



Standby SRU(525TPD) Train of IOCL Paradip Refinery
(Purchase specification for SWS Acid Gas KOD Pumps, Tag no.088-P-002A/B)

PUMP CENTRIFUGAL HORIZONTAL (SPP)

(Document No : B366-088-PA-MR-5001)



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ITEM DESCRIPTION: PUMP-CENTRIFUGAL.HORIZONTAL (SPECIAL PURPOSE PROCESS)

GROUP ITEM CODE: 04AB

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)

B366	088	PA	MR	5001	B	06/01/2022	80	42
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	25/05/2021	VKS	MG	TK	ISSUED FOR BIDS
B	06/01/2022	SG	MG	TK	REVISED & RE-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, page no 331 onwards. 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

Sheet 1 of 4

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 mandatory spares specified in the spec no. B366-999-80-42-SL-5001 (note-1), commissioning spares (note-2), O&M Spares (within Defect Liability period), special tools and tackles (note-3), first fill of consumables & documentation as per the enclosed Job Spec 080557C-000-JSS-0910-001 Rev. B & EDB, instructions to vendors, data sheets etc. and other codes and standards attached or referred.	
 01.01 ^{A1}	088-P-002 A	SWS ACID GAS KO DRUM PUMPS	1 Nos
 01.02 ^{A1}	088-P-002 B	SWS ACID GAS KO DRUM 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 and commissioning of items specified at item 1.00 above (note-5).	
 08.01 ^{A1}	{08}088-P-002 A	For Item 01.01	1 /diem rate
 08.02 ^{A1}	{08}088-P-002 B	For Item 01.02	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		<< DELETED >>	

 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

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.

Note:

Bidder to note that,one fixed price is to be quoted for grouped items. The groups



ENGINEERS INDIA LIMITED
NEW DELHI

Project: Standby SRU unit

Client: BHEL

REQUISITION NO.

B366-088-PA-MR-5001

Sheet 2 of 4

REV.

B

LIST OF ATTACHMENTS

SL. No.	DOCUMENT TITLE	DOCUMENT NO.	REVISION			
			REV.	REV.	REV.	REV.
			DATE	DATE	DATE	DATE
1						

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:


NOTE-1: BIDDERS ARE REQUIRED TO QUOTE MANDATORY SPARES: 1 LOT FOR EACH GROUPED ITEM.

NOTE-2: 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.

NOTE-3: 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.

NOTE-4: 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.

NOTE-5: BIDDER SHALL PROVIDE HIS SERVICES FOR SUPERVISION DURING ERECTION & COMMISSIONING OF THE PUMP PACKAGES. SUPERVISORY COST OF 5 MAN-DAYS PER PUMP PACKAGE SHALL BE CONSIDERED FOR PURPOSE OF COMMERCIAL COMPARISON. 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 MAN-DAYS CONSUMED AT SITE.

 ENGINEERS INDIA LIMITED NEW DELHI	Project: Standby SRU unit Client: BHEL	REQUISITION NO.	REV.
		B366-088-PA-MR-5001 Sheet 4 of 4	B

CHANGE LIST

- PUMP ITEM # 088-P-001 A/B (ACID GAS KO DRUM PUMPS) STAND DELETED FROM THIS MATERIAL REQUISITION. IN CASE, THE SAID PUMP ITEM NO. IS REFERRED / SPECIFIED ANYWHERE IN THIS MATERIAL REQUISITION, THE SAME SHALL NOT BE TAKEN IN CONSIDERATION BY BIDDER
- BIDDER SHALL MEET ALL THE TECHNICAL REQUIREMENTS OF THE SPECIFICATION REGARDING THE $NPSH_R$, RATIO OF RATED FLOW TO BEP FLOW, RATIO OF SHUT OFF HEAD TO RATED HEAD ETC., APART FROM THE OTHER REQUIREMENTS SPECIFIED IN MR.* IN CASE, BIDDER IS UNABLE TO MEET THE REQUIREMENTS WITH THE AVAILABLE PUMP MODEL(S) WITH THEM, BIDDER MAY CHOOSE AN OPTION WITH CONTINUOUS FLOW RE-CIRCULATION IN ORDER MEET THE ABOVE CONDITIONS. HOWEVER, BIDDER SHALL ENSURE THAT THIS RECIRCULATION FLOW SHALL BE THE LOWEST POSSIBLE FLOW. THE REFERENCE PROJECT DETAILS / PTR SHALL MEET THE REQUIREMENT W.R.T. NEW FLOW (I.E., RATED FLOW + PROPOSED RECIRCULATION FLOW, IF OFFERED)

* MR - Material Requisition (ie., this specification document)

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. EQUIPMENT 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)

SPECIAL INSTRUCTION TO BIDDERS

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	24.03.21	ISSUED WITH MR	VS	MG	TK
Rev. No.	Date	Purpose	Prepared by	Reviewed 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 meeting and/or technically infeasible deviations) or incomplete offers may be liable for rejection.

2.2 Pre-Bid stage:

- i) The bidders will be invited for an extensive pre-bid meeting after floating of enquiry. Participation in pre-bid meeting is preferred from all the bidders. The Pre-bid meeting shall be attended by competent representative(s) of bidder who is competent enough to discuss and conclude all the technical and commercial issues. **It is in Bidder's interest to participate in pre-bid meeting to have all their doubts clarified so that their bid is inline with enquiry specification requirements.**
- ii) 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, before the pre-bid meeting.
- iii) Bidder to note that only technically infeasible deviations shall be discussed during **PRE- BID meeting** 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.
- iv) 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 (Doc No. B366-088-80-42-TCL-5001)
 - (b) Mechanical datasheet for each pump item in EIL format only (for OH2 type pump: doc. no. B366-088-80-42-DS-5001.
 - (c) General reference list of offer pump model.
 - (d) Filled in Un-Priced EIL priced schedule format without any alteration/comments/clarifications. The Mandatory spares, Commissioning spares and Special tools & Tackles shall be a part of base price
 - (e) List of Mandatory Spares, Commissioning Spares, and Special Tools & Tackles.
 - (f) Operation & maintenance spares as per vendor recommendation during the defect liability period
 - (g) Un-priced List of 2 year spare parts for normal operation and maintenance with quotations beyond the defect liability period
 - (h) Clarifications / deviations finalised during Pre bid meeting. 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 / EIL during evaluation & Purchaser's / EIL'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).

(j) Required documents for PQC evaluation to be furnished along with the offer. For list of documentation, refer PQC requirements part of NIT.

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
PROJECT : 525 TPD STANDBY SRU PROJECT

UNIT : SRU

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.:

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 		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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			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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JOB SPECIFICATION FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS	Project No. 080557C001	Document No. 080557C-000-JSS-0910-001	Rev. No. B	Page 4 of 24

1. **INTRODUCTION:**

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th 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:**

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. 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 – 11th 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/cm² 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 (m³/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 L₁₀ 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 (L₁₀h) in accordance with API standards. Bearing cooling shall not be considered in achieving the required L₁₀ 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 610-11th 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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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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 		PROJECT	Standby SRU & Additional Tanks	
		CLIENT	INDIAN OIL CORPORATION	
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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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SCOPE OF SUPPLY/ WORK FOR CENTRIFUGAL PUMPS (Special Purpose Process)

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	24.05.2021	Issued with MR	VS	MG	TK
A	23.03.2021	Issued with MR	VS	MG	TK
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- ❖ Vendor 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 vendor in his scope without any cost /time implications to purchaser and mentioned in additional sheets attached to this list in the vendor's proposal.
- ❖ Vendor's scope of supply shall include but not be limited to the following for each Pump package:

Sr. No.	Description	Specified by Purchaser & Included in Vendor's scope (Yes/No)	Remarks
A	MECHANICAL		
A.1	PUMP (Refer process datasheet, equipment data sheets and specs. for full details)		
A.1.1	Centrifugal Pump with electric motor driver complete with the following:	Yes	Type : OH2
A.1.2	Mechanical Seal & Seal system	Yes	
A.1.3	Couplings (non-lubricated type), spacers and non-spark guards	Yes	
A.1.4	Cooling Water Plans including all piping and fittings.	Yes	As applicable
A.1.5	Matching companion flanges, gaskets, bolts & nuts etc. at all terminating points requiring purchaser's interface.	Yes	(For non standard sizes/ ratings)
A.1.6	All associated auxiliary piping etc., prefabricated and duly mounted on the equipment/base-plate	Yes	
A.1.7	Common skid for pump, driver, seal system and other auxiliaries as required.	Yes	
B	ELECTRICAL- Refer electrical specification		
C	INSTRUMENTATION – Refer instrumentation specification		
D	Spares & Tools/Tackles <i>Spares for the pump package including Mechanical, Electrical, Instrumentation etc</i>		
D.1	Mandatory spares, as specified in the spec no. B366-999-80-42-SL-5001.	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	Operation & maintenance spares as per vendor recommendation during the defect liability period	Yes	Part of base Price
D.5	Quote for vendor recommended spares parts for normal operation & maintenance spares required beyond the defect liability period	Yes	
E	Inspection & testing:		
E.1	Shop inspection and Testing:		
E.1.1	Inspection and testing of pump package as specified in MR.	Yes	
E.2	Other Shop inspection and Testing for all items under bidder's scope of supply, as specified in the inquiry document	Yes	
F	Vendor Data & Drawings		
F.1	All data & drawings as required per Vendor data requirements, data sheets, specifications and referenced codes and standards.	Yes	
G	Erection, Site testing & Commissioning		
G.1	Supervision of erection, commissioning & site testing for complete pump package	Yes	Per diem rate (Supervision shall be provided considering presence of Original Equipment Manufacturer)

Sr. No.	Description	Specified by Purchaser & Included in Vendor's scope (Yes/No)	Remarks
			(OEM) i.e. motor manufacturer in case of main motors including supply of all specialised tools & tackles / instruments required for above service.
H	Miscellaneous		
H.1	All Foundation / Anchor Bolts	Yes	
H.2	First fill of oils and lubricants, sealing fluid and other consumables required for equipment preservation, start-up & commissioning during defect liability period.	Yes	
H.3	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	Yes	Same shall be included in the base price. (Vendor to furnish separate list of such items in his proposal)

MANDATORY SPARE PARTS CENTRIFUGAL PUMPS (Special Purpose Process)

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	27.05.21	Issued with MR	VS	MG	TK
A	23.03.21	Issued with MR	VS	MG/SPC	TK
Rev. No.	Date	Purpose	Prepared by	Reviewed by	Approved by

PART-A: MECHANICAL

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
	FLANGES (All flanges including blind flanges)						
24.	Gaskets	200% Extra					
25.	Bolting	10% Extra					



PART B: ELECTRICAL

Sr. no.	Item description	Quantity
1.0	Mandatory spares	One set of spare for each rating & type
	MV Induction motors	
1.1	Bearing (DE & NDE)	One set
1.2	Terminal studs / bushing assembly	One set each





PART-C : INSTRUMENTATION MANDATORY SPARES:

1.	Pressure Gauges	20% (Subject to min. of 2) of each type, range, material of construction and rating.
2.	Temperature Gauges	20% (Subject to min. of 2) of each type, range of Temperature Gauges
3.	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)
4.	Orifice Plates	10% or minimum 1 of blind plates of each size, rating, thickness & material of construction
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.
6.	Valve manifolds	10% (subject to minimum of 1) of each type, size and material of construction.
7.	Guided wave Radar Level Instrument	10% or minimum one number of full set of transmitter
8.	Safety/ Thermal Relief Valves	A) 10%(subject to minimum 1 no.) of disc for identical valves B) 10%(subject to minimum 1 no.) of spring for identical valves C) 10%(subject to minimum 1 no.) of gasket set for identical valves D) 20%(subject to minimum 1 no.) of expansion bellows for identical valves (Only for balanced bellows type) E) 10%(subject to minimum 1 no.) of Soft Good Kit for identical Main valves and Pilot Valves (Only for pilot operated type)
	<u>Notes for Instrumentation Mandatory Spares: -</u>	

- | | |
|--|--|
| | <ol style="list-style-type: none">1. 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.2. The word 'TYPE' means the Make, model no., type, range, size/length, rating, material as applicable. |
|--|--|

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ENGINEERING DESIGN BASIS FOR ROTATING EQUIPMENT

			 Written By Shankar Ramasubramanian 2020.06.11 15:25:27 +05'30'	 Checked By Arundan Ananthapadmanaban 2020.06.11 17:54:17 +05'30'	 Approved By Arundan Ananthapadmanaban 2020.06.11 17:54:37 +05'30'	 Authorized By Munichandrasekar Jeyaraman 2020.06.11 18:01:53 +05'30'
B	10-Jun-2020	REISSUED FOR DESIGN	RS	AA	AA	JMC
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REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED

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1. Introduction:



INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th 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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			IOCL Paradip Refinery		
		CLIENT	INDIAN OIL CORPORATION LIMITED		
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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 – 11th Edition
- Centrifugal Pumps for Water service – ISO 5199 Edition 2002 – Class II
- Centrifugal Fans – Fired Heaters for General Refinery Service API Std. 560 – 5th Edition
- Pressure Lubrication, Shaft sealing and Oil control Systems – API Std. 614-5th Edition
- Shaft sealing for centrifugal & rotary pumps- API Std. 682 – 4th Edition
- Special Purpose couplings – API 671 4th 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

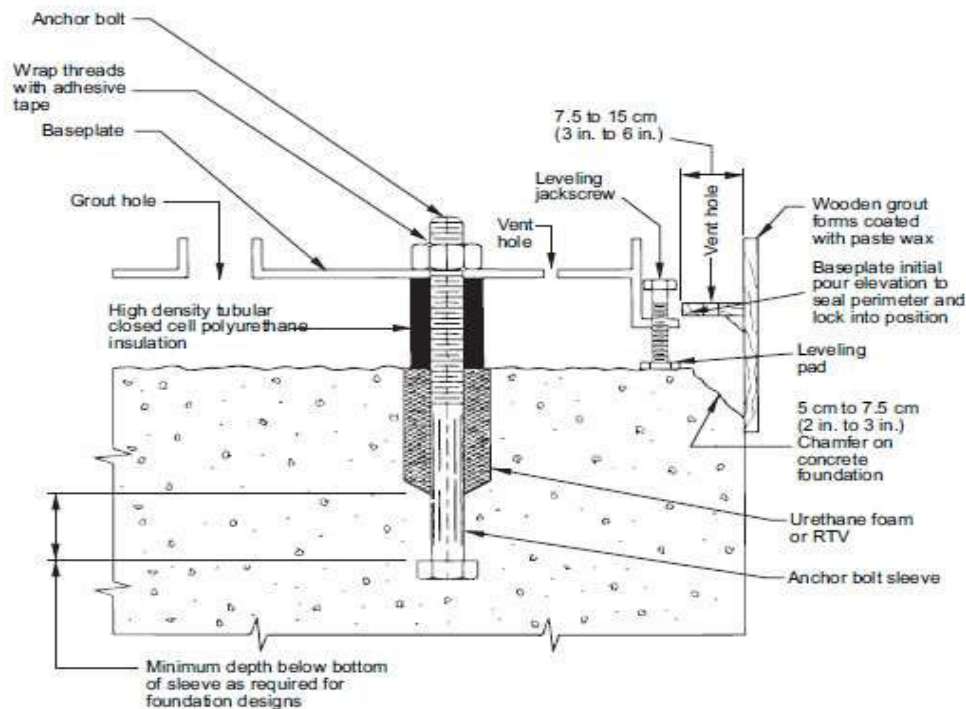




Figure G.1—Typical Grouting Installation of Baseplates for Pumps and General-purpose Equipment

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TYPICAL GROUTING INSTALLATION OF SOLEPLATES

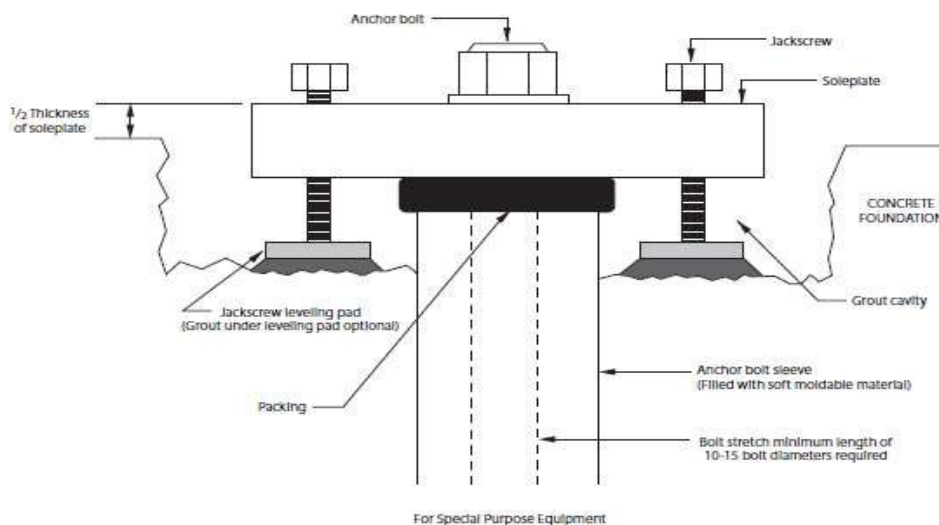


Figure F.1—Typical Grouting Installation of Soleplates

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 610-11th 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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	CLIENT		IOCL Paradip Refinery	
ENGINEERING DESIGN BASIS FOR ROTATING EQUIPMENT	Project No. 080557C001	Document No. 080557C-088-JSD-0900-001	Rev. No. B	Page 18 of 22

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 ± 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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	CLIENT	INDIAN OIL CORPORATION LIMITED		
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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:

- 20 percent in excess of the maximum BKW (including +4% tolerance) required to drive the pump at rated condition.
- 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:



- 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.

 		PROJECT	Standby SRU & Additional Tanks IOCL Paradip Refinery	
		CLIENT	INDIAN OIL CORPORATION LIMITED	
MECHANICAL DATA SHEET FOR SWS ACID GAS KOD PUMPS	Project No. 080557C001	Document No. 080557C-088-SP-0910-002	Rev. No. B	Page 1 of 2

SULPHUR RECOVERY UNIT

UNIT : 088

MECHANICAL DATASHEET FOR SWS ACID GAS PUMPS

TAG NO: 088-P-002 A/B

Reference Document: Process datasheet 080557C-088-PDS-0910-002 Rev A

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

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DATA SHEET No. _____

080557C-088-SP-0910-002

Sheet: 2 of 2

B

Note: The above notes ('A' to 'N') to be followed strictly. The reference of these notes are indicated in the subsequent pages.

ANNEXURE 1 OF PUMP DATASHEET 080557C-088-SP-0910-002 REV B

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: SWS ACID GAS KO DRUM PUMPS				ITEM No: 086/087-P-002A/B No. REQD: 4	
				DOCUMENT CAT.-CLASS 1	
REV	O1	F1		DOCUMENT No. PDRP4220-8110-PS-086-0002	
DATE	03-Jul-09	02-Oct-09		SHEET 1 OF 1	
ORIG. BY	SMR	DJL <i>DTL</i>		DOCUMENT SEQUENCE No. 17790	
APP. BY	SRB	SMR <i>SRB</i>			

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.

```

graph TD
    SRU1[SRU#1 Unit 86] --- TGTU1[TGTU#1 Unit 89]
    SRU2[SRU#2 Unit 87] --- TGTU1
    SRU2 --- TGTU2[TGTU#2 Unit 90]
    SRU3[SRU#3 Unit 88] --- TGTU2
    Common[Common Unit 85]
            
```

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 & IS 5572 will be applied. F1
- NPSHa has been updated to 1.51m after detailed hydraulic calculations. F1
- 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 2.5 kg/cm2.g and 3.5kg/cm2.g respectively.

ITEM No. 086/087-P-002A/B	SHEET 1 OF 1
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Black & Veatch				PAGE 1 OF 6																																																			
ISO 13709 (API 610 9TH) CENTRIFUGAL PUMP PROCESS DATA SHEET ISO STANDARDS(4.2) S.I. UNITS (4.3)				JOB NO. 160796.1000 ITEM NO.(S) 086/087/088-P-002A/B Note 1																																																			
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PURCHASER'S REQUIREMENTS				PURCH ORDER NO. 0																																																			
DATE				9-May-08																																																			
BY				PTJ / AB																																																			
1 APPLICABLE TO: <input checked="" type="radio"/> PROPOSALS <input type="radio"/> PURCHASE <input checked="" type="checkbox"/> AS BUILT																																																							
2 FOR Indian Oil Corporation Limited (IOCL) UNIT Sulfur Recovery Units 086, 087, 088																																																							
3 SITE Paradip, Orissa State, India SERVICE SWS Acid Gas KO Drum Pumps																																																							
5 NOTES: INFORMATION BELOW TO BE COMPLETED: <input type="radio"/> BY PURCHASER <input type="checkbox"/> BY MANUFACTURER <input checked="" type="checkbox"/> BY MANUFACTURER OR PURCHASER																																																							
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12 APPLICABLE OVERLAY STANDARD(S):																																																							
<input checked="" type="checkbox"/> OPERATING CONDITIONS (5.1.3)																																																							
14 CAPACITY, NORMAL 5.68 (m3/h) RATED 5.68 (m3/h)																																																							
15 OTHER																																																							
17 SUCTION PRESSURE MAX./RATED 4.11 / 0.91 (kg/cm ² .g)																																																							
18 DISCHARGE PRESSURE 7.99 (kg/cm ² .g)																																																							
19 DIFFERENTIAL PRESSURE 7.08 (kg/cm ² .g)																																																							
20 DIFF. HEAD 73.34 (m) NPSHA 1.14 (m)																																																							
21 PROCESS VARIATIONS (5.1.4) Note 4																																																							
22 STARTING CONDITIONS (5.1.4)																																																							
23 SERVICE: <input type="radio"/> CONT. <input checked="" type="radio"/> INTERMITTENT (STARTS/DAY)																																																							
24 <input type="radio"/> PARALLEL OPERATION REQ'D (5.1.13)																																																							
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27 LOCATION: (5.1.30)																																																							
28 <input type="radio"/> INDOOR <input type="radio"/> HEATED <input checked="" type="radio"/> OUTDOOR <input type="radio"/> UNHEATED																																																							
29 <input checked="" type="radio"/> ELECTRICAL AREA CLASSIFICATION (5.1.24 / 6.1.4) Note 3																																																							
30 ZONE Hold GR Hold CL Hold																																																							
31 <input type="radio"/> WINTERIZATION REQ'D <input type="radio"/> TROPICALIZATION REQ'D																																																							
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33 <input checked="" type="radio"/> ALTITUDE 3.91 (m) BAROMETER 1.025 (kg/cm ² .a)																																																							
34 <input checked="" type="radio"/> RANGE OF AMBIENT TEMPS: MIN/MAX. 11.3 / 42.4 (°C)																																																							
35 <input checked="" type="radio"/> RELATIVE HUMIDITY: MIN / MAX 24.7 / 99.7 (%)																																																							
36 UNUSUAL CONDITIONS: (5.1.30) <input checked="" type="radio"/> DUST <input type="radio"/> FUMES																																																							
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45 <input type="checkbox"/> MANUFACTURER																																																							
46 <input type="checkbox"/> FRAME (kW) <input type="checkbox"/> ENCLOSURE TEFC (RPM)																																																							
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48 <input checked="" type="radio"/> VOLTS/PHASE/HERTZ 415 / 3 / 50																																																							
50 <input checked="" type="radio"/> TYPE Squirrel Cage Induction																																																							
51 <input type="radio"/> MINIMUM STARTING VOLTAGE (6.1.5)																																																							
52 <input checked="" type="radio"/> INSULATION Class F <input checked="" type="radio"/> TEMP. RISE Class B																																																							
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54 <input type="radio"/> LOCKED ROTOR AMPS																																																							
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56 <input checked="" type="radio"/> LUBE Grease																																																							
58 BEARINGS (TYPE/NUMBER):																																																							
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<input type="checkbox"/> IMPELLER TYPE																																																							
<input type="checkbox"/> RATED POWER (kW) EFFICIENCY (%)																																																							
<input type="checkbox"/> MINIMUM CONTINUOUS FLOW:																																																							
THERMAL (m ³ /h) STABLE (m ³ /h)																																																							
<input type="checkbox"/> PREFERRED OPER. REGION TO (m ³ /h)																																																							
<input type="checkbox"/> ALLOWABLE OPER. REGION TO (m ³ /h)																																																							
<input type="checkbox"/> MAX HEAD @ RATED IMPELLER (m)																																																							
<input type="checkbox"/> MAX POWER @ RATED IMPELLER (kW)																																																							
<input type="checkbox"/> NPSHR AT RATED CAPACITY (m) (5.1.10)																																																							
<input checked="" type="checkbox"/> SUCTION SPECIFIC SPEED																																																							
MAX/ACTUAL / (5.1.11)																																																							
<input checked="" type="checkbox"/> MAX. SOUND PRESS. LEVEL REQ'D 85 @ 1m (dBA) (5.1.16)																																																							
<input checked="" type="checkbox"/> EST MAX SOUND PRESS. LEVEL (dBA) (5.1.16)																																																							
<input type="checkbox"/> UTILITY CONDITIONS																																																							
ELECTRICITY																																																							
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>VOLTAGE</th> <th>PHASE</th> <th>HERTZ</th> </tr> </thead> <tbody> <tr> <td>DRIVERS</td> <td>415</td> <td>3</td> <td>50</td> </tr> <tr> <td>HEATING</td> <td>240</td> <td>1</td> <td>50</td> </tr> </tbody> </table>							VOLTAGE	PHASE	HERTZ	DRIVERS	415	3	50	HEATING	240	1	50																																						
	VOLTAGE	PHASE	HERTZ																																																				
DRIVERS	415	3	50																																																				
HEATING	240	1	50																																																				
SYSTEM VOLTAGE DIP <input type="radio"/> 80% <input type="radio"/> OTHER (6.1.5)																																																							
STEAM																																																							
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>MAX. PRESS.</th> <th>MAX. TEMP.</th> <th>MIN. PRESS.</th> <th>MIN. TEMP.</th> </tr> </thead> <tbody> <tr> <td>DRIVERS</td> <td>43 kg/cm².a</td> <td>400 °C</td> <td>39 kg/cm².a</td> <td>380 °C</td> </tr> <tr> <td>HEATING</td> <td>5 kg/cm².g</td> <td>190 °C</td> <td>3 kg/cm².g</td> <td>143 °C</td> </tr> </tbody> </table>							MAX. PRESS.	MAX. TEMP.	MIN. PRESS.	MIN. TEMP.	DRIVERS	43 kg/cm ² .a	400 °C	39 kg/cm ² .a	380 °C	HEATING	5 kg/cm ² .g	190 °C	3 kg/cm ² .g	143 °C																																			
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HEATING	5 kg/cm ² .g	190 °C	3 kg/cm ² .g	143 °C																																																			
COOLING WATER: (5.1.19) SOURCE																																																							
SUPPLY TEMP. 35 (°C) MAX. RETURN TEMP. 44 (°C)																																																							
NORM. PRESS. 5.5 (kg/cm ² .g) DESIGN PRESS. 6.5 (kg/cm ² .g)																																																							
MIN. RET. PRESS. 2.0 (kg/cm ² .g) MAX. ALLOW. D.P. 0.7 (kg/cm ² .g)																																																							
CHLORIDE CONCENTRATION: (PPM)																																																							

05/01 610 ISO.XLS REV 0 PUMP DATA SHEET

B&V Standard Rev. 1 2/22/2007

* With ref. to flow requirement of the pumps, please also refer to page no.7, change list.

Black & Veatch
ISO 13709 (API 610 9TH)
CENTRIFUGAL PUMP
PROCESS DATA SHEET
ISO STANDARDS(4.2)
S.I. UNITS (4.3)

PAGE 2 OF 6

JOB NO. **160796.1000** ITEM NO.(S) **086/087/088-P-002A/B Note 1**
 REQ / SPEC NO. **1**
 PURCH ORDER NO. _____ DATE **9-May-08**
 INQUIRY NO. **0** BY **PTJ / AB**

R

1	(1) Total of six (6) pumps required. Note 2	
2	(2) Pump shall be built in compliance with ISO 13709 (API 610, 10 th Edition). Sealing system shall conform to Note D & G	
3	ISO 21049 (ANSI/API 682)- Category 2 requirements. See mechanical seal data sheet for additional information.	
4	(3) Compliance with NACE MR0103 is required.	
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Black & Veatch
ISO 13709 (API 610 9TH)
SINGLE STAGE OVERHUNG (TYPE OH)
CENTRIFUGAL PUMP DATA SHEET
ISO STANDARDS(4.2)
S.I. UNITS (4.3)

PAGE **3** OF **6**

JOB NO. **160796.1000** ITEM NO.(S) **086/087/088-P-002A/B**
 REQ / SPEC NO. **7**
 PURCH ORDER NO. _____ DATE **9-May-08**
 INQUIRY NC **0** BY **PTJ / AB**

R

1	CONSTRUCTION			
2	ROTATION: (VIEWED FROM COUPLING END) <input type="checkbox"/> CW <input type="checkbox"/> CCW			
3	PUMP TYPE: (1.3)			
4	<input checked="" type="radio"/> OH2 <input type="radio"/> OH3 <input type="radio"/> OH6 <input type="radio"/> OTHER _____			
5	CASING MOUNTING:			
6	<input checked="" type="radio"/> CENTERLINE <input type="radio"/> IN-LINE <input type="checkbox"/> OTHER _____			
7				
8	CASING TYPE:			
9	<input checked="" type="checkbox"/> SINGLE VOLUTE <input type="checkbox"/> MULTIPLE VOLUTE <input type="checkbox"/> DIFFUSER			
10	CASE PRESSURE RATING:			
11	<input type="checkbox"/> OH6 PUMP SUCTION REGION DESIGNED FOR MAWP (5.3.6)			
12	<input type="checkbox"/> MAX ALLOWABLE WORKING PRESSURE _____ (kPag)			
13	@ _____ (°C)			
14	<input type="checkbox"/> HYDROTEST PRESSURE _____ (kPag)			
15	NOZZLE CONNECTIONS: (5.4.2)			
16	SIZE	FLANGE RATING	FAC'G	POSITION
17				
18	SUCTION	300#	RF	END
19	DISCHARGE	300#	RF	TOP
20				
21	PRESSURE CASING AUX. CONNECTIONS: (5.4.3)			
22	NO.	SIZE (NPS)	TYPE	
23	<input checked="" type="radio"/> DRAIN		SW RF	
24	<input type="radio"/> VENT			
25	<input type="radio"/> WARM-UP			
26				
27	<input type="checkbox"/> MACHINED AND STUDDED CONNECTIONS (5.4.3.8)			
28	<input type="checkbox"/> CYLINDRICAL THREADS REQUIRED (5.4.3.3)			
29	ROTOR:			
30	<input checked="" type="radio"/> COMPONENT BALANCE TO ISO 1940 G2.5 (5.9.4.4)			
31	COUPLINGS:(6.2.2)			
32	<input type="checkbox"/> MANUFACTURER <input checked="" type="checkbox"/> MODEL _____			
33	<input type="checkbox"/> RATING (kW/100 RPM) _____			
34	<input checked="" type="checkbox"/> SPACER LENGTH _____ (mm) <input checked="" type="checkbox"/> SERVICE FACT.			
35	<input type="checkbox"/> COUPLING BALANCED TO ISO 1940-1 G6.3 (6.2.3)			
36	<input type="checkbox"/> COUPLING WITH PROPRIETARY CLAMPING DEVICE (6.2.10)			
37	<input type="checkbox"/> COUPLING PER ISO 14691(6.2.3)			
38	<input type="checkbox"/> COUPLING PER ISO 10441(6.2.3)			
39	<input type="checkbox"/> COUPLING PER API 671(6.2.3) <input checked="" type="radio"/> ASME B15.1			
40	<input checked="" type="radio"/> NON SPARK COUPLING GUARD (6.2.13)			
41	<input checked="" type="radio"/> COUPLING GUARD STANDARD PER OSHA			
42	BASEPLATES:			
43	<input type="checkbox"/> API BASEPLATE NUMBER _____			
44	<input type="checkbox"/> NON-GROUT CONSTRUCTION (6.3.13)			
45	<input checked="" type="radio"/> OTHER Epoxy Grout			
46	MECHANICAL SEAL:(5.8.1) (ANNEX C)			
47	<input checked="" type="radio"/> SEE ATTACHED ISO 21049/API 682 DATA SHEET			
48				
49				
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SURFACE PREPARATION AND PAINT	
<input checked="" type="radio"/> MANUFACTURER'S STANDARD <input type="radio"/> OTHER (SEE BELOW) Note F	
<input type="radio"/> SPECIFICATION NO. _____	
PUMP:	
<input type="radio"/> PRIMER	
<input type="radio"/> FINISH COAT _____	
BASEPLATE: (6.3.17)	
<input type="radio"/> PRIMER	
<input type="radio"/> FINISH COAT _____	
<input type="radio"/> DETAILS OF LIFTING DEVICES(6.3.20) _____	
SHIPMENT: (7.4.1) Note E	
<input type="radio"/> DOMESTIC <input type="radio"/> EXPORT <input type="radio"/> EXPORT BOXING REQUIRED	
<input checked="" type="radio"/> OUTDOOR STORAGE MORE THAN 6 MONTHS	
SPARE ROTOR ASSEMBLY PACKAGED FOR:	
<input type="radio"/> HORIZONTAL STORAGE <input type="radio"/> VERTICAL STORAGE	
<input type="radio"/> TYPE OF SHIPPING PREPARATION _____	
HEATING AND COOLING	
<input type="radio"/> HEATING JACKET REQ'D. (5.8.9)	
<input checked="" type="radio"/> COOLING REQ'D.	
<input checked="" type="radio"/> COOLING WATER PIPING PLAN (6.5.4.1) _____	
C.W. PIPING:	
<input type="radio"/> PIPE <input checked="" type="radio"/> TUBING; FITTINGS _____	
C.W. PIPING MATERIALS:	
<input checked="" type="radio"/> S. STEEL <input checked="" type="radio"/> C. STEEL <input type="radio"/> GALVANIZED	
COOLING WATER REQUIREMENTS:	
<input type="checkbox"/> BEARING HOUSING	(m³/h)
<input type="checkbox"/> HEAT EXCHANGER	(m³/h)
TOTAL COOLING WATER (m³/h)	
HEAT MEDIUM: <input type="radio"/> STEAM <input type="radio"/> OTHER	
HEATING PIPING: <input type="radio"/> TUBING <input type="radio"/> PIPE	
BEARINGS AND LUBRICATION	
BEARING (TYPE/NUMBER):	
<input checked="" type="checkbox"/> RADIAL	A-F /
<input checked="" type="checkbox"/> THRUST	A-F /
LUBRICATION (5.11.3, 5.11.4):	
<input checked="" type="radio"/> GREASE <input checked="" type="radio"/> OIL Note L	
<input type="radio"/> PURGE OIL MIST <input type="radio"/> PURE OIL MIST	
<input checked="" type="radio"/> CONSTANT LEVEL OILER PREFERENCE (5.10.2.2): _____	
<input checked="" type="radio"/> OIL VISC. ISO GRADE _____	
INSTRUMENTATION	
<input type="radio"/> ACCELEROMETER (6.4.2.1)	
<input type="radio"/> PROVISION FOR MOUNTING ONLY (5.10.2.10)	
<input type="radio"/> FLAT SURFACE REQ'D (5.10.2.11) Note M	
<input type="radio"/> TEMP. GAUGES (WITH THERMOWELLS) (8.1.3.6)	
<input type="radio"/> PRESSURE GAUGE TYPE _____	
REMARKS: _____	
<input type="checkbox"/> WEIGHTS	
WEIGHT OF PUMP (kg) _____	
WEIGHT OF BASEPLATE (kg) _____	
WEIGHT OF DRIVER (kg) _____	
TOTAL WEIGHT (kg) _____	

Black & Veatch
ISO 13709 (API 610 9TH)
SINGLE STAGE OVERHUNG (TYPE OH)
CENTRIFUGAL PUMP DATA SHEET
ISO STANDARDS(4.2)
S.I. UNITS (4.3)

PAGE **4** OF **6**
 JOB NO **160796.1000** ITEM NO (S) **086/087/088-P-002A/B**
 REQ / SPEC **7**
 PURCH ORDER _____ DATE **9-May-08**
 INQUIR' **0** BY **PTJ / AB**

R

SPARE PARTS (TABLE 18)		QA INSPECTION AND TESTING (CONT.)			
2	<input checked="" type="radio"/> START-UP <input checked="" type="radio"/> NORMAL MAINTENANCE	<input type="radio"/> TEST (7.3.1.2)	NON-WIT	WIT	OBSERVE
3	<input type="radio"/> SPECIFY	<input type="radio"/> HYDROSTATIC (7.3.2)	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	<input type="radio"/> OTHER PURCHASER REQUIREMENTS	<input type="radio"/> PERFORMANCE (7.3.3)	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	<input type="radio"/> COORDINATION MEETING REQUIRED (9.1.3)	<input type="radio"/> RETEST ON SEAL	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	<input type="radio"/> MAXIMUM DISCHARGE PRESSURE TO INCLUDE (5.3.2)	<input type="radio"/> LEAKAGE (7.2.2.3c)			
7	<input type="radio"/> MAX RELATIVE DENSITY	<input type="radio"/> NPSH (7.3.4.2) Note H	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	<input type="radio"/> MAX DIA. IMPELLERS AND/OR NO OF STAGES Note I	<input type="radio"/> TRUE PEAK VELOCITY	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	<input type="radio"/> OPERATION TO TRIP SPEED	<input type="radio"/> DATA (7.3.3.4e)			
10	<input type="radio"/> OH3 BEARING HS6 LIFTER (8.1.2.6)	<input type="radio"/> COMPLETE UNIT TEST (7.3.4.3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11	<input type="radio"/> CONNECTION DESIGN APPROVAL (5.12.3.4)	<input type="radio"/> SOUND LEVEL TEST (7.3.4.4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12	<input checked="" type="radio"/> TORSIONAL ANALYSIS REQUIRED	<input type="radio"/> CLEANLINESS PRIOR TO	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13	<input type="radio"/> TORSIONAL ANALYSIS REPORT (5.9.2.1)	<input type="radio"/> FINAL ASSEMBLY (7.2.2.2)			
14	<input checked="" type="radio"/> PROGRESS REPORTS (9.3.3)	<input type="radio"/> NOZZLE LOAD TEST (6.3.6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15	<input type="radio"/> OUTLINE OF PROCEDURES FOR OPTIONAL TESTS (9.3.5)	<input type="radio"/> CHECK FOR CO-PLANAR	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16	<input type="radio"/> ADDITIONAL DATA REQUIRING 20 YEARS RETENTION (7.2.2.1f)	<input type="radio"/> MOUNTING PAD SURFACES (6.3.3)			
17	PIPING AND APPURTENANCES	<input type="radio"/> MECHANICAL RUN UNTIL OIL	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18	MANIFOLD PIPING TO SINGLE CONNECTION (6.5.1.6)	<input type="radio"/> TEMP. STABLE (7.3.4.7.1)			
19	<input checked="" type="checkbox"/> VENT <input checked="" type="checkbox"/> DRAIN <input checked="" type="checkbox"/> COOLING WATER	<input type="radio"/> 4 HR. MECHANICAL RUN AFTER	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20	<input checked="" type="checkbox"/> MOUNT SEAL RESERVOIR OFF BASEPLATE (6.5.1.4)	<input type="radio"/> OIL TEMP. STABLE			
21	<input checked="" type="checkbox"/> FLANGES REQUIRED IN PLACE OF SOCKET WELD UNIONS (6.5.2.8)	<input type="radio"/> MECHANICAL RUN TEST(7.3.4.7.2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22	<input checked="" type="checkbox"/> INSTALLATION LIST IN PROPOSAL (9.2.3L)	<input type="radio"/> BRG HSG RESONANCE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23	CONNECTION BOLTING	<input type="radio"/> TEST (7.3.4.6)			
24	<input type="radio"/> PTFE COATING <input type="radio"/> ASTM A153 GALVANIZED	<input type="radio"/> AUXILIARY EQUIPMENT	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25	<input type="radio"/> PAINTED <input type="radio"/> SS	<input type="radio"/> TEST (7.3.4.5)			
26	QA INSPECTION AND TESTING Note K	<input type="radio"/> CHARPY TEST (EN 13445/ASME VIII)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27	<input type="radio"/> SHOP INSPECTION (7.1.4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
28	<input checked="" type="radio"/> PERFORMANCE CURVE APPR.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29	<input checked="" type="radio"/> TEST WITH SUBSTITUTE SEAL (7.3.3.2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30	<input checked="" type="radio"/> MATERIAL CERTIFICATION REQUIRED (5.12.1.8)	<input checked="" type="radio"/> VENDOR KEEP REPAIR AND HT RECORDS (7.2.1.1c)			
31	<input checked="" type="radio"/> CASING <input checked="" type="radio"/> IMPELLER <input checked="" type="radio"/> SHAFT	<input checked="" type="radio"/> VENDOR SUBMIT TEST PROCEDURES (7.3.1.2 / 9.2.5)			
32	<input type="radio"/> OTHER	<input type="radio"/> VENDOR SUBMIT TEST DATA WITHIN 24 HOURS (7.3.3.3e)			
33	<input type="radio"/> CASTING REPAIR PROCEDURE APPROVAL REQ'D (5.12.2.5)	<input type="radio"/> INCLUDE PLOTTED VIBRATION SPECTRA (5.9.3.3)			
34	<input checked="" type="radio"/> INSPECTION REQUIRED FOR CONNECTION WELDS (5.12.3.4)	<input type="radio"/> COMPLETION OF INSPECTION CHECK LIST (7.1.6)			
35	<input checked="" type="checkbox"/> MAG PARTICLE <input checked="" type="checkbox"/> LIQUID PENETRANT	<input checked="" type="radio"/> REVIEW VENDOR'S QA PROGRAM			
36	<input checked="" type="checkbox"/> RADIOGRAPHIC <input checked="" type="checkbox"/> ULTRASONIC	<input type="radio"/> RECORD FINAL ASSEMBLY RUNNING CLEARANCES			
37	<input checked="" type="radio"/> INSPECTION REQUIRED FOR CASTINGS (7.2.1.3)				
38	<input checked="" type="checkbox"/> MAG PARTICLE <input checked="" type="checkbox"/> LIQUID PENETRANT				
39	<input checked="" type="checkbox"/> RADIOGRAPHIC <input checked="" type="checkbox"/> ULTRASONIC				
40	<input type="radio"/> HARDNESS TEST REQUIRED: _____ (7.2.2.3)				
41	<input type="radio"/> ADDITIONAL SUBSURFACE EXAMINATION FOR 7.2.1.3				
42	FOR _____				
43	METHOD _____				
44	REMARKS				
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BLACK & VEATCH		REQUIRED FOR: IOCL SITE: Paradip UNIT: 086, 087, 088	
Category 1 & 2 Seals		JOB/PROJECT NO. 160796.1000 ITEM NC 086/087/088-P-002A/B	
MECHANICAL SEAL DATA SHEET FOR CENTRIFUGAL & ROTARY PUMPS		REQUISITION / SPEC. NUMBER _____ / _____	
S.I. UNITS PAGE 1 OF 2		INQUIRY NUMBER _____ BY PTJ / AB	
		PURCH ORDER NUMBER _____ DATE _____	
		REVISION NO. 0 DATE 9-May-08	
		PAGE 5 OF 6	
<input checked="" type="checkbox"/> <input type="checkbox"/> DEFAULT SELECTION <input type="checkbox"/> INDICATES DATA COMPLETED BY PURCHASER <input type="checkbox"/> BY SEAL VENDOR <input type="checkbox"/> BY SEAL VENDOR OR PURCHASER		DATA SUPPLIED; <input type="checkbox"/> CUSTOMARY UNITS <input checked="" type="checkbox"/> SI UNITS HARDWARE SUPPLIED <input type="checkbox"/> CUSTOMARY UNITS <input checked="" type="checkbox"/> SI UNITS STANDARDS APPLICABLE; <input type="checkbox"/> PRIMARY REFERENCE (5.2) <input type="checkbox"/> SECONDARY REFERENCE (5.2)	
SEAL SPECIFICATION - (REF CLAUSE 1.2, FIGURES 1 TO 6) Note G			
CATEGORY <input type="checkbox"/> SEAL CATEGORY 1 (1.2) <input checked="" type="checkbox"/> SEAL CATEGORY 2 (1.2)		<input type="checkbox"/> SEAL CODE (ANNEX J)	
TYPE <input checked="" type="checkbox"/> TYPE A (3.78) <input type="checkbox"/> TYPE B (3.79)		<input type="checkbox"/> ALTERNATE STATIONARY (TYPE A & B)	
(CODE-CW) <input type="checkbox"/> TYPE C (3.80) <input type="checkbox"/> ALTERNATE ROTATING (TYPE C)		<input type="checkbox"/> SINGLE SPRING (TYPE A)	
ARR'GT DEFAULT CONFIGURATION		ALTERNATE DESIGN	
1 (3.2) <input type="checkbox"/> 1CW-FX <input type="checkbox"/> 1CW-FL <input type="checkbox"/> DIST. FLUSH <input type="checkbox"/> ALTERNATE BUSH		<input type="checkbox"/> 01 <input type="checkbox"/> 11 <input type="checkbox"/> 14 <input type="checkbox"/> 23 <input type="checkbox"/> 32 <input type="checkbox"/> 51 <input type="checkbox"/> 62 <input type="checkbox"/> 02 <input type="checkbox"/> 13 <input type="checkbox"/> 21 <input type="checkbox"/> 31 <input type="checkbox"/> 41 <input type="checkbox"/> 61	
2 (3.3) <input type="checkbox"/> LIQUID <input checked="" type="checkbox"/> 2CW-CW <input type="checkbox"/> FX <input type="checkbox"/> DIST. FLUSH <input type="checkbox"/> TANGENTIAL LBO CONN'N		<input type="checkbox"/> 01 <input type="checkbox"/> 13 <input checked="" type="checkbox"/> 23 <input type="checkbox"/> 41 <input type="checkbox"/> 62 <input type="checkbox"/> 75 <input type="checkbox"/> 02 <input type="checkbox"/> 14 <input type="checkbox"/> 31 <input checked="" type="checkbox"/> 52 <input type="checkbox"/> 71 <input type="checkbox"/> 76	
3 (3.4) <input type="checkbox"/> LIQUID <input type="checkbox"/> 3CW-FB <input type="checkbox"/> 3CW-BB <input type="checkbox"/> FX <input type="checkbox"/> 3CW-FF <input type="checkbox"/> TANG. LBO		<input type="checkbox"/> 01 <input type="checkbox"/> 13 <input type="checkbox"/> 53B <input type="checkbox"/> 61 <input type="checkbox"/> 02 <input type="checkbox"/> 32 <input type="checkbox"/> 53C <input type="checkbox"/> 62	
<input type="checkbox"/> GAS <input type="checkbox"/> 3NC-BB <input type="checkbox"/> 3NC-FF <input type="checkbox"/> 3NC-FB		<input type="checkbox"/> 11 <input type="checkbox"/> 53A <input type="checkbox"/> 54 <input type="checkbox"/> 74	
SLEEVE-SHAFT DRIVE <input type="checkbox"/> SET-SCREW ONTO SHAFT <input type="checkbox"/> ALTERNATE (6.1.3.13) - SPECIFY			
MATERIALS (REFERENCE 6.1.6 & ANNEX C)			
SECONDARY SEALS		METAL BELLOWS	
<input checked="" type="checkbox"/> FKM <input checked="" type="checkbox"/> FFKM <input checked="" type="checkbox"/> CARBON VS SIC <input type="checkbox"/> UNS N10276 (TYPE B) <input type="checkbox"/> SPIRAL-W GASKET <input type="checkbox"/> SIC VS SIC <input type="checkbox"/> UNS N07718 (TYPE C) <input type="checkbox"/> NBR <input type="checkbox"/> EPM/EPDM <input type="checkbox"/> SS-SIC <input type="checkbox"/> RB-SIC <input type="checkbox"/> UNS N08020 <input type="checkbox"/> OTHER: <input type="checkbox"/> VS <input type="checkbox"/> OTHER:		<input type="checkbox"/> UNS N10276 <input checked="" type="checkbox"/> UNS S31600/ S31635 <input type="checkbox"/> OR N06455 <input type="checkbox"/> UNS N10276 <input type="checkbox"/> UNS S31600 <input type="checkbox"/> UNS N08020 <input type="checkbox"/> OR S31635 <input type="checkbox"/> OTHER:	
MECHANICAL SEAL DATA			
<input type="checkbox"/> SEAL VENDOR <input type="checkbox"/> DATA REQUIREMENTS FORM (ANNEX G) <input type="checkbox"/> SIZE/TYPE <input type="checkbox"/> SEAL DRAWING NUMBER <input type="checkbox"/> VENDOR'S SEAL CODE <input type="checkbox"/> MODIFIED FACES FOR PUMP PERFORMANCE TEST		<input type="checkbox"/> ALTERNATE SEAL FOR PUMP PERFORMANCE TEST <input type="checkbox"/> DYNAMIC SEALING PRESSURE RATING (3.19) _____ bar (ga) <input type="checkbox"/> STATIC SEALING PRESSURE RATING (3.74) _____ bar (ga) <input type="checkbox"/> MAXIMUM ALLOWABLE TEMPERATURE (3.39) _____ °C <input type="checkbox"/> MINIMUM DESIGN METAL TEMPERATURE _____ °C	
SEAL CHAMBER DATA (REFERENCE 6.1.2.4)			
ASME B73.1 & 2 <input type="checkbox"/> CYLINDRICAL <input type="checkbox"/> TAPERED <input checked="" type="checkbox"/> ISO 13709 <input type="checkbox"/> ISO 3069-C <input type="checkbox"/> OTHER, SPECIFY <input type="checkbox"/> BOLT-ON CHAMBER (6.1.2.5) <input type="checkbox"/> SEAL CHAMBER FLUSH PORT REQ'D <input type="checkbox"/> SEAL CHAMBER VENT REQ'D <input checked="" type="checkbox"/> FLOATING THROAT BUSH <input type="checkbox"/> FIXED THROAT BUSH <input type="checkbox"/> CHAMBER HEATING/COOLING <input type="checkbox"/> H <input type="checkbox"/> C			
PUMP DATA			
PUMP DESIGN <input type="checkbox"/> MANUFACTURER _____ <input type="checkbox"/> MODEL _____ <input type="checkbox"/> FRAME/SIZE _____ <input type="checkbox"/> CASE MATERIAL _____ PUMP OPERATING PRESSURE <input type="checkbox"/> SUCTION PRESS. (RATED) _____ bar (ga) <input type="checkbox"/> DISCHARGE PRESSURE _____ bar (ga) SEAL CHAMBER <input type="checkbox"/> NORMAL _____ bar (ga) <input type="checkbox"/> MIN / MAX (3.41) _____ / _____ bar (ga) <input type="checkbox"/> MSSP (3.43) _____ bar (ga) SHAFT <input type="checkbox"/> DIA. _____ mm <input type="checkbox"/> SHAFT SPEED _____ r/min <input type="checkbox"/> SHAFT DIRECTION (FROM DRIVER) <input type="checkbox"/> CW <input type="checkbox"/> CCW			
FLUID DATA - (FOR QUENCH, BUFFER AND BARRIER FLUID DATA, SEE PAGE 2)			
PUMPED STREAM		<input type="checkbox"/> HAZARDOUS <input type="checkbox"/> FLAMMABLE <input type="checkbox"/>	
<input checked="" type="checkbox"/> TYPE OR NAME SEE PUMP DS CONC'N _____ % <input type="checkbox"/> DISSOLVED CONTAMINANT H_2S _____ ml/m ³ <input type="checkbox"/> WET <input type="checkbox"/> Cl_2 _____ ml/m ³ <input type="checkbox"/> OTHER _____ @ _____ ml/m ³		<input type="checkbox"/> FLUID SOLID @ AMBIENT <input type="checkbox"/> SOLIDIFIES @ _____ °C POUR POINT _____ °C	
<input type="checkbox"/> SOLID CONTAMINANT <input type="checkbox"/> CONCENTRATION (MASS FRACTION) _____ <input type="checkbox"/> PUMPING TEMPERATURE MIN _____ °C NORMAL _____ °C MAX _____ °C		<input type="checkbox"/> PUMPED STREAM SOLIDIFIES UNDER SHEAR <input type="checkbox"/> PUMPED STREAM CONTAINS AGENTS THAT POLYMERIZE SPECIFY AGENTS _____ @ TEMP _____ °C	
<input type="checkbox"/> RELATIVE DENSITY (TO WATER @ 25°C) AT REF. TEMP. @ NORMAL TEMP _____ @ MAX TEMP _____ <input type="checkbox"/> ABSOLUTE VAPOR PRESSURE AT REFERENCE TEMP. NORMAL TEMP _____ bar MAX TEMP _____ bar		<input type="checkbox"/> PUMPED STREAM CAN PLATE OUT OR DECOMPOSE: SPECIFY CONDITIONS _____ <input type="checkbox"/> PUMPED STREAM IS REGULATED FOR FUGITIVE OR OTHER EMISSIONS. REGULATION LEVEL _____ ml/m ³	
<input type="checkbox"/> ATMOSPHERIC BOILING POINT. _____ °C <input type="checkbox"/> VISCOSITY @ NORMAL PUMPING TEMP. _____ Pa.s		<input type="checkbox"/> SPECIAL PUMP CLEANING PROCEDURES SPECIFY: _____ <input type="checkbox"/> ALTERNATE PROCESS FLUIDS & CONCENTRATION (INCL. COMMISSIONING)	
FLUSH FLUID If flush fluid is pumpage, then flush fluid data is not required.			
<input type="checkbox"/> TYPE OR NAME _____ CONC'N _____ % <input type="checkbox"/> SEAL VENDOR REVIEW REQUIRED <input type="checkbox"/> FLUID TEMPERATURE MIN _____ °C NORMAL _____ °C MAX _____ °C		<input type="checkbox"/> ABSOLUTE VAPOR PRESSURE AT REFERENCE TEMP. NORMAL TEMP _____ bar MAX TEMP _____ bar <input type="checkbox"/> ATMOSPHERIC BOILING POINT. _____ °C <input type="checkbox"/> VISCOSITY @ NORMAL PUMPING TEMP. _____ Pa.s	
<input type="checkbox"/> RELATIVE DENSITY (TO WATER @ 25°C) AT REF. TEMP. @ NORMAL TEMP _____ @ MAX TEMP _____ <input type="checkbox"/> FLOW RATE REQ'D MAX/MIN _____ / _____ l/min <input type="checkbox"/> PRESSURE REQ'D MAX/MIN _____ / _____ bar (ga)			
REMARKS:			

