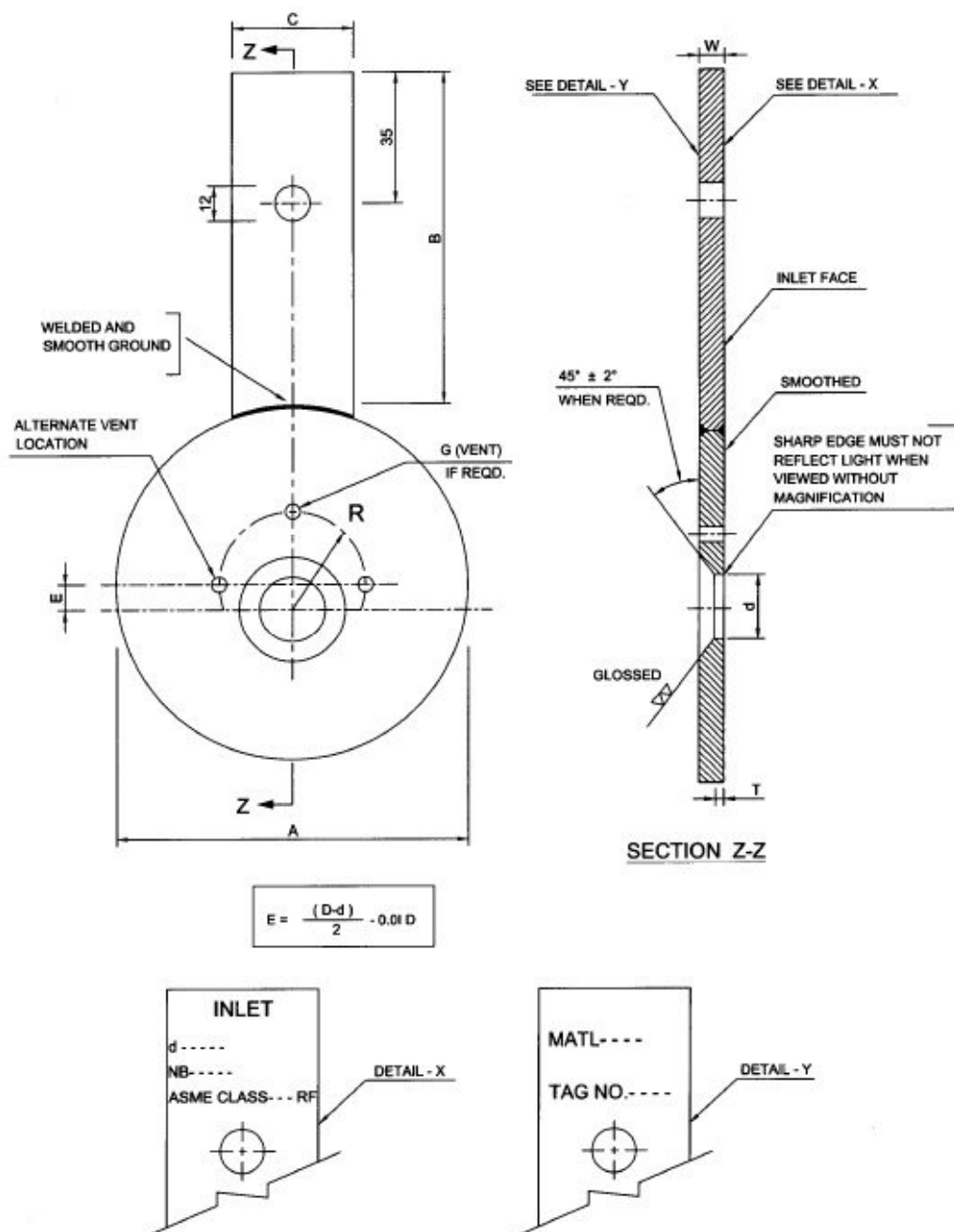


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				IOCL Paradip Refinery		
			CLIENT	INDIAN OIL CORPORATION LIMITED		
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### 3.2 ECCENTRIC ORIFICE PLATE



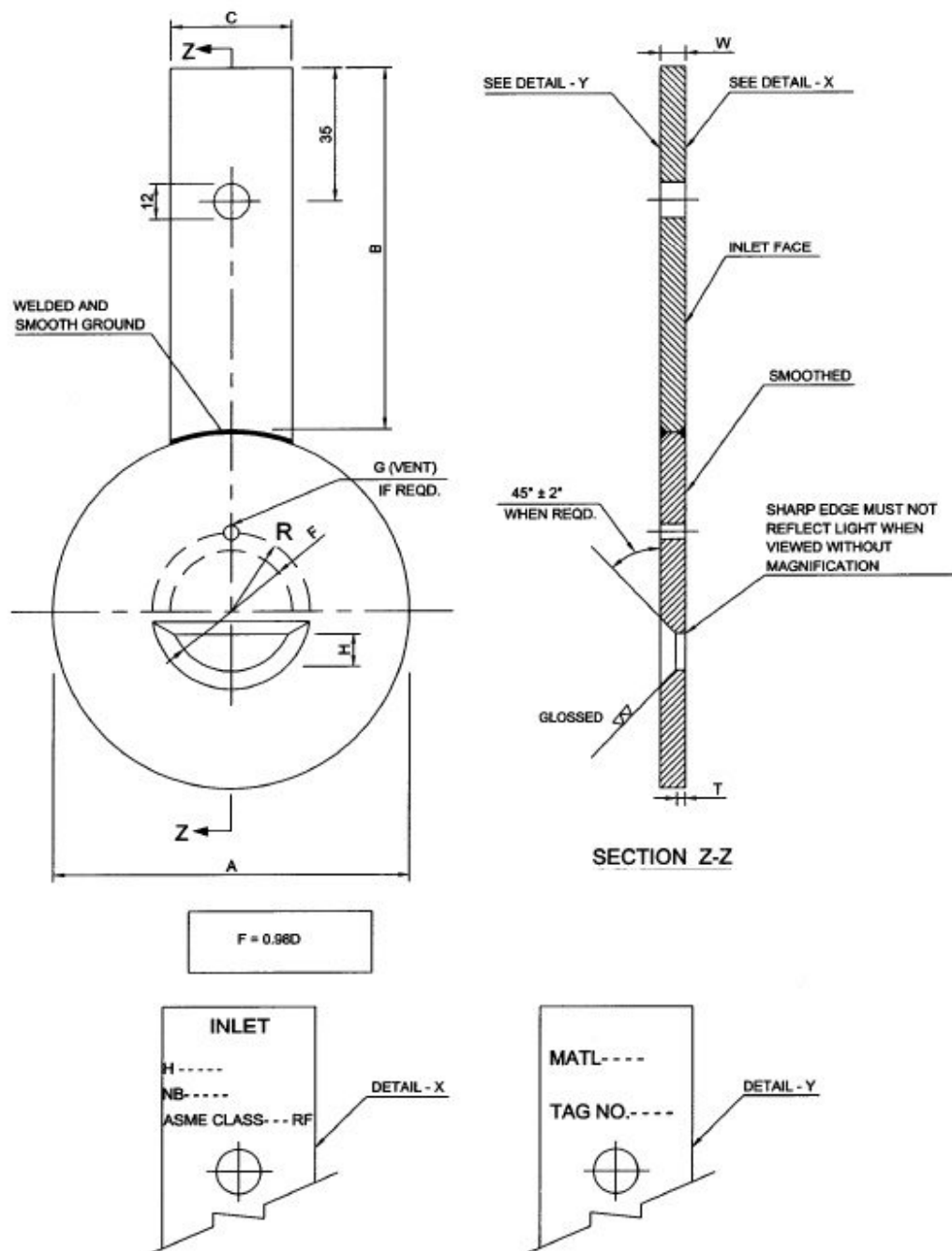
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### 3.3 SEGMENTAL ORIFICE PLATE

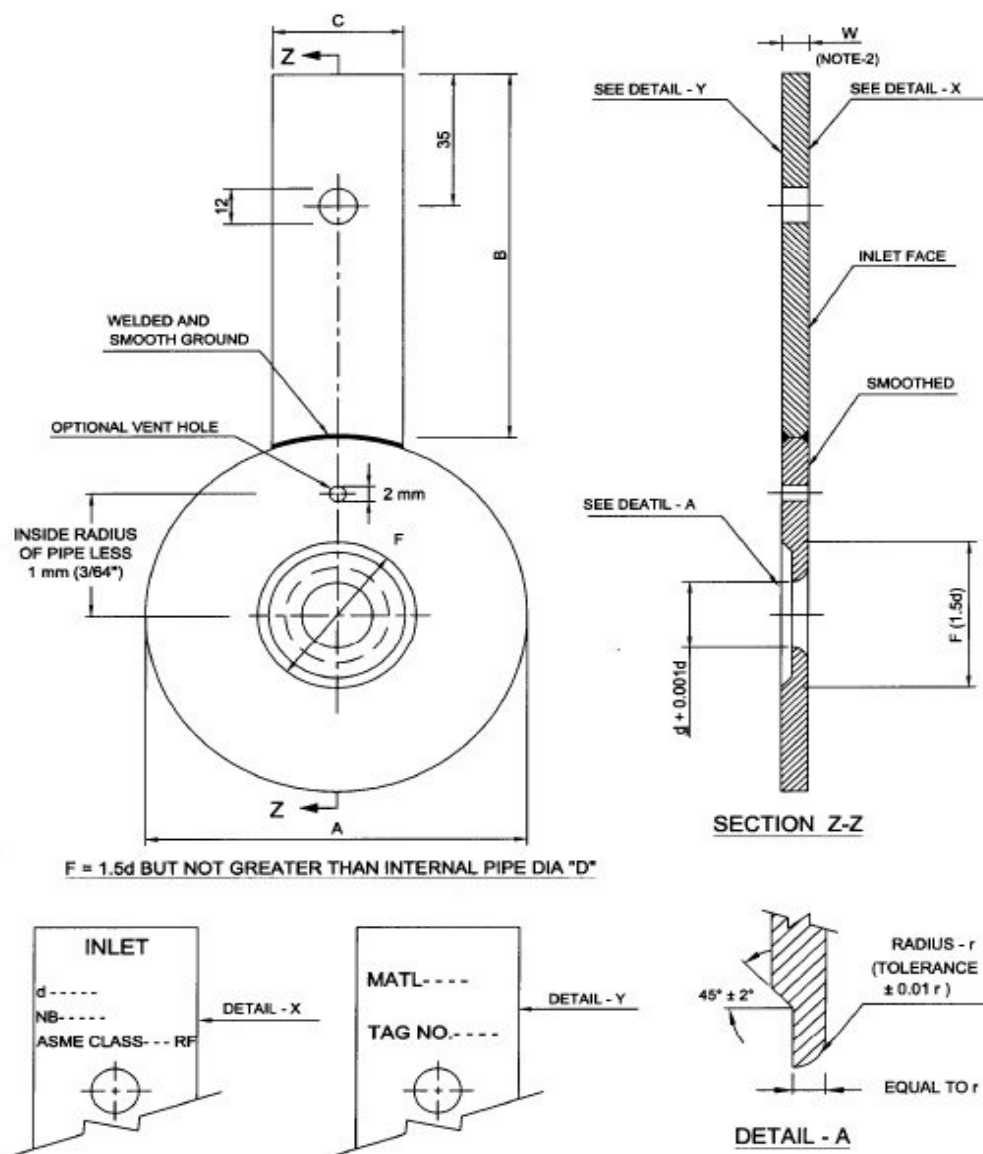


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### 3.4 QUADRANT EDGE ORIFICE PLATE



#### NOTE:

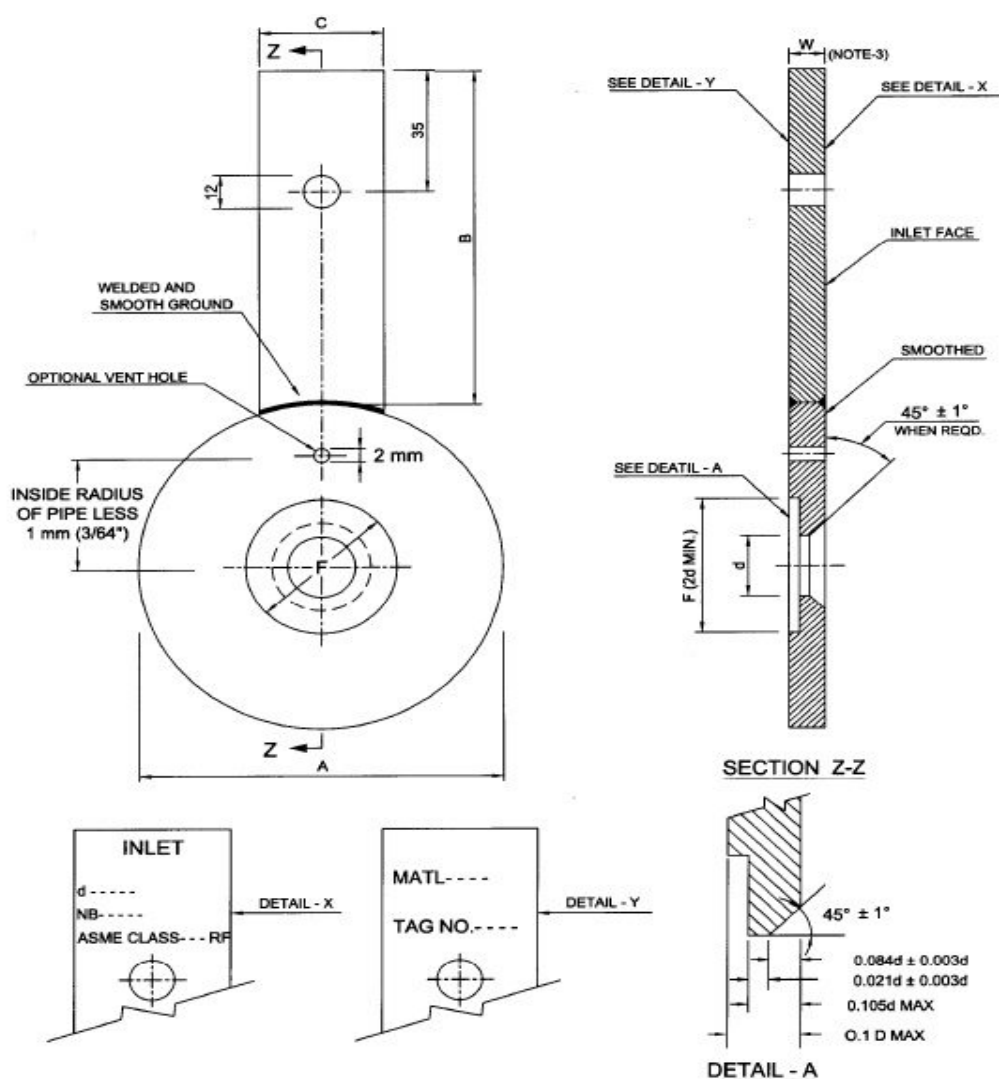
1. DIMENSIONS A, B, C ARE SAME AS SQUARE EDGE ORIFICE PLATES.
2. 'W' SHALL NOT BE LESS THAN 2.54 mm AND SHALL NOT EXCEED 0.1D WHERE THE RADIUS 'r' OF THE UPSTREAM PROFILE EQUALS OR EXCEEDS 0.1D (WHERE IS THE CASE WHEN  $\beta \geq 0.571$  OR  $m \geq 0.325$ ), 'W' SHALL BE REDUCED FROM 'r' TO 0.1D BY REMOVING METAL FROM THE UPSTREAM FACE.

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### 3.5 CONICAL ENTRANCE ORIFICE PLATE



#### NOTES:

1. DIMENSIONS A, B, C ARE SAME AS SQUARE EDGE ORIFICE PLATES.
2. DIMENTION 'd' SHALL NOT BE LESS THAN 0.25" AND NOT GREATER THEN 0.316D.
3. DIMENSION 'W' SHALL BE GENERALLY SAME AS FOR SQUARE EDGE ORIFICE PLATES AND SHALL CONFORM 'W' SHALL NOT EXCEED 0.1D WHERE D IS THE INTERNAL DIAMETER OF UPSTREAM PIPE LINE.  
(ALL RATING AS PER ASME CLASS)

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### 3.6 DIMENSTIONS TABLE

Nominal Bore		A ± 0.40							Rating 125# TO 2500#						
									≤ 315 °C			> 315 °C			
		Rating							W	TOLE R. Limits	T + 0.0 - 0.25	W	TOLE R. Limits	T + 0.0 - 0.25	
mm	Inch	125# 150#	250# 300#	400#	600#	900#	1500#	2500#							
25	(1)	66.7	73.0	73.0	73.0	79.4	79.4	85.7	3.18	+0.12	See Note – 1	0.51	6.35	± 0.25	See Note – 1
40	(1.5)	85.7	95.3	95.3	95.3	98.4	98.4	117.5	3.18			0.76	6.35		
50	(2)	104.8	111.1	111.1	111.1	142.9	142.9	146.1	3.18			0.79	6.35		
80	(3)	136.5	149.2	149.2	149.2	168.3	174.6	196.9	3.18			0.79	6.35		
100	(4)	174.6	181.0	177.8	193.7	206.4	209.6	235.0	3.18	-0.25		1.59	9.52		
150	(6)	222.3	250.8	247.7	266.7	288.9	282.6	317.5	3.18			1.59	9.52		
200	(8)	279.4	308.0	304.8	320.7	358.8	352.4	387.4	3.18			3.18	12.7		
250	(10)	339.7	362.0	358.8	400.1	435.0	435.0	476.3	6.35			3.18	12.7		
300	(12)	409.6	422.3	419.1	457.2	498.5	520.7	549.3	6.35	±0.25		3.18	12.7		
350	(14)	450.8	485.8	482.6	492.1	520.7	577.9		6.35			3.18	12.7		
400	(16)	514.4	539.8	536.6	565.2	574.7	641.4		9.52			6.35	12.7		
450	(18)	549.3	596.9	593.7	612.8	638.2	704.9		9.52			6.35	12.7		
500	(20)	606.4	654.1	647.7	682.6	698.5	755.7		9.52			6.35	12.7		
550	(22)	660.4	704.9	701.7	733.4				9.52			6.35	12.7		
600	(24)	717.6	774.7	768.4	790.6	838.2	901.7		9.52			6.35	12.7		

Nominal Bore		B - 0 +10							C ± 0.4	R
		Rating							Rating	
		125# 150#	250# 300#	400#	600#	900#	1500#	2500#	125# to 600# to 400# to 2500#	
mm	Inch	88	88	88	88	100	100	100	30	$R = \frac{(D - G)}{2}$
25	(1)									
40	(1.5)									
50	(2)									
80	(3)									
100	(4)									
150	(6)		100	100	100	114	114	114	40	
200	(8)									
250	(10)									
300	(12)									
350	(14)									
400	(16)		114	114	127	127	152	152	50	
450	(18)									
500	(20)									
550	(22)									
600	(24)									

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d		
From	To	TOLER.
<6.350		0.007
6.350	9.525	0.013
9.526	12.700	0.015
12.701	15.875	0.020
15.876	19.050	0.023
19.051	22.225	0.025
22.226	25.400	0.030
25.401	31.750	0.036
31.751	38.100	0.043
38.101	44.450	0.051
44.451	127.000	0.064
>127.000		0.0005 x d

G		
≤d		C
From	To	± 0.05
<25.400	-	-
25.400	88.900	2.38
88.901	104.775	3.18
104.776	127.000	3.97
127.001	152.400	4.76
152.401	171.450	5.56
171.451	190.500	6.35
190.501	212.725	7.14
212.726	234.950	7.94
234.951	254.000	8.73
254.001	276.225	9.53
276.226	295.275	10.32
295.276	317.500	11.11
317.501	336.550	11.91
>336.550		12.70

#### Legend:

D - Internal Diameter of The Pipe  
NB - Nominal Bore  
d - Orifice Bore Diameter

\* All dimensions are in "mm" unless otherwise specified

#### Note:

Values of 'T' shown in this standard are valid for the corresponding 'W' and d/D (β) between 0.25 and 0.70 incl. when the values are not shown and for β <0.25 and β >0.70, 'T' shall be calculated every time and shall not be higher than the smaller of the values resulting from the following ratios: -

$$\frac{d}{8}, \quad \frac{D}{50}, \quad \frac{D-d}{8}$$





### 3.8 DIMENSIONAL DETAILS (IN MM) FOR 300# WELD NECK, RAISED FACE ORIFICE FLANGES



Flange		A	X	O	K	C	Y	f	R	G	No. of Bolt Holes	M	h	P <sub>1</sub>	t	q	U	α°	Weight (Kg)
Rating	NB mm Inch																		
300#	25 (1)	33.5	54.0	124	88.9	38.1	82.6	17.5	50.8	1.6	4	6.4	102.2	12.7	9.5	21.8	19.1	82° 30'	8
300#	40 (1 ½)	48.3	69.9	155.6	114.3	38.1	85.9	20.6	73.2	1.6	4	6.4	133.8	12.7	9.5	21.8	19.1	82° 30'	12
300#	50 (2)	60.5	84.1	165.1	127.0	38.1	85.9	17.5	92.1	1.6	8	6.4	141.3	14.3	12.7	23.8	20.6	45°	15
300#	80 (3)	88.9	117.5	209.6	168.3	38.1	88.9	20.6	127.0	1.6	8	9.5	185.7	14.3	12.7	23.8	20.6	45°	22
300#	100 (4)	114.3	146.1	254.0	200.0	38.1	92.1	20.6	157.2	1.6	8	12.7	230.2	14.3	12.7	23.8	20.6	45°	31
300#	150 (6)	168.4	206.4	317.5	269.9	38.1	100.1	22.4	215.9	1.6	12	12.7	293.7	14.3	12.7	23.8	20.6	60°	45
300#	200 (8)	219.2	260.4	381.0	330.2	41.3	111.2	25.4	269.9	1.6	12	12.7	351.6	15.9	15.9	29.4	25.4	60°	70
300#	250 (10)	273.1	320.7	444.5	387.4	47.8	117.5	28.6	323.9	1.6	16	12.7	411.6	19.1	19.1	32.9	28.6	67° 30'	100
300#	300 (12)	323.9	374.7	520.7	450.9	50.8	130.2	31.8	381.0	1.6	16	12.7	482.2	22.2	22.2	38.5	33.3	67° 30'	150
300#	350 (14)	355.6	425.5	584.2	514.4	54.0	142.9	31.8	412.8	1.6	20	12.7	545.7	22.2	22.2	38.5	33.3	72°	193
300#	400 (16)	406.4	482.6	647.7	571.5	57.2	146.1	35.1	469.9	1.6	20	12.7	603.6	25.4	25.4	44.1	38.1	72°	260
300#	450 (18)	457.2	533.4	711.2	628.7	60.5	158.8	35.1	533.4	1.6	24	12.7	667.1	25.4	25.4	44.1	38.1	75°	340
300#	500 (20)	508.0	587.4	774.7	685.8	63.5	162.1	35.1	584.2	1.6	24	12.7	730.6	25.4	25.4	44.1	38.1	75°	413
300#	550 (22)	558.8	641.4	838.2	743.0	66.7	165.1	41.3	641.4	1.6	24	12.7	783.4	31.8	31.8	54.8	47.6	75°	510
300#	600 (24)	609.6	701.7	914.4	812.8	69.9	168.3	41.3	692.1	1.6	24	12.7	854.1	34.9	31.8	60.3	52.4	75°	618

### 3.9 DIMENSIONAL DETAILS (IN MM) FOR 600# WELD NECK, RAISED FACE ORIFICE FLANGES

A	X	O	K	C	Y	f	R	G	No. of Bolt Holes	M	h	P <sub>1</sub>	t	q	U	α°	Weight (Kg)			
33.5	54.0	124.0	88.9	38.1	82.6	17.5	50.8	1.6	4	6.4	102.2	12.7	9.5	21.8	19.1	82° 30'	8			
48.3	69.9	155.6	114.3	38.1	85.9	20.6	73.2	1.6	4	6.4	133.8	12.7	9.5	21.8	19.1	82° 30'	12			
60.5	84.1	165.1	127.0	38.1	85.9	17.5	92.1	1.6	8	6.4	141.3	14.3	12.7	23.8	20.6	45°	15			
88.9	117.5	209.6	168.3	38.1	88.9	20.6	127.0	1.6	8	9.5	185.7	14.3	12.7	23.8	20.6	45°	22			
114.3	152.4	273.1	215.9	44.5	108.0	25.4	157.2	6.4	8	12.7	234.6	22.2	14.7	38.5	33.3	45°	44			
168.4	222.3	355.6	292.1	54.0	123.8	28.6	215.9	6.4	12	12.7	311.5	25.4	21.1	44.1	38.1	60°	89			
219.2	273.1	419.1	349.3	61.9	139.7	31.8	269.9	6.4	12	12.7	375.0	25.4	21.1	44.1	38.1	60°	130			
273.1	342.9	508.0	431.8	69.9	158.8	35.1	323.9	6.4	16	12.7	463.9	25.4	21.1	44.1	38.1	67° 30'	204			
323.9	400.1	558.9	489.0	73.0	161.9	35.1	381.0	6.4	20	12.7	514.7	25.4	21.1	44.1	38.1	72°	245			
355.6	431.8	603.3	527.1	76.2	171.5	38.1	412.8	6.4	20	12.7	559.2	25.4	21.1	44.1	38.1	72°	312			
406.4	495.3	685.8	603.3	82.6	184.2	41.2	469.9	6.4	20	12.7	636.2	28.6	21.1	49.6	42.9	72°	428			
457.2	546.1	743.0	654.1	88.9	190.5	44.5	533.4	6.4	20	12.7	693.3	28.6	21.1	49.6	42.9	72°	525			
508.0	609.6	812.8	723.9	95.3	196.9	44.5	584.2	6.4	24	12.7	763.2	28.6	21.1	49.6	42.9	75°	650			
558.8	666.8	870.0	777.9	101.6	203.2	47.6	641.4	6.4	24	12.7	820.3	28.6	21.1	49.6	42.9	75°	797			
609.6	717.6	939.8	838.2	108.0	209.6	50.8	692.1	6.4	24	12.7	890.2	28.6	21.1	49.6	42.9	75°	926			

### 3.10 DIMENSIONAL DETAILS (IN MM) FOR 900# WELD NECK, RAISED FACE ORIFICE FLANGES

Flange	NB mm Inch	A	X	O	K	C	Y	f	R	G	No. of Bolt Holes	M	h	P <sub>1</sub>	t	q	U	α°	Weight (Kg)	Flange	
																				Rating	NB mm Inch
25	(1)	33.5	52.4	149.2	101.6	44.5	89.0	25.4	50.8	6.4	4	6.4	116.3	19.1	14.7	32.9	28.6	82° 30'	12	600#	25 (1)
40	(1 ½)	48.3	69.9	177.8	124.0	44.5	95.3	28.6	73.2	6.4	4	6.4	144.9	19.1	14.7	32.9	28.6	82° 30'	16	600#	40 (1 ½)
50	(2)	60.5	104.8	215.9	165.	44.5	108.0	25.4	92.1	6.4	8	6.4	183.0	19.1	14.7	32.9	28.6	45°	29	600#	50 (2)
80	(3)	88.9	127.0	241.3	190.5	44.5	108.0	25.4	127.0	6.4	8	9.5	208.4	19.2	17.9	32.9	28.6	45°	34	600#	80 (3)
100	(4)	114.3	158.8	292.1	235.0	50.8	120.7	31.8	157.2	6.4	8	12.7	253.6	22.2	17.9	38.5	33.3	45°	57		
150	(6)	168.4	235.0	381.0	317.5	61.9	146.1	31.8	215.9	6.4	12	12.7	336.9	25.4	24.2	44.1	38.1	60°	118	600#	100 (4)
																				600#	150 (6)
200	(8)	219.2	298.5	469.9	393.7	69.9	168.3	38.1	269.9	6.4	12	12.7	420.3	28.6	24.2	49.6	42.9	60°	190	600#	200 (8)
250	(10)	273.1	368.3	546.1	469.9	76.2	190.5	38.1	323.9	6.4	16	12.7	496.5	28.6	24.2	49.6	42.9	67° 30'	277	600#	250 (10)
300	(12)	323.9	419.1	609.6	533.4	85.7	206.4	38.1	381.0	6.4	20	12.7	560.0	28.6	24.2	49.6	42.9	72°	345	600#	300 (12)
350	(14)	355.6	450.9	641.4	558.8	92.1	219.1	41.3	412.8	6.4	20	12.7	591.7	28.6	24.2	49.6	42.9	72°	441		
400	(16)	406.4	508.0	704.9	616.0	95.3	222.3	44.5	469.9	6.4	20	12.7	655.2	28.6	24.2	49.6	42.9	72°	545	600#	350 (14)
450	(18)	457.2	565.2	787.4	385.8	108.0	235.0	50.8	533.4	6.4	20	12.7	732.6	31.8	27.4	54.8	47.6	72°	761		
500	(20)	508.0	622.3	857.3	749.3	114.3	254.0	54.0	584.2	6.4	20	12.7	802.5	31.8	27.4	54.8	47.6	75°	927	600#	400 (16)
600	(24)	609.6	749.3	1041.4	901.7	146.1	298.5	66.7	692.1	6.4	20	12.7	986.6	31.8	27.4	54.8	47.6	75°	1697	600#	450 (18)
																				600#	500 (20)
																				600#	550 (22)
																				600#	600 (24)

			
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3.11 DIMENSIONAL DETAILS (IN MM) FOR 900# WELD NECK, RAISED FACE ORIFICE FLANGES

Flange Rating	Flange	A	X	O	K	C	Y	f	R	G	No. of Bolt Holes	M	h	P <sub>1</sub>	t	q	U	α°	Weight (Kg)	Rating
1500#	NB mm Inch	33.5	52.4	149.2	101.6	44.5	89.0	25.4	50.8	6.4	4	6.4	116.3	19.1	22.2	32.9	28.6	82° 30'	12	900#
1500#	25 (1)	48.3	69.9	177.8	124.0	44.5	95.3	28.6	73.2	6.4	4	6.4	144.9	19.1	25.4	32.9	28.6	82° 30'	16	900#
1500#	40 (1 ½)	60.5	104.8	215.9	165.1	44.5	108.0	25.4	92.1	6.4	8	6.4	183.0	19.1	22.2	32.9	28.6	45°	29	900#
1500#	50 (2)	88.9	133.4	266.7	203.2	54.0	123.8	31.8	127.0	6.4	8	9.5	228.2	22.2	28.6	38.5	33.3	45°	55	900#
1500#	80 (3)	114.3	161.9	311.2	241.3	60.3	130.2	34.9	157.2	6.4	8	12.7	272.7	22.2	31.8	38.5	33.3	45°	82	900#
1500#	100 (4)	168.4	228.6	393.7	317.5	88.9	177.8	38.1	215.9	6.4	12	12.7	349.6	25.4	34.9	44.1	38.1	60°	184	900#
1500#	150 (6)	219.2	292.1	482.6	393.7	98.4	219.1	44.5	269.9	6.4	12	12.7	433.0	28.6	41.3	49.6	42.9	60°	286	900#
1500#	200 (8)	273.1	368.3	584.2	482.6	114.3	260.4	50.8	323.9	6.4	12	12.7	534.6	28.6	47.6	49.6	42.9	60°	498	900#
1500#	250 (10)	323.9	450.9	673.1	571.5	130.2	288.9	54.0	381.0	6.4	16	12.7	623.5	28.6	50.8	49.6	42.9	67° 30'	760	900#
1500#	300 (12)	355.6	495.3	749.3	635.0	139.7	304.8	60.3	412.8	6.4	16	12.7	694.5	31.8	53.2	54.8	47.6	67° 30'	1053	900#
1500#	350 (14)	406.4	552.5	825.5	704.9	152.4	317.5	66.7	469.9	6.4	16	12.7	765.2	34.9	63.5	60.3	52.4	67° 30'	1406	900#
																				900#
1500#	400 (16)	457.2	596.9	914.4	774.7	168.3	333.4	73.0	533.4	6.4	16	12.7	854.1	34.9	69.9	60.3	52.4	67° 30'	1836	900#
1500#	450 (18)	508.0	614.4	984.3	831.9	184.2	362.0	79.4	584.2	6.4	16	12.7	923.9	34.9	76.2	60.3	52.4	67° 30'	2324	900#
600 (24)	500 (20)	609.6	762.0	1168.4	990.6	209.6	412.8	92.1	692.1	6.4	16	12.7	1108.1	34.9	88.9	60.3	52.4	67° 30'	3749	

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### 3.12 ALLOWABLE TOLERANCES FOR WELD NECK RAISED FACE ORIFICE FLANGES ACCORDING TO ASME B16.36 / B16.5

Dimensions		Tolerances
O	$\leq$ 609.6 mm	$\pm 1.59$ *
	$>$ 609.6 mm	$\pm 3.18$ *
C	NB $\leq$ 450 (18)	+ 3.18 - 0
	NB $>$ 450 (18)	+ 4.76 - 0
X	$\leq$ 609.6 mm (24)	$\pm 1.59$ *
	$>$ 609.6 mm (24)	$\pm 3.18$ *
A	NB $\leq$ 125 (5)	+ 2.38 - 0.79
	NB $\geq$ 150 (6)	+ 3.96 - 0.79
Y	NB $\leq$ 250 (10)	$\pm 1.59$
	NB $\geq$ 300 (12)	$\pm 3.18$
Drilling	K	$\pm 1.59$
	Centres between holes	$\pm 0.79$
R	FOR G = 1.6 mm	$\pm 0.79$
	FOR G = 6.4 mm	$\pm 0.40$
Eccentricity between K & R diameters		$\pm 0.79$
Eccentricity between K & D diameters		$\pm 0.79$ *
Eccentricity between R & D diameters		$\pm 0.79$ *
D	NB $\leq$ 150 (6)	$\pm 0.12$ *
	NB 200 & 250 8 & 10	+ 0.12 * - 0.25 *
	NB 300 (12)	+ 0.12 * - 0.38 *
	NB 350 & 400 (14 & 16)	+ 0.12 * - 0.50 *
	NB $\geq$ 450 (18)	+ 0.12 * - 0.76 *

\* Not covered by ASME B16.5

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### 3.13 STUD BOLTS DETAILS FOR RAISED FACE FLANGES

DIMENSIONS AS SHOWN

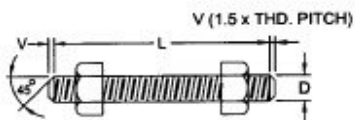
THREAD : ASME B 1.1

FOR D"  $\leq 1$  - UNC - 2A

FOR D"  $\geq 1 \frac{1}{8}$  - 8 UN - 2A

CONSTRUCTION

FORGED, BAR STOCK



D mm (Inches)	THREAD PITCH	V	2V *
15.9 (5/8)	UNC	2.309	3.46
19.0 (3/4)		2.54	3.78
22.2 (7/8)		2.822	4.23
25.4 (1)		3.175	4.76
$\geq 28.6$ (1 1/8)	8 UN	3.175	4.76

\* APPROXIMATE VALUE OF THE TWO BEVELS

(ALL RATING AS PER ASME CLASS)

DIAMETER (NB,D) mm (INCHES) & LENGTH - (L) IN mm (NOTE-1)									
RATING		300		600		900		1500	
DIM.	N B	D	L	D	L	D	L	D	L
25	(1)	15.9 (5/8)	127	15.9 (5/8)	127	22.2 (7/8)	152	22.2 (7/8)	152
40	(1 1/2)	19.0 (3/4)	133	19.0 (3/4)	133	25.4 (1)	159	25.4 (1)	159
50	(2)	15.9 (5/8)	127	15.9 (5/8)	127	22.2 (7/8)	152	22.2 (7/8)	152
80	(3)	19.0 (3/4)	133	19.0 (3/4)	133	22.2 (7/8)	152	28.6 (1 1/8)	184
100	(4)	19.0 (3/4)	133	22.2 (7/8)	152	28.6 (1 1/8)	178	31.7 (1 1/4)	203
150	(6)	19.0 (3/4)	133	25.4 (1)	178	28.6 (1 1/8)	203	34.9 (1 3/8)	266
200	(8)	22.2 (7/8)	146	28.6 (1 1/8)	203	34.9 (1 3/8)	229	41.3 (1 5/8)	298
250	(10)	25.4 (1)	165	31.7 (1 1/4)	222	34.9 (1 3/8)	241	47.6 (1 7/8)	343
300	(12)	28.6 (1 1/8)	178	31.7 (1 1/4)	229	34.9 (1 3/8)	260	50.8 (2)	381
350	(14)	28.6 (1 1/8)	191	34.9 (1 3/8)	248	38.1 (1 1/2)	282	57.1 (2 1/4)	418
400	(16)	31.7 (1 1/4)	203	38.1 (1 1/2)	266	41.3 (1 5/8)	295	63.5 (2 1/2)	458
450	(18)	31.7 (1 1/4)	209	41.3 (1 5/8)	286	47.6 (1 7/8)	333	69.8 (2 3/4)	503
500	(20)	31.7 (1 1/4)	216	41.3 (1 5/8)	298	50.8 (2)	355	76.2 (3)	548
600	(24)	38.1 (1 1/2)	241	47.6 (1 7/8)	337	63.5 (2 1/2)	445	88.9 (3 1/2)	623

TOLERANCES ON 'L'

L-LENGTH mm	$\leq 305$	310 TO 455	$\geq 455$
TOLERANCE mm	- 0 + 1.6	- 0 + 3.2	- 0 + 6.4

NOTE:

- FOR BOLT DIAMETER 1" (25 mm) & ABOVE IN EACH RATING, FOLLOWING SHALL BE CONSIDERED TO TAKE CARE OF BOLT TENSIONING.
  - ONE EXTRA NUT SHALL BE CONSIDERED FOR EACH BOLT/STUD.
  - BOLT/STUD LENGTH SHALL BE INCREASED BY ONE DIAMETER.



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### 3.14 DIMENSIONAL DETAILS OF SEMI-FINISHED SQUARE HEAD, FULL THREAD, JACK SCREW

DIMENSIONS : ASME B 18.2.1

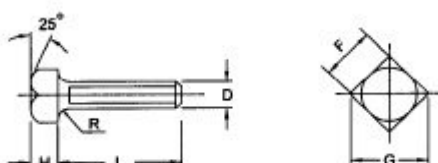
CONSTRUCTION : FORGED, BAR STOCK

TOLERANCES : ASME B 18.2.1 ASME B 1.1

THREAD : ASME B 1.1

FOR D" ≤ 1 - UNC - 2A

FOR D" ≥ 1 1/8 - 8 UN - 2A



D mm (Inches)	F	G mm		H mm	R mm
		MAX.	MIN.		
9.5 (3/8)	14.3	20.2	19.0	6.4	0.8
11.1 (7/16)	15.9	22.5	21.0	7.5	0.8
12.7 (1/2)	19.1	26.9	25.3	8.3	0.8
15.9 (5/8)	23.8	33.7	31.6	10.7	1.6
19.1 (3/4)	28.6	40.4	37.9	12.7	1.6
22.2 (7/8)	33.3	47.1	44.2	15.1	1.6
25.4 (1)	38.1	53.9	50.6	16.7	2.4
28.6 (1 1/8)	42.9	60.6	56.9	19.1	2.4
31.8 (1 1/4)	47.6	67.4	63.2	21.4	2.4
38.1 (1 1/2)	57.2	80.8	75.8	25.4	2.4

(ALL RATING AS PER ASME CLASS)

DIAMETER (NB,D): mm (INCHES) AND LENGTH - (L) IN mm									
RATING		300		600		900		1500	
DIM.	N B	D	L	D	L	D	L	D	L
25	(1)	9.5 (3/8)	75	9.5 (3/8)	75	15.9 (5/8)	90	15.9 (5/8)	90
40	(1 1/2)	9.5 (3/8)	75	9.5 (3/8)	75	15.9 (5/8)	90	15.9 (5/8)	90
50	(2)	11.1 (7/16)	85	11.1 (7/16)	85	15.9 (5/8)	100	15.9 (5/8)	100
80	(3)	11.1 (7/16)	85	11.1 (7/16)	85	15.9 (5/8)	100	19.1 (3/4)	115
100	(4)	11.1 (7/16)	85	19.1 (3/4)	100	19.1 (3/4)	110	19.1 (3/4)	120
150	(6)	11.1 (7/16)	90	22.2 (7/8)	115	22.2 (7/8)	130	22.2 (7/8)	160
200	(8)	12.7 (1/2)	100	22.2 (7/8)	130	25.4 (1)	140	25.4 (1)	170
250	(10)	15.9 (5/8)	110	22.2 (7/8)	135	25.4 (1)	145	25.4 (1)	190
300	(12)	19.1 (3/4)	115	22.2 (7/8)	140	25.4 (1)	155	25.4 (1)	215
350	(14)	19.1 (3/4)	120	22.2 (7/8)	140	25.4 (1)	165	28.6 (1 1/8)	235
400	(16)	22.2 (7/8)	130	25.4 (1)	155	25.4 (1)	170	31.8 (1 1/4)	255
450	(18)	22.2 (7/8)	130	25.4 (1)	160	28.6 (1 1/8)	200	31.8 (1 1/4)	275
500	(20)	22.2 (7/8)	140	25.4 (1)	165	28.6 (1 1/8)	205	31.8 (1 1/4)	295
550	(22)	28.6 (1 1/8)	155	25.4 (1)	180	-	-	-	-
600	(24)	31.8 (1 1/4)	160	25.4 (1)	185	28.6 (1 1/8)	240	31.8 (1 1/4)	315

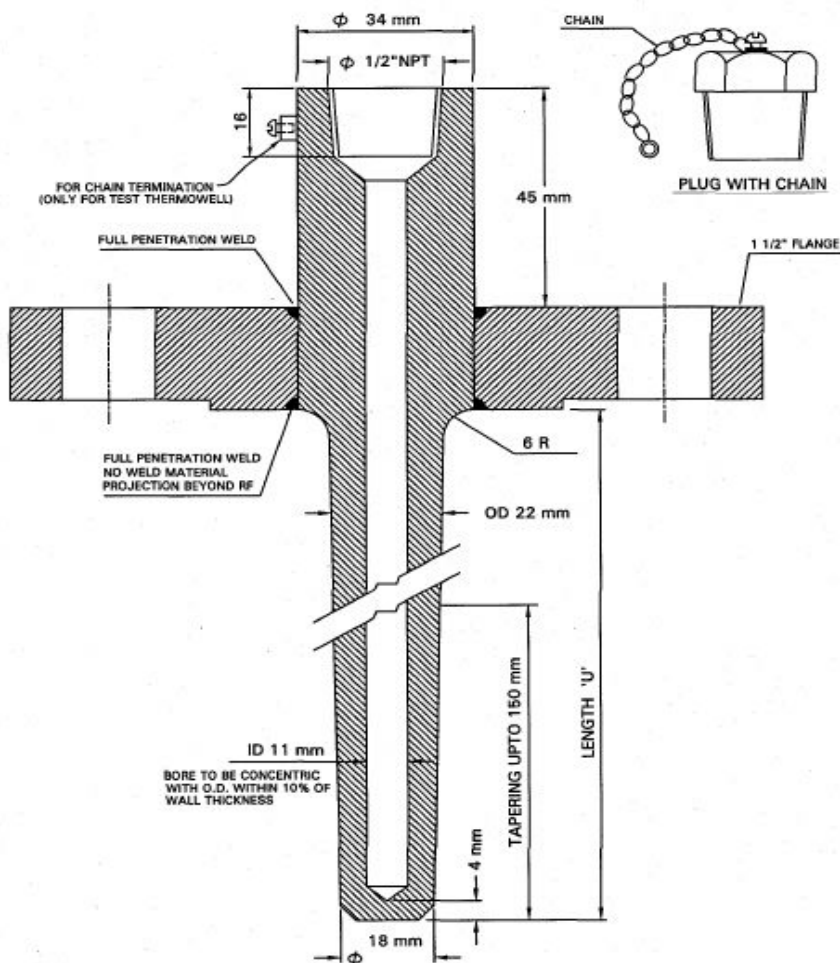
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#### 4. THERMOCOUPLE / RTD ASSEMBLY WITH THERMOWELL

##### 4.1 THERMOWELL FOR DUPLEX ELEMENT



#### NOTES:

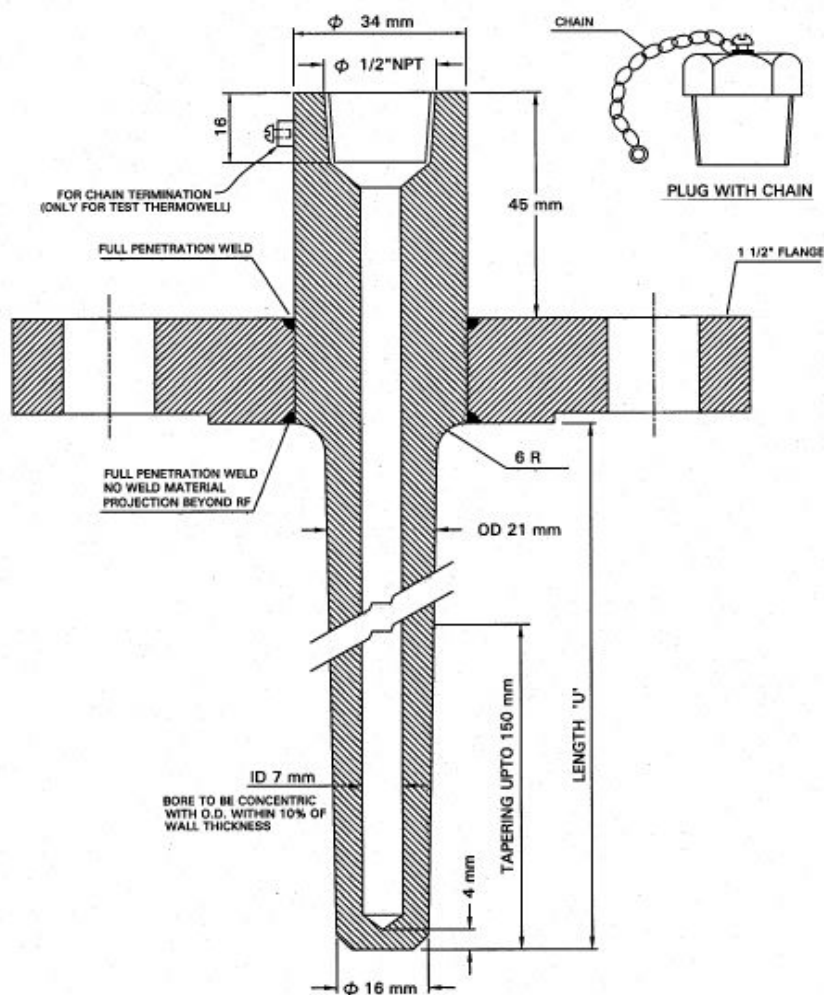
- THIS STANDARD IS APPLICABLE FOR;
  - TEMPERATURE GAUGES, BEADED TEMPERATURE ELEMENTS AND DUPLEX TEMPERATURE ELEMENT.
  - THERMOWELL UPTO 1500# ANSI RATING OR EQUIVALENT.
- TYPE OF FLANGE SHALL BE RTJ TYPE FOR ANSI RATING > 600#.
- DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS.
- CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.

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## 4.2 THERMOWELL

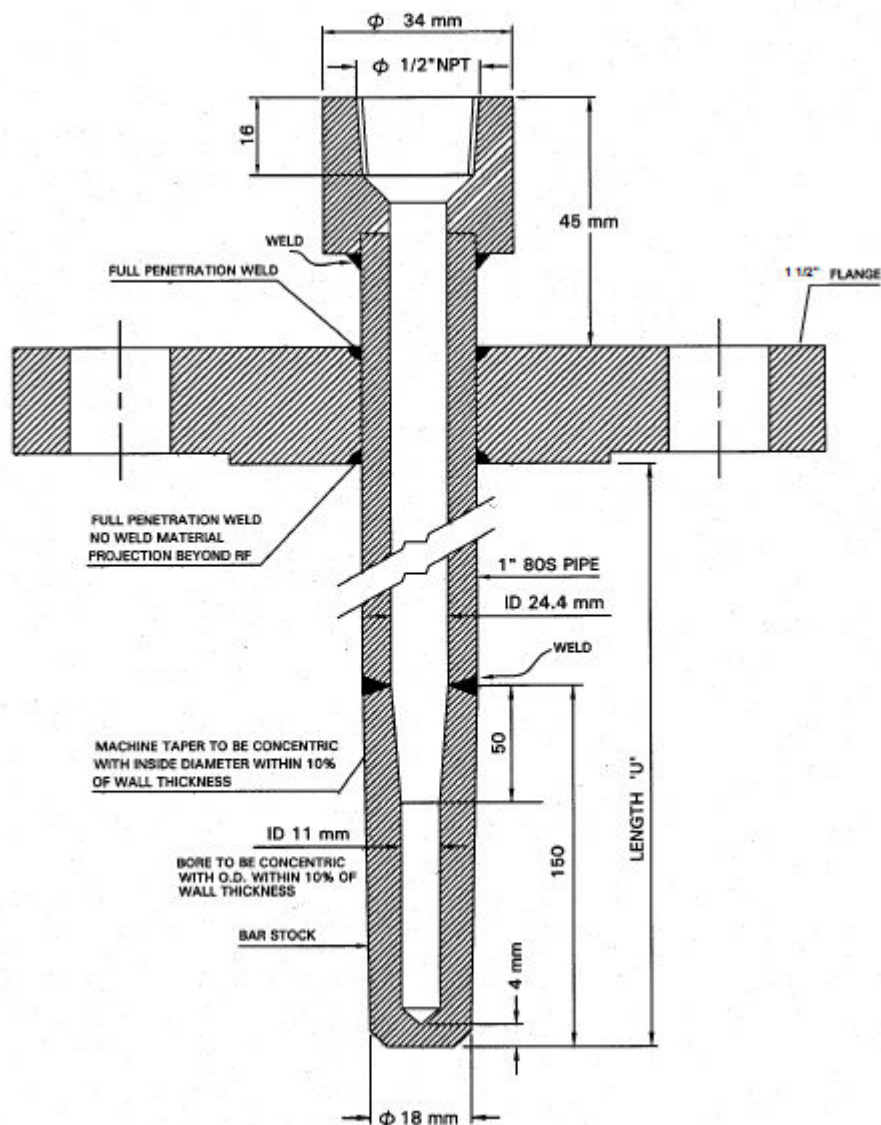


### NOTES:

- THIS STANDARD IS APPLICABLE FOR;
  - SINGLE TEMPERATURE ELEMENT.
  - THERMOWELL UPTO 1500# ANSI RATING OR EQUIVALENT.
- TYPE OF FLANGE SHALL BE RTJ TYPE FOR ANSI RATING > 600#.
- DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS.
- CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.