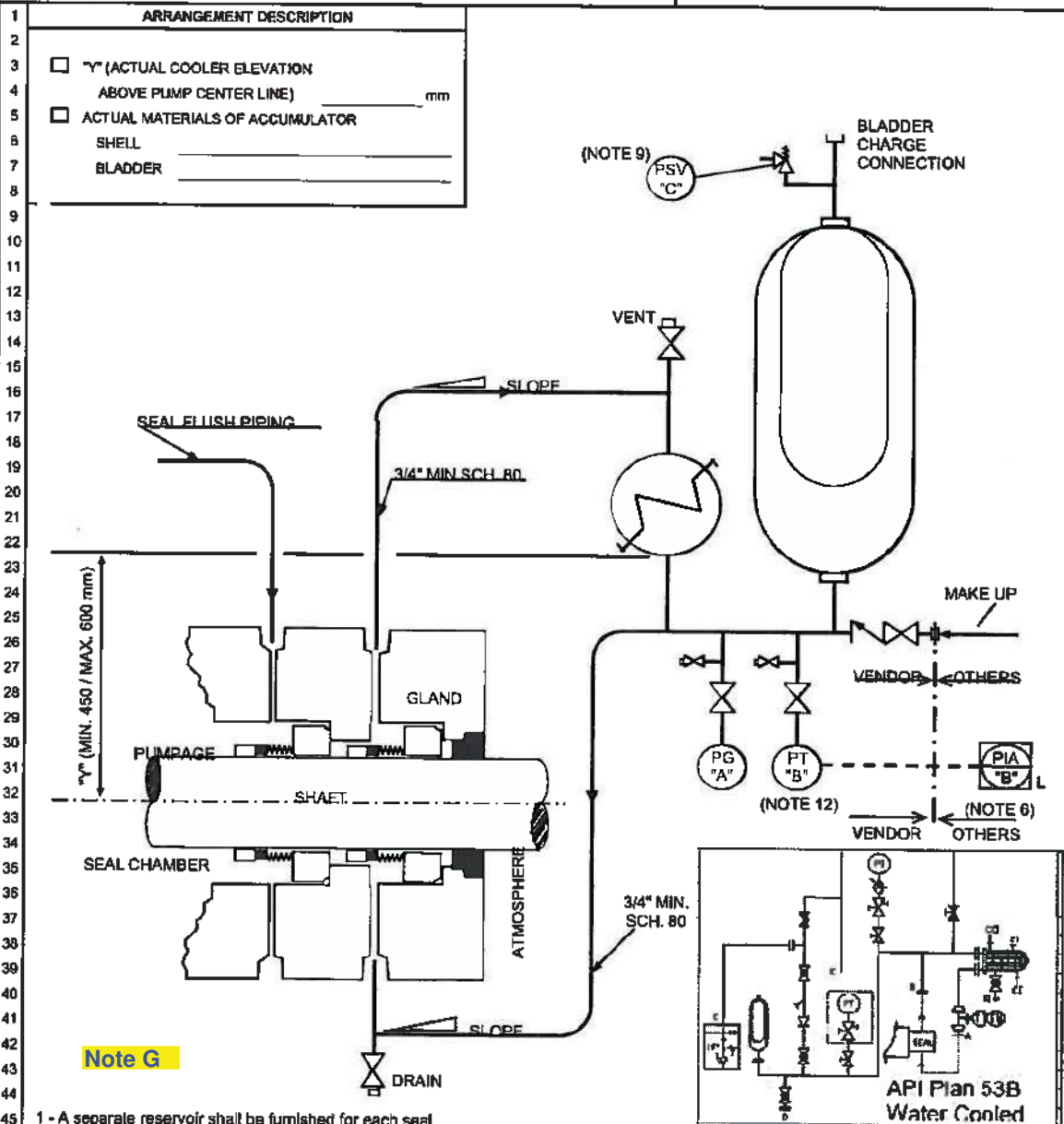
BLACK & VEATCH		REQUIRED FOR: IOCL SITE: Paradip UNIT: 086, 087, 088	
Category 1 & 2 Seals		JOB/PROJECT NO. 160796.1000 ITEM NO 086/087/088-P-002A/B	
MECHANICAL SEAL DATA SHEET FOR CENTRIFUGAL & ROTARY PUMPS S.I. UNITS SHEET 2 OF 2		REQUISITION / SPEC. NUMBER _____ / _____ INQUIRY NUMBER _____ BY PTJ / AB PURCHASE ORDER NUMBER _____ DATE _____ REVISION NO. 0 DATE 9-May-08 PAGE 6 of 6	
<input type="checkbox"/> INDICATES DATA COMPLETED BY PURCHASER <input type="checkbox"/> BY SEAL VENDOR <input checked="" type="checkbox"/> BY SEAL VENDOR OR PURCHASER <input checked="" type="checkbox"/> <input type="checkbox"/> DEFAULT SELECTION			
FLUID DATA - (QUENCH, BUFFER AND BARRIER FLUID DATA, LIQUID AND GAS)			
4 QUENCH MEDIUM 5 <input checked="" type="checkbox"/> TYPE OR NAME		<input checked="" type="checkbox"/> SUPPLY TEMPERATURE MAX/MIN _____ / _____ °C <input type="checkbox"/> FLOW RATE REQ'D MAX/MIN _____ / _____ l/min	
6 BUFFER/BARRIER MEDIUM 7 <input checked="" type="checkbox"/> TYPE OR NAME 8 ● PURCHASER SELEC'N <input type="checkbox"/> SEAL VENDOR SELEC'N 9 ● SEAL VENDOR REVIEW <input type="checkbox"/> PURCHASER REVIEW 10 <input type="checkbox"/> FLOW RATE REQ'D MAX/MIN. _____ / _____ l/min 11 <input type="checkbox"/> COOLING/HEATING REQUIRED (+ OR -) _____ Kw 12 <input checked="" type="checkbox"/> SUPPLY PRESSURE MAX/MIN. _____ / _____ bar (ga) 13 <input checked="" type="checkbox"/> FLUID OPERATING TEMPERATURE 14 MIN _____ °C NORMAL _____ °C MAX _____ °C		<input checked="" type="checkbox"/> RELATIVE DENSITY (TO WATER @ 25°C) AT REF. TEMP. @ NORMAL TEMP _____ @ MAX TEMP _____ <input checked="" type="checkbox"/> ABSOLUTE VAPOR PRESSURE AT REFERENCE TEMP. NORMAL TEMP _____ bar MAX TEMP _____ bar <input checked="" type="checkbox"/> ATMOSPHERIC BOILING POINT (LIQUID) _____ °C <input checked="" type="checkbox"/> VISCOSITY @ NORMAL TEMP (LIQUID) _____ Pa.s <input checked="" type="checkbox"/> SPECIFIC HEAT CAPACITY @ CONSTANT PRESSURE FOR LIQUID @ NORMAL TEMPERATURE _____ J/Kg.K	
SITE AND UTILITIES			
16 ● CONTROL VOLTAGE 110 V PHASE 3 HERTZ 50 17 ● ELECTRICAL AREA CL Hold GR Hold DIV Hold 18 ● DESIGN AMBIENT MIN./MAX. 11 / 43 °C Note 3 19 ● COOLING H ₂ O SUPPLY TEMP 35 °C <input type="checkbox"/> Cl ₂ ml/m ³ 20 ● COOLING H ₂ O PRESS. NORM./DES 5.5 / 6.5 kg/cm ² 21 ● EXPLOSIVE AREA CLASS (DIRECTIVE 94/9/EC)			
ACCESSORIES (CLAUSES 8 AND 9)			
20 GENERAL 21 <input type="checkbox"/> JOINT USER/VENDOR LAYOUT OF EQUIPMENT (8.1.4) 22 <input type="checkbox"/> SPECIAL REQUIREMENTS FOR HAZARDOUS SERVICE 23 24 <input type="checkbox"/> SPECIAL CLEANING AND DECONTAMINATION REQ'TS 25 <input type="checkbox"/> UTILITY MANIFOLD CONNECTIONS REQUIRED (8.4.4) 26 <input type="checkbox"/> TYPE AND SPEC. OF HEAT TRACING (8.6.5.8) 27 28 <input type="checkbox"/> THERMAL RELIEF VALVES REQUIRED (9.8.3)		20 PLAN 52 AND 53 SYSTEMS CONTINUED 21 ● EQUIPMENT SUPPORT SUPPLIER Pump or Seal Vendor 22 ● FILLING SYSTEM SUPPLIER Pump or Seal Vendor 23 ● ASME CODE STAMP REQUIRED Note N 24 ● RESERVOIR CAPACITY (8.5.4.3.a) _____ l 25 <input checked="" type="checkbox"/> NLL TO GLAND PLATE HEIGHT (8.5.4.2.3) _____ m 26 <input type="checkbox"/> PRESSURE CASING MAWP (3.40) _____ bar (ga) @ _____ °C 27 <input checked="" type="checkbox"/> SET PRESSURE RANGE, MAX/MIN _____ / _____ bar (ga) 28 <input checked="" type="checkbox"/> SYSTEM HOLD-UP PERIOD (PLANS 53B & 53C) _____ DAYS 29 PRESSURE SWITCH (8.5.4.2.7) TO ACTIVATE ON; 30 ● RISING PRESSURE (ARR 2) SET @ _____ bar (ga) 31 <input checked="" type="checkbox"/> FALLING PRESSURE (ARR 3) SET @ _____ bar (ga) 32 ● HIGH LEVEL ALARM REQUIRED (8.5.4.2.i) 33 <input type="checkbox"/> H/Q CURVE FOR INTERNAL CIRCULATING DEVICE (8.6.2.1) 34 <input type="checkbox"/> TEST BASED H/Q CURVE FOR INTERNAL CIRC. DEVICE 35 <input type="checkbox"/> EXTERNAL CIRCULATING PUMP (8.6.3.1)	
29 COOLING SYSTEM 30 <input type="checkbox"/> HEAT EXCHANGER SUPPLIER 31 <input checked="" type="checkbox"/> WATER COOLED <input checked="" type="checkbox"/> AIR COOLED <input type="checkbox"/> ASME B31.3 32 <input checked="" type="checkbox"/> EQUIPMENT REFERENCE/CODE _____ 33 <input type="checkbox"/> COOLING WATER LINES SUPPLIER 34 <input type="checkbox"/> TUBING <input type="checkbox"/> GALVANISED PIPING (8.4.2) 35 <input checked="" type="checkbox"/> COOLING WATER FLOW RATE _____ l/min 36 <input type="checkbox"/> SIGHT FLOW INDICATORS (8.4.3) <input type="checkbox"/> OPEN <input type="checkbox"/> CLOSED 37 PLAN 11, 12, 13, 31 AND 41 SYSTEMS 38 ● CONNECTING LINES SUPPLIER Pump Vendor 39 ● TUBING <input type="checkbox"/> PIPING (8.5.2.1) 40 <input type="checkbox"/> RESTRICTION ORIFICE NIPPLE IN FLUSH LINE (8.5.2.3) 41 <input type="checkbox"/> CYCLONE SEPARATOR SUPPLIER 42 PLAN 52 AND 53 SYSTEMS 43 <input checked="" type="checkbox"/> STANDARD (FIG G.27) <input checked="" type="checkbox"/> ALTERNATE (FIG G.28) 44 <input type="checkbox"/> DIMENSIONAL VARIATIONS TO STANDARD (FIG G.27) 45 <input type="checkbox"/> DIMENSIONAL VARIATIONS TO ALTERNATE (FIG G.28) 46 <input checked="" type="checkbox"/> ALTERNATE FABRICATION STANDARD 47 <input type="checkbox"/> PRIMARY EQUIPMENT SUPPLIER 48 <input checked="" type="checkbox"/> SUPPLIER REFERENCE/CODE _____ 49 ● CONNECTING LINES SUPPLIER Pump Vendor 50 ● TUBING <input type="checkbox"/> PIPING (8.5.4.4.9)		37 PLAN 72 AND 74 SYSTEM 38 <input type="checkbox"/> EQUIPMENT SUPPLIER 39 <input type="checkbox"/> HIGH FLOW ALARM SWITCH (8.6.6.5) 40 PLAN 75 AND 76 SYSTEM 41 <input type="checkbox"/> EQUIPMENT SUPPLIER 42 <input type="checkbox"/> HIGH LEVEL ALARM SWITCH FOR PLAN 75 (8.6.5.3) 43 <input type="checkbox"/> TEST CONNECTION (8.6.5.4) 44 INSTRUMENTATION 45 USER SPECIFICATION REFERENCE FOR 46 INSTRUMENTATION/CONTROLS 47 PRESSURE GAUGES (9.4); 48 <input type="checkbox"/> OIL FILLED PRESSURE GAUGES (9.4.3) 49 ● PRESSURE SWITCHES (9.5.2); <input type="checkbox"/> TRANSMITTER (9.5.2.3) 50 LEVEL SWITCHES (9.5.3); 51 ● HYDROSTATIC <input type="checkbox"/> CAPACITANCE <input type="checkbox"/> ULTRASONIC 52 LEVEL INDICATORS (9.6) <input type="checkbox"/> TRANSMITTER (9.5.3.2) 53 ● WELD PAD <input type="checkbox"/> EXTERNAL, REMOVABLE (9.6.2) 54 FLOW INDICATORS (9.7); <input type="checkbox"/> TRANSMITTER (9.7.2)	
INSPECTION AND TESTING			
55 <input type="checkbox"/> PURCHASER PARTICIPATION IN INSPECTION & TEST 56 SPECIFY: _____ 57 <input type="checkbox"/> INSPECTOR'S CHECK LIST (10.1.7 & ANNEX E) 58 <input type="checkbox"/> OPTIONAL QUALIFICATION TESTING REQ'D (10.3.1.1.2) 59 <input type="checkbox"/> PURCHASER APPROVAL REQUIRED FOR WELDED 60 CONNECTION DESIGNS, (6.1.6.10.5.4) 61 <input type="checkbox"/> HARDNESS TEST (10.2.14) REQUIRED FOR;		55 <input type="checkbox"/> 100% INSPECTION OF ALL WELDS (6.1.6.10.5.1) USING; 56 <input type="checkbox"/> MAGNETIC PARTICLE <input type="checkbox"/> LIQUID PENETRANT 57 <input type="checkbox"/> RADIOGRAPHIC <input type="checkbox"/> ULTRASONIC 58 <input checked="" type="checkbox"/> MODIFIED FACES FOR PUMP TEST (10.3.5.2.1) 59 (SEE PAGE 1, LINE 31) 60 <input checked="" type="checkbox"/> ALTERNATE SEAL PUMP TEST (10.3.5.2.2) 61 (SEE PAGE 1, LINE 26)	
REMARKS:			

SI units (API)



PARADIP REFINERY PROJECT
SUPPLEMENTAL SEAL HARNESS DATA SHEET
 DUAL SEAL / PRESSURD - Barrier fluid w/ bladder (WC)

DOCUMENT No. PDRP4220-8410-DS-086-2003
 REQUISITION N° PDRP4220-RQ-4303-1311A-201
 REVISION A2 DATE 05-Apr-2010
 PAGE 8 OF 11

**Note G**

- 1 - A separate reservoir shall be furnished for each seal.
- 2 - Reservoir design pressure shall equal pump casing MAWP or 45 bar, whichever is greater. Material for vessel, piping, valves and fittings shall be 316 SS as a minimum, however shall be same grade as pump casing if superior to 316 ss. Unless otherwise specified or required by local codes, design, fabrication and inspection shall be per ASME B31.3 and ASME Sect. VIII.
- 3 - Min. height to be specified by seal manufacturer, but not less than 0.45 m between gland center line and bottom of cooler.
- 4 - The volume of liquid in reservoir not be less than 20 litres at barrier liquid operating pressure and bladder normal pre-charge.
- 5 - Minimise pipe runs and use long radius bends. Slope shall equal or exceed 40 mm/m (4%).
- 6 - Low pressure alarm (PIAL) shall be provided to monitor leakage from both seals and bladder pressure decay.
- 7 - Use of barrier fluid cooler shall be specified by seal manufacturer.
- 8 - Unless otherwise specified, barrier fluid system shall comply with API 682.
- 9 - Unless otherwise specified, PSV shall be supplied to prevent system overpressuring from gas charging system (N2 bottles)
- 10 - Pressure instruments shall be equipped with overpressure protector.
- 11 - All connections shall be two-plane braced.
- 12 - Level and Pressure transmitters shall be supplied by vendor as per project specification. Alarm settings shall be configured in DCS by others.

THIS DOCUMENT IS THE PROPERTY OF PDRP. HOLDERS CERTIFY THAT NO DISCLOSURE HAS BEEN LAWFULLY MADE TO THEM AND THAT ANY REPRODUCTION USE OR DISCLOSURE SHALL BE SUBJECT TO SPECIFIC PRIOR AUTHORIZATION.



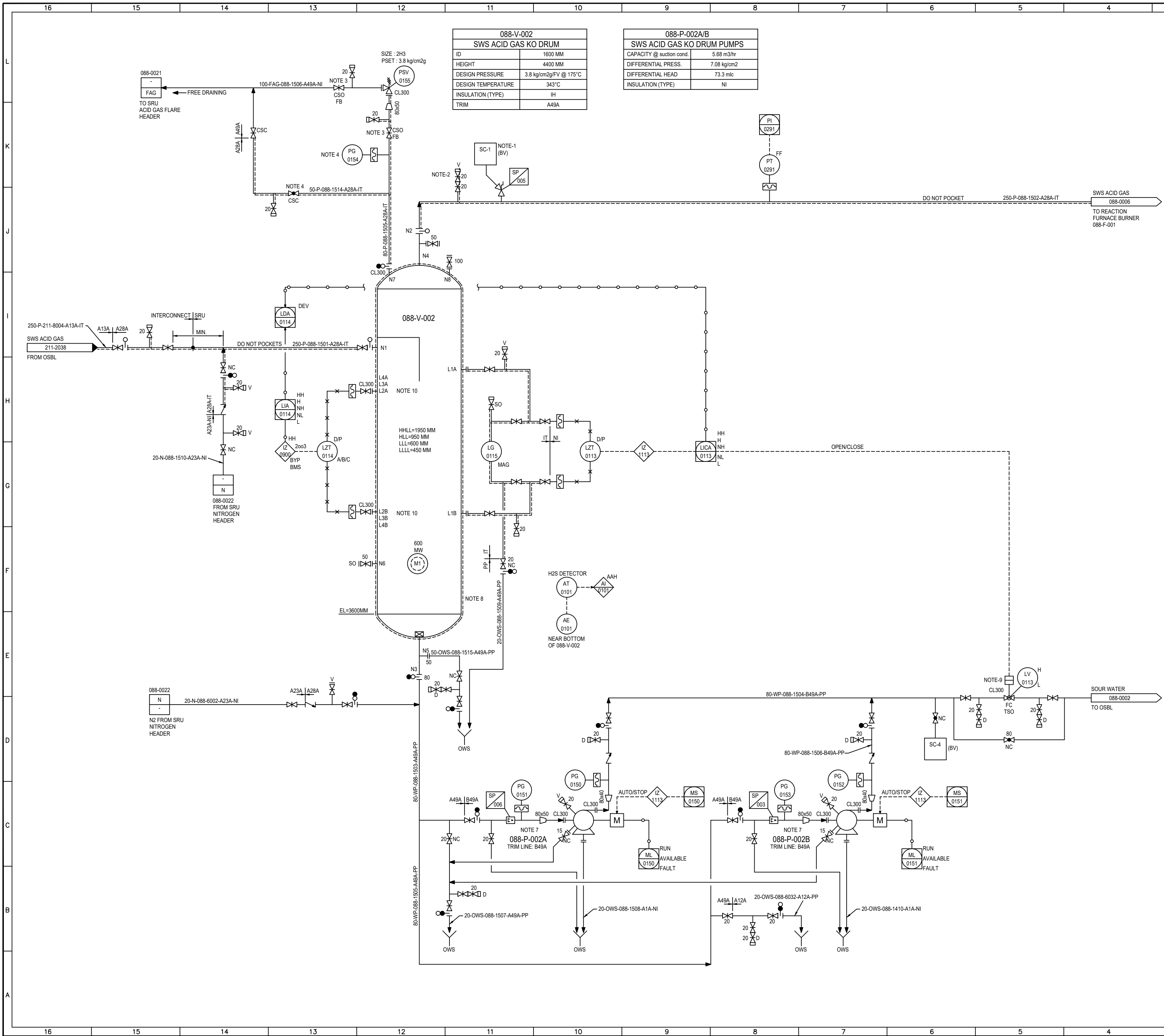
PARADIP REFINERY PROJECT
SUPPLEMENTAL SEAL HARNESS DATA SHEET
DUAL SEAL / UNPRESSURIZED - BUFFER FLUID

DOCUMENT No. PDRP4220-0410-DS-085-2063
REQUISITION N° PDRP4220-RQ-4303-1311A-201
REVISION A2 DATE 05-Apr-2010
PAGE 10 OF 11

INSTRUMENTATION & CONTROL NOTES:

- A **For Pump Seal systems:** **Note G**
- A1 All control and Instrumentation for reliable operation of the pumps shall be supplied by vendor as per attached pumps seal data sheets as minimum.
- A2 Pressure gauge cases shall be made of stainless steel with 150mm dials, Measuring elements shall be C-type Bourdon Tube manufactured from 316SS as minimum, unless process conditions require a more suitable material. Gauge movements shall be constructed from stainless steel and shall be zero adjustable. If required diaphragm seals shall be provided to protect the instruments from process fluid.
- A3 All temperature gauges shall be installed in thermowells, Generally local indicators shall be every angle bi-metallic, dial thermometers, 150mm diameter.
- A4 All field mounted Instruments shall be certified to IP 66 as minimum in accordance with IEC 60529.
- A5 All field instruments shall be certified as a minimum EEXIb, suitable for Zone 1 with the Gas Group determine by the process area classification in which the Instrument is located. The certification listed above, shall be provided by the Chief Controller of Explosives (CCOE), Nagpur, India, and an Internationally recognised organization.
- A6 Electrical entries to instruments shall be ISO M20 X 1.5
- A7 Transmitters used for monitoring shall utilise Foundation Field Bus protocol certified for compliance to Interoperability Test Kit (ITK), revision 4.01 (or later).
- A8 Critical transmitters used for trip action shall utilise 4~20 mA with HART protocol.
- A9 With exception of thermal relief valves, all relief valves shall be ASME code stamped.
- A10 Process connection for instruments shall be as per PDRP-8550-SP-0001.
- A11 Instrument Index/list in specified format shall be submitted for IOCL approval.
- A12 Data sheets for all the Instruments in the package shall be submitted with model number.
Instrument Data sheets shall be submitted in INTOOLS data Sheets format provided by Purchaser.
- A13 Positive Material Identification (PMI) for in-line Instruments such as relief valves, orifice plates.
- A14 All instruments shall be provided with calibration certificate & Hazardous area compliance certificate.

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A 19.02.21		ISSUED FOR COMMENTS		BSR	SYD	RK	RK
संख्या	तिथि	संशोधन	रिवीजन्स	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
SWS ACID GAS KO DRUM AND PUMPS

अनुमाप	कार्य संख्या	विभाग	अनुभाग	इकाई	आरेख संख्या	रैंको
SCALE	JOB NO.	DEPT.	SECTN.	UNIT	DWG. No.	REV.
B366	02	42	088	0003	A	

EIL-0241-502-REV-0-A

DISTRIBUTION CODE

**CENTRIFUGAL PUMP
(HORIZONTAL- SPECIAL
PURPOSE PROCESS)
(OH2 / BB2 TYPE)**

**Document No.
B366-999-80-42-DS-5001
Rev no: A
Page 1 of 1**

GENERAL											
2	Project: BS VI					Job. No.: B366					
3	Client: M/s IOCL					Site: Paradip Refinery					
4	Purchaser: M/s EIL					Unit: SRU		Unit No.: 88			
5	Item No.:					Service:					
6	No. Required:	Working:	Standby:			Parallel Operation Required:		<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
7	Applicable to		<input type="checkbox"/> Proposals		<input type="checkbox"/> Purchase		<input type="checkbox"/> As Built				
8	<input type="checkbox"/> Scope, option & Information Specified By Purchaser					<input type="checkbox"/> Information reqd. from and options left to vendor		Vendor to cross <input checked="" type="checkbox"/> the selected option			
9	Driver: Working		Standby		Driver Supplied & Mounted By:		<input checked="" type="checkbox"/> Pump Mfr.		<input type="checkbox"/> Other		
OPERATING CONDITIONS (Refer Pump Process Datasheet)											
11	Liquid Handled					Capacity : Min/Nor/Rated:		m3/hr			
12	Pumping Temp. (°C):		Normal		Max.		Discharge Pressure (kg/cm ² .A):				
13	Specific Gravity at P.T./15°C:					Suction Pressure: Nor./ Max. (kg/cm ² .A):					
14	Vapour Pressure (kg/cm ² .A):					Diff. Pressure (kg/cm ²) @ Rated Capacity:					
15	Viscosity at P.T.		cP		cst		Diff. Head (m) @ Rated Capacity:				
16	Solids in suspension		<input type="checkbox"/> Yes		<input type="checkbox"/> No		NPSH Available (m):				
MANUFACTURERS SPECIFICATIONS											
18	Pump Manufacturer:					Model No.:					
CONSTRUCTION											
20	Casing Mounting:		<input checked="" type="checkbox"/> Centerline		<input type="checkbox"/> Foot		<input type="checkbox"/> Inline		Proposal Curve No. L³/D⁴		
21	Casing Split:		<input type="checkbox"/> Axial		<input type="checkbox"/> Radial		Visc. Corr. Factor: C _n		C _o		C _H
22	Type:	<input type="checkbox"/> Single Volute		<input type="checkbox"/> Double Volute		<input type="checkbox"/> Diffuser		NPSH Req. (Water) (m):		F/L Speed (rpm):	
23	Casing Connection:		<input checked="" type="checkbox"/> Vent		<input type="checkbox"/> Drain		<input type="checkbox"/> Gauge		No. of stages:		Efficiency (%):
24	Nozzles	Size	ANSI Rating	Facing	Position	Rated BKW(0% Tol.):		BKW rtd. Imp.:			
25	Suction			RF		BKW @ MCF(p=1.0):		Driver Rating: (kW)			
26	Discharge			RF		Max.head rtd imp.(m):		Cap@ BEP(m ³ /hr):			
27	Imp. Ø (mm)	Max:	Rated:	Min:	Type:	Closed		MCF (m ³ /hr):Stable		Suc. Specific Speed	
28	Brg.Type/No.	Radial:	Thrust:	Lub:	M.A.W.P @ 15°C/P.T./Design Temp.(kg/cm ² .G):						
29	Cplg.:Make/Type	Fleximetl with spacer		Nonspark Guard	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No		Hydrostatic Test pressure (kg/cm ² .G): 1.5 x MAWP			
30	Driver Half cplg. mounted by:		Pump Mfr.		<input type="checkbox"/> Others		Rotation facing coupling end:		<input type="checkbox"/> CW	<input type="checkbox"/> CCW	
31	Packing Type:	Size:	No. of rings:		Seal flush/ Quench plan:		Material:				
32	Mech. Seal: Make	Model:	API Code:	Ext. seal flush fluid:		LPM:	Kg/cm ² .G	°C			
33	Base Plate Drain Rim Type :		<input checked="" type="checkbox"/> Yes		<input type="checkbox"/> No		Fdn. Bolts: <input checked="" type="checkbox"/> Yes		<input type="checkbox"/> No		
34	Throat Bush:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No		Matl.:		Bal. Device: <input type="checkbox"/> Yes		<input type="checkbox"/> No		
35	Materials (API-610 Matl. Class):		MOC		ASTM Grades		C.W. Plan :		LPM:	Kg/cm ² .G	°C
36	I - Cast Iron (Ductile)	Casing			Weight(kg): Pump+Base+Coupling:		Driver:				
37	B - Bronze	X-AISI 4140	Impeller		Auxiliary Piping Interfacing Plan						
38	S - Carbon Steel (KCS)	Inner Case parts			All interface conn.shall be termntd.with a flng. block valves)						
39	Z-LTCS	C - 11-13% Chr. S	Sleeve Packed		Size		Rating(ANSI)	Facing			
40	C(S)- 11-13% Chr.Stt.(*LC)	Sleeve Seal			Lantern Ring Inlet/Outlet						
41	K - SS 304	K(S)-SS304L (*LC)	Casing ring	ØH-BHN	Ext. Seal flush fluid Inlet/Outlet						
42	L - SS 316	L(S)-SS316L (*LC)	Impeller ring	50(min)	Seal Quench fluid Inlet						
43	D-Duplex SS	h - Hardened	Shaft		Seal pot vent/ drain						
44	SD-Super Duplex	f - Faced	Throttle Bush		Casing vent/ drain						
45	*LC - Low Carbon	Throat Bush			C.W Inlet/ Outlet						
46	Balance Drum				Base plate drain (only flanged)						
47	<input type="checkbox"/> Driver suitable for Pump starting with open Disc. Valve condition.					Casing steam jacket					
INSPECTION & TESTS (EACH PUMP)(Also Refer ITP Attached)											
49	Witness		Observe						Witness		Observe
50	<input checked="" type="checkbox"/> Shop Test / Inspection		<input type="checkbox"/>		<input checked="" type="checkbox"/> NPSH As Req.		<input checked="" type="checkbox"/> Per Spec		<input type="checkbox"/> Mandatory		<input checked="" type="checkbox"/>
51	<input checked="" type="checkbox"/> Material Certificates		<input type="checkbox"/>		<input checked="" type="checkbox"/> Dismantle Insp. & Re-assembly after Test		<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
52	<input checked="" type="checkbox"/> Hydrostatic		<input type="checkbox"/>		<input checked="" type="checkbox"/> Utilisation/Check for direction of rotation of pump & driver		<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
53	<input checked="" type="checkbox"/> Performance/Sound Level		<input type="checkbox"/>		<input checked="" type="checkbox"/> Visual, Dimension & skid completeness check		<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
54	Applicable Specification: API Std. 610,11th Edition along with Job Spec 080557C-000-JSS-0910-001 Rev. B & EDB										
55	REMARKS:- 1) Max. allowable casing working pressure shall not be less than _____ kg/cm ² .g @ _____ °C										
56	2) Down Stream Design Pressure is _____ kg/cm ² .g. Maximum shut-off, considering max suction pressure, including all tolerances shall not exceed this val										
57	3) Above is typical mechanical data sheet for OH2 / BB2 type pumps included in MR. vendor shall furnish duly filled in pumps data										
58	sheet for each item separately in the offer.										
59	5) For Pump Type, MOC class and Seal Plan, refer Process data sheet.										
60											
62											
63	A VS MG TK										
64	REV. PREPARED BY REVIEWED BY APPROVED BY										

VENDOR DATA REQUIREMENTS FOR CENTRIFUGAL PUMP (SPP)

A	05-APR-2021	ISSUED WITH MR	VS	MG	TK
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 - HORIZONTAL

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Cross Sectional Drawings (with Bill of Materials & Part Nos.) for Pump			✓	✓	
2.	Precommissioning & commissioning procedures for the complete pump package			✓	✓	
3.	Data Sheets along with performance curves	✓	✓		✓	
4.	P&ID seal system		✓		✓	
5.	GAD - Couplings			✓	✓	
6.	GAD - Sealing system - Seal plan			✓	✓	
7.	Cross Sectional Drawings (with Bill of Materials & Part Nos.) - Sealing system - Mechanical seal		✓		✓	
8.	Test Procedure(s) : MRT, Performance test, NPSH test and other test as per MR		✓		✓	To be submitted to Inspection
9.	General Arrangement & Foundation drawing showing main as well as all associated equipment / skids (driven equipment, drive transmission devices, driver (turbine / motor / engine), lube oil system, Fuel oil system, local guage board, local control panel, etc.) with interface connection, maintenance space, cable trays, table of termination points and details of foundation bolts, their location, foundation bolt pocket dimensions, foundation load data (static & dynamic), estimated quantity & detail	✓	✓		✓	
10.	List of Mandatory Spares (indicating exact name of the part, part no. and material of construction)	✓	✓		✓	
11.	List of spare parts for normal operation during defect liability period Quotation for recommended spare parts for two years of normal operation beyomg defect liability period (indicating exact name of the part, part no. and material of construction)	✓		✓	✓	
12.	List of recommended commissioning spares (indicating exact name of the part, part no. and material of construction)	✓		✓	✓	
13.	List of recommended Special Tools & Tackles (indicating exact name of the part and part no.)	✓		✓	✓	
14.	List of Deviations to specifications/datasheets/standards of MR	✓	✓			
15.	Filled in experience record proforma for main equipment and its driver	✓	✓			

**VENDOR DATA REQUIREMENTS
FOR
CENTRIFUGAL PUMP (SPP)**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
16.	Duly filled-in check list scope of supply (as applicable)	✓	✓			
17.	Tabulation of Utility consumption data including electric load data, schedule of lubricants, chemicals & consumables with specifications	✓		✓	✓	
18.	List of loose supply items in vendor's scope, to be installed in purchaser's piping			✓	✓	
19.	Test Procedure(s) : Witness tests as specified in data sheets / other specs enclosed in the inquiry / MR or as required by approved ITP/QAP			✓	✓	
20.	Curve for pump power-shaft speed v/s torque			✓	✓	
21.	Installation, Operation & Maintenance manuals - 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. 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.
8. 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).
9. "@@" indicates submission of documents to Inspection Agency.
10. Bill of Material shall form part of the respective drawing.
11. Also refer other department's VDR :-
12. Electrical
13. Instrumentation
14. Piping

SITE & UTILITY DATA

PROJECT : STANDBY SRU & ADDITIONAL TANKS
UNIT : SULPHUR RECOVERY UNIT
CLIENT : M/s INDIAN OIL CORPORATION LTD., PARADIP

A	01.04.2021	Issued with MR	VS	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 ²	mm ²
Composition - Gas or Vapor	vol% or mol%	ppmv
Composition - Liquid	wf%	ppmw
Enthalpy, Entropy	kcal/kg	
Flow (gas)	Nm ³ /hr	kg/hr
Flow (liquid)	m ³ /hr	kg/hr (for < 1TPH), TPH (for > 1TPH)
Flow (steam)	kg/hr	
Force	N	
Fouling resistance	m ² hr °C / kcal	

3 Climatic Data

3.1 Wind

3.1.1 Wind Velocity

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

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

3.1.2 Wind Direction and Percentage of Time for Each Quadrant

% of time	N	NE	E	SE	S	SW	W	NW	Calm
Morning (0830)	13.8	8.4	2.1	2.4	7.7	21.6	11.0	8.2	(Δ 26.8)
Evening (1730)	15.0	6.7	9.41	8.16	15.0	24.8	4.8	1.8	(Δ 27.8)

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 ² .hr	Notes
Minimum		
Maximum	678.2	
Average		

3.8 Atmosphere

- a) Extreme moisture (tropical climate) _____ YES
- b) Marine exposure (salt spray) _____ YES
- c) Sand storms _____ NO
- d) Copper-attacking fumes (ammonia, sulphur, etc.)
SO₂: 16.6 micro gm (maximum)

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

3.9 Miscellaneous Site Data

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

3.9.1 Seismic design shall be as follows;

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

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

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

ANNEXURE-I

UTILITY CONDITIONS AT VENDOR BATTERY LIMIT

S.No.	Describe	Parameter	Minimum	Normal	Maximum	Design
1	HP Steam	Pressure Kg/cm ² (g)			42.0	46/FV
		Temp, Deg C			400	427
2	LP Steam	Pressure Kg/cm ² (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 ² (g)	58.0	58.0	60.0	82.0
		Temp, Deg C	105	105	116	150
4	Instrument Air(Note-1)	Pressure Kg/cm ² (g)	4.2	7.0	8.0	10.5
		Temp, Deg C	ambient	40	50	65
5	Nitrogen	Pressure Kg/cm ² (g)	3.0	8.0	8.3	10.5
		Temp, Deg C	20	amb	amb	65
6	Fuel gas	Pressure Kg/cm ² (g)	2.5	3.9	4.2	6.0
		Temp, Deg C	Amb	40	55	65
7	Service Water	Pressure Kg/cm ² (g)	4.0	6.0	8.0	10.5
		Temp, Deg C	Amb	Amb	Amb	65
8	Cooling Water	Supply Pressure Kg/cm ² (g)	4	4.5	5.0	8.0
		Return Pressure Kg/cm ² (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 ² (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/cm² (g).

NOTES TO BIDDERS:

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

1. Prototype pump model/ model series shall not be considered.
2. It is mandatory that all references furnished for pump model/ model series should have similar parameters and in similar fluid (liquid) service.
3. **Vendor shall furnish only those references which have completed 1 (one) year of operation, as on bid due date.**

DESCRIPTION OF MODEL DESIGNATION SYSTEM: _____

S. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS		REMARKS
			Ref.-1	Ref.-2	
1	GENERAL				
1.1	Model Number				
1.2	Type of Driver / Driver Rating (kW)				
1.3	Rated Speed (rpm)				
1.4	Shop where pump is designed, manufactured, packaged, tested & supplied				
2	OPERATING CONDITIONS				
2.1	Service / Fluid handled / Fluid temperature (deg C)				
2.2	Rated Capacity (m ³ /hr) & Rated Diff. Head (m)				
2.3	NPSHR (m) / Efficiency (%)				
2.4	No. of stages / Impeller Dia. (Max/Rated/min.) (mm)				
2.5	Maximum Suction pressure (kg/cm ² g)				

Place:
Date:

[Signature of Authorized Signatory]*

Name:
Designation:
Seal:

*: To be authenticated in-line with provisions indicated in Commercial Section (in NIT, in case of press enquiries)

[To be submitted in original, along with bid]

S. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS		REMARKS
			Ref.-1	Ref.-2	
2.6	Type of lubrication system				
2.7	Type of Bearings / Bearing span (mm)				
2.8	Shaft Diameter under Bearing (mm)				
2.9	Casing MAWP (15°C / PT / Design Temperature)				
3	MATERIAL OF CONSTRUCTION				
3.1	Casing / Impeller / Shaft				
4	OTHER INFORMATION ON INSTALLATIONS				
4.1	Date of supply / commissioning				
4.2	Purchaser's Name, Address, Contact No. & email ID				

Place:
Date:

[Signature of Authorized Signatory]*

Name:
Designation:
Seal:

*: To be authenticated in-line with provisions indicated in Commercial Section (in NIT, in case of press enquiries)

[To be submitted in original, along with bid]

ANNEXURE

SCOPE OF WORK AND JOB SPECIFICATIONS (ELECTRICAL)

FOR HORIZONTAL CENTRIFUGAL PUMPS (B366-088-PA-MR-5001)

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-001 A/B	Ex-n	Zone-2, IIA/IIB, Temp. Class T3
2.	088-P-002 A/B	Ex-n	Zone-2, IIA/IIB, Temp. Class T3

- 4.2 All the motors with enclosure protection Ex-n 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
	MOTORS-INDUCTION-MV (ZONE-2 TYPE E & N)	
1	ABB INDIA LTD	INDIA
2	BHARAT BIJLEE LIMITED	INDIA
3	CG POWER AND INDUSTRIAL SOLUTIONS LTD	INDIA
4	KIRLOSKAR ELECTRIC LTD	INDIA
5	LAXMI HYDRAULICS PVT LIMITED	INDIA
6	LOHER	INTERNATIONAL
7	MARATHON ELCTRIC MOTOR LIMITED	INDIA
8	SIEMENS LIMITED	INTERNATIONAL
9	WEG ELECTRIC INDIA PVT LTD	INDIA / INTERNATIONAL
	MOTORS-IMPORTED	
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

				 		 		 		 	
A	26.11.2019	ISSUED FOR DESIGN		NM	CG	SV	JMC				
REV	DATE	DESCRIPTION		WRITTEN	CHECKED	APPROVED	AUTHORIZED				

 		DATA SHEET MEDIUM VOLTAGE INDUCTION MOTOR - HAZARDOUS AREA					
PROJECT : STANDBY SRU & ADDITIONAL TANKS, IOCL - PARADIP REFINERY CLIENT : INDIAN OIL CORPORATION LIMITED		PROJECT N°: 080557C001	UNIT: 000	DOCT. CODE: SP 1691	SERIAL N°: 002	REV: A	SHEET: 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	ENVIRONMENTAL CONDITIONS					
	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	DRIVEN MACHINE DATA					
	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	
	18	Driven Machine Inertia (GD ²)				kg.m ²	
	19	Brake torque curve / Required starting, brake torque				N.m	
	20						
TO BE COMPLETED BY MANUFACTURER	21	MOTOR GENERAL CHARACTERISTICS					
	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 ²	
	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	MOTOR MANUFACTURER'S DATA					
	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		4/4		3/4	
	57	Full load Torque		N.m			
	58	Starting/Pull Up/Breakdown Torque		L %		PU %	
	59	Rotor Motor Inertia (GD ²)		kg.m ²			
	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 ²				
67	Motor Weight		kg				
68	Canopy		For Outdoor Motors				
69	Certifying authority / certificate Nr						
70							
TO BE COMPLETED BY MANUFACTURER	Notes:						
	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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JOB SPECIFICATION FOR MV INDUCTION MOTORS

A	26.11.2019	ISSUED FOR DESIGN	NM	CG	SV	JMC
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED

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1. INTRODUCTION

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th 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.

VENDOR DATA REQUIREMENTS FOR HORIZONTAL CENTRIFUGAL PUMPS

A	05-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).

**VENDOR DATA REQUIREMENTS
FOR
HORIZONTAL CENTRIFUGAL PUMPS**

-
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.
 10. Documents for analysis of delay in delivery of the entire package will be identified during post order stage.

**JOB SPECIFICATION AND SCOPE OF WORK OF
INSTRUMENTATION FOR
HORIZONTAL CENTRIFUGAL PUMPS (SPP)
(Tag Nos. 088-P-001 A/B, 088-P-002 A/B)
FOR
STANDBY SRU PROJECT
IOCL – PARADIP**

**MECHANICAL SEAL FLUSHING PLANS:
088-P-001 A/B – 11,52
088-P-002 A/B – 23,52**

MR No.: B366-088-PA-MR-5001

A	25.03.2021	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 for Mechanical Seal Flushing Plan 11, 23, 52 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, required for Plan- 11, 23, 52.
- 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

- 2.1 Bidder's scope of instrumentation supply and work shall include the following as a minimum:
 - a) Supply of all instruments as per typical schematic for Seal Flushing Plan- 11, 23, 52 attached and described elsewhere in this requisition & applicable code API 682 and any other vendor furnished instruments as per specifications.
 - b) Design, Engineering and procurement of instruments.
 - c) Piping and all other erection material including all fittings, mounting accessories, instruments supports (2" yoke type) required for erection of instruments, under Bidder's scope of supply, as per list of applicable installation standards (shall be given to successful Bidder after order).
 - d) Cable glands/plug shall be duly installed with the instruments.
 - e) Submission of filled in data sheets for all instruments along with sizing calculations for safety valve and restriction orifice where applicable. 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.
- 2.2 Instrumentation cabling required for interconnection between Bidder's supplied field instruments like Pressure, level etc. and Purchaser's Control System shall be done **by Others** and it is excluded from Bidder's scope of work.

3.0 DESIGN PHILOSOPHY AND TECHNICAL REQUIREMENTS

- 3.1 All electronic field transmitters shall be suitable for intrinsic safe circuit and shall be intrinsically safe certified suitable for Zone-1 Gr IIA/B, Temp. Class T3 hazardous area classification by Statutory body. All the instruments shall also be dust proof. Additionally instruments shall be certified by CCOE/ PESO India, irrespective of the origin of the instrument.
- 3.2 All instruments shall also be weatherproof to IP-65 as per IS/IEC-60529.

- 3.3 Process switches shall not be considered and instead transmitters shall be used. For pressure and level transmitters, **Foundation Fieldbus transmitters shall be provided for seal plan.** Pump Vendor shall provide the alarm set values during detail engineering.

FF Transmitter provided by the bidder shall be bus powered type. FF transmitter shall have interoperability test clearance complying ITK (latest revision). FF transmitter shall also have capability to become device link master whenever required. It shall be compatible with EDDL (Electronic Device Description Language) as per IEC 61804, latest revision or FDT/DTM requirements.

Foundation Fieldbus type transmitters shall be used in high powered trunk FF concept with intrinsically safe Field barrier (MTL, P&F or equivalent for Field bus). Hence the intrinsically safe (entity concept) parameters of the transmitters shall match with the entity parameters of field barriers to be supplied by Vendor.

- 3.4 All instruments/transmitters shall be with dual cable entries. Unused entry shall be plugged using suitable metallic plug. All cable entries shall be 1/2" NPT (F) size and shall be fitted with double compression type nickel-plated brass cable glands with Slipper type PVC sleeves (cable shrouds) and suitable for hazardous area classification as indicated elsewhere in the bid package.
- 3.5 The procurement of all instruments shall be strictly from the manufacturers listed in Purchaser's approved vendor list attached elsewhere in this requisition.
- 3.6 Pressure rating of thermowell for temperature element/ temperature gauge, PSV inlet and outlet rating (in case flanged PSVs are provided) shall be minimum 300# rating or as per respective piping specification whichever is higher.
- 3.7 Instrument connection on vessels, standpipes and tanks shall be as per 7-52-0001 and Instrument connection on pipes shall be as per B366-7-52-0002. The minimum rating of all instrument nozzles on the vessels shall be 300#.
- 3.8 All instruments as applicable shall have internal terminal block, anti-vibration type for cable termination. Flying leads are not acceptable.
- 3.8 S.S. tag plates shall be provided for all the instruments.
- 3.9 Prefabricated FRP canopy shall be used for field electronic instruments with minimum 3 mm thickness. Canopy for transmitters shall cover TOP and all 4 SIDES with transparent door on the front; canopy for JB shall cover 3 SIDES. Tag number shall be printed on the canopy.

Typical characteristics of FRP canopy shall be following:

- i) High mechanical strength
- ii) Weather resistant (Resistant to most of the acids, alkalies, vapours & fumes).
- iii) UV resistant
- iv) Anti Static
- v) Special rubber grommets for Cable/ Tube entry.

- 3.10 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.

3.11 Level Transmitter

- a) Level Transmitter shall be Time Domain Reflectometry type Guided Wave Radar level instrument.
- b) Sensor shall be Wave Guided type with process wetted parts material suitable for process fluid (SS316 / 316L as minimum).
- c) Accuracy of Guided wave radar shall be 0.2% FS. Co-axial shall be preferred.
- d) Transmitter housing shall be of die cast Aluminum material, weatherproof to IP65 and suitably IS certified for specified hazardous area.
- e) Level transmitter Chamber and other accessories materials like mounting Flanges; Stud bolts material shall be suitable for the process fluid.

3.12 Level Gauge

- a) Level Gauges shall be steel armoured reflex type with body material of SS 316 as a minimum or better corresponding to seal pot material and tempered borosilicate glass.
- b) For all level gauges, automatic shutoff arrangement like ball check valve etc to be used such that the level gauge is automatically isolated in case gauge glass breaks.
- c) Level Gauge shall be supplied with off-set type quick closing ball check valve (Gauge Glass and cock type) with carbon steel body and SS 316 trim as a minimum.
- d) Level gauge shall be hydrostatically tested up to 72 Kg/cm² (as a minimum) or up to hydrostatic test pressure of seal pot, whichever is higher. Hydro test certificates shall be furnished.
- e) Vessel (Seal Pot) connection for level gauge shall be 3/4" NPT (F) with primary isolation valve and 3/4" spherical union.
- f) Studs and bolt material shall be ASTM A193 Gr. B7 and ASTM A194 Gr. 2H respectively.
- g) Magnetic level gauges may be used for congealing/ fouling/ sour service and for vessel rating above 600 ASME class.

3.13 Pressure Gauge

- a) Pressure gauge dial shall be 150mm white of non-rusting material with black figures. Pressure gauge shall have solid front for operating pressure exceeding 60 Kg/cm²g.
- b) Pressure gauge shall have 1/2" NPT (M) bottom connection.
- c) Pressure gauge shall be provided with features like screwed bezel, externally adjustable zero, over range protection and blow out disc.
- d) Sensing element (bourdon tube) shall be of SS 316 and movement of SS 304, as a minimum. Case material for pressure gauges shall be SS 304.

- d) Pressure gauge shall have an accuracy within 1% of URV (Upper Range Value) and range shall be so selected that gauge normally operates in middle third of the range.
- e) Pressure gauge shall be suitable for maximum pressure or 130% of the range whichever is higher, without any calibration drift.

3.14 Transmitter

- a) All transmitters used in the pump seal plan shall be Foundation Fieldbus type and shall be suitable for the specified area class.
- b) Integral LED/LCD output meter shall be provided for all transmitters.
- e) Transmitters calibrated accuracy shall be within $\pm 0.05\%$ of span. Calibrated accuracy for diaphragm seal transmitters shall be within $\pm 0.5\%$ of span.
- f) Transmitters shall have minimum static pressure/overpressure rating of 160 kg/cm²g except for very low-range for which the static pressure will be considered suitably based on the availability.
- g) Threaded end connections shall be to NPT as per ANSI B 1.20.1. Flanged end connections shall be as per ANSI B 16.5.

3.15 Pressure Relief Valve / Thermal Relief Valve

- a) Pressure Relief Valve shall meet the limiting relief valve requirements as defined in API RP-520 (part-I & II) and in API-526.
- b) Pressure Relief Valve shall be full nozzle full lift type and Thermal Relief Valve shall be modified nozzle type.
- c) Percentage Accumulation shall be 10% for Pressure Relief Valve and 25% for Thermal Relief Valve.
- d) Body material shall be Carbon Steel as a minimum. Nozzle and disc material shall be SS 316 as a minimum with machined SS guide and spindle.
- e) Spring material shall be selected as per operating conditions. Normally it shall be Nickel/Zinc/Aluminium plated Carbon Steel.
- f) Pressure Relief Valve shall have flanged connections for sizes 1" and above and shall have screwed connection for sizes 3/4" and below. Thermal Relief Valve shall have screwed connection with 0.38 cm² orifice size and inlet outlet shall be of 3/4" NPT (M) X 1" NPT (F) sizes.
- g) Pressure relief valve type shall be Vendor's responsibility suitable for the system.

3.16 Restriction Orifice Plate

- a) Restriction Orifice Plate shall be concentric square edged type.
- b) Each Restriction Orifice Plate shall have an integral handle, which shall, upon assembly with flanges, extend to a distance of 50 mm. with following information punched on it:
 - Tag Number.
 - Nominal pipe size in inches and rating in psi.
 - Material of plate.
- c) Restriction Orifice Plate material shall be SS 316 as a minimum or better.

3.17 Temperature Gauges

- The temperature gauges shall be bimetallic type and shall be provided with 1½" flanged (min. 300# rating) thermo well with ½" NPT (F) connection for temperature gauges.
- Thermo well shall be fabricated out of bar stock.
- Temperature gauges shall have accuracy within ± 1 % of URV (Upper Range Value).
- Thermo well and flanges of Thermo well shall be minimum of SS-316 or better to suit the service conditions.
- Case material for temperature gauges shall be SS 304

3.18 Installation Standards/ Material:

Pump seal instruments shall be pre-installed on the skid by the bidder. Pressure instrument Installation shall be Close coupled with 3 valve integral manifold. Instrument impulse lines shall be Piping. Piping with tubing at instrument end (for remote installation) is also acceptable for non-hydrocarbon services.

Hook-up drawings shall be submitted by the Vendor for review and approval.

- 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

- Instrumentation symbol shall follow latest edition of ISA standard S 5.1.
- 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:

- 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.
- c. The Fieldbus devices configuration shall be provided by Bidder in the form of soft file (CD) as part of VDR during detailed engineering.