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#### 4.3 BUILT-UP THERMOWELL

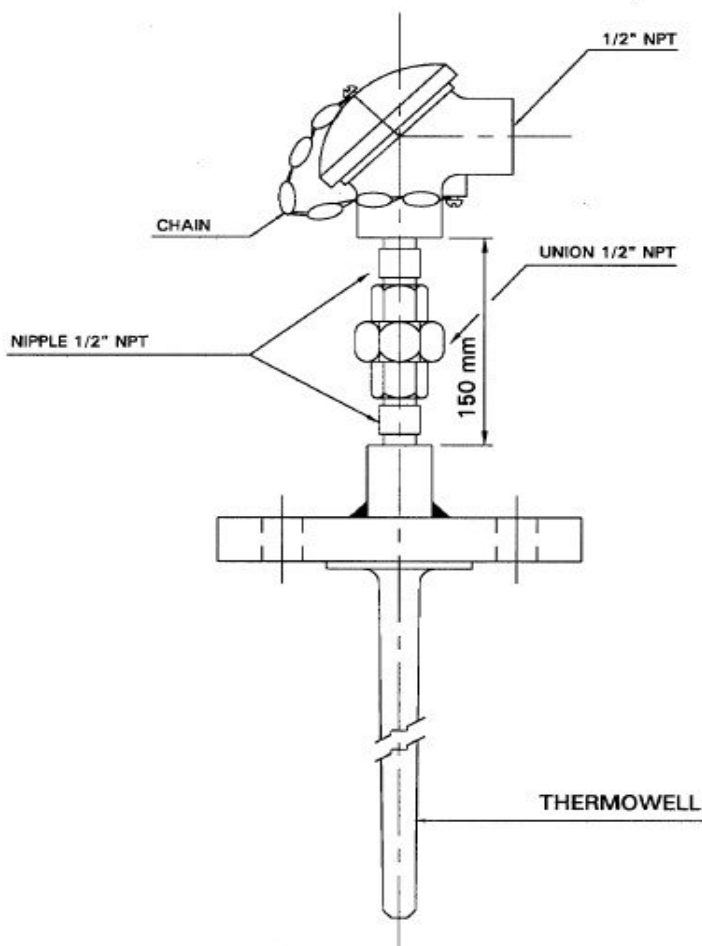


#### NOTES:

1. TYPE OF FLANGE SHALL BE RTJ TYPE FOR ANSI RATING > 600#.
2. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS.

 	<b>PROJECT</b>		<b>Standby SRU &amp; Additional Tanks</b>	
	<b>CLIENT</b>		<b>INDIAN OIL CORPORATION LIMITED</b>	
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#### 4.4 THERMOCOUPLE / RTD ASSEMBLY WITH THERMOWELL



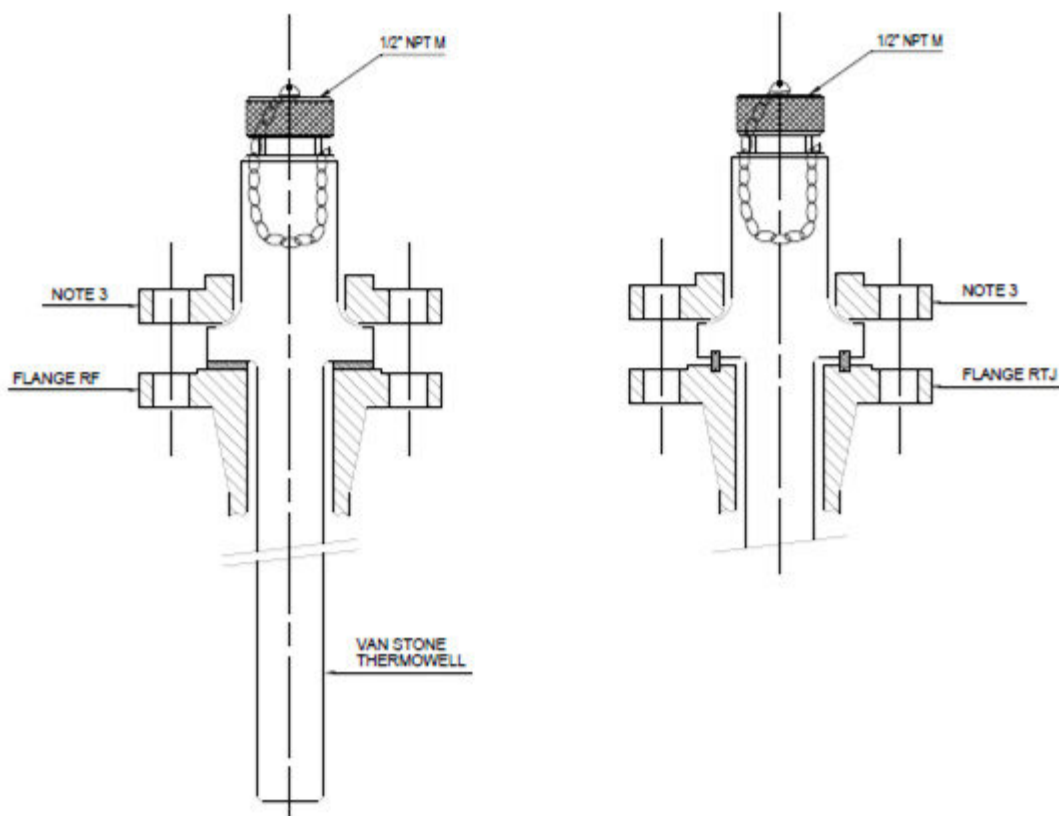
#### **NOTES:**

1. IN THE CASE OF DUPLEX THERMOCOUPLE/RTD, TWO INDEPENDENT CABLE ENTRIES SHALL BE PROVIDED.



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#### 4.5 VAN STONE THERMOWELL (>600#)



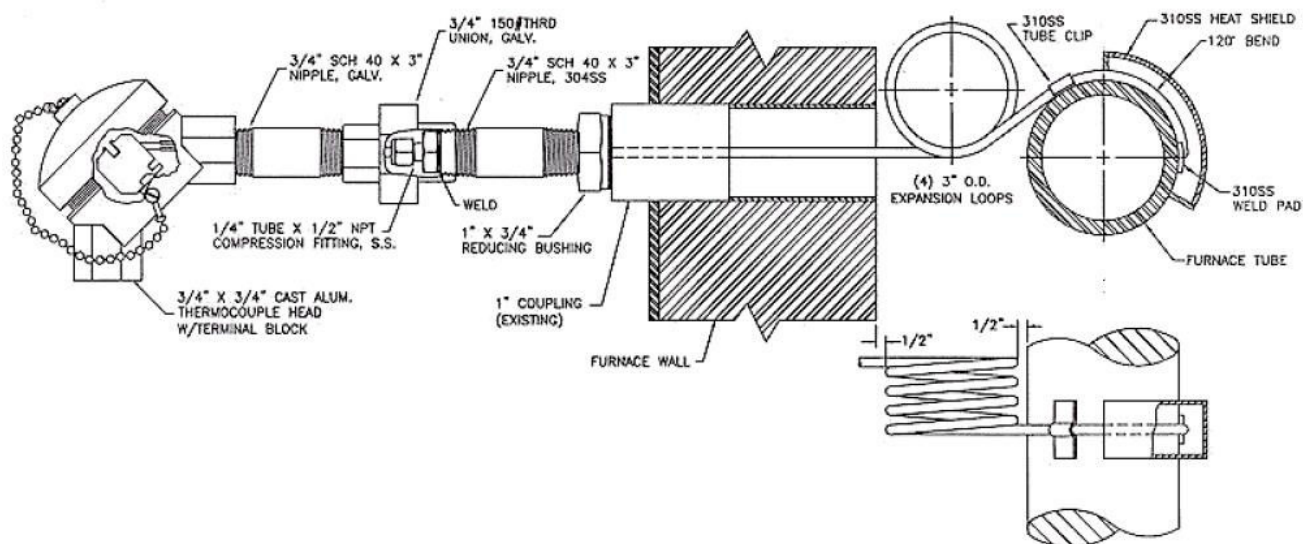
#### **NOTES:**

1. FOR PLUG AND CHAIN MATERIAL REFER TO THERMOWELL DATASHEET
2. FLANGE DN40 WHEN TW IS CONNECTED TO PIPING AND DN50 WHEN TW IS CONNECTED TO VESSEL.
3. LAP FLANGE AS PER ASME B16.5.



 <b>TechnipFMC</b>		<b>PROJECT</b>	<b>Standby SRU &amp; Additional Tanks</b>		
			<b>IOCL Paradip Refinery</b>		
		<b>CLIENT</b>	<b>INDIAN OIL CORPORATION LIMITED</b>		
<b>ORIFICE PLATES FLANGES AND THERMOWELL DIMENSIONAL DETAILS</b>	<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-000-STC-1580-005	<b>Rev. No.</b> B	Page 24 of 24	

#### 4.6 TUBE SKIN THERMOCOUPLE ASSEMBLY



#### NOTES:

1. THIS DRAWING IS ONLY TYPICAL. THE DIMENSSIONS SHALL BE DECIDED DURING DETAILED ENGINEERING BASED ON VESSEL DIMENSSIONS.

**VENDOR LIST  
(INSTRUMENTATION)  
CENTRIFUGAL VERTICAL PUMPS**

**DOCUMENT NO.  
B366-088-16-51-MD-1005  
REV.A  
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**VENDOR LIST (INSTRUMENTATION)**  
**CENTRIFUGAL VERTICAL PUMPS**

Sl No. 5.34 : ORIFICE PLATES & FLANGES		
Supplier Code	Supplier Name	Country
<b>Approved Suppliers</b>		
1	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	India
2	CAMERON CANADA CORPORATION	International
3	COMFIT & VALVES PVT. LTD.	India
4	DANIEL MEASUREMENT & CONTROL ASIA PACIFIC	India/ International
5	EUREKA INDUSTRIAL EQUIPMENTS (P) LTD.	India
6	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	India
7	GURU NANAK ENGG WORKS	India
8	HYDROPNEUMATICS PVT. LTD.	India
9	INSTRUMENTATION LTD. (PALGHAT)	India
10	MICRO PRECISION PRODUCTS PVT LTD	India
11	MINCO (INDIA) PVT LTD (GEN. INST.)	India
12	PETROL VALVES SRL	International
13	PIETRO FIORENTINI SPA	International
14	STAR-MECH CONTROLS (INDIA) PVT LTD	India
15	TM TECNOMATIC SPA	International

# VENDOR DATA REQUIREMENTS FOR VERTICAL CENTRIFUGAL PUMPS (MOLTEN SULPHUR)

A			-NA-	-NA-	-NA-
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

## VENDOR DATA REQUIREMENTS

The following drawings/documents marked "✓" shall be furnished by the bidder.

### CENTRIFUGAL PUMPS - VERTICAL

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	General Arrangement & Foundation drawing showing arrangement of main equipment skid as well as all associated equipment (pump, motor etc.) along with interface connections, maintenance space, table of termination points etc. as well as details of foundation bolts, their location, foundation bolt pocket dimensions, foundation load data (static & dynamic), recommended grout thickness.		✓		✓	
2.	Precommissioning & commissioning procedures for the complete pump package			✓	✓	
3.	Data Sheets alongwith performance curves - Pump	✓	✓		✓	
4.	GAD - Gear box / Couplings / Fluid coupling			✓	✓	
5.	Test Procedure(s) : Performance Test, NPSH Test		✓		✓	@
6.	List of Mandatory Spares (indicating exact name of the part, part no. and material of construction)	✓	✓		✓	
7.	Quotation for recommended spare parts for two years of normal operation (indicating exact name of the part, part no. and material of construction)	✓		✓	✓	
8.	List of recommended commissioning spares (indicating exact name of the part, part no. and material of construction)	✓		✓	✓	
9.	List of recommended Special Tools & Tackles (indicating exact name of the part and part no.)	✓		✓	✓	
10.	List of Deviations to specifications/datasheets/standards of MR	✓				
11.	Filled in experience record proforma for main equipment and its driver	✓				
12.	Duly filled-in check list scope of supply (as applicable)	✓				
13.	Tabulation of Utility consumption data including electric load data, schedule of lubricants, chemicals & consumables with specifications	✓		✓	✓	
14.	List of loose supply items in vendor's scope, to be installed in purchaser's piping			✓	✓	
15.	P&ID for Pump Jacketing System		✓		✓	
16.	Test Procedure(s) : Witness tests as specified in data sheets / other specs enclosed in the inquiry / MR or as required by approved ITP/QAP			✓	✓	@

**VENDOR DATA REQUIREMENTS  
FOR  
VERTICAL CENTRIFUGAL PUMPS  
(MOLTEN SULPHUR)**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
17.	Curve for pump power-shaft speed v/s torque superimposed over motor power-shaft speed v/s torque			✓	✓	
18.	Installation, Operation & Maintenance manuals - Pump			✓	✓	
19.	Cross Sectional Drawings (with Bill of Materials & Part Nos.) for Pump			✓	✓	

**Notes :**

1. "TICK" denotes applicability
2. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
3. All post order documents shall be submitted / approved through EIL eDMS portal
4. Final documentation shall be submitted in hard copy (Six prints) and soft ( two CDs/DVDs ) in addition to submission through EIL eDMS.
5. Refer - 6-78-0001: Specification for quality management system from Bidders.
6. Refer - 6-78-0003: Specification for documentation requirement from Suppliers.
7. Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
8. "@" indicates submission of documents to Inspection Agency.
9. Bill of Material shall form part of the respective drawing.
10. "TICK" denotes applicability.
11. All post order documents shall be submitted / approved through EIL eDMS portal.
12. All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
13. Document for analysis of delay in delivery of the entire package will be identified during post order stage.

# **VENDOR DATA REQUIREMENTS FOR VERTICAL CENTRIFUGAL PUMPS**

A	06-APR-2021	Issued with MR	GCS	AR	SV
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by



## VENDOR DATA REQUIREMENTS

The following drawings/documents marked "✓" shall be furnished by the bidder.

### MV MOTOR

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Schedule of Vendor Documents		✓		✓	
2.	Data Sheets (Duly filled-in)		✓		✓	
3.	Dimensional/Assembly Drawings : GA Drawing For motors < 75kW			✓		
4.	Dimensional/Assembly Drawings : GA Drawing For motors >= 75kW		✓			
5.	Dimensional/Assembly Drawings : Installation Plan/Mounting Details			✓	✓	
6.	Dimensional/Assembly Drawings : Terminal Box Arrangement			✓	✓	
7.	Dimensional/Assembly Drawings : Name Plate Drawing			✓	✓	
8.	Performance Curves : Speed Torque Curves			✓	✓	
9.	Performance Curves : Speed-Current/Time Curves			✓	✓	
10.	Performance Curves : Thermal Withstand Curves (Hot & Cold)			✓	✓	
11.	Performance Curves : P.f. & Efficiency Curves			✓	✓	
12.	Inspection & Test Plan (ITP)		✓		✓	Refer Note-8
13.	Test Records				✓	
14.	Type Test Certificates for similar equipment			✓	✓	
15.	List of Commissioning Spares			✓		
16.	List of Maintenance Spares			✓		
17.	List of Mandatory Spares			✓		
18.	List of Special Tools & Tackles			✓		
19.	Data Books/ Manuals : Installation Manual			✓	✓	
20.	Data Books/ Manuals : Operating/ Maintenance Manual				✓	
21.	Data Books/ Manuals : Catalogues/ Brochures				✓	
22.	Equipment storage procedure at site				✓	

#### Notes :

1. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).

- 
2. All post order documents shall be submitted / approved through EIL eDMS portal and HMEL TDMS.
  3. All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
  4. Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
  5. Bill of Material shall form part of the respective drawing.
  6. All technical details and documents furnished with bids shall be treated as data for engineering. These shall however be subject to Purchasers review after order placement and bidder shall comply to MR/Tender requirements without any cost & time implication to EIL/Owner.
  7. Vendor to submit all record category documents directly to site with one copy through eDMS and shall proceed further without waiting for comments from EIL/Owner.
  8. All inspection related documents (QA/QC/ITP) shall be submitted to Third party inspection authority (TPIA).
  9. Final documentation shall be submitted to site in-charge in hard copy (Six prints) and soft ( two CDs/DVDs ) in addition to submission through EIL eDMS.

# **VENDOR DATA REQUIREMENTS FOR VERTICAL CENTRIFUGAL PUMPS**

A	19-APR-2021	Issued for Bids	VK	JJ	AR
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

## VENDOR DATA REQUIREMENTS

The following drawings/documents marked "✓" shall be furnished by the bidder.

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Drawing and Document Schedule		✓		✓	
2.	Sub-Vendor List for Instruments and accessories			✓	✓	
3.	Instrument Specification / Datasheets with model decoding		✓		✓	Note-8
4.	Instrument Sizing calculations		✓		✓	
5.	General Arrangement Drawings (GAD) of instruments			✓	✓	
6.	Instrument Installation Drawings			✓	✓	
7.	Certificate (Statutory / Test/ calibration/ inspection)			✓	✓	
8.	Complete catalogues with part list for all vendor supplied instruments			✓	✓	
9.	Installation, Operation and Maintenance Manuals			✓	✓	
10.	Spare part list for Mandatory Spares		✓		✓	
11.	Spare part list for 2 years operation as per vendor recommendation	✓		✓	✓	



### Notes :

- "TICK" denotes applicability.
- Post order, drawing / document review shall commence only after approval of Document Control Index (DCI). The schedule of submission shall be as per approved DCI during detail engineering adhering to the required time schedule submission of the document.
- All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances
- All inspection related documents (QA/QC/ITP) shall be submitted to Third Party Inspection Agency (TPIA).
- Final documentation shall be submitted to site in-charge in hard copy (Six prints) and soft ( two CDs/DVDs ).
- Post order- The schedule of drawing / data submission shall be mutually agreed between Purchaser & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
- All technical details and documents furnished with bids shall be treated as data for engineering. These shall however be subject to Purchaser's review after order placement and bidder shall comply to MR/Tender requirements without any cost & time implication to Purchaser.
- Vendor shall generate and submit all instrument datasheets using Intergraph Smart Plant Instrumentation

**VENDOR DATA REQUIREMENTS  
FOR  
VERTICAL CENTRIFUGAL PUMPS**

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(SPL) as per the job specifications mentioned in the MR.

 	<b>PROJECT</b>		<b>Standby SRU &amp; Additional Tanks</b>	
	<b>CLIENT</b>		<b>IOCL Paradip Refinery</b>	
<b>INSPECTION AND TEST PLAN FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS</b>		<b>Project No.</b> 080557C001	<b>Document No.</b> 080557C-000-ITP-0910-001	<b>Rev. No.</b> C
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# INSPECTION AND TEST PLAN FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS

## INSPECTION CATEGORY: 2

REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED
C	10-Jun-2020	REISSUED FOR BID	RS	GM	AA	JMC
B	10-Jan-2020	ISSUED FOR BID	RS	GM	AA	JMC
A	03-Dec-2019	ISSUED FOR BID	RS	GM	AA	JMC

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 	PROJECT	Standby SRU & Additional Tanks IOCL Paradip Refinery		
	CLIENT	INDIAN OIL CORPORATION LIMITED		
INSPECTION AND TEST PLAN FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS	Project No. 080557C001	Document No. 080557C-000-ITP-0910-001	Rev. No. C	Page 2 of 9

## 1. SCOPE

This Inspection and Test Plan is an engineering document which defines for each type of equipment:

- the type and extent of CONTRACTOR (third party whose services are obtained for performing the works specified as part of LSTK/packages) involvement in Inspection and testing and documentation review.
- the type and extent of PMC (Project Management Consultant) and OWNER (IOCL) involvement in each phase of fabrication, control and testing requiring an inspection or a record review
- the resulting Vendor's contractual obligations, in accordance with applicable Project General Purchase Conditions. (Vendor shall mean third party supplying the equipment/materials.)

**Note:** The Inspection and Test Plan may under no circumstances be used as a substitute to the Vendor's Fabrication and Quality Control Plan.

## 2. GENERAL DEFINITIONS

Abbreviation	Definition /Expanded form
IOCL/CLIENT/ OWNER	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the

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	CLIENT	INDIAN OIL CORPORATION LIMITED		
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	Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit
TPIA	Third Party Inspection Agency
WPS	Welding Procedure Specification
PQR	Procedure Qualification Record
WPQ	Welder Performance Qualification
MRT	Mechanical Run Test

Extent of Inspection: The extent of Inspection activities is defined as follows:

H (Hold Point): Mandatory witness of testing or inspection activities by CONTRACTOR / OWNER. The Vendor shall notify at least 15 days in advance and CONTRACTOR / OWNER must be present during the specified activity. The Vendor cannot deviate from this rule unless written approval has been given by PMC / OWNER.

W (Witness): Optional witness of testing or inspection activities by CONTRACTOR / OWNER. The Vendor must notify at least 15 days in advance. If CONTRACTOR / OWNER does not elect to be present, the Vendor may proceed with the intended activity, provided controls and test reports are made available for the inspector's review during his subsequent visit.

R (Review): Review and acceptance of documentation such as reports, procedures and qualification records. Other applicable documents will be reviewed at Vendor facility by the CONTRACTOR / OWNER.

 		PROJECT	Standby SRU & Additional Tanks IOCL Paradip Refinery	
		CLIENT	INDIAN OIL CORPORATION LIMITED	
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### 3. CATEGORY OF INSPECTION

Inspection activities shall be based on hold/witness/review points specified in the Inspection & Test Plan (ITP) and confirmed at the Pre-Inspection Meeting. CONTRACTOR / TPIA / OWNER Inspection will be based on critical ratings and corresponding levels of inspection.

Category of inspection are defined as follows:

**Category 1:** Stage wise and final inspection including monitoring of critical phases of fabrication performed at main supplier and main sub-supplier and Documents review as per ITP by CONTRACTOR / TPIA; Witness of Critical Stage / Test / Final inspections by OWNER wherever felt necessary.

**Category 2:** Stage wise and final inspection and Documents review as per ITP by CONTRACTOR / TPIA; Witness of final inspection, by OWNER, if felt necessary.

**Category 3:** Final inspection and Documents review as per ITP by CONTRACTOR / TPIA;

**Category 4:** Documents Review as per ITP by CONTRACTOR / TPIA.

### 4. PRE-INSPECTION MEETING



A Pre-Inspection meeting to be held at Vendor's Works is a review with Vendor, prior to the start of manufacturing, to ensure understanding of purchase order requirements, including project specifications, applicable codes/standards and all inspection requirements.

### 5. VENDOR 'S FABRICATION AND QUALITY CONTROL PLAN (FQCP)

The Vendor shall issue Fabrication and Quality Control Plan for each equipment. The Vendor's Fabrication and Quality Control Plan is a document, which defines in a chronological manner, the list of the operations of fabrication, controls and tests in accordance with his own "know-how" and with the requirements specified in the project specifications attached with the Inquiry document and/or relevant codes & standards.

Following information shall be clearly specified against each operation:

- Reference documents (drawings, procedures, etc.)
- Acceptance criteria (code, etc.)
- Recording documents for controls and tests
- Involvement of the Quality Control department of the Vendor and/or his Sub-Vendor
- Involvement of CONTRACTOR / TPIA

 		PROJECT	Standby SRU & Additional Tanks IOCL Paradip Refinery	
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## 6. RIGHT TO INSPECT

All Equipment shall be subject to inspection by CONTRACTOR / TPIA / OWNER. The Inspector shall have free access to the Vendor's shop/work site. The Vendor shall provide all facilities like tools and tackles, instruments and personnel to the inspector.

The CONTRACTOR / TPIA / OWNER shall be entitled to reject at any time any portion of the Equipment which is defective, deficient, not within specifications or otherwise of inferior quality or faulty workmanship and require its re-performance or replacement. Rejected and other defective or deficient workmanship shall be satisfactorily redone. The costs associated with such re-performance or replacements shall be for the account of the Vendor. After completion of the necessary re-performance or replacements, the Equipment shall be subject to further Inspection and examination by CONTRACTOR / TPIA / OWNER. Applicable repair procedure and Vendor's repair recommendations shall be submitted to the Inspector for approval. No repair shall be made without the Inspector's acceptance.

## 7. INSPECTION RELEASE CERTIFICATE

This document permits the Vendor to proceed with the packing and to notify the shipment of the Equipment.

## 8. INSPECTION AND TESTING REQUIREMENTS

STAGE	ACTIVITIES DESCRIPTION	INSPECTION REQUIREMENT				APPLICABLE DOCUMENTS AND REMARKS
		VENDOR	CONTRACTOR / TPIA	PMC	OWNER	
BEFORE MANUFACTURING	Sub-orders check	H	R			For main materials and/or activities complete with all the technical attachments
	Fabrication Quality Control Plan	W	H	R		<div style="border: 2px solid red; padding: 5px;">           Pump-Cent.Vert.(Molten Sulphur) is in Inspection Category-II and as per M/s Technip's comments on ICP for Inspection Category-II item, there shall be only Stage wise, Final inspection and Document review by BHEL TPIA. End Customer/Client may witness if felt necessary and shall be as per approved ITP. Hence, in view of the above, H (Hold point) for Contractor/ TPIA before manufacturing is not applicable for this item and the same shall be review category only.         </div>
	Welding Book, WPS/PQR, Welder performance qualification record (WPQ) for all components and accessories	W	H	R		
	Hydro test, MRT, Performance test, NDT and other procedure (as applicable)	W	H	R		
	Pre-inspection meeting	W	H	R		
	Inspection of sub-ordered components	H	R	R		

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 		PROJECT	Standby SRU & Additional Tanks	
			IOCL Paradip Refinery	
		CLIENT	INDIAN OIL CORPORATION LIMITED	
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STAGE	ACTIVITIES DESCRIPTION	INSPECTION REQUIREMENT				APPLICABLE DOCUMENTS AND REMARKS
		VENDOR	CONTRACTOR / TPIA	PMC	OWNER	
BEFORE MANUFACTURING	Material Inspection					
	Chemical & Physical properties of incoming materials	H	R			EN10204 Type 3.1 for Casing, Shaft, impellers, shaft sleeve and wear rings. Compliance certificates for other components.
	Piping and Hardware items: Valves, Flanges, Pipes, Fittings, Gaskets, Fasteners, etc. (As applicable)	R	-			Material Certificate for Fasteners, which include Casing Bolts EN10204 Type 2.2. For other items like Gaskets, Gland packing etc. Compliance Certificate is required.
	Surface quality of Incoming materials: Casing, Stuffing box, Impeller, Bearing housing & Shaft material, sleeve, wear rings, column pipe (As applicable)	H	R			
	Dimensional measurement of Casing, Stuffing box, Impeller, Bearing housing, shaft, column pipe etc.	H	R			As per approved drawings
DURING MANUFACTURING	Welding consumable certificates	H	R			Batch Test Certificate from Manufacturer
	Welds and Weld repairs (if any) of Pressure Retaining Parts and Piping	H	R			Radiography Testing
	Post weld heat treatment	H	R			If any – Recorded chart. For caustic service, all welds shall be stress relieved.
	Intermediate NDE	H	R			On shop welding including repairs
	Final NDE	H	R			Which includes review of RT Report, lifting lugs/trunnions welds of base plate and structural frame, UT of shaft and Radiography of casing etc.
	Hardness measurement at Heat affected zone	H	R			For all pumps in NACE service, casing, shaft, impeller, wetted bolting, bowls and pressure retaining mechanical seal components shall meet the requirements of NACE MR0103.

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 		PROJECT	Standby SRU & Additional Tanks	
			IOCL Paradip Refinery	
		CLIENT	INDIAN OIL CORPORATION LIMITED	
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STAGE	ACTIVITIES DESCRIPTION	INSPECTION REQUIREMENT				APPLICABLE DOCUMENTS AND REMARKS
		VENDOR	CONTRACTOR / TPIA	PMC	OWNER	
	Wear ring Overlay Visual and hardness measurement	H	R			
DURING MANUFACTURING	Chemical Compliance (PMI Test) for all alloy pressure containing components and welds (including shaft sleeve, auxiliary piping etc.)	H	H			PMI report
	Impact Test of all pressure containing components and welds	H	R			Only if the specified MDMT is lower than -30°C.
	Hydro test of casing & Stuffing box before assembly of pump	H	W			The chloride content of test liquid shall be < 30 ppm.
	Impeller / Rotor assembly dynamic balancing	H	R			
	Actual running clearances throughout the pump	H	R			
	Cleanliness Test of all components before assembly	H	R			
	Accessories (Bought-out Items): Barrier/Buffer liquid reservoir, Cooling coil, Barrier/Buffer liquid cooler, Mechanical seal, Gland, Coupling etc	H	R			Material Compliance, WPS/PQR/WPQ, PMI, Dimensional check, Hydro/Pneumatic Test & Seal qualification test (As applicable) for Mechanical seal, Reservoir, Coolers, Dynamic balancing of mech seal and coupling
	Motor / VFD (as applicable): Type test / Routine test of Motor	H	(Note-3)			
	Engine / Turbine (as applicable): - Load test / MRT of engine - MRT of Turbine	H	(Note-3)			
	Gear Box (as applicable) Mechanical Run Test	H	R			
	Functional / Performance run test, Flush Test of Lube oil system (as applicable)	H	R			As per API 614 (shall include Pressure test, Cleanliness test, Material TC, Review of test certificates for lube oil pump, motor, filter, cooler, control valves, PSV etc, Review of test and calibration certificates for instruments, Operational test, check controls, Flush test)

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 		PROJECT	Standby SRU & Additional Tanks	
			IOCL Paradip Refinery	
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STAGE	ACTIVITIES DESCRIPTION	INSPECTION REQUIREMENT				APPLICABLE DOCUMENTS AND REMARKS
		VENDOR	CONTRACTOR / TPIA	PMC	OWNER	
FINAL INSPECTION	Testing of pumps - Performance test (at least 5 points) - NPSH (R) – (NPSH margin @ rated point < 1 m or if specified) - Mechanical run test (Vibration, Noise measurement, Bearing temp rise)	H	W	R	W	As per API 610, Job specification, Design basis etc.
	Impeller re-machining to achieve guaranteed duty point (if required)	H	W	-	-	Performance test required after impeller trimming
	Dismantle inspection of pump after performance test	H	W (Note-4)			- Visual inspection of casing inside surface - Wear ring area visual check - Clearance measurement - Examination of mechanical seal
	Unitization of pump with job driver	H	W			Alignment of pump with driver and check direction of rotation
	Testing of auxiliary piping - if applicable	H	R			
	Job instruments – If applicable	H	R			Compliance to Purchase Requisition requirements
	Testing and Measuring instruments	H	R			Validity of calibration & accuracy check
	Full Skid Completeness check	H	W			Visual & Dimensional and skid completeness check
	Painting of pump skid & associated parts (as applicable)	H	W			Paint Scheme, Visual & Paint thickness check
DOCUMENTATION	Stamping and Review of inspection documents, Issue of Inspection Release Certificates (IRC)	--	H	R*	R	Review of documents for compliance as per Purchase Requisition
	Manufacturer's Data/Record Book	H	H	R*		All approved Quality documents such as QCP, Test Procedures, all Material certificates, Test and Inspection reports, Statutory Certificates, Non-conformity / Repairs, Deviation/ Concession Request etc.