LIST OF DOCUMENTS (INSTRUMENTATION)

S. No.	DOCUMENT NAME	DOCUMENT NO.
1	JOB SPECIFICATION AND SCOPE OF WORK FOR INSTRUMENTATION FOR HORIZONTAL CENTRIFUGAL PUMPS (SPP)	B366-088-16-51-SP-1003
2	VENDOR DATA REQUIREMENTS	B366-088-16-51-VDR-1003
3	DESIGN BASIS - INSTRUMENTATION	080557C-088-JSD-1540-002
4	INSTRUMENT CONNECTION ON VESSEL, STANDPIPES AND TANKS	7-52-0001
5	INSTRUMENT CONNECTION ON PIPES	B366-7-52-0002
6	ORIFICE PLATES, FLANGES AND THERMOWELL DIMENSIONAL DETAILS	080557C-000-STC-1580-005

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		CLIENT	INDIAN OIL CORPORATION LIMITED	
DESIGN BASIS - INSTRUMENTATION	Project No. 080557C001	Document No. 080557C-088-JSD-1540-002		Rev. No. C Page 1 of 74

DESIGN BASIS - INSTRUMENTATION

REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED
C	11-06-2020	ISSUED FOR DESIGN	CRK	KRS	SS	JMC
B	14-02-2020	ISSUED FOR DESIGN	CRK	KRS	SS	JMC
A	27-11-2019	ISSUED FOR REVIEW	CRK	KRS	SS	JMC

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1. Introduction:

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th 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

3. Technical Abbreviations

CODE	DESCRIPTION
APC	Advanced Process Control

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CODE	DESCRIPTION
CCOE	Chief Controller Of Explosives
CPCB	Central Pollution Control Board
CDSU	Central Database Storage Unit
DCS	Distributed control System
DGMS	Director General of Mines Safety
DMR	Dual Modular Redundant
ESD	Emergency Shutdown System
FDAS	Fire Detection Alarm System
FF	Foundation Fieldbus
HVAC	Heating Ventilation and Air Conditioning System
HWC	Hard Wired Console
IBR	Indian Boiler Regulations
I/O	Input / Output
IRP	Interface Relay Panel
LED	Light Emitting Diode
MCT	Multi Cable Transit
MPV	Machine Package Vendor
MFR	Manufacturer
NACE	National Association of Corrosion Engineers
OPC	OLE for Process Control
PDB	Power Distribution Board
PESO	Petroleum and Explosives Safety Organisation
PLC	Programmable Logic Controller
QMR	Quad Modular Redundant
SS	Stainless Steel (ASI Type)
SRR	Satellite Rack Room
TMR	Triple Modular Redundant



4. 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.



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5. Referenced Project Standards

080557C-000-JSD-1540-003	Instrument Numbering and Identification
080557C-000-JSD-1503-001	Smartplant Instrumentation Specification
080557C-000-JSS-1511-001	Distributed Control System Specification
080557C-000-JSS-1511-002	Emergency Shutdown System Specification
080557C-000-JSS-1511-003	Gas Detection System Specification
080557C-000-JSS-1511-004	Fire Detection System Specification
080557C-000-JSS-1511-005	Control & Marshalling Cabinet Specification
080557C-000-JSS-1515-001	Instrumentation for Packaged Units
080557C-000-JSS-1590-001	Instrument Installation Specification
080557C-000-JSS-1560-001	Analyser Systems Specification
080557C-000-JSS-1500-010	Protection of Instruments
080557C-000-JSS-1500-013	Instrument/ Piping Interface Standard
080557C-000-DI-1500-010	SIL Procedure
080557C-000-JSS-1514-003	Machine Monitoring Specification
080557C-000-JSS-1546-003	Custody Transfer Specification
080557C-000-JSS-1552-007	Tank Gauging Specification
080557C-000-JSS-1513-001	Foundation Fieldbus (FF) System Specification
080557C-000-JSS-1574-001	Instrument Cables specification
080557C-000-JSS-1500-004	Instrument Piping Material Specification
080557C-000-JSS-1541-001	Job Specification for Control Valves

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080557C-000-JSS-1543-001	Job Specification for On-Off Valves & MOV
080557C-000-JSS-1545-001	Job Specification for Safety Valves
080557C-000-JSD-1530-003	Telecommunications Equipment and Cable Tagging
080557C-000-JSS-1530-002	Telecom Cable Specification
080557C-000-JSS-1553-001	Job Specification for Electronic Field Transmitters
080557C-000-JSS-1546-001	Job Specifications for Flow Elements
080557C-000-JSS-1554-002	Job Specification for Temperature Element
080557C-000-JSS-1530-001	Job Specifications for Public Address and General Alarm
080557C-000-JSS-1531-001	Job Specifications for Process CCTV System
080557C-000-JSS-1533-001	Job Specifications for Telephone network
080557C-000-JSS-1591-001	Job Specification of Cable Trays and Ducts
080557C-000-SP-1500-001	Data sheet formats (Typical) for Instrumentation Items
080557C-000-SP-1500-002	Instrumentation Templates
080557C-000-STD-1540-008	Instrument Earthing Philosophy Drawing
080557C-000-ITP-1500-001	Inspection and Test Plan for Instrumentation
080557C-000-ITP-1500-002	Inspection & Testing of Electronic Control Systems
080557C-000-ITP-1541-001	Inspection and Test Plan for Control Valves
080557C-000-ITP-1541-002	Inspection and Test Plan for Self Regulating Valves
080557C-000-ITP-1541-003	Inspection and Test Plan for PRDS and Desuperheaters
080557C-000-ITP-1543-001	Inspection and Test Plan for On-Off Valves
080557C-000-ITP-1543-002	Inspection and Test Plan for Motor Operated Valves

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080557C-000-ITP-1545-001	Inspection and Test Plan for Safety Relief Valves
080557C-000-ITP-1545-002	Inspection and Test Plan for Rupture Disc
080557C-000-ITP-1546-001	Inspection and Test Plan for Orifice Plate & Flange and Restriction Orifice
080557C-000-ITP-1546-002	Inspection and Test Plan for Venturi tube
080557C-000-ITP-1546-003	Inspection and Test Plan for Flow nozzle
080557C-000-ITP-1546-004	Inspection and Test Plan for Elbow tube
080557C-000-ITP-1547-001	Inspection and Test Plan for Averaging Pitot tube
080557C-000-ITP-1547-002	Inspection and Test Plan for Magnetic flow meters
080557C-000-ITP-1547-003	Inspection and Test Plan for Mass flow meters
080557C-000-ITP-1547-004	Inspection and Test Plan for Vortex flow meters
080557C-000-ITP-1547-005	Inspection and Test Plan for Ultrasonic flow meters
080557C-000-ITP-1547-006	Inspection and Test Plan for Turbine flow meters
080557C-000-ITP-1547-007	Inspection and Test Plan for Target flow meters
080557C-000-ITP-1547-008	Inspection and Test Plan for Variable area flow meters
080557C-000-ITP-1547-009	Inspection and Test Plan for Positive Displacement flow meters
080557C-000-ITP-1545-003	Inspection and Test Plan for Breather Valves
080557C-000-STC-1590-001	Installation Standards

6. Reference National / International Standards



Design and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

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NATIONAL AND INTERNATIONAL STANDARDS	
STANDARDS/CODES	DESCRIPTION
AGA	
AGA REPORT No-3 Part-1	Orifice Metering of Natural Gas and Other related Hydrocarbon Fluids-Concentric, Square-edged Orifice Meters-General Equations and Uncertainty Guidelines
AGA Report No-7	Measurement of Natural Gas by Turbine Meters
AGA Report No-9	Measurement of Gas by Multipath Ultrasonic Meters
ASME	
ASME B 1.20.1	Pipe Threads General Purpose (Inch)
ASME B 16.5	Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard
ASME B 16.20	Metallic Gaskets for pipe Flanges Ring-Joint, Spiral-Wound and Jacketed
ASME B 16.34	Valves-Flanged, Threaded and Welding End
ASME/BPVC-VIII-1	Section VIII, Division 1: Rules for Construction of Pressure Vessels
ASME/BPVC-I	Section I Rules for Construction of Power Boilers
PTC 19.3 TW	Thermowell Performance Test Codes
ANSI B 16.10	Face-to-Face and End-to-End Dimensions of valves
ANSI B 16.36	Orifice Flanges
ANSI B 16.47	Large Diameter Steel Flanges NPS 26 through NPS 60 Metric/Inch Standard
ANSI B 16.104	Control valve seat leakage classification (FCI 70-2)
ANSI B 40.100	Pressure gauges and Gauge attachments
ANSI/FCI	
FCI 70-2	Control Valve Seat Leakage
API	
API STD 520 Part 1	Sizing, Selection and Installation of Pressure Relieving Devices in Refineries Part-1: Sizing and Selection
API STD 520 Part 2	Sizing, Selection and Installation of Pressure Relieving Devices in Refineries Part-2: Installation
API STD 521	Guide for Pressure Relieving and Depressurising Systems
API STD 526	Flanged Steel Pressure Relief Valves
API STD 527	Seat Tightness of Pressure Relief Valves
API MPMS 1	API Manual of Petroleum Measurement Standards-Vocabulary
API MPMS 4	API Manual of Petroleum Measurement Standards-Proving Systems
API MPMS 5	API Manual of Petroleum Measurement Standards-Metering
API RP 551	Process Measurement
API RP 552	Transmission Systems
API RP 553	Refinery Valves and Accessories for Control and Safety Instrumented Systems

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NATIONAL AND INTERNATIONAL STANDARDS	
STANDARDS/CODES	DESCRIPTION
API RP 554	Process Control Systems Part 1-Process control systems Functions and Functional Specification Development Part 2-Process Control Systems-Process Control System Design Part 3-Process Control Systems-Project execution and Process control system ownership
API RP 555	Process Analyzers
API RP 557	Guide to Advanced Control Systems
API 609	Butterfly valves:Double Flanged,Lug and Wafer type
API 670	Vibration, Axial-Position and Bearing-Temperature Monitoring Systems
API STD 2000	Venting Atmospheric and Low Pressure Storage Tanks
BS	
BS EN 50288-7	Multi-Element Metallic Cables used in Analogue and Digital Communication and Control-Part 7:Sectional Specification for Instrumentation and Control Cables
BSI BS 3463	Observation and Gauge glasses for Pressure Vessels
BS 5308 Part-I	Specification for PVC Insulated cables
BSI BS 6121	Mechanical cable glands-Part 1:Armour glands-Requirements and test methods. Mechanical cable glands-Part 5:Code of practice for Selection,Installationand Inspection of cable glands and armour glands
BS 1042	Measurement of fluid flow in closed circuits (contains 2 sections)
EN	
BS EN 10204:2004	Metallic products Types of Inspection Documents
IEC	
IEC 60227	Polyvinyl chloride Insulated cables of rated voltages upto and including 450/750 V (contains 7 sections)
IEC 60079-0	Explosive Atmosphere-Part 0:Equipment-General Requirements
IEC 60085	Electrical Insulation-Thermal Evaluation and Designation
IEC 60331	Testing of Fire resistant cables
IEC 60332-1-1	Tests on Electric and Optical Fibre Cables under Fire Conditions-Part 1-1:Test for Vertical Flame Propagation for a Single Insulated Wire or Cable Apparatus
IEC 60332-3-21	Tests on Electric cables under fire conditions-Part 3-21:Test for vertical flame spread of vertically mounted bunched wires or cables-Category A F/R
IEC 60529	Degree of Protection provided by enclosures(IP code)
IEC 60534-2-1	Industrial Process Control Valves-Part 2-1:Flow Capacity-Sizing Equations for Fluid flow under Installed Conditions
IEC 60534-2-3	Industrial Process Control Valves-Part 2-3:Flow Capacity-Testing Procedures

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NATIONAL AND INTERNATIONAL STANDARDS	
STANDARDS/CODES	DESCRIPTION
IEC 60534-2-4	Industrial Process Control Valves-Part 2-4:Flow Capacity-Inherent Flow Characteristics and rangeability
IEC 60534-2-5	Industrial Process Control Valves-Part 2-5:Flow Capacity-Sizing equations for fluid flow through multistage control valve with Interstage Recovery
IEC 60534.3	Industrial Process Control Valves -Face to Face dimensions (Part 1 to 3)
IEC 60534.8	Industrial Process Control Valves-Noise considerations (Part 1 to 4)
IEC 60584-2	Thermocouple Tolerances
IEC 60751	Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors
IEC 60754	Test on Gases evolved during Combustion of Materials from cables-Part 1:Determination of the Halogen Acid gas content
IEC 60801	Electromagnetic compatibility for Industrial Process Measurement and control equipment Part 1:General Introduction
IEC 61000-4	Electromagnetic compatibility (EMC)-Part 4:Testing and Measurement Techniques Set (contains 30 sections)
IEC 61000-4-1	Electromagnetic compatibility (EMC)-Part 4-1:Testing and Measurement Techniques-Overview
IEC 61000-4-2	Electromagnetic compatibility (EMC)-Part 4-2:Electrostatic Discharge Immunity Tests
IEC 61000-4-3	Electromagnetic compatibility (EMC)-Part 4-3:Testing and Measurement Techniques-radiated,radio frequency,Electrostatic Field Immunity Tests
IEC 61000-4-4	Electromagnetic compatibility (EMC)-Part 4-4:Testing and Measurement Techniques-Electrical Fast Transient/Burst Immunity Tests
IEC 61000-4-5	Electromagnetic compatibility (EMC)-Part 4-5:Testing and Measurement Techniques-Surge Immunity Test
IEC 61034	Measurement of Smoke Density of cables burning under defined conditions-Part 2:Test Procedures and Requirements
IEC 61508	Functional Safety of electrical / electronic programmable electronic safety related systems (contains 7 sections)
IEC 61511	Functional Safety of Safety Instrumented Systems for the Process Industry Sector (Part 1 to 3)
IEC/TR 61158-1	Industrial Communication Networks-Fieldbus Specificatins -Part 1:Overview and Guidance for IEC 61158 and IEC 61784
IEC/TR 61158-2	Industrial Communication Networks-Fieldbus Specificatins -Part 2:Physical layer Specification and Service Definition
IS	
IS-1271	Specification of Thermal Evaluation and Classification of Eletrical Insulation

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NATIONAL AND INTERNATIONAL STANDARDS	
STANDARDS/CODES	DESCRIPTION
IS-1554	Specification for PVC Insulated (heavy duty) electric cables Part I-for working voltages upto and including 1100V
IS 13947	Degrees of Protection provided by enclosures for low voltage switch gear and control gear
IS 2148 (IEC 60079-1)	Specification for Flame proof enclosures of electrical apparatus
IS-3624	Specification for pressure and vacuum gauges
IS-5608	Low Frequency cables and wires with PVC Insulation and PVC sheath (part 1, 2 and 4)
IS-5831	Specification for PVC Insulation and sheath of electric cables
IS-7358	Specifications for Thermocouples
IS-8784	Thermocouple Compensating Cables
ISA	
ISA 5.1	Instrumentation Symbols & Identification
ISA S5.2	Binary logic diagrams for process operations
ISA 5.3	Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer systems
ISA 5.4	Instrument Loop Diagrams
ISA 7.0.01	Quality Standard for Instrument Air
ISA S 18.1	Annunciator sequences & specifications
ISA S71.01	Environmental conditions for process measurement & control systems: Temperature & Humidity
ISA 71.04	Environmental conditions for process measurement & control systems: Airborne contaminants
ISA-RP-55.1/BS-588	Hardware testing of digital process computers
ISA 75.01	Industrial Process Control Valves-Part 2-1:Flow Capacity-Sizing Equations for Fluid flow under Installed Conditions
ISA 75.08.01	Face-to-Face Dimensions for Integral Flanged Globe-Style Control valve bodies
ISA 75.08.02	Face-to-Face Dimensions for Flanged and Flangeless Rotary Control Valves (Classes 150, 300, and 600, and PN 10, PN 16, PN 25, PN 40, PN 63 and PN 100)
ISA 75.19.01	Hydrostatic Testing of Control Valves
ISA MC 96.1	Temperature Measurement Thermocouples
ISA S84.00.01	Application of Safety instrumented Systems in the Process Industries (part 1 to 3)
S-75.xx	Standards related to control valves
ISO	

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NATIONAL AND INTERNATIONAL STANDARDS	
STANDARDS/CODES	DESCRIPTION
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 5208	Industrial valves-Pressure testing of metallic valves
ISO 4266	Petroleum and liquid petroleum products-Measurement of level and temperature in storage tanks by Automatic methods (Part 1 to 6)
ICS-6	Industrial control and systems: Enclosures
NFPA-496	Standard for Purged and pressurized enclosures for electrical equipment
MIL-STD-217E	Military Handbook-Reliability prediction of electronic equipment
IEEE C37.90.1	Surge Withstand Capability (SWC) Tests for Relays and Relay Systems associated with electronic power apparatus
ITU-T	Telecommunication Standardization Sector of the International Telecommunications Union
ITU-T-G652	Characteristics of a Single Mode Optical Fibre and Cable
ITU-T-G651	Characteristics of a multimode graded index optical fibre cable
NACE	
NACE MR0175/ ISO 15156	Petroleum, Petrochemical and Natural gas Industries-Material for Use in H ₂ 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
FF-940	Foundation Fieldbus Specification
ITK-X.X	Interoperability Test Kit (Latest Version)
AERB	Atomic Energy Regulatory Board
CCOE	Chief Controller of Explosives
DGMS	Director General of Mines Safety
PESO	Petroleum and Explosives Safety Organisation
OPCB	Odisha Pollution Control Board
OISD	

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NATIONAL AND INTERNATIONAL STANDARDS	
STANDARDS/CODES	DESCRIPTION
OISD-STD-152	Safety Instrumentation for Process system in Hydrocarbon Industry
OISD-STD-132	Inspection of Pressure Relieving Devices

7. General Design Requirements

7.1 General

Instrumentation shall be complete in all respects for the safe, efficient and easy operation, start up and shutdown of the units. This specification covers minimum requirements for the project. If any specific requirement as per licensor or Owner specific, it shall be taken care by Contractor based on project specifications in line with the FEED document.

All Instruments and equipment shall be designed and suitable for use in specified site climatic conditions and industrial environment in which corrosive gases and / or chemicals may be present. For site conditions, refer doc. No. 080557C-088-CN-0007-003 attached with bid..



All atmospheric vents of instruments shall be fitted with bug screens. As a minimum, all instruments and enclosures (Junction Boxes/ cabinets/panels/ accessories) in field, not subject to flooding, shall be dust proof and weather proof to IP-66 as per IEC-60529/ IS 13947 and secure against the ingress of fumes, dampness, insects and vermin.

Instruments shall not be located in areas that are subject to flooding. Where this is unavoidable, their protection certification shall be upgraded to IEC 60529, Type 67 or 68 dependent on the potential depth and possible duration of submersion. All external surfaces shall be suitably treated to provide protection against corrosive plant atmospheres.

All the cabinets and panels inside the control room shall be IP- 53 certified as a minimum. All cabinets located in building shall be fabricated from cold rolled carbon steel. Cabinet internal & external shall be painted and finish shall be RAL 7035.

All the field instruments, Junction boxes and accessories except for H2 service shall be suitable for use in area classification of Zone-1 Gr. IIA & IIB, T3 as minimum as per IEC 60079 / IS 2148. Field instruments, Junction boxes and accessories used for H2 service shall be suitable for use in Zone-1 Gr. IIC, T3. as minimum. However, in case hazardous is Zone 0 as per area classification, offered Instruments shall be suitable for specific area, as identified.

All transmitters/instruments shall be intrinsically safe, smart type and shall be certified for use in the specified hazardous area classification by any recognized authority like ATEX, CIMFR, ERTL, FM, CENELEC, PTB, BASEEFA etc. Solenoid valves shall be Direct acting type without any pilot operation and shall be 24VDC operated, Intrinsically safe, SIL-3 certified.

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All intrinsically safe and explosion proof instruments and accessories shall in addition to the approvals by any of the above agencies have the certification of Chief Controller of Explosives (CCOE/PESO), Nagpur, India. This is a mandatory requirement. Also Indigenous flameproof equipments shall comply with BIS requirements. All instruments connected/wired to ESD system shall be minimum SIL-2 certified. However, based on SIL study, if any instruments are identified with higher SIL level, same shall be provided. Separate instruments shall be provided for ESD applications.

All instrumentation in safety/interlock loop shall be subject to SIL Assessment. The implementation of SIL requirements shall be in accordance with IEC 61508 & 61511.

All the instruments 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. Specific treatment (e.g: Silicon-coating) shall be given to threads and stem to avoid Galling.

For the Foundation Fieldbus (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.



For HART signals, the preferred method of protection shall be Intrinsic Safety using galvanic isolators. The isolators shall have status indicating LED's. Dual channel devices shall not be used for conventional signals.

The isolators shall be located in the equipment rooms / Satellite Rack Room / Control Room. If Intrinsic safety certification is not available, then Flame proof Instruments shall be used and same shall be brought to the notice of Owner / PMC.

The meter electronics of all instruments shall be protected against transients induced by lightning and power supply surges. Universal type Transient protection of electronics shall preferably be provided in the terminal block (Integral type). 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.

Instrument systems shall be designed to avoid interaction between associated electrical circuits. Spurious signals that cause interference shall be suppressed, preferably at source. Flying leads shall not be used.

The instrument item like control valve, pressure relief valve, orifice flanges, level instrument, thermowell, etc. coming on pipe and vessel under IBR services shall be certified by IBR or IBR authorized representative. All IBR certified drawings and certificates shall be submitted to Owner

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through PMC.

All instruments wetted parts shall be SS316 as a minimum.

Electronic housing material shall be of Epoxy coated die cast Aluminium.

For Fire and Gas detectors, housing shall be SS316.

MB Lal committee recommendation, Latest OISD guideline shall be considered for design. In addition to OISD 152, instrument related clause of other OISDs (tanks/furnaces etc) shall be complied with as applicable.

Instruments shall be protected in accordance with Project Standard 080557C-000-JSS-1500-0010, Protection of Instrumentation.



7.2 Electrical Certification

For hazardous areas, instruments and associated equipment's shall be certified as mentioned below. For such electrical apparatus, the appropriate safety documentation shall be available.

Any certified equipment shall be stamped according to the protection and the relating code and shall be delivered with a conformity certificate issued by a recognized laboratory.

The selection of protection shall be as follows:

Instruments	:	Ex-ia (Ex-d for special cases)
Solenoid valves	:	Ex-ia
Junction boxes	:	Ex-d JB for all Non-FF signals Ex-e JB for FF signals (enclosed with Ex-ia barriers)
Thermocouple head	:	Ex-d
Resistance thermometer head	:	Ex-d
Push button	:	Ex-ia
Local enclosure/Panel (with electronic)	:	Weatherproof with Ex-ia electronic accessories (If not available, Ex-d enclosure / panel with Ex-d accessories) shall be used. Else Type-X can be used with approval from Owner/PMC as per NFPA – 496 and reliability recommendations.

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Lamp / Indicator (LED)	:	Ex-ia (24VDC)
Level gauge illuminator	:	Ex-d
Horn / Hooters / Beacons	:	Ex-d
Cable Glands/Plugs	:	Ex-e/Ex-d dual certified
Limit Switch	:	Ex-ia (Limit switch on MOV shall be Ex-d)
Vibration Switch / Transmitter	:	Ex-ia
Positioner (Smart)	:	Ex-ia
Selector Switch	:	Ex-ia
Annunciators on Local Panel	:	Ex-ia
Fire and gas Detectors	:	Ex-d
Speakers (Field)	:	Ex-d
HMI Consoles / MMS monitors	:	Ex-ia (If located in field)
I/P Converter	:	Ex-ia
Special Instruments like Analysers	:	Ex-ia / Ex-d
Analyser accessories (part of cabinet)	:	Ex-ia

7.3 Instrument Selection

Instruments and their installation shall be selected for reliability in the working environment without the need for special environmental control. Particular attention shall be paid to the effects of corrosion, vibration, humidity, and extremes of temperature.

The instrumentation shall be electronic type. Only final control elements shall be pneumatic type. Proven Track Record (PTR) for all field instruments and for system oriented items such as DCS, PLC etc., shall be considered for minimum of 8000 hours continuously working in similar refinery applications for the past 5 years.

To prevent the permeation of hydrogen, instruments utilizing very thin diaphragms for process measurements in hydrogen service, shall have gold plated SS316L.

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Foundation Fieldbus shall be applied only for DCS open loops. Conventional 4-20 mA (HART) / discrete I/O shall be applied for all other DCS loops, all ESD Signals, all fire & gas signals and for all Package Instruments. FF temperature transmitters shall be used in place of TMUX.

Fieldbus transmitters shall be capable of detecting and transmitting sensor failure or electronics failure. The fieldbus host shall be capable of detecting when a transmitter has been added or removed from the bus and when the host has lost communication with the transmitter.

All transmitters and positioners shall be HART-7 certified.

This specification shall be read in connection with Job Specifications for all Instruments.

7.4 Electromagnetic Compatibility Requirements

All equipment shall meet the technical requirements as defined in the following specifications:

IEC 61000 Sections 4.1 thru 4.5 Electromagnetic Compatibility.

IEC 61326 section 1 Electrical Equipment for Measurement, Control and Laboratory use -EMC requirements.

IEEE C37.90.1 Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

To demonstrate compliance with the above referenced specifications, the vendor shall submit a 'Technical Construction File' (TCF) or a 'Declaration of Compliance.



7.5 Accessibility and Readability

All locally mounted gauges, e.g. level, pressure, temperature gauges etc., and all local electronic indicators shall be readable from grade or permanent platforms.

Locally mounted gauges, measuring elements and root valves at elevations ≤ 4 meters shall be considered accessible by a temporary ladder or portable platform. Above this height, a permanent platform shall be provided. Instruments that are ≤ 0.5 meters from a permanent platform shall be considered accessible from that platform.

7.6 Location

Instruments shall be positioned to minimise the effects of fire, solar radiation, heat from adjacent equipment, condensation, spillage, rain, wash water and maintenance activities. Field mounted Instruments hook-up to process, where feasible shall be pre-fabricated, else close-coupled. Where this is not possible, they shall be post mounted. Attachment to removable flooring sections, handrails or mounting directly on machinery and equipment subject to vibration is prohibited.

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7.7 Selection of Materials

Selection of body materials for all in-line instruments, including all their components connected to the line, e.g. instrument valves, flow meters etc., shall be in accordance with the associated piping material specification, as a minimum. The valve trim / internals and other wetted parts shall be compatible with process fluid and SS316 as a minimum. The selection of materials for all vessel mounted instruments, including all their components connected to the vessel, e.g. level transmitter chambers, level gauges etc., shall be in accordance with the associated vessel trim material specification as a minimum. Thermowells and orifice plates shall be SS316 as a minimum.



All remote mounted instruments, including instruments connected to lines or vessels by means of flush or remote mounted diaphragm seals shall be SS316 minimum unless process conditions require a superior material. For hydrogen service: Gold plated Diaphragm instrument.

Positive Material Identification (PMI) shall be carried out on all instrumentation at Supplier's Works.

7.8 Accuracy of Instruments

Accuracy of the Instruments shall be minimum as follows:



Type of Instrument	Accuracy
Differential pressure & Pressure transmitter – SMART (HART/ FF)	i) For transmitter ranges of 760 mm WC and above, the accuracy shall be equal to or better than 0.05% within a turndown of 1:10 of the offered span. ii) For transmitters with ranges less than 760 mm WC the accuracy shall be equal to or better than 0.15% within a turndown of 1:10 of the offered span.
Variable area type flow meter with transmitter	2.0% FS Note (1)
Vortex flow meter	Accuracy inclusive of linearity, repeatability and hysteresis shall be better than 0.25% of full scale for liquid and 1.0% of full scale for gas and steam.
Coriolis Mass Flowmeter	0.1% FS (for Custody transfer) or 0.2% FS for other service depending upon applicability, 0.0005 gm/cc for Density measurement
Magnetic type flow meter	0.5% FS
Ultrasonic type flow meter	1% for liquids (normal operation) 1% for gas (normal operation) 0.1% for custody transfer 5% for flare applications
Positive Displacement flow meter	0.2 % FS
Target flow meter	0.2 % FS

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Turbine flow meter	i) Accuracy inclusive of linearity, repeatability and hysteresis shall be better than 0.15% of actual flow rate (liquids) ii) Accuracy inclusive of linearity, repeatability and hysteresis shall be better than 0.2% of full scale between 20% of maximum flow rate and maximum flow rate (gas)
Thermal mass flow meter	1% or better
Displacement type level indicator	(including linearity, repeatability and hysteresis) better than 0.15% of actual flow rate
Displacement type level transmitter	0.2% FS (Smart)
Guided Wave Radar Level Transmitter	0.2% FS
Radar type tank Instruments	For Servo and Radar: i) +/- 1mm for TGS / custody transfer (at CIU) ii) +/- 3mm for control and interlock applications. iii) +/- 5 mm or better for normal application.
Draft range Pressure transmitter – SMART (HART/ FF)	0.15% of span within TD ratio of 1: 10
Diaphragm seal transmitter – SMART (HART/ FF)	i) With ranges 500 mm WC and above, the accuracy shall be equal to or better than 0.25% within a turndown of 1:10 of the offered span. ii) For all diaphragm seal transmitter with ranges less than 500 mm WC, the accuracy shall be equal to or better than 0.5% within a turndown of 1:10 of the offered span.
Pressure gauge	1.0% FS
Differential Pressure gauge	2.0% FS
Temperature Transmitter SMART (HART)	For RTD: i) For temperature range above 350°C, the accuracy shall be equal to or better than 0.075% of full scale. ii) For temperature range with ranges between 350°C to 150°C, the accuracy shall be equal to or better than 0.15% of full scale. iii) For temperature range below 150°C, the accuracy shall be equal to or better than 0.25% of full scale. For Thermocouple: accuracy shall be 0.25% of range.
Filled system/Bimetallic	1.0% FS
Small size pressure gauge	3.0% FS
Draft gauge	3.0% FS

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Receiver gauge	1.5% FS
Thermocouple & Resistance Bulb	Applicable Codes/Standards

Note: 1. Vendor's standard accuracy is applied to local indicator type.

Remarks:

FS: Full scale.

- Accuracy of instrument and special articles except for above mentioned instrument shall be in accordance with the applicable codes/standards, or Vendor's standards as approved by Purchaser.
- Overall rangeability of transmitter except Draft range and Wafer seal transmitters shall be 1:100. Draft range transmitter rangeability shall be 1: 30 & wafer seal transmitters shall be 1:20 or better, for the accuracy indicated above.

Accuracy indicated above is minimum requirement, unless otherwise specified for any specific requirement by Licensor / Owner / Regulations.

Calibration stability of standard Pressure / DP Pressure Transmitter shall be minimum 10 years.

7.9 Earthing System

The Earthing of measurement, control and computer systems shall be arranged to prevent electrical interference. Particular attention shall be given to the arrangement of earthing circuits to prevent unwanted circulating currents in earthing, signal and measurement conductors and screens.

Refer to Instrument Earthing Philosophy enclosed elsewhere.

8. Design Requirements for Control and Monitoring / Safety Systems



8.1 Distributed control system (DCS) / Emergency Shutdown System (ESD) / Gas Detection System (GDS) / Fire Detection Alarm System (FDAS)

Honeywell make control & safety system (DCS, ESD, GDS, FDAS) is in place at IOCL, Paradip for control, monitoring, safeguarding and alarm handling of existing SRU-I, SRU-II & TGTU and existing VGO, DHDT, NHT, Sulphur, MS storage, Alkylate, PCK storage tanks in Tank Farm Area.

The GDS shall be a sub-system of the main ESD system and shall have segregation of Marshalling and I/O, but share the same processor.

New SRU-3 & TGTU-2 :

Existing Honeywell make DCS, ESD, GDS, FDAS in SRR-811 & Main Control Room shall be augmented to cater for new SRU-3 (unit 088)& new TGTU Incinerator (unit 090) units by providing new dedicated controller with all required hardware, software, license. This new dedicated controller of DCS, ESD, GDS & FDAS for SRU-3 & TGTU-2 with its accessories shall be hooked up with existing

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control/safety system network to integrate with existing SRU/TGTU units. All new cabinets such as system, marshalling, Power Distribution Boards (PDB), Unit Control Panel etc., associated to new SRU & TGTU shall be placed in SRR-811, MCR(SRR-815) & Interposing Relay Panel (IRP) in SS-331S.

New operator consoles shall be provided in Main Control Room for monitoring & control of new SRU-3 (unit 088) and TGTU-2 (unit 090) units. Graphics for new SRU-3, TGTU-2r units shall be configured & modify existing graphics as required in existing operator consoles to integrate new units with existing one.

Instrument signals, Fire & Gas signals associated to new SRU-3 and TGTU Incinerator shall be interfaced with SRR-811.

New additional Storage Tanks in Tank Farm Area:

Spare of existing Honeywell DCS, ESD, GDS, FDAS in SRR-801, SRR-816, SRR-817 & SRR-819 shall be utilized to interface instrument signals associated to new additional storage tanks in Tank Farm Area. However, if existing system spare is not sufficient, system augment shall be done as required.

Instrument signals, Fire & Gas signals associated to new VGO (203-TK-012) shall be interfaced with SRR-816, DHDT (203-TK-004), NHT (203-TK-003) storage tanks shall be interfaced with SRR-817.



Instrument signals, Fire & Gas signals associated to new Sulphur (203-TK-054 & 055) storage tanks shall be interfaced with SRR-801.

Instrument signals, Fire & Gas signals associated to new MS (205-TK-039 & 040), Alkylate (203-TK-043 & 044), PCK (205-TK-050) storage tanks and PCK metering skid shall be interfaced with SRR-819.

Signals associated to pumps of new Sulphur, MS, Alkylate & PCK storage tanks shall be interfaced with SS-312-N.

Existing Operator consoles in Main Control Room for existing VGO, DHDT, NHT, Sulphur storage tanks shall be used for monitoring & control of new VGO (203-TK-012), DHDT (203-TK-004), NHT (203-TK-003), Sulphur (203-TK-054 & 055) storage tanks also. Accordingly, Graphics for these new storage tanks shall be configured & modify existing graphics as required in existing operator consoles for existing VGO, DHDT, NHT, Sulphur storage tanks to integrate new tanks with existing one.

Existing Operator consoles in SRR-819 for existing MS storage, Alkylate, PCK storage tanks shall be used for monitoring & control of new MS (205-TK-039 & 040), Alkylate (203-TK-043 & 044), PCK (205-TK-050) storage tanks (203-TK-054 & 055) also. Accordingly, Graphics for these new storage tanks shall be configured & modify existing graphics as required in existing operator consoles for existing MS storage, Alkylate, PCK storage tanks to integrate new tanks with existing one.

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8.2 Local panel requirement:

Location:

- ☒ Hazardous Area
- ☒ Non-hazardous Area

Type:

- ☒ Weatherproof with Ex-ia electronic accessories (If not available, Ex-d panel with Ex-d accessories) shall be used. Else Type-X can be used with approval from Owner/PMC as per NFPA – 496 and reliability recommendations.

Note--3: Purging of Local control panel and other Enclosures shall not be allowed.

Instrument type:

- ☒ Electronic
- ☐ Pneumatic

Local control panels in general shall be of free standing totally enclosed construction, fabricated from 3 mm thick SS316 steel plate. Doors, sides, top & bottom shall be 3mm thick. Max dimension shall be 2100 mm (H) X 1200 mm (W) X 800 mm (D).

All lamps, status as well as alarm, shall be provided with lamp test facility. One single lamp test push button shall be provided for each panel. Cable entry to the panel shall be only from bottom through MCT blocks only. Side and top entries are not acceptable.

All Lamps powered from SRR/Control room shall be 24VDC operated. Push buttons and Selector Switches shall be Ex-ia IS, if not available Flameproof and non-IS type. DPDT (Double Pole Double Throw) type of switches shall be considered as a minimum.



No Bulk Power Supply /Regulated Power Supply /Barriers to be installed in field panels.

All local panel shall be provided with a rain cum sun shade canopy /shed.

The Local Panel shall include approximately 20% installed additional equipment such as local indicators, lamps, switches etc. Local Panel shall also have 20% additional spare space for future requirement of all type of instrument, switches, lamps etc.

The insulation colour of cabinet internal wiring shall be as follows:

- AC live: Red
- AC neutral: Black
- Safety ground: Green with Yellow stripe
- Instrument ground: Green
- DC positive: White
- DC negative: Black
- IS signals: Blue
- All other signals: Grey

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8.3 Telecom System

S.No	Description	Requirement	Remarks
1	Telephone system – Avaya make		Existing system shall be used, Note-17
2	PA/GA System – Neumann make		Existing system shall be used, Note-17
3	CCTV System		Existing system shall be used, Note-17

Note 17:



- Existing Telephone, PA/GA & CCTV system in SS-331-S to which new field telecom equipment like Analog phone, PA/GA speakers, Field Call Station, CCTV cameras associated to new SRU & TGTU-2 shall be interfaced. Additional hardware if any required in existing Telecom system shall be provided to interface & integrate new telecom equipment of new SRU & TGTU-2 with existing one.
- Existing Telephone, PA/GA & CCTV system in SS-334-S to which new field telecom equipment like Telephone, PA/GA speakers, Field Call Station, CCTV cameras associated to new VGO, DHDT & NHT storage tanks shall be interfaced.
- Existing Telephone, PA/GA & CCTV system in SS-312-N to which new field telecom equipment like Telephone, PA/GA speakers, Field Call Station, CCTV cameras associated to new Sulphur, MS, Alkylate, PCK storage tanks shall be interfaced.

9. Package Philosophy:

- Control & monitoring, interlocks functions of packages like incinerator, Blowers, etc. shall be implemented in respective unit DCS & ESD PLC. Software / Logics required for Control & monitoring, interlocks of packages shall be developed and implemented by package vendor in main plant DCS/ ESD PLC. However, for proprietary items like soot blower or licensors's specific requirements, package vendor's PLC/ control system shall be used.
- Dedicated and separate BMS PLCs with same make & configuration of ESD PLC shall be provided by bidder for each package item.
- All packages shall be mapped in DCS with dedicated graphics.

9.1 Machine Monitoring System

S.No	Description	Requirement	Remarks
1	Type		
1.1	Machine Monitoring System with Condition Monitoring System (BN 3500 series)	YES	<p>a) MMS shall be interfaced with DCS through redundant MODBUS serial communications.</p> <p>b) All interlock signals from MMS to ESD / PLC shall be</p>

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			by means of hardwired I/O. DO from MMS shall be realised through three relay modules configured in 2oo3 logic for each trip and independently communicated to ESD/PLC.
2	Machine Monitoring System Monitors Location		
2.1	SRR / Control Room	YES	
2.2	Field Local Panel		
2.3	Air-conditioned shelter	YES	Only when there is distance limitation to install in SRR/Control room.
3	MMS Display Unit Location		
3.1	Local Panel	YES	

Note-10:

- i) Facia of the machine monitoring rack to be built in DCS HMI. MMS rack shall be supplied with TDI module to connect with existing Condition Monitoring System (BN System 1) for data acquisition, trending, analyses, online performance monitoring, diagnosis of machinery problems.
- ii) MMS local display unit shall be put into a EEx(d) console. No purge panel shall be used.
- iii) All MMS hardware shall be safety function certified
- iv) Independent racks/chassis are to be considered for individual machines.

9.2 Others:

Manual Loading Station (As per PID):

- ☐ On panel
- ☒ On Console

Note: Control panel shall be considered only when mounting of instruments on auxiliary console is not feasible.

Selector Switch (As per PID):



- ☒ On panel
- ☒ On console

Start/Stop, Emergency Push Button (As per PID):

- ☒ On panel
- ☒ On console

Process Bypass Switch/Indication (As per PID):

- ☐ On panel
- ☒ On console (as per licensor documents)

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10. Power Supply:

S.No	Description	110 V DC	24 V DC	48 V DC	230 V AC 50Hz UPS	110 V AC 50 Hz (UPS)	230 V AC 50 Hz (Non UPS)	415 V AC - 3 Phase	Remarks
1	Distributed Control System					YES	YES		Non UPS for Lighting
2	Package Units					YES	YES		Non UPS for Lighting
3	Alarm Annunciator					YES			
4	PLC					YES	YES		Non UPS for Lighting
5	Solenoid valves		YES						
6	Smart positioners, I/P, Transmitters		YES						
7	Digital Input / Output Interrogation Voltage		YES						
8	Gas detectors		YES						
9	Analyzers and Analyzer System					YES	YES		
10	Chromatographs					YES			
11	Level gauge illumination						YES		
12	Cabinets Fan						YES		
13	Cabinets Lighting						YES		
13.1	Control Room						YES		
13.2	Local Panel						YES		
14	CCTV				YES				
15	Local Panel					YES			
16	Analyzer cabinet Air Conditioning							YES	
17	Analyzer Shelter, HVAC /Heat traced lines							YES	
18	Stack Analyzer					YES	YES	YES	
19	Instruments like Coriolis Mass flow meter					YES			
20	Hooters, Beacons (if required).		YES						
21	Telephone system				YES				
22	Paging System				YES				
23	Access Control system					YES			
24	Speakers				YES				
25	Telephone		YES						

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For new SRU-III, TGTU-2 , new Storage Tanks in Tank Farm Area,
- existing voltage level shall be followed for DCS, ESD, GDS which is 110V AC 50Hz UPS power supply with 60 minutes back up
- existing voltage level shall be followed for FDAS which is 110V AC 50Hz UPS power supply with 24 hours backup with additional 5 mins for UPS fault alarming back up
- existing voltage level shall be followed for Telephone, CCTV, PAGA system which is 230V AC 50Hz UPS power supply with 60 minutes back up

11. Type of Instruments for Interlock and Shut-Down:

For pressure and level:

- ☐ Direct actuated
☒ Field transmitter connected through ESD PLC

For Flow and temperature, interface level and very low pressure:

- ☐ Hardwired receiver switches
☒ Field transmitter connected through ESD PLC



Note :

- 2 out of 3 voting shall be considered for all shutdown logic & trip interlock with three field instruments wired to different I/O cards placed at 3 different racks of ESD system.
- Instruments used for shutdown application shall be separate from those used for control / monitoring application.

12. Field Transmitter Signal:

S.No	Description	Conventional	HART 7	Fieldbus	Wireless	Remarks
1	DCS Open loops			YES		
2	DCS closed loops, ESD Signals, Fire & Gas signals and all package Instruments	4-20mA	YES			Except Digital Input / Digital Output
3	For anti-surge loops	4-20mA	YES			As suggested by anti-surge controller vendor.
4	For interlock/shut-down loops/safety system loops	4-20mA	YES			
5	Pump seal Instruments (2oo3)	4-20mA	YES			
6	For Equipment Packages	4-20mA	YES			

All transmitters shall be intrinsically safe and SMART type with HART/FF protocol with integral LCD indicator and be furnished with test terminals and bypass diode to facilitate field testing without

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disconnection of integral indicator. The transmitter electronics shall be capable of monitoring their performance during normal operation. The transmitter diagnostic shall be able to detect both an input sensor failure and transmitter electronics failure. The sensor &/or electronics failure shall be transmitted to the host system (e.g. DCS / PLC). The transmitter shall have zero and span adjustable. Field transmitters shall be used in place of switches for all the digital inputs used in process interlocks. For FF transmitters, minimum operating voltage shall be 9V. For detailed FF segmentation philosophy, refer 080557C-000-JSS-1513-001.

Diaphragm seal instruments with capillary shall be used for crystallization and viscous fluid services where plugging of the element may occur or where suitable material is not available in highly corrosive services. In these cases, flange material shall be according to pipe class but minimum SS316 and the diaphragm material shall be minimum SS316 or better depending on process requirement. In case of pure H₂ services transmitter diaphragm shall be gold plated SS316L.

Whenever Differential pressure transmitter is considered for level measurement, the element shall be preferably remote seal type with drip ring provision & with welded joint for vent & drain.

For SMART remote output meters /loop powered local indicators, repeat signal shall be provided from Analog Output card of the control system.

Wherever remote display is required the cable between sensor and electronics shall be armoured preferably or it shall run in SS 304 Conduit for protection.

Flushing / Spacer ring wherever provided shall be from transmitter vendor, of min SS316 material and shall have seal welded vent and drain connections. Capillary shall be of min SS316 and shall have SS304 armoring with PVC covering. Seal fluid shall be DC 704 or equivalent suitable for service conditions. Cable entry shall be ½" NPT(F). Spare cable entry shall be plugged suitably. For flow, level, pressure and DP the body and other wetted parts material shall be SS316 min. All transmitters shall have 130% over-range protection, lightning and surge protection.

12.1 Intrinsic Safety Barriers



- ☒ Required
- ☒ Galvanic Isolating type (Active Barriers)
- ☐ Not Required

Note :

- In case hazardous is Zone 0 as per area classification, offered Instruments shall be suitable for specific area, as identified.
- For FF instruments, signals shall be connected to field barriers.

12.2 Earthing System

- ☒ Electrical earth grid required for panels, racks, cabinets, consoles, shelter etc. and all Junction boxes with power $\geq 110V$
- ☒ Separate dedicated Earthing grid/ pit required for signal/ screen earth for DCS/PLC/Analyser shelters.
- ☒ Separate dedicated Earthing grid/ pit required for field signal earth.

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- Separate dedicated Earthing grid/ pit required for IS Barrier earth (Only for Passive Barriers) for DCS/PLC.

Note: A single earth pit shall not be used for any system. Instead, an earth grid shall be made of minimum two numbers of earth pits connected in parallel. Suitable distance shall be maintained between various earth pits (minimum 3m) as per guidelines of API RP550.



12.3 Field HART Communicator:

- a) It shall be possible to perform routine configuration, calibration, display process variable, diagnostics etc. from a hand held portable communicator, which can be connected at any location in the transmitter loop. It shall be possible to perform all the above functions on-line. The loop function shall remain unaffected while communication is going on between transmitter and the field communicator.
- b) There should be no interruption on the output while communicating with the transmitter.
- c) Field communicator shall meet the following requirements:
 - i. Hand Held communicator shall be universal type and shall be compatible with all make and models of HART transmitters, Smart positioners, instruments, Analysers with all engineering capability like calibration, diagnostics, configuration, inhibition of HART signal, etc.
 - ii. It shall be possible to connect the communicator at any of the following locations for purpose of digital communication.
 - Marshalling cabinet serving the transmitter, in safe area.
 - Junction box serving the transmitter, in hazardous area.
 - Directly at the transmitter, in hazardous area.
Plug-in type connections shall be provided with field communicator. Necessary interconnection shall be supplied by the vendor.
 - iii. Offered communicator shall be dust-proof, certified intrinsically safe and suitable for outdoor location. Carrying case shall be supplied with each communicator.
 - iv. When specified, the software shall also be capable of configuring other makes of transmitters.
 - v. They shall be battery powered with replaceable and rechargeable batteries.

12.4 Field Bus Tester:

- a) The field bus testers shall be able to determine the ability of the field bus wiring to carry field bus signals. The field bus tester shall be capable of testing both signal and resistance of the field bus.
- b) There shall not be any interruption on the output while communicating with the field bus devices.

Note: Two nos. Universal Handheld Communicator with charger, common for all smart type HART instruments and Foundation Fieldbus devices shall be provided. In case of

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separate communicator/ tester provided for HART instruments and FF devices Two nos. of communicator for HART instruments and two nos. for Foundation Fieldbus device shall be provided. Suitable intrinsically safe certificate shall be provided for the area class.

12.5 Instrument Connections:



For Instrument connection details on vessels, standpipes, tanks and pipes shall be provided as below

- SRU-3 & TGTU-2 shall be provided as per 080557C -000-JSS-1500-013
- Storage Tanks in Tank Farm shall be provided as per 080557C-000-STD-1540-001.

13. Impulse Piping / Tubing Hook-Ups

Instrument piping shall be in accordance with Project Standard 080557C-000-JSS-1500-004, Instrument Piping Material Specification. Only BW or SW fittings and valves are to be considered for impulse piping fabrication of instrument hook-ups. Flanged valves shall not be considered



S.No	Description	Requirement	Remarks
1	Instrument installation		For licensor units, Licensor requirements to be followed.
1.1	Close coupled	YES	For Non-Congeaing Hydrocarbon services, where pre-fabricated & pretested hook-ups cannot be used.
1.2	Remote	YES	For Non-congealing Hydrocarbon services (for DP type FT & PT above 600 class and maximum operating temp. above 325 Deg C.), steam services, For DP type Level and PDT, For DP type FT (pertaining to Venturi, Flow nozzle, D-D/2 tapping, Meter run), and For congealing Hydrocarbon service where diaphragm seal type transmitter shall be used.
1.3	Prefabricated	YES	For Non-congealing Hydrocarbon services (Upto 600 class and maximum operating temp. upto 325 Deg C.) as well as utility services except steam, standard bought out Pre-fabricated (with 5 valve manifold) for flow orifice with flange tapping and (with 2 valve manifold) for PT & PG and pretested hook-up for all flow (dP) transmitters, Pressure transmitters shall be used. These hook-ups shall be basically close coupled instrument hookup integral type complete with instrument root valve, equalizing valves, oval flange adaptors, vent, drain pre-tested

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			and pre-engineered ready for installation.
2	Instrument Impulse Lines		
2.1	Piping Impulse Lines	YES	For all HC, hydrogen services irrespective of rating and for other services with pipe classes of rating 600# and above. For ratings up to 900#, 3/4" line to be used. For ratings >900#, 1" line to be used.
2.1.1	Instrument manifolds		
2.1.1.1	For PT / pressure gauges – isolation valves and drain / vent valves	YES	
2.1.1.2	For DP type flow transmitter-Integral valve manifold	YES	
2.1.2	Impulse line valves		
2.1.2.1	Isolation valves	Double Block and Bleed	
2.1.2.2	Vent/Drain valves	Gate	Globe valve shall be provided for high pressure and high temperature application
2.2	Piping with tubing at Instrument end (for remote installation)	YES (maximum 2 tube fittings per impulse line)	Only for non-hydrocarbon , non-hydrogen and pipe classes of ratings below 600#
2.2.1	Instrument manifolds		
2.2.1.1	For PT/pressure gauges -3 valve manifold	YES	
2.2.1.2	For DP type flow transmitter-5 valve integral manifold	YES	
2.2.2	Impulse Line valves		
2.2.2.1	Isolation valves	Double Block and Bleed	
2.2.2.2	Vent / Drain valves	Gate	Globe valve shall be provided for high pressure and high temperature application
3	Air Supply Tubing		
3.1	Material		
3.1.1	SS 316L	YES	
3.2	Tube size		
3.2.1	10mm OD x 1mm wall thick	YES	Refer 080557C-000-JSS-1500-004 for further details.
4	Steam Tracing Tubing	YES	Steam tracing for instrument impulse lines shall be provided as per process requirements (like in congealing, highly viscous, highly corrosive e.g : crude oil, fuel gas etc)
4.1	Bare copper	YES	For services like acid, acid gas and sour water, SS tubes to be used in

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			place of copper tubing
4.2	Tube size	10mm OD x 1mm wall thick	Refer 080557C-000-JSS-1500-004 for further details.
4.2.1	Others		
5	Impulse Tubing		
5.1	Material		
5.1.1	SS 316	YES	
5.2	Tube size		
5.2.1	12mm OD x 1.5 mm wall thick	YES	Refer 080557C-000-JSS-1500-004 for further details.
6	Electrical Tracing	YES	

Note-1: Instrument air distribution branch header Piping (after main header) MOC shall be minimum SS304. In case of use of Instrument air manifold, the length of the air header tubing from manifold to individual valve shall be limited to 20 mtr only. In case of length more than 20 mtrs, supply piping from header to proximity of instrument shall be provided.

Note-2a: No pipe unions shall be used, only break flanges shall be used in instrument hook-ups. Equalising valves shall be globe valves.

Note-2b: Instruments root valve shall be Double block & bleed for instruments on lines and equipment in acid gas service and Sour water service, where H₂S content is significant causing safety concerns.

Note-3: Instrument impulse pipes and nipples shall be of minimum schedule sch-160 and associated fittings shall be of minimum 3000 lbs.

Note-4: All valves and manifolds shall be forged type only and of minimum 800 LBS rating.

Note-5: Instrument air manifolds shall be made of 1 inch Seamless SS pipe. Isolation valves on instrument air service shall be packless gland type full-bore ball valves and body material shall be SS 304. For corrosive services air tube shall be SS 304 with PVC coating.



Note-6: Final connection to instrument of impulse piping shall be made using 12mm OD ASTM A - 269 TP 316 stainless seamless tubes and SS 316 double compression fittings.

Note-7: All instrument piping shall have properly designed support systems. Length shall be minimized to the extent possible.

Note-8: Where three or more single tubes are run parallel to each other, cable tray, as used for instrument cables, shall be used for support.

Note-9: In steam and BFW application, Hookup material shall be made of stainless steel.

Note-10: For all sour services/inflammable gases, instrument drain and vent points shall be connected to flare header and CBD/OWS by way of providing separate isolation valves, NRVs and break flanges in between instrument hook up assembly and CBD/OWS & flare for maintenance purpose.

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For Instrument connections on pipeline and vessels, refer 080557C-000-STD-1540-001 attached with this document and refer 080557C-000-JSS-1500-013 for Instrument and piping Interface standard

Hot and Cold Protections

Heat Tracing

Heating medium :

- ☒ Steam
☐ Hot water

Piping style:

- a) Signal tube :
- ☒ Branch piping
- b) Header piping with manifold valves
- ☒ Open loop ☒ closed loop (With steam traps)
☐ Reduced end of pipe (without steam trap)
☐ With ¾" Flanged block valves for supply piping
☒ With steam trap in each trace piping
- c) Return Piping :
- ☒ To open pit or funnel
☐ To condensate and/or return header piping

Piping materials:

- a) Branch Piping :
- ☒ As per piping Spec
- b) Trace tubing :
- ☒ Copper tube ☐ 8 mm out dia. ☒ 10 mm out dia.
☒ 316 S.S ☐ 8 mm out dia. ☒ 10 mm out dia.

Fittings:

- ☒ Bronze with chrome plated
☐ 316 S.S



Note: For critical services, dual steam tracing with individual supply from header shall be provided.

Protection of instrument

Heating box and medium:

- Yes ☐
 No ☒
- ☐ Steam ☐ Hot water ☐ Electric heater

Sun shade :

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- ☒ Yes, Sunshields 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.
- ☐ No

Hot and Cold Insulation

Hot and Cold insulation shall be considered to protect instruments, instrument pressure piping or process fluid from freezing, vaporizing, crystallizing, thermal shock and personnel against scaled. The specification shall be in accordance with the applicable Insulation Specification and as required.

14. Analyser Installation

Analyser installation:

- ☒ Analyser Cabinet
☒ Analyser shelter with Air conditioning

Type of HVAC

- ☒ Packaged
☐ Separate Air Conditioning and Ventilation unit

15. Painting

Materials and painting process shall be specified in consideration of the ambient conditions described above. The painting colour shall be as follows:

Panel mounted instruments:

- ☐ Black for bezel
☒ MFR STD

Locally mounted instruments:



- ☒ MFR STD

Steel Valve bodies and top works shall be painted. The top works shall be painted in the following colours:

- ☒ Red – Air Failure Closed
☒ Green – Air Failure Open
☒ Orange – Air Failure Locked

Austenitic stainless steel and non-ferrous valves shall not be painted.

- ☒ Carbon steel Body: Light Grey

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- ☒ Alloy steel: Canary Yellow
- ☒ SS Body: Natural
- ☐ MFR STD

Actuators:

- ☒ Direct (Open on Air Failure) - Green
- ☒ Reverse acting (Close on Air failure) - Red

Panels:

- ☐ Opaline green IS 275
- ☒ RAL 7035
- ☐ Sky blue IS 101

As approved by the OWNER/PMC.

DCS and the peripheral equipment

- ☒ MFR STD

15.1 Safety Design

Fail-safe design of instruments and/or instrument system shall be considered for safety of plant, personnel and equipment in case of failure of instrument air and/or electric power.

No process streams and air shall be brought into control room.

15.2 Marking

Corrosion-proof metal name plate Stainless steel which is engraved with the tag number, range, model number, size, rating, materials, explosion-proof grade, etc. shall be permanently be affixed on the case or body unless otherwise specified.

15.3 Jacketing

Instruments mounted on jacketed lines and jacketed equipment shall be jacketed only. In case the jacketing of any particular instrument item is not possible, heat tracing may be selected after intimation to Owner / PMC before proceeding ahead.



16. Field Instruments

16.1 Flow Instrument

16.1.1 D/P Type Flow meters and Orifices

D/P type flow meters employing thin square edge concentric orifice plates shall normally be used where the piping sizes are 2 inches or larger and integral orifice shall be used for line sizes 1-1/2" and below.

Eccentric and segmental orifice shall be used for specific applications.

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Quadrant edge and conical entrance orifice plates shall be used for low Reynolds number.

Straight length requirements shall be based on ISO 5167 for 0.5% additional uncertainty. The orifice meter run (straight length) shall, as a minimum, be in accordance with the length shown in Table-3 of ISO-5167-2 column-B for a Beta ratio of 0.75.

Orifice plates:

Design standard :

- ☐ ASME Fluid Meter, their theory and application.
- ☒ ISO 5167
- ☐ DIN 1952.
- ☐ BS 1042.

Materials :

- ☒ SS316 (minimum).

Drain & Vent holes :

- ☒ Yes
- ☐ No.

Type of pressure taps:

For line size 14" and smaller :

- ☐ Corner taps
- ☒ Flange taps

For line size greater than 14" :

- ☐ Vena contracta taps
- ☒ D-D/2 taps



For Integral Orifice with Transmitter or Meter run without Transmitter

- ☒ Corner taps
- ☐ Flange taps

d/D (Beta) ratio : As per ISO 5167.

Note: For orifice meters where flow range ability exceeds 4:1, dual / multiple transmitters shall be used irrespective whether same is shown in the P&ID's or not. Dedicated orifice tapings shall be used for each transmitter for the installation of multiple transmitters from a common orifice.

Orifice flanges:

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The minimum pressure rating for orifice flanges shall be 300#, mounted between a pair of weld neck flanges.

Individual taps on the orifice flange shall be provided for individual transmitter. In case of 2oo3 logic requirement, 3 transmitters' independent taps on orifice shall be used. In such cases 3 set of taps shall be provided on orifice assembly. In case separate transmitter is required for Indication/control in DCS in addition to 2oo3 logic requirement, then 4 sets of tap shall be provided in orifice assembly.

Instrument tapping connection shall be ½"NPT(F) up to 600# pressure rating and ¾" tapping for congealing, viscous and for services above 600# pressure rating.

All the Orifice flanges shall have 4 sets of tapping. Unused tapings shall remain capped.

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.

Orifice flanges shall be specified in accordance with the piping specification and following standard.

- ANSI B 16.36, B16.36a & B16.5.

Type of tap connections is as follows:

- Screwed with Seal welding
- Socket welded

Marking of orifice plates :

Orifice plate shall be provided with Tab handle, which is welded on the orifice plate and engraved with following information:



- Tag number,
- diameter (mm) of orifice,
- Nominal pipe size (in.),
- ANSI flange rating, materials ,
- DP Range and meter Flow Range and
- "UPSTREAM" (or "UP").

For D/P Flow Transmitters, Piping hookup with five valve manifolds shall be considered for all HC and H2 services irrespective of piping class rating and for all other services above 600# rating.

Hybrid hookup with pipes and tubes and not exceeding 2 ferrule tube fittings per impulse pipe may be considered for services below 600# (Non HC and H2). Double isolation, double vent/ drain valves shall be provided for all H2/ toxic services and for all services above 600# pipe class.

The full scale of a differential pressure meter shall be chosen from the following:

- 1250 mm H2 O
- 2500 mm H2 O (preferred)
- 3750 mm H2 O
- 5000 mm H2 O

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Carrier rings for corner tappings (As required):

Type of carrier rings:

- ☐ Separated ring and orifice plate
- ☐ Integrated ring and orifice plate

Carrier ring facing, rating and materials:

Facing and rating:

- ☐ As per piping spec.

Materials:

- ☐ As per piping spec. or equivalent
- ☒ Same materials as per orifice plate

Marking of orifice plates:

Tag number, diameter (mm) of orifice, nominal pipe size (in.), flange rating, materials and "UPSTREAM" (or "UP") shall be engraved on the upstream face of the tab handle.

Variable Area Flow meters (Rotameters) for local indicator if specified (to be as per PID)

Applicable service conditions (except purge meters) :

- ☒ Piping size is 1-1/2 in. and smaller
- ☒ Rangeability of more than 10:1 is required
- ☐ Local indication / control is required
- ☐ Nature of fluid, such as viscous and crystallizing

Indicator type :

- ☒ Magnetic coupling linked type
- ☐ Direct reading type



Body Type:

- ☒ Metal tube type
- ☒ Glass tube type (only for purge, seal, flushing applications.)

Flow direction (except purge meter) :

- ☒ Bottom to top
- ☐ Side to top : ☐ Only gas service
- ☐ Side to side : ☐ Only gas service

Connection flanged (except purge meter) :

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■ As per piping spec.

Materials (except purge meter)

Body :

■ As per piping spec or better

Protections

Float damper :

☐ Gas service

■ Pulsating flow

Cooling fins or extension well :

■ High or low temperature service (150 °C and above or 0 °C and below)

☐ The type specified by MFR's recommendation

Jackets :

■ Crystallizing fluid at ambient temperature

16.1.2 Other Flow elements and Flow meters

Other flow elements and flow meters, such as Venturi tube, flow nozzle, annular (averaging pitot), quadrant edged orifice, eccentric / segmental orifice for flow elements and vortex flow meter, magnetic flow meter, mass flow meter (Coriolis principle), ultrasonic flow meter, etc. will be considered individually as specified by process licensor/ PIDs to the specified service conditions and based on Job specification/ Licensor specification.

Mass flow meter will be used for high accuracy totalizing of raw material and products, in liquid.

Mass flow meters shall be provided with remote mounted electronics only.



Mass flow meters used in congealing services shall be with integral steam tracing jacket for sensor assembly.

For critical application, mass flow meter multivariable signals (flow, density, temperature, totaliser value etc) to be taken in control system.

Venturi and Flow nozzles may be selected where system requires Low pressure drops.

Venturi shall be selected for Non-Viscous Fluids. Venturi tubes and flow nozzles of circular cross section shall be constructed in accordance with the requirements of ISO 5167. Peizometric ring around the circumference of Venturi shall be used for tappings.

Pitot tube should be an averaging Pressure type and may be selected for Clean fluids, Low pressure loss, and large quantity measurement. However, Pitot tube shall not be used for air flow measurement instead venture tube or Thermal mass flow meter shall be used.

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Vortex shedding meters will be used for Clean liquids, gases and steam application with higher turndown ratio wide range flows.

Ultrasonic type flow meters for monitoring (not for control) will be used for Flare application & large pipe size. Ultrasonic shall be Multi-path type where higher accuracy is required.

Magnetic type flow meters will be used for Electrically conductive slurry or corrosive services, etc. Annubar Flow Element / Thermal mass flow meters shall be used for stack flow measurement.

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.

Magnetic flow meters used for cooling water service shall be insertion type.

Hydrocarbon volume/mass measurement for Custody transfer shall be by Multi-path Ultrasonic flow meter or Coriolis Mass flow meter.

All custody transfer meters shall be calibrated by FCRI with accuracy required for custody transfer metering. Meter proving skid with Master meter to be considered for accuracy checking of all the custody transfer duty meters. Stamping of custody transfer meters to be considered in scope of vendor/contractor which would mandatorily be completed before actual custody transfer operation.

For custody transfer applications, responsibility of stamping (weigh bridges/check scales/MFM etc. as required by regulatory requirement) and FCRI calibration to be kept in scope of supplying vendor during warranty and CAMC duration. For MFMs, Scope shall include dismantling, transportation (including packing) from refinery to FCRI and return back to refinery and reinstallation.

A 5 year rate contract to be firmed up with vendor for calibration of MFMs at FCRI (including transportation to & fro FCRI) and stamping of meters.



Flow meter in Flare line shall be designed to measure the flow in entire design range (Min to Max) as per process. In case one flow meter is not able to cater the whole range, multiple flow instruments may be considered.

Custody & Product Metering

Liquids

- ☐ PD Meter
- ☐ Turbine
- ☒ Ultrasonic

Gas

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- ☐ Orifice
- ☐ Turbine
- ☒ Ultrasonic
- ☐ As per P&ID

Performance metering

- ☒ Orifice
- ☒ Turbine
- ☐ PD Meter
- ☒ Mass
- ☒ Any Other as per P&ID

16.2 Level Instruments

For most liquid level applications, normally Guided Wave Radar type Smart level instruments shall be used for level measurement of liquids up to and including 2.4 m. Differential pressure transmitter shall be used for level measurement above 2400mm and for services requiring purge or where liquid might boil in external portion. Side-side flanged connections are preferred when directly connected to the vessel or to stand pipe. The minimum flange rating shall be 300#. Transmitters that require heat tracing shall be supplied with the manufacturer standard integral steam tracing jacket. Where these restrictions cannot be met, differential transmitters shall be considered.

All storage tanks shall have local level indication, readable from grade.

Generally for top mounted LT's, internal guided wave radar type instruments shall be used for level measurement up to 3000mm. Above that, non-contact type radar shall be used.

Ultrasonic or radar type level instruments shall be used for acid and alkali services. For sumps and tanks, Radar type level instruments shall be used.



Level instruments that require heat tracing shall be supplied with the manufacturer standard integral steam tracing jacket.

All level instrument process hook-ups, in the services listed below, utilizing impulse piping shall include an excess flow check valve.

This shall be located as close as possible to the isolation "root" valve. Root valves for all high-pressure ($> 60 \text{ Kg/Cm}^2$) applications shall be of double isolation type.

- In hydrogen and toxic services above 40 kg/ cm^2
- In hydrocarbon and gas services above 70 kg/ cm^2
- In services where the products are in liquid phase at process operating pressures and in the gas phase at atmospheric pressure, e.g. LPG
- In toxic product services with a threshold limit value (TLV) below 20 and where the gauges are located in confined spaces.
- All auto ignition services

Standpipe shall have isolation valves.

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Diaphragm seal D/P Level transmitters wherever used shall have process connection with minimum 300# rating, drip ring provision & with welded joint for vent & drain

DM plant and all corrosive service shall have non-contact type level instrument.

For high-pressure steam drum application, conductivity type ("Hydra step" or equivalent) level instrument is preferred, in addition to the continuous level measurement.

For solid level measurement, type of instrument shall be ultrasonic / radio frequency/ nucleonic. The actual type selection shall be carried out based on the proven track record of the selected type for the similar type of application.

In addition to Alarm in DCS, additional repeat alarms with hooter to be considered in operator cabin/room for tank levels.

Level Control System

- ☐ Local control and remote readout to control room
- ☒ Remote control from control room
- ☐ Local control



Cage / chamber

- 1) Cage/chamber shall be external mounted on the vessel /on stand pipe, process connection orientation shall be side- side & process connection shall be of 2" flanged for uncladded vessels /equipments and 3" flanged for cladded vessels/equipments, pressure rating of minimum ANSI-300#.
- 2) Probe connection of Level Transmitter shall be of 2" flanged for uncladded vessels, equipments / standpipe and 3" flanged for cladded vessels, equipments/ standpipe, pressure rating of minimum ANSI-300#.
- 3) Material of construction of Cage/ chamber shall be in accordance with associated vessel trim material specification, flange & probe shall be SS316, as a minimum. Vent and drain connection sizes for cages shall be 3/4" NPTF, vendor shall also supply drain & vent valves of 3/4" size socket weld gate valves & nipples.

The Guided Wave Radar Level Transmitter shall have Overfill protection feature

16.2.1 D/P transmitters

For slurries or other difficult services wafer/flush Diaphragm seal D/P type level transmitters shall be used for level measurement except for interface level measurement. Diaphragm material shall normally be SS316 stainless steel or any other special alloy. Response time for Diaphragm seal type transmitters shall be 3 seconds. Diaphragm seal D/P type level transmitters wherever used shall have process connection with minimum 300# rating.

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In case, condensation is expected on top connection, Diaphragm seal type DP level transmitters shall be used. Seal pot to be avoided.

Displacement type level transmitter and/ or controllers

Displacement type Transmitters shall be used only when GWR instrument is not suitable.

Guided Wave Radar Transmitters shall be used for interface level measurement. In case, Guided wave radar type is not feasible due to limitations in dielectric constant, Displacer instruments can be used.

Radar type level transmitters shall be used in place of internal displacer type wherever service is of varying density.

Preferred maximum range for these instruments is 1219 mm. For greater length and the particular service conditions required by the process, D/P transmitter shall be used.

Materials :

The following materials shall normally be used, unless other materials are required for the particular service:

Body :

- ☐ As per piping spec. or equivalent

Displacer :

- ☐ 316 S.S. or MFR STD (minimum) of better as per piping specification

Torque Tube :

- ☒ 316 SS. or MFR STD (minimum) of better as per piping specification
☐ With gold plated
☐ Inconel (at operating temperature 200 °C and above)
☐ MFR STD

Cooling fins or extensions



Cooling fins or extension shall be provided where operating temperature is above 200 °C or below 0 °C, or extension type as specified by MFR's recommendation.

Other requirements :

- ☐ ¾ in. screwed plugs for drain shall be provided unless otherwise specified.
☐ Damping adjustment for indication and output signal if possible.
☐ Specific gravity adjustment if possible

16.2.2 Tank Level gauging (As per P&ID, Generally Radar type)

- ☒ Servo

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- ☐ Mechanical Float or DP
☐ Hydrostatic
☒ Radar

16.2.3 Tank Farm Management System

Tank Farm Management

- ☒ Dedicated with communication to DCS (New / Existing)
☐ With DCS

Redundancy

- ☒ Required
☐ Not required

No. Of CRT's

- ☐ Two
☐ Three
☐ Any Other

Note:

- Tank gauging instruments of New VGO, DHDT, NHT Storage tanks shall be interfaced and integrated with existing Honeywell TFMS for BS-VI Project in SRR-823.
- Tank gauging instruments of MS Tank, Sulphur tank and Alkylate Tanks shall be interfaced with existing Emerson TFMS for MEG Project in SRR 827
- Tank gauging instruments on new PCK tanks shall be interfaced to existing Emerson TFMS in SRR-819

16.2.4 Other type Level Instruments

RF type for

- ☐ Silos
☐ Crude Desalter
 Capacitance type _____

Note: For high pressure steam drum application, conductivity type ("Hydra step" or equivalent) level instrument is preferred, In addition to the continuous level measurement.



16.2.5 Gauge Glasses

Magnetic level gauge made of Stainless Steel (non-magnetic type) shall be used for congealing, fouling, sour service and for vessel ratings above 600#.

Glass type

Gauge glasses shall generally be steel armoured reflex or transparent.

a) Reflex type shall be used where a liquid-gas interface exists and light coloured liquids, low viscosity liquids which will not make deposits on the glass.

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b) Transparent through-vision type shall be used where a liquid-liquid interface exists, on services involving dark-colored materials, viscous fluid, high pressure steam applications.

General Requirements :

Gauge glass column shall not exceed 1470 mm of visible length for single gauge

- Illuminator for transparent level gauge-Flameproof (Ex-d)
- Non-frosting type for temperature 0 °C and below
- On low temperature services with liquids having very high vapour pressure at ambient temperatures, safety valves shall be provided on the vent connection of the gauge glass.
- Protective mica shield for steam service.
- Jacket type for crystallizing fluids at ambient temperature.

Note: Transparent type with mica or Kel-F shield shall be used for treated water, boiler and condensate services and corrosive liquids which will attack glass.

Mounting style :

- Side-side
- ☐ Top bottom (In General)

Process connections :

- 2 in. flanged (on standpipe)
- ☐ ¾ in. screwed
- 2 in. flanged direct on vessel

Gauge valves :

Type:



- ☐ Conventional type
- Offset type with ball check

Accessories:

- 1/2 in. drain valve with screwed end cap.
- 1/2 in. Vent valve with screwed end cap.
- Ball check mechanism

Lead pipes between body and gauge valves :

- Welded nipple
- ☐ With union
- ☐ Screwed nipple
- ☐ Flanged (for large chamber type)
- Expansion nipple with flange (for operating temperature 300 °C and above)

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Materials :

Body :

■ As per Piping spec. or equivalent

Trim of gauge valve:

■ SS316 or MFR STD

16.2.6 Standpipe

The usage of standpipe shall be considered for clean, non-viscous and non-crystallizing services. Wherever, Standpipe, is specified by the P&ID or Licensors/Packages, for viscous and crystallizing, it shall be heat traced.

Normally, Standpipe to be avoided and individual tapping to be considered. However, if at all standpipe is used, not more than two level instruments shall be installed on a standpipe. Standpipe shall have isolation valves. However if multiple level gauge (LG) with overlapping is required to cover minimum to maximum level on single standpipe in that case more than one level gauge can be accepted as one instrument in addition to one level transmitter mounted on the same stand pipe.

Connection of standpipe from the bottom of equipment shall be avoided.

Multiple gauges shall be used for visible lengths more than 1470 mm with overlap of 250mm for gauge glasses (Top-Bottom type) and 50mm for magnetic level gauges and gauge glasses (side-side).

Master and redundant level transmitter(LT) connected to DCS shall not be mounted on same stand pipes.



Where level gauges are to be used along with transmitter, the visible length of the level gauge shall be selected to cover the complete transmitter range.

Level instruments used for ESD shall be directly mounted on vessel. Use of standpipe shall be avoided for these instruments.

DM plant and all corrosive service shall have non-contact type level instrument.

16.2.7 Guided Wave Radar Level Transmitter

- 1) The instrument shall work on the principle of Time Domain Reflectometry and shall be capable of measuring level of process fluid of dielectric constant as low as 1.9.
- 2) The type of wave guide i.e. coaxial/twin rod/single rod shall be selected by the vendor based on the specified application.
- 3) The instrument probe length shall be selected based on the minimum and maximum levels.
- 4) Guided Wave Radar shall be used for level measurement upto 2400mm and also for interface level

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measurement.

- 5) Level measured shall be independent of the temperature, pressure, specific gravity, and presence of dust/vapour. Vendor shall indicate the effect of dielectric constant, conductivity of the fluid on the level measurement.
- 6) The instrument shall meet the following performance requirement:
 - i. The accuracy inclusion of linearity, repeatability and hysteresis shall be better than ± 3 mm.
 - ii. The repeatability of level instrument shall be better than ± 3.0 mm.
 - iii. The response time (i.e. 63.2% response) shall be better than 1 second.



The Power supply shall be 24 V DC, 2-wire loop powered

16.2.8 Displacer / Float And Torque Tube

- 1) Displacer / float shall be designed to:
 - i) Consider the specific gravity of upper and lower fluids.
 - ii) Withstand maximum pressure / temperature conditions specified.
- 2) In case of internal displacer float level instruments, the design shall ensure the following:
 - i) Diameter of displacer / float is less than the internal diameter of the equipment nozzle.
 - ii) The insertion of displacer shall be field adjustable.
- 3) The level instruments (indicator / controller / transmitter) shall have torque tube design. Unless specified otherwise, torque tube material shall be Inconel as a minimum.
- 4) Level instrument in fluid temperature greater than 200°C shall be supplied with heat insulator or cooling fins.
- 5) Displacer chamber and mechanism chamber shall be separable with a flange connection in case of level transmitter.
- 6) The float shall be a 'Ball' type with a float cum shaft and lever arm having an adjustable balancing weight.
- 7) Performance Requirements
Unless specified, the performance requirements for electronic level instruments shall be as follows:
 - i) Accuracy inclusive of repeatability and hysteresis shall be $\pm 0.2\%$ of full scale.
 - ii) Repeatability of level instrument shall be $\pm 0.3\%$ of full scale.

16.2.9 Capacitive Type Level Measurement

- 1) The type of instrument probe rod or rope shall be selected by vendor based on the specified level range.
- 2) The material of construction of the probe shall be SS316/ SS316L with insulation of PTFE.
- 3) For non-metallic equipments or equipments lined internally with insulation material, probe having suitable ground reference shall be provided.
- 4) The performance specification of the level instrument shall be as follows:
The accuracy inclusive of linearity, repeatability and hysteresis shall be $\pm 0.5\%$ of the specified level

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measurement range.

16.2.9 Ultrasonic Type Level Instrument

- 1) The ultrasonic probe shall be selected based on the level measurement range.
- 2) Probe shall be selected to ensure that distance between the probe and the maximum level of interest is more than the blocking distance of the probe.
- 3) Unless otherwise specified, the instrument probe shall have 2" flanged end connection.
- 4) The material of construction of the probe shall be SS316 as minimum.
- 5) The instrument shall meet the following performance requirements:
The accuracy inclusive of linearity, repeatability and hysteresis shall be better than $\pm 0.25\%$ of measuring range

16.3 Pressure Instruments

16.3.1 Pressure Gauges

Local indication shall be by means of pressure gauges utilizing a bourdon tube, diaphragm or other element to suit the application.

For Pressure Gauges Diaphragm type shall be used where necessary to protect gauges from corrosive fluid, crystallizing fluid, fluid including solids, high viscous fluid and high vibration services. Diaphragm seals shall be of welded diaphragm type close coupled to the instrument, or connected to it with capillary tubing. The connection size for diaphragm type gauge shall be 1-1/2" flanged. The diaphragm material shall be minimum SS316 & flange material and rating shall be as per piping specification / SS 316, 300# minimum.

In case, the diaphragm seal type instrument with extended capillary is used, extended capillary tube shall be armored with stainless steel, and length shall be as determined individually but minimum 3 meters. Silicone oil filled remote capillary gauges alone shall be considered.

Ranges of gauges shall be selected such that the normal operating pressure indication is approximately at mid-scale.



All pressure gauges shall be provided with zero adjustment.

Nominal dial size

Local Gauges :	<input type="checkbox"/> 100mm	<input checked="" type="checkbox"/> 150mm
Receiver gauges:	<input type="checkbox"/> 100mm	<input type="checkbox"/> 150mm
Draft gauges (Note 1) :	<input type="checkbox"/> 100mm	<input type="checkbox"/> 150mm

Connections

Local Gauges :	<input checked="" type="checkbox"/> 1/2 in.
	<input type="checkbox"/> GA <input type="checkbox"/> BSP <input checked="" type="checkbox"/> NPT (M)

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Receiver gauges :

- ☐ 1/4 in.
☐ NPT (M)

Types

Local gauges :

- ☒ Weatherproof (IP-66)
☐ Heat proof
☐ Vibration proof
☒ Blow-out disc
☒ Solid front (for pressure ≥ 100 kg/cm² g)
☒ Safety glass
☒ Board mounted

Receiver gauges & Draft gauges : ☒ Weatherproof (IP-66)

- ☐ Indoor type

Glycerin filled gauges shall be used for pressure fluctuating services like reciprocating compressors and pump discharge etc.

Case materials:

Local gauges :

- ☐ Metallic
☐ Synthetic resin
☒ SS304

Receiver gauges :
and Draft gauges

- ☐ Metallic
☐ Synthetic resin
☒ SS304

Element materials

Local gauges :

- ☒ SS316 (Note-1)

Receiver gauges :

- ☐ Bronze
☐ SS316

Note-1: The standard measuring element shall be a bourdon tube of AISI 316 stainless steel, except where the process fluid requires the use of special material.

Protections:



Pigtail siphons shall be provided for :

- ☒ Steam service
☒ Hot vapour service of temperature above 80°C

Over range protector (gauge saver) shall be provided where a pressure gauge cannot withstand protuberant pressure due to unavoidable operation.

Pulsation dampener shall be provided for pulsating service, e.g discharge piping of reciprocating pumps, etc.

Over range protector & Pulsation dampener shall be made of minimum SS316.

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Diaphragm and flange

Connection size:

■ 3in. for D/p transmitter and 2" for Pressure transmitter. However, connections sizes shall be as per section 12.5

Materials:

Flange : ■ As per piping spec. or equivalent

Diaphragm: ■ SS316 or better depending upon the process requirement

16.4 Temperature Instruments

16.4.1 Thermowells

Thermowells for thermocouples, RTD, bi-metallic sensor and liquid/gas filled sensor shall be equipped, except where they are not available to install in the service such as tube surface, bearings of rotating machine etc.

Thermo-wells shall generally be provided for protection of the primary measuring element. Thermowells process connections shall be flanged 1-1/2" on piping and 2" on vessel/equipment ANSI, 300# rating as minimum. Well and flange material shall be SS316 minimum, However connections sizes shall be as per section 12.5

In general, immersion length of thermowells shall be as follows:

Line Size	Immersion length (When nozzle height - 200mm)
From 4" to 6"	280 mm
From 8" onwards	320 mm
Vessels / columns	400 mm

The immersion length should be between one third to two-third of the respective pipe diameter plus nozzle length.



Built-up thermowells may be considered in low pressure and low velocity services like in fired heaters and also where longer thermowell immersion length is required (for greater than or equal to 500 mm)

Offered Thermowells shall be within the vibration limit as per ASME PTC 19.3

Pipe line below 4" nominal bore shall be blown to 4" NB size to install thermowell.

Other sizes and immersion lengths may be considered based on special condition / actual requirements.

Please check Licenser requirements before finalizing the TE requirements.

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The specifications shall be as follows:

- ☒ SS316 (Barstock) minimum
- ☐ As per piping spec. (for weld type)

Connection flanges:

- ☐ As per piping spec.
- ☒ The same materials as thermowell
- ☐ ASTM-A182 F316
- ☒ Flange rating (1-1/2", 300# as a minimum).

16.4.2 Thermocouples

Standard:

- ☒ IEC 60584-2
- ☐ ANSI MC 96.1
- ☐ DIN 43710
- ☐ BS 4937

Thermocouples shall normally be spring loaded, Magnesium Oxide (MgO) mineral insulated and metal sheathed type, and the hot junction shall be ungrounded to the sheath except skin type thermocouples.

In general, duplex type thermocouple shall be used and this shall have two separate cable entries and shall be plugged with SS plug. Simplex type may be used if required by licensor.



For single element wire size shall be 18 AWG and for duplex element wire size shall be 20 AWG for most of the applications.

For ratings 900# and above, Vanstone thermowell shall be used.

The specified thermocouples such as reactor thermocouples, multipoint thermocouples, Skin thermocouples shall be as per licensor's drawings / documents provided elsewhere. Heater tube skin thermocouple, where applicable, shall meet heater design requirement and shall be provided with expansion loops.

Heater skin thermocouple shall generally be grounded and Xtracto pad type unless otherwise specified in Licensor's specification. All skin thermocouple shall be provided with heat shield assembly. For Heater thermocouples, mineral insulated Inconel 600 / SS446 sheath may be considered suitably.

Installation of thermocouples should be in such a way so that lead tube is not exposed in the direct flame of the burner. Sufficient retention clamps should be provided on unsupported portion of thermocouple lead tube.

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All thermocouple impulse lines routing shall be designed in such a way that there shall not be any vibration during vibration.

For operating temperature range 0 - 1000 Deg C, Type K (Chromel/Alumel) thermocouples generally shall be used. For operating temperature range 1000 - 1500 Deg C, or for H2 services above 750 Deg C Platinum / 10% Rhodium-Platinum thermocouples shall be used (Type S).

Type	Temperature Limit (°C)	Operating Temp. Range (°C)	Sheath	
			* Dia	** Material
R ,S	■ 0 to 1600	1000 to 1500	D	4
K	■ (-)200 to 1200	0 to 1000	C	2,3,5
E	□ (-)200 to 800	(-)200 to 700		
J	□ 0 to 750	0 to 600		
T	□ (-)200 to 350	(-)200 to 300	C	2
	□			

TABLE – I - APPLICATION OF THERMOCOUPLE

The thermocouple / RTD head shall have 3-piece union to connect head with thermowell.

Electrical properties and tolerance (class 1) shall be as per IEC-60584-2.

The specifications shall be as listed in TABLE-I, except for the multipoint elements as specified suitably to the service condition.

* Dia(mm) A : 3.1 B: 4.8 C: 6.0 D: 8.0 E: MFR. STD



** Material 1: 304S.S 2: 316 S.S 3: 347 S.S 4: Inconel 5: Inconel 600(> 600°C)

16.4.3 Resistance Temperature Detectors (RTD)

RTD (Pt 100 Ohm at 0°C) shall be considered where very narrow spans or high accuracy (Class A) (e.g temperature compensation of flow rate) are required. The applicable operating temperature range shall be (-)200 to 200°C. RTD element shall be duplex type.

The elements shall be MgO insulated and metal sheathed type and shall be of three wire system.

Standard : ■ IEC 60751 □ SAMA RC21-4
 □ DIN 43760 □ BS 1904
 Sheath diameters (mm) : □ 3.2 □ 4.8 ■ 6.0 □ 8.0
 Sheath materials : □ SS304 ■ SS316 (minimum)

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Tolerance shall be class A as per IEC 60751.

16.4.4 Temperature Transmitters

Temperature transmitters shall be Remote mounted type (on 2" Pipe), smart with HART / Foundation Field bus protocol and integral output meter. Head mounted transmitters shall not be used.

- ☒ Required (Dual channel & Dual Chamber Type)
- ☐ Not required
- ☒ For all ☐ For control, interlock and shutdown

Temperature transmitter location

- ☐ Control room
- ☐ Field (head mounted)
- ☒ Field remote mounted with local indicator

Transmitter shall have universal input for thermocouple / RTD and output 4-20mA DC/ FF for 2 wire system.

Transmitter output signal shall be linear and directly proportional to the measured temperature.

Transmitter shall have automatic cold junction compensation for thermocouples.

Burnout protection (selectable Up Scale / Down Scale) must be provided for temperature transmitters.

Temperature transmitter used for control loops shall have provision of dual sensor with auto switch over facility.

Temperature transmitters shall be used for measurement of all the temperature parameters, except for the purpose of data acquisition system (DAS).



16.4.5 Dial Thermometers

Type:

- ☒ Bimetal type
- ☒ Liquid/gas filled type with temperature compensator (where bimetal type is not suitable, only gas filled gauges shall be considered. Liquid filled system should not be used)
- ☒ (Explosion, flammable or toxic liquid/gas should not be used as the filling medium)
- ☐ Fixed angle type
- ☒ Every angle type (For Bi-Metal type only)

Indicator:

- ☐ 100mm dial
- ☒ 150mm dial
- ☒ Adjustable pointer

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Thermo bulb:

- ☐ Nickel plated brass bulb
☒ Stainless steel bulb (SS 316)
☐ Sliding union connection
☒ ½ in. ☒ NPT (M)

Capillary tube (if specified):

- ☐ Copper tube with stainless steel armor
☒ Stainless steel tube with stainless steel armour
☒ MFR STD length (approx. 5 m minimum) as a general or it suits the site conditions

Stem & case material of dial thermometer shall be 316 SS

Following standard ranges are preferred for Filled system / Bimetallic element local gauges

- -30 to +70°C
- 0 to +160°C
- 0 to +250°C
- 0 to +400°C

16.4.6 Special Thermometers

Infrared radiation thermometer, pyrometers, thermistor sensor etc. will be employed depending on the service conditions.



17. Analysers

17.1 Gas Analyser (Both Stack and Process Analyser)

On-line gas analysers as listed in TABLE I will be provided as required by the process

Table I : List of Stack and Process Analysers

S.No	Description	Requirement	Remarks
1	Stack Monitoring System required	YES	Stack CEMS Analyzer data shall be made available directly to the server located at CPCB & OPCB by data acquisition server/data loggers through leased telephone line, Cloud/internet connection.
1.1	Separate for each stack	YES	Stack flow measurement and stack analyzer requirements shall be as per statutory regulations.
1.2	Common for all stacks	YES	
2	Sample Extraction		
2.1	Hot extraction	YES	
2.2	Dilution type	YES	

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2.3	Types of Analyzer		
2.3.1	Stack Analyser		
2.3.1.1	CO-ND IR	YES	
2.3.1.2	SOx-UV Fluorescence / UV	YES	
2.3.1.3	NOx-Chemiluminescence	YES	
2.3.1.4	SPM-opacity	YES	
2.3.1.5	O2 (Stack) – Zirconia	YES	
2.3.2	Process Analyser		
2.3.2.1	HC-Thermal Conductivity or Flame Ionization	YES	
2.3.2.2	O2 (Process) – Paramagnetic or Electro chemical	YES	
2.3.2.3	H2-Thermal Conductivity or Flame Ionization	YES	
2.3.2.4	Moisture-Al2O3 probe, Vibrating crystal principle, fiber optic type or tunable laser diode Thermal Conductivity or Flame Ionization	YES	
2.3.2.5	NH3 Analyser-UV / Chemiluminescence	YES	
2.3.2.6	H2S Analyser	YES	
2.3.2.7	SO2 Analyser-UV Fluorescence	YES	
2.3.2.8	Total Sulphur Analyser- UV Fluorescence	YES	
3	Analyser Shelter		
3.1	Required	YES	
4	Shelter/Analyser Panel Location		As per area classification
4.1	Hazardous Area		
4.2	Safe Area		

Note:

1. In general Dilution type sampling to be used for all stack analysers except Oxygen Analyser where extraction type shall be used.



2.Flue gas analysers shall be TUV approved or it shall be as per EPA, USA requirement.

3. Annubar Flow element / Thermal mass flow meters shall be used for stack flow measurement.

4. Make of Analysers for SRU unit should be M/s AMETEK only if there is no specific vendor / make requirement from Licensor.

5. Analysers of new SRU-3& TGTU-2 shall be interfaced to new Analyser Management and Data Acquisition System (AMADAS).

6. Analyser system for stack emissions shall have Remote calibration facility as per CPCB guidelines for verification of Online Continuous Emission Monitoring System (OCEMS) performance i.e., data verification / validation by SPCSBs / PCCs, whenever felt necessary. The following facilities shall be available as a minimum as per CPCB directives.

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- Alarm & error messages
- Diagnostic information & data
- Real time measurement data
- Dynamic Emission Limit Values
- Remote Calibration Facility

7. On-line data monitoring of all Process and stack analysers shall be made available by interfacing to refinery LAN.

8. All required hardware/software required for connectivity to ADAS and CPCB shall be provided.

9. All the stacks shall be provided with Sox/Nox/CO/PM Analysers and its integration with CPCB and OPCB to be ensured for regulatory compliance. Review latest Gazette/guideline for provision of Analysers (and any other parameters) and its connectivity with regulatory authority.

Housing (Free-standing type):

☒ Rack ☐ Cubicle

Enclosure class:

- ☒ Explosion proof (for in-situ analysers)
- ☒ Weatherproof(for in-situ analysers)
- ☒ General Purpose (for shed mounted analysers)

Mounting location as per project requirement:

☒ Field ☒ Closed shed ☒ Open shed
☒ Walk-in type shelter

Air Conditioning as per project requirement:

☐ No need ☒ Air Conditioner ☐ Heater
☐ Cooler ☐ Ventilation fan

Features of analyser



a) Output signal TYPE

- ☒ Linearized
- ☒ 4-20mA DC (HART Protocol, if available)
- ☐ 0-10mV DC

b) Change of range: ☒ Yes ☐ No

- ☒ Manual: _____ ranges
- ☐ Remote Control: _____ ranges
- ☐ Automatic: _____ ranges

c) Zero and span Calibration:

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- ☒ Manual at field (analyser)
☐ Remote manual control
☐ Automatic remote control

d) Local Indicator: ☒ Yes ☐ No

17.2 Sample Conditioning System

Main sampling system will normally be provided by the same vendor who supplies the analyzer. The tube and parts, which are contacted with the sampling fluid, shall generally be stainless steel, unless other materials are required in consideration of the sample compositions and conditions. The same bypass shall be provided in order to purge the sample and shorten the time lag of sampling. The system shall generally be provided with pressure regulators, flow meters, filters and drainers and may have an additional heater or a chiller, so that the sample will be constant pressure and/or temperature, clean, free of mist and dust particles etc. to meet the requirement of analyzer. Samples shall be returned to a relatively low pressure return point where available such as Process pump suction, the low pressure side of pressure controlled static equipment, to closed or atmospheric drain (where suitable or environmentally acceptable), or from the point of origin using a sample pump. Where the analyser or related sample system components cannot be rated for the return pressure then the sample should be recovered using a sample recovery system.

Mounting style of main sampling system:

- ☐ Assembled as part of analyzer
☒ Separated from analyzer
☒ Free standing rack or Analyser Shelter as per Data sheet
☐ Cubicle
☐ Wall mounted

Sample connection:

- ☐ 1/4 in. ☐ 1/8 in.
☐ NPT (F) ☒ MFR STD



17.3 Other Type of Analyzer

Other type of analyzer such as moisture analyzer, SPM analysers, electro-conductivity meter, pH meter, oxidation-reduction potential analyzer, etc. will be provided where the process requires.

The Process Analysers shall be connected to the DCS which shall include the following:

Each shelter shall be provided with facility for either hooking up a portable PC with each analyser or a fixed PC with a printer in each shelter for fault analysis, calibration or as a maintenance and monitoring tool.

All process analyser shelters and all analysers shall provide 4 – 20 mA isolated output for remote indication on central DCS. Serial output may be used from analysers wherever available.

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18. Control Valves

All control valves shall be flanged type only. All flanges shall be in accordance with ANSI B16.5. The pressure ratings of all control valves and all ESD Valves shall be Piping Class valves rated in accordance with the related piping class, with a minimum Class 300 rating. Control valves shall not be used for ESD service.

ESD valves identified as SIL 2 or higher SIL level shall be subjected to Partial Valve Stroke Test.

Butterfly valves shall be double flanged. Wafer design is not acceptable. Valves up to NPS 600 mm shall be flanged to ANSI B16.5 and to ANSI B16.47 for valves larger than NPS 600 mm. All flanges shall be drilled for through bolting. Flanges which are drilled and tapped for studs are not acceptable. Gasket surface finish for raised face flanges shall be in accordance with ANSI B16.5 Para 6.4.4. Control Valve body size shall be of minimum 1". Valve body size 1 ¼", 2 ½" 3 ½" and 5" shall not be used. Valve sizing shall be as per ANSI/ISA S75.01. Manufacturer's formula may be used in order to determine the suitable size after Purchase Order.

All control valves shall be sized and selected with controllable range (20% to 80%) covering the turndown and maximum capacity of the plant. Valve sizing shall normally be based on the maximum flow x 1.3, at the coincident temperature, pressure and pressure drop conditions. Range-ability shall be checked for the anticipated minimum flow rate, which should be ≥ 20% of full stroke.

Valve travel at minimum flow rate during normal operation shall be not less than 20%. The maximum flow shall be between 60 to 80% of full stroke for equal percent trims and 50 to 80% for linear trims

The minimum size of butterfly valve shall be of 4" (100mm). Butterfly valve shall comply with API 609.



Self-acting regulator valves shall be used for local, fixed gain control of utilities, such as fuel systems and Nitrogen blanketing, and where failure action and lower precision of such devices is acceptable. The maximum size shall be 1½" (40 mm)

Notwithstanding the requirements above, the control valve body size shall not be less than half the nominal pipe size in which it is installed.

Generally, each valve trim shall be constructed from 316 SS, unless stated otherwise on the datasheet. However, the use of trim materials such as Stellite faced 316 SS, 17-4 PH, 440C, Hastelloy C, Monel or tungsten Carbide coated 316 SS etc should be considered in the following applications:

- Flashing service
- Cavitating service
- Erosive service
- Corrosive service
- Slurry service
- Wet Gas or Steam service
- Pressure drops that exceed 10 kg/cm²

For valves in cavitating service, anti-cavitation trims shall be used.

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Multi-stage trims shall be used where large differential (>40 kg/cm²) are encountered on case to case basis.

Series/ parallel labyrinth trims shall not be used on fluids that have solids in suspension with particle size > 3 microns. Where multistage trims are necessary in services where particle size is > 3 microns, a valve having a high resistance multistep axial flow trim shall be utilised. To avoid solids build-up the use of angle valves shall be given serious consideration.

Noise level measured at 1m. downstream of valve and at 1 m. distance from pipe wall shall not exceed 85 dB. Source treatment of noise shall be preferred by using special trims like low dB trim. If source treatment is not adequate to control the noise, path treatment e.g. expander and diffuser/ baffle plates shall be used at downstream of valve.

Seat Leakage shall be chosen in accordance with process requirements, safe operation of plant and shall conform to ANSI /FCI 70.2.

Control Valves connected to flare line shall be TSO(Leakage class VI).

Control Valves having SMART positioners shall be provided with Valve signatures for downloading in Instrument Asset Management System (IAMS).

For details of Control Valve specification refer 080557C- 000-JSS-1541-001.

All ESD and Depressurizing valves shall be metal seated Fire Safe Design with seat leakage rate shall not exceed ISO 5208 Rate D. Valves having soft components (stem, seat or body seals) shall be of a fire type tested design in accordance with ISO 10497 and provided with appropriate certification. For valves that have been type tested before 2005, testing in accordance with BS 6755 Part 2, ISO 10423 (API 6A) is acceptable.

Leakage for soft-seated valves shall not exceed ISO 5208 Rate A (no visible leakage). Face to face dimensions for control valves shall be as per ANSI / ISA S75.03.

Unless stated otherwise, valve closing speeds shall be:

15 – 65 mm valve size : 2 seconds



80 – 150 mm valve size : 3 – 6 seconds: dependant on size

200 – 600 mm valve size : 8 – 24 seconds: dependant on size

Valve type shall be selected taking into account such factors as operating and design conditions, fluid being handled, rangeability required, allowable leakage, noise and other special requirements.

Control valve shall normally be Globe type single seated. For clean services, guiding shall be top and bottom/ cage type. For highly viscous services, cage guiding shall be avoided.

Ball valves are preferred but where process conditions dictate (like solids in suspension, high rangeability, low pressure drop, tight shutoff), other valve body design may be employed, subject to

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approval by IOCL/PMC.

Ball support shall be by one of two methods, i.e. via trunnions or via the seats (floating). Generally, ball valves used on dirty services shall be trunnion mounted.

Butterfly valves shall be considered for services where solids in suspension, high rangeability and low pressure drop.

Angle valves shall be considered for services where flashing, coking, solids in suspension or very large pressure drops are encountered.

Bellow seal type valves shall be used for H₂S services or H₂ service or wherever specified by licensor.

On Off valves shall be as per PID and Licensor package otherwise Ball or Butterfly to be considered.

Other Special type valve shall be Angle valve, Low Noise valve, Anti-cavitation valve, Parallel slide valve,

Diaphragm valve, Three-way valve. These valves will be used if required/specified by licensor. Wherever pressure reduction is also required along with De-super heater, PRDS design shall be with separate pressure reduction valve and separate temperature valve.

Electronic motor valves are not part of this specification and specified by the Electric and the Piping if required.

In each instance, the Supplier shall select the method of ball support to suit the applicable piping classes and process conditions.



When requested on the datasheets, the Supplier shall provide those actuators with a means to protect them against the effects of fire.

Generally, protection can be provided by the use of shields, casings or intumescent coatings (e.g. K-Mass).

Low emission packing / bellow seal shall be considered, if fugitive emission is unacceptable as per the process service conditions.

Inventory isolation valves and its associated accessories shall be provided as fire safe type.

For fire safe valve with fire safe actuator, contractor shall provide fire resistant blanket / jacket, as specified in Licensor specifications. In case, the type of protection is not specified by licensor, contractor can consider fire resistant blanket / jacket type of protection. The protection system supplied shall be able to provide fire coverage of minimum half an hour of hydrocarbon pool fire to protect the valve components i.e., valve positioner, actuator and accessories like air tank, limit switch, SOV, AFT etc. Selected fire protection system should have undergone type test as per UL1709 (Hydrocarbon fire exposures) and BS 476 Part 20 for hydrocarbon fire & type test certification shall be provided for the same.

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The actuator of Motorised valves shall be certified EEx'd', suitable for Zone 1, with the Gas Group determined by the hazardous area classification in which the instrument is located. Ingress protection class shall be IP-66 as per IEC-60529 / IS-13947.

Valve Trim Characteristic

Characteristic of plug shall be selected as follows:

a) Equal percentage

- ☒ General process conditions
- ☒ Having large variations in valve pressure drop
- ☒ Split Range & Parallel control by 2 valves

b) Linear

- ☒ Minimum flow control for compressor and pump
- ☐ Split control and parallel control by 2 valves
- ☒ Small Cv and low noise valves as designated by MFR
- ☐ Having small variation in valve pressure drop
- ☐ Over pressure control in steam or gas service
- ☐ Level control
- ☐ On-off service

c) Quick opening

- ☒ On-off service

Seat leakage

The following leakage class conformed to ANSI/FCI 70-2 shall normally be applied to each type of valve.

<u>Class</u>	<u>Application</u>
<input checked="" type="checkbox"/> IV	: In General as a minimum, for Single/double ported valves, cage guided valves, Angle type valve, Butterfly valves, three way valves etc.
<input checked="" type="checkbox"/> V	: Shutoff valves or valves as determined by Licensor
<input checked="" type="checkbox"/> VI	: Soft sealed valves, shut-off valves or wherever tight shut off (TSO) is specified.
<input checked="" type="checkbox"/>	: Licensor's Specs.



Packing Glands:

- ☒ PTFE packing (Operating temp. -40 to +230 °C)
- ☒ Graphite packing (> 230°C)

Bonnets:

Operating temperature ≥ 200 °C:

- ☐ Finned bonnet
- ☐ Extension bonnet
- ☒ Bonnet type as specified by MFR's recommendation

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Operating temperature ≤ 200 °C :

- ☐ Extension bonnet
☒ Bonnet type as specified by MFR's recommendation

Severe service condition of leakage :(e. g. deadly poisonous fluid)

- ☐ Bellows seal type

Valve Actuators:

Valve actuators shall normally be of spring – diaphragm or – piston type. Spring-less piston type, electric type may be considered in special cases, if specified by the licensor. All actuators shall be adequate to fully stroke the valve under the maximum differential pressure specified by the process requirements.

The following air pressure shall normally be used to determine the actuator spring and/or the size of actuator.

- a) Without positioner : ☒ 0.2 – 1.0 kg/cm²G
- b) With positioner : ☒ Max 3.5 kg/cm²G air supply available
- c) On-off valve without positioner : ☒ Max. 3.5 kg/cm²G air supply available
- d) Maximum mechanical design pressure shall be 10 kg/cm²G.
- e) Air filter regulator with SS316 body shall be provided with sintered bronze filter with 5 micron size (max)



Hand-wheel:

Hand-wheel shall normally be provided when required by the process or the following conditions:

- ☒ No bypass line (except for shutdown valve)
☐ Used as a limit stopper of valve stroke
☒ As per P&ID

Valve Positioner:

- a) They will be provided for all control valves except the following cases:
- ☐ On-off valves
☐ 0.2 – 1.0 kg/cm² G. Spring range and having a good response time to the control signal

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b) Type of valve positioner, which is used in the remote control loop, shall be as follows:

- ☐ Electropneumatic type (for general use)
- ☒ Smart positioner (4-20 mA with HART)
- ☐ FF positioner for FF loops

c) Control valves position feedback shall be configured in the DCS with trend recording.

Auxiliary Devices:

Solenoid valve

Body material : SS316 ☒

Insulation : Type H ☒

Note : Solenoid coil shall be of epoxy-encapsulated type rated for continuous duty

Limit Switches

They shall be equipped for the following valves so as to indicate the open or closed position (Limit Switches shall be intrinsic safe proximity type)

- ☒ Emergency shutdown valves
- ☐ Batch control valves
- ☒ Control valves (if specified in P&ID)

Volume tank/Air receiver

For Depressurization valves which are designed to fail open and valves where approval has been given for double acting piston actuators, a stainless steel local air receiver shall be supplied. This shall be sized to provide at least three strokes over the full travel of the valve. Each volume tank shall be provided with Safety Valve, double Non-return Valve, Pressure Transmitter for alarm in the Control Room. They shall comply with ASME VIII requirements.



De-pressurisation valve actuators shall normally be designed to fail open, be fitted with two IS solenoid valves piped and wired to be "fault tolerant" and have discrete local reserve air cylinders.

Piston Actuators

Pneumatic piston actuators shall be used on all ESD and Depressurization valves. They may also be used, where necessary on modulating control valves, to provide longer strokes or greater thrust than is available from spring diaphragm units. They shall preferably be the single acting spring return design and sized to operate at a minimum air supply of 3.5 kg/cm².

Other auxiliary devices

A lock up relay, pilot relay, booster relay, volume tank, etc. shall be provided as parts of the actuating system in order to achieve the required stroke-speed, fail-safe action etc.

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Proximity switch feedback leading to production loss in the event of trip actuation shall be provided with dual proximity switches. This is to ensure that failure of one proximity switch does not result in production loss.

Separate field reset switch to be provided for fire case ESD valve.

Following is to be noted regarding various configurations of SOVs:

- For critical solenoid valves in safety applications which lead to complete plant shutdown: - where single SOVs are installed, multiple SOV configuration which will qualify overall SIL3 rating may be considered so that failure of one SOV does not trip the plant.
- For critical solenoid valves in safety applications which lead to complete plant shutdown: - where multiple SOVs with overall SIL3 certification are installed, the same shall be without manual bypass for the individual SOVs.
- 2oo2 solenoid valves shall be used where it is recommended by process licensor.
- TMR Solenoid valves with overall SIL3 rating may be used in supercritical applications like Dump valves.

19. Safety And Relief Valves

Sizing Basis



Safety and relief valves shall be sized in strict accordance with:

- ☒ USA Code and practice:
 - ☒ ASME SECTION I (Power Boilers)
 - ☒ ASME SECTION VIII (Pressure Vessels)
 - ☒ API RP 520, RP 526
- ☒ Indian Boiler Regulation:
 - ☐ Other

Type

The valves shall normally be of direct spring-loaded type, and provided with full nozzle type. For special service conditions, following types may be considered:

- i) Balanced bellows type:
 - ☒ Unstable back pressure (Variable back pressure more than 10% of set pressure)
 - ☒ Corrosive/ Flammable/ Toxic Fluid
- ii) Thermal relief type:
 - ☒ Thermal expansion of liquid or gas
 - ☐ Others
- iii) Vacuum relief type:
 - ☒ Storage tank

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☐ Others

iv) Pilot operated type:

- ☒ Operating pressure close to the set pressure (set pr. closer than 10% of operating pressure)
☐ Others

v) Steam jacket type:

- ☒ Crystallizing fluid at ambient temperature
☐ Others

Bonnet Construction

i) Plain closed bonnet for general service:

- ☒ Screwed cap
☒ Bolted cap
☒ Test gag
☒ Open lever (only for steam service where conforms to ASME SEC.VIII/IBR)
☐ Packed lever

ii) Exposed spring bonnet:

- ☒ For superheated steam at over 232 °C where conforms to ASME SEC I
☒ Open lever
☐ Test gag

Material

Body:

- ☒ As per piping Spec. or equivalent
☐ Trim (e.g. Dics, nozzle, etc):
☒ Anti-corrosive & erosive materials (e.g. S.S) recommended by the manufacturer (SS316 minimum)

Connections and ratings

Flanged connections :



- ☒ Yes ☐ No
☒ As per Piping Specification, if the flange is withstood against the maximum impact strength calculated by the manufacturer.

Welded connections :

- ☐ Yes ☒ No
☒ As per Piping Spec.

Screwed connections :

- ☒ Yes ☐ No
☒ As per Piping Spec.
☒ Thermal expansion relief valve
☐ 3/4in. or smaller

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Code Stamp ☒ Yes ☐ No

☒ ASME / IBR certification for safety valve where equipment needs the stamp.