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 		PROJECT	Standby SRU & Additional Tanks IOCL Paradip Refinery	
		CLIENT	INDIAN OIL CORPORATION LIMITED	
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NOTES (as applicable):

- 1) This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable
- 2) Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in / Job Specification / Approved documents.
- 3) Inspection and test requirements shall be as per relevant ITP.
- 4) Dismantle inspection of pump after performance test shall include examination of mechanical seal faces, close clearance parts for any rubbing and wear and measuring and recording wear ring running clearances. In case of multistage pumps having hydrodynamic bearings, the bearing shall be removed, inspected and reassembled.
- 5) \* = CONTRACTOR shall forward all relevant Inspection reports and Documents (MDRB) for PMC review after approval by CONTRACTOR.
- 6) Deleted.

 	PROJECT:	STANDBY SRU & ADDITIONAL TANKS IOCL - PARADIP REFINERY					
	CLIENT:	INDIAN OIL CORPORATION LIMITED					
INSPECTION AND TEST PLAN (ITP) FOR MV INDUCTION MOTORS	Project N°	Unit	Doc Type	Material Code	Serial N°	Rev.	Page
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## 1 SCOPE

This Inspection and test plan is an engineering document which defines for each type of equipment:

- > The type and extent of CONTRACTOR and PMC / OWNER involvement in each phase of fabrication, control and testing requiring an inspection.
- > The resulting vendor's contractual obligations, in accordance with applicable Project General Purchase Conditions.

**Note:** The inspection and test plan may under no circumstances be used as a substitute for the vendor's Quality Control Plan.

## 2 GENERAL DEFINITIONS

**EXTENT OF INSPECTION :** The extent of inspection activities is defined as follows;

### H: (Hold) Point

The Supplier cannot carry out the specified controls and tests without Inspector attendance.

Consequently, the attendance to witnessing is mandatory. The Supplier must notify CONTRACTOR / PMC / OWNER by fax of the dedicated inspection activity at least fifteen (15) days in advance.

The Supplier cannot deviate from this rule unless written approval has been given by involved operating center.

### W: (Witness)

The Supplier must notify dedicated inspection activity at least fifteen (15) days in advance. CONTRACTOR / PMC / OWNER witnessing is not mandatory, but optional. If CONTRACTOR / PMC / OWNER does not elect to be present, the supplier may proceed with the intended activity, provided controls and test reports are made available for the inspector's review during his subsequent visit.

When a percentage value is indicated (i.e. W 10%) the inspection activities will be witnessed on spot basis as per percentage indicated.

### R: (Review) - Review of Documents

The Supplier has either to submit to Inspector for comments the documents required prior to the performance of the dedicated activity or to transmit or make available for the review of Inspector the results of the controls and tests conducted, as the case may be.

## 3 SUPPLIER'S FABRICATION AND QUALITY CONTROL PLAN

- > The Supplier must issue a Fabrication and Quality Control Plan for each Equipment / Machinery / Package/ Bulk Item
- > The Supplier's Fabrication and Quality Control Plan is a document which defines in a chronological manner the list of the operations of fabrication, controls and tests in accordance with his own "know-how" and with the requirements specified in MR.

Following information shall be clearly specified against each operation:

- Reference documents (drawings, procedures, etc.)
- Acceptance criteria (code, etc.)
- Recording documents for controls and tests
- Involvement of the Quality Control department of the Supplier and/or his subsupplier

This Supplier's Fabrication and Quality Control Plan will have to include all inspection activities defined in Inspection and Test Plan as well as all inspection activities scheduled by Independent Inspection Authority and/or the Client





## 4 INSPECTION RELEASE CERTIFICATE

This document issued by CONTRACTOR/TPIA, permits the Vendor to proceed with the packing and to notify the shipment

## 5 QUALITY CONTROL MANUFACTURING DOSSIER "QCMD" (ex Inspection Book)

This document must be completely reviewed during the final Inspection. Preliminary Copy (Waiting for CLIENT final approval), checked and signed by the Inspector, must be shipped together with the goods and indicated in the relevant Packing List.

### INSPECTION CATEGORY : 3


			 Gopi Chellappa 2019.11.26 10:55:25 +05'30'	 Mathivanan Ganesan 2019.11.26 17:52:28 +05'30'	 Velmurugan Shanmugam 2019.11.26 18:19:35 +05'30'	 Morchistopher 2019.11.29 19:52:30 +05'30'
A	26.11.2019	ISSUED FOR QUOTATION	CG	GM	SV	JMC
REV	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORISED


 		PROJECT: STANDBY SRU & ADDITIONAL TANKS IOCL - PARADIP REFINERY						
		CLIENT: INDIAN OIL CORPORATION LIMITED						
INSPECTION AND TEST PLAN (ITP) FOR MV INDUCTION MOTORS		Project N°	Unit	Doc Type	Material Code	Serial N°	Rev.	Page
		080557C001	000	ITP	1691	001	A	2 of 2
<p><b>1.0 SCOPE</b> This Inspection and test Plan covers the minimum testing requirement of MV Induction Motors.</p> <p><b>2.0 REFERENCE DOCUMENTS</b> PO/PR &amp; Standards referred there in / Job specification / Approved documents</p> <p><b>3.0 INSPECTION AND TEST REQUIREMENTS</b></p>								
SL.No	STAGE	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION			
					SUPPLIER	CONTRACTOR / TPIA	PMC	OWNER
1	Raw Material: Body (casting or fabrication), Rotor Shaft, Core Laminations, Copper, Insulation Material, Bearings, Cable Boxes, Cable Glands, etc	Chemical, Physical properties, finish as per relevant standard.	100%	Supplier's Test Records	W	W	-	-
2	Motor Assembly	Vacuum impregnation and Bracing of winding, Core Assembly, Rotor Bars and end rings assembly, Rotor Balancing, Terminal Box mounting and clearances in between, Bearing setting etc as per Supplier's internal Standards.	100%	Supplier's Test Records	W	W	-	-
3	Routine Tests	> Visual Check (Name plate, Terminal Box location, Terminal Type, Clearances, Size, Entries, Space adequacy etc) > Dimensional Check (Including shaft height etc, Foundation Hole dia and distance, Shaft dia) > General check by visual inspection of the mechanical operation of motor at no-load (bearings, vibrations, noise etc.). > Measurement of resistance of windings of stator & wound rotor. > Measurement of stator insulation resistance. > No load test at rated voltage with current, losses, speed and pf measurements. > Locked rotor test at rated current with losses and pf measurements > Check of phase sequence and terminal markings. > Direction of rotation > RTD/BTD, space heater resistance measurement > Withstand voltage test of stator winding > Vibrations measurement > Functional check of accessories, e.g. temperature detectors in windings and bearings, vibration monitoring, heaters, thermister > Open circuit secondary induced voltage at standstill (Wound rotor machines only) > Reduced Voltage Starting and Running > Shaft voltage measurement (for motors of rating 55 kW & above) > High Voltage Test (HV) > Insulation Resistance test before & after HV test > Terminal Box location & clearances in between. > Cable Glands, Cable lugs size and No. of entries in Terminal box.	100%	Supplier's Test Records / Inspection Witness Record.	W	W	R	-
4	Type Tests	> Temperature rise test > Full load test and measurement of voltage, current, power, slip, power factor, bearing, noise. > Efficiency & p.f at 100%, 75%, and 50% load. > Noise level measurement and determination of the relevant curve > Vibration > Momentary overload test. > Measurement of Starting Torque, Starting Current, full load torque	1 No of each type	Test Agency Reports	W	R (Note 6)	R	-
5	Other tests	Overspeed (**) (**) To be performed as a routine test during the no-load test if the test power supply has overspeed frequency capability	1 No of each type	Supplier's Test Records / Inspection Witness Record.	W	R (Note 6)	R	-
6	Certificates	> Type test certificates > Certificate from statutory testing agencies like CIMFR or equivalent for suitability of area classification and weather proofness. > Statutory approval certificates from CCoE/PESO etc > Valid BIS license, if indigneous supply > Degree of protection certificate for enclosure. > Certificate for short-circuit withstand capability of main terminal box.	Each type	Certificates from Statutory bodies	R	R (See Note 6)	R	-
7	Painting	Visual and DFT check	100%	Supplier's Test Records / Inspection Witness Record.	H	W	-	-
8	Packing	> Visual > Suitable protection to prevent entry of foreign material. > Proper packing with suitable plugs to prevent ingress of moisture and any damage during Transportation and Storage	100%	Supplier's Test Records / Inspection Witness Record.	H	W	-	-
9	MDRB Review	Compilation of test reports/test records as per Project Procedure	100%	Supplier's Test Records / Inspection Witness Record.	H	H	-	-
<p>* Prototype test certification only is required. If prototype test certification is not available, type tests shall be performed on no. 1 motor for each motor type. Selected motor for type tests shall be the largest one among the relevant type.</p> <p>- Supplier to submit internal test reports before offering items for inspection to CONTRACTOR / PMC / OWNER.</p> <p><b>LEGEND:-</b></p> <p><b>CCE or CCOE:</b> Chief controller of Explosives, <b>DT</b> - Destructive testing, <b>HT</b> - Heat treatment, <b>H</b> - Hold (Do not proceed without approval), <b>IBR</b> - Indian Boiler Regulations, <b>ITP</b> - Inspection Test Plan, <b>NDT</b> - Non Destructive Testing, <b>P</b> - Perform, <b>PESO</b> - Petroleum and Explosives Safety Organisation, <b>PO</b> - Purchase Order, <b>PR</b> - Purchase Requisition, <b>PQR</b> - Procedure Qualification Record, <b>QAP</b> - Quality Assurance Plan, Random-10% (min 1no) of each size and type of bulk item, <b>R</b> - Review, <b>RT</b> - Radiography Testing, <b>RW</b> - Random Witness, <b>TC</b> - Test Certificate, <b>TPI</b> or <b>TPIA</b> - Third Party Inspection Agency, <b>VDR</b> - Vendor Data Requirements, <b>WPS</b> - Welding Procedure Specification, <b>WPO</b> - Welders Performance Qualification, <b>W</b> - Witness (Give due notice, work may proceed after scheduled date), <b>MDRB</b> - Manufacturer's Data/Record Book, <b>DFT</b> - Dry Film Thickness</p> <p><b>Notes (As applicable)</b></p> <p>1 Whenever W/R or H/W is indicated, CONTRACTOR / PMC / OWNER shall decide the option to be exercised for the particular stage and supplier.</p> <p>2 Supplier's in house procedures may be accepted in case CONTRACTOR / PMC / OWNER is satisfied with adequacy of procedures to comply with the purchase order/specifications requirements, in case of non availability of suitable procedures fresh procedures may be qualified under CONTRACTOR / PMC / OWNER witness.</p> <p>3 In case of conflict between purchase specification, contract documents and ITP more stringent conditions shall be applicable.</p> <p>4 This document describes generally the requirements pertaining to all types of the item. Requirements specific to PO and the item are only applicable.</p> <p>5 Acceptance norms for all the activities shall be as per PO/PR/STANDARDS referred therein / Job specification / Approved documents.</p> <p>6 If test certificate is not available, this will be witnessed.</p>								

Annexure-1A							
BHARAT HEAVY ELECTRICALS LIMITED PROJECT ENGINEERING & SYSTEMS DIVISION RAMACHANDRAPURAM: HYDERABAD - 502 032							
PRICE FORMAT (R00) FOR SULPHUR PIT PUMPS PROJECT: 525 TPD STANDBY SRU PROJECT IOCL PARADIP REFINERY, ODISHA, INDIA CUSTOMER: INDIAN OIL CORPORATION LIMITED PARADIP REFINERY PROJECT, PARADIP, ODISHA CONSULTANT : TECHNIP ENERGIES ESC: ENGINEERS INDIA LIMITED							
SL NO	ITEM DESCRIPTION	QTY	UNIT	Weightage w.r.t Overall Price (In %)	Bidder confirmation (Quoted/ Not Quoted)	HSN/SAC Code	GST (%)
Bidder's Name : <Bidder to indicate> Bidder's Offer No. & Dt. : <Bidder to indicate> Bidder's Ref No. & Dt. :<Bidder to indicate> BHEL Eng. No. & date :<Bidder to indicate>							
I	MAIN OFFER						
A	MATERIAL SUPPLY : Sulphur Pit Pumps sets [Material code: PY9751729017]						
	Sulphur Pit Pumps with motor along with all accessories including commissioning spares, special tools & tackles documentation as per the enclosed specifications, instructions to vendors, job specification, data sheets etc. and other codes and standards attached or referred.	2	Set	77.6			
B	MATERIAL SUPPLY: Mandatory spares [Material code: PY9751729025], Refer Note-14						
B.1	Pump Spares						
1	Set of impellers (Full dia) with wear rings fitted)	1	Sets	21.2			
2	Shaft with keys	1	Sets				
3	Set of shaft sleeves	1	Sets				
4	Set of case wear rings	3	Sets				
5	Set of impeller wear ring	3	Sets				
6	Set of throat bushing	1	Sets				
7	Set of throttle bushing	1	Sets				
8	Set of gaskets	4	Sets				
9	Set of labyrinths – as applicable	1	Sets				
10	Set of oil seals – as applicable	2	Sets				
11	Set of constant level oiler	1	Sets				
12	Set of deflectors	1	Sets				
13	Impeller nut	2	Sets				
14	Set of mechanical seals (complete assembly) With sleeve and gland plate (for cartridge seal)	1	Sets				
15	Set of mechanical seals (complete assembly) Without sleeve and gland plate (for cartridge seal)	1	Sets				
16	Set of mechanical seal parts: Seal faces (stationary + rotary)* *For bellow type seal, set of faces shall mean face along with bellow	3	Sets				
17	Set of mechanical seal parts: Secondary seal	3	Sets				
18	Set of mechanical seal parts: Gaskets/O-rings & Packings	4	Sets				
19	Set of mechanical seal parts: Springs and pins, screws	2	Sets				
20	Set of gland packings	3	Sets				
21	Set of bearing pads (if bearings are tilting pad type): Radial bearing pads	1	Sets				
22	Set of bearing pads (if bearings are tilting pad type): Thrust bearing pads	1	Sets				
23	Set of balance drum and balance sleeve insert (if provided)	1	Sets				
24	Set of interstage bushes	1	Sets				
25	Complete coupling (balanced) (only for multistage pumps- pumps with more than 2 stages)	1	Sets				
26	Flushing oil cooler in case of Plan 23	1	Sets				
B.2	Motor Spares						
1	Set of bearings (DE & NDE both)	1	Sets				
2	Set of Terminal studs / bushing assembly	1	Sets				
B.3	FLANGES (All flanges including blind flanges) Spares						
1	Gaskets	200% Extra					
2	Bolting	10% Extra					
B.4	Orifice Plates:10% or minimum 1 of blind plates of each size, rating, thickness & material of construction.	10% or minimum 1					
C	Supervision charges for erection & commissioning at site [Material code:PY9751729050]						
	Supervision charges for erection & commissioning shall include the following: 1. Per diem charge of for supervision of erection & commissioning of Pump set package. 2. Charges for 1 visit Note: The above shall also include all other expenses like boarding, lodging, local travel, insurance, travel expenses (inclusive of all other charges like visa fee (if applicable), insurance etc) from / to vendor works to site for Engineer. [Refer Note 11]	5 Days and 1 Visit		1.2			
	Grand total price for sl no A ,B and C (Inclusive of Packing & Forwarding, Freight)			100			


SL NO	ITEM DESCRIPTION	QTY	UNIT	Weightage w.r.t Overall Price (In %)	Bidder confirmation (Quoted/ Not Quoted)	HSN/SAC Code	GST (%)
	Bidder's Name : <Bidder to indicate> Bidder's Offer No. & Dt. : <Bidder to indicate> Bidder's Ref No. & Dt. : <Bidder to indicate> BHEL Enq. No. & date : <Bidder to indicate>						
<b>Packing &amp; Forwarding, Frieght, Insurance and GST :</b>							
<b>(A) For Supply:</b>							
(i) Packing & Forwarding	In bidder scope			Included in basic price			
(ii) Frieght:	In bidder scope			Included in basic price			
(iii) Insurance:	In BHEL scope						
(iv) GST	Extra at actuals			Extra at actuals			
(v) Any other:	shall be included in baisc price of pumps			Included in basic price			
<b>(B) For supervision of E&amp;C:</b>							
(i) GST:	Extra at actuals			Extra at actuals			
(ii) Any other:	Included in basic price			Included in basic price			
<b>Notes:</b>							
1) Bidders should quote the Total Bid Value in both in figures & words in the specified place.							
2) Bidders should mention the applicable HSN/SAC code along with GST% against respective line items.							
3) Bidders shall not fill/edit/modify anything else in the Price Bid Format.							
4) The rates of line items mentioned in the Price Format shall be derived by BHEL by multiplying the Total Bid Value quoted by the Bidder with the Weighttage Factor assigned against respective line items. The rate of each item shall be rounded off to the next 1 (one) paisa.							
5) The Total Bid Value quoted by the Bidder shall represent the total landed cost for this enquiry and shall include Packing & Forwarding Charges, Freight Charges, and all applicable taxes and duties, other than GST. GST shall be paid extra by BHEL at applicable rates.							
6) Evaluation shall be done on the basis of total bid value i.e. the total landed cost to BHEL for this enquiry. Loading on the price(as applicable) shall be added to the Total Bid Value for evaluation purpose. For more details, please refer "POWER LOADING CRITERIA FOR ROTATING EQUIPMENT, Doc No. 080557C-000-JSD-0900-002" of NIT.							
7) The bidders will also provide un-priced price format strictly in the BHEL price format given above, in the techno commercial part of their offers. Bid will be rejected if any other price format is used. Both priced and un-priced price formats to be provided by the bidders shall be signed and stamped copies.							
8) Bidder to quote strictly as per BHEL's NIT requirements.							
9) Bidder to note that this is a LUMP SUM Turn-Key Order. However							
(a) Changes to the tender specification during execution of the project for successful operation of the system need to be carried out by bidder and commercial implications if any will be settled suitably.							
(b) Unit rates quoted by bidder shall be applicable for any changes in BOQ during detailed engineering stage.							
10) <b>Main offer (Annexure-1A)</b> consists of those items which will be part of main order after successful bidder is identified. <b>Optional Items (Annexure-1A-I)</b> consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under <b>Main offer</b> and <b>Optional items</b> as per the prescribed format.							
11) Prices quoted by bidders for items under main offer : Sl. No.(A+B+C) will be considered for evaluation of lowest bidder.							
For the purpose of tender (L1 bidder evaluation) following shall be noted:							
Referring to Sl no C- Supervision charges for Pump set package, For the purpose of Quotation, total no of 5 man days (92.1% of price quoted against sl no C) for Pump set pacakge will be covered in 1 visit (7.9% of price quoted against sl no C) have been considered and payment against Sl.No C above shall be made as per the actual number of visits and man days required for the supervision of the complete E&C activities as per these diem rates. Purchase Order for supply of main items, ( A to B) shall be placed by BHEL- PE&SD Hyderabad. For Supervisionof E&C, LOI shall be placed by PE&SD and PO By PE&SD-site.							
However, BHEL reserves the right							
(a) To include any of the optional items in scope of supply (as per customer contract requirements) and accordingly consider the same in evaluation. Any such scope increase and change in evaluation will be intimated to vendor during technical evaluation(before price bid opening).							
(b) To place PO for any of the Optional items with in the contract period.							
Hence bidders need to mandatorily quote reasonable prices for all optional items considering such requirement and keep the validitv of the prices till the end of contract period.							
12.a) For all items including Optional items, prices to be furnished in this prescribed price bid format only for each individual item. The price to be quoted against sl no A & B shall be Weighttage w.r.t Overall Prices mentioned above. No combined prices, common prices or any other format will be accepted and such bids may be liable for rejection.							
12 b) Bidder must not change the indicated item description, quantity & units in the price bid format. Bidder should only fill the unit rates & total price.							
12 c) Bidder to quote for all the items as per price bid format. Incomplete/partial offer may be liable for rejection.							
13 a.) Commissioning spares are those spares which are required at the time of commissioning and shall be recommended (as per bidders experience) and quoted by bidder. However commissioning spares indicated in the price bid format shall be quoted as minimum.							
13.b) Commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor.							
14)With respect to Mandatory Spares;							
A) If any of above items indicated by the specified name are not applicable, bidder to offer alternative item serving the same function as per equipment's design and indicate below the item being replaced.							
B) If bidder is not able to meet the above note, then bidder may mention "Not Applicable". However, if found applicable during detailed engg. stage or alternative item as per equipment design can serve the same function, bidder to supply the specified quantity with out any delivery and commercial implications to BHEL..							
15) Reference document: <b>PY51729, R00 &amp; annexures.</b>							
16) Unpriced price bid format indicating as quoted against each applicable item shall be submitted duly signed & stamped along with technical offer by bidder as a token of concurrence that prices are submitted in this format only. The offer shall be liable for rejection in case if un-priced price bid format is not submitted or any modification is carried out in price bid format.							
17) <b>In case the systems are being supplied from outside India</b> , Following Third Party Inspection to be followed:							
a. M/s ABS Industrial Verification Private Limited							
b. M/s Bureau Veritas (India) Pvt. Ltd.							
c. M/s Certification Engineers International Limited							
d. M/s International Certification Services Private Limited							
e. M/s IR Class systems and Solutions Pvt. Ltd.							
f. M/s Projects and Development India Ltd.							
g. M/s SGS India Private Limited							
h. M/s TATA Project Limited							
i. M/s TUV SUD South Asia Pvt. Ltd.							
j. M/s VCS Quality Services Private Limited							
The charges should be included in the Main offer. For those bidders who are supplying from India, such third party inspection charges need not be considered and same will be arranged by BHEL/BHEL nominated inspection agency.							



Annexure-1A-I						
		<b>BHARAT HEAVY ELECTRICALS LIMITED</b> <b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> <b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b>				
		<b>PRICE FORMAT (R00) FOR 'SULPHUR PIT PUMPS'</b> <b>PROJECT: 525 TPD STANDBY SRU PROJECT IOCL PARADIP REFINERY, ODISHA, INDIA</b> <b>CUSTOMER: INDIAN OIL CORPORATION LIMITED PARADIP REFINERY PROJECT, PARADIP, ODISHA</b> <b>CONSULTANT : TECHNIP ENERGIES</b> <b>ESC: ENGINEERS INDIA LIMITED</b>				
SL NO	ITEM DESCRIPTION	QTY	UNIT	Bidder confirmation (Quoted/ Not Quoted)	HSN/SAC Code	GST (%)
Bidder's Name : <Bidder to indicate> Bidder's Offer No. & Dt. : <Bidder to indicate> Bidder's Ref No. & Dt. :<Bidder to indicate> BHEL Enq. No. & date :<Bidder to indicate>						
<b>II</b>	<b>Optional Items</b>	--	--			
A	<b>Two Years spares (O &amp; M Spares):</b> Parts or assemblies normally used or consumed on the basis of scheduled maintenance, overhauls, inspections, wear, corrosion, erosion or deterioration in normal service for a period of TWO years beyond the Defect Liability Period as recommended by manufacturers of various equipment (other than commissioning and mandatory required during the Defect Liability Period). Bidder to quote for their recommended two years' operation and maintenance spares. Recommended spares list for two years normal operation along with unit price breakup for Pump, Drives & other accessories. <b>(List with price break up to be enclosed)</b> (1 set stands for quantity required for the replacement of one pump, drive (or) accessories)	1 Set	Set			

		<div>Annexure-1B</div> <div>BHARAT HEAVY ELECTRICALS LIMITED</div> <div>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</div> <div>RAMACHANDRAPURAM: HYDERABAD - 502 032</div>						
		<div>PRICE FORMAT (R00) FOR DEGASSING PUMPS</div> <div>PROJECT: 525 TPD STANDBY SRU PROJECT IOCL PARADIP REFINERY, ODISHA, INDIA</div> <div>CUSTOMER: INDIAN OIL CORPORATION LIMITED PARADIP REFINERY PROJECT, PARADIP, ODISHA</div> <div>CONSULTANT : TECHNIIP ENERGIES</div> <div>ESC: ENGINEERS INDIA LIMITED</div>						
SL NO	ITEM DESCRIPTION	QTY	UNIT	Weightage w.r.t Overall Price (In %)	Bidder confirmation (Quoted/ Not Quoted)	HSN/SAC Code	GST (%)	
Bidder's Name : <Bidder to indicate> Bidder's Offer No. & Dt. : <Bidder to indicate> Bidder's Ref No. & Dt. : <Bidder to indicate> BHEL Eng. No. & date : <Bidder to indicate>								
I	MAIN OFFER							
A	MATERIAL SUPPLY : Degassing Pumps sets [Material code: PY9751729033]							
	Degassing Pumps with motor along with all accessories including commissioning spares, special tools & tackles documentation as per the enclosed specifications, instructions to vendors, job specification, data sheets etc. and other codes and standards attached or referred.	2	Set	77.1				
B	MATERIAL SUPPLY: Mandatory spares [Material code: PY9751729041], Refer Note-14							
B.1	Pump Spares							
1	Set of impellers (Full dia) with wear rings fitted)	1	Sets	21.5				
2	Shaft with keys	1	Sets					
3	Set of shaft sleeves	1	Sets					
4	Set of case wear rings	3	Sets					
5	Set of impeller wear ring	3	Sets					
6	Set of throat bushing	1	Sets					
7	Set of throttle bushing	1	Sets					
8	Set of gaskets	4	Sets					
9	Set of labyrinths – as applicable	1	Sets					
10	Set of oil seals – as applicable	2	Sets					
11	Set of constant level oiler	1	Sets					
12	Set of deflectors	1	Sets					
13	Impeller nut	2	Sets					
14	Set of mechanical seals (complete assembly) With sleeve and gland plate (for cartridge seal)	1	Sets					
15	Set of mechanical seals (complete assembly) Without sleeve and gland plate (for cartridge seal)	1	Sets					
16	Set of mechanical seal parts: Seal faces (stationary + rotary)* *For bellow type seal, set of faces shall mean face along with bellow	3	Sets					
17	Set of mechanical seal parts: Secondary seal	3	Sets					
18	Set of mechanical seal parts: Gaskets/O-rings & Packings	4	Sets					
19	Set of mechanical seal parts: Springs and pins, screws	2	Sets					
20	Set of gland packings	3	Sets					
21	Set of bearing pads (if bearings are tilting pad type): Radial bearing pads	1	Sets					
22	Set of bearing pads (if bearings are tilting pad type): Thrust bearing pads	1	Sets					
23	Set of balance drum and balance sleeve insert (if provided)	1	Sets					
24	Set of interstage bushes	1	Sets					
25	Complete coupling (balanced) (only for multistage pumps- pumps with more than 2 stages)	1	Sets					
26	Flushing oil cooler in case of Plan 23	1	Sets					
B.2	Motor Spares							
1	Set of bearings (DE & NDE both)	1	Sets					
2	Set of Terminal studs / bushing assembly	1	Sets					
B.3	FLANGES (All flanges including blind flanges) Spares							
1	Gaskets	200% Extra						
2	Bolting	10% Extra						
B.4	Orifice Plates:10% or minimum 1 of blind plates of each size, rating, thickness & material of construction.	10% or minimum 1						
C	Supervision charges for erection & commissioning at site [Material code:PY9751729068]							
	Supervision charges for erection & commissioning shall include the following: 1. Per diem charge of for supervision of erection & commissioning of Pump set package. 2. Charges for 1 visit Note: The above shall also include all other expenses like boarding, lodging, local travel, insurance, travel expenses (inclusive of all other charges like visa fee (if applicable), insurance etc) from / to vendor works to site for Engineer. [Refer Note 11]	5 Days and 1 Visit		1.4				
	Grand total price for sl no A , B and C (Inclusive of Packing & Forwarding, Freight)			100				

SL NO	ITEM DESCRIPTION	QTY	UNIT	Weightage w.r.t Overall Price (In %)	Bidder confirmation (Quoted/ Not Quoted)	HSN/SAC Code	GST (%)
	Bidder's Name : <Bidder to indicate> Bidder's Offer No. & Dt. : <Bidder to indicate> Bidder's Ref No. & Dt. : <Bidder to indicate> BHEL Enq. No. & date : <Bidder to indicate>						
<b>Packing &amp; Forwarding, Frieght, Insurance and GST :</b>							
<b>(A) For Supply:</b>							
(i) Packing & Forwarding	In bidder scope			Included in basic price			
(ii) Frieght:	In bidder scope			Included in basic price			
(iii) Insurance:	In BHEL scope						
(iv) GST	Extra at actuals			Extra at actuals			
(v) Any other:	shall be included in baisc price of pumps			Included in basic price			
<b>(B) For supervision of E&amp;C:</b>							
(i) GST:	Extra at actuals			Extra at actuals			
(ii) Any other:	Included in basic price			Included in basic price			
<b>Notes:</b>							
1) Bidders should quote the Total Bid Value in both in figures & words in the specified place.							
2) Bidders should mention the applicable HSN/SAC code along with GST% against respective line items.							
3) Bidders shall not fill/edit/modify anything else in the Price Bid Format.							
4) The rates of line items mentioned in the Price Format shall be derived by BHEL by multiplying the Total Bid Value quoted by the Bidder with the Weightage Factor assigned against respective line items. The rate of each item shall be rounded off to the next 1 (one) paisa.							
5) The Total Bid Value quoted by the Bidder shall represent the total landed cost for this enquiry and shall include Packing & Forwarding Charges, Freight Charges, and all applicable taxes and duties, other than GST. GST shall be paid extra by BHEL at applicable rates.							
6) Evaluation shall be done on the basis of total bid value i.e. the total landed cost to BHEL for this enquiry. Loading on the price(as applicable) shall be added to the Total Bid Value for evaluation purpose. For more details, please refer "POWER LOADING CRITERIA FOR ROTATING EQUIPMENT, Doc No. 080557C-000-JSD-0900-002" of NIT.							
7) The bidders will also provide un-priced price format strictly in the BHEL price format given above, in the techno commercial part of their offers. Bid will be rejected if any other price format is used. Both priced and un-priced price formats to be provided by the bidders shall be signed and stamped copies.							
8) Bidder to quote strictly as per BHEL's NIT requirements.							
9) Bidder to note that this is a LUMP SUM Turn-Key Order. However							
(a) Changes to the tender specification during execution of the project for successful operation of the system need to be carried out by bidder and commercial implications if any will be settled suitably.							
(b) Unit rates quoted by bidder shall be applicable for any changes in BOQ during detailed engineering stage.							
10) <b>Main offer (Annexure-1B)</b> consists of those items which will be part of main order after successful bidder is identified. <b>Optional Items (Annexure-1B-I)</b> consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under <b>Main offer</b> and <b>Optional items</b> as per the prescribed format.							
11) Prices quoted by bidders for items under main offer : SI. No.(A+B+C) will be considered for evaluation of lowest bidder.							
For the purpose of tender (L1 bidder evaluation) following shall be noted:							
Referring to SI no C- Supervision charges for Pump set package, For the purpose of Quotation, total no of 5 man days (92.1% of price quoted against sl no C) for Pump set pacakge will be covered in 1 visit (7.9% of price quoted against sl no C) have been considered and payment against SI.No C above shall be made as per the actual number of visits and man days required for the supervision of the complete E&C activities as per these diem rates. Purchase Order for supply of main items, ( A to B) shall be placed by BHEL- PE&SD Hyderabad. For Supervisionof E&C, LOI shall be placed by PE&SD and PO By PE&SD-site.							
However, BHEL reserves the right							
(a) To include any of the optional items in scope of supply (as per customer contract requirements) and accordingly consider the same in evaluation. Any such scope increase and change in evaluation will be intimated to vendor during technical evaluation(before price bid opening).							
(b) To place PO for any of the Optional items with in the contract period.							
<u>Hence bidders need to mandatorily quote reasonable prices for all optional items considering such requirement and keep the validitv of the prices till the end of contract period.</u>							
12.a) For all items including Optional items, prices to be furnished in this prescribed price bid format only for each individual item. The price to be quoted against sl no A & B shall be Weightage w.r.t Overall Prices mentioned above. No combined prices, common prices or any other format will be accepted and such bids may be liable for rejection.							
12 b) Bidder must not change the indicated item description, quantity & units in the price bid format. Bidder should only fill the unit rates & total price.							
12 c) Bidder to quote for all the items as per price bid format. Incomplete/partial offer may be liable for rejection.							
13 a.) Commissioning spares are those spares which are required at the time of commissioning and shall be recommended (as per bidders experience) and quoted by bidder. However commissioning spares indicated in the price bid format shall be quoted as minimum.							
13.b) Commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor.							
14)With respect to Mandatory Spares;							
A) If any of above items indicated by the specified name are not applicable, bidder to offer alternative item serving the same function as per equipment's design and indicate below the item being replaced.							
B) If bidder is not able to meet the above note, then bidder may mention "Not Applicable". However, if found applicable during detailed engg. stage or alternative item as per equipment design can serve the same function, bidder to supply the specified quantity with out any delivery and commercial implications to BHEL..							
15) Reference document: <b>PY51729, R00 &amp; annexures.</b>							
16) Unpriced price bid format indicating as quoted against each applicable item shall be submitted duly signed & stamped along with technical offer by bidder as a token of concurrence that prices are submitted in this format only. The offer shall be liable for rejection in case if un-priced price bid format is not submitted or any modification is carried out in price bid format.							
17) <b>In case the systems are being supplied from outside India</b> , Following Third Party Inspection to be followed:							
a. M/s ABS Industrial Verification Private Limited							
b. M/s Bureau Veritas (India) Pvt. Ltd.							
c. M/s Certification Engineers International Limited							
d. M/s International Certification Services Private Limited							
e. M/s IR Class systems and Solutions Pvt. Ltd.							
f. M/s Projects and Development India Ltd.							
g. M/s SGS India Private Limited							
h. M/s TATA Project Limited							
i. M/s TUV SUD South Asia Pvt. Ltd.							
j. M/s VCS Quality Services Private Limited							
The charges should be included in the Main offer. For those bidders who are supplying from India, such third party inspection charges need not be considered and same will be arranged by BHEL/BHEL nominated inspection agency.							

Annexure-1B-I						
 <div> <b>BHARAT HEAVY ELECTRICALS LIMITED</b>  <b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b>  <b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b> </div>						
<b>PRICE FORMAT (R00) FOR DEGASSING PUMPS</b> <b>PROJECT: 525 TPD STANDBY SRU PROJECT IOCL PARADIP REFINERY, ODISHA, INDIA</b> <b>CUSTOMER: INDIAN OIL CORPORATION LIMITED PARADIP REFINERY PROJECT, PARADIP, ODISHA</b> <b>CONSULTANT : TECHNIP ENERGIES</b> <b>ESC: ENGINEERS INDIA LIMITED</b>						
SL NO	ITEM DESCRIPTION	QTY	UNIT	Bidder confirmation (Quoted/ Not Quoted)	HSN/SAC Code	GST (%)
Bidder's Name : <Bidder to indicate> Bidder's Offer No. & Dt. : <Bidder to indicate> Bidder's Ref No. & Dt. :<Bidder to indicate> BHEL Enq. No. & date :<Bidder to indicate>						
<b>II</b>	<b>Optional Items</b>	--	--			
A	<b>Two Years spares (O &amp; M Spares):</b> Parts or assemblies normally used or consumed on the basis of scheduled maintenance, overhauls, inspections, wear, corrosion, erosion or deterioration in normal service for a period of TWO years beyond the Defect Liability Period as recommended by manufacturers of various equipment (other than commissioning and mandatory required during the Defect Liability Period). Bidder to quote for their recommended two years' operation and maintenance spares. Recommended spares list for two years normal operation along with unit price breakup for Pump, Drives & other accessories. <b>(List with price break up to be enclosed)</b> (1 set stands for quantity required for the replacement of one pump, drive (or) accessories)	1 Set	Set			

Sr,no	VENDOR NAME	COUNTRY
<b>1.61</b>	<b>VAPOUR SEAL CHAMBERS</b>	
1	BRLIBASI HI-TECH UDY00	INDIA
2	HD FIREPROTECT PVT. LTD.	INDIA
3	NEWAGE FIREFIGHTING CO LTD.	INDIA
<b>2.51</b>	<b>MECHANICAL SEALS (API 622 TWIN SH DRY ME NIAL}</b>	
1	AESSEAL PLC	INTERNATIONAL
2	CHHETRA SEALS	INDIA
3	EAGLE	INDIA / INTERNATIONAL
4	FLOWSERVE (ENQ ISSUED TO: FLOWSERVE INDIA LTD)	INTERNATIONAL
5	JOHN CRANE	INTERNATIONAL
6	LEAK PROOF ENGG PVT LTD.	INDIA
<b>4.18</b>	<b>MOTOR-INDUCTION-M.V ( ZONE 2-TYPE E&amp;N)</b>	
1	ABB LIMITED	INDIA
2	BHARAT BIJLEE LIMITED	INDIA
3	CG POWER AND INDUSTRIAL SOLUTIONS LTD	INDIA
4	CG POWER AND INDUSTRIAL SOLUTIONS LTD	INDIA
5	KIROLOSKAR ELECTRIC CO. LTD	INDIA
6	LAXMI HYDRAULICS PVT LTD	INDIA
7	LOHER	INDIA
8	MARATHON ELECTRIC MOTOR LTD	INDIA
9	SIEMENS LTD	INDIA
10	WEG ELECTRIC INDIA PVT LTD	INDIA
<b>4.19</b>	<b>MOTOR-INDUCTION-M.V ( FLAMEPROOF)</b>	
1	ABB INDIA LTD	INDIA
2	BHARATBIJLEE UNTIED	INDIA
3	CEMP	INTERNATIONAL
4	CG Power and Industrial Solutions Ltd	INDIA
5	LAXMI HYDRAULICS PVT LTD	INDIA
6	MARATHON ELECTRIC MOTOR LTD	INDIA
7	SIEMENS LIMITED	INDIA
<b>4.21</b>	<b>MOTORS-IMPORTED</b>	
1	ABB	INDIA / INTERNATIONAL
2	CEMP SRL	INDIA / INTERNATIONAL
3	GE ENERGY POWER CONVERSION FRANCE SAS	INDIA / INTERNATIONAL
4	GENERAL ELECTRIC CANADA	INDIA / INTERNATIONAL
5	HITACHI LTD	INDIA / INTERNATIONAL
6	HYUNDAI HEAVY INDUSTRIES CO. LTD	INTERNATIONAL
7	JEUMONT SA / FRAMATONE ANP	INTERNATIONAL
8	LLOYD DYNAMOWERKE GMBH & CO. KG	INTERNATIONAL
9	LOHER GMBH	INTERNATIONAL
10	NIDEC ASI SPA	INTERNATIONAL
11	SIEMENS AG '	INTERNATIONAL
12	TOSHIBA CORPORATION	INDIA / INTERNATIONAL
13	WEG EQUIPMENTS ELETRICOS S.A..	INDIA / INTERNATIONAL
14	WEGEURO - INDUSTRIAIELECTRICA S.A	INTERNATIONAL
<b>4.35</b>	<b>CABLE TERMINATOR &amp; JOINING KIT</b>	
1	3M INDIA LIMITED	INDIA
2	ABB INDIA LTD	INDIA
3	EUROMOLD	INDIA
4	HEATSHRINK TECHNOLOGIES LTD.	INDIA
5	RAYCHEM RPG LTD	INDIA

6	REPL ENGINEERING LTD	INDIA
7	YAMUNA GASES & CHEMICALS PVT LTD	INDIA
<b>5.34</b>	<b>ORIFICE PLATE AND FLANGES</b>	
1	BALIGA LIGHTING EQUIMENTS (P) LTD	INDIA
2	CAMERON CANADA CORPORATION	INTERNATIONAL
3	COMMFIT & VALVES PVT LTD	INDIA
4		INDIA / INTERNATIONAL
5	EUREKA INDUSTRIAL EQUIMENTS (P) LTD	INDIA
6	GAUGES BOURDON ( I ) PVT LTD ( GEN. INST)	INDIA
7	GURU NANAK ENGG WORKS	INDIA
8	HYDROPNEUMATIC PVT LTD	INDIA
9	INSTRUMENTATION LTD ( PALGHAT)	INDIA
10	MICRO PRECISION PRODUCTS PVT LTD	INDIA
11	MINCO (INDIA) PVT LTD ( GEN INST)	INDIA
12	PETROL VALVES SRL	INTERNATIONAL
13	PIETRO FIORENTINI SPA	INTERNATIONAL
14	STAR-MECH CONTROLS ( INDIA ) PVT LTD.	INDIA
15	TM TECNOMATIC SPA	INTERNATIONAL
<b>5.35</b>	<b>FLOW ELEMENTS : (VENTURI, FLOW NOZZLES )</b>	
1	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA
2	FMC MEASUREMENTS SOLUTION	INTERNATIONAL
3	GAUGES BOURDON ( I ) PVT LTD ( GEN. INST)	INDIA
4	HYDROPNEUMATIC PVT LTD	INDIA
5	INSTRUMENTATION LTD ( PALGHAT)	INDIA
6	MICRO PRECISION PRODUCTS PVT LTD	INDIA
7	MINCO (INDIA) PVT LTD ( GEN INST)	INDIA
8	SMITH METERS	INTERNATIONAL
9	SOLARTRON ISA	INTERNATIONAL
10	STAR-MECH CONTROLS ( INDIA ) PVT LTD.	INDIA
11	TM TECNOMATIC SPA	INTERNATIONAL
<b>5.36</b>	<b>TEMP ELEMENTS THERMOWELLS</b>	
1	ABB AUTOMATION LTD	INTERNATIONAL
2	ALTOP INDUSTRIES LTD	INDIA
3	DAILY THERETRICS CORPORATION	INTERNATIONAL
4	DETRIV INSTRUMENTATION & ELECTRONICS L,TD	INDIA
5	GAUGES BOURDON ( I ) PVT LTD ( GEN. INST)	INDIA
6	GAYESCO LLC	INTERNATIONAL
7	GOA INSTRUMENTS INDUSTRIES PVT LTD	INDIA
8	PYRO-ELECTRIC INSTRUMENTS GOA PVT LTD	INDIA
9	TECHNO-INSTRUMENTS	INDIA
10	TEMPSSENS INSTRUMENTS INDIA PVT LTD	INDIA
11	TEMP-TECH	INDIA
12	THERMO ELECTRIC CO.INC	INDIA
13	THERMO-COUPLE PRODUCTS CO	INDIA
14	THERMO-ELECTRA B.V	INTERNATIONAL
15	TM TECHNOMATIC SPA	INTERNATIONAL
16	WIKA ALEXANDER WIEGAND & CO GMBH	INTERNATIONAL
17	THERMAL INSTRUMENTS INDIA PVT LTD	INDIA
<b>5.78</b>	<b>TEMP. GAUGES ( BI METALLIC FILLED SYSTEMS)</b>	
1	AN INSTRUMENTS PVT LTD	INDIA
2	ASHCROFT INDIA PVT LTD	INDIA
3	BADOTHERM PROCESS INSTRUMENTS B.V/BADOTHERM FAR EA	INTERNATIONAL



4	BAUMER BOURDON HEINNI SAS	INDIA
5	BAUMER TECHNOLOGIES INDIA PVT LTD	INDIA
6	GAUGES BOURDEN (i) PVT LTD. ( GEN. INST)	INDIA
7	GOA INSTRUMENTS INDUSTRIES PVT LTD	INDIA
8	H GURU INSTRUMENTS ( SOUTH INDIA) PVT LTD	INDIA
9	PRECISION MASS PRODUCTS PVT LTD OLD NAME ASHCROFT IN	INDIA
10	WALCHANDNAGAR INDUSTRIES LTD ( TIWAC DIVN)	INDIA
11	WIKA ALEXANDER WIEGAND & CO GMBH	INDIA / INTERNATIONAL
<b>6.32</b>	<b>FLANGE-CARBON STEEL</b>	
1	ABASI ENGINEERING WORKS	INDIA
2	ANANDMAYEE FORGINGS PVT LTD	INDIA
3	BHARAT FORGE LTD	INDIA
4	BRITEX ENGINEERING WORKS	INDIA
5	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA
6	ECHJAY INDUSTRIES PVT LTD	INDIA
7	FIVEBROS FORGINGS PVT LTD	INDIA
8	GOOD LUCK ENGINEERING CO.	INDIA
9	HILTON METAL FORGINGS LIMITED	INDIA
10	JAI AUTO PVT LTD	INDIA
11	JAV FORGINGS (P) LTD	INDIA
12	KISAAN DIETECH PVT LTD	INDIA
13	KISAAN STEEL (P) LTD	INDIA
14	LAL METALS FORGE LTD	INDIA
15	M.S FITTINGS MFG.CO PVT LTD	INDIA
16	MAASS FLANGE INDIA PVT LTD	INDIA
17	METAL FORGINGS PVT LTD	INDIA
18	P.K TUBES & FITTINGS PVT LTD	INDIA
19	PARAMOUNT FORGE	INDIA
20	PRADEEP METAL LIMITED	INDIA
21	R.D FORGE	INDIA
22	R.N GUPTA & CO. LTD	INDIA
23	SANGHVI FORGINGS & ENGINEERING LTD	INDIA
24	UTSAH ENGINEERING PVT LTD ( CD ENGG COMPANY)	INDIA
<b>6.33</b>	<b>FLANGE-ALLOY STEEL</b>	
1	ANANDMAYEE FORGINGS PVT LTD	INDIA
2	BHARAT FORGE LTD	INDIA
3	BRITEX ENGINEERING WORKS	INDIA
4	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA
5	ECHJAY INDUSTRIES PVT LTD	INDIA
6	FIVEBROS FORGINGS PVT LTD	INDIA
7	GOOD LUCK ENGINEERING CO.	INDIA
8	JAV FORGINGS (P) LTD	INDIA
9	LAL METALS FORGE LTD	INDIA
10	M.S FITTINGS MFG.CO PVT LTD	INDIA
11	METAL FORGINGS PVT LTD	INDIA
12	P.K TUBES & FITTINGS PVT LTD	INDIA
13	PARAMOUNT FORGE	INDIA
14	R.D FORGE	INDIA
15	SANGHVI FORGINGS & ENGINEERING LTD	INDIA
16	UTSAH ENGINEERING PVT LTD ( CD ENGG COMPANY)	INDIA
<b>6.34</b>	<b>FLANGE-STAINLESS STEEL</b>	
1	ANANDMAYEE FORGINGS PVT LTD	INDIA
2	BHARAT FORGE LTD	INDIA
3	BRITEX ENGINEERING WORKS	INDIA

4	CHANDAN STEEL LTD	INDIA
5	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA
6	ECHJAY INDUSTRIES PVT LTD	INDIA
7	FIVEBROS FORGINGS PVT LTD	INDIA
8	GOOD LUCK ENGINEERING CO.	INDIA
9	HILTON METAL FORGINGS LIMITED	INDIA
10	JAV FORGINGS (P) LTD	INDIA
11	LAL METAL FORGE LTD	INDIA
12	MAASS FLANGE INDIA PVT. LTD	INDIA
13	METAL FOROINOS PVT LTD	INDIA
14	PK TUBES & FITTINGS PVT.LTD.	INDIA
15	PARAMOUNT FORGE	INDIA
16	PRADEEP METAL LIMITED	INDIA
17	R D FORGE	INDIA
18	SANGHVI FORGINGS & ENGINEERING LTD	INDIA
19	UTSAH ENGINEERING PVT LTD A CD ENGG COMPANY	INDIA
20	VIRAJ PROFILES LIMITED	INDIA
<b>6.36</b>	<b>SIGHT FLOW INDICATORS (SIGHT GLASSES)</b>	
1	AMARAMA ENGINEERS	INDIA
2	BLISS ANAND PVT LTD	INDIA
3	C-TRU PROCESS EQUIPMENTS	INDIA
4	FRIEDRICH KROMBACH GMBH & CO.KG	INTERNATIONAL
5	LEVCON INSTRUMENTS PVT LTD	INDIA
6	PRATOLINA INSTRUMENTS PVT LTD	INDIA
7	SIGMA INSTRUMENTS CO	INDIA
8	TELEFLO INSTRUMENTS AND CONTROLS	INDIA
<b>6.37</b>	<b>PIPES-CARRON STEEL TO INDIAN STANDARDS</b>	
1	A.S.T. PIPES PVT. LTD.(AST GROUP)	INDIA
2	ADVANCED STEEL TUBE LTD.	INDIA
3	APL APOLLO TUBE LTD.	INDIA
4	ASIAN MILLS PVT LTD	INDIA
5	ASIAN TUBES LTD.	INDIA
6	ASRANI TUBES LIMITED	INDIA
7	CAPACITY STRUCTURES LTD.	INDIA
8	DADU PIPES (P)LTD	INDIA
9	ESSAR STEEL INDIA LIMITED	INDIA
10	GOODLUCK STEEL TUBES LTD	INDIA
11	INDUS TUBE LIMITED	INDIA
12	JCO GAS PIPE LIMITED	INDIA
13	JINDALINDIA LIMITED	INDIA
14	JINDAL INDUSTRIES LTD	INDIA
15	JINDAL PIPES LTD JINDAL SAW LTD I I, •• : -I WORKS	INDIA
16	JINDAL SAW LTD (KOSI WORKS)	INDIA
17	LAL BABA SEAMLESS TUBES PVT. LTD	INDIA
18	LALIT PIPES S PIPES LTD	INDIA
19	MAHARATRA SEAMLESS LTD	INDIA
20	MUKUT TANKS & VESSELS PVT	INDIA
21	NEZONE TUBES LIMITED	INDIA
22	NORTH ESTERN TUBES LIMITED	INDIA
23	P S STEEL TUBES LTD	INDIA
24	PRATIBHA INDUSTRIAL LIMITED	INDIA
25	RAMA STEEL TUBES LTD.	INDIA
26	RATNAMANI METALS AND TUBES LTD	INDIA
27	RAVINDRA TUBES LIMITED	INDIA

28	SAMSHI PIPE INDUSTRIES LIMIED	INDIA
29	SURYA ROSHNI LTD	INDIA
30	SWASTIK PIPES LTD	INDIA
31	UTIKARSH TUBES S PIPES LTD (FORMLY BMW)	INDIA
32	WELSPUN CORP LIMITED .	INDIA
33	ZENITH BIRLA (INDIA) LIMITED	INDIA
34	ZENITH FIRE SERVICES INDIA PVT LTD.	INDIA
<b>6.38</b>	<b>PIPES and TUBULARS TO A.P.I. STANDARDS</b>	
1	BHEL	INDIA
2	ESSAR STEEL INDIA LIMITED	INDIA
3	ISMT LTD	INDIA
4	JCO GAS PIPE LIMITED	INDIA
5	JDIDAL PIPES LTD	INDIA
6	JINDAL SAW LTD (KOSI WORKS)	INDIA
7	JINDAL SAW LTD (NASHIK WORKS)	INDIA
8	LALIT PIPES & PIPES LTD	INDIA
9	MAHARASHTRA SEAMLESS LTD.	INDIA
10	MUKUT TANKS & VESSELS PVT ITD	INDIA
11	PRATIBHA INDUSTRIES LIMITED	INDIA
12	RATNAMANI METALS AND TUBES LTD	INDIA
13	SUMITOMO METAL IND,LTD	INDIA
14	SURYA ROSHNI LTD	INDIA
15	SWASTIK PIPES LTD	INDIA
16	WELSPUN CORP LIMITED	INDIA
17	YANOZHOU LONTRIN STEEL TUBE CO. LTD.	INDIA
<b>6.39</b>	<b>PIPE/TUBE - CS (SEAMLESS) TO ASTM STDS</b>	
1	ANAND SEAMLESS TUBES PVT. LTD	INDIA
2	AVON TUBETECH PVT LTD	INDIA
3	BHEL	INDIA
4	HEAVY METALS & TUBES LIMITED(MEHSANA)	INDIA
5	ISMT LTD	INDIA
6	ISMT LTD-AHMEDNGR	INDIA
7	JINDAL SAW LTD (NASHIK WORKS)	INDIA
8	JR SEAMLESS PVT.LTD	INDIA
9	LAL BABA SEAMLESS TUBES PVT. LTD	INDIA
10	MAHALAXMI SEAMLESS LIMITED	INDIA
11	MAHARASHTRA SEAMLESS LTD.	INDIA
12	MAHARASHTRA SEAMLESS LTD.	INDIA
13	Patel Airflow Ltd.	INDIA
14	RATNADEEP METAL TUBES LTD.	INDIA
15	SAINEST TUBES PVT LTD	INDIA
16	SN TUBES PRIVATE METED	INDIA
17	SUMITOMO METAL IND.LTD	INDIA
18	YANOZHOU LONTRIN STEEL TUBE CO. LTD.	INDIA
<b>6.40</b>	<b>PIPE-CARPON STEEL (WELDE) TO ASTM STD,</b>	
1	ESSAR STEEL INDIA LIMITED	INDIA
2	JINDAL SAW LTD E081 WORKS	INDIA
3	LALIT PIPES & PIPES LTD	INDIA
4	MUXUT TANKS & VESSELS PVT LTD	INDIA
5	RATNAMANI METALS AND WEBS LID	INDIA
6	SUMITOMO METAL IND.LTD	INDIA
<b>6.41</b>	<b>PIPE/TUBE - AS (SEAAMLESS) TO ASTM STD</b>	
1	ANAND SEAMLESS TUBES PVT. LTD	INDIA