Safety valve testing shall be carried out by the Contractor with the help of Test Jig provided .

20. CCTV system (With IP Base Cameras Only)

For process Units
☒ Required ☐ Not Required

For Flare
☒ Required ☐ Not Required

Plant Surveillance
☐ Required ☐ Not Required

Any Other: As per Owner/PMC Requirement

S.No	Description	Requirement	Remarks
1	CCTV Required	YES	
1.1	For Process Units	YES	
1.2	Flare, loading facility (coke yard)		
1.3	Tank Farm Area	YES	
1.4	Plant Surveillance		
2	Monitor		
2.1	Size		
2.2	Location		
2.3	Number		
2.4	Type		
3	Recording facility required		
3.1	All cameras	PTZ camera	
3.2	Selective number of points		

Note:



- Existing Monitor, Video recorder, switching matrix in SS-331S shall be utilized to interface new CCTV camera of new SRU-3& TGTU-2 units.
- Existing Monitor, Video recorder, switching matrix in SS-312N shall be utilized to interface new CCTV camera of new Storage tanks on North side of Creek.
- Existing Monitor, Video recorder, switching matrix in SS-334S shall be utilized to interface new CCTV camera of new Storage tanks on South side of Creek.

21. Fire and Gas Detectors

a) HC, H2 Detectors

Type: ☒ Catalytic diffusion for H2
☒ IR Type for HC

Output :

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- ☒ 4-20 mA DC
☐ Vendor standard

b) H2S Detector

Type

- ☒ Electrochemical
☒ Semiconductor
☐ Any Other

Output

- ☒ 4-20 mA DC
☐ Vendor standard

c) Other detectors

As per process Package



S.No	Description	Requirement	Remarks
1	Gas detectors required	YES	
1.1.1	HC detectors (Point IR type)	YES	
1.1.2	Open path type	YES	
1.1.3	H2 Detectors (Catalytic diffusion)	YES	
1.2	Toxic gas and H2S detector	YES	
1.2.1	Electrochemical	YES	
1.2.2	Semiconductor		
2	Fire detection system		
2.1	Automatic fire detection required	YES	
2.2	Plant fire detection required	YES	As per process & HSE requirements
2.3	Flame Detectors	YES	As per process & HSE requirements
3	Separate F&G LAN required		
4	F&G PLC / Monitor		
4.1	Separate F&G PLC (SIL-3)		
4.2	Plant PLC		
4.3	Plant DCS		
4.4	Separate Controller / Monitor		
5	Integration with DGFAP		

22. Hazardous Area Protection

S.NO	Description	Intrinsically safe	Flame proof	Remarks
1	Field transmitters	YES		Note-1
2	Field Switches		YES	Where applicable. Field Switches not to be used in general instead transmitters to be used.

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3	Solenoid valves	YES		SIL-3 certification required.
4	Positioners	YES		
5	Special Instruments / analyzers etc	YES		Note-1
6	Fieldbus Instrument			
6.1	IS (Entity concept) with high Power Trunk	YES		
6.2	FISCO			
6.3	FISCOIC/FNIICO			
7	Gas Detectors		YES	Minimum SIL-2 certification required.
8	Fire Detectors		YES	Minimum SIL-2 certification required.

Note:

1. As a minimum, Instruments in all areas (including safe areas) shall be intrinsically safe. If intrinsic safety is not available for any instrument type, flameproof shall be provided.

2. Field transmitters shall be used in place of switches used in process interlocks.

23. Junction Boxes

Separate junction boxes shall be used for IS and non IS signals. Further it shall be segregated based on signal types with respect to system as given below;



- Analogue input/Analogue output
- Foundation Fieldbus signal
- Thermocouple
- Digital input
- Digital output
- Power cable
- RTD
- Vibration signals
- Pulse or Frequency signals
- Gas detector signals
- Fire detection signals

In general direct cable shall be avoided, but direct cable shall be considered for pulse signals(if any).

The junction boxes shall be of die cast aluminum alloy (LM-6) body, flameproof with Ex (d) certification and weather proof as a minimum. Junction Box shall be CCOE approved, for specified hazardous area class based on gas group service. For Fieldbus cables, junction boxes shall be of SS with Increased safety (EExe) type.

Junction boxes shall have terminals suitable for the cable conductor sizes to be terminated but shall be minimum suitable for 2.5 mm² conductor size. 20% spare terminals shall be supplied in each junction box. The terminals shall be mounted on rails in the junction box. Cross ferruling philosophy to be followed for wiring.

Telephone sockets and plugs shall be provided in junction boxes.

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The cable entry to the junction boxes shall be from only from bottom for both Multipair and Branch cables. Sides and top entries are not acceptable.

Each junction box shall have minimum of 10% or 2 Nos. minimum spare entries for Branch cables and 1 no. from Bottom for main cable entry. All spare entries shall be provided with SS plugs certified suitable to use in hazardous area class.

FF JB with IS Barriers shall be located in Field. In general, the field JBs are installed at grade level. Some JBs may be installed along the walkway provided for the cable duct / tray which will ensure easy access to the JBs. This will ensure optimization of segment cable length in FF.

Junction box colour shall be as follows:

- For all IS Junction Boxes: Blue (Epoxy shade)- Inside Epoxy Yellow
- For Non IS & Power Junction Boxes: Gray (Epoxy shade)- Inside Epoxy Yellow.
- Alternatively as per Owner/PMC requirement.

S.NO	Description	Weather proof	Flame proof + Weather proof	Remarks
1	For IS instruments		YES	
2	For Flame proof instruments		YES	
3	Foundation Fieldbus JBs	YES		Increased safety (EExe) type.

Note-1: All cable entries in the junction boxes shall be from bottom.

Note-2: Foundation fieldbus junction boxes (including barriers, end connectors, cable glands and other accessories) shall be supplied by LSTK contractor.

BARRIERS

S.No	Description	Requirement	Remarks
1	Intrinsic safety barriers with 3-port active isolating type	YES	



CANOPY

S.No	Description	Requirement	Remarks
1	Material		
1.1	FRP	YES	Minimum 3mm thick
2	Canopy to be provided for		
2.1	Transmitter	YES	
2.2	JB	YES	
2.3	Temperature elements	YES	
2.4	Local panels	YES	
2.5	Positioner	YES	
2.6	Gas Detectors	YES	

24. Cable Glands

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All cable glands shall be flameproof Ex-e/Ex-d dual certified to the specified hazardous area and shall be double compression type. Cable gland and plug material shall be SS304 with Shrouds.

25. Cable Way

Main Cable way

All cables on the main pipe rack & sub pipe rack shall be laid in cable duct / cable trays. Cable ducts shall be made of G.I. sheets and shall be covered. Cable duct shall be epoxy painted.

All cables to/ from the cable duct shall run on cable trays with cover. Tray shall be made of anodized aluminium as per IS 737. Anodized Aluminium perforated cable tray shall be used upto 300 mm size.

Anodized aluminium cable tray upto 300mm width shall be used for all units except DM plant/SRU plant and corrosive services where FRP cable tray shall be used for all sizes.

Thickness of tray shall be minimum 2.0 mm for 50 mm wide tray, 3.0 mm for 100 to 400 mm wide and 4.0 mm for 500 mm wide tray.

Suitable cable clamps shall be supplied for binding the cables/tubes at every 500 mm.

The width shall be so selected that 50% of tray space is available for future use.

Structural angles used for cable dropping to Junction Box or to field device shall be preferably galvanized.

All cable ducts on main pipe rack/ other fire zone area and cable trays from JB to main cable duct inside battery limit shall be fire proofed as per OISD requirements.

a) Fire protection system shall be provided for cable ducts and cable trays using flexible mattress system.



b) The system for fire proofing of cable duct provided shall be readily removable and re-installable type on-line without the use of any elaborate procedure, need of structure and damaging the mattress used.

c) The system shall typically utilize compressed layers of asbestos free, non-toxic, non-fumable ceramic fibre combined with layers of metallic/ aluminum foil. The design selected should be able to avoid ingress of water and dust into the mattress.

d) The system supplied should be able to provide a fire coverage of minimum half an hour of hydrocarbon fire to cable ducts / trays without damaging the cable.

The following testing requirements shall be met for the offered fire proofing system with the selected thickness and density, to ensure contract performance requirements.

a) Vendor to carry out testing at CBRI or any accredited testing laboratory, as per ASTM –E 119 /UL 1724 for Hydrocarbon fire with flame temperature of 1100°C for 30 minutes.

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b) Vendor to ensure that the mattress thickness and fibre density is selected to meet the temperature in the unexposed portion of coverage to less than 100°C, which is the tolerance temperature of PVC cable .

c) The type test certificate should be part of the purchase requisition which should be forwarded to IOCL/PMC for review. The type testing should have been carried out/ witnessed either by any recognized testing authority or test house.

Cable tray laying to take care of the necessary clearance for fire proofing of structures.
Cable trench to be used only when there is no other possibility of roof/ overhead cable tray/duct e.g for Road Crossing, to route cable upto Local Panel for side entry if Panel is located at grade level.

Trench

- ☒ Concrete trench : ☒ with cover
☐ Buried cable

Trough:

- ☐ Concrete trough ☐ with cover

Branch cable way

Protected by:

- ☐ Conduit pipe:
☐ Closed conduit piping ☐ Open conduit piping
☒ Tray perforated:
☒ With cover ☐ without cover

26. Instrument Cables

26.1 Instrument signal / Power cable

Different electronic signals shall not be combined in the same multiconductor cable, Alarm and trip in the same multiconductor cable will not be allowed. Minimum conductor size of signal cables shall 1.5 sq. mm., SOV, power cable & F&G cables shall be 2.5 sq. mm minimum.

26.2 Communication cable



Size of conductors for different communication cables as follows:

- Communication system cables shall be 0.9mm diameter copper as minimum.
- Telephone system cables shall be 0.9mm diameter copper as minimum.

26.3 Direct cable

For the following signals, the cables as specified in the following Table shall normally be used and shall be directly connected without any intermediate junction box from field-instruments to terminal boards for receiver instruments in the control room.

- ☒ Power Supply
☒ Pulse signal for flow meter, speed meter etc.
☐ RTD signal

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- ☐ Analyser signal (except for 4-20 mA DC transmission)

Spare quantities of multi-conductor cables for signal lines shall be 20% as a minimum.

Note 1: All instrument signal and power cables shall be flame retardant low smoke (FRLS) Zero Halogen type except cables for ESD, emergency isolation valves, storage tank MOVs, F&G cables which shall be fire resistant, low smoke, zero halogen (LSZH) type with outer sheath colour red. For IS fire resistant cables, Colour shall be Red with light blue strip.

26.4 Cable Ferruling Philosophy

Engraved tag plates / PVC ferrules shall be used for Instruments, Junction Boxes, Panels, Cabinets and its supports.

PVC ferrules shall be used for Single and Multipair cables and also for cross ferruling.

For Instrument Impulse lines, Sampling lines and steam tracing lines, ferrules shall be sleeve type with letters and numbers neatly printed.

27. Packaged Units

Minimum spares shall be supplied as per spare parts list attached elsewhere in bid document.

28. Spare Philosophy

Minimum spares shall be supplied as per spare parts list attached elsewhere in bid document.

Maintenance Tools and tackles / Special Tools:

Equipment like calibrators, other test & measuring equipment including hand held and portable spot measurement instruments, test bench, tools, jigs and fixtures which are necessary to carry out maintenance activities shall be supplied by Contractor.



Special Tools that are recommended by Vendors, or requested in Material Requisitions as per experience of owner/ consultant, will be procured along with main Instrument / systems.

29. Instrument / Electrical Interface

All hardwired signal /cable interfaces between electrical control equipment and SRRs / RRs, except serial interface to Motor Control System, shall take place at an Instrument/Electrical Interface Cabinet (also termed as IRP - Interposing Relay Panel). IRP cabinet shall be located in the substation of respective unit.

Sufficient terminals shall be provided in the interface cabinet to allow the termination of all cores of cables entering the cabinet. This shall include a minimum of 10% spare cables and cores.

Refer to Attachment 080557C-000-STD-1540-006 for diagrammatic representation of

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interface signal requirements.

30. Post Warranty Annual Maintenance Contract

5 year maintenance contract after expiry of warranty shall be considered for package vendor's PLC, custody transfer metering systems.

31. Annexures

1. 080557C-000-STD-1540-001: Instrument Connection Details on pipes and Vessels
2. 080557C-000-STD-1540-006: Relay Contact types
3. 080557C-000-STD-1540-008: Instrument Earthing Philosophy



 	PROJECT	Standby SRU & Additional Tanks		
	CLIENT	IOCL Paradip Refinery		
INSTRUMENT CONNECTION DETAILS	Project No. 080557C001	Document No. 080557C-000-STD-1540-001	Rev. No. A	Page 1 of 4

a) INSTRUMENT CONNECTION DETAILS FOR VESSEL, STANDPIPES AND TANKS

S.NO	TYPE OF INSTRUMENTS	UNCLADDED EQUIPMENTS EQUIPMENT / STANDPIPE CONNECTION	FIRST BLOCK VALVE	CLADDED EQUIPMENTS VESSEL / STANDPIPE CONNECTION	FIRST BLOCK VALVE	INSTRUMENT CONNECTION
1	EXTERNAL DISPLACER LEVEL INSTRUMENTS ON EQUIPMENT	2" FLGD.	2" FLGD	3" FLGD	3" FLGD	2" FLGD, 300#
2	EXTERNAL DISPLACER LEVEL INSTRUMENTS ON STANDPIPE	2" FLGD.	2" FLGD	2" FLGD	2" FLGD	2" FLGD, 300#
3	EXTERNAL GUIDED WAVE LEVEL INSTRUMENT ON EQUIPMENT	2" FLGD	2" FLGD	3" FLGD	3" FLGD	2" FLGD, 300#
4	EXTERNAL GUIDED WAVE LEVEL INSTRUMENT ON STAND PIPE	2" FLGD	2" FLGD	2" FLGD	2" FLGD	2" FLGD, 300#
5	EXTERNAL MAGNETIC LEVEL INSTRUMENT ON EQUIPMENT	2" FLGD.	2" FLGD.	3" FLGD.	3" FLGD.	2" FLGD, 300#
6	EXTERNAL MAGNETIC LEVEL INDICATOR ON STANDPIPE	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD, 300#
7	EXTERNAL BALL FLOAT LEVEL INSTRUMENTS ON VESSEL	2" FLGD.	2" FLGD	3" FLGD	3" FLGD	1" SW
8	EXTERNAL BALL FLOAT LEVEL INSTRUMENTS ON STAND PIPE	2" FLGD. # (3 NOS)	2" FLGD#	3" FLGD#	3" FLGD	1" SW
9	INTERNAL DISPLACER LEVEL INSTRUMENTS	4" FLGD.	-	4" FLGD	-	4" FLGD, 300#
10	INTERNAL GUIDED WAVE LEVEL INSTRUMENT ON EQUIPMENT	4" FLGD	-	4" FLGD		4" FLGD, 300#
11	MAGNETIC LEVEL INDICATOR (INTERNAL)	4" FLGD.	-	4" FLGD.	-	4" FLGD, 300#
12	LEVEL GAUGE ON VESSEL	2" FLGD.	2" FLGD	3" FLGD	3" FLGD	2" FLGD, 300#
13	LEVEL GAUGE ON STANDPIPE	2" FLGD#	2" FLGD#	3" FLGD#	3" FLGD#	2" FLGD, 300#
14	SPECIAL LEVEL INSTRUMENTS ON EQUIPMENT (CAPACITANCE PROBE ULTRASONIC PROBE R.F. PROBE)	2" FLGD	-	3" FLGD		2" FLGD, 300#
15	D.P. INSTRUMENTS ON VESSEL	1 ½" FLGD.	1 ½" SW/BW/ FLGD	3" FLGD	3" FLGD	½" SCRD.
16	D.P. INSTRUMENTS ON STANDPIPE	1 ½" FLGD#	1 ½" SW/BW/ FLGD#	3" FLGD#	3" FLGD#	½" SCRD.
17	DIAPHRAGM SEAL D.P. INSTRUMENTS ON VESSEL	3" FLGD.	3" FLGD.	3" FLGD.	3" FLGD.	3" FLGD, 300#
18	EXTENDED DIAPHRAGM SEAL D.P. INSTRUMENTS ON VESSEL	4" FLGD.(NOTE-1)	-	4- " FLGD. .(NOTE 1)	-	4" FLGD, 300#
19	DIP TUBE LEVEL INSTRUMENTS	1 ½" FLGD.	½" SW (BY INST)	3" FLGD.	½" SW (BY INST)	½" SCRD, 300#

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 		PROJECT	Standby SRU & Additional Tanks	
			IOCL Paradip Refinery	
		CLIENT	INDIAN OIL CORPORATION LIMITED	
INSTRUMENT CONNECTION DETAILS	Project No. 080557C001	Document No. 080557C-000-STD-1540-001	Rev. No. A	Page 2 of 4

20	TANK LEVEL INSTRUMENTS (MECH.)	1 ½" FLGD	1 ½" FLGD (BY INST.)	-	-	½" SCR.D, 300#
21	TANK LEVEL INSTRUMENTS (SERVO.) ON ATMOSPHERIC TANKS	6" FLGD.	6" FLGD (BY INST.)	-	-	6" FLGD, 300#
22	TANK LEVEL INSTRUMENTS (SERVO.) FOR PRESSURISED EQUIPMENTS	6" FLGD	6" FLGD (BY INST.)	6" FLGD	6" FLGD BY INST)	6" FLGD, 300#
23	TANK LEVEL INSTRUMENTS (RADAR.) ON ATMOSPHERIC TANK (CLEAN SERVICE)	8" FLGD	-	-	-	8" FLGD, 300#
24	TANK LEVEL INSTRUMENTS (RADAR) ON ATMOSPHERIC TANKS VISCOUS SERVICE	24" FLG.	-	-	-	24" FLGD, 300#
25	TANK LEVEL INSTRUMENTS (RADAR) ON PRESSURESED EQUIPMENTS	8" FLGD	-	8" FLGD	-	8" FLGD, 300#
26	TANK LEVEL INSTRUMENTS (CAPACITANCE ULTRASONIC RF TYPE ON ATMOSPHERIC TANKS PRESSURESED EQUIPMENTS)	2" FLGD	-	3" FLGD	-	2" FLGD, 300#
27	TANK LEVEL INSTRUMENT – TUNING FORK	3" FLGD	-	3" FLGD	-	3" FLGD
28	PRESSURE INSTRUMENTS ON VESSEL	1 ½" FLGD.	1 ½" FLGD#	3" FLGD	3" FLGD	½" SCR.D.
29	PRESSURE INSTRUMENTS ON STANDPIPE	¾" SW/BW/ FLGD#	¾" SW/BW/ FLGD#	¾" SW/BW/ FLGD#	¾" SW/BW/ FLGD#	½" SCR.D.
30	CHEMICAL SEAL PRESSURE INSTRUMENT ON VESSEL.	1 ½" FLGD.	1 ½" FLGD.	3" FLGD.	3" FLGD.	½" SCR.D.
31	DIAPHRAGM SEAL PRESSURE INSTRUMENT GAUGE ON VESSEL	1 ½" FLGD.	1 ½" FLGD.	3" FLGD.	3" FLGD.	1 ½" FLGD, 300#
32	THERMOWELL ON EQUIPMENT	1 ½" FLGD.	-	3" FLGD.	-	1 ½" FLGD. / 3" FLGD, 300#
33	MULTI-POINT TEMPERATURE ELEMENTS FOR TANKS	3" FLGD	-	3" FLGD.	-	3" FLGD.
34	STAND PIPE	3" FLGD	-	3" FLGD	-	-

- NOTES:**
- 1 NOZZLE I.D SHALL BE SELECTED TO SUIT O.D OF EXTENDED DIAPHRAGM OF INSTRUMENT.
 - 2 IN CASE OF DIRECT MOUNTED FLANGED INSTRUMENTS AND WHERE FLANGED, FIRST ISOLATION VALVES, BOLTING AND GASKETS SHALL BE IN PIPING SCOPE.
 - 3 INSTALLATION OF TANK LEVEL INSTRUMENT (SERVO, MECHANICAL AND MULTIPOINT TEMPERATURE ELEMENTS ON TANKS) ARE IN TANK VENDOR SCOPE.
 - 4 NO STILL WELL IS REQUIRED FOR ATMOSPHERIC TANK. FOR PRESSURIZED EQUIPMENT AND FOR FLOATING ROOF TANK, STILL WELL SIZE SHALL BE 6" / 8".
 - 5 ANY OTHER INSTRUMENTS NOT REFERED ABOVE, THE CONNECTION DETAILS SHALL BE AS PER INDIVIDUAL REQUIREMENTS WITH APPROVAL FROM OWNER / PMC.
 - 6 # AS PER PIPING SPECIFICATION (FOR MATERIALS, RATINGS).
- INSTRUMENT CONNECTIONS ON VESSELS, STANDPIPES AND TANKS SHALL BE AS PER LICENSOR RECOMMENDATIONS.

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 		PROJECT	Standby SRU & Additional Tanks		
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b) INSTRUMENTS CONNECTION ON PIPES

(A) Pipes (Bare type)

S. NO	TYPE OF INSTRUMENTS		WHERE PIPING CLASS RECOMMENDS SCDR CONNECTION			WHERE PIPING CLASS RECOMMENDS SW/BW # CONNECTION			WHERE PIPING CLASS RECOMMENDS FLGD CONNECTION		
			PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION
1	FLOW METER	≤ 600#	1/2" SCDR*	1/2" SCDR*	1/2" SCDR	1/2" SCDR*	1/2" SW/BW#	1/2" SCDR	1/2" SCDR*	1/2" SW/BW#	1/2" SCDR
	ORIFICE	> 600#	-	-	-	3/4" SCDR**	3/4" SW/BW#	1/2" SCDR	3/4" SCDR**	3/4" SW/BW#	1/2" SCDR
2	FLOWMETER	≤ 600#	1/2" SCDR*	1/2" SW/BW#	1/2" SCDR	1/2" SCDR*	1/2" SW/BW#	1/2" SCDR	1/2" SCDR*	1/2" SW/BW#	1/2" SCDR
	VENTURI/NOZZLE	> 600#	3/4" SCDR**	3/4" SW/BW#	1/2" SCDR	3/4" SCDR**	3/4" SW/BW#	1/2" SCDR	3/4" SCDR**	3/4" SW/BW#	1/2" SCDR
3	FLOW METER	≤ 600#	1/2" SCDR*	1/2" SCDR*	3" FLGD	1/2" SCDR*	1/2" SW/BW#	3" FLGD	1/2" SCDR*	1/2" SW/BW#	3" FLGD
	ORIFICE (DIAPH.SEAL)	> 600#	-	-	-	3/4" SCDR**	3/4" SW/BW#	3" FLGD	3/4" SCDR**	3/4" SW/BW#	3" FLGD
4	FLOW METER	≤ 600#	1/2" SCDR*	1/2" SW/BW#	3" FLGD	1/2" SCDR*	1/2" SW/BW#	3" FLGD	1/2" SCDR*	1/2" SW/BW#	3" FLGD
	VENTURI/NOZZLE (DIAPH.SEAL)	> 600#	-	-	-	3/4" SCDR**	3/4" SW/BW#	3" FLGD	3/4" SCDR**	3/4" SW/BW#	3" FLGD
5	FLOW METER AVERAGE PITOT TUBE		3" FLGD	3" FLGD (BY INST)	3" FLGD+	3" FLGD	3" FLGD (BY INST)	3" FLGD	3" FLGD	3" FLGD (BY INST)	3" FLGD+
6	DIFFERENTIAL PRESSURE (DP) INSTRUMENTS		3/4" SCDR*	3/4" SCDR*	1/2" SCDR.	3/4" SW/BW#	3/4" SW/BW#	1/2" SCDR	3/4" SW/BW#	3/4" SW/BW#	1/2" SCDR
7	DIAPHRAGM SEAL D.P. INSTRUMENTS		3" FLGD.	3" FLGD.	3" FLGD.	3" FLGD.	3" FLGD.	3" FLGD	3" FLGD.	3" FLGD.	3" FLGD.
8	PRESSURE INSTRUMENTS <5>		3/4" SCDR*	3/4" SCDR*	1/2" SCDR.	3/4" SW/BW#	3/4" SW/BW#	1/2" SCDR	3/4" SW/BW#	3/4" SW/BW#	1/2" SCDR
9	DIAPHRAGM SEAL PRESSURE INSTRUMENTS (SCRD.)		3/4" SCDR*	3/4" SCDR*	1/2" SCDR.	3/4" SW/BW#	3/4" SW/BW#	1/2" SCDR	3/4" SW/BW#	3/4" SW/BW#	1/2" SCDR
10	DIAPHRAGM SEAL PRESSURE INSTRUMENTS (FLGD.)		1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.
11	THERMOWELL (Min 300#)		1 1/2" FLGD.	-	1 1/2" FLGD	1 1/2" FLGD.	-	1 1/2" FLGD	1 1/2" FLGD.	-	1 1/2" FLGD

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 	PROJECT		Standby SRU & Additional Tanks	
	CLIENT		IOCL Paradip Refinery	
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(B) Pipes (Cladded/Lined/Cemented)

S. NO	TYPE OF INSTRUMENTS		WHERE PIPING CLASS SPECIFIES CLADDIED PIPES			WHERE PIPING CLASS SPECIFIES CEMENT LINED PIPES			WHERE PIPING CLASS SPECIFIES RUBBER/TEFLON LINED PIPES		
			PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION
1	FLOW METER ORIFICE	≤ 600#	½" SCRD*	½" SCRD*	½" SCRD	½" SCRD*	½" SW/BW	½" SCRD	1" FLGD	1" FLGD	½" SCRD
		> 600#	¾" SCRD**	¾" SW/BW	½" SCRD	-	-	-	-	-	-
2	FLOW METER ORIFICE (DIAP. SEAL)	≤ 600#	½" SCRD*	½" SCRD*	3" FLGD	½" SCRD*	½" SW/BW	3" FLGD	1" FLGD	1" FLGD	3" FLGD
		> 600#	¾" SCRD**	¾" SCRD*	3" FLGD	-	-	-	-	-	-
3	FLOW METER AVERAGE PITOT TUBE		3" FLGD	3" FLGD (BY INST)	3" FLGD+	3" FLGD	3" FLGD (BY INST)	3" FLGD+	3" FLGD	3" FLGD (BY INST)	3" FLGD+
4	DP INSTRUMENTS		¾" SW/BW#	¾" SW/BW#	½" SCRD.	3" FLGD	¾" FLGD	½" SCRD	1½" FLGD	1 ½" FLGD	½" SCRD
5	DIAPHRAGM SEAL D.P. INSTRUMENTS		3" FLGD.	3" FLGD.	3" FLGD	3" FLGD	3" FLGD	3" FLGD	3" FLGD.	3" FLGD.	3" FLGD.
6	PRESSURE INSTRUMENTS		¾" SW/BW#	¾" SW/BW#	½" SCRD.	3" FLGD	¾" SW/BW	½" SCRD	1" FLGD	1" FLGD	½" SCRD
7	DIAPHRAGM SEAL PRESSURE INSTRUMENTS (SCRD)		¾" SW/BW#	¾" SW/BW#	½" SCRD.	3" FLGD	1 ½" SW/BW	½" SCRD	1" FLGD	1" FLGD	½" SCRD
8	DIAPHRAGM SEAL PRESSURE INSTRUMENTS (FLGD) <5>		1 ½" FLGD.	1 ½" FLGD.	1 ½" FLGD.	3" FLGD	1 ½" FLGD	1 ½" FLGD	1 ½" FLGD	1 ½" FLGD	1 ½" FLGD
9	THERMOWELL (Min 300#)		1 ½" FLGD.	-	1 ½" FLGD	3" FLGD	-	3" FLGD	3" FLGD	-	3" FLGD

- NOTES:** 1 FOR ANY OTHER INSTRUMENTS NOT REFERRED ABOVE, THE CONNECTION DETAILS SHALL BE AS PER INDIVIDUAL REQUIREMENT WITH APPROVAL FROM OWNER / PMC.
- 2 IN CASE OF DIRECT MOUNTED FLANGED INSTRUMENTS AND WHERE FLANGED, FIRST ISOLATION VALVE, BOLTING AND GASKETS SHALL BE IN PIPING SCOPE.
- 3 INSTALLATION OF ALL IN-LINE INSTRUMENTS SHALL BE IN PIPING SCOPE.
- 5 PRESSURE INSTRUMENTS INCLUDE PRESSURE TRANSMITTERS AND PRESSURE GAUGES.
- * SEAL WELDING REQUIRED.
- # AS PER PIPING SPECIFICATION.(FOR MATERIALS,RATINGS)
- ** STRENGTH WELD
- + CONNECTIONS FOR D.P INSTRUMENT ½" SCRD

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 		PROJECT	Standby SRU & Additional Tanks IOCL Paradip Refinery	
		CLIENT	INDIAN OIL CORPORATION LIMITED	
RELAY CONTACT TYPES	Project No. 080557C001	Document No. 080557C-000-STD-1540-006	Rev. No. A	Page 1 of 4

RELAY CONTACT TYPES

INTERFACE TYPES

- A Start or Start permissive
- B Stop or trip for 415V drives rating less than or equal to 55kW
- C Status
- D UPS/Other status
- E 4-20 mA control signal
- F 4-20 mA Indication
- G Stop or trip for 415V drives rating above 55kW


All relay coils shall be > 1000 ohms impedance and shall be fitted with diode suppression circuits. IRP relays to be rated at 5A to prevent burnout / sticking.

All relay contacts shall be suitable for the Electrical control voltage.

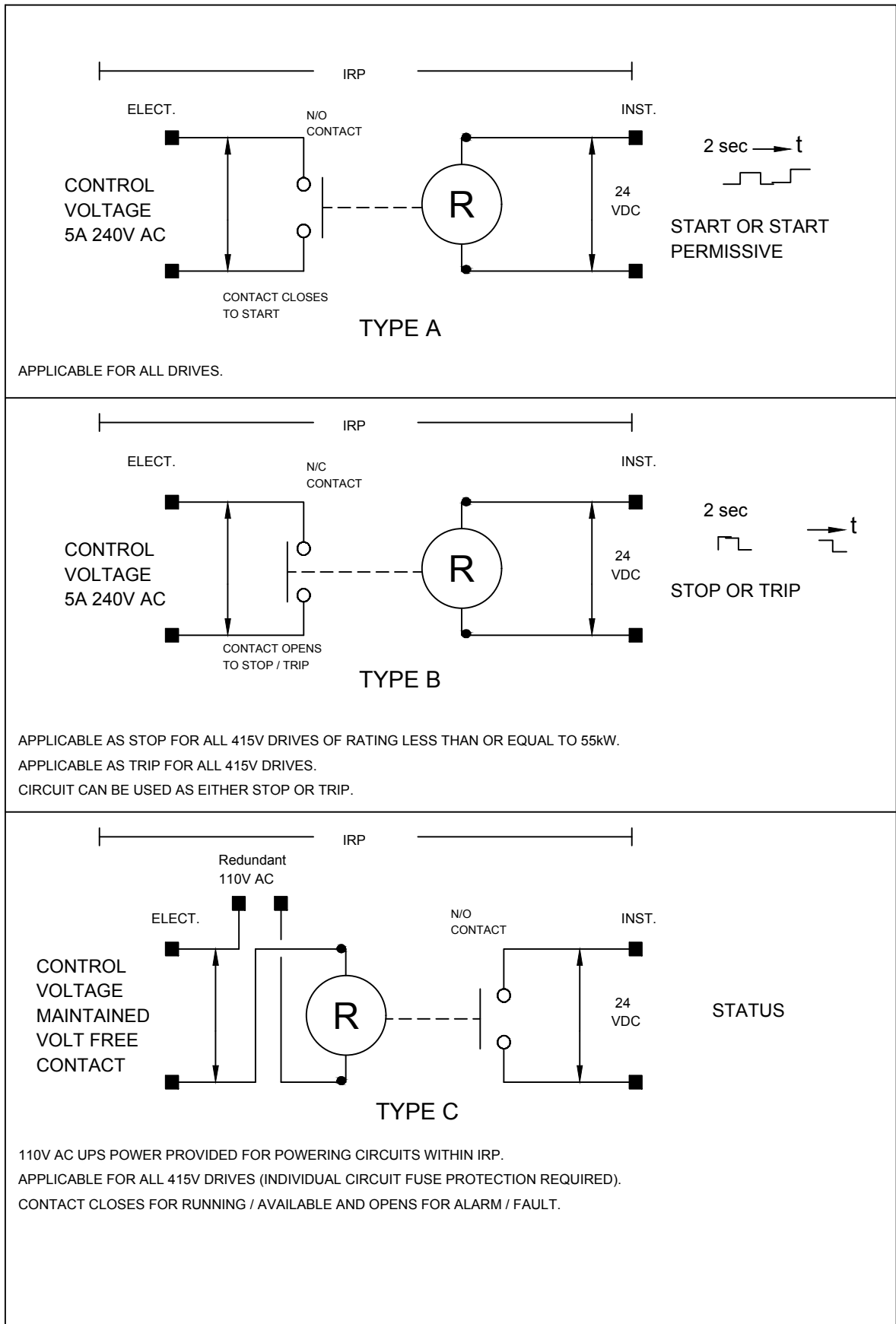
All relays shall have LED indication. All interposing relays at Instrument end shall be dual contact type only.

There shall not be any remote start/stop command from DCS/ESD unless specifically required by process and shown in P&ID. However in case of auto-start applications based on interlocks, control signals shall be sent from DCS / ESD to MCC.

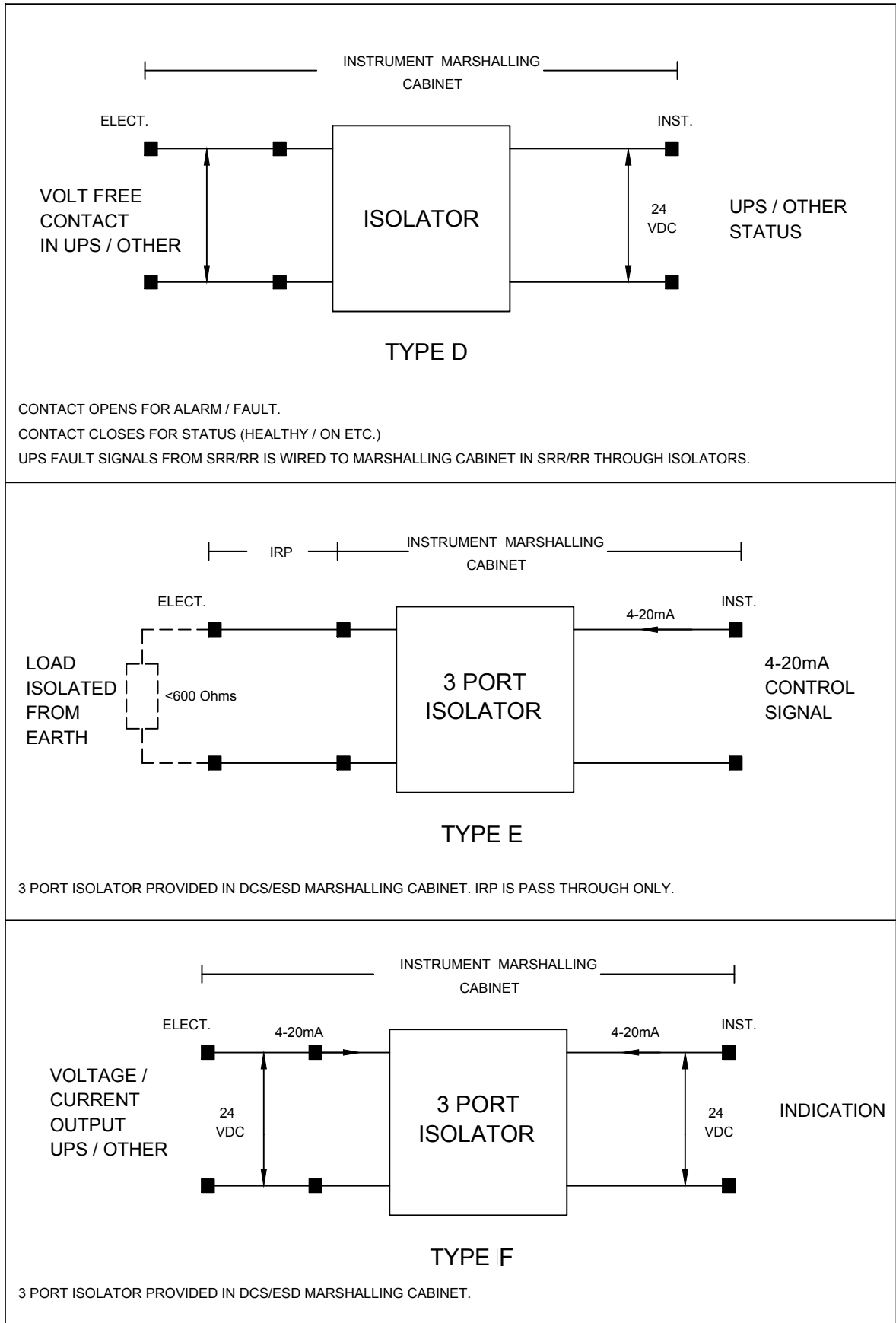
Remote stop (manual, and automatic if necessary) shall be provided for each motor/load.



 	PROJECT	STANDBY SRU & ADDITIONAL TANKS IOCL PARADIP REFINERY		
	CLIENT	INDIAN OIL CORPORATION LIMITED		
ATTACHMENT-2 RELAY CONTACT TYPES	Project No. 080557C001	Document No. 080557C-000-STD-1540-006	Rev No. A	Page 2 of 4

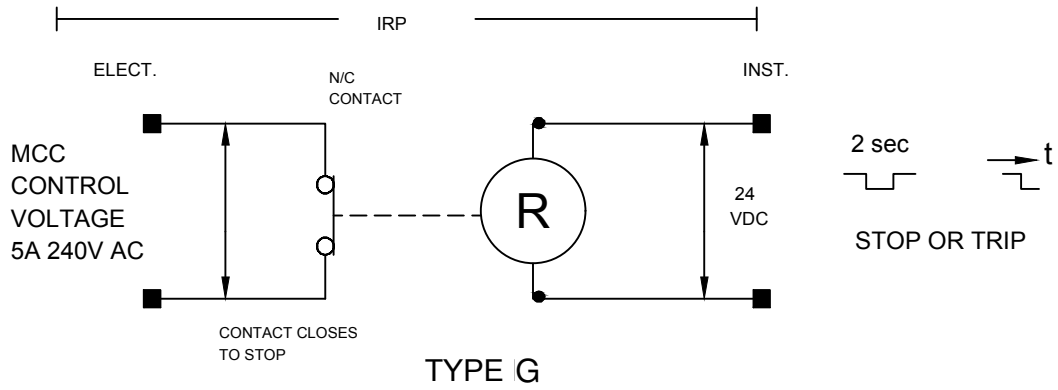
Electrical / Instrument Interface Schematics



 	PROJECT	STANDBY SRU & ADDITIONAL TANKS IOCL PARADIP REFINERY		
	CLIENT	INDIAN OIL CORPORATION LIMITED		
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 	PROJECT	STANDBY SRU & ADDITIONAL TANKS IOCL PARADIP REFINERY		
	CLIENT	INDIAN OIL CORPORATION LIMITED		
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APPLICABLE FOR LV/HV DRIVES OF RATING ABOVE 55kW ONLY.

NOTES						
1. CONNECTIONS TO THE UNIFIED EARTH BAR IS BASED ON A STAR CONFIGURATION. 2. THIS DRAWING IS A PHILOSOPHY ONLY. FOR SPECIFIC EARTHING REQUIREMENTS SEE EARTHING SCHEMATICS OR SYSTEM SUPPLIERS DOCUMENTATION. 3. CABLE SCREENS SHALL BE EARTHED AT ONE POINT ONLY. THIS SHALL BE AT THE RIB/ANALYSER HOUSE/LOCAL PANEL EARTH BARS. CONTINUITY OF THE SIGNAL SCREEN SHALL BE MAINTAINED THROUGHOUT THE CABLE RUN. 4. MINIMUM DISTANCE BETWEEN GROUND ROOFS OF DIFFERENT SYSTEMS TO BE 5 METRES (IE INSTRUMENT EARTH/OTHER EARTH SYSTEM). 5. FIELD JUNCTION BOXES TO BE DEDICATED TO ONE SIGNAL CATEGORY ONLY. 6. ON SYSTEM CABLES THE SCREEN SHALL IN ALL CASES BE TERMINATED AT THE SOCKET (AT BOTH ENDS) EARTHED AT ONE POINT ONLY. 7. ALL INTERCONNECTIONS BETWEEN EARTH BARS TO BE 35mm ² CONDUCTORS. 8. I.S. AND NON-I.S. SIGNALS/CABLES SHALL NOT BE MIXED. 9. ALL SPARE CORES WITHIN FIELD MULTICORE CABLES SHALL BE CONNECTED TO TERMINALS AT BOTH ENDS AND EARTHED DOWN AT REMOTE INSTRUMENT BUILDING TO THE INSULATED INSTRUMENT EARTH BAR. 10. ALL EARTH STUDS FOR JUNCTION BOXES, JUNCTION BOX FRAMES, ETC. SHALL BE 10mm DIA MIN. 11. INTERCONNECTION BETWEEN EARTH BARS SHALL BE DOUBLE BOLTED FOR SECURITY. 12. METAL CABLE TRAY & LADDER RACK ETC SHALL BE EARTHED BY A 35mm ² CONDUCTOR TO A FIELD SAFETY GROUND BAR AT EACH END OF RUN WHEN ADEQUATE EARTH CANNOT BE MADE VIA ADJOINING STRUCTURAL STEELWORK. COPPER WIRE BONDING JUMPER TO BE ADDED ONLY WHERE A BREAK OCCURS IN THE TRAY SYSTEM. 13. TAPE AND INSULATE NON GROUNDED ENDS OF SCREENS OF SIGNAL CABLES. 14. ALL WIRE LINK CONNECTIONS TO EARTH BARS IN EQUIPMENT CABINETS SHALL BE 10mm ² PVC COVERED CONDUCTORS GREEN/YELLOW. 15. WHERE INSTRUMENT STANDS/JUNCTION BOX FRAMES ARE PROVIDED. INSTRUMENTS/JUNCTION BOXES SHALL BE BONDED TO ADJACENT STRUCTURAL STEELWORK, WHERE ADEQUATE EARTH CONTINUITY CANNOT BE PROVIDED BY MECHANICAL CONNECTIONS. STAND/FRAME SHALL BE EARTHED BY A 25mm ² CONDUCTOR TO FIELD SAFETY GROUND. 16. GALVANIC BARRIERS MOUNTING RAIL TO BE EARTHED VIA CABINET FRAMEWORK TO NON-INSULATED SAFETY EARTH BAR. 17. ZENER BARRIERS MOUNTING RAIL TO BE INSULATED AND LINKED TO DEDICATED I.S. EARTH BAR. 18. TWO IDENTICAL 70mm ² CONDUCTORS OF EQUAL LENGTH RUN FROM UNIFIED EARTH BAR TO ELECTRODE. A FURTHER 70mm CONDUCTOR CONNECTED TO PLANT EARTH. 19. THE RESISTANCE TO EARTH FOR THE INSTRUMENT EARTH AND I.S. SHALL BE LESS THAN 10HML. 20. CABLES SHALL BE CLAMPED TO A RAIL AT THE BASE OF A CABINET. THE INSULATION AND ARMOUR IS TO BE CUT BACK AND THE ARMOUR CONNECTED TO THE NON-INSULATED SAFETY EARTH USING 25mm ² EARTH CABLE. 21. STEEL WIRE ARMOUR WILL BE EARTHED VIA A CABLE GLAND TO THE JUNCTION BOX. 22. FOR INTERCONNECTING HARDWIRED CABLES BETWEEN MCB EQUIP. ROOM AND OTHER BUILDINGS SCREEN SHALL BE EARTHED AT MCB EQUIP. ROOM ONLY. 23. EARTHING OF DATA HIGHWAYS ACCORDING TO SYSTEM SUPPLIER'S REQUIREMENTS. SCREEN EARTHED AT ONE LOCATION ONLY. 24. FIELD BUS CONDUCTORS FROM FIELD TERMINALS TO CONDITIONER BOARD ARE TO BE TWISTED PAIR. THIS IS TO BE SO EVEN IF FIELD TERMINALS AND CONDITIONER ARE IN THE SAME PANEL. 25. SYSTEM EARTH SHALL BE CHECKED BY THE RELEVANT SYSTEM VENDOR, AND CONFIRMED BY THE SAME RELEVANT SYSTEM VENDOR, THAT IT IS BELOW 1.0 OHMS (SEE NOTE 19).						
A	15/10/2019	ISSUED FOR DESIGN	EK	KRS	SS	JMC
Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
DOCUMENT CATEGORY			DOCUMENT REVIEW STATUS (BY CLIENT)			
(USE " X " MARK)						
<input type="checkbox"/> APPROVAL <input type="checkbox"/> REVIEW <input type="checkbox"/> INFORMATION						
PROJECT						
<h1 style="margin: 0;">STANDBY SRU & ADDITIONAL TANKS</h1> <h2 style="margin: 0;">IOCL PARADIP REFINERY, ODISHA, INDIA</h2>						
OWNER						
<h2 style="margin: 0;">INDIAN OIL CORPORATION LTD.</h2>						
PMC						
<p style="margin: 0;">CONFIDENTIAL. NOT TO DISCLOSE WITHOUT AUTHORISATION</p>						
TITLE						
<h2 style="margin: 0;">INSTRUMENT EARTHING PHILOSOPHY</h2>						
DRAWING NO.					PAGE	REV.
SCALE	080557C	000	STD	1540	008	1 OF 1
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.	A

INSTRUMENT CONNECTION ON VESSEL, STANDPIPES AND TANKS

6	13 02 20	REVISED AND REISSUED	MN	JJ	RG	RKT
5	10 10 19	REVISED AND REISSUED	MN	AJS	RG	RKT
4	27.01.15	REVISED AND REISSUED	MN	RKG	RG	SC
3	11 02 13	REVISED AND REISSUED	MN	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	

INSTRUMENT CONNECTION ON VESSEL, STANDPIPES AND TANKS

STANDARD No.
7-52-0001 Rev. 6
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SR. NO	TYPE OF INSTRUMENTS	UNCLADDED EQUIPMENTS		CLADDED EQUIPMENTS		INSTRUMENT CONNECTION
		EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	
1	EXTERNAL DISPLACER LEVEL INSTRUMENT ON EQUIPMENT	2" FLGD	2" FLGD	3" FLGD	3" FLGD	2" FLGD
2	EXTERNAL DISPLACER LEVEL INSTRUMENT ON STANDPIPE	2" FLGD	2" FLGD	2" FLGD	2" FLGD	2" FLGD
3	EXTERNAL GUIDED WAVE LEVEL INSTRUMENT ON EQUIPMENT	2" FLGD	2" FLGD	3" FLGD	3" FLGD	2" FLGD
4	EXTERNAL GUIDED WAVE LEVEL INSTRUMENT ON STANDPIPE	2" FLGD	2" FLGD	2" FLGD	2" FLGD	2" FLGD
5	EXTERNAL MAGNETIC LEVEL INSTRUMENT/ GAUGE ON EQUIPMENT	2" FLGD	2" FLGD	3" FLGD	3" FLGD	2" FLGD
6	EXTERNAL MAGNETIC LEVEL INSTRUMENT/ GAUGE ON STANDPIPE	2" FLGD	2" FLGD	2" FLGD	2" FLGD	2" FLGD
7	EXTERNAL BALL FLOAT LEVEL INSTRUMENT ON VESSEL	2" FLGD	2" FLGD	3" FLGD	3" FLGD	1" SW
8	EXTERNAL BALL FLOAT LEVEL INSTRUMENT ON STANDPIPE	1" SW/BW #	1" SW/BW #	1" SW/BW #	1" SW/BW #	1" SW
9	INTERNAL DISPLACER / FLOAT LEVEL INSTRUMENTS	4" FLGD	-	4" FLGD	-	4" FLGD
10	INTERNAL GUIDED WAVE LEVEL INSTRUMENT ON EQUIPMENT	4" FLGD	-	4" FLGD	-	4" FLGD
11	MAGNETIC LEVEL INSTRUMENT/ GAUGE (INTERNAL - TOP MOUNTED)	4" FLGD	-	4" FLGD	-	4" FLGD
12	LEVEL GAUGE ON VESSEL	2" FLGD	2" FLGD	3" FLGD	3" FLGD	¾" SCR.D
13	LEVEL GAUGE ON STANDPIPE	¾" SW/BW #	¾" SW/BW #	¾" SW/BW #	¾" SW/BW #	¾" SCR.D
14	SPECIAL LEVEL INSTRUMENT ON EQUIPMENT (CAPACITANCE PROBE/ULTRASONIC PROBE/R F PROBE)	2" FLGD	-	3" FLGD	-	2" FLGD
15	D P INSTRUMENT/ GAUGES ON VESSEL	2" FLGD	2" BW/FLGD #	3" FLGD	3" FLGD	½" SCR.D
16	D P INSTRUMENT/ GAUGES ON STANDPIPE	¾" SW/BW #	¾" SW/BW #	¾" SW/BW #	¾" SW/BW #	½" SCR.D
17	DIAPHRAGM SEAL D P INSTRUMENT/ GAUGES ON VESSEL	3" FLGD	3" FLGD	3" FLGD	3" FLGD	3" FLGD
18	EXTENDED DIAPHRAGM SEAL D P INSTR/ GAUGE ON VESSEL	4" FLGD (NOTE-1)	-	4" FLGD (NOTE-1)	-	4" FLGD

INSTRUMENT CONNECTION ON VESSEL, STANDPIPES AND TANKS

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SR. NO	TYPE OF INSTRUMENTS	UNCLADDED EQUIPMENTS		CLADDED EQUIPMENTS		INSTRUMENT CONNECTION
		EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	
19	DIP TUBE LEVEL INSTRUMENT	6" FLGD	½" SW (BY INST)	6" FLGD	½" SW (BY INST)	½" SCR D
20	TANK LEVEL INSTRUMENT (MECHANICAL)	1½" FLGD	1½" FLGD (BY INST)	-	-	½" SCR D
21	TANK LEVEL INSTRUMENT (SERVO) ON ATMOSPHERIC TANKS (NOTE-7)	6" FLGD	-	-	-	6" FLGD
22	TANK LEVEL INSTRUMENT (SERVO) FOR PRESSURISED EQUIPMENT (NOTE-7)	6" FLGD	6" FLGD (BY INST)	6" FLGD	6" FLGD (BY INST)	6" FLGD
23	TANK LEVEL INSTRUMENT (RADAR) ON ATMOSPHERIC TANK (CLEAN SERVICE) (NOTE-8)	8" FLGD	-	-	-	8" FLGD
24	TANK LEVEL INSTRUMENT (RADAR) ON ATMOSPHERIC TANK (VISCIOUS SERVICE)	24" FLGD	-	-	-	24" FLGD
25	TANK LEVEL INSTRUMENT (RADAR) FOR PRESSURISED EQUIPMENTS (NOTE-9)	8" FLGD	-	8" FLGD	-	8" FLGD
26	TANK LEVEL INSTRUMENT - CAPACITANCE / ULTRASONIC/ RF TYPE ON ATMOSPHERIC TANKS/PRESSURISED EQUIPMENTS	2" FLGD	-	3" FLGD	-	2" FLGD
27	TANK LEVEL INSTRUMENT - TUNING FORK	3" FLGD	-	-	-	3" FLGD
28	PRESSURE INSTRUMENT/ GAUGE ON VESSEL	2" FLGD	2" BW/ FLGD #	3" FLGD	3" BW/FLGD #	½" SCR D
29	PRESSURE INSTRUMENT/ GAUGE ON STANDPIPE	¼" SW/BW #	¼" SW/BW #	¼" SW/BW #	¼" SW/BW #	½" SCR D
30	DIAPHRAGM SEAL PRESSURE INSTRUMENT /GAUGE ON VESSEL	2" FLGD	2" FLGD	3" FLGD	3" FLGD	2" FLGD
31	THERMOWELL ON EQUIPMENT	2" FLGD	-	3" FLGD	-	2" FLGD/ 3" FLGD
32	MULTI-POINT TEMPERATURE ELEMENTS FOR ATMOSPHERIC TANKS (NOTE-10)	3" FLGD	-	3" FLGD	-	3" FLGD
33	MULTI-POINT TEMPERATURE ELEMENTS FOR PRESSURISED EQUIPMENTS (NOTE-11)	3" FLGD	-	3" FLGD	-	3" FLGD

INSTRUMENT CONNECTION ON VESSEL, STANDPIPES AND TANKS

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SR. NO	TYPE OF INSTRUMENTS	UNCLADDED EQUIPMENTS		CLADDED EQUIPMENTS		INSTRUMENT CONNECTION
		EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	
34	STANDPIPE (RATING UP TO 600#)	2"FLGD	-	3" FLGD	-	-
35	STANDPIPE (RATING > 600#)	3"FLGD	-	3" FLGD	-	-
36	LEVEL INSTRUMENT (NON CONTACT RADAR) ON PROCESS VESSELS (NOTE-6)	4" FLGD				