2	BHEL	INDIA
3	HEAVY METALS & TUBES LIMITED MEHSAN V	INDIA
4	ISMT LID	INDIA
5	ISMT LTD-AHMEDNOR	INDIA
6	JINDAL SAW LTD (NABHIK WORKS)	INDIA
7	JR SEAMLESS PVT.LTD	INDIA
8	MAHALAXMI SEAMLESS LIMITED	INDIA
9	MAHARASHTRA SEAMLESS LTD.	INDIA
10	Patel Airflow Ltd.	INDIA
11	RATNADEEP METAL TUBES LTD.	INDIA
12	SAINEST TUBES PVT LTD	INDIA
13	SUMITOMO METAL IND.LTD	INDIA
14	YANOZHOU LONTRIN STEEL_TUBE CO. LTD.	INDIA
<b>6.42</b>	<b>PIPE/TUBES-SS(S.LESS &amp; WELDED) TO ASTM STD</b>	
1	APEX TUBES PVT LTD	INDIA
2	ARVIND PIPES & FITTING IND PVT LTD	INDIA
3	BHANDARI FOILS AND TUBES LTD.	INDIA
4	CHANDAN STEEL LTD	INDIA
5	DIVINE TUBES PVT. LTD	INDIA
6	HEAVY METALS & TUBES LIMITED (MEHSANA)	INDIA
7	HELLIOS TUBE ALLOYS PVT LTD	INDIA
8	JINDAL SAW LTD (NASHIK WORKS)	INDIA
9	KRYSTAL STEEL MFG PVT. LTD.	INDIA
10	MAHALAXMI SEAMLESS LIMITED	INDIA
11	MAXIM TUBES COMPANY PVT LTD	INDIA
12	MBM TUBES PVT LTD	INDIA
13	RATNADEEP METAL TUBES LTD.	INDIA
14	RATNAMANI METALS AND TUBES LTD	INDIA
15	SANDVIK AB	INDIA
16	SANDVIK ASIA PVT. LIMITED (AHMEDABAD)	INDIA
17	SANDVIK MATERIALS TECHNOLOGY (CHINA) CO.	INDIA
18	SCODA TUBES LTD	INDIA
19	SCORODITE STAINLESS PVT LTD	INDIA
20	SHALCO INDUSTRIES PVT LTD.	INDIA
21	SHUBHLAXMI METALS AND TUBES PVT, LTD	INDIA
22	SLS TUBES MT LTD	INDIA
23	STEAMLINE INDUSTRIES Ltd	INDIA
24	SUMITOMO METAL IND.LTD	INDIA
25	SURAJ LIMITED	INDIA
26	TUBACEX PRAKASH INDIA PVT. LTD.	INDIA
27	TUBACEX TUBOS INOXIDABLES SAU	INDIA
<b>6.43</b>	<b>PIPE/TUBE-S.LESS(DUPLEX/SUPER DUPLEX SS)</b>	
1	RATNADEEP METAL TUBES LTD	INDIA
2	RATNAMANI METALS AND TUBES LTD	INDIA
3	SALZGITTER MANNESMANN ST DEUTSCHLANDOMBH	INTERNATIONAL
4	SANDVIK ASIA PVT. LIMITED (AHMEDABAD)	INDIA
5	SANDVIK MATERIALS TECHNOLOGY (CHINA) CO	INDIA
6	TUBACEX TUBOS INOXIDABLES SAU	INDIA
7	ZHEJIANG JIULI HI-TECH METALS CO. LTD.	INTERNATIONAL
<b>6.44</b>	<b>PIPE - SS WELDED TO A 358</b>	
1	OUTOKUMPU STAINLESS TUBULAR P.AB	INDIA
2	RATNAMANI METALS AND TUBES LTD	INDIA
3	REMI EDELSTAHL TUBULARS LTD.	INDIA
4	SCORODITE STAINLESS PVT LTD	INDIA

5	SUMITOMO METAL IND,LTD	INDIA
6	TUBACEX PRAKASH INDIA PVT, LTD. •	INDIA
<b>6.45</b>	<b>DUPLEX/SUPER. DUPLEX SS WELDED PIPES</b>	
1	GIEMINOX TECTUBI RACCORDI SRL	INTERNATIONAL
2	H.BUTTING GMBH & CO.KG	INTERNATIONAL
3	RIVIT SPA	INTERNATIONAL
4	SOSTA GMBH	INTERNATIONAL
<b>6.46</b>	<b>PIPES- INDIAN STOCKIST</b>	
1	BHARAT ENTERPRISES	INDIA
2	EVERGREEN SEAMLESS PIPES & TUBES PVT. LT	INDIA
3	GREEN LINE PIPE AND FITTINGS	INDIA
4	HI TECH METAL AND TUBES	INDIA
5	INDUSTRIAL METAL CORPORATION	INDIA
6	KWALITY TUBES	INDIA
7	MOKSHI INDUSTRIES PVT. LTD	INDIA
8	MOTILAL LAXMICHAND SANGHVI	INDIA
9	N-PIPE SOLUTION INC	INDIA
10	PK FORGE & FITTINGS INDUSTRIES	INDIA
11	RAJENDRA PIPING & FITTINGS	INDIA
12	SADAF TRADING COMPANY	
13	STAR METAL AND TUBES	INDIA
14	VENUS TRADING COMPANY	INDIA
<b>6.47</b>	<b>PIPE-CLADDED</b>	
1	CLADTEK MIDDLE EAST FZC	INTERNATIONAL
2	EISENBAU KRAMER GMBH	INTERNATIONAL
3	PTV PROCLAD L.L.C.	INTERNATIONAL
4	JAPAN STEEL WORKS LTD	INTERNATIONAL
5	NOBELCLAD	INTERNATIONAL
<b>6.48</b>	<b>PIPE WELDED ALLOY STEEL</b>	
1	LALIT PIPES & PIPES LTD	INDIA
2	RATNAMANI METALS AND TUBES LTD	INDIA
<b>6.49</b>	<b>PIPING SYSTEM - CLAD (SHOP FABRICATED)</b>	
1	BHEL	INDIA
2	KRYSTAL INDUSTRIAL SYNDICATE PVT LTD.	INDIA
3	OR ENGINEERING PRIVATE LTD (TARAPORE)	INDIA
4	INDUS PROJECTS LIMITED	INDIA
5	ISGEC HEAVY ENGINEERING LTD INDIA	INDIA
6	LARSEN & TOUBRO LTD INDIA	INDIA
7	TECHNO PROCESS EQUIPMENTS (INDIA) PVT LTD	INDIA
<b>6.50</b>	<b>PRE-FABRICATED PIPING SPOOL</b>	
1	BHARAT HEAVY ELECTRICAL LTD.	INDIA
2	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA
3	FTV PROCLAD L.L.C.	INTERNATIONAL
4	NASS INDUSTRIAL SERVICES	INTERNATIONAL
5	YINGKOU LIAOHE PIPE FITTINGS CO. LTD	INTERNATIONAL
<b>6.51</b>	<b>FITTINGS-FOREIGN AGENTS / STOCKIST TRADERS</b>	
1	AMERICAN PIPING PRODUCTS INC	INTERNATIONAL
2	AUSTIN STROUD & CO LTD	INTERNATIONAL
3	BUHLMANN ROHR-FITTINGS-STAHLANDEL GMBH	INTERNATIONAL
4	EDOEN MURRAY FZE (C/o Edgen Murray (India) Pvt. Limited	INTERNATIONAL

5	HART BV	INTERNATIONAL
6	HORST KURVERS GMBH	INTERNATIONAL
7	IBF S P A	INTERNATIONAL
8	IGAWARA INDL. SERVICES & TRADING PTE LTD	INTERNATIONAL
9	INTERNATIONAL INDUSTRIAL EQPT FZCO.	INTERNATIONAL
10	MARDALE PIPES PLUS LIMITED	INTERNATIONAL
11	OFFSHORE ENGINEERING & MARKETING LTD.	INTERNATIONAL
12	PETROGAS PIPING MIDDLE EAST FZCO	INTERNATIONAL
13	SIDECO SPA	INTERNATIONAL
14	TECHNICAL PARTS ESTABLISHMENT	INTERNATIONAL
15	VAN LEEUWEN BUIZEN	INTERNATIONAL
<b>6.52</b>	<b>FITTING BLOCK FORGED-CARBON STEEL</b>	
1	CSA FITTINGS	INDIA
2	EBY FASTENERS	INDIA
3	FLASH FORGE PVT LTD	INDIA
4	HILTON METAL FORGING LIMITED	INDIA
6	LEADER VALVES LTD	INDIA
6	M.S. FITTINGS MFG. CO PVT LTD	INDIA
7	P.K. TUBES & FITTINGS PVT.LTD.	INDIA
8	REAL FORGE & FITTINGS	INDIA
9	TUBE BEND (CALCUTTA) PVT LTD	INDIA
10	U I PIPE FITTINGS PVT LTD	INDIA
11	Sidharth & Gautam Engineers	INDIA
<b>6.53</b>	<b>FITTING BLOCK FORGED-ALLOY STEEL</b>	
1	CSA FITTINGS	INDIA
2	EBY FASTENERS	INDIA
3	FLASH FORGE PVT LTD	INDIA
4	LEADER VALVES LTD	INDIA
5	M.S. FITTINGS MFG. CO PVT LTD	INDIA
6	REAL FORGE & FITTINGS	INDIA
7	Sidharth & Gautam Engineers	INDIA
<b>6.54</b>	<b>FITTING BLOCK TORGED-STAINLESS STEEL</b>	
1	CSA FITTINGS	INDIA
2	EBY FASTENERS	INDIA
3	FLASH FORGE PVT LTD	INDIA
4	HILTON METAL FORGING UNITED	INDIA
6	LEADER VALVES LTD	INDIA
6	MiS. FITTINGS MFG. CO PVT LTD	INDIA
7	REAL FORGE & FITTINGS	INDIA
8	Sidharth & Gautam Engineers	INDIA
<b>6.55</b>	<b>WELDOLETS/ SOCKOLETS/ ELBOWLET</b>	
1	CSA FITTINGS	INDIA
2	EBY FASTENERS	INDIA
3	FLASH PORGE PVT LTD	INDIA
4	M.S. FITTINGS MFG. CO PVT LTD	INDIA
5	REAL FORGE & FITTINGS	INDIA
<b>6.56</b>	<b>FITTINGS FROM SEEMLESS PIPE-CARBON STEEL</b>	
1	ALLIED INTERNATIONAL S.R.L.	INDIA
2	CSA FITTINGS	INDIA
3	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA
4	FITTECH INDUSTRIES PVT LTD	INDIA
5	GUJRAT INFRAPIPES PVT. LIMITED	INDIA



6	K.B. PIPE FITTINGS (P) LTD	INDIA
7	M.S. FITTINGS MFG. CO PVT LTD	INDIA
8	P.K.TUBES & FITTINGS PVT.LTD.	INDIA
9	PATTECH FITWELL TUBE COMPONENTS	INDIA
10	PETRO CHEM INDUSTRIES	INDIA
11	REAL FORGE & FITTINGS	INDIA
12	SAWAN ENGINEERS PVT LTD	INDIA
13	TEEKAY TUBES PVT LTD	INDIA
14	TOPAZ PIPING INDUSTRIES	INDIA
15	TUBE BEND (CALCUTTA) PVT LTD	INDIA
16	U I PIPE FITTINGS PVT LTD	INDIA
17	Sidharth & Gautam Engineers	INDIA
<b>6.57</b>	<b>FITTINGS FROM SEAMLESS PIPE- ALLOY STEEL</b>	
1	ALLIED INTERNATIONAL S.R.L.	INDIA
2	CSA FITTINGS	INDIA
3	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA
4	FITTECH INDUSTRIES PVT LTD	INDIA
5	GUJRAT INFRAPIPES PVT. LIMITED	INDIA
6	P.K.TUBES & FITTINGS PVT.LTD.	INDIA
7	REAL FORGE & FITTINGS	INDIA
8	SAWAN ENGINEERS PVT LTD	INDIA
9	TEEKAY TUBES PVT LTD	INDIA
10	TOPAZ PIPING INDUSTRIES	INDIA
11	Sidharth & Gautam Engineers	INDIA
<b>6.58</b>	<b>FITTINGS FROM SEAMLESS PIPE- S.S.</b>	
1	ALLIED INTERNATIONAL S.R.L.	INDIA
2	CSA FITTINGS	INDIA
3	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA
4	FITINCH INDUSTRIES PVT LTD	INDIA
5	GUJRAT INFRAPIPES PVT. LIMITED	INDIA
6	K.S.PIPE FITTINGS Pi LTD	INDIA
7	M.S. FITTINGS MFG. CO PVT LTD	INDIA
8	P.K.TUBES & FITTINGS PVT.LTD.	INDIA
9	PETRO CHEM INDUSTRIES	INDIA
10	REAL FORGE & FITTINGS	INDIA
11	SAWAN ENGINEERS PVT LTD	INDIA
12	TEEKAY TUBES PVT LTD	INDIA
13	TOPAZ PIPING INDUSTRIES	INDIA
14	Sidharth & Gautam Engineers	INDIA
<b>6.59</b>	<b>FITTINGS FROM S/LESS PIPS-EXOTIC MATLS</b>	
1	ALLIED INTERNATIONAL S.R.L.	INDIA
2	ERNE FITTINGS GMBH	INTERNATIONAL
3	RACCORTUBI SPA	INTERNATIONAL
4	SAWAN ENGINEERS PVT LTD	INDIA
5	SUNGKWANG BEND CO. LTD	INTERNATIONAL
6	WILH SCHULZ GmbH	INTERNATIONAL
<b>6.60</b>	<b>FITTINGS CROSS-FROM SEAMLESS PIPES</b>	
1	GUJRAT INFRAPIPES PVT. LIMITED	INDIA
2	M.S. FITTINGS MFG. CO PVT LTD	INDIA
3	VALVITALIA SPA-TECNOFORGE DIVISION'	INTERNATIONAL
<b>6.61</b>	<b>FITTINGS TO IS-1239</b>	
1	CSA FITTINGS	INDIA

2	M.S. FITTINGS MFG. CO PVT LTD	INDIA
3	REAL FORGE & FITTINGS	INDIA
4	VIJAY CYCLE & STEEL INDUSTRIES	INDIA
<b>6.62</b>	<b>FITTINGS FABRICATED FROM PLATE - C.S.</b>	
1	ALLIED INTERNATIONAL S.R.L.	INDIA
2	DEE DEVELOPMENT ENGINEERS warm	INDIA
3	GUJRAT INFRAPIPES PVT. LIMITED	INDIA
4	P.K.TUBES & FITTINGS PVT.LTD.	INDIA
5		
7		
5	PETRO CHEM INDUSTRIES	INDIA
6	REAL FORGE & FITTINGS	INDIA
7	SAWAN ENGINEERS PVT LTD	INDIA
8	TEEKAY TUBES PVT LTD	INDIA
9	TOPAZ PIPING INDUSTRIES	INDIA
10	TUBE BEND (CALCUTTA) PVT LTD	INDIA
<b>6.63</b>	<b>FITTINGS FABRICATED FROM PLATE - A.S.</b>	
1	ALLIED INTERNATIONAL S.R.L.	INDIA
2	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA
3	GUJRAT INFRAPIPES PVT. LIMITED	INDIA
4	P.K.TUBES & FITTINGS PVT.LTD.	INDIA
5	REAL FORGE & FITTINGS	INDIA
6	SAWAN ENGINEERS PVT LTD	INDIA
7	TEEKAY TUBES PVT LTD	INDIA
<b>6.64</b>	<b>FITTINGS FABRICATED FROM PLATE - S.S.</b>	
1	ALLIED INTERNATIONAL S.R.L.	INDIA
2	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA
3	GUJRAT INFRAPIPES PVT. LIMITED	INDIA
4	P.K.TUBES& FITTINGS PVT.LTD.	INDIA
5	REAL FORGE & FITTINGS	INDIA
6	SAWAN ENGINEERS PVT LTD	INDIA
7	TEEKAY TUBES PVT LTD	INDIA
<b>6.65</b>	<b>FITTINGS FAB. FROM PLATE-EXOTIC MATLS.</b>	
1	ALLIED INTERNATIONAL S.R.L.	INDIA
2	IBF S P A	INTERNATIONAL
3	RACCORTUBI SPA	INTERNATIONAL
4	SAWAN ENGINEERS PVT LTD	INDIA
5	SUNGKWANG BEND CO. LTD	INTERNATIONAL
6	WILH SCHULZ GmbH	INTERNATIONAL
<b>6.66</b>	<b>FITTINGS PIPES CAP (C S)</b>	
1	ALLIED INTERNATIONAL S.R.L.	INDIA
2	CSA FITTINGS	INDIA
3	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA
4	GUJRAT.INFRAPIPES PVT. LIMITED	INDIA
5	K.S.PIPE FITTINGS (P) LTD	INDIA
6	M.S. FITTINGS MFG. CO PVT LTD	INDIA
7	P.K.TUBES & FITTINGS PVT.LTD.	INDIA
8	PATTECH FITWELL TUBE COMPONENTS	INDIA
9	PETRO CHEM INDUSTRIES	INDIA
10	REAL FORGE & FITTINGS	INDIA
11	SAWAN ENGINEERS PVT LTD	INDIA

12	TEEKAY TUBES PVT LTD	INDIA
13	TUBE BEND (CALCUTTA) PVT LTD	INDIA
<b>6.67</b>	<b>FITTINGS PIPE CAP (A. S.)</b>	
1	ALLIED INTERNATIONAL S.R.L.	INDIA
2	CSA FITTINGS	INDIA
3	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA
4	GUJRAT INFRAPIPES PVT. LIMITED	INDIA
5	P.K.TUBES & FITTINGS PVT.LTD.	INDIA
6	REAL FORGE & FITTINGS	INDIA
7	SAWAN ENGINEERS PVT LTD	INDIA
8	TEEKAY TUBES PVT LTD	INDIA
<b>6.68</b>	<b>FITTINGS PIPE CAP (S S)</b>	
1	ALLIED INTERNATIONAL S.R.L.	INDIA
2	CSA FITTINGS	INDIA
3	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA
4	GUJRAT INPRAPIPES PVT. LIMITED	INDIA
5	K.S.PIPE PTITINGS (P) LTD	INDIA
6	P.K.TUBES & FITTINGS PVT.LTD.	INDIA
7	PETRO CHEM INDUSTRIES	INDIA
8	REAL FORGE & FITTINGS	INDIA
9	SAWAN ENGINEERS PVT LTD	INDIA
10	TEEKAY TUBES PVT LTD	INDIA
<b>6.69</b>	<b>FITTINGS PIPE CAP (EXOTIC)</b>	
1	RACCORTUBI SPA	INTERNATIONAL
2	SUNGKWANG BEND CO. LTD	INTERNATIONAL
<b>6.70</b>	<b>GASKET (IMPORTED)</b>	
1	FLEXITALLIC LTD .	INTERNATIONAL
2	JAMES WALKER CO LTD.	INTERNATIONAL
3	MOORSIDE MACHINING CO LTD	INTERNATIONAL
<b>6.71</b>	<b>GASKET NON-ASBESTOS</b>	
1	CHAMPION JOINTINGS PVT LTD.	INDIA
2	DAVE ENGINEERS PVT.LTD	INDIA
3	FLEXITALLIC LTD	INTERNATIONAL
4	IGP ENGINEERS PVT. LIMITED	INDIA
5	JAMES WALKER INMARCO INDUSTREIS PVT. LTD	INDIA
6	MADRAS INDUSTRIAL PRODUCTS	INDIA
7	NEOSEAL ENGINEERING PRIVATE LIMITED	INDIA
8	SEALANT AND GASKET INDIA PVT LTD	INDIA
9	STARFLEX SEALING INDIA PVT LTD	INDIA
10	UNI KLINGER LTD	INDIA
11	TEADIT PACKING AND GASKETS PVT LTD	INDIA
<b>6.72</b>	<b>GASKET METALLIC &amp; SOFT IRON</b>	
1	IGP ENGINEERS PVT. LIMITED	INDIA
2	MADRAS INDUSTRIAL PRODUCTS	INDIA
3	MICRO PRECISION PRODUCTS PVT LTD	INDIA
4	STARFLEX SEALING INDIA PVT LTD	INDIA
5	TEADIT PACKING AND GASKETS PVT LTD	INDIA
<b>6.73</b>	<b>GASKET METAL JACKETED</b>	
1	DAVE ENGINEERS PVT.LTD	INDIA
2	IGP ENGINEERS PVT. LIMITED	INDIA

3	MADRAS INDUSTRIAL PRODUCTS	INDIA
4	STARFLEX SEALING INDIA PVT LTD	INDIA
5	TEEKAY PWWFLEJC PVT. LTD.	INDIA
6	UNI KLIINGER LTD	INDIA
7	TEADIT PACKING AND GASKETS PVT LTD	
<b>6.74</b>	<b>GASKET SPIRAL WOUND</b>	
1	BOMBAY CHEMICAL EQUIPMENTS	INDIA
2	CHAMPION JOINTINGS PVT LTD.	INDIA
3	DAVE ENGINEERS PVT.LTD	INDIA
4	IGP ENGINEERS PVT. LIMITED	INDIA
5	JAMES WALKER INMARCO INDUSTREIS PVT. LTD	INDIA
6	MADRAS INDUSTRIAL PRODUCTS	INDIA
7	NEOSEAL ENGINEERING PRIVATE LIMITED	INDIA
8	STARFLEX SEALING INDIA PVT LTD	INDIA
9	TEADIT PACKING AND GASKETS PVT LTD	INDIA
10	TEEKAY FLOWFLEX PVT. LTD.	INDIA
11	UNI KLINGER LTD	INDIA
<b>6.75</b>	<b>HOSE RUBBER (STEAM/GAS/AIR /WATER/CHEM)</b>	
1	DEWAS HYDROQUIP PVT LTD	INDIA
2	GAYTRI INDUSTRIAL CORPORATION	INDIA
3	HELIFLEX HYDRAULICS & ENGG.CO.	INDIA
4	INSAP ENGINEERS PVT.. LTD	INDIA
5	PIX TRANSMISSIONS LIMITED	INDIA
6	RM APPLIED ENGINEERS	INDIA
7	ROYAL INDIA CORP (JRE PVT LTD)	INDIA
8	SRIDHAR ENGG & RUBER PRODUCTS PVT LTD.	INDIA
9	SWAGELOK CO.	INDIA
<b>6.76</b>	<b>NOON METALLIC FLEXIBLE SS</b>	
1	BENGAL INDUSTRIES PVT LTD	INDIA
2	DEWAS HYDROQUIP PVT LTD	INDIA
3	GAYTRI INDUSTRIAL CORPORATION	INDIA
4	HELIFLEX HYDRAULICS & ENGG.CO.	INDIA
5	INDIA FLEX INDUSTRIES PVT.LTD.	INDIA
6	INSAP ENGINEERS PVT. LTD INSAP FLEXIBLES & ENGINEERS PVT LTD	INDIA
7	INSAP FLEXIBLES & ENGINEERS PVT LTD	INDIA
8	RM APPLIED ENGINEERS	INDIA
9	SENIOR INDIA PRIVATE LIMITED	INDIA
10	SWAGELOK CO.	INDIA
<b>6.77</b>	<b>FASTENERS</b>	
1	AEP COMPANY	INDIA
2	FASTENERS & ALLIED PRODUCTS PVT LTD.	INDIA
3	FIX FIT FASTENERS MFG. PVT.LTD.	INDIA
4	HARDWIN FASTENERS PVT LTD.	INDIA
5	HEM INDUSTRIES	INDIA
6	INDUSTRIAL ENGINEERING CORP.	INDIA
7	KUNDAN INDUSTRIES LTD.	INDIA
8	LAKSHMI PRECISION SCREWS LTD	INDIA
9	MEGA ENGINEERING PVT. LTD.	INDIA
10	MULTI FASTENERS PVT LTD '	INDIA
11	NITIN FASTNERS PVT LTD	INDIA
12	OME METALLURGICA ERBESE S.r.l.	INTERNATIONAL
13	PANKAJ INTERNATIONAL	INDIA

14	PIONEER NUTS & BOLTS PVT LTD	INDIA
15	PRECISION AUTO ENGINEERS	INDIA
16	PRECISION ENGG. INDUSTRIES	INDIA
17	PRESIDENT ENGINEERING WORKS	INDIA
18	PROCYON TCHNOLOOY	INDIA
19	SAVETA ENGINEERING CO.PVT.LTD.	INDIA
20	SOUVENIR INTERNATIONAL	INDIA
21	SYNDICATE ENGINEERING INDUSTRIES	INDIA
22	UDEHRA FASTNERS LTD	INDIA
23	UDEHRA MECHANICAL WORKS	INDIA
<b>6.78</b>	<b>FASTENERS: HIGH TEMPERTURE TO A 452</b>	
1	BEA SRL	INTERNATIONAL
2	FASTENERS & ALLIED PRODUCTS PVT LTD.	INDIA
3	OME METALLLTRGICA ERBESE S.r.l.	INTERNATIONAL
4	PRESIDENT ENGINEERING WORKS	INDIA
5	SYNDICATE ENGINEERING INDUSTRIES	INDIA
6	TRIPLE FAST MIDDLE EAST LTD	INTERNATIONAL
<b>6.79</b>	<b>EXPANSION JOINTS (RUBBER)</b>	
1	CORI ENGINEERS PVT LTD	INDIA
2	FLEXOCON ENGINEERS PVT LTD.	INDIA
3	MACOGA S.A.	INTERNATIONAL
4	MIL INDUSTRIES LIMITED	INDIA
5	RM APPLIED ENGINEERS	INDIA
6	RRD DECORS PVT LTD.	INDIA
7	SRM EXOFLEX PVT. LTD.	INDIA
<b>6.81</b>	<b>STRAINERS</b>	
1	FORAIN S.R.L.	INTERNATIONAL
2	FRIEDRICH KROMBACH GMBH & CO.KG	INTERNATIONAL
3	FUJI FILTER MFG CO LTD	INTERNATIONAL
4	JFC CORPORATION	INTERNATIONAL
5	NEWARK WIRE CLOTH CO	INTERNATIONAL
6	SPIRAX SARCO INTERNATIONAL INC	INTERNATIONAL
7	VEE BEE LIMITED	INTERNATIONAL
<b>6.82</b>	<b>STRAINERS (FAB/CAST/FORGED)</b>	
1	BOMBAY CHEMICAL EQUIPMENTS	INDIA
2	ESCO STEAMCON PVT. LTD.	INDIA
3	FORBES MARSHALL PVT LTD.	INDIA
4	GRAND PRIX ENGINEERING PVT LTD.	INDIA
5	GUJARAT OTOFILT	INDIA
6	LEADER VALVES LTD	INDIA
7	MULITTEX FILTRATION ENGINEERS LTD.	INDIA
8	PENNANT ENGINEERING PVT LTD	INDIA
9	SUNGOV ENGINEERING PVT LTD	INDIA
10	VERMEER PROCESS TECHNOLOGY B.V	INTERNATIONAL
<b>6.83</b>	<b>STEAM TRAPS-BUCKET/TH. DYN/TH. STAT/FLOAT</b>	
1	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA
2	ESCO STEAMCON PVT. LTD.	INDIA
3	FORBS MARSHALL PVT. (Old Name:FORBS MARSH	INDIA
4	GESTRA AG (FLOWSERVE GROUP)	INDIA
5	LEADER VALVES LTD	INDIA
6	PENNANT ENGINEERING PVT LTD	INDIA

7	UNI KLINGER LTD	INDIA
<b>6.84</b>	<b>COMPACT STEAM TRAPING ASSY /SS/CR MANIFOLD</b>	
1	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA / INTERNATIONAL
2	FORBES MARSHALL PVT. LTD. Old Name: FORBES MARSH	INDIA
3	UNI KLINGER LTD	INDIA
<b>6.85</b>	<b>STEAM TRAPS</b>	
1	ARMSTRONG INTERNATIONAL S.A.	INTERNATIONAL
2	PLENTY STEAM TRAPS, PLENTY LIMITED	INTERNATIONAL
3	TLV INTERNATIONAL INC	INTERNATIONAL
4	YARWAY CORPORATION	INDIA
<b>6.86</b>	<b>STEAM SUPPLY / COND. RECOVERY MANIFOLD</b>	
1	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA / INTERNATIONAL
2	FORBES MARSHALL PVT. LTD. Old Name: FORBES MARSH	INDIA
3	UNI KLINGER LTD	INDIA
<b>6.87</b>	<b>VALVE GATE (THRU CONDUIT) (AP16D)</b>	
1	PENTAIR VALVES & CONTROLS INDIA PVT LTD	INDIA
2	Z & J TECHNOLOGIES GMBH	INTERNATIONAL
<b>6.88</b>	<b>VALVE GATE- (FOREIGN SUPPLIERS)</b>	
1	BFE SRL	INTERNATIONAL
2	CESARE BONNETTI S.P.A.	INDIA
3	DOUGLAS CHERO SPA	INTERNATIONAL
4	FLOWSERVE PTE (MFR. EDWARD)	INDIA
5	FRIEDRICH KROMBACH GMBH & CO.KG	INTERNATIONAL
6	FRIULCO SPA	INDIA
7	HANGZHOU NEW TIME VALVE CO. LTD.	INTERNATIONAL
8	JC FABRICA DE VALVULAS S.A.	INTERNATIONAL
9	JIANGSU Jiulong Valve Manufacture CilLid	INTERNATIONAL
10	KITZ CORPORATION	INTERNATIONAL
11	LVF SPA	INTERNATIONAL
12	MSA A.S.	INTERNATIONAL
13	PENTAIR VALVES	INDIA
14	PETROL VALVES SRL	INTERNATIONAL
15	PK VALVE CO. LTD	INTERNATIONAL
16	TH. JANSEN-ARMATUREN GMBH	INTERNATIONAL
17	VELAN INC	INDIA
18	VITAS - DIVISION OF VALVITALIA B.P.A	INTERNATIONAL
19	WUZHOU VALVE CO LTD	INTERNATIONAL
<b>6.89</b>	<b>VALVE GATE CAST</b>	
1	AMPO VALVES INDIA PVT LTD	INDIA
2	AMPO S.COOP (POYAM) VALVES,	INDIA
3	AV VALVES LIMITED	INDIA
4	BHEL	INDIA
5	BOTELI VALVE GROUP CO.	INDIA
6	CESARE BONNETTI S.P.A.	INDIA
7	CRI PUMPS PVT LTD UNIT-VALVES	INDIA
8	EXPERT ENGINEERING ENTERPRISES.	INDIA
9	FLOTEK INDUSTRIES	INTERNATIONAL



10	FLOWSERVE PTE (MFR. EDWARD)	INDIA
11	FLULDLINE VALVES CO.PVT LTD	INDIA
12	FORWARD ALLOYS & CASTINGS	INDIA
13	FOURESS ENGG (I) LTD. (AURANGABAD)	INDIA
14	FRIEDRICH KROMBACH GMBH & CO.KG	INTERNATIONAL
15	GM ENGINEERING PVT. LTD.	INDIA
16	HAWA ENGINEERS LTD	INDIA
17	INTERVALVE POONAWALLA MUTED	INDIA
18	KSB PUMPS LTD (COMBATTORE)	INDIA
19	L & T VALVES LIMITED	INDIA
20	LAZARO ITUARTE INTERNATION' SA	INTERNATIONAL
21	LEADER VALVES LID	INDIA
22	MH VALVES PVT LTD.	INDIA
23	MICON ENGINEERS (HUBLI) PVT LTD	INDIA
24	MSA A.S.	INTERNATIONAL
25	NEWAY VALVE (SUZHOU) CO LTD	INTERNATIONAL
26	NILON VALVES PRIVATE LIMITED	INDIA
27	NSSL PVT. LTD. (NECO SCHUBERT & SAIZER)	INDIA
28	OSWAL INDUSTRIES LTD	INDIA
29	PANCHVATI VALVES & FLANGES PVT LTD	INDIA
30	PEE INDUSTRIAL VALVES PVT. LTD,	INDIA
31	SAKHI ENGINEERS WT. LTD.	INDIA
32	SHALIMAR VALVES PVT LTD	INDIA
83	SHAYBURG VALVES WI' LTD	INDIA
34	SHENJIANG VALVE CO LTD	INTERNATIONAL
35	STEEL STRONG VALVES INDIA PVT LTD	INDIA
36	SUZHOU VIZA VALVE CO. LTD	INTERNATIONAL
37	T.S. PUMPS AND VALVES PVT.LTD	INDIA
38	VELAN VALVES INDIA PVT LTD	INDIA
39	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT LTD	INDIA
40	XOMOX SANMAR LTD-PACIFIC VALVES DIVISION	INDIA / INTERNATIONAL
41	Z & J TECHNOLOGIES GMBH	INTERNATIONAL
42	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA
<b>8.90</b>	<b>VALVE GATE CRYOGENIC CAST</b>	
1	AMPO S.COOP (POYAM VALVES)	INDIA
2	BOTELI VALVE GROUP CO.	INDIA
3	L & T VALVES LIMITED	INDIA
4	LAZARO ITUARTE INTERNATIONAL ,SA	INTERNATIONAL
5	LEADER VALVES LTD	INDIA
6	NSSL PVT. LTD.(NECO SCHUBERT & SALZER)	INDIA
7	OSWAL INDUSTRIES LTD	INDIA
8	PANCHVATI VALVES & FLANGES PVT LTD	INDIA
9	SHENJIANG VALVE CO LTD	INTERNATIONAL
10	STEEL STRONG VALVES INDIA PVT LTD	INDIA
11	VELAN INC	INDIA
12	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT	INDIA
13	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA
<b>6.91</b>	<b>VALVE GATE FORGED</b>	
1	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA
2	ATAM VALVE PVT LTD	INDIA
3	AUTOCAP INDUSTRIES	INDIA
4	AV VALVES LIMITED	INDIA
5	BFE SRL	INTERNATIONAL
6	BHEL	INDIA

7	BOTELI VALVE GROUP CO.	INDIA
8	DOUGLAS CHERO SPA	INTERNATIONAL
9	ECONO VALVES LTD (NSSL LTD GROUP CO)	INDIA
10	FLUIDLINE VALVES CO.PVT LTD	INDIA
11	GM ENGINEERING PVT. LTD.	INDIA
12	HAWA ENGINEERS LTD	INDIA
13	INTERVALVE POONAWALLA LIMITED	INDIA
14	KSB PUMPS LTD	INDIA
15	L & T VALVES LIMITED	INDIA
16	LEADER VALVES LTD	INDIA
17	MH VALVES WT' LTD.	INDIA
18	MICON ENGINEERS (HUBLI) PVT LTD	INDIA
19	NSSL LTD	INDIA
20	OSWAL INDUSTRIES LTD	INDIA
21	PANCHVATI VALVES & FLANGES PVT LTD	INDIA
22	PEE INDUSTRIAL VALVES PVT. LTD.	INDIA
23	SHALIMAR VALVES PVT LTD	INDIA
24	SHAYBURG VALVES PVT LTD	INDIA
28	STEEL STRONG VALVES INDIA PVT LTD	INDIA
26	VEE TECH VALVES PRIVATE LIMITED	INDIA
27	VELAN VALVES INDIA PVT LTD	INDIA
28	WEIR BDK VALVES	INDIA
29	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA
<b>6.92</b>	<b>VALVE GATE CRYOGENIC FORGED</b>	
1	ASSOCIATED TOOLINGS INDIA WT' LTD	INDIA
2	BOTELI VALVE GROUP CO.	INDIA
3	L & T VALVES LIMITED	INDIA
4	LEADER VALVES LTD	INDIA
5	LVF SPA	INTERNATIONAL
6	OSWAL INDUSTRIES LTD	INDIA
7	PANCHVATI VALVES & FLANGES WT' LTD	INDIA
8	STEEL STRONG VALVES INDIA WT' LTD	INDIA
9	VELAN VALVES INDIA PVT LTD	INDIA
10	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT LTD	INDIA
11	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA
<b>6.93</b>	<b>VALVE GATE GUNMETAL BRASS / BRONZE</b>	
1	AV VALVES LIMITED	INDIA
2	H. SARKER & COMPANY	INDIA
3	LEADER VALVES LTD	INDIA
4	SANT VALVES PVT LTD	INDIA
5	ZOLOTO INDUSTRIES	INDIA
<b>6.94</b>	<b>VALVE GATE (MOTOR OPERATED)</b>	
1	AMPO VALVES INDIA PVT LTD	INDIA
2	AMPO S.COOP (POYAM VALVES)	INDIA
3	BHEL	INDIA
4	BOTELI VALVE GROUP CO.	INDIA
5	CESARE BONNETT1 SPA	INDIA
6	FLOWSERVE PTE (MFR. EDWARD)	INDIA
7	FLUIDLINE VALVES CO.PVT LTD	INDIA
8	FRIEDRICH KROMBACH GMBH A CO.XO	INTERNATIONAL
9	GM ENGINEERING PVT. LTD.	INDIA
10	INTERVALVE POONAWALLA LIMITED	INDIA
11	KSB PUMPS LTD (COIMBATTORE)	INDIA
12	L & T VALVES LIMITED	INDIA
13	LEADER VALVES LTD	INDIA

14	MSA A.S.	INTERNATIONAL
15	NSSL. LTD (NECO SCHUBERT & SALZER LTD)	INDIA
16	OSWAL INDUSTRIES LTD	INDIA
17	STEEL STRONG VALVES INDIA PVT LTD	INDIA
18	VELAN VALVES INDIA PVT LTD	INDIA
19	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT	INDIA
20	XOMOX SANMAR LTD-PACIFIC VALVES DIVISION	INDIA
21	Z & J TECHNOLOGIES GMBH	INTERNATIONAL
22	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA
<b>6.95</b>	<b>VALVE KNIFE GATE</b>	
1	BRAY CONTROLS INDIA PVT. LTD.	INDIA
2	EXPERT ENGINEERING ENTERPRISES	INDIA
3	HANGZHOU NEW TIME VALVE CO. LTD.	INTERNATIONAL
4	JASH ENGINEERING LTD.	INDIA
5	MICROFINISH VALVES PVT LIMITED	INDIA
6	TOTAL ENGINEERING CO. LTD	INTERNATIONAL
7	VAAS INDUSTRIES PVT LTD	INDIA
<b>6.96</b>	<b>VALVE GLOBE- (FOREIGN SUPPLIERS)</b>	
1	BFE SRL	INTERNATIONAL
2	DOUGLAS CHERO SPA	INTERNATIONAL
3	FLOWERVE PTE (MRF. EDWARD)	INDIA
4	FRIEDRICH KROMBACH GMBH & CO.K0	INTERNATIONAL
5	FRIULCO SPA	INDIA
6	JC FABRICA DE VALVULAR S.A.	INTERNATIONAL
7	JIANGSU Jluiong Valve Manufacture Co.Ltd	INTERNATIONAL
8	XITZ CORPORATION	INTERNATIONAL
9	LVF SPA	INTERNATIONAL
10	MSA A.S.	INTERNATIONAL
11	PENTAIR VALVES	INDIA
12	PETROL VALVES SRL	INTERNATIONAL
13	PK VALVE CO. LTD	INTERNATIONAL
14	TYCO VALVES & CONTROL ITALIA SRL	INTERNATIONAL
15	VELAN INC	INDIA
16	VITAS - DIVISION OF VALVITALIA S.P.A	INTERNATIONAL
17	WUZHOU VALVE CO LTD	INTERNATIONAL
<b>6.97</b>	<b>VALVE GLOBE CAST</b>	
1	AMPO VALVES INDIA PVT LTD	INDIA
2	AMPO S.COOP (POYAM VALVES)	INDIA
3	AV VALVES LIMITED	INDIA
4	BHEL	INDIA
5	BOTELI VALVE GROUP CO,	INDIA
6	CRI PUMPS PVT LTD (UNIT -VALVES)	INDIA
7	EXPERT ENGINEERING ENTERPRISES	INDIA
8	FLOTEK INDUSTRIES	INTERNATIONAL
9	FLUIDLINE VALVES CO.PVT LTD	INDIA
10	FORWARD ALLOYS & CASTINGS	INDIA
11	FOURERS ENG (I) LTD. (AURANGABAD)	INDIA
12	FRIEDRICH KROMBACH GMBH & CO.KG	INTERNATIONAL
13	GM ENGINEERING PVT. LTD.	INDIA
14	HAWA ENGINEERS LTDINDIA	
15	INTERVALVE POONAWALLA LIMITED	INDIA
16	KSB PUMPS LTD (COIMBTTORE)	INDIA
17	L & T VALVES LIMITED	INDIA
18	LAZARO ITUARTE INTERNATION SA	INTERNATIONAL

19	LEADER VALVES LTD	INDIA
20	MH VALVES PVT LTD.	INDIA
21	MICON ENGINEERS . HUHUI PVT LTD	INDIA
22	NSA A.S.	INTERNATIONAL
23	NEWAY VALVE (SUZHOU) CO LTD	INTERNATIONAL
24	NILON VALVES PRIVATE LIMITED	INDIA
25	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA
26	OSWAL INDUSTRIES LTD	INDIA
27	PANCHVATI VALVES & FLANGES PVT LTD	INDIA
28	PEE INDUSTRIAL VALVES PVT. LTD.	INDIA
29	SAM ENGINEERS PVT. LTD.	INDIA
30	SHALIMAR VALVES PVT LTD	INDIA
31	SHAYBURG VALVES PVT LTD	INDIA
32	SHENJIANG VALVE CO LTD	INTERNATIONAL
33	STEEL STRONG VALVES INDIA PVT LTD	INDIA
34	SUZHOU VIZA VALVE CO. LTD	INTERNATIONAL
35	WEIR BDK VALVES-A UNIT OP WEIR INDIA PVT	INDIA
36	XOMOX SANMAR LTD-PACIFIC VALVES DIVISION	INDIA
37	NTTON VALVE INDUSTRIES PRIVATE LTD .	INDIA
<b>6.98</b>	<b>VALVE GLOBE CRYOGENIC CAST</b>	
1	AE VALVES	INTERNATIONAL
2	AMPO S. COOP (POYAM VALVES]	INDIA
3	BOTELI VALVE GROUP CO.	INDIA
4	L & T VALVES LIMITED	INDIA
5	LAZARO ITUARTE INTERNATIONAL SA	INTERNATIONAL
6	LEADER VALVES LTD	INDIA
7	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA
8	OSWAL INDUSTRIES LTD	INDIA
9	PANCHVATI VALVES & FLANGES PVT LTD	INDIA
10	STEEL STRONG VALVES INDIA PVT LTD	INDIA
11	VELAN INC	INDIA
12	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT	INDIA
13	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA
<b>6.99</b>	<b>VALVE GLOBE FORGED</b>	
1	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA
2	ATAM VALVES PVT LTD.	INDIA
3	AUTOCAP INDUSTRIES	INDIA
4	AV VALVES LIMITED	INDIA
5	BFE SRL	INTERNATIONAL
6	BHEL	INDIA
7	BOTELI VALVE GROUP CO.	INDIA
8	DOUGLAS CHERO SPA	INTERNATIONAL
9	FLOWSERVE PTE (MFR. EDWARD)	INDIA
10	FLUIDLDIE VALVES CO.PVT LTD	INDIA
11	GM ENGINEERING WT. LTD.	INDIA
12	HAWA ENGINEERS LTD	INDIA
13	INTERVALVE POONAWALLA LIMITED	INDIA
14	KSB PUMPS LTD (COIMBATTORE)	INDIA
15	L & T VALVES LIMITED	INDIA
16	LEADER VALVES LTD	INDIA
17	MICON ENGINEERS (HUBLI) PVT LTD	INDIA
18	OSWAL INDUSTRIES LTD	INDIA
19	PANCHVATI VALVES & FLANGES PVT LTD	INDIA
20	PEE INDUSTRIAL VALVES PVT. LTD.	INDIA
21	SEMPPELL VALVES PVT LTD	INDIA

22	SHALIMAR VALVES PVT LTD	INDIA
23	SHAYBURG VALVES PVT LTD	INDIA
24	STEEL STRONG VALVES INDIA PVT LTD	INDIA
25	VEE TECH VALVES PRIVATE LIMITED	INDIA
26	VELAN VALVES INDIA PVT LTD	INDIA
27	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT	INDIA
28	NITON VALVE INDUSTRIES PRIVATE LTD	INDIA
<b>6.100</b>	<b>VALVE GLOVE CRYOGENIC FORGED</b>	
1	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA
2	BOTELI VALVE GROUP CO.	INDIA
3	L & T VALVES LIMITED	INDIA
4	LEADER VALVES LTD	INDIA
5	LVF SPA	INTERNATIONAL
6	OSWAL INDUSTRIES LTD	INDIA
7	STEEL STRONG VALVES INDIA PVT LTD	INDIA
8	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT LTD	INDIA
9	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA
<b>6.101</b>	<b>VALVE GLOBE GUNMETAL/ BRASS/BRONZE</b>	
1	AV VALVES LIMITED	INDIA
2	H. SARKER & COMPANY	INDIA
3	LEADER VALVES LTD	INDIA
4	SANT VALVES PVT LTD	INDIA
<b>6.102</b>	<b>T TYPE GLOBE &amp; STOP CHECK VALVES</b>	
1	ADAMS ARMATUREN GMBH	INDIA
2	AMPO VALVES INDIA PVT LTD	INDIA
3	AMPO S.COOP (POYAM VALVES)	INDIA
4	BFE SRL	INTERNATIONAL
5	BOTELI VALVE GROUP CO.	INDIA
6	CESARE BONNETII S.P.A.	INDIA
7	DOUGLAS CHERO SPA	INTERNATIONAL
8	FLOWSERVE PTE (MFR. EDWARD)	INDIA
9	L & T VALVES LIMITED	INDIA
10	LVF SPA	INTERNATIONAL
11	PETROL VALVES SRL	INTERNATIONAL
12	SCHUF CHEMIEVENTILE VERTRIEBS GMBH & co.	INTERNATIONAL
13	SCHUF SPECIALITY VALVES INDIA PVT LTD	INDIA
14	TAKAMISAWA VALVE CO LTD, ENQ TO MEC CORPN	INTERNATIONAL
15	VELAN. INC	INDIA
16	VELAN VALVES INDIA PVT LTD	INDIA
17	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA
<b>6.103</b>	<b>VALVE- BLOWDOWN (Straight/Angle Pattern)</b>	
1	BHEL	INDIA
2	CESARE BONNETTI S.P.A.	INDIA
3	GESTRA AG (FLOWSERVE GROUP)	INDIA
4	INSTRUMENTATION LTD. (PALGHAT)	INDIA
5	PENTAIR VALVES & CONTROLS INDIA PVT LTD	INDIA
6	SCHUF CHEMIEVENTILE VERTRIEBS GMBH & co.	INTERNATIONAL
7	SCHUF SPECIALITY VALVES INDIA PVT LTD	INDIA
8	SEMPELL VALVES PVT LTD	INDIA
9	YARWAY CORPORATION	INDIA
<b>6.104</b>	<b>VALVE CHECK (FOREIGN SUPPLIERS)</b>	
1	BFE SRL	INTERNATIONAL

2	CESARE BONNETTI S.P.A.	INDIA
3	DOUGLAS CHERO SPA	INTERNATIONAL
4	FLOWSERVE PTE (MFR. EDWARD)	INDIA
5	FRIEDRICH KROMBACH GMBH & CO.KG	INTERNATIONAL
6	FRIULCO SPA	INDIA
7	HANGZHOU NEW TIME VALVE CO. LTD.	INTERNATIONAL
8	JC FABRICA DE VALVULAS B.A.	INTERNATIONAL
9	JIANGSU Jiulong Valve Manufacture Co.Ltd	INTERNATIONAL
10	LVF SPA	INTERNATIONAL
11	MSA A.S.	INTERNATIONAL
12	PENTAIR VALVES	INDIA
13	PETROL VALVES SRL	INTERNATIONAL
14	PK VALVE CO. LTD	INTERNATIONAL
15	TAKAMISAWA VALVE CO LTD ENQ TO MEC CORPN	INTERNATIONAL
16	TOM WHEATLEY VALVE OPERATIONS	INTERNATIONAL
17	TYCO VALVES & CONTROL ITALIA SRL	INTERNATIONAL
18	VELAN INC	INDIA
19	VITAS - DIVISION OF VALVITALIA S.P.A	INTERNATIONAL
20	WUZHOU VALVE CO LTD	INTERNATIONAL
<b>6.105</b>	<b>VALVE CHECK CAST</b>	
1	AMPO VALVES INDIA PVT LTD	INDIA
2	AMPO SCOOP (POYAM VALVES)	INDIA
3	AV VALVES LIMITED	INDIA
4	BHEL	INDIA
5	BOTELI VALVE GROUP CO.	INDIA
6	CESARE BONNETTI S.P.A.	INDIA
7	CRI PUMPS PVT LTD (UNIT-VALVES)	INDIA
8	FLOTEK INDUSTRIES	INTERNATIONAL
9	FLUIDLINE VALVES CO.PVT LTD	INDIA
10	FORWARD ALLOYS & CASTINGS	INDIA
11	FOURESS ENGG (I) LTD. (AURANGABAD)	INDIA
13	FRIEDRICH KROMBACH GMBH & CO.KO	INTERNATIONAL
13	GESTRA AG- (FLOWSERVE GROUP)	INDIA
14	GM ENGINEERING PVT. LTD.	INDIA
15	HAWA ENGINEERS LTD	INDIA
16	INTERVALVE POONAWALLA LIMITED	INDIA
17	KSB PUMPS LTD (COIMBATTORE)	INDIA
18	L & T VALVES LIMITED	INDIA
19	LAZARO ITUARTE INTERNATIONALSA	INTERNATIONAL
20	LEADER VALVES LTD	INDIA
21	MH VALVES PVT LTD.	INDIA
22	MICON ENGINEERS (HUBLI) PVT LTD	INDIA
23	MSA A.S.	INTERNATIONAL
24	NEWAY VALVE (SUZHOU) CO LTD	INTERNATIONAL
25	NILON VALVES PRIVATE LIMITED	INDIA
26	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA
27	OSWAL INDUSTRIES LTD	INDIA
28	PANCHVATI VALVES & FLANGES PVT LTD	INDIA
29	PEE INDUSTRIAL VALVES PVT. LTD.	INDIA
30	SAKHI ENGINEERS PVT. LTD.	INDIA
31	SHALIMAR VALVES PVT LTD	INDIA
32	SHAYBURG VALVES PVT LTD	INDIA
33	SHENJLANG VALVE CO LID	INTERNATIONAL
34	STEEL STRONG VALVES INDIA PVT LTD	INDIA
35	SUZHOU VIZA VALVE CO. LID	INTERNATIONAL
36	T.S. PUMPS AND VALVES PVT.LTD	INDIA

37	VELAN VALVES INDIA PVT LTD	INDIA
38	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT	INDIA
39	XOMOX SANMAR LTD-PACIFIC VALVES DIVISION	INDIA
40	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA
<b>6.106</b>	<b>VALVE CHECK CRYOGENIC CAST</b>	
1	AE VALVES	INTERNATIONAL
2	AMPO S.COOP (POYAM VALVES)	INDIA
3	BOTELI VALVE GROUP CO.	INDIA
4	L & T VALVES LIMITED	INDIA
5	LAZARO ITUARTE INTERNATIONAL SA	INTERNATIONAL
6	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA
7	OSWAL INDUSTRIES LTD	INDIA
8	PANCHVATI VALVES & FLANGES PVT LTD	INDIA
9	STEEL STRONG VALVES INDIA PVT LTD	INDIA
10	VELAN INC	INDIA
11	LEADER VALVES LID	INDIA
12	NITON VALVE INDUSTRIES PRIVATE LTD	INDIA
<b>6.107</b>	<b>VALVE CHECK FORGED</b>	
1	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA
2	ATAM VALVES PVT LTD.	INDIA
3	AUTOCAP INDUSTRIES	INDIA
4	AV VALVES LIMITED	INDIA
5	BFE SRL	INTERNATIONAL
6	BHEL	INDIA
7	BOTELI VALVE GROUP CO.	INDIA
8	DOUGLAS CHERO SPA	INTERNATIONAL
9	FLOWSERVE PTE (MFR. EDWARD)	INDIA
10	FLUIDLINE VALVES CO.PVT LTD	INDIA
11	GM ENGINEERING PVT. LTD.	INDIA
12	HAWA ENGINEERS LTD	INDIA
13	INTERVALVE POONAWAUA LIMITED	INDIA
14	KSB PUMPS LTD (COIMBATTORE)	INDIA
15	L & T VALVES LIMITED	INDIA
16	LEADER VALVES LTD	INDIA
17	MICON ENGINEERS (HUBLI) PVT LTD	INDIA
18	NSSL LTD	INDIA
19	OSWAL INDUSTRIES LTD	INDIA
20	PANCHVATI VALVES & FLANGES PVT LTD	INDIA
21	PEE INDUSTRIAL VALVES PVT. LTD.	INDIA
22	SHALIMAR VALVES PVT LTD	INDIA
23	SHAYBURG VALVES PVT LTD	INDIA
24	STEEL STRONG VALVES INDIA PVT LTD	INDIA
25	VEE TECH VALVES PRIVATE LIMITED	INDIA
26	VELAN VALVES INDIA PVT LTD	INDIA
27	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT	INDIA
28	NITON VALVE INDUSTRIES PRIVATE LTD.	INDIA
<b>6.108</b>	<b>VALVE CHECK CRYOGENIC FORGED</b>	
1	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA
2	BOTELI VALVE GROUP CO.	INDIA
3	LEADER VALVES LTD	INDIA
4	LVF SPA	INTERNATIONAL
5	OSWAL INDUSTRIES LTD	INDIA
6	STEEL STRONG VALVES INDIA PVT LTD	INDIA



<b>6.109</b>	<b>VALVE CHECK GUNMETAL / BRASS / BRONZE</b>	
1	ATAM VALVES PVT LTD,	INDIA
2	AV VALVES LIMITED	INDIA
3	H. SARKER & COMPANY	INDIA
4	LEADER VALVES LTD	INDIA
5	SANT VALVES PVT LTD	INDIA
6	ZOLOTO INDUSTRIES	INDIA
<b>6.110</b>	<b>VALVE CHECK (DUAL PLATE TYPE)</b>	
1	ADVANCE VALVES PVT LTD.	INDIA
2	CRANE STOCKHAM VALVE LTD	INDIA
3	FLOVEL 'VALVES PVT.LTD.	INDIA
4	GESTRA AG (FLOWERVE GROUP)	INDIA
5	GOODWIN INTERNATIONAL LTD	INTERNATIONAL
6	LEADER VALVES LTD	INDIA
7	NEWAY VALVE (SUZHOU) CO LTD	INTERNATIONAL
8	PETROL VALVES SRL	INTERNATIONAL
9	SHALIMAR VALVES PVT. LTD	INDIA
10	SHENJIANG VALVE CO LTD	INTERNATIONAL
11	VITAS - DIVISION OF VALVITALIA S.P.A	INTERNATIONAL
12	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT	INDIA
13	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA
<b>6.111</b>	<b>VALVE-NON SLAM CHECK (NOZZLE)</b>	
1	ATWOOD es MORRILL & CO	INTERNATIONAL
2	CRANE STOCKHAM VALVE LTD	INDIA
3	DFT INC	INTERNATIONAL
4	FLOVEL VALVES PVT.LTD.	INDIA
5	GOODWIN INTERNATIONAL LTD	INTERNATIONAL
6	MOKVELD VALVES BV	INTERNATIONAL
<b>6.112</b>	<b>VALVE BALL- (FOREIGN SUPPLIERS)</b>	
1	CAMERON ITALY SRL	INTERNATIONAL
2	FRANK SCHUCK GMBH (FORMERLBORSIG)	INDIA / INTERNATIONAL
3	FRIEDRICH KROMBACH GMBH & CO.KG	INTERNATIONAL
4	FRIULCO SPA	INDIA / INTERNATIONAL
5	JC FABRICA DE VALVULAR S.A.	INTERNATIONAL
6	JIANGSU Jiulong Valve Manufacture Co.Ltd	INTERNATIONAL
7	KITAMURA VALVE MANUFACTURING CO LTD	INDIA
8	KITZ CORPORATION	INTERNATIONAL
9	LCM ITALIA SPA	INTERNATIONAL
10	MECA FRANCE S.A.	INTERNATIONAL
11	METSO FLOW CONTROL OY	INDIA
12	OMS SALERI	INTERNATIONAL
13	PENTAIR VALVES	INDIA
14	PERAR S.P.A	INTERNATIONAL
15	PETROL VALVES SRL	INTERNATIONAL
16	PIBIVIEMSSE S. R. L.	INTERNATIONAL
17	TK VALVES OPERATIONS	INTERNATIONAL
18	TRUFLO VALVES LIMITED	INTERNATIONAL
19	TYCO VALVES & CONTROL ITALIA SRL	INTERNATIONAL
20	VALBART SRL (A FLOWERVE COMPANY)	INTERNATIONAL
21	WUZHOU VALVE CO LTD	INTERNATIONAL
<b>6.113</b>	<b>VALVE BALL CRYOGENIC</b>	
1	AE VALVES	INTERNATIONAL
2	AMPO. SCOOP (POYAM VALVES)	INDIA