- NOTES:**
- 1 O D OF EXTENDED DIAPHRAGM OF INSTRUMENT SHALL BE SELECTED TO SUIT NOZZLE I D OF EQUIPMENT.
 - 2 ALL FLANGES/SW RATING SHALL BE AS PER PIPING SPECIFICATION UNLESS PROJECT SPECIFICATION REQUIRES MIN 300#
 - 3 IN CASE OF DIRECT MOUNTED FLANGED INSTRUMENTS AND WHERE FLANGED TYPE FIRST ISOLATION VALVE ARE PROVIDED, STUD/BOLTS & NUTS AND GASKETS SHALL BE IN PIPING SCOPE
 - 4 INSTALLATION OF STILL WELL OF TANK LEVEL INSTRUMENTS (SERVO, MECHANICAL AND MULTIPOINT TEMPERATURE ELEMENT) ON TANKS ARE IN TANK VENDOR SCOPE
 - 5 FOR ANY OTHER INSTRUMENTS NOT REFERED ABOVE THE CONNECTION DETAILS SHALL BE AS PER PROJECT REQUIREMENT
 - 6 4"LWN NOZZLE HAVING I/D OF 101.6 MM WILL BE CONSIDERED IN VESSEL STILLWELL SIZE (IN CASE REQUIRED) SHALL BE 4" SCH 80 WITH SS METALLURGY AND WILL BE IN VESSEL VENDOR SCOPE
 - 7 STILLWELL SIZE SHALL BE 12" SCH 40 WITH SS316 METALLURGY AND WILL BE IN TANK / EQUIPMENT VENDOR SCOPE. STILLWELL SHALL BE HAVING 20MM DIA HOLE AND EVERY HOLE TURNED 180 DEG 500mm EQUAL SPACE BETWEEN 2 HOLES FOR ENTIRE PIPE LENGHT
 - 8 8" TANK NOZZLE SHALL BE OF SS METALLURGY WITH SCH 40 AND STILLWELL SIZE SHALL BE 8" SCH 40 WITH SS316 METALLURGY AND WILL BE IN TANK / EQUIPMENT VENDOR SCOPE STILLWELL SHALL BE HAVING 20MM DIA HOLE AND EVERY HOLE TURNED 180 DEG 500mm EQUAL SPACE BETWEEN 2 HOLES FOR ENTIRE PIPE LENGHT
 - 9 STILLWELL SIZE SHALL BE 6" OR 4" SCH 40 WITH SS316 METALLURGY STILLWELL ALONG WITH FILLER FLANGE TO MATCH WITH 8" NOZZLE WILL BE IN EQUIPMENT VENDOR SCOPE STILLWELL SHALL BE HAVING 20MM OR 5 MM DIA HOLE ON ONE SIDE OF STILLWELL AND 500mm EQUAL SPACE BETWEEN 2 HOLES FOR ENTIRE PIPE LENGHT EXACT SIZE OF STILLWELL AND HOLE SIZE WILL BE FIRMED ONCE INSTRUMENT VENDOR IS FIANLISED
 - 10 STILLWELL SIZE SHALL BE 3" SCH 40 WITH SS METALLURGY / SCH 80 WITH CS METALLURGY AND WILL BE IN TANK / EQUIPMENT VENDOR SCOPE STILLWELL SHALL BE HAVING 20MM DIA HOLE AND EVERY HOLE TURNED 180 DEG 500mm EQUAL SPACE BETWEEN 2 HOLES FOR ENTIRE PIPE LENGHT
 - 11 STILLWELL SIZE SHALL BE 3" SCH 40 WITH SS METALLURGY / SCH 80 WITH CS METALLURGY AND WILL BE IN EQUIPMENT VENDOR SCOPE STILLWELL-CLOSED (WITHOUT ANY HOLES) UPTO BOTTOM (LIKE A THERMOWELL) SHALL BE PROVIDED
 - # AS PER PIPING SPECIFICATION/PROJECT PHILOSOPHY

INSTRUMENT CONNECTION ON PIPES

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
0	30.12.20	ISSUED AS JOB STANDARD	VK	JJ	AR

INSTRUMENT CONNECTION ON PIPES

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(A) BARE PIPES

S. NO	TYPE OF INSTRUMENTS		WHERE PIPING CLASS RECOMMENDS SCRD CONNECTION			WHERE PIPING CLASS RECOMMENDS SW/BW # CONNECTION			WHERE PIPING CLASS RECOMMENDS FLGD CONNECTION		
			PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION
1	FLOW METER ORIFICE	≤ 600#	½" SCRD*	½" SCRD*	½" SCRD	½" SCRD*	½" SW	½" SCRD	½" SCRD*	½" FLGD	½" SCRD
		> 600#	-	-	-	¾" SCRD**	¾" BW	½" SCRD	¾" SCRD**	¾" FLGD	½" SCRD
2	FLOWMETER VENTURI/NOZZLE	≤ 600#	½" FLGD	½" FLGD	½" SCRD	½" FLGD	½" FLGD	½" SCRD	½" FLGD	½" FLGD	½" SCRD
		> 600#	-	-	-	¾" FLGD	¾" FLGD	½" SCRD	¾" FLGD	¾" FLGD	½" SCRD
3	FLOW METER ORIFICE (DIAPH.SEAL)	≤ 600#	½" SCRD*	½" SCRD*	3" FLGD	½" SCRD*	½" SW	3" FLGD	½" SCRD*	½" FLGD	3" FLGD
		> 600#	-	-	-	¾" SCRD**	¾" BW	3" FLGD	¾" SCRD**	¾" FLGD	3" FLGD
4	FLOW METER VENTURI/NOZZLE (DIAPH.SEAL) <6>	≤ 600#	½" FLGD	½" FLGD	3" FLGD	½" FLGD	½" FLGD	3" FLGD	½" FLGD	½" FLGD	3" FLGD
		> 600#	-	-	-	¾" FLGD	¾" FLGD	3" FLGD	¾" FLGD	¾" FLGD	3" FLGD
5	FLOW METER AVERAGING PITOT TUBE		3" FLGD	3" FLGD (BY INST)	3" FLGD+	3" FLGD	3" FLGD (BY INST)	3" FLGD	3" FLGD	3" FLGD (BY INST)	3" FLGD+
6	DIFFERENTIAL PRESSURE (DP) INSTRUMENTS <5>		¾" SCRD*	¾" SCRD*	½" SCRD.	¾" SW/BW#	¾" SW/BW#	½" SCRD	¾" FLGD	¾" FLGD	½" SCRD
7	DIAPHRAGM SEAL D.P. INSTRUMENTS <5,6>		3" FLGD.	3" FLGD.	3" FLGD.	3" FLGD.	3" FLGD.	3" FLGD	3" FLGD.	3" FLGD.	3" FLGD.
8	PRESSURE INSTRUMENTS <5>		¾" SCRD*	¾" SCRD*	½" SCRD.	¾" SW/BW#	¾" SW/BW#	½" SCRD	¾" FLGD	¾" FLGD	½" SCRD
9	DIAPHRAGM SEAL PRESSURE INSTRUMENTS (FLGD.) <6>		2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.
10	THERMOWELL	≤1500#	1 ½" FLGD.	-	1 ½" FLGD	1 ½" FLGD.	-	1 ½" FLGD	1 ½" FLGD.	-	1 ½" FLGD
		>1500#	2" FLGD.	-	2" FLGD	2" FLGD.	-	2" FLGD	2" FLGD.	-	2" FLGD

INSTRUMENT CONNECTION ON PIPES

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
(B) CLADDED\CEMENTED\LINED PIPES

S. NO	TYPE OF INSTRUMENTS		WHERE PIPING CLASS SPECIFIES CLADDED PIPES			WHERE PIPING CLASS SPECIFIES CEMENT LINED PIPES			WHERE PIPING CLASS SPECIFIES RUBBER/TEFLON LINED PIPES		
			PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION
1	FLOW METER ORIFICE	≤ 600#	½" SCR D*	½" SCR D*	½" SCR D	½" SCR D*	½" SW/BW	½" SCR D	1" FLGD	1" FLGD	½" SCR D
		> 600#	¾" SCR D**	¾" SW/BW	½" SCR D	-	-	-	-	-	-
2	FLOW METER ORIFICE (DIAPHRAGM SEAL)	≤ 600#	½" SCR D*	½" SCR D*	3" FLGD	½" SCR D*	½" SW/BW	3" FLGD	1" FLGD	1" FLGD	3" FLGD
		> 600#	¾" SCR D**	¾" SCR D*	3" FLGD	-	-	-	-	-	-
3	FLOW METER ++ AVERAGING PITOT TUBE		3" FLGD	3" FLGD (BY INST)	3" FLGD+	3" FLGD	3" FLGD (BY INST)	3" FLGD+	3" FLGD	3" FLGD (BY INST)	3" FLGD+
4	DP INSTRUMENTS <5>		¾"SW/BW#	¾"SW/BW#	½" SCR D.	3" FLGD	¾" FLGD	½" SCR D	1½" FLGD	1 ½" FLGD	½" SCR D
5	DIAPHRAGM SEAL D.P. INSTRUMENTS <5,6>		3" FLGD.	3" FLGD.	3" FLGD	3" FLGD	3"FLGD	3" FLGD	3" FLGD.	3" FLGD.	3" FLGD.
6	PRESSURE INSTRUMENTS <5>		¾"SW/BW#	¾"SW/BW#	½" SCR D.	3" FLGD	¾"SW/BW	½" SCR D	1" FLGD	1" FLGD	½" SCR D
7	DIAPHRAGM SEAL PRESSURE INSTRUMENTS (FLGD) <5,6>		2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.
8	THERMOWELL		3" FLGD.	-	3 " FLGD	3" FLGD	-	3" FLGD	3" FLGD	-	3" FLGD

- NOTES:**
- FOR ANY OTHER INSTRUMENTS NOT REFERRED ABOVE THE CONNECTION DETAILS SHALL BE AS PER INDIVIDUAL REQUIREMENT.
 - ALL FLANGES/SW RATING SHALL BE AS PER PIPING SPECIFICATION.
 - IN CASE OF DIRECT MOUNTED FLANGED INSTRUMENTS AND WHERE FLANGED FIRST ISOLATION VALVE ARE PROVIDED, STUD/BOLTS & NUTS AND GASKETS SHALL BE IN PIPING SCOPE.
 - INSTALLATION OF ALL IN LINE INSTRUMENTS SHALL BE IN PIPING SCOPE.
 - PRESSURE INSTRUMENTS INCLUDE PRESSURE TRANSMITTERS AND PRESSURE GAUGES.
 - * SEAL WELDING REQUIRED.
 - # AS PER PIPING SPECIFICATION.
 - ** STRENGTH WELD.
 - + CONNECTIONS FOR D.P. INSTRUMENT ½" SCR D.
 - ++ WELDOLET, FLANGE, BOTTOM SUPPORT SHALL BE SUPPLIED BY INSTRUMENT VENDOR. HOWEVER ERECTION BY MECHANICAL CONTRACTOR.
- 6 RATING OF FLANGED ISOLATION VALVE FOR THE INSTALLATION OF DIAPHRAGM SEAL SHALL BE MINIMUM 300#.
- 7 ALL INSTRUMENT ROOT VALVES SHALL BE DOUBLE BLOCK & BLEED TYPE.

 		PROJECT	Standby SRU & Additional Tanks IOCL Paradip Refinery		
		CLIENT	INDIAN OIL CORPORATION LIMITED		
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ORIFICE PLATES, FLANGES AND THERMOWELL DIMENSIONAL DETAILS

			 <small>Written By</small> <small>Gandhag Subramanian</small> <small>2020.06.11</small> <small>18:37:18 +05'30'</small>	 <small>Checked By</small> <small>Shyam Sunder</small> <small>2020.06.11</small> <small>18:37:18 +05'30'</small>	 <small>Approved By</small> <small>Suman Sarikatsanjanjan</small> <small>2020.06.11 12:03:07</small> <small>+05'30'</small>	 <small>Authorized By</small> <small>Moushmitogher Jaisankar</small> <small>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
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED

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1. INTRODUCTION:

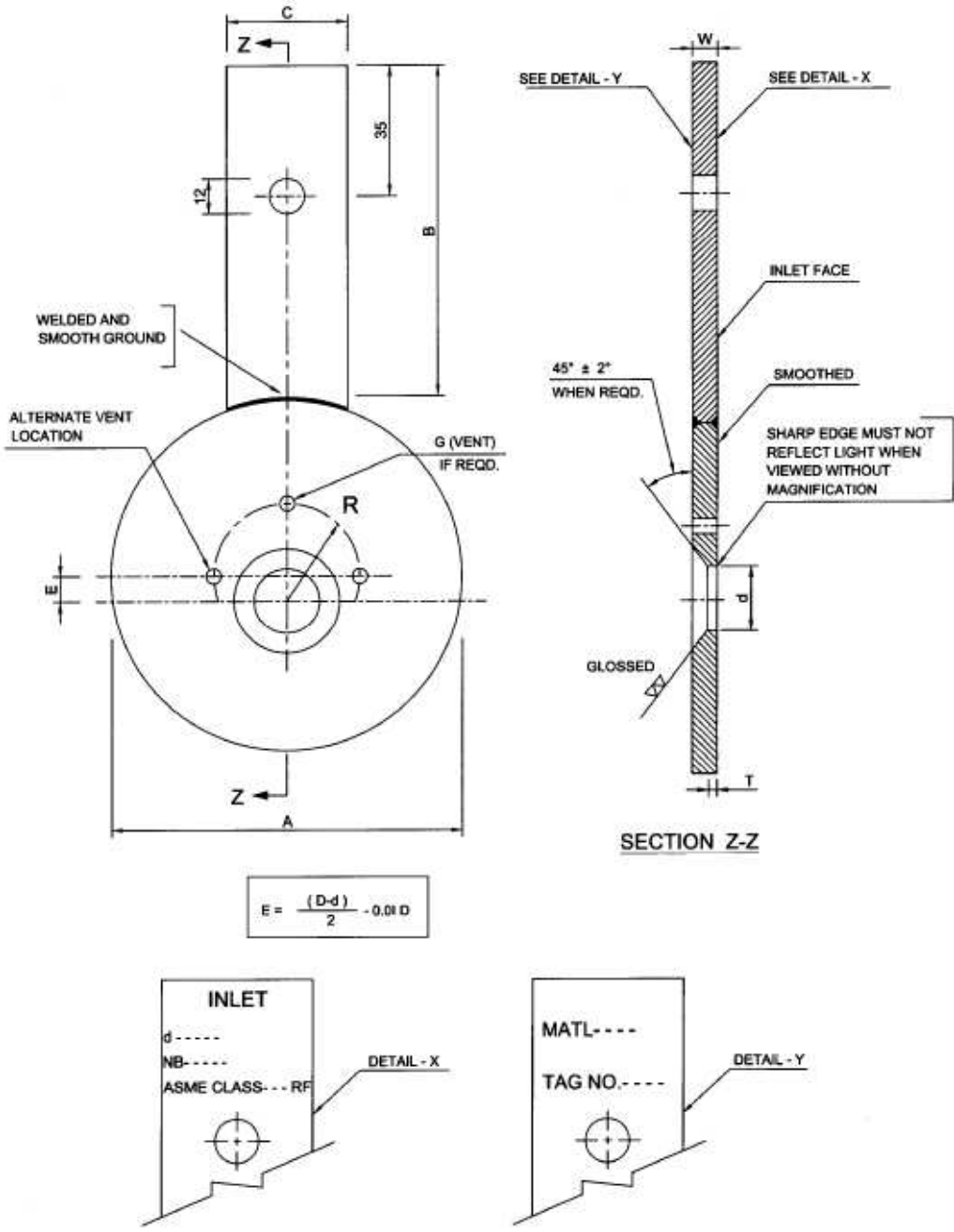
INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, 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		
				IOCL Paradip Refinery		
			CLIENT	INDIAN OIL CORPORATION LIMITED		
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3.2 ECCENTRIC ORIFICE PLATE

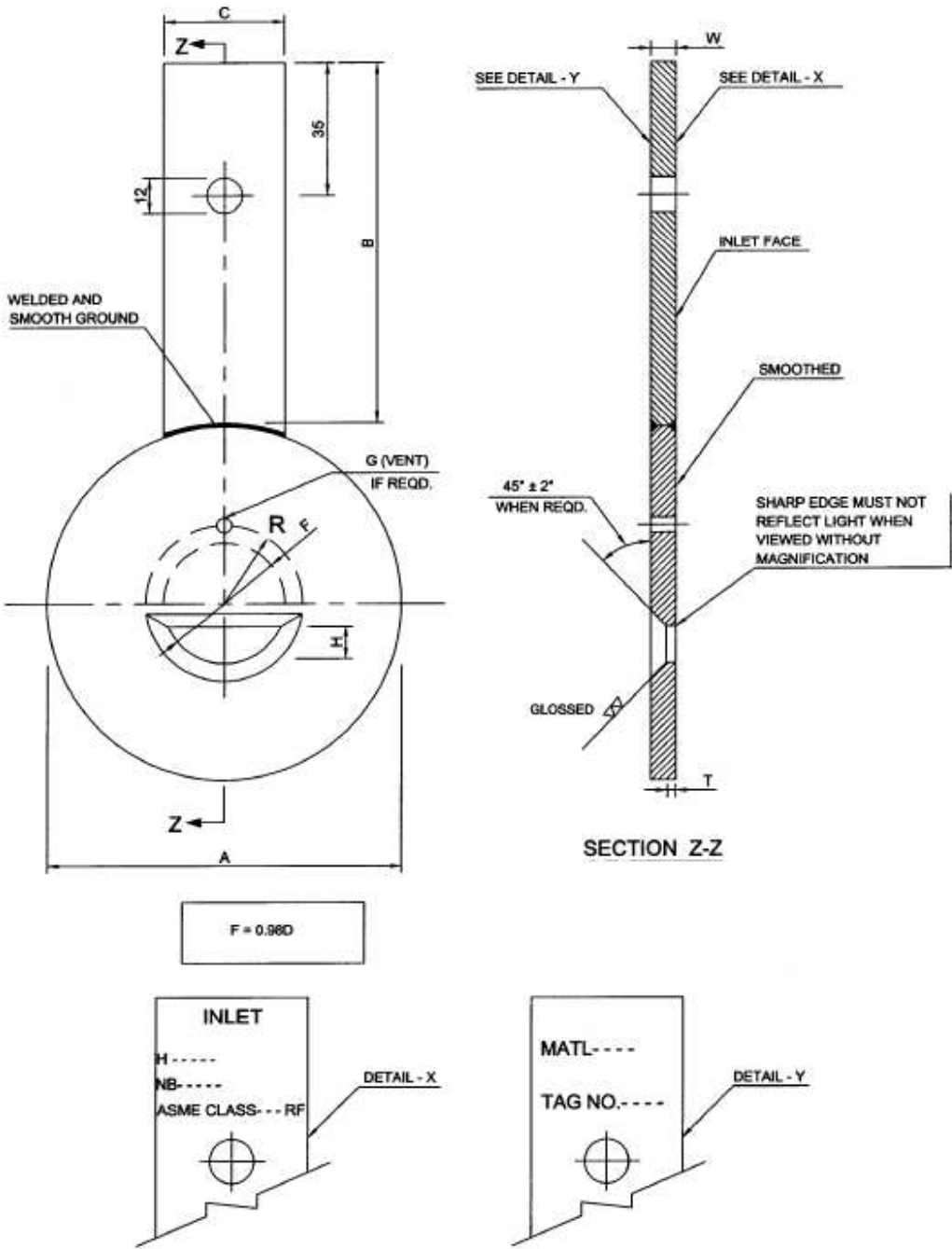


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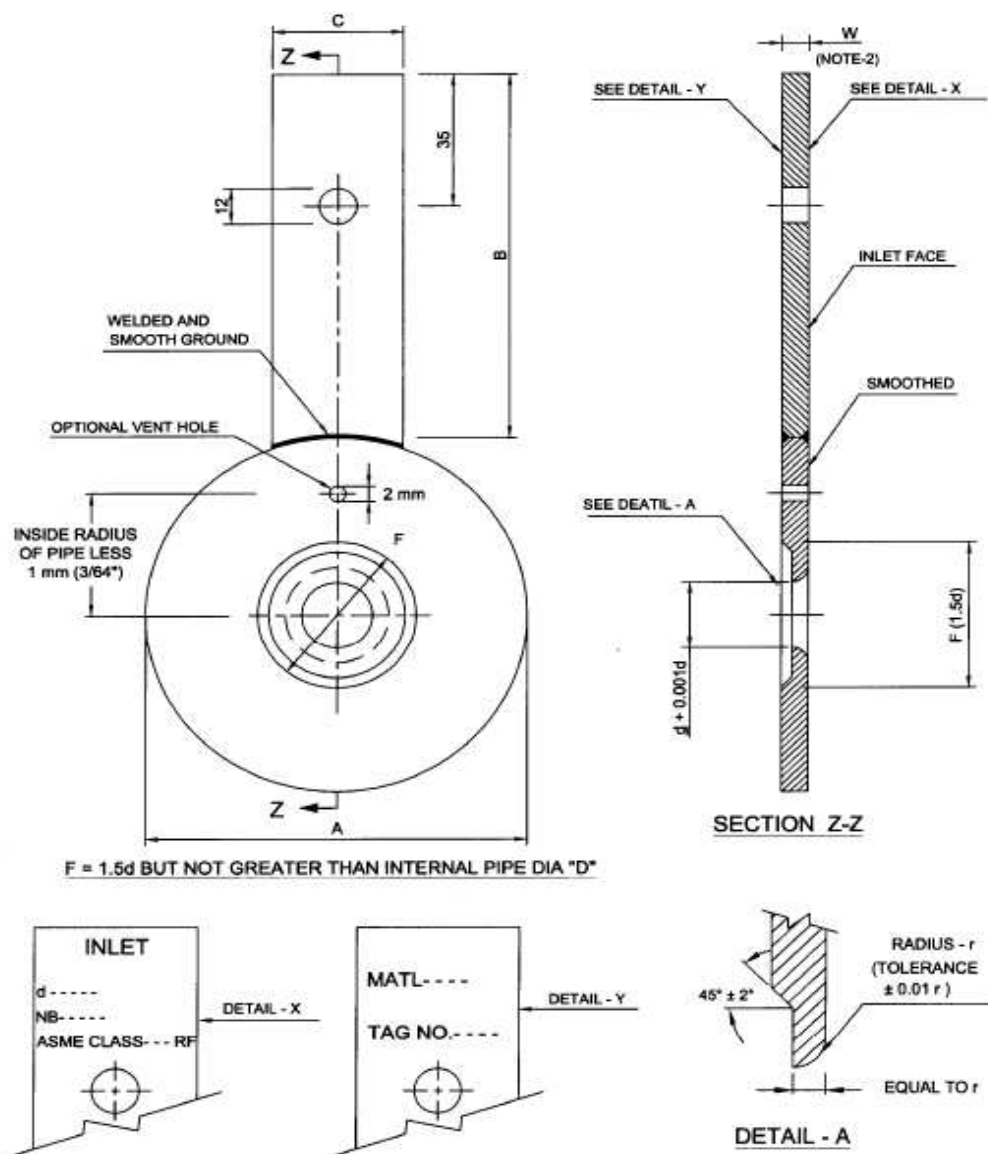
3.3 SEGMENTAL ORIFICE PLATE



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3.4 QUADRANT EDGE ORIFICE PLATE



NOTE:

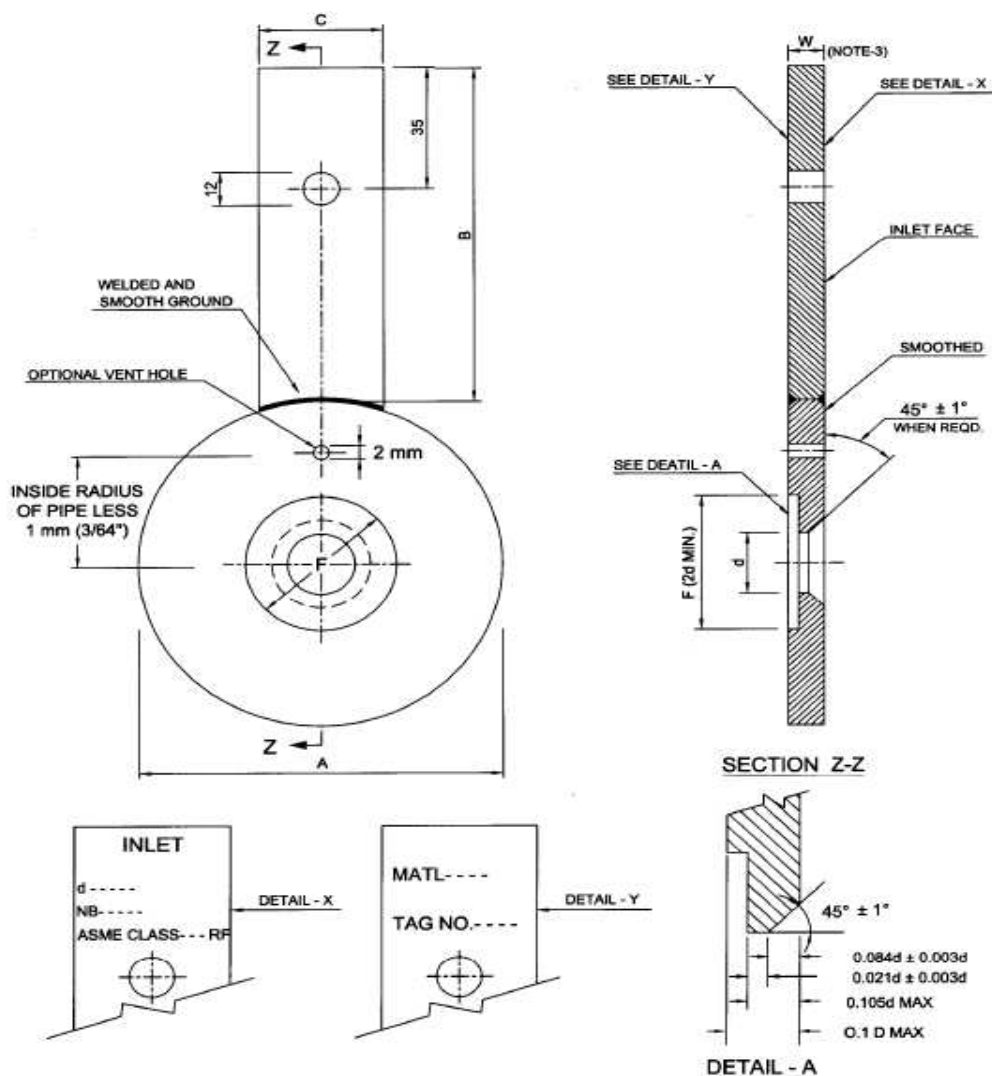
1. DIMENSIONS A, B, C ARE SAME AS SQUARE EDGE ORIFICE PLATES.
2. 'W' SHALL NOT BE LESS THAN 2.54 mm AND SHALL NOT EXCEED 0.1D WHERE THE RADIUS 'r' OF THE UPSTREAM PROFILE EQUALS OR EXCEEDS 0.1D (WHERE IS THE CASE WHEN $\beta \geq 0.571$ OR $m \geq 0.325$), 'W' SHALL BE REDUCED FROM 'r' TO 0.1D BY REMOVING 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	
125# 150#	250# 300#	400#	600#	900#	1500#	2500#									
mm	Inch														
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	158	40	
200	(8)									
250	(10)									
300	(12)									
350	(14)									
400	(16)		114	114	127	127	152	50		
450	(18)									
500	(20)									
550	(22)									
600	(24)									

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			PROJECT	Standby SRU & Additional Tanks	
				IOCL Paradip Refinery	
			CLIENT	INDIAN OIL CORPORATION LIMITED	
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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

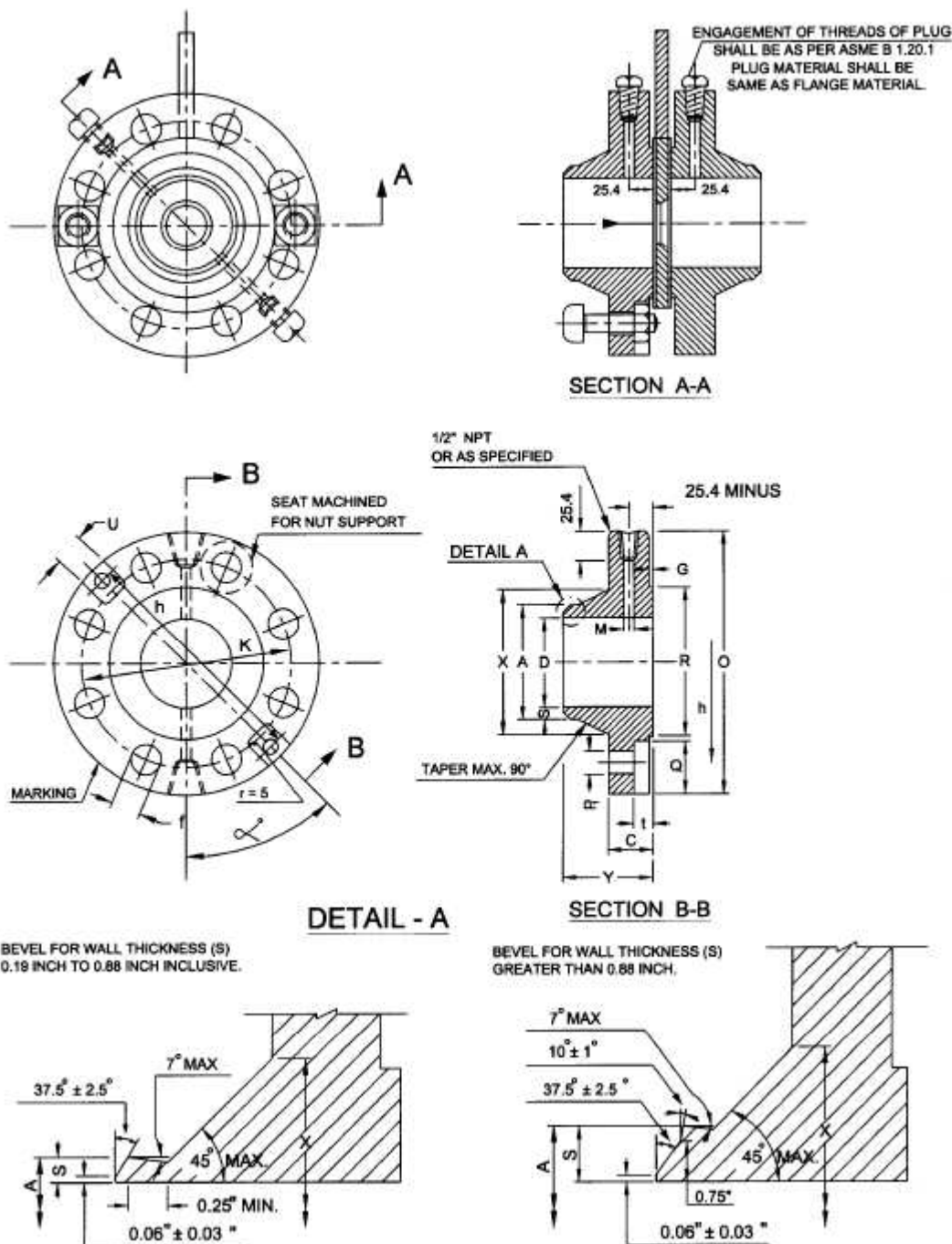
Note:

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: -

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



		PROJECT	Standby SRU & Additional Tanks		
			IOCL Paradip Refinery		
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3.7 WELD NECK, RAISED FACE ORIFICE FLANGES



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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 ₁	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

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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 ₁	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			

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

Flange		A	X	O	K	C	Y	f	R	G	No. of Bolt Holes	M	h	P ₁	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 ₁	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 1/2)	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#
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	± 1.59 *
	$>$ 609.6 mm	± 3.18 *
C	NB \leq 450 (18)	+ 3.18 - 0
	NB $>$ 450 (18)	+ 4.76 - 0
X	\leq 609.6 mm (24)	± 1.59 *
	$>$ 609.6 mm (24)	± 3.18 *
A	NB \leq 125 (5)	+ 2.38 - 0.79
	NB \geq 150 (6)	+ 3.96 - 0.79
Y	NB \leq 250 (10)	± 1.59
	NB \geq 300 (12)	± 3.18
Drilling	K	± 1.59
	Centres between holes	± 0.79
R	FOR G = 1.6 mm	± 0.79
	FOR G = 6.4 mm	± 0.40
Eccentricity between K & R diameters		± 0.79
Eccentricity between K & D diameters		± 0.79 *
Eccentricity between R & D diameters		± 0.79 *
D	NB \leq 150 (6)	± 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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		PROJECT	Standby SRU & Additional Tanks		
		CLIENT	INDIAN OIL CORPORATION LIMITED		
ORIFICE PLATES FLANGES AND THERMOWELL DIMENSIONAL DETAILS	Project No. 080557C001	Document No. 080557C-000-STC-1580-005	Rev. No. B	Page 17 of 24	

3.13 STUD BOLTS DETAILS FOR RAISED FACE FLANGES

DIMENSIONS AS SHOWN

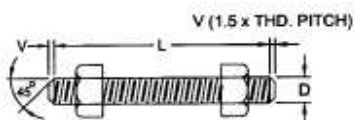
THREAD : ASME B 1.1

FOR D" ≤ 1 - UNC - 2A

FOR D" ≥ 1 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
≥ 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)	185	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	≤ 305	310 TO 455	≥ 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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		PROJECT	Standby SRU & Additional Tanks		
		CLIENT	INDIAN OIL CORPORATION LIMITED		
ORIFICE PLATES FLANGES AND THERMOWELL DIMENSIONAL DETAILS	Project No. 080557C001	Document No. 080557C-000-STC-1580-005	Rev. No. B	Page 18 of 24	

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

DIMENSIONS : ASME B 18.2.1

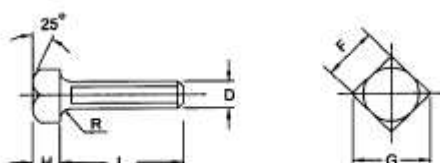
CONSTRUCTION : FORGED, BAR STOCK

TOLERANCES : ASME B 18.2.1 ASME B 1.1

THREAD : ASME B 1.1

FOR $D^* \leq 1$ - UNC - 2A

FOR $D^* \geq 1 \frac{1}{8}$ - 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

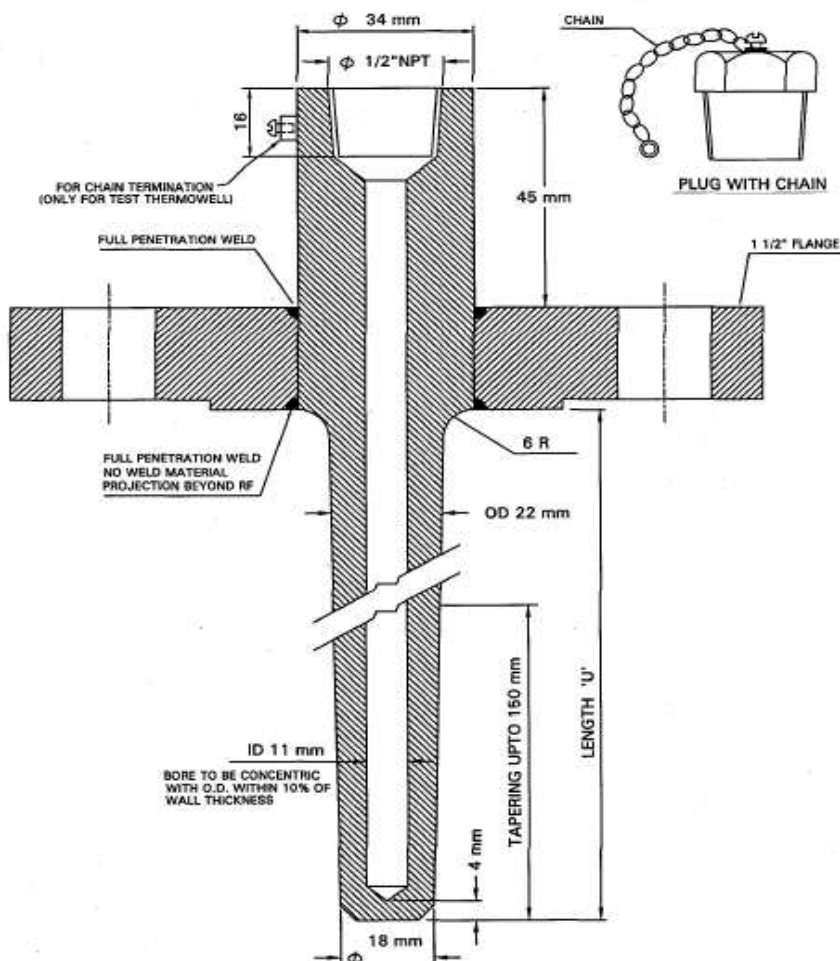
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		PROJECT	Standby SRU & Additional Tanks		
		CLIENT	IOCL Paradip Refinery		
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4. THERMOCOUPLE / RTD ASSEMBLY WITH THERMOWELL

4.1 THERMOWELL FOR DUPLEX ELEMENT



NOTES:

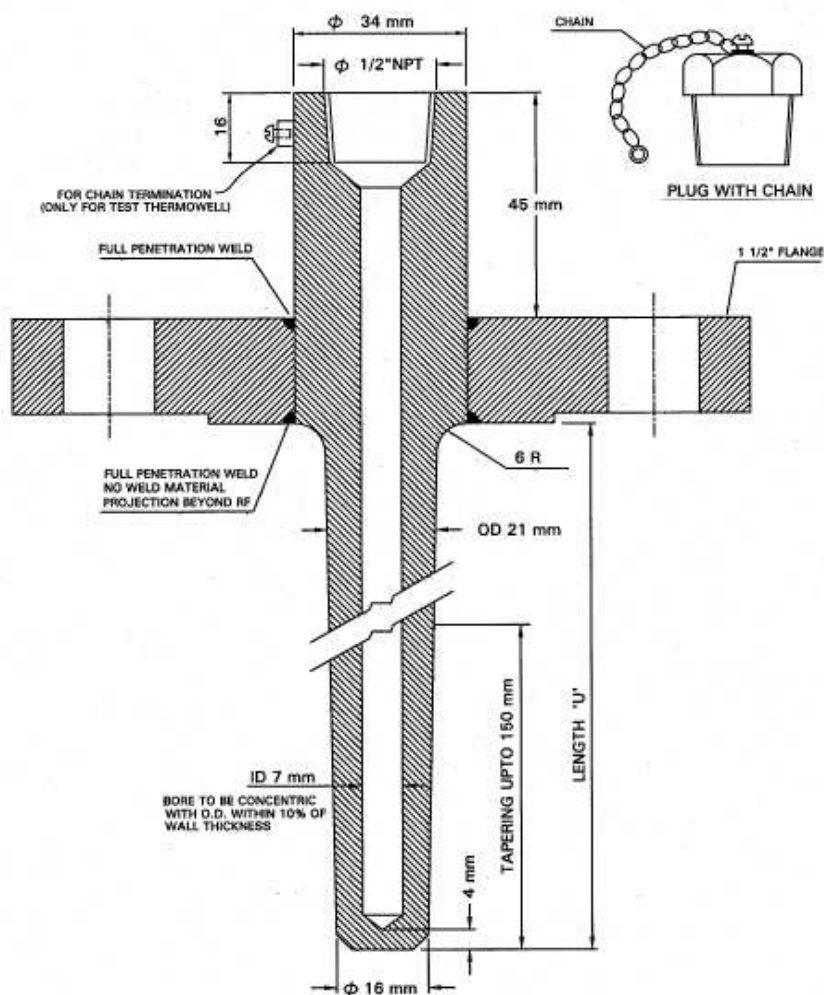
- THIS STANDARD IS APPLICABLE FOR;
 - TEMPERATURE GAUGES, BEADED TEMPERATURE ELEMENTS AND DUPLEX TEMPERATURE ELEMENT.
 - THERMOWELL UPTO 1500# ANSI RATING OR EQUIVALENT.
- TYPE OF FLANGE SHALL BE RTJ TYPE FOR ANSI RATING > 600#.
- DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS.
- CHAIN AND PLUG SHALL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

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		PROJECT	Standby SRU & Additional Tanks		
		CLIENT	INDIAN OIL CORPORATION LIMITED		
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4.2 THERMOWELL

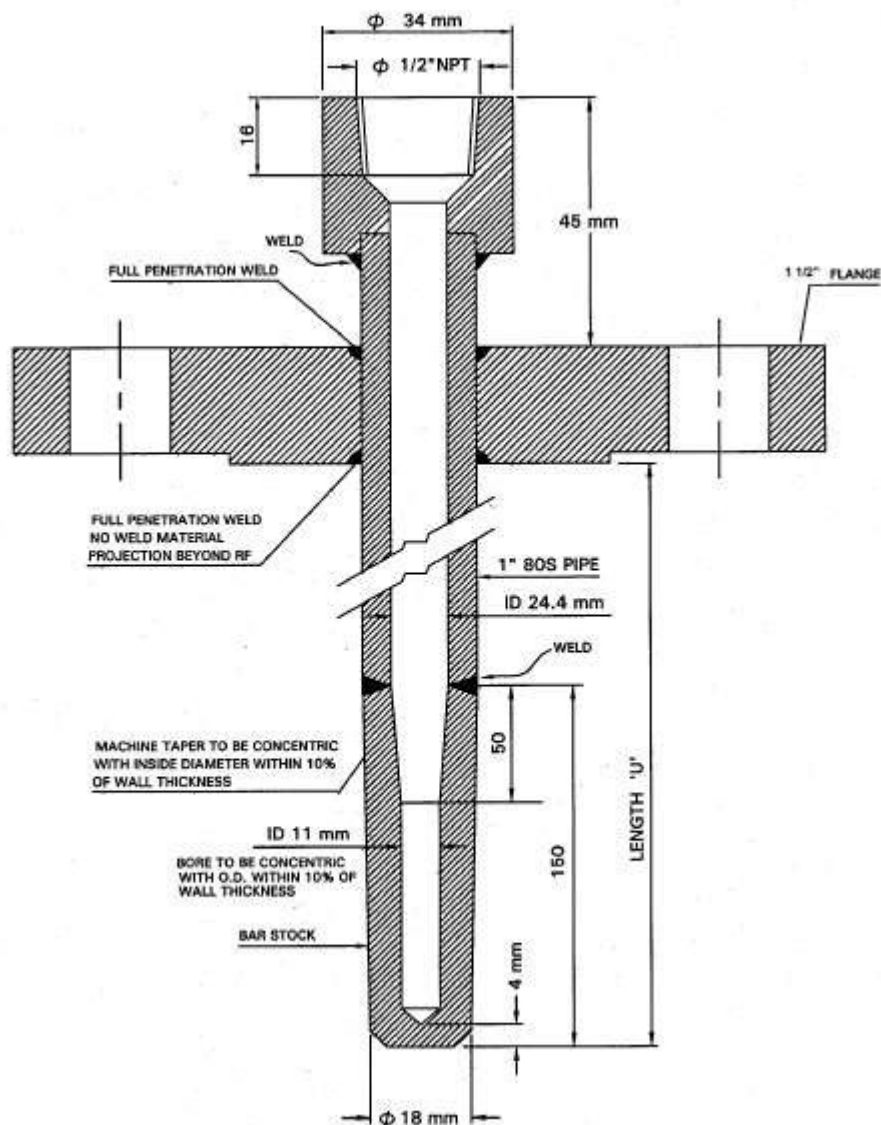


NOTES:

- 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.

		PROJECT	Standby SRU & Additional Tanks		
		CLIENT	INDIAN OIL CORPORATION LIMITED		
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4.3 BUILT-UP THERMOWELL



NOTES:

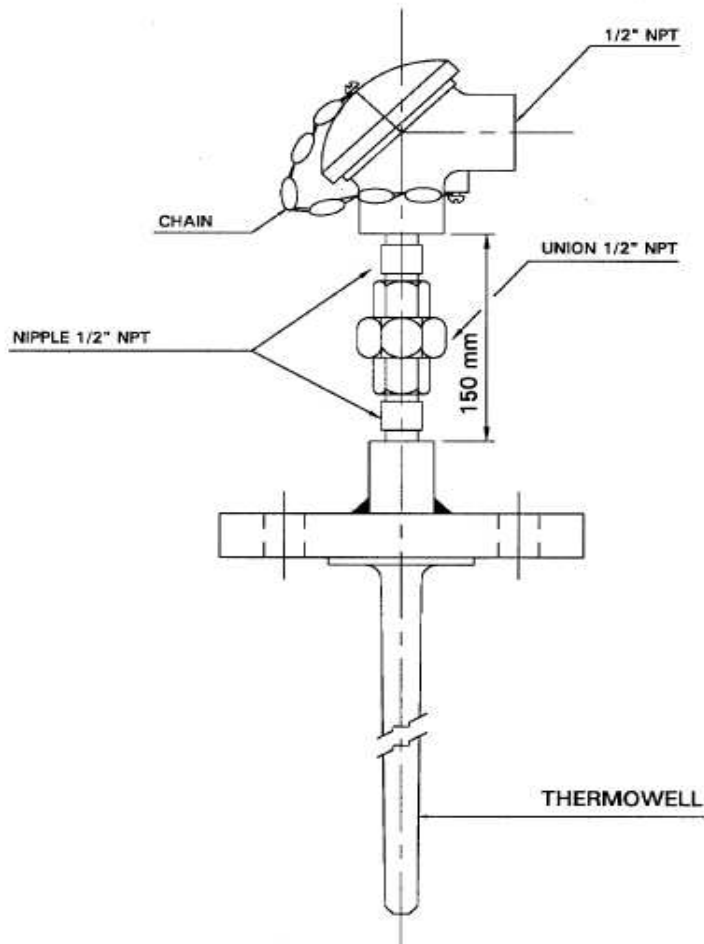
1. TYPE OF FLANGE SHALL BE RTJ TYPE FOR ANSI RATING > 600#.
2. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS.

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 	PROJECT		Standby SRU & Additional Tanks	
	CLIENT		INDIAN OIL CORPORATION LIMITED	
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4.4 THERMOCOUPLE / RTD ASSEMBLY WITH THERMOWELL

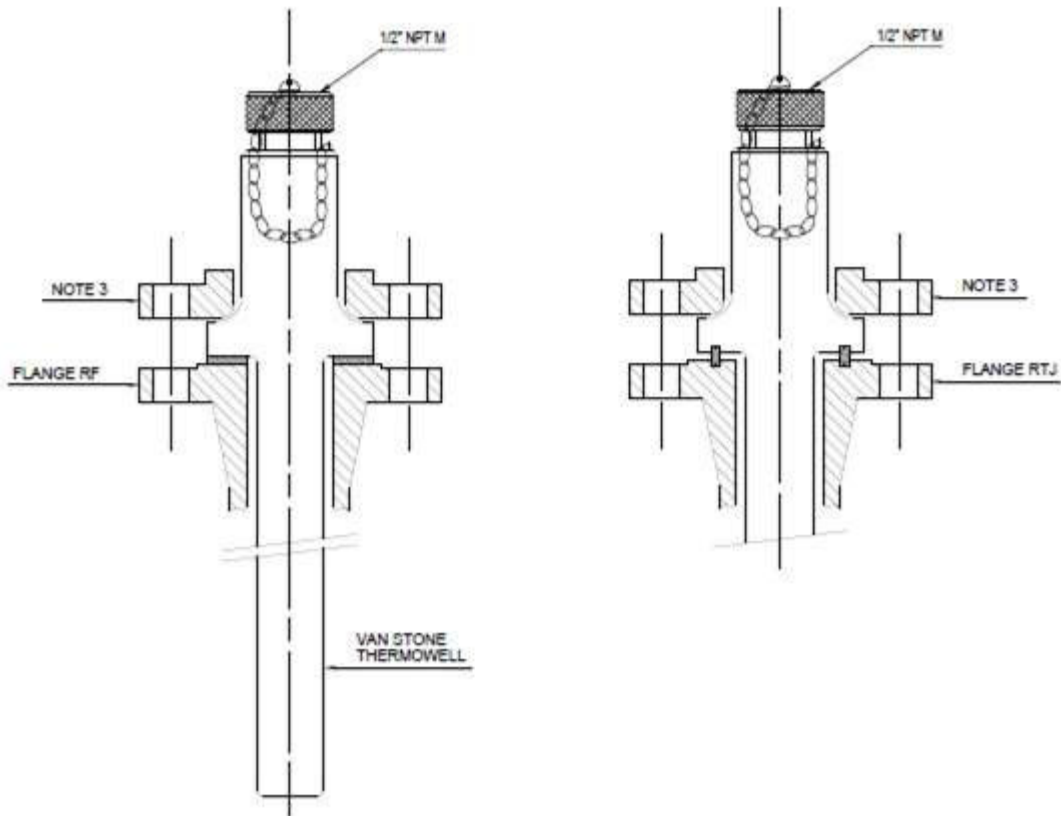


NOTES:

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

			PROJECT	Standby SRU & Additional Tanks IOCL Paradip Refinery	
			CLIENT	INDIAN OIL CORPORATION LIMITED	
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4.5 VAN STONE THERMOWELL (>600#)

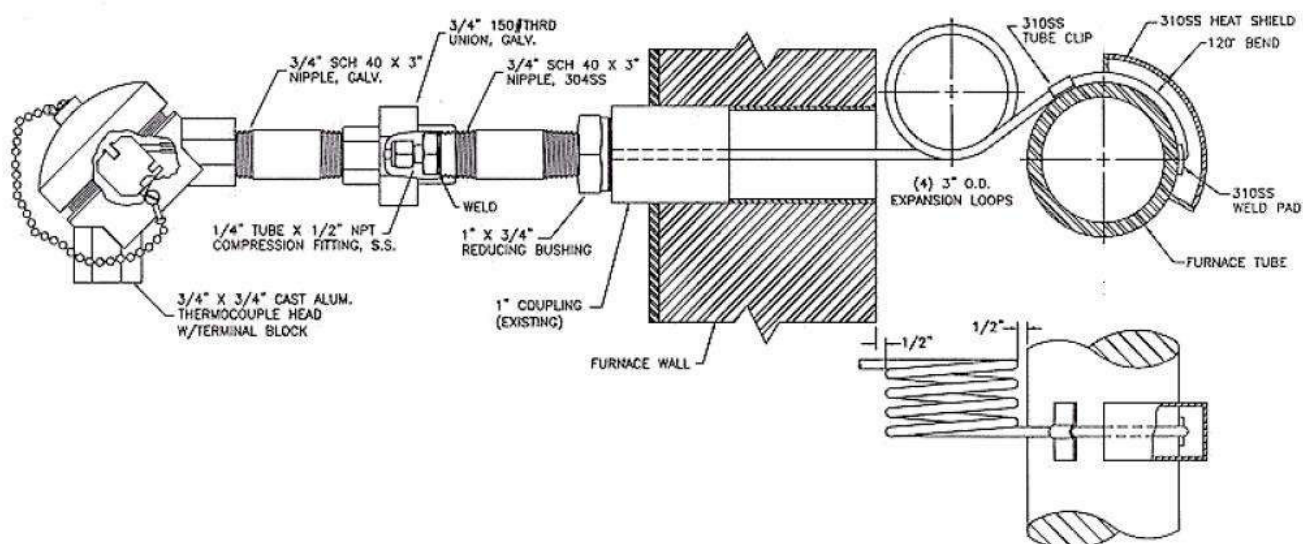


NOTES:

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.