S	BELGAUM.AQUA VALVES PVT. LTD.	INDIA
4	LAZARO ITUARTE INTERNATION SA	INTERNATIONAL
5	MICROFINISH VALVES PVT LIMITED	INDIA
6	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT LTD	INDIA
<b>6.114</b>	<b>VALVE BALL NON FIRE SAFE-CCS</b>	
1	AMPO. SCOOP (POYAM VALVES)	INDIA
2	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD	INDIA
3	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD.	INDIA
4	BELGAUM AQUA VALVES PVT, LTD.	INDIA
5	BOTELI VALVE GROUP CO.	INDIA
6	CAMERON ITALY SRL	INTERNATIONAL
7	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA
8	DEMBLA VALVES LIMITED	INDIA
9	DEMBLA VALVES LTD.	INDIA
10	FLOW CHEM INDUSTRIES	INDIA
11	FLUIDLINE VALVES CO.PVT LTD	INDIA
12	FLUITEK ORSENIGO VALVES	INTERNATIONAL
13	FRANZ SCHUCK GMBH (FORMERLY BORSIG-B506)	INDIA
14	FRIEDRICH KROMBACH GMBH & CO.KO	INTERNATIONAL
15	GALPERTI ENGINEERING AND FLOW CONTROL SPA	INTERNATIONAL
16	GM ENGINEERING PVT, LTD.	INDIA
17	HAWA ENGINEERS LTD	INDIA
18	INTERVALVE POONAWALLA LIMITED	INDIA
19	JC FABRICA DE VALVULAR S.A.	INTERNATIONAL
20	JIANGSU Jiulong Valve Manufacture Co.Ltd	INTERNATIONAL
21	KITAMURA VALVE MANUFACTURING CO LTD	INDIA
22	KUMKANG VALVE MFG CO.LTD	INTERNATIONAL
23	L & T VALVES LIMITED	INDIA
24	LCM ITALIA SPA	INTERNATIONAL
25	LEADER VALVES LTD	INDIA
26	MECA FRANCE S.A.	INTERNATIONAL
27	METSO FLOW CONTROL OY	INDIA
28	MEVADA ENGG.WORKS PVT LTD	INDIA
29	MICON ENGINEERS ENGINEERS (HUBLI) PVT LTD	INDIA
30	MICROFINISH VALVES PVT LIMITED	INDIA
31	MIR VALVE SDN.BHD.	INTERNATIONAL
32	NEWAY VALVE (SUZHOU) CO LTD	INTERNATIONAL
33	NSSL ITALIA	INDIA
34	OSWAL INDUSTRIES LTD	INDIA
35	REYNOLD VALVES LTD	INDIA
36	SHALIMAR VALVES PVT LTD	INDIA
37	SHAYBURG VALVES PVT LTD	INDIA
38	SHENJIANG VALVE CO LTD	INTERNATIONAL
39	SUZHOU VITA VALVE CO. LTD	INTERNATIONAL
40	VAAS AUTOMATION PVT LTD	INDIA
41	VALBART SRL (A FLOWSERVE COMPANY)	INTERNATIONAL
42	VALVITALIA SPA	INTERNATIONAL
43	VIRGO VALVES & CONTROLS PVT LTD.	INDIA
44	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT	INDIA
45.	ZA.VE.RO. SRL	INTERNATIONAL
46	NITON VALVE INDUSTRIES PRIVATE LTD.	INDIA
<b>6.118</b>	<b>VALVE BALL NON FIRE SAFE-CSS</b>	
1	AMPO S.COOP (POYAM VALVES)	INDIA
2	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD	INDIA
3	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD.	INDIA

4	BELGAUM AQUA VALVES PVT. LTD.	INDIA
5	BOTELI VALVE GROUP CO.	INDIA
6	CAMERON ITALY SRL	INTERNATIONAL
7	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA
8	DEMBLA VALVES LIMITED	INDIA
9	FLOW CHEM INDUSTRIES	INDIA
10	FRIEDRICH KROMBACH GMBH & CO.KG	INTERNATIONAL
11	GALPERTI ENGINEERING AND FLAW CONTROL SPA	INTERNATIONAL
12	GM ENGINEERING PVT. LTD.	INDIA
13	HAWA ENGINEERS LTD	INDIA
14	INTERVALVE POONAWALLA LIMITED	INDIA
15	JC FABRICA DE VALVULAS S.A.	INTERNATIONAL
16	JIANGSU Jiulong Valve Manufacture Co.Ltd	INTERNATIONAL
17	KITAMURA VALVE MANUFACTURING CO LTD	INDIA
18	KUMKANG VALVE MFG CO.LTD	INTERNATIONAL
19	L & T VALVES LIMITED	INDIA / INTERNATIONAL
20	LCM ITALIA SPA	INTERNATIONAL
21	LEADER VALVES LTD	INDIA
22	MECA FRANCE S.A.	INTERNATIONAL
23	MESTO FLOW CONTROL OY	INDIA
24	MEVADA ENGG. WORKS PVT LTD	INDIA
25	MICON ENGINEERS (HUBLI) PVT LTD	INDIA
26	MICROFINISH VALVES PVT LIMITED	INDIA
27	NEWAY VALVE (SUZHO) CO LTD	INTERNATIONAL
28	NSSL ITALIA	INDIA
29	OSWAL INDUSTRIES LTD	INDIA
30	REYNOLD VALVES LTD	INDIA
31	SHAYBURG VALVES PVT LTD	INDIA
32	SHENJIANG VALVE CO LTD	INTERNATIONAL
33	SUZHOU VIZA VALVE CO. LTD	INTERNATIONAL
34	VAAS AUTOMATION PVT LTD	INDIA
35		
35	VALBART SRL (FLOWSERVE COMPANY)	INTERNATIONAL
36	VALVITALIA SPA	INTERNATIONAL
37	VIRGO VALVES & CONTROLS PVT LTD.	INDIA
38	VIRGO VALVES & CONTROLS PVT LTD.	INDIA
39	ZA.VE.RO. SRL	INTERNATIONAL
40	NITON VALVE INDUSTRIES PRIVATE LTD.	INDIA
<b>6.116</b>	<b>VALVE BALL FIRE SAFE-CCS</b>	
1	AMPO SCOOP (POYAM VALVES)	INDIA
2 —		
3		
2	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD	INDIA
3	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD.	INDIA
4	BELGAUM AQUA VALVES PVT. LTD.	INDIA
5	BOTELI VALVE GROUP CO.	INDIA
6	DEMBLA VALVES LIMITED	INDIA
7	FLOW CHEM INDUSTRIES	INDIA
8	FLUITEK ORSENIGO VALVES	INTERNATIONAL
9	FRIEDRICH KROMBACH GMBH & CO.KG	INTERNATIONAL
10	GALPERTI ENGINEERING AND FLOW CONTROL SPA	INTERNATIONAL
11	GM ENGINEERING PVT. LTD.	INDIA
12	HAWA ENGINEERS LTD	INDIA
13	INTERVALVE POONAWALLA UNITED	INDIA
14	JC FABRICA DE VALVULAS S.A.	INTERNATIONAL
15	JIANGSU Jiulong Valve Manufacture Co.Ltd	INTERNATIONAL

16	KUMKANG VALVE MFG CO.LTD	INTERNATIONAL
17	L & T VALVES LIMITED	INDIA
18	LAZARO ITUARTE INTERNATIONAL. SA	INTERNATIONAL
19	LEADER VALVES LTD	INDIA
20	METSO FLOW CONTROL OY	INDIA
21	MICON ENGINEERS (HUBLI) PVT LTD	INDIA
22	MICROFINISH VALVES PVT LIMITED	INDIA
23	MIR VALVE SDN.BHD.	INTERNATIONAL
24	NEWAY VALVE (SUZHOU) CO LTD	INTERNATIONAL
26	NSSL ITALIA	INDIA
26	OSWAL INDUSTRIES LTD	INDIA
27	REYNOLD VALVES LTD	INDIA
28	SHAYBURG VALVES PVT LTD	INDIA
29	SHENJIANG VALVE CO LTD	INTERNATIONAL
30	SUZHOU VIZA VALVE CO. LTD	INTERNATIONAL
31	VAAS AUTOMATION PVT LTD	INDIA
32	VALBART SRL (A FLOWSERVE COMPANY)	INTERNATIONAL
33	VALVITALIA SPA	INTERNATIONAL
34	VIRGO VALVES & CONTROLS PVT LTD.	INDIA
35	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT	INDIA
36	ZA.VE.RO. SRL	INTERNATIONAL
37	NITON VALVE INDUSTRIES PRIVATE LTD	INDIA
<b>6.117</b>	<b>VALVE BALL FIRE SAFE-CSS</b>	
1	AMPO SCOOP (POYAM VALVES)	INDIA
2	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD.	INDIA
3	BELGAUM AQUA VALVES PVT. LTD.	INDIA
4	BOTELI VALVE GROUP CO.	INDIA
5	FLOW CHEM INDUSTRIES	INDIA
6	FRIEDRICH KROMBACH GMBH & CO.KG	INTERNATIONAL
7	GALPERTI ENGINEERING AND FLOW CONTROL SPA	INTERNATIONAL
8	GM ENGINEERING PVT. LTD.	INDIA
9	INTERVALVE POONAWALLA LIMITED	INDIA
10	JC FABRICA DE VALVULAS S.A.	INTERNATIONAL
11	JIANGSU Jiulong Valve Manufacture Co.Ltd	INTERNATIONAL
12	KUMKANG VALVE MFG CO.LTD	INTERNATIONAL
13	L & T VALVES LIMITED	INDIA
14	LAZARO ITUARTE INTERNATIONAL SA	INTERNATIONAL
15	LEADER VALVES LTD	INDIA
16	MESTO FLOW CONTROL OY	INDIA
17	MICON ENGINEERS (HUBLI) PVT LTD	INDIA
18	MICROFINISH VALVES PVT LIMITED	INDIA
19	NEWAY VALVE (SUZHOU) CO LTD	INTERNATIONAL
20	NSSL ITALIA	INDIA
21	REYNOLD VALVES LTD	INDIA
22	SHENJIANG VALVE CO LTD	INTERNATIONAL
23	SUZHOU VIZA VALVE CO. LTD	INTERNATIONAL
24	VAAS AUTOMATION PVT LTD	INDIA
25	VALBART SRL (A FLOWSERVE COMPANY)	INTERNATIONAL
26	VALVITALIA SPA	INTERNATIONAL
27	VIRGO VALVES & CONTROLS PVT LTD.	INDIA
28	WEIR BOK VALVES-A UNIT OF WEIR INDIA WIT	INDIA
29	ZA.VE.RO. SRL	INTERNATIONAL
30	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA
<b>6.118</b>	<b>VALVE BALL - FIRE SAFE (FORGED)</b>	

1	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD.	INDIA
2	BELGAUM AQUA VALVES PVT. LTD.	INDIA
3	GALPERTI ENGINEERING AND FLOW CONTROL SPA	INTERNATIONAL
4	INTERVALVE POONAWALLA LIMITED	INDIA
5	MICON ENGINEERS (HUUBI) PVT LTD	INDIA
6	MICROFINISH VALVES PVT LIMITED	INDIA
7	SHAYBURG VALVES PVT LTD	INDIA
8	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT LTD	INDIA
<b>6.119</b>	<b>VALVE BALL NON FIRE SAFE-FCS</b>	
1	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD.	INDIA
2	BELGAUM AQUA VALVES PVT. LTD.	INDIA
3	FLOW CHEM INDUSTRIES	INDIA
4	GALPERTI ENGINEERING AND FLOW CONTROL SPA	INTERNATIONAL
5	HAWA ENGINEERS LTD	INDIA
6	INTERVALVE POONAWALLA LIMITED	INDIA
7	LEADER VALVES LTD	INDIA
8	MEVADA ENGO.WORKS PVT LTD	INDIA
9	MICROFINISH VALVES PVT LIMITED	INDIA
10	SHAYBURG VALVES PVT LTD	INDIA
11	NITON VALVE INDUSTRIES PRIVATE LTD.	INDIA
<b>6.120</b>	<b>VALVE BALL NON FIRE SAFE-FSS</b>	
1	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD.	INDIA
2	BELGAUM AQUA VALVES PVT. LTD.	INDIA
3	FLOW CHEM INDUSTRIES	INDIA
4	HAWA ENGINEERS LTD	INDIA
5	INTERVALVE POONAWALLA LIMITED	INDIA
6	LEADER VALVES LTD	INDIA
7	MEVADA ENGG.WORKS PVT LTD	INDIA
8	MICROFINISH VALVES PVT LIMITED	INDIA
9	SHAYBURG VALVES PVT LTD	INDIA
10	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA
<b>6.121</b>	<b>VALVE BALL JACKETED- NON FIRE SAFE</b>	
1	BELGAUM AQUA VALVES WT. LTD.	INDIA
2	MICROFINISH VALVES PVT LIMITED	INDIA
<b>6.122</b>	<b>VALVE BALL MULTIFORT NON FIRE SAFE</b>	
1	BELGAUM AQUA VALVES PVT. LTD.	INDIA
2	MICROFINISH VALVES PVT LIMITED	INDIA
<b>6.123</b>	<b>VALVE BUTTERFLY. (FOREIGN SUPPLIERS)</b>	
1	FLOWERVE PTE LTD	INTERNATIONAL
2	FRIEDRICH KROMBACH OMBH & CO.KG	INTERNATIONAL
3	HANGZHOU NEW TIME VALVE CO. LTD.	INTERNATIONAL
4	KOREA UNICOM VALVE CO.LTD	INTERNATIONAL
5	METSO FLOW CONTROL	INTERNATIONAL
6	NAKAKITA SEISAKUSHO CO LTD	INTERNATIONAL
7	PENTAIR VALVES & CONTROLS INDIA PVT LTD	INDIA
8	PIETRO FIORENTINI SPA	INTERNATIONAL
<b>6.124</b>	<b>VALVE BUTTERFLY -CCS</b>	
1	ADVANCE VALVES PVT LTD,	INDIA
2	BRAY CONTROLS	INDIA
3	BRAY CONTROLS INDIA PVT LTD.	INDIA
4	CRANE PROCESS FLOW TECHNOLOGIES IND. LTD	INDIA

5	DEMBLA VALVES LIMITED	INDIA
6	DEMBLA VALVES LTD.	INDIA
7	FLOTEK INDUSTRIES	INTERNATIONAL
8	FLOWSERVE INDIA CONTROLS PVT LTD-MMN	INDIA
9	FLOWSERVE PTE LTD	INTERNATIONAL
10	FLUIDLINE VALVES CO.PVT LTD	INDIA
11	FOURESS ENGG. (IND) LTD. (BLR.WORK)	INDIA
12	FRIEDRICH KROMBACH GMBH & CO.KG	INTERNATIONAL
13	GM ENGINEERING PVT. LTD.	INDIA
14	HAWA ENGINEERS LTD	INDIA
15	INSTRUMENTATION LTD. (PALGHAT)	INDIA
16	INTERVALVE POONAWALLA LIMITED	INDIA
17	L & T VALVES LIMITED	INDIA
18	LEADER VALVES LTD	INDIA
19	MASCOT VALVES PVT LIMITED (FMLY VALFLO)	INDIA
20	METSO FLOW CONTROL OY	INDIA
21	NEWAY VALVE (SUZHOU) CO LTD	INTERNATIONAL
22	ORTON S.R.L	INTERNATIONAL
23	PENTAIR VALVES & CONTROLS INDIA PVT LTD	INDIA
24	STAFFORD CONTROLS LIMITED	INDIA
25	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT LTD	INDIA
<b>6.125</b>	<b>VALVE BUTTERFLY -CBS</b>	
1	ADVANCE VALVES PVT LTD.	INDIA
2	BRAY CONTROLS INDIA PVT LTD.	INDIA
3	CRANE PROCESS FLOW TECHNOLOGIES IND. LTD	INDIA
4	FLOWSERVE INDIA CONTROLS PVC LTD-MMN	INDIA
5	FLOWSERVE PTE LTD	INTERNATIONAL
6	FLUIDLINE VALVES CO.PVT LTD .	INDIA
7	FOURESS ENGG. (IND) LTD. (BLR.WORK)	INDIA
8	FRIEDRICH KROMBACH GMBH & CO KG	INTERNATIONAL
9	INSTRUMENTATION LTD. (PALGHAT)	INDIA
10	INTERVALVE POONAWALLA LIMITED	INDIA
11	L & T VALVES LIMITED	INDIA
12	LEADER VALVES LTD	INDIA
13	MASCOT VALVES PVT LIMITED (FMLY VALFLO)	INDIA
14	METSO FLOW CONTROL OY	INDIA
15	NEWAY VALVE (SUZHOU) CO LTD	INTERNATIONAL
16	ORTON S.R.L	INTERNATIONAL
17	PENTAIR VALVES & CONTROLS INDIA PVT LTD	INDIA
18	STAFFORD CONTROLS LIMITED	INDIA
19	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT LTD.	INDIA
<b>6.126</b>	<b>VALVE BUTTERFLY -CAS</b>	
1	BRAY CONTROLS INDIA PVT LTD.	INDIA
2	CRANE PROCESS FLOW TECHNOLOGIES IND. LTD	INDIA
3	LEADER VALVES LTD	INDIA
4	NEWAY VALVE (SUZHOU) CO LTD	INTERNATIONAL
5	ORTON S.R.L	INTERNATIONAL
<b>6.127</b>	<b>VALVE BUTTERFLY (PTFE SEATED)</b>	
1	BRAY CONTROLS INDIA PVT LTD.	INDIA
2	CRANE PROCESS FLOW TECHNOLOGIES IND. LTD	INDIA
3	DELVAL PLOW CONTROLS PRIVATE LIMITED	INDIA
4	DEMBLA VALVES LIMITED	INDIA
5	EMERSON (TYCO VALVES & CONTROL-PANTAIR	INDIA

6	GM ENGINEERING PVT, LTD.	INDIA
7	HI TECH BUTTERFLY VALVES INDIA PVT LTD:	INDIA
8	INTERVALVE POONAWALLA LIMITED	INDIA
9	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT LTD	INDIA
<b>6.128</b>	<b>VALVE BELLOW SEALED</b>	
1	BELL-O-SEAL VALVES PVT LTD	INDIA
2	BOTELI VALVE GROUP CO.	INDIA
3	CESARE BONNETTI S.P.A.	INDIA
4	L & T VALVES LIMITED	INDIA
5	LVF SPA	INTERNATIONAL
6	MICROFINISH VALVES PVT LIMITED	INDIA
7	PHONIX ARMATUREN WERKE BREGEL GMBH	INTERNATIONAL
8	TH. JANSEN-ARMATUREN GMBH	INTERNATIONAL
9	UNI KLINGER LID	INDIA
10	VELAN INC	INDIA
<b>6.129</b>	<b>VALVE BUTTERTLY (TRIPLE OFFSET)</b>	
1	ADAMS ARMATUREN GMBH	INDIA
2	ADVANCE VALVES PVT LTD.	INDIA
3	BRAY CONTROLS	INDIA
4	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA
5	DEMBLA VALVES LIMITED	INDIA
6	FLOTEK INDUSTRIES	INTERNATIONAL
7	HOBBS VALVE LTD	INTERNATIONAL
8	KOREA UNICOM VALVE CO.LTD	INTERNATIONAL
9	L & T VALVES LIMITED	INDIA
10	ORTON S.R.L	INTERNATIONAL
11	PENTAIR VALVES & CONTROLS INDIA PVT LTD	INDIA
12	TYCO VALVES & CONTROL ITALIA SRL	INTERNATIONAL
13	VIRGO VALVES & CONTROLS PVT LTD.	INDIA
<b>6.130</b>	<b>VALVE DIAPHRAGM CAST CARBON STEEL</b>	
1	CRANE PROCESS FLOW TECHNOLOGIES IND. LTD	INDIA
2	PROCON ENGINEERS	INDIA
3	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT LTD	INDIA
<b>6.131</b>	<b>VALVE DIAPHRAGM CAST STAINLESS STEEL</b>	
1	CRANE PROCESS FLOW TECHNOLOGIES IND. LTD	INDIA
2	PROCON ENGINEERS	INDIA
3	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT LTD	INDIA
<b>6.132</b>	<b>VALVE PLUG- (FOREIGN SUPPLIERS)</b>	
1	FLOWSERVE PTE (MFR SERCK)	INTERNATIONAL
2	FLOWSERVE PTE LTD	INTERNATIONAL
3	HANGZHOU NEW TIME VALVE CO. LTD.	INTERNATIONAL
<b>6.133</b>	<b>VALVE PLUG CONCENTRIC- CCS ( F.S &amp; N.F.S)</b>	
1	FLOWSERVE INDIA CONTROLS PVT LTD-MMN	INDIA
2	FLOWSERVE PTE (MFR SERCK)	INDIA
3	FLOWSERVE PTE LTD	INTERNATIONAL
4	GALLI & CASSINA SPA	INTERNATIONAL
5	GM ENGINEERING PVT. LTD.	INDIA
6	RASAI FLOW LINES PVT LTD.	INDIA
7	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT	INDIA
8	XOMOX SANMAR LIMITED	INDIA



9	ZHEJIANG FLOWTECH MACHINERY CO.LTD	INDIA
<b>6.134</b>	<b>VALVE PLUG CONCENTRIC -CSS ( F.S &amp; N.F.S)</b>	
1	FLOWSERVE INDIA CONTROLS PVT LTD-MMN	INDIA
2	FLOWSERVE PTE (MFR. SERCK)	INDIA
3	FLOWSERVE PTE LTD	INTERNATIONAL
4	RASAI FLOW LINES PVT LTD.	INDIA
5	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT	INDIA
6	XOMOX SANMAR LIMITED	INDIA
<b>6.135</b>	<b>VALVE PLUG CONCENTRIC-CAS ( F.S &amp; N.F.S)</b>	
1	FLOWSERVE PTE (MFR. SERCK)	INDIA
2	FLOWSERVE PTE LTD	INTERNATIONAL
3	XOMOX SANMAR LIMITED	INDIA
<b>6.136</b>	<b>VALVE PISTON (GLANDLESS)</b>	
1	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA
2	ARMSTRONG INTERNATIONAL SA	INTERNATIONAL
3	CESARE BONNETTI B.P.A.	INDIA
4	FORBES MARSHALL PVT. LTD. (Old Name: FORBES MARH)	INDIA
5	UNI KLINGER LTD	INDIA
<b>6.137</b>	<b>VALVE PLUG MULTIPOINT - NON FIRE SAFE</b>	
1	FLOWSERVE PTE (MFR.SERCK)	INDIA
2	FLOWSERVE PTE LTD	INTERNATIONAL
3	XOMOX SANMAR LIMITED	INDIA
<b>6.138</b>	<b>VALVE NEEDLE</b>	
1	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA
2	ASTEC VALVES & FITTINGS PVT.	INDIA
3	ATAM VALVES PVT LTD.	INDIA
4	EXCELSIOR ENGG WORKS	INDIA
5	LEADER VALVES LTD	INDIA
6	PANCHVATI VALVES & FLANGES PVT. LTD.	INDIA
7	TECHNOMATIC INDIA PVT LTD.	INDIA
<b>6.139</b>	<b>VALVE DOUBLE DISC GATE</b>	
1	BOUVIER DARLING	INTERNATIONAL
2	L & T VALVES LIMITED	INDIA
3	STRACK-MASCHINENBAU GMBH	INTERNATIONAL
<b>6.140</b>	<b>VALVE SLIDE</b>	
1	ENPRO SYSTEMS INC	INTERNATIONAL
2	Z & J TECHNOLOGIES GMBH	INTERNATIONAL
3	TOTAL ENGINEERING CO. LTD	INTERNATIONAL
<b>6.141</b>	<b>VALVE SHUT DOWN</b>	
1	JOSEPH STRACK ARMATUREN FABRIK GmbH	INTERNATIONAL
2	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	INDIA
3	NITON VALVE INDUSTRIES PRIVATE LTD.	INDIA
<b>6.142</b>	<b>VALVE CRYOGENIC SS / LTCS</b>	
1	AMPO S.COOP (POYAM VALVES)	INDIA
2	BOTELI VALVE GROUP CO.	INDIA
3	LVF SPA	INTERNATIONAL
4	SENJIANG VALVE CO LTD	INTERNATIONAL

5	VELAN INC	INDIA
<b>6.143</b>	<b>VALVE SPECIAL CATEGORY</b>	
1	ADAMS AREMATUREN GMBH	INDIA
2	AMPO VALVES INDIA PVT LTD	INDIA
3	AMPO S.COOP (POYAM) VALVES	INDIA
4	CESARE BONNETTI S.P.A.	INDIA
5	CONTROL SEAL BV	INTERNATIONAL
6	ENPRO SYSTEMS INC	INTERNATIONAL
7	GUICHON VALVES .	INTERNATIONAL
8	HANGZHOU NEW TIME VALVE CO LTD.	INTERNATIONAL
9	L & T VALVES LIMITED	INDIA
10	LVF SPA	INTERNATIONAL
11	PENTAIR VALVES & CONTROLS INDIA PVT LTD	INDIA
12	SCHUF CHEMIEVENTILE VERTRIEBS GMBH & CO.	INTERNATIONAL
13	SCHUF SPECIALITY VALVES INDIA PVT LTD	INDIA
14	STRAHMAN VALVES INC.	INTERNATIONAL
15	TOTAL ENGINEERING CO. LTD	INTERNATIONAL
16	WUZHOU VALVE CO LTD	INTERNATIONAL
17	YARWAY CORPORATION	INDIA
18	Z & J TECHNOLOGIES GMBH	INTERNATIONAL
<b>6.144</b>	<b>VALVE TANK BOTTOM / FLUSH BOTTOM</b>	
1	MICROFINISH VALVES PVT LIMITED	INDIA
2	SCHUF SPECIALITY VALVES INDIA PVT LTD	INDIA
3	TOTAL ENGINEERING CO. LTD	INTERNATIONAL
<b>6.145</b>	<b>SAMPLING SYSTEM</b>	
1	CHEMTRON SCIENCE LABORATORIES PVT LTD	INDIA
2	FLOWLINE INSTRUMENTATION	INDIA
3	PROSYS SAMPLING SYSTEMS LTD	INTERNATIONAL
4	STEAM EQUIPMENT PVT LTD	INDIA
<b>6.146</b>	<b>CONDENSATE RECOVERY MANIFOLD</b>	
1	ARMSTRONG INTERNATIONAL PVT. LTD.	INDIA
2	ARMSTRONG INTERNATIONAL SA.	INTERNATIONAL
3	CESARE BONNETTI INDIA PVT LTD	INDIA
4	FORBS MARSHALL PVT. (Old Name:FORBS MARSH	INDIA
<b>5</b>	UNI KLINGER LTD	INDIA