		PROJECT	Standby SRU & Additional Tanks		
		CLIENT	IOCL Paradip Refinery		
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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)

HORIZONTAL CENTRIFUGAL PUMPS (SPP)

S1 No. 5.16 : PRESSURE RELIEF VALVE		
Supplier Code	Supplier Name	Country
Approved Suppliers		
1	ANDERSON GREENWOOD CROSBY	India
2	AST APPARECCHI DI SICUREZZA E TENUTA SPA	International
3	BHEL	India
4	BLISS ANAND PVT LTD	India
5	DARLING MUESCO (I) PVT. LTD.	India
6	CURTISS WRIGHT FLOW CONTROL CORPORATION	India
7	DRESSER INC.	India
8	FAINGER LESER VALVES (P) LTD.	India
9	GE OIL AND GAS INDIA PVT LTD	India
10	INSTRUMENTATION LTD. (PALGHAT)	India
11	LESER GMBH & CO. KG	International
12	NAKAKITA SEISAKUSHO CO LTD	International
13	WEIR BDK VALVES-A UNIT OF WEIR INDIA PVT	India
S1 No. 5.36 : TEMP.ELEMENTS, THERMOWELLS		
Supplier Code	Supplier Name	Country
Approved Suppliers		
1	ABB AUTOMATION LTD	UK
2	ALTOP INDUSTRIES LTD.	India
3	DAILY THERMETRICS CORPORATION	International
4	DETRIV INSTRUMENTATION & ELECTRONICS LTD	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	TEMP-TECH	India
11	TEMPSSENS INSTRUMENTS INDIA PVT LTD	India
12	THERMAL INSTRUMENT (I) P LTD	India
13	THERMO ELECTRIC CO. INC.	India
14	THERMO-COUPLE PRODUCTS CO	India
15	THERMO-ELECTRA B.V	International
16	TM TECNOMATIC SPA	International
17	WIKA ALEXANDER WIEGAND & CO GMBH	International
S1 No. 5.75 Description : PRESSURE GAUGES		
Supplier Code	Supplier Name	Country
Approved Suppliers		
1	AN INSTRUMENTS PVT LTD	India
2	MASS PRODUCTS PVT LTD	India

3	BADOTHERM PROCESS INSTRUMENTS B.V. / BADOTHERM FAR EAST Co. Ltd	International
4	BAUMER BOURDON HAENNI SAS	India
5	BAUMER TECHNOLOGIES INDIA PVT.LTD	India
6	BUDENBERG GAUGE CO. LTD	International
7	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	India
8	GOA INSTRUMENTS INDUSTRIES PVT. LTD.	India
9	H GURU INSTRUMENTS(SOUTH INDIA)PVT. LTD	India
10	H.GURU INDUSTRIES	India
11	MANOMETER (INDIA) PVT. LTD.	India
12	WALCHANDNAGAR INDUSTRIES LTD(TIWAC DIVN)	India
13	WIKA ALEXANDER WIEGAND & CO GMBH	India / International
14	PRESISION MASS PRODUCTS PVT LTD (Old Name: ASHCROFT INDIA PVT LTD)	India

S1 No. 5.78 Description : TEMP.GAUGES (BI METALLIC, FILLED SYSTEM)

Supplier Code	Supplier Name	Country
Approved Suppliers		
1	AN INSTRUMENTS PVT LTD	India
2	ASHCROFT INDIA PVT LTD	India
3	BADOTHERM PROCESS INSTRUMENTS B.V. / BADOTHERM FAR EAST Co. Ltd	International
4	BAUMER BOURDON HAENNI SAS	India
5	BAUMER TECHNOLOGIES INDIA PVT.LTD	India
6	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	India
7	GOA INSTRUMENTS INDUSTRIES PVT. LTD.	India
8	H GURU INSTRUMENTS(SOUTH INDIA)PVT. LTD	India
9	PRESISION MASS PRODUCTS PVT LTD (Old Name: ASHCROFT INDIA PVT LTD)	India
10	WALCHANDNAGAR INDUSTRIES LTD(TIWAC DIVN)	India
11	WIKA ALEXANDER WIEGAND & CO GMBH	India / International

S1 No. 5.3: INSTRUMENT TUBING

Supplier Code	Supplier Name	Country
Approved Suppliers		
1	HEAVY METALS & TUBES LIMITED	India
2	JINDAL SAW LTD.	India
3	NUCLEAR FUEL COMPLEX	India
4	RATNAMANI METALS AND TUBES LTD.	India
5	REMI EDELSTAHL TUBULARS LTD	India
6	TK FUJIKIN CORPORATION	India

S1 No. 5.2: TUBE FITTINGS

Supplier Code	Supplier Name	Country
1	ARYA CRAFTS & ENGINEERING PVT LTD	INDIA
2	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA
3	AUTOCLOVE ENGINERS FLUID COMPONENTS	INTERNATIONAL
4	CIRCOC INSTR. TECHNOLOGIES INC-	INDIA
5	COMFIT & VALVES PVT. LTD.	INDIA

6	EXCEL HYDRO PNEUMATICS PVT LTD	INDIA
7	EXCELSIOR ENGEL WORKS	INDIA
8	FLUID CONTROLS PVT LTD	INDIA
9	MULTIMETAL INDUSTRIES	INDIA
10	PANAM ENGINEERS	INDIA
11	PARKER HANNIFIN CORPORATION	INDIA
12	PRECISION ENGINEERING INSDUSTRIES	INDIA
13	PRIME ENGINEERS	INDIA
14	RELIANCE ENGINEERING & ELECTRICALS CORPN	INDIA
15	SEALEXCEL (INDIA) PVT. LTD.	INDIA
16	SSP FITTINGS CORPORATION	INTERNATIONAL
17	SWAGELOK CO.	INDIA
18	SWASTIK ENGINEERING WORKS	INDIA
19	TK FUJIKIN CORPORATION	INDIA
20	FITOK INCORPORATED	INTERNATIONAL
21	WESMEC ENGINEERING PVT. LTD.	INDIA

S1 No. 5.20: SELF ACTUATED PR.CONTROL VALVES

Supplier Code	Supplier Name	Country
1	DRESSER PRODUITS INDUSTRIELS	INTERNATIONAL
2	GE OIL & GAS INDIA PVT LTD	INDIA
3	ELSTER-INSTROMET NV	Belgium
4	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA/ INTERNATIONAL
5	ESME VALVES LTD.	INTERNATIONAL
6	GORTER CONTROLS B.V.	INTERNATIONAL
7	MIL CONTROLS LIMITED	India
8	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	India
9	PIETRO FIORENTINI SPA	INTERNATIONAL
10	RICHARDS INDUSTRIES (FORMERLY TRELOAR)	INTERNATIONAL
11	RMG REGEL+MESSTECHNIK GMBH	India
12	SAMSON CONTROLS PVT LTD	INDIA/ INTERNATIONAL

S1 No. 5.34: ORIFICE PLATES & FLANGES

Supplier Code	Supplier Name	Country
1	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	India
2	CAMERON CANADA CORPORATION	INTERNATIONAL
3	COMFIT & VALVES PVT. LTD.	India
4	DANIEL MEASURMNT & 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	Italy
Sl No. 5.87: GAUGE GLASSES & COCKS		
Supplier Code	Supplier Name	Country
1	ASIAN INDUSTRIAL VALVES & INSTRUMENTS	India
2	BLISS ANAND PVT LTD	India
3	CESARE BONNETTI S.P.A.	India
4	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	India
5	TECHNOMATIC INDIA PVT. LTD	India
6	JERGUSON GAUGE & VALVE	INTERNATIONAL
7	KLINGER SPA	INTERNATIONAL
8	LEVCON INSTRUMENTS PVT LTD	India
9	NIHON KLINGAGE CO LTD	INTERNATIONAL
10	NISAN SCIENTIFIC PROCESS EQUIP. P LTD	India
11	PRATOLINA INSTRUMENTS PVT LTD	India
12	PUNE TECHTROL PVT LTD	India
13	SIGMA INSTRUMENTS CO	India
Sl No. 5.101: FIELD INSTRUMENTS (P,DP,F,L,T,TD)		
Supplier Code	Supplier Name	Country
1	ABB AUTOMATION PRODUCTS GMBH	India
2	ABB INDIA LTD (BANGALORE)	India
3	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	INDIA/INTERNATIONAL
4	ENDRESS+HAUSER GMBH+CO. KG	INDIA/INTERNATIONAL
5	ENDRESS+HAUSER WETZER GMBH+ CO.KG	India
6	FUJI ELECTRIC SYSTEMS CO. LTD	India
7	HONEYWELL AUTOMATION INDIA LTD.	India
8	HONEYWELL INC.	INTERNATIONAL
9	INVENSYS INDIA PRIVATE LIMITED	India
10	YOKOGAWA ELECTRIC CORPORATION	INDIA/INTERNATIONAL
Sl No. 5.92: SPL. LEVEL INSTRUMENTS-GUIDED WAVE RADAR		
Supplier Code	Supplier Name	Country
1	ABB INC	India
2	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	India
3	ENDRESS+HAUSER (I) AUTO. INSTR. PVT. LTD	INDIA/INTERNATIONAL
4	KROHNE MESSTECHNIK GMBH & CO KG	INTERNATIONAL
5	L & J TECHNOLOGIES	INTERNATIONAL
6	MAGNETROL INTERNATIONAL N.V	India
7	VEGA GRIESHABER KG	India

VENDOR DATA REQUIREMENTS FOR HORIZONTAL CENTRIFUGAL PUMPS (SPP)

A	25-MAR-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.	Instrument Index			✓	✓	
3.	Sub-Vendor List for Instruments and accessories			✓	✓	
4.	Instrument Specification / Datasheets with model decoding		✓		✓	Note-8
5.	Instrument Sizing calculations		✓		✓	
6.	Alarm Set points			✓	✓	
7.	Instrument Installation Drawings			✓	✓	
8.	Information pertaining to SMART/FF field devices			✓	✓	
9.	Certificate (Statutory / Test/ calibration/ inspection)			✓	✓	
10.	Fieldbus instruments (if provided)- Necessary data like Device Tag, Device type, Device revision, Device address, DD file revision, CFF revision, ITK version etc as actually configured in the supplied instruments shall be provided in CD.			✓	✓	
11.	Complete catalogues with part list for all vendor supplied instruments			✓	✓	
12.	Installation, Operation and Maintenance Manuals			✓	✓	
13.	Spare part list for Mandatory Spares		✓		✓	
14.	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).

**VENDOR DATA REQUIREMENTS
FOR
HORIZONTAL CENTRIFUGAL PUMPS (SPP)**

-
6. 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).
 7. 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.
 8. Vendor shall generate and submit all instrument datasheets using Intergraph Smart Plant Instrumentation (SPI) as per the job specifications mentioned in the MR.

 TechnipFMC  IndianOil	PROJECT		Standby SRU & Additional Tanks		
	CLIENT		IOCL Paradip Refinery		
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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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	CLIENT	INDIAN OIL CORPORATION LIMITED		
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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 (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

 	PROJECT	Standby SRU & Additional Tanks IOCL Paradip Refinery		
	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		
		CLIENT	INDIAN OIL CORPORATION LIMITED		
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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		ITP of PMC attached is generic in nature irrespective of category 1 & 2. Approval of job specific ITP during execution stage based on category of the pump which is already specified in para 3 of subject document (INSPECTION AND TEST PLAN FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS)
	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		

 	PROJECT		Standby SRU & Additional Tanks	
	CLIENT		IOCL Paradip Refinery	
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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	
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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	
INSPECTION AND TEST PLAN FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS	Project No. 080557C001	Document No. 080557C-000-ITP-0910-001	Rev. No. C	Page 9 of 9

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
	080557C001	000	ITP	1691	001	A	1 of 2

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

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					
		080557C001	000					
		Doc Type	Material Code					
		ITP	1691					
		Serial N°	Rev.					
		001	A					
		Page						
		2 of 2						
1.0 SCOPE This Inspection and test Plan covers the minimum testing requirement of MV Induction Motors.								
2.0 REFERENCE DOCUMENTS PO/PR & Standards referred there in / Job specification / Approved documents								
3.0 INSPECTION AND TEST REQUIREMENTS								
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	-	-
* 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. - Supplier to submit internal test reports before offering items for inspection to CONTRACTOR / PMC / OWNER.								
LEGEND:- CCE or CCOE: Chief controller of Explosives, DT - Destructive testing, HT - Heat treatment, H - Hold (Do not proceed without approval), IBR - Indian Boiler Regulations, ITP - Inspection Test Plan, NDT - Non Destructive Testing, P - Perform, PESO - Petroleum and Explosives Safety Organisation, PO - Purchase Order, PR - Purchase Requisition, PQR - Procedure Qualification Record, QAP - Quality Assurance Plan, Random-10% (min 1no) of each size and type of bulk item, R - Review, RT - Radiography Testing, RW - Random Witness, TC - Test Certificate, TPI or TPIA - Third Party Inspection Agency, VDR - Vendor Data Requirements, WPS - Welding Procedure Specification, WPO - Welders Performance Qualification, W - Witness (Give due notice, work may proceed after scheduled date), MDRB - Manufacturer's Data/Record Book, DFT - Dry Film Thickness								
Notes (As applicable) 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. 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. 3 In case of conflict between purchase specification, contract documents and ITP more stringent conditions shall be applicable. 4 This document describes generally the requirements pertaining to all types of the item. Requirements specific to PO and the item are only applicable. 5 Acceptance norms for all the activities shall be as per PO/PR/STANDARDS referred therein / Job specification / Approved documents. 6 If test certificate is not available, this will be witnessed.								

 	PROJECT:		STANDBY SRU & ADDITIONAL TANKS IOCL - PARADIP REFINERY				
	CLIENT:		INDIAN OIL CORPORATION LIMITED				
INSPECTION AND TEST PLAN (ITP) FOR HV INDUCTION & SYNCHRONOUS 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

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					
				Project N°	Unit	Doc Type	Material Code	Serial N°	Rev.	Page	
				080557C001	000	ITP	1692	001	A	2 of 2	
INSPECTION AND TEST PLAN (ITP) FOR HV INDUCTION & SYNCHRONOUS MOTORS											
1.0 SCOPE This inspection and test Plan covers the minimum testing requirement of HV Induction & Synchronous Motors.											
2.0 REFERENCE DOCUMENTS PO/PR & Standards referred there in / Job specification / Approved documents											
3.0 INSPECTION AND TEST REQUIREMENTS											
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, Heat Exchanger type, Lubrication system type 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, paint shade 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. (Induction machines only) > Locked rotor test at reduced voltage and measurement of voltage, current and wattage. (Induction machines only) > Check of phase sequence and terminal markings. > Direction of rotation > Withstand voltage test of stator winding > Polarization index > Reduced Voltage starting and running. > Shaft Voltage > RTD/BTD, space heater resistance measurement > Vibrations measurement > Functional check of accessories, e.g. temperature detectors in windings and bearings, vibration monitoring, heaters > Open circuit secondary induced voltage at standstill (Wound rotor machines only) > 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. > Operation of control panel (in case of pressurised motors) > Measurement of interturn insulation and radial air gap. > Verification of CTs rating in neutral terminal box. > Verification of Cooling system and lubrication control. > Provision of online greasing facilities, earth pads, lifting hooks etc. > Coupling details and type of bearing verification.	100%	Supplier's Test Records / Inspection Witness Record.	W	W	R	-			
4	Additional Routine Tests for Synchronous motors.	> Measurement of rotor winding resistance > Measurement of rotor insulation resistance > No load test at unit power factor (***) > No-load excitation current at rated voltage (***) > Withstand voltage test of rotor winding > Functional check of excitation equipment (***) Only one of these tests is required	100%	Supplier's Test Records / Inspection Witness Record.	W	W	R	-			
5	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. > Momentary overload test. > Vibration. > Measurement of Starting Torque, Starting Current, full load torque, pull out torque. > Test on Insulation system > Tan Delta Test > No load noise level measurement and determination of the relevant curve > Degree of protection for enclosure > RTD/BTD, space heater resistance measurement > Measurement of radial and axial clearance between fan and stationary parts.	1 No of each type	Test Agency Reports	W	R (Note 6)	R	-			
6	Other tests	Overspeed (**) (**) To be performed as a routine test during the no-load test if the test power supply has overspeed frequency capability	100%	Supplier's Test Records / Inspection Witness Record.	W	R (Note 6)	R	-			
7	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 indigenous 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	-			
8	Painting	Visual and DFT check	100%	Supplier's Test Records / Inspection Witness Record.	H	W	-	-			
9	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	-	-			
10	MDRB Review	Compilation of test reports/test records as per Project Procedure	100%	Supplier's Test Records / Inspection Witness Record.	H	H	-	-			
* 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.											
# Including bearing visual inspection (with bearing disassembly) on large machines equipped with sleeve bearings - extent to be defined. - Supplier to submit internal test reports before offering items for inspection to CONTRACTOR / PMC / OWNER.											
LEGEND:- CCE or CCOE: Chief controller of Explosives, DT - Destructive testing, HT - Heat treatment, H - Hold (Do not proceed without approval), IBR - Indian Boiler Regulations, ITP - Inspection Test Plan, NDT - Non Destructive Testing, P - Perform, PESO - Petroleum and Explosives Safety Organisation, PO - Purchase Order, PR - Purchase Requisition, POR - Procedure Qualification Record, QAP - Quality Assurance Plan, Random-10% (min 1no) of each size and type of bulk item, R - Review, RT - Radiography Testing, RW - Random Witness, TC - Test Certificate, TPI or TPIA - Third Party Inspection Agency, VDR - Vendor Data Requirements, WPS - Welding Procedure Specification, WPO - Welders Performance Qualification, W - Witness (Give due notice,work may proceed after scheduled date), MDRB - Manufacturer's Data Record Book, DFT - Dry Film Thickness											
Notes (As applicable) 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. 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. 3 In case of conflict between purchase specification, contract documents and ITP more stringent conditions shall be applicable. 4 This document describes generally the requirements pertaining to all types of the item. Requirements specific to PO and the item are only applicable. 5 Acceptance norms for all the activities shall be as per PO/PR/STANDARDS referred therein / Job specification / Approved documents. 6 If test certificate is not available, this will be witnessed.											


ADDITIONAL TECHNICAL REQUIREMENTS / CLARIFICATIONS

FOR SWS ACID GAS KOD PUMPS

Following technical requirements shall be complied in addition to the requirements mentioned in the specification. If case of contradictory requirement between the specification and below requirements, bidder shall consult the purchaser for clarification, failing which most stringent of the both shall be followed :

1. The design temperature of pump shall be 175 Deg C as per process requirement.
2. Material of construction of the pump shall be as per annexure-G of API 610. Accordingly, D-1 MOC is required for sour water service. Hence, MOC of the pump shall be as per API class D-1 with NACE requirement.
3. The reference point at which NPSH (A) indicated in the pump datasheet is @ centerline of suction nozzle)
4. Downstream design pressure is 15 kg/cm² (g).
5. Mechanical seal shall be as per API 682 as per specification requirement. OEM standard is not acceptable. Further, sealing plans shall be as per specification only. Seal plan shall be as per Note G of PMC mechanical data sheet. Bidder to obtain seal vendor recommendation and highlight discrepancy, if any.
6. Bidder shall follow following vendors list for mechanical seal:
 - AESSEAL PLC -International
 - Chhetra Seals- India
 - Eagle India - International
 - Flowserve (enquiry issued to Flowserve India controls Pvt Ltd.)-International
 - Johncrane-International
 - Leakproof Engg (I) Pvt Ltd-India
7. Strainer at Pump suction is not in bidder's scope.
8. Battery / Instrumentation Panel is not required. Bidder shall fully comply with the specifications and scope of works as per Document No. B366-088-16-51-SP-1004 (Job Specifications & Scope of Works of Instrumentation) attached with MR.
9. Bidder to furnish following at normal flow of the pump as per performance curve of pump. Also submit curve with points marked for normal case
 - a. Normal Head
 - b. Normal shaft power consumption with 0% positive tolerance
 - c. Coupling losses
 - d. Motor efficiency
 - e. Absorbed power (b+c+d)
10. For pump & motor, instrumentation is not required. However, bidder to consider instrumentation as applicable for sealing plans in their scope of supply.
11. Bidder must include O&M spares as per their recommendation required during defect liability period and include the same in their scope of supply.
12. Pumps with suction specific speed greater than 12,780 (m³/h, m, rpm) at the best efficiency point for the maximum diameter impeller is not acceptable. Bidder to furnish value of suction specific speed, alongwith relevant calculations sheet.

13. Bidder to furnish L3/D4 values for each pump item as per equation K2 and I_{SF} as per equation K4 of annexure-K of API 610 11th edition. Bidder to confirm that offered pump models are inline with Annexure –K of API 610 11th edition.
14. Bidder to furnish maximum allowable working temperature of offered pump model. Note that design temperature of pump shall be at-least 175 deg C as per process requirement.
15. The pressure casing shall be designed to at least 42.2 kg/cm²(g) and have a corrosion allowance of 3 mm. Confirm compliance and revise the MAWP and Hydro test pressure accordingly. Furnish MAWP values at 175 deg C for offered metallurgy.
16. 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.
17. Bidder to note that minimum NPSH margin of 0.6m shall be available from rated flow to pump MCF. Bidder to confirm that above requirement is being met by offered pump model and furnish NPSHR at MCF.
18. Bidder to confirm that 5% head rise by change of impeller at rated flow is possible for offered pump model. Confirm compliance and furnish value of head at rated flow at max impeller diameter.
19. Bidder to confirm that 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 shall be demonstrated at site & if the noise limit exceeds the specified value, the necessary arrangement to meet the noise criteria, shall be provided by vendor without any time / cost implication. Jackets for Noise attenuation around the suction and discharge nozzles shall be supplied by the vendor if found necessary to limit noise level within specified limits.
20. Bidder shall meet all the technical requirements of the specification regarding the NPSHr, Ratio of Rated flow to BEP Flow, Ratio of Shut-off head to Rated head etc., apart from the other requirements specified in this specification.
In case, bidder is unable to meet the requirements with all the available pump model(s) with them, Bidder may choose an option with continuous re-circulation flow in order meet the above conditions. However, bidder shall ensure this recirculation flow shall be the lowest possible flow.
The reference project details / PTR shall meet the requirement w.r.t. New flow (i.e., rated flow + proposed recirculation flow, if offered)
21. 080557C-000-JSD-2300-001-Painting specification to be followed attached with this document.
22. ITP of PMC attached is generic in nature. Therefore, it is suggested to leave this unaltered and the same can be implemented during approval of job specific ITP during execution stage which is already specified in para-3 of subject document (INSPECTION AND TEST PLAN FOR SPECIAL PURPOSE CENTRIFUGAL PUMPS)
23. Barrier Fluid for mechanical seals during commissioning will be in bidder scope of supply.

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SPECIFICATION FOR PAINTING

Page modified under this revision: Page number 11

C	11-JUNE-2020	ISSUED FOR DESIGN	CK	AS/SL	VV	JMC
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A	14-OCT-2019	ISSUED FOR DESIGN	CK	AS	VV	JM
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED

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1. INTRODUCTION

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th 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

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SRU	Sulphur Recovery Unit
OISD	Oil Industry Safety Directorate
ASME	American Society of Mechanical Engineers
API	American Petroleum Institute
P&ID	Piping and Instrumentation Diagram
A/G	Above Ground
U/G	Under Ground
B/L	Battery Limit
ISBL	Inside Battery Limit
EOT	Electrically-operated Overhead Travelling
MTO	Material Take Off

3. **SCOPE**

This specification defines the requirements of surface preparation, selection and application of paints and primers for all piping, equipment and structures etc.

The specification is applicable for supply of all paints, coatings, primers and other ancillary items etc. Method of surface preparation, supply and application of paints and primers shall suit given environment, location and temperature. Items requiring painting, field application procedures, inspection and testing of painting shall be governed by this specification.

This specification is suitable for use in normal, corrosive and marine environment of various process, utility and other plants and offsite of refineries, petro-chemicals, onshore terminals and other chemical / industrial plants. Alternative paints / coatings would be specified if necessary for specific or more stringent requirements.

The painting specification covers every type of equipment such as tanks, vessels, drums, heat exchangers/ coolers, air fin coolers, pumps, turbines, compressors, filters, engines, motors, boilers or heaters /furnaces their accessories, fans, stacks / chimney and package units etc.

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The painting specification covers all types of process and utility piping services which can be non-insulated / insulated, jacketed or lined requiring painting. All types of pipe supports, hangers, spring boxes are also covered.

All types of structural steel members, platforms ladders, chequered plates, gratings, walkways, trolleys, monorails, davits, structural steel sheds and buildings are also covered under this painting specification.

The painting of equipment shall conform to equipment data sheets. Painting of piping shall conform to line schedule and piping isometrics etc.

4. **TERMINOLOGY**

MR	Material Requisition
PR	Purchase Requisition
PO	Purchase Order
CS	Carbon steel
LTCS	Low Temp. Carbon Steel
AS	Alloy Steel
SS	Stainless steel
MS	Mild Steel
GI.	Galvanized Iron / steel
ITP	Inspection Test Plan
TPI	Third Party Inspection
DFT	Dry Film Thickness
WFT	Wet Film Thickness
TSAC	Thermally Sprayed Aluminium Coating
Micr.	Micron

5. **EXCLUSIONS**

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

- Plastics and or plastic coated surfaces
- Non-ferrous materials like Aluminum, Cu-Ni alloy, Monel, Incoloy
- RCC or cement lined surfaces except those specified
- Gaskets / seals

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- Gauge Glasses
- Meter Faces
- Valve Stem and Threads
- Name Plates
- Insulation or Fireproofing
- Factory Finished Control Panels
- Factory Finished Instrument Cases and Meters

6. **REFERENCE CODES & STANDARDS**

The following codes shall be applicable, however purchaser may specify any other relevant code for any purpose at any time. The codes latest edition as on date of issue of material requisition shall be applicable.

Code /Std. No	Description
IS: 5	Colours for ready mixed paints and enamels
IS: 101	Methods of test for ready mixed paints and enamels
IS: 2379	Indian Standard for Pipe line identification-colour code
ISO 209	Aluminium and aluminium alloys Chemical composition
ISO 8501-01	Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness
ISO 8502-3 & 9	Preparation of steel substrates before application of paints and related products - Test for assessment of surface cleanliness : Field method for conductometric determination of water soluble salts
ISO12944	Corrosion Protection of steel Structures by Protective Paint System
ASTM E3	Metallographic Examinations
ASTM VOL 6.01 & 6.03	American standard test methods for Paints and Coatings.
ASTM B833	Standard Specification for Zinc and Zinc Alloy Wire for Thermal Spraying (Metallizing) for the Corrosion Protection of Steel , corrosion protection
ASTM C633	Test Method for Adhesive / Cohesive Strength of Flame Sprayed Coatings.

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ASTM D4285	Method for indicating Oil or Water in Compressed Air.
ASTM D4417	Test Method for Field Measurement of Surface Profile of Blasted Steel.
ASTM D4541	Test method for Pull-Off Strength of Coating using Portable Adhesion Testers.
ASTM D4940	Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives.
ASTM D6677	Standard Test Method for Evaluating Adhesion by Knife1
ANSI A13.1	Scheme for identification of piping systems: American National Standards Institution
ANSI/AWS C2.18	Guide for the Protection of Steel with Thermal Spray Coatings of Aluminium, Zinc and Their Alloys and Composites.
AWS C.2.17	Recommended Practice for Electric Arc Spray.
SSPC-SP	Steel Structures Painting Council
SSPC Publication	The inspection of coatings and linings: A Handbook of Basic practice for Inspectors, Owners, and Specifiers.
SSPC-AB 1	Mineral and Slag Abrasives.
SSPC-AB 3	Ferrous Metallic Abrasives.
SSPC-PA 1	Shop, Field, and Maintenance Painting of Steel.
SSPC-PA 2	Measurement of Dry Coating Thickness with Magnetic Gages.
NACE No. 1 / SSPC-SP 5	White Metal Blast Cleaning.
NACE No. 2 / SSPC-SP 10	Near -White Metal Blast Cleaning.
SSPC-VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.
RAL DUTCH	International Standard for color shade (Dutch Standard)
SIS-05 59 00	Pictorial surface preparation standard for painting of steel surfaces
BS1475	Specification for Wrought Aluminium & Aluminium Alloys for General Engineering Purposes.
BS 2569	Specification for Sprayed Metal Coating.
BS 4232	British Standards (Surface Finish of Blast-cleaned Steel for Painting
NACE Std. RP 0287	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape.

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NACE No.12 / AWS C2.23 M / SSPC-CS 23.00	Specification for the application of thermal spray coatings (Metallizing) of aluminium, zinc, and their alloys and composites for the corrosion protection of steel.
NACE RP 198	The control of corrosion under Thermal Insulation and Fireproofing Materials

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


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

The Contractor shall perform the work in accordance with the following reference documents issued to him for execution of painting works.

- Bill of quantities for piping, equipment, machinery and structures etc
- Piping Line List
- Specifications for Painting
- Any Specific requirements from client

7. **GENERAL REQUIREMENTS**

- This specification shall govern all works covered by the contract, and without prejudice to the provisions of various Indian and international codes of practice, standard specifications etc. The Contractor shall carry out the works in all respects with the best quality of materials and workmanship and in accordance with the best engineering practices and instructions of Owner / Engineer in charge.
- All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning and all equipment, scaffolding materials, shot / sand blasting equipment and air compressors etc. required to be used shall be suitable for the work and all in good order and shall be arranged by the Contractor at site and in sufficient quantity.
- The compressed air supply used for blasting shall be free of water and oil. Adequate separators and traps shall be provided and these shall be drained continuously. Pressure Gauges fitted to compressor shall be calibrated with necessary certificate.
- Blast cleaning equipment shall be in accordance with all applicable regulations. The spraying equipment to be used shall meet the recommendations and instructions set forth by the paint supplier for each specific paint or coating system.
- All mechanical equipment shall be earthed and all necessary precautions shall be taken to prevent the build-up of static electricity. Especially blasting equipment, its operators and the equipment being blasted shall be properly earthed to prevent the occurrence of electro-

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static discharges

- Mechanical mixing shall be used for paint mixing operations in case of two pack systems except that the Engineer in charge may allow the hand mixing of small quantities at his discretion.
- All painting materials and ancillary materials needed for completion of the contract shall conform to the prescribed specifications. Contractor shall procure these materials from specified manufacturers or their stockiest with proper marking and identification as proof of original materials.
- Any sub-standard or duplicate materials or lower grade/ brand materials shall not be used. Owner / Engineer in charge shall have the right to reject all such materials at any stage. Contractor shall seek prior approval from Owner before actual application to avoid rejection of works carried out with such sub-standard materials.
- The Contractor shall bring to the notice of Owner any discrepancy between this specification and codes specified herein. Contractor may request Owner for clarification of any of the applicable clause of this specification or about applicability of a particular painting system for any service / surface. Any deviation from this specification pertaining to supply or application without written permission of Owner shall be rejected by Engineer in charge.
- The items listed in the paint systems is indicative only, however Engineer in charge may decide about the applicability of the paint system for any of the works.
- The Contractor shall ensure all safety and protective apparatus are fully provided to their staffs.
- The contractor shall be fully responsible for carrying out all the necessary painting, coating and lining on external and internal surfaces as per the tender requirement.
- The paint manufacturer's instructions shall be followed as far as practicable at all times for best results. Particular attention shall be paid to the following:
 - Instructions for storage to avoid exposure as well as extremes of temperature.
 - Surface preparation prior to painting shall be followed as per the specification.
 - Mixing and thinning.
- Paint manufacturers shall furnish the characteristics of all paints materials on original printed literature, along with the test certificate for all specified characteristics given in this specification. All the paint materials shall be of first quality and conform to the general characteristics described in various tables.
- Contractor shall fully comply with the client specification for Colour Coding of Piping, Equipment and Structures issued during EPC stage of the project. This specification covers colour codes, identification marking on piping and equipment, recommended colours for paint systems and painting for "Civil Defence" requirements etc.
- Contractor shall ensure that the paint material supplied are fully within the validity period of the product and not exposed to open atmosphere.

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8. EXTENT OF PAINTING

The following surfaces and materials shall require shop, pre-erection and field painting:

- All Non-insulated carbon steel and alloy steel piping as described under scope Including valves, flanges, fittings, specialty items, in line items, and all supports (including painting of identification marks), flare lines ,furnace ducts and stacks.
- Titanium catalyzed inorganic copolymer can be used commonly for all valves.
- All insulated parts of vessels, boilers, chimneys, stacks, piping and steam piping, and any other insulated items present.
- All items contained in a package unit requiring painting.
- All types of structural steel members, platforms ladders, chequered plates, gratings, walkways, trolleys, monorails, davits, structural steel sheds and buildings are also covered under this painting specification.
- External surfaces of MS chimney with or without refractory lining and internal surfaces of MS chimney without refractory lining. (If present)
- Representation of colour bands on all piping including insulated aluminum clad, galvanized, SS and nonferrous piping.
- Identification lettering / numbering on all painted surfaces of equipment / piping insulated aluminum clad, galvanized SS and non-ferrous piping.
- Marking / identification signs on painted surfaces of equipment / piping including hazardous service.
- Supply of all primers, paints and all other materials required for painting (other than Owner supplied materials)
- Metal Area over which insulation surface of equipment and pipes wherever required.
- Painting under insulation for carbon steel, alloy steel and stainless steel as per relevant NACE RP 198 to prevent corrosion.
- Painting of pre-erection / fabrication and Shop primer.
- Repair work of damaged pre-erection / fabrication and shop primer and weld joints in the field / site before and after erection as required.

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- All CS Piping, equipment, storage tanks and internal surfaces of RCC tanks in ETP plant.
- Quality control, testing and inspection during all stages of work (surface preparation, application of coating and testing of furnished coating).

9. **SURFACE PREPARATION**

Any one of following methods of surface preparation shall be followed, depending on condition of surface to be painted and as approved or instructed by Engineer in charge.

- Manual or hand tool cleaning
- Mechanical or power tool cleaning
- Dry abrasive blast cleaning

Before blasting salt contamination test to be carried out for metals & Testing for chloride and soluble salt concentrations and the pH level shall be done using a Bresle Sampler according to ISO 8502-6. The chloride and soluble salt concentrations shall be less than 20 mg/ m² and the pH shall be neutral (between 6 and 8). When these levels are exceeded, the surfaces shall be either steam cleaned or high pressure water washed as per SSPC SP1 or ISO 12944 before abrasive blasting. The cleaned surface shall be retested to verify that the contaminant levels are within the acceptable range. Checks shall be done on each component at least once per 200 m² of blasted surface and a minimum of 3 checks per shift. The test report shall be maintained recording the ambient and substrate temperature, relative humidity, abrasive medium, test obtained valves etc., Measuring device shall be regularly calibrated.

9.1 **Surface Finish Requirements:**

- When surface is exposed to normal atmospheric conditions and where other methods cannot be adopted. May also be used for spot cleaning during maintenance.
 - Solvent Cleaning to SSPC - SP1. Remove oil, grease or wax with a suitable solvent/degreaser (Non-Chloride solvent to be used on SS substrate)
 - Manual or hand tool cleaning to: SSPC-SP-2 or ST.2 Level

Remove loose rust / mill scale / loose paint thoroughly by chipping, scrapping, sanding and or wire brushing. Finished surface shall have a faint metallic

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sheen.

- Mechanical or power tool cleaning to SSPC-SP-3 or ST.3 Level

Remove loose rust / mill scale / loose paint to degree specified by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.

Care to be taken where the welding / riveting portion of the joints.

- **Dry abrasive Blast cleaning:**

There are four different methods of dry abrasive blast cleaning as described below. Each method shall be selected depending on surface finish required for particular paint system. However Engineer in charge may instruct about any of the system to be followed for a particular job / item as deem necessary.

- White metal to SSPC-SP-5 or SA.3 or NACE #1 Level

Remove all visible rust / Mill scale / paint and foreign matter 100% to achieve desired surface profile with blast cleaning to white metal cleanliness in order to achieve extremely clean surface for prolonged life of paint system.

- Near white metal to SSPC-SP-10 or SA.2 ½ or NACE # 2 Level

Blast clean to near white metal cleanliness until at least 95% of each element of surface area is free of all visible residues with desired surface profile in order to have minimum acceptable clean surface. This is the minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc silicate paints, also for conventional paint systems used under fairly corrosive conditions to obtain desired life of paint system.

- Commercial Blast to SSPC-SP-7 or SA.2 or NACE # 3 Level

Blast clean until at least two-third of each element of surface area is free of all visible residues with desired surface profile. Used for steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.

- Brush-off Blast to SSPC-SP-7 or SA.1 or NACE # 4 Level

Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint and foreign matter where surface profile is not so important


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9.2 Equipment surface Preparation:

- All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning and all equipment, scaffolding materials, shot & grit blasting equipment and air compressors etc. required to be used shall be suitable for the work and all in good order and shall be arranged by the Contractor at site and in sufficient quantity. The manufacturer's test certificates & data sheets for all the above items shall be reviewed by Engineer in charge at site before start of work.
- Mechanical mixer shall be used for paint mixing operations in case of two pack systems except that the Engineer in charge may allow the hand mixing of small quantities at his discretion in case of specific requirement for touch up work only.
- Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. The minimum acceptable standard, in case of thermally sprayed metal coatings, in case of mechanical or power tool cleaning it shall be St. 3 or equivalent. In case of blast cleaning it shall be Sa 2-1/2 as per Swedish Standard SIS-055900 or SSPC-SP or ISO 8501-01. Blast cleaning shall be Sa 3 as per Swedish Standard in case thermally sprayed metal coatings.
- Before surface preparation by blast cleaning, the surface shall be degreased by aromatic solvent to remove all grease, oil etc.

9.3 Use of Dehumidifiers:

- Blast cleaning shall not be performed for internal or external surface, where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceed 85%. In case of internal coating of storage tanks, dehumidifier shall be used, to control humidity level below 60%. Dehumidifier should depress the dew point of air in the enclosed space, enough to maintain it 3°C below the metal substrate temperature during entire period of blasting and coating application. During the interval time between application of primer coat and subsequent intermediate and top coats or between blast cleaning completion and start of application of primer coat,

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dehumidifier unit should be in continuous operation to ensure that no condensation occurs on substrate.

- Dehumidifier should be able to maintain grain drop (moisture removal) at the rate of 25 grains per pound of air per hour. Dehumidifier should have capacity of at least 2 air changes per hour of the enclosed space. All necessary psychometric data should be collected by contractor for the given site conditions before starting operation of dehumidifier to ensure that desired values of dew point, moisture content in enclosed scope is achieved.
- Dehumidification shall be maintained round the clock for surface preparation and painting till the total coating application is over.
- Dehumidifier shall not be stopped under any condition till the entire blasted surface is primed to the satisfaction of the technical representative of the paint manufacturer interested with quality assurance for the work. In case the dehumidifier breaks down in middle of the job, the same shall be replaced at the risk and the cost of the contractor and the entire unfinished work shall be repeated.
- The Engineer in charge shall have the right to disallow usage of dehumidifier if the performance is not meeting the specified requirements. Under such circumstances the contractor shall remove the equipment and replace the same with another equipment to provide satisfactory results without any additional cost to the owner.
- Irrespective of the method of surface preparation, the first coat of primer must be applied by airless spray / air assisted conventional spray if recommended by the paint manufacturer on dry surface. This should be done immediately and in any case within 4 hours of cleaning of surface. However, at times of unfavourable weather conditions, the Engineer in charge shall have the liberty to control the time period, at his sole discretion and/or to insist on recleaning, as may be required, before primer application is taken up. In general, during unfavourable weather conditions, blasting and painting shall be avoided as far as practicable.
- The external surface of R.C.C. chimney stack to be painted shall be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed by scrubbing with soft wire brush. Acid etching with 10-15% HCL solution for about 15 minutes shall be carried and surface must be thoroughly washed with water to remove acid & loose particles and then dried completely before application of paint.

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9.4 Air Blast Cleaning with abrasives:

- The surfaces shall be blast cleaned using one of the abrasives like angular chilled cast iron or steel grit, copper slag or Nickel slag, Al_2O_3 particles at pressure of 7 kg/cm² at an appropriate distance and angle depending of nozzle size maintaining constant velocity and pressure.
- Chilled cast iron or steel shall be in the form of shot or grit of size in the range of G 16 - G42 conforming to SSPC AB1 and S250 grade size of steel shots (maximum) to obtain a desired surface profile of 35-50 microns trough to peak. For all other abrasives, size shall be in the range of G16 -G24. The combination of steel grits and shots shall be normally in the ratio of 3 : 1 . The quality of abrasives shall be free from contaminants and impurities and shall meet the requirements of SSPC AB1.
- Compressed air shall be free from moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the materials for liners. Nozzles orifice may vary from 3/16" to 3/4". On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic luster. Primer / first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bad weather without adequate protection or when there is dew on the metal, which is to be cleaned. Surface profile shall be uniform to provide good key to the paint adhesion (i.e. 35 to 50 microns). If possible vacuum collector shall be installed for collecting the abrasives and recycling.

9.5 Mechanical or Power Tool Cleaning:

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

9.6 Non-Compatible Shop Coat Primer:

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- For equipment on which application of total protective coating (Primer+ Intermediate + top coat) is carried out at shop, compatibility of finish coat with primer should be checked with paint manufacturer. Specific duration mentioned in the manufacturer specification shall be fully If the shop coat is in satisfactory condition showing no major defect upon arrival at site, the shop coat shall not be removed.
- Shop coated equipment (coated with Primer & finishing coat) should not be repainted unless paint is damaged. Repair shall be carried out as per **Table 10.2** of paint systems depending upon compatibility of paint.
- Shop primed equipment and surfaces will only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer should be completely removed before application of selected paint system for particular environment.
- For Package units/equipment, shop primer should be as per the paint system given in this specification. However, manufacturer's standard can be followed after review.
- Coating application at field (field primer, intermediate and top coat) on equipment, structures, piping, etc. shall be carried out only after its erection and all welding, testing, steam purging (wherever carried out) have been completed.

10. **COATING PROCEDURE & APPLICATION**

- All paint coatings shall be applied by airless spray excepting at the following special cases where application can be carried out by brush subject to suitability of the application of the paint product by brush.
 - Spot repair
 - Stripe coating on edges
 - Small bore parts not suitable for spray application
- Irregular surfaces such as sharp edges, welds, small brackets, and interstices may stripe coated to ensure specified DFT is achieved. Paint manufacture's recommendation should be followed before deciding for brush application.

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- Surface shall not be coated in rain, wind or in environment where injurious airborne elements exists, when the steel surface temperature is less than 5°F above dew point when the relative humidity is greater than 85% or when the temperature is below 40°F and when the ambient/substrate temp is below the paint manufacturer's recommended temperature of application and curing. De-humidifier equipment shall be used to control RH and Dew point. The paint application shall not be done when the wind speed exceeds 20 km per hour.
- Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hours the same day.
- To the maximum extent practicable, each coat of material shall be applied as a continuous film uniform thickness free of probes. Any spots or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.
- Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer instruction shall be followed for inter-coat interval.
- When the successive coat of the same colour have been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate complete coverage of the surface. The tinting material shall be compatible with the material and not detrimental to its service life and shall be recommended by the original paint manufacturer.
- Airless spray application shall be in accordance with the following procedure: as per steel structure paint Manual Vo. 1 & Vol. 2 by SSPC, USA, Air less spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor is used to operate a pump to produce pressures of 1000 to 6000 psi. Paint is delivered to the spray gun at this pressure through a single hose within the gun, a single paint stream is divided into separate streams, which are forced through a small orifice resulting in atomization of paint without the use of air. This results in more rapid coverage with less over spray.

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- Airless spray equipment is mounted on wheels, and paint is aspirated in a hose that sucks paint from any container, including drums. The unit shall have in built agitator that keep the paint uniformly mixed during the spraying. The unit shall consist of in built strainer. Usually very small quantity of thinning is required before spray. In case of high build epoxy coating (two pack). 30:1 pump ratio and 0.020-0.023" tip size will provide a good spray pattern. Ideally fluid hoses should not be less than 3/8" ID and not longer than 50 ft to obtain optimum results. In case of gun choking, de-choking steps shall be followed immediately.
- Brush application of paint shall be in accordance with the following:
 - Brushes shall be of a style and quality that will enable proper application of paint.
 - Round or oval brushes are most suitable for rivets, bolts, irregular surface, and rough or pitted steel. Wide flat brushes are suitable for large flat areas, but they shall not have width over five inches.
 - Paint shall be applied into all corners.
 - Any runs or sags shall be brushed out.
 - There shall be a minimum of brush marks left in the applied paint
 - Surfaces not accessible to brushes shall be painted by spray, doublers, or sheepkin.
- For each coat the painter should know the WFT corresponding to the specified DFT and standardize the paint application technique to achieve the desired WFT. This has to be ensured in the qualification trial.
- No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or maxing is faulty.
- No paint shall be force dried under conditions which will cause chalking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.
- No drier shall be added to paint on the job unless specifically called for in the manufacturer's specification for the paint.

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- Paint shall be protected from rain, condensation, contamination, snow and freezing until dry to the fullest extent practicable.

11. SURFACE PREPARATION METHOD

The table below describes the methods for surface preparation and the standards used for cleanliness and surface preparation for painting /coating works.

SURFACE PREPARATION

Sr. No.	Description	International Standards (Equivalent)			Remarks
		ISO 8501-1 / SIS-05 59 00	SSPC-SP, USA	NACE, USA	
1.	- Solvent Cleaning Remove oil, grease or wax with a suitable solvent/degreaser (Non-Chloride solvent to be used on SS substrate)	ST-1	SSPC - SP1		
2.	Manual or hand tool cleaning: Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, standing and wire brushing. Surface shall have a faint metallic sheen.	ST.2	SSPC-SP-2	-	This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.
3.	Mechanical or power tool cleaning: Removal of loose rust loose mill scale and loose paint to by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface shall have a pronounced	ST.3	SSPC-SP-3	-	

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	metallic sheen.				
4	Dry abrasive Blast cleaning: There are four common grades of blast cleaning White metal				
4.1	Blast cleaning to white metal cleanliness: Removal of all visible rust. Mill scale, paint & foreign matter 100% cleanliness with desired surface profile	SA 3	SSPC-SP-5	NACE #1	Where extremely clean surface can be expected for prolong life of paint system.
4.2	Near white metal: Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues with desired surface profile.	SA 2 ½	SSPC-SP-10	NACE #2	For chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc silicate paints, and for paint systems used under fairly corrosive conditions to obtain desired life of paint system.
4.3	Commercial Blast: Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.	SA 2	SSPC-SP-6	NO. 3	For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.
4.4	Brush-off Blast: Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, and paint foreign matter. Surface profile is not so important	SA 1	SSPC-SP-7	NO. 4	

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12. PAINTING / COATING MATERIALS

12.1 List of Primers and Finish Paints used:

A broad list of primers and finish paints to be used for painting and coating works is as given below:

PRIMERS	
PR-1	Chlorinated Rubber Zinc Phosphate Primer
PR-2	Etch Primer / Wash Primer
PR-3	Two component Epoxy Zinc Phosphate Primer cured with polyamine hardener
PR-4	Single pack, cold galvanizing compounds containing minimum 92% Electrolytic Zinc in dry film. make ZINGA, LOCKTITE (of HENKEL) or ZRC
FINISH COATS / PAINTS	
FP-1	Two component Acrylic – Polyurethane finish paint
FP-2	Chlorinated Rubber finish paint
FP-3A	High Build Epoxy finish coating cured with polyamine hardener
FP-3B	High Build Epoxy finish coating cured with polyamide hardener
FP-3C	Solvent less Epoxy Coating cured with polyamine hardener
FP-4	High build Coal Tar Epoxy coating cured with polyamine hardener
FP-5	Self-priming surface Tolerant High Build Epoxy coating. cured with polyamine hardener
FP-6	Two component Inorganic Zinc Silicate coating
FP-7	Heat resistant synthetic medium based Aluminium paint
FP-8	Two component Heat resistant Silicone Aluminium paint.
FP-9	Specially formulated Coal Tar Epoxy coating. cured with polyamine hardener
FP-10	Two component Epoxy Phenolic coating cured with Polyamine adduct hardener system
FP-11	Engineered Epoxy Poly Siloxane Coating or High Build cold applied inorganic Co-polymer based Aluminium coating
FP-12	Two component solvent free type High Build Epoxy Phenolic / Novalac Epoxy Phenolic coating cured with Polyamine adduct hardener system


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12.2 Detailed Specification of Primers and Finish Paints

The following are the various parameters of primers, finish paints and coating materials to be used for carrying out various painting / coating works


PRIMERS

Sr. No.	Description	PR-1	PR-2	PR-3	PR-4
1.	Technical Name	Chlorinated Rubber Zinc Phosphate Primer	Etch Primer / Wash Primer	Epoxy Zinc Phosphate Primer	Zinga, Locktite or ZRC Cold Galvanized
2.	Pack Type	Single Pack	Two Pack	Two Pack	Single Pack
3	Composition	Air Drying Chlorinated, Rubber based medium Plasticized with unsaponifiable Plasticizer, pigmented with zinc phosphate	Polyvinyl butyral resin medium cured with phosphoric acid solution. pigmented with zinc tetroxy chromate	Polyamine cured epoxy resin, medium, pigmented with zinc phosphate	Synthetic resin based zinc galvanizing containing min 92% of electrolytic zinc dust of 99.95% purity.
4.	Vol. Solids %	40±3	10±1	50±1	37%
5.	DFT (Micron) / Coat	40-45	8-10	40-50	40-50fl
6.	Covering M ² / Coat / Litre	8-10	8-10	8-10	4 m ² /kg
7.	Wt. Kg. / Litre	1.3±0.05	1.2±0.05	1.4±0.05	2.67 kg at 15°C
8.	Touch Dry at 30°C Min.	30 minutes	2hrs.	After 30 min.	10 minutes
9.	Hard Dry at 30°C Max.	8 hrs.	24 hrs.	8 hrs.	24 hrs.
11.	Over-coat Interval at 30°C	Min.: 8 hrs.	Min.: 4-6 hrs.	Min.:8hrs.	Min.:4 hrs
12.	Pot Life at 30°C	Not applicable	Not applicable	6-8 hrs.	Unlimited
13.	Temperature. Resistance min	60°C Dry service	NA Dry service	80°C Dry service	50°C Dry service

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FINISH PAINTS

Sr. No.	Description	FP-1	FP-2	FP-3A /B	FP-3C	FP-4
1.	Technical Name	Acrylic Polyurethane finish paint	Chlorinated Rubber based finish paint	Epoxy-High Build coating	Solvent less Epoxy coating	High Build Coal Tar Epoxy coat.
2.	Pack Type	Two pack	Single pack	FP-3A: Two pack	Two pack	Two pack
3	Composition	Aliphatic isocyanate cured acrylic finish paint with Glossy-High Glossy finish	Plasticized chlorinated rubber based medium with chemical and weather resistant pigments.	FP-3A: Aromatic amine cured epoxy resin medium suitably pigmented. FP-3B: polyamide cured epoxy resin medium suitably pigmented	Cured with Amine Adduct; catalyzed epoxy resin suitably pigmented.	Polyamide cured epoxy resin blended with coaltar medium, suitably pigmented
4.	Vol. Solids %	40±3	38±2	60±3	99±1	65±3
5.	DFT (Micron) / Coat	30-40	30-40	100-125	200-500	100-125
6.	Covering M ² / Coat / Litre	11-15	11-15	5-6	2-3	5.2-6.5
7.	Wt. Kg. / Litre	1.15±0.03	1.15±0.03	1.42±0.03	1.40±0.03	1.40±0.03
8.	Touch Dry at 30°C Max.	30 Min.	30 Min.	3 Hrs.	3 Hrs.	4 Hrs..
9.	Hard Dry at 30°C Max. Full Cure at 30°C for Immersion	8 Hrs. NA	8 Hrs.. NA	16 Hrs. 5 days	16 Hrs. NA	48 Hrs. 5 days
10.	Over-coat Interval at 30°C (Min)	12 Hrs.	Overnight.	Overnight. Max.: 5 days	8 Hrs.. Max.: 48 hrs	24 Hrs. Max.: 5 days
11.	Pot Life at 30°C for paints -two components	6-8 Hrs.	NA	4-6 Hrs.	30 Min.	4-6 Hrs.
12.	Temperature. Resistance - Dry service - Immersion	80°C -	- 60°C	80°C -	120°C 50°C	- 125°C

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Sr. No.	Description	FP-5	FP-6	FP-7	FP-8
1.	Technical Name	High Build Epoxy , self-priming type surface tolerant coating (for complete rust control)	Inorganic zinc silicate coating	Aluminum Paint Heat resistant synthetic medium based suitable up to 250°C dry temp	Silicone Aluminum Paint Heat resistant suitable up to 500°C dry temp.
2.	Pack Type	Two pack	Two pack	Two pack	Single pack
3	Composition	Epoxy resin based suitable pigmented and capable of adhering to manually prepared surface and old coating.	Air drying self curing solvent based inorganic zinc silicate coating with minimum 80% zinc content on dry film. The final cure of the dry film shall pass the MEK rub test. Zinc purity shall be Type-II of ASTM D520	Heat resistant synthetic medium based Aluminium paint suitable upto 250°C.	Silicon resin based medium with Aluminum flakes.
4.	Vol. Solids %	78±3	60±3	38±0.03	20±2
5.	DFT (Micron) / Coat	100-125	65-75	15-20	15-20
6.	Covering M ² / Coat / Litre	6.0-7.2	8-9	10-12	8-10
7.	Wt. Kg. / Litre	1.41 ± 0.03	2.3 ± 0.03	0.95 ± 0.03	1.0 ± 0.03
8.	Touch Dry at 30°C Max.	3 Hrs.	30 Min.	3 Hrs.	30 Min.
9.	Hard Dry at 30°C Max. Full Cure 30°C for Immersion	24 Hrs. 5 days	12 Hrs. NA	12 Hrs. NA	24 Hrs. NA
10.	Over-coat Interval Min.	10 hrs.	12 hrs. at 20°C & 50% RH.	24 hrs.	24 hrs.
11.	Pot Life at 30°C	90 Min.	4-6 Hrs.	NA	NA
12.	Temperature. Resistance Min. Dry service	80°C	540°C.	250°C	500°C .

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FINISH PAINTS... CONT'D

Sr. No.	Description	FP-9	FP-10	FP-11	FP-12
1.	Technical Name	Coal Tar Epoxy Polyamine cured	Epoxy Phenolic coating Two-component cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint).	Poly Siloxane Coating - ambient temperature curing / High build inorganic copolymer based Aluminium coating, cold applied suitable for under insulation coating of CS and SS piping for high temperature service	High Build Epoxy phenolic based - Two components solvent free type / Novalac Epoxy Phenolic coating
2.	Pack Type	Single pack	Two pack	Two pack	Single pack
3	Composition	Specially formulated polyamine cured coal tar epoxy suitable for application under insulation	Temperature curing epoxy phenolic coating system suitable for application under insulation of CS/AS/SS piping	Amercoat 738 from PPG Protective & Marine Coatings or Interterm 751 CSA of International (Akzo Nobel). Note: 6	High build epoxy phenolic / Novalac Epoxy phenolic coating cured with Polyamine adduct hardner system
4.	Vol. Solids %	70 ± 3	70 ± 3	60 ± 2	98 -100
5.	DFT (Micron) / Coat	100-125	75-100	75-100	125-150
6.	Covering M ² / Coat / Litre	5-8	4-5	7-9	6.5-8
7.	Wt. Kg. / Litre	1.45 ± 0.03	1.65 ± 0.03	1.3	1.7
8.	Touch Dry at 30°C Min.	4 Hrs.	3 Hrs.	1 Hrs.	2 Hrs.
9.	Hard Dry at 30°C Max.Full Cure 30°C for Immersion	24 Hrs. 168 Hrs.(7days)	24 Hrs. 168 Hrs.(7days)	16 Hrs. -	24 Hrs. 168 Hrs.7days)
10.	Over-coat Interval Min,	6 Hrs. Max.: 5 days	16 Hrs. Max.: 21 days	16 Hrs.. Max.: NA	16 Hrs. Max.: 21 days
11.	Pot Life at 30°C	4 Hrs.	4-6 Hrs.	1 Hr.	1 Hr.

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12.	Temperature. Resistance Min.	-45°C to 125°C under insulation And immersion	-45°C to 150°C under insulation & immersion. (Note: 5)	<ul style="list-style-type: none"> Up to 400 °C for CS & SS for Intertherm 751 CSA Up to 480 °C for CS and up to 600 °C for SS for Amercoat 738 (Note 6) 	-45°C to 150°C for immersion service
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Notes:

- Covering capacity and DFT depends on method of application. Covering capacity specified above is theoretical. Allowing the losses during application, min. specified DFT shall be maintained.
- All primers and finish coats shall be cold cured and air drying unless otherwise specified.
- All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship shall be ensured. In case of conflict between this specification and manufacturer's recommendation, the same shall be clarified with Engineer in charge.
- Technical data sheets for all paints shall be supplied at the time of submission of quotations.
- FP-10 Two-component Epoxy phenolic coating cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint) suitable upto 225°C (Intertherm 228 from M/s Akzo Nobel Coatings India Pvt Ltd. Bangalore). For all other companies, the temperature resistance shall be a maximum of 150°C.
- FP-11 Ambient temperature curing epoxy poly siloxane Coating or high build cold applied inorganic co-polymer based aluminium coating. Amercoat 738 from PPG Protective & Marine coatings, Mumbai is suitable up to 480°C for CS surfaces and 600°C for SS surfaces. Intertherm 751 from Akzo Nobel Coatings India Pvt Ltd., Bangalore, Inorganic co- polymer cold applied Aluminium spray coating is suitable upto 400°C of CS & SS surfaces.

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13. PAINTING SYSTEM TABLES & SELECTION CRITERIA

13.1 Painting System Tables:

There are 11 painting system tables in this specification covering most of painting and coating works. However, new table may be added based on project requirement for any specific painting works as necessary. The tables are as under:

Table-01	Painting systems for uninsulated piping, equipment and structures in process units, power plant, DM plant, cooling tower, chimney / stack, package units and any other equipment in process units also including offsite in coastal areas
Table-02	Painting system for insulated equipment and piping (under insulation) in process units and off sites (Carbon steel, LTCS, SS & low alloy steel)
Table-03	Painting system for uninsulated storage tanks in process units and off sites (Carbon steel & low alloy steel)
Table-04	Painting system for internal surface of storage tanks in process units and off sites (Carbon steel & low alloy steel)
Table-05	Painting system for external surface of underground piping and vessels in units and off sites (Carbon steel)
Table-06	Painting system for internal protection of components of coolers / condensers in fresh water service in units and off sites (Carbon steel)
Table-07	Painting system for internal protection of components of coolers / condensers in fresh water service in units and off sites (Stainless steel, duplex stainless steel, non-ferrous materials & galvanized steel)
Table-08	Painting system for effluent treatment plants (ETP)
Table-09	Coating systems for gratings, rolling & stationery ladders, spiral stairways and hand rails in all location
Table-10	Repair of pre-erection / pre-fabrication or shop primer after erection / welding of uninsulated piping and equipment in all environments. (CS, LTCS & low allow steel)
Table-11	Painting system for uninsulated Piping, Equipment, Tanks & Package units in Process Units & Off-Sites (Stainless Steel)

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13.2 Table selection Criteria:

The painting Table shall be selected based on following broad parameters given below. The selection criteria shall also be in the order below. All necessary precaution shall be taken in selecting the applicable table. In case of any difficulty Contractor may seek clarification before starting the works from Engineer in charge whose decision shall be final and binding on the Contractor.

Sr. No.	Criteria	Description	Details
1	Plant Location	<ul style="list-style-type: none"> Non Coastal / Inland Coastal / Marine 	More than 50 KM from Sea shore Coastal / Marine Within 50 KM from Sea shore
2	Environment	<ul style="list-style-type: none"> Industrial Industrial Marine 	Use Industrial , if Marine environment is not mentioned
3	Type of facility	<ul style="list-style-type: none"> Units Offsite 	Process Units, Power Plant, Cooling Towers, DM Plant, pipe Rack in units, Package units, chimney/ stack, any other equipment in units Offsite- pipe racks, Piping on Sleepers
4	Temperature Ranges	(-) 180°C to 600°C	Temperature varies for case to case. Selection of painting systems according to the operating temperatures of the line.
5	Material of Const. (MOC)	Carbon Steel (CS) Low Alloy Steel, Stainless Steel (SS)	Aluminium, Copper , Monel, Incoloy, Nickel No painting is required
6	<ul style="list-style-type: none"> Insulated Non Insulated 	Equipment / Piping Equipment / Piping	See Under insulation table

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7	<ul style="list-style-type: none"> • Aboveground • Underground 	Equipment / Piping Equipment / Piping	Equipment /piping in pit consider underground
8	Surface	<ul style="list-style-type: none"> • External • Internal 	Equipment /piping Equipment only

NOTES: (For ALL Tables)

1. The list of items specified in tables is not exhaustive. More items may be included for a particular Contract as necessary. The Contractor shall complete painting including prefabrication primer for all the items in his scope of work as per tender documents and instructions of Engineer in charge.
2. If the pre-erection / prefabrication and shop primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the Engineer in charge may decide and advise re-blasting and priming again. Repair of pre- fabrication / pre-erection primer, as instructed, shall be carried out by Contractor.
3. All coating system including surface preparation, primer and finish coat for piping shall be done at site / field only.
4. Finish coating is not permitted at equipment manufacture shop.



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TABLE -01
PAINTING SYSTEMS FOR UNINSULATED PIPING, EQUIPMENT AND STRUCTURES IN
PROCESS UNITS, POWER PLANT, DM PLANT, COOLING TOWER, CHIMNEY / STACK,
PACKAGE UNITS AND ANY OTHER EQUIPMENT IN PROCESS UNITS ALSO INCLUDING
OFFSITES (Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Temp.in °C	Surface Preparation & Pre erection / Shop Primer	Painting System (Post-erection / Field)		Total Final DFT in Micr. (min.)	Remarks
			Primer	Finish Coat		
						<ul style="list-style-type: none"> No over coating to be done on FP-6 as it will lead to mud cracking.
1.2	-14 to 100	SSPC-SP-10 FP-6 = 75 µm FP-3A =150 µm FP-1 =35 µm Total DFT at shop = 260 µm	FP-1 =40 µm will apply after pressure water wash & surface rubbing Cumulative DFT = 300		300	<ul style="list-style-type: none"> FP-8 shall be ambient temperature curing type. Finish coat including primer compatible with finish coat. (I.e. field primer) shall be applied at site only.
1.3	101 to 400	SSPC-SP-10; 1 coat of FP-6 @ 65 - 75 micr. DFT / Coat	None	2 Coat of FP-8 @ 20 micr. DFT / Coat 2x20 =40	105 - 115	
1.4	401 to 540	SSPC-SP-10; 1 coat of FP-6 @ 75 micr. DFT / Coat	None	2 Coat of FP-8 @ 25 micr. DFT / Coat (2x25 =50)	125	

➤ For external surface of MS chimney with or without refractory lining and for internal surface without refractory lining, paint system at Sl. No.1.3 of the above table shall be followed.

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- For external surface of RCC Chimney 2 coats of FP-3A @ 100 Micr. DFT/ coat to obtain total DFT of 200 Micr. shall be applied after proper surface preparation as per Clause 9.3.7
- In case of paint systems as per Sl. Nos. 1.3 and 1.4, the colour bands shall be applied over the Aluminum paint as per the Color coding system requirement for specific service of piping.
- For 1.3 & 1.4 finish coat at field may be applied at shop itself and touch-up will be done at field.

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TABLE -02
PAINTING SYSTEM FOR INSULATED EQUIPMENT AND PIPING (UNDER INSULATION) IN
PROCESS UNITS AND OFFSITES (Carbon Steel, LTCS, SS & Low Alloy Steel)

Sl. No.	Temp.in °C	Surface Preparation & Pre erection / Shop Primer	Painting System (Post-erection / Field)		Total Final	Remarks
			Primer / Intermediate	Finish Coat	DFT in Microns (min.)	
2.1	Equipment & Piping - Carbon steel, LTCS and low Alloy steel					
2.1.1	- 45 to 200	SSPC-SP-10 1 coat of FP-10 @ 125 micr. DFT/coat.	None	1 coat of FP-10 @ 75micr. DFT/coat. (1x125=125)	250	
2.1.2	201 to 540	SSPC-SP-10; 1 coat of Titanium catalyzed inorganic ceramic coploymer @ 150 micr. DFT/coat.	None	1 coat of Titanium catalyzed inorganic ceramic coploymer @ 150micr. DFT/coat.	300	
2.2	Piping -Stainless Steel including Alloy-20 (Note:2)					
2.2.1	-180 to 600	For SS SSPC-SP-6 Commercial Blast/ For SS SSPC-SP-1 With non-chloride solvent 1 coat of Titanium catalyzed inorganic ceramic coploymer @ 150 micr. DFT/coat.	None	1 coat of Titanium catalyzed inorganic ceramic coploymer @ 150micr. DFT/coat. (150x1=150)	300	
2.3	No painting is required for insulated Monel, Incoloy and Nickel lines.					

- **"Cyclic Service"** is characterized by rapid temperature fluctuation.
- The blast cleaning abrasives for SS and Alloy steel surfaces shall be Aluminium oxide grits/shots or garnet.
- Surface shall be thoroughly degreased using an appropriate emulsion cleaner and

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abrasive cleaned (sweep blasting) to create a sufficient anchor profile. Abrasive for blast cleaning of stainless steel surfaces shall be performed with a suitable non-metallic abrasive such as aluminum oxide. When hand or power tool cleaning is required on stainless steel, only stainless steel wire brushes that have not been previously used on carbon steel surface must be used. All coatings and solvents for use on stainless steel shall be free of substances such as chlorides and other halides, sulfur, and shall be free of low melting point metals (zinc, aluminum, tin and lead).

- For 2.1.1, 2.1.2 & 2.2.1 finish coat at field may be applied at shop itself and touch-up will be done at field.

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TABLE -03
PAINTING SYSTEM FOR UNINSULATED STORAGE TANKS IN PROCESS UNITS AND
OFFSITES (Carbon Steel & Low Alloy Steel)

Sl. No.	Temp.in °C	Surface Preparation (Field)	Painting System (In field after welding & erection)		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
3.1	All external surfaces of shell, wind girders, appurtenances, roof tops of all above ground tank including top side of external and internal floating roof and associated external structural works.					
3.1.1	-14 to 100	SSPC-SP-10	1 coat of FP-6 @ 65-75 micr. DFT/coat +1 coat of PR-3@ 40 micr. DFT/coat.	2 coats of FP=3A @ 100 micr. DFT/coat + 1 coat of FP-1 @ 70 micr. DFT/coat;	345-355	FP-3A should be suitable for occasional water immersion.
3.1.2	101 to 150	SSPC-SP-10	1 coat of FP-10 @ 80 micr. DFT/coat +1 coat of FP-10 intermediate coat @ 80 micr. DFT/coat.	1 coats of FP-10 @80 micr. DFT/coat + 1 coat of FP-1@ 40 micr. DFT/coat;	280	-
3.1.3	151 to 500	SSPC-SP-10	1 coat of FP-6 @ 65-75 micr. DFT/coat	2 coats of FP-8 @20 micr. DFT/coat (or) 1coat of FP-11 @ 50 micr.	105	-
3.2	External surfaces of bottom plate (soil side) for all storage tanks.					
3.2.1	-14 to 80	SSPC-SP-10	1 coat of FP-6 @ 75 micr. DFT/coat.	2coat of High Glass Flake Epoxy @ 200 micr. DFT/coat.(2x200=400)	475	

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3.2.2	81 to 150	SSPC-SP-10	1 coat of FP-10 @ 80 micr. DFT/ coat +1 coat of FP-10 intermediate coat @ 80 micr. DFT/ coat. (80+80=160)	1 coats of FP-10 finish coat @80 micr. DFT/coat.	240	-
3.2.3	151 to 550	SSPC-SP-10	1 coat of FP-11 @ 125 micr. DFT/coat	1 coats of FP-11 finish coat @80 micr. DFT/coat.	250	-
3.3	For underside of the bottom plate (in case tank is not lifted during PWHT) (see Note 2c)					
3.3.1	-180 to 650	For CS SSPC-SP-6 Commercial Blast For SS SSPC-SP-1 With non-chloride solvent	1 coat of inter polymeric matrix coating @ 125 microns.	2 coat of inter polymeric matrix coating @ 125 microns.	350-400	Products from JOTUN or HI-TEMP coating or SK FOMULATION recommended.

- All paint coating application including primer for tankage shall be carried out at field after erection and completion of all welding.
- For underside of bottom plate, painting shall be carried out before laying of bottom plate for tanks with Non-Post Weld Heat Treatment (PWHT).
- For tanks with PWHT, painting shall be carried out after PWHT.
- In case tank is not lifted during PWHT then painting shall be applied before laying of bottom plate, SI no. 3.3.1 shall be followed.

Caution: PWHT temperature shall not exceed 650°C.

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TABLE -04

PAINTING SYSTEM FOR INTERNAL SURFACE OF STORAGE TANKS IN PROCESS UNITS AND OFFSITES (Carbon Steel & Low Alloy Steel)

Sl. No.	Temp.in °C	Surface Preparation (Field)	Painting System (In field after welding & erection)		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
4.1	Crude oil, ATF, Turpentine oil, Lubricating oil and Vegetable oil Underside of floating roof, internal surface of cone roof, inside of bottom plate, Internal surfaces of Shell - including wetted and free board height, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel, ladders and other carbon steel internals.					
4.1.1	-14 to 90	SSPC-SP-10	1 coat of FP-10 primer@ 80 micr. DFT/coat.	1 coats of FP-10 intermediate coat @80micr. DFT/coat+ 1coat of FP-10 finish coat@ 80 micr.	240 - 300	-
4.2	Petroleum products & Intermediates Like LDO, HSD, Gas oil, Feeds of FCC -PC, FCC-LCO, VGU-HDT, ISOM, DHDT, Reformate, DCU, NHT & Gasoline, Naphtha, Isomerate and Kerosene. Underside of Floating roofs, internal surface of cone roof, inside of bottom plate, internal surfaces of Bare shell for full height, underside of floating roof, oil side surfaces of deck plates, oil side surfaces of pontoons, support structures and ladders etc.					
4.2.1	-14 to 45	SSPC-SP-10	1 coat of FP-6 @ 75 micr. DFT/coat.	-	75	Note-1
4.2.2	46 to 90	SSPC-SP-10	1 coat of FP-10 primer@ 80 micr. DFT/coat+	1 coats of FP-10 intermediate coat @80micr. DFT/coat+ 1coat of FP-10 finish coat@ 80 micr. DFT/coat;	240-300	-
4.3	Raw / Fresh water, Potable water and Fire water All internal surfaces, accessories and roof structures of cone and dome roof tanks					
4.3.1	-14 to 65	SSPC-SP-10	1 coat of PR-3 @ 100 microns. DFT/coat	2 coats of FP3A @ 100 micr. DFT/coat. (2x100=200)	300	Note-2

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4.4	De-mineralized water (DM) All internal surfaces, accessories and roof structures of cone and dome roof tanks					
4.4.1	-14 to 60	SSPC-SP-10	1 coat of PR-3@ 100micr. DFT/coat.	2 coats of FP-3C @ 200 micr. DFT/coat. (2x100=200)	400 - 450	-
4.4.2	61 to 150	SSPC-SP-10	1 coat of FP-10 primer@ 80 micr. DFT/coat.	1 coats of FP-10 intermediate coat @80micr. DFT/coat+ 1coat of FP-10 finish coat@ 80 micr. DFT/coat; (80+80=160)	240 - 300	-
4.5	Hydrochloric Acid (HCl) 10% All internal surfaces, accessories and roof structures of cone and dome roof tanks					
4.5.1	-14 to 60	SSPC-SP-10	None	Natural Rubber Lining	4.5 mm	-
4.6	Aggressive Solvents like Hexane, Hexene, Benzene, Xylene and Toluene All internal surfaces, accessories and roof structures of cone and dome roof tanks.					
4.6.1	-14 to 65	SSPC-SP-10	1 coat of FP-6 @ 75microns. DFT/coat	-	75	-
4.7	Ethylene Glycol (EG) Tanks Internal shell-full height, bottom plate, underside of roof and all accessories					
4.7.1	ALL	SSPC-SP-10	1 coat of FP-10 primer@ 80micr. DFT/coat.	31 coats of Vinyl chloride Co-polymer Amercoat 23 @75micr. DFT/coat (3x75=225)	225	-
4.8	Inside pontoon and inside of double deck of all tanks floating roofs					
4.8.1	-14 to 80	SSPC-SP-3	1 coat of FP-5@ 100micr. DFT/coat.	1 coats of FP-5 coat @100micr. DFT/coat	200	-
4.9	Wet Slops, Amine Solutions, Sour water, Water draw off All internal surfaces, accessories and roof structures of Cone and Dome roof tanks.					


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4.9.1	-14 to 90	SSPC-SP-10	1 coat of Novolac Phenolic Epoxy Primer@ 125micr. DFT/coat.	1coat of Novolac Phenolic Epoxy finish coat@ 125 micr. DFT/coat; (80+80=160)	250	-
4.10	Vacuum Residue, Fuel oil, Dry Slop, Bitumen and other High Temperature Hydrocarbon Liquids. Underside of floating roof, internal surface of cone roof, bottom plate, inside of bare shell - including wetted and non-wetted surfaces, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel and ladders.					
4.10.1	Up to 150	SSPC-SP-10	1 coat of FP-12 Primer@ 125micr. DFT/coat.	1 coats of FP-12 intermediate coat @125micr. DFT/coat+ 1coat of FP-12 finish coat@ 125 micr. DFT/coat; (125+125=250)	375	Note-3
4.11	Alkalis up to 50 % Concentration All internal surfaces accessories and roof structures of cone and dome roof tanks					
4.11.1	Up to 60	SSPC-SP-10	1 coats of Novolac Phenolic Epoxy primer @125micr. DFT/coat.	1coats of Novolac Phenolic Epoxy @100micr. DFT/coat. (1x125=1250)	250	-

Notes:

1. FP-6 shall be suitable and resistant for immersion service for the respective Hydrocarbons.
2. FP-3A shall be suitable for drinking water service and should have competent authority certification.
3. This system can be used where maximum operating temperature is below 150°C and design temperature is up to 200°C. Cases of operating temperature above 150°C are not covered in this spec; such cases shall be covered in the job specifications.

TABLE -05

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PAINTING SYSTEM FOR EXTERNAL SURFACE OF UNDERGROUND PIPING AND VESSELS IN UNITS AND OFFSITES (Carbon Steel)

Sl. No.	Temp.in °C	Surface Preparation & Shop Primer	Coating System (Field)		Total	Remarks
			Surface Preparation & Primer	Finish Coat	Final DFT in Microns (min.)	
5.1	External surface of non-insulated underground piping					
5.1.1	25 to 65	-	SSPC-SP-10; Three layer polyethylene coating, thickness as per JSS for coating.			
5.1.2	66 to 150	-	SSPC-SP-10; 1 coat of FP-12 primer @ 125micr. DFT/coat.	1 coats of FP-12 intermediate coat @125micr. DFT/coat+ 1coat of FP-12 finish coat @ 125 micr. DFT/coat;	375	-
5.1.3	151 to 400	-	SSPC-SP-10; 1 coat of FP-11 primer @ 125micr. DFT/coat.	1 coat of FP-11 finish coat @ 125micr. DFT/coat.	250	-
5.2	External surface of non-insulated underground storage vessels					
5.2.1	-14 to 80	SSPC-SP-10; 1 coat of FP-6 @ 65-75 micr. DFT/coat.	-	3 coat of FP-4 @ 100 micr. DFT/coat.	365-375	-
5.2.2	81 to 150	SSPC-SP-10; 1 coat of FP-6 @ 125 micr. DFT/coat.	-	1 coat of FP-12 Intermediate coat @ 125micr. DFT/coat+ 1coat of FP-12 finish coat @ 125 micr. DFT/coat;	375	-
5.2.3	151 to 400	SSPC-SP-10; 1 coat of FP-11 @ 125 micr. DFT/coat.	-	1 coats of FP-11 finish coat @125micr. DFT/coat	250	-

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TABLE -06
PAINTING SYSTEM FOR INTERNAL PROTECTION OF COMPONENTS OF COOLERS /
CONDENSERS IN FRESH WATER SERVICE IN UNITS AND OFFSITES (Carbon Steel)

Sl. No.	Temp.in °C	Surface Preparation & Shop Primer	Coating System (Field)		Total	Remarks
			Surface Preparation & Primer	Finish Coat	Final DFT in Microns (min.)	
6.1	Fresh water boxes, channels, partition plates, end covers and tube sheets etc.					
6.1.1.	Up to 80	SSPC-SP-10;	1 coat of FP-10 @ 80micr.	2 coat of FP-10@ 80 micr. DFT/coat;	240	-
6.1.2.	80 to 140	SSPC-SP-10;	-	1Coat of glass Fibre Reinforced Novolac epoxy of 1.5mm DFT	1500	-

TABLE -07
PAINTING SYSTEM FOR INTERNAL PROTECTION OF COMPONENTS OF COOLERS /
CONDENSERS IN FRESH WATER SERVICE IN UNITS AND OFFSITES
(Stainless Steel, Duplex Stainless Steel, Non-ferrous materials & Galvanized Steel)

Sl. No.	Temp.in °C	Surface Preparation & Shop Primer	Coating System (Field)		Total Final DFT in Microns (min.)	Remarks
			Surface Preparation & Primer	Finish Coat		
7.1	Up to 80	Sweep Blasting	1 coat of FP-10 @ 80micr. DFT/coat;	1 coat of FP-105@ 80 micr. DFT/coat;	160	-
7.2.	80 to 140	Sweep Blasting	-	1Coat of glass Fibre Reinforced Novolac epoxy of 1.5mm DFT	1500	-

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TABLE -08

PAINTING SYSTEM FOR EFFLUENT TREATMENT PLANTS (ETP)

Sl. No.	Temp.in °C	Surface Preparation	Coating System		Total	Remarks
			Primer	Finish Coat	DFT in Microns	
8.1	External Surface of C.S./ M.S. items screens, walk way, bridges, baffles, dual media filters, Vertical pumps, piping in treated effluent sump, bio sludge pump,					
8.1.1	-14 to 80	SSPC-SP-10	1 coat of FP-6 @ 65-75 micr. DFT/coat	2 coats of FP-3A@100 micr. DFT/coat+ 1coat of FP-1 @ 40 micr. DFT/coat; (2x100+40=240)	305 - 315	
8.2	Internal surfaces of CS/MS Items: Bio-sludge sump, Filter feed sump, Process sump, Sanitary sump, Transfer sump, Sludge, Slop oil tank, scrapping mechanism in Clarifier					
8.2.1	-14 to 80	SSPC-SP-10	1 coat of FP-6 @ 65-75 micr. DFT/ coat.	3 coats of FP-3A @100 micr. DFT/coat (3x100=300)	365 - 375	See * below
8.3	R.C.C./concrete surfaces exposed to effluent water / liquid such as tanks, structures, drains etc. in process sump, TPI separator (Process and oil), Aeration tank and Transfer sump etc.					
8.3.1	-14 to 80	Blast cleaning to SSPC-SP guide lines and Acid etching with 10-15% HCl acid followed by thorough water washing.	Epoxy Screed lining		3mm	Epoxy screed lining shall be applied as per specific manufacturer and Engineer in charge instructions.
8.4	C.S/ M.S Dual media filters (Internal), Chemical dosing tanks(internal) such as Di Ammonium Phosphate (DAP) and Urea					
8.4.1	Up to 60	SSPC-SP-10	Natural Rubber Lining (As per IS 4682, Part I)		4.5mm	Natural Rubber lining shall be applied as per specific manufacturer and Engineer in charge instructions.

- The paint /coating manufacturers shall provide their Quality control test certificate of coating materials (F-3A) for immersion service of the exposed effluent given in 9.2.

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TABLE -09

**COATING SYSTEMS FOR GRATINGS, ROLLING & STATIONERY LADDERS, SPIRAL STAIRWAYS
AND HAND RAILS IN ALL LOCATION**

Sl. No.	Temp.in °C	Coating System	Total DFT in Microns (min,)
9.1	Up to 60	1 coat of High Build Epoxy @ 75 micr. DFT/Coat and 1 coat pf FP-1 @ 50 micr. DFT/Coat	80 microns of finish coat (excluding the thickness of galvanizing) 125

NOTES:

1. No galvanized specimen shall have thickness less than 125 microns.
2. Repair of the damaged area of galvanized coatings due to welding during erection shall be carried out as per recommended practice IS 11759 using cold galvanizing spray process. Organic Paint systems are not acceptable for repair.
3. Approved Cold Galvanizing manufacturers are **ZINGA, LOCKTITE** or **Z.R.C.**

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TABLE -10

**REPAIR OF PRE-ERECTION / PRE-FABRICATION OR SHOP PRIMER AFTER ERECTION /
WELDING OF UNINSULATED PIPING AND EQUIPMENT IN ALL ENVIRONMENTS.
(CS, LTCS & low allow steel)**

Sl. No.	Temp.in °C	Surface Preparation	Coating System	Total DFT in Micr (min.)	Remarks
10.1	-90 to 400	SSPC-SP-3	1coat of FP-6	65-75	See note below and clause 5.9.3
10.2	401 to 550	SSPC-SP-3	1coat of FP-8	20	

- The repair of pre-erection / pre-fabrication or Shop Primer given above shall be done for all items requiring repairs. In case the damages of primer are severe and spread over large area, entire primer shall be removed by blasting to achieve SSPC-SP-10 and surfaces to be primed again with FP-6 or FP-8 as applicable.
- The primer shall be quickly removed from damaged area by mechanical scraping and emery paper conforming to SSPC-SP-3 to expose the white metal. Blast cleans the surface, if possible. Feather the primed surface over the intact adjacent surface(approximately 50mm) surrounding the damaged area by emery paper.

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TABLE -11

**PAINTING SYSTEMS FOR UN-INSULATED PIPING, EQUIPMENT, TANKS & PACKAGE
UNITS IN PROCESS UNITS AND OFFSITES
(STAINLESS STEEL)**

Sl. No.	Temp.in °C	Surface Preparation	Painting System (Post-erection / Field)		Total Final DFT in Micr. (min.)	Remarks
			Primer	Finish Coat		
11.1	0 to 120	SSPC-SP-6 'Sweep blast' using Aluminium Oxide or Garnet abrasive media SSPC-SP-1 With non-chloride solvent	2 Coats of FP-10 @ 125 micr. DFT / Coat 2x125=250	1 Coat of FP-1 @ 75 micr. DFT / Coat 1x75 =75	325	
11.2	121 to 200	SSPC-SP-6 'Sweep blast' using Aluminium Oxide or Garnet abrasive media SSPC-SP-1 With non-chloride solvent	2 Coats of FP-10 @ 125 micr. DFT / Coat 2x125=250	2 Coats of Silicon Acrylic @ 20 micr. DFT / Coat 2x20 =40	290	

- Surface preparation of stainless steel shall be in accordance with IS 8504-2, Sa 1 light blast cleaning to achieve a 25-40µm profile.
- Surface shall be thoroughly degreased using an appropriate emulsion cleaner and abrasive cleaned (sweep blasting) to create a sufficient anchor profile. Abrasive for blast cleaning of stainless steel surfaces shall be performed with a suitable non-metallic abrasive such as aluminum oxide. When hand or power tool cleaning is required on stainless steel, only stainless steel wire brushes that have not been previously used on carbon steel surface must be used. All coatings and solvents for use on stainless steel shall be free of substances such as chlorides and other halides, sulfur, and shall be free of low melting point metals (zinc, aluminum, tin and lead).
- Only air curing heat resistant silicone aluminium paints shall be applied, post heat curing materials are not acceptable
- The colour bands shall be applied over the Aluminum paint as per the Color coding system requirement for specific service of piping.
- Finish coat at field may be applied at shop itself and touch-up will be done at field.


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14. FINISH COLOUR SCHEDULE

14.1 General

This section covers the general colour requirements for structural steelwork and equipment with operating temperatures below 120 deg.C:

Structural Steel, Tanks, Spheres, Electrical Equipment		
Sl. No:	Service	Shade – Shade Number
N/A	Structural Steelwork	Light Grey – RAL 7035
N/A	Spheres and Storage tanks	White – RAL 9003
N/A	Electrical Switch Boards, Cable Conduit and Transformers and all other electrical equipment	Manufacturers Painting standard (including RAL 7035) conforming to relevant code and practices prevailing in the country of manufacture
Un-insulated Equipment, Tanks and Structures		
Sl. No:	Service	Shade – Shade Number
-	Loading Arms (i) Structural Steel (ii) Arms	Light Grey – RAL 7035 Yellow – RAL 1023
96	Heater Structure	Signal Grey – RAL 7004
97	Heater Casing	Aluminium – RAL 9006
98	Vessels and Columns	Aluminium – RAL 9006
99	Hydrogen Bullets	Antique Pink – RAL 3014
100	LPG Vessels	Oxide Red – RAL 3009
101	SO ₂ Vessel	Yellow – RAL 1023
102	Heat Exchangers	Aluminium – RAL 9006
103	FO Tank and Hot Tanks	Black – RAL 9017
104	All Other Tanks	Aluminium – RAL 9006
105	Caustic/Amine/Acid Tanks	Gold/Yellow – RAL 1004
106	Sour Water	Sky Blue – RAL 5015
107	Outer Surface in Boiler House	Aluminium – RAL 9006
108	Steam Turbine	Aluminium – RAL 9006
109	Compressors and Blowers	Dk Grey BS4800 18 B 25
110	Pumps	Cobalt Blue RAL – 5013
111	Motors (Except Fire Motors)	Bluish Green RAL 5021
112	Hand Railing	Red – RAL 3001
113	Staircase, Ladders and Walkways	Black – RAL 9017
114	Load lifting equipment & mono rails etc.	Brown – RAL 8003

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Safety Colour Schemes		
Sl. No:	Service	Shade – Shade Number
115	General Structure	Black – RAL 9017
116	Switchgear (including inside sub- station)	Light Grey RAL 7035
117	Dangerous Obstruction	Alternate Black (RAL 9017) and Orange (RAL 2008) Diagonal Banding
118	Dangerous or Exposed Parts of Machinery	Orange – RAL 2008

14.2 Pipe Colour Bands

This section covers the requirements for a colour scheme identifying the contents of piping carrying products. The colour coding system is based on international specifications such as ASME, ANSI, BS and Indian Standards including IOCL's existing specification for colour coding.

The system of coding consists of a ground/base colour superimposed with secondary colour bands. The ground colour identifies the basic nature of the service and the secondary colour bands distinguish the particular service product contained.

Ground colour shall be applied to the entire length of un-insulated piping.

The ground colours and secondary banding colours are defined in section 14.4.

The frequency of banding on un-insulated pipe shall be as follows:

- Unit Area – Bands at intervals of 6 metres
- Offsite Area – Bands at intervals of 10 metres

Each pipe segment will have a minimum of 1 identification band irrespective of length.

Colour bands of the correct size shall be applied to the pipe, at:

- Both sides of valves, tees and other fittings
- Where pipes enter and emerge through walls
- Where pipes enter and emerge from walkway overpasses and battery limits
- At uniform intervals along long sections of pipe
- Adjacent to tanks, vessels and pumps.

Insulated piping shall received ground colouring and coloured (secondary) identification bands at a minimum of either side of valves, flanges and the like, at each change in flow direction and at no greater than 6 metre intervals, ground colours should be 2 metres long.

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Secondary colours are to be applied using adhesive plastic tapes to the specified colour.

Bands widths are shown below for different pipe diameters and are to be spaced 25mm apart when two bands (or more) are used:

Outside diameter of pipe or covering (inches)	Width of colour bands (mm)
< 2"	200
2" – 4"	300
6" – 8"	600
>= 10"	800

Bands shall also be displayed conspicuously near walkways, both sides of culverts, tanks, dykes, vessels, suction and discharge of pumps/compressors, unit battery limit, near valves of line, etc.,

14.3 Identification Lettering

Name of service and direction of flow, for all lines shall be positioned at the following locations:

- Offsite lines: Both sides of culverts, any one side of walkways, near tank dykes, at tank inlet/outlet points and suction/discharge pumps/compressors.
- Unit lines: At the battery limit, suction/discharge of pumps/compressors, near vessels, columns, tanks, exchangers etc.,

Identification/legend letter sizes on piping shall depend on the pipe diameter. Either white or black letters are to be selected so as to afford maximum contrast with the identification band colour.

Outside diameter of pipe or covering (inches)	Size of legend letters (mm)
< 2"	19
2" – 4"	32
6" – 8"	64
>= 10"	89

Pipe contents and direction of flow is to be identified using legend letters and arrows, any hazard must be identified clearly by the legend.

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Size of letters (stenciled or pre-formed adhesive) for equipment shall be:

Equipment	Size of legend letters
Column and vessel	150 mm (height)
Pump, compressor and other machinery	50 mm (height)

Lettering shall be black on pipes painted with light shade colours and white on pipes painted with dark shade colours to give good contrast.

14.4 IOCL Paint Colour Code and Banding

The following base / ground and secondary colour designation for identification of various important services shall be followed:

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Sl. No:	Service	Base/Ground Colour	Secondary Band Colours
	Hydrocarbon Lines – (Un-insulated)		
1.	Crude Sour	Dk Grey BS4800 18 B 25	(x1) Orange – RAL 2008
2.	Crude Sweet	Dk Grey BS4800 18 B 25	(x1) Red – RAL 3001
3.	Lube Oils	Dk Grey BS4800 18 B 25	(x1) Green – RAL 6002
4.	Flare Line	Aluminium – RAL 9006	Aluminium – RAL 9006
5.	L.P.G.	Orange – RAL 2008	(x1) Oxide Red – RAL 3009
6.	Propylene	Orange – RAL 2008	(x2) Oxford Blue – RAL 5003
7.	Naptha	Orange – RAL 2008	(x1) Green – RAL 6002
8.	M.S.	Orange – RAL 2008	(x1) Dk Grey BS4800 18 B 25
9.	AV. Gasoline (96 RON)	Orange – RAL 2008	(x1) Green – RAL 6002 + (x1) White – RAL 9003 + (x1) Red – RAL 3001
10.	Gasoline (regular, leaded)	Orange – RAL 2008	(x1) Black – RAL 9017
11.	Gasoline (premium, leaded)	Orange – RAL 2008	(x1) Blue – RAL 5017
12.	Gasoline (white)	Orange – RAL 2008	(x1) White – RAL 9003
13.	Gasoline (aviation 100/130)	Orange – RAL 2008	(x1) Red – RAL 3001
14.	Gasoline (aviation 115/145)	Orange – RAL 2008	(x1) Purple – RAL 4006
15.	N-Pentane	Orange – RAL 2008	(x2) Blue – RAL 5017
16.	Diesel Oil (white)	Oxide Red – RAL 3009	(x1) White – RAL 9003
17.	Diesel Oil (black)	Oxide Red – RAL 3009	(x1) Yellow – RAL 1023
18.	Kerosene	Oxide Red – RAL 3009	(x1) Green – RAL 6002
19.	HY. Kero	Oxide Red – RAL 3009	(x2) Green – RAL 6002
20.	Disulfide Oil (Ex-Merox)	Oxide Red – RAL 3009	(x1) Black – RAL 9017
21.	M.T.O.	Oxide Red – RAL 3009	(x3) Green – RAL 6002
22.	DHPPA	Oxide Red – RAL 3009	(x2) White – RAL 9003
23.	Flushing Oil	Oxide Red – RAL 3009	(x2) Black – RAL 9017
24.	Lab FS	Oxide Red – RAL 3009	(x2) Dk Grey BS4800 18 B 25
25.	Lab RS	Oxide Red – RAL 3009	(x3) Dk Grey BS4800 18 B 25
26.	Lab (Off. Spec.)	Oxide Red – RAL 3009	(x1) Lt Grey RAL 7036
27.	N-Paraffin	Oxide Red – RAL 3009	(x1) Blue – RAL 5017
28.	Heavy Alkylate	Oxide Red – RAL 3009	(x1) Red – RAL 3001
29.	Blow Down, Vapour Line	Aluminium – RAL 9006	(x1) Brown – RAL 8003
30.	Blow Down	Aluminium – RAL 9006	(x2) Brown – RAL 8003

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Sl. No:	Service	Base/Ground Colour	Secondary Band Colours
31.	A.T.F.	Brown – RAL 8003	(x1) White – RAL 9003
32.	Toluene	Brown – RAL 8003	(x1) Yellow – RAL 1023
33.	Benzene	Brown – RAL 8003	(x1) Green – RAL 6002
34.	Lab Product	Brown – RAL 8003	(x1) Blue – RAL 5017
35.	Fuel Oil	Black – RAL 9017	(x1) Yellow – RAL 1023
36.	Fuel Oil (aromatic rich)	Black – RAL 9017	(x2) Yellow – RAL 1023
37.	Asphalt	Black – RAL 9017	(x1) White – RAL 9003
38.	Slop and Waste Oils	Black – RAL 9017	(x1) Orange – RAL 2008
39.	Slop Aromatic	Black – RAL 9017	(x2) Orange – RAL 2008

Chemical Lines (Un-insulated)			
40.	Tri-Sodium Phosphate	Yellow – RAL 1023	(x1) Violet – RAL 4008
41.	Caustic Soda	Yellow – RAL 1023	(x1) Black – RAL 9017
42.	Sodium Chloride	Yellow – RAL 1023	(x1) White – RAL 9003
43.	Ammonia	Yellow – RAL 1023	(x1) Blue – RAL 5017
44.	Corrosion Inhibitor	Yellow – RAL 1023	(x1) Aluminium – RAL 9006
45.	Hexameta Phosphate	Yellow – RAL 1023	(x2) Black – RAL 9017
46.	Acid Lines	Gold/Yellow – RAL 1004	(x1) Red – RAL 3001
47.	Rich Amine	Yellow – RAL 1023	(x2) Blue – RAL 5017
48.	Lean Amine	Yellow – RAL 1023	(x3) Blue – RAL 5017
49.	Solvent	Yellow – RAL 1023	(x1) Green – RAL 6002
50.	LCS	Yellow – RAL 1023	(x1) Grey – RAL 7001

Water Lines (Un-insulated)			
51.	Raw Water	Sky Blue – RAL 5015	(x1) Black – RAL 9017
52.	Industrial Water	Sky Blue – RAL 5015	(x2) Red – RAL 3001
53.	Treated Water	Sky Blue – RAL 5015	(x1) Oxide Red – RAL 3009
54.	Drinking Water	Sky Blue – RAL 5015	(x1) Green – RAL 6002
55.	Cooling Water	Sky Blue – RAL 5015	(x1) Pale Brown – RAL 8025
56.	Service Water	Sky Blue – RAL 5015	(x1) Red – RAL 3001
57.	Tempered Water	Sky Blue – RAL 5015	(x2) Green – RAL 6002
58.	DM Water	Sky Blue – RAL 5015	(x1) Aluminium – RAL 9006
59.	DM Water above 150°F	Sky Blue – RAL 5015	(x2) Black – RAL 9017
60.	Sour Water	Sky Blue – RAL 5015	(x2) Yellow – RAL 1023

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Sl. No:	Service	Base/Ground Colour	Secondary Band Colours
61.	Stripped Water	Sky Blue – RAL 5015	(x2) Blue – RAL 5017
62.	ETP Treated Water	Sky Blue – RAL 5015	(x2) Oxide Red – RAL 3009

Fire Protection System (Above Ground)			
63.	Fire Water, Foam and Extinguishers	Red – RAL 3001	Red – RAL 3001

Air and Other Gas Lines (Un-insulated)			
64.	Service Air	May Green – RAL 6017	(x1) Red – RAL 3001
65.	Instrument Air	May Green – RAL 6017	(x1) Black – RAL 9017
66.	Nitrogen	May Green – RAL 6017	(x1) Orange – RAL 2008
67.	Freon	May Green – RAL 6017	(x1) Yellow – RAL 1023
68.	Chlorine	Yellow – RAL 1023	(x1) Oxide Red – RAL 3009
69.	SO ₂	Yellow – RAL 1023	(x2) White – RAL 9003
70.	H ₂ S	Orange – RAL 2008	(x2) Oxide Red – RAL 3009
71.	Gas (fuel)	Orange – RAL 2008	(x1) Aluminium – RAL 9006
72.	Gas (sour)	Orange – RAL 2008	(x2) Aluminium – RAL 9006
73.	Gas (sweet)	Orange – RAL 2008	(x1) Red – RAL 3001
74.	Hydrogen	Orange – RAL 2008	(x1) May Green – RAL 6017

Steam and Condensate Lines (Un-insulated)			
75.	HP Steam & VHP Steam Line	Aluminium – RAL 9006	(x1) Yellow – RAL 1023
76.	MP Steam	Aluminium – RAL 9006	(x1) Red – RAL 3001
77.	MLP Steam	Aluminium – RAL 9006	(x1) Orange – RAL 2008
78.	LP Steam	Aluminium – RAL 9006	(x1) Green – RAL 6002
79.	Condensate	Sky Blue – RAL 5015	(x1) White – RAL 9003
80.	Condensate above 150°F	Sky Blue – RAL 5015	(x3) Oxide Red – RAL 3009
81.	BFW	Sky Blue – RAL 5015	(x2) Traffic Red – RAL 3020
Note: For all insulated steam lines, the colour coding shall be followed as given for un-insulated lines with the specified length of colour bands			

Insulated Hydrocarbon Lines			
82.	IFO Supply	Black – RAL 9017	(x1) Yellow – RAL 1023
83.	IFO Return	Black – RAL 9017	(x1) Green – RAL 6002
84.	HPS	Black – RAL 9017	(x1) Red – RAL 3001
85.	Bitumen	Black – RAL 9017	(x2) Red – RAL 3001

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Sl. No:	Service	Base/Ground Colour	Secondary Band Colours
86.	CLO	Black – RAL 9017	(x1) Brown – RAL 8003
87.	VB Tar	Black – RAL 9017	(x2) Brown – RAL 8003
88.	VR AM (Bitumen/VBU Feed)	Black – RAL 9017	(x1) Blue – RAL 5017
89.	VR BH	Black – RAL 9017	(x2) Blue – RAL 5017
90.	VAC. Slop	Black – RAL 9017	(x1) White – RAL 9003
91.	Slop	Black – RAL 9017	(x1) Orange – RAL 2008
92.	Crude Sweet	Dk Grey BS4800 18 B 25	(x1) Red – RAL 3001
93.	Crude Sour	Dk Grey BS4800 18 B 25	(x1) Orange – RAL 2008
94.	VGO/HCU Feed	Oxide Red – RAL 3009	(x1) Signal Grey – RAL 7004
95.	OHCU Bottom/FCCU Feed	Oxide Red – RAL 3009	(x2) Signal Grey – RAL 7004

15. STORAGE

All paints and painting materials shall be stored only in rooms to be arranged by contractor and approved by Engineer in charge for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent building. A signboard bearing the word **"Paint Storage – No Naked Light - Highly Inflammable"** shall be clearly displayed outside. Manufacturer's recommendation shall be followed for storage of paint materials.

16. QUALITY CONTROL, INSPECTION & TESTING

- All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable
- The contractor must produce Test Certificate from Pre-Qualified Paint Manufacturer for various tests as specified in this document, for each batch and for each category of product. The Engineer in charge shall have the right to test wet samples of paint from each batch at random for verifying quality of paint supplied. Contractor shall arrange to have such tests, when called for by Engineer in charge, performed at his cost any one of the independent laboratories listed in this document.

Samples for the test will be drawn at random in presence of Engineer in charge or his

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representations. Following tests to be carried out if called for by Engineer in charge:

- Specific Gravity
- % solids by weight (% zinc content in case of inorganic or organic zinc primer)
- Drying time (touch dry & full curing)
- Adhesion
- Flexibility
- Hardness
- Storage stability (pot life)

Test methods for above tests shall be as per relevant ASTM or ISO Standard.

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

During surface preparation, following tests are to be carried out:

- Test for absence oil and grease after degreasing before blasting.
- Tests for surface finish of blasted surface shall be done by visual inspection using SSPC-VIS1. Clear cellophane tape test as per ISO 8502-9 shall be used to confirm absence of dust on blasted surface. Checks shall be done on each component at least once per 200 m2 of blasted surface and minimum of 3 checks per shift.
- Test for presence of soluble salt as per method ISO 8502-9. Maximum allowable salt content shall be considered 20 mg /m². Checks shall be done on each component at least once per 200 m2 of blasted surface and minimum of 3 checks per shift. In case salt exceeds specified limit, the contaminated surface shall be cleaned by method as per Annexure-C of ISO: 12944-4 (water cleaning). After cleaning surface shall be retested for salt after drying.
- Blast profile measurement
- Test for blasting Media and Blasting air- In addition to above, record should include type of shop primer already applied on equipment e.g. zinc silicate, or zinc rich epoxy, or zinc phosphate.

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

- **Primer Application:** After surface preparation, the primer should be applied to cover the crevices, comers, sharp edges etc. in the presence of inspector nominated by Engineer in charge.
- The shades of successive coats should be slightly different in colour in order to ensure application of individual coats, the thickness of each coat and complete coverage should be checked as per provision of this specification. This should be approved by Engineer in charge before application of successive coats.
- The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.
 - Dry film thickness of each coat,
 - Surface profile gauge for checking of surface profile in case of sand blasting.
 - Holiday detectors and pinhole detector and protector whenever required for checking in case of immersion conditions.
- Prior to application of paints on surfaces of chimneys, the thickness of the individual coat shall be checked by application of each coat of same paint on M.S.test panel. The thickness of Paint on test panels shall be determined by using gauge such as 'Elkometer'. The thickness of each coat shall be checked as per provision of this specification. This shall be approved by Engineer in charge before application of paints on surface of chimney.
- At the discretion of Engineer in charge, the paint manufacturer must provide the expert technical service at site as and when required. This service should be free of cost and without any obligation to the owner, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations. The contractor is responsible to arrange the same.
- Final inspection of finished coating shall consist of measurement of:
 - Paint dry film thickness (DFT),

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- Adhesion, and,
- Holiday detection check as well as for finish and workmanship.

- Coating DFT measurement shall be as per ISO: 2808. Type II electromagnetic gauges should be used for ferrous substrates. DFT gauge calibration, number of measurement shall be as per SSPC-PA 2. Measured DFT shall be within + 10% of the dry film thickness, specified in the specifications.
- Adhesion of the primer to the steel substrate and intercoat adhesion of the subsequent coat(s) after curing for at least a week after application of the topcoat shall be examined by a knife-test in accordance with ASTM D6677. For the knife test, if the rating is better than 8, the adhesion is considered acceptable. The adhesion is defective and:-tested areas shall be repaired afterward using the spot repair procedure. Alternatively, the applicator may perform the adhesion test on a steel coupon coated using the same surface preparation and coating application procedure as the work piece. Adhesion testing shall be carried out for each component at least once per 200 m² (2000 ft²) of coated surface.
- Holiday testing shall be conducted in accordance with NACE SP0188. For immersion services, 100% of coated area shall be inspected for holidays. For atmospheric exposure, 10% of coated area which must include weld seams, corners and edges to be holiday tested. Voltage at which test is to be carried out will depend upon DFT of coating being tested and shall be as per NACE SP0188. Any holiday is unacceptable and should be marked and repaired immediately.
- The contractor shall arrange for spot checking of paint materials for Specific gravity, glow time (ford cup) and spreading rate.
- **Final Inspection of coating system:**

A final inspection shall be conducted prior to the acceptance of the work. The Contractor and the Owner / Engineer in charge shall both be present and they shall sign an agreed inspection report. Such reports shall include:

 - General
 - Names of the painting Contractor and the responsible personnel
 - Dates when work was performed
 - Painting Materials

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- Information on painting materials being applied
- Condition of painting materials received
- Environmental Conditions
 - Weather and ambient conditions
 - Painting periods
- Surface Preparation
 - Condition of surface before preparation
 - Tools and methods used to prepare surface
 - Condition of surface after preparation
- Painting Application
 - Equipment used
 - Mixing procedure prior to application
 - Coating application techniques used
- Testing
 - Type and calibration of inspection instruments used
 - Type of quality control tests performed, and results

17. **GUARANTEE**

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

18. **QUALIFICATION CRITERIA OF PAINTING CONTRACTOR / SUB-CONTRACTOR**

Painting contractor who is awarded the contract for painting by the Owner, must have necessary equipment's, machinery, tools and tackles for surface preparation, paint application and

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inspection. The contractor must have qualified, trained and experienced surface preparator, paint applicator, inspector and supervisors. The Contractor supervisor, inspector, surface preparator and paint applicator must be conversant with the standards referred in this specification.

19. **QUALIFICATION / ACCEPTANCE CRITERIA FOR PAINT COATING SYSTEM**

- Pre-Qualification of Paint Coating Manufacturer and his Products
Paint / coating manufacture meeting the following requirements shall be considered for supply of their products. Contractor is advised to select coating manufacturer. Only after obtaining prequalification from Owner for the manufacturer based on following requirements. Even those manufacturers, whose names are appearing elsewhere in the tender document, under the list of "Owner Recommended or Approved Vendors", will also be required to meet the following prequalification requirements.
 - Manufacturer should have been in continuous business of paint / coating formulation and manufacturer for at least past 5 years.
 - Manufacturer should possess past experience of supplying his products to hydrocarbon processing industry or offshore platforms in the past 5 years.
 - Coating manufacturer should have supplied at least 10000 litre of an individual product to hydrocarbon processing industry or offshore platform.
 - The manufacturer's manufacturing procedure & QA/QC system shall meet ISO 9001 Requirements and preferably should possess ISO 14000 certificate.
 - The Quality control set up should be manned by qualified paint technologists whose bio data should be sent along with quality control organization chart.
- Pre-Qualification Testing:
Manufacturer should have got his products tested at least one time in last 3 years at a reputed independent laboratory for the following test items. Test certificates which are more than 3 years old will not be considered.

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Test	Test Method
Specific gravity	ASTM D1475
Dipping properties	ASTM D823
Film characteristics	-
Solid content by weight	ASTM D2369
Drying Time	ASTM D1640
Flexibility	ASTM D1737 / D522
Hardness	ASTM D3363
Adhesion	ASTM D2197
Abrasion resistance	ASTM D968/ D1044
DFT/coat	As per SSPC guidelines
Storage Stability	ASTM D1849
Resistance to moisture vapour permeability for 2000 hrs	ASTMD2247
Cyclic Test for the duration of 4200 h (25 cycles a 168 hours)	ASTM D5894
% Zn in Dry film for Inorganic Zinc Silicate primer	-
Chemical Resistance test - 10% & 40% NaOH (applicable only for F-6 & F-15) - 10% H ₂ SO ₄ (applicable only for F-6 & F-15) - 10% Nitric Acid test (applicable only for F-6 & F-15) - Benzene / Toluene (applicable only for F-6 & F-15) - Kerosene (applicable only for F-6 & F-15) - Sea water (applicable only for F-6 & F-15) - MIBK test (applicable only for F-6 & F-15)	ASTM D543
Resistance to water using water immersion (applicable only for F6-, F-7, F-8, F-14 & F-15)	ASTM D870
Dry Heat Resistance test (applicable only for F-9, F-6AIB, F-2, F-15, F-16, Polysiloxane, heat;:resistance Al silicone)	ASTM D2485
Thermal shock resistance test (only for F-9, F-6, Polysiloxane)	ASTM D2485 - 91
Cathodic Disbondment Test	ASTM G42 @60 deg C

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- Each coating product to be qualified shall be identified by the following
 - An infrared scan (fingerprint), for Part A and B, each component as per ASTM D2621
 - Specific gravity of Base and curing agent (Ref. ISO 2811)
 - Ash content (ASTM 01650), volatile and non-volatile matters (ISO 3251) of each component
- The identification shall be carried out on the batch, which is used for the Pre-qualification testing. Pre-qualification of the products shall be carried out at an independent laboratory.
- Test shall be carried out at any one of the following laboratories and tests to be witnessed & certified by third party inspection agency (TUV, BY, DNV)
 - IICT, Hyderabad
 - HBTI, Kanpur
 - DMSRDE, Kanpur
 - BIS Laboratories
 - UICT, Matunga, Mumbai
 - UTES, Kolkata
 - PDIL,-Sindri
 - NTH, Kolkata
- Contractor shall furnish to Owner for approval / acceptance of all necessary documents / information including test certificates to prove that the paint manufacturers, from whom he intends to procure paint products, meet the various requirements for fulfilling the pre-qualification criteria as given above. The paint manufacturer shall be qualified and approved for supply after review / assessment of the submission made by the contractor.
- Contractor along with delivery of paint material has to furnish following information from paint manufacturer to Owner for acceptance / approval of products.
 - a) Batch test certificates (Batch Testing)

Contractor has to produce test certificate from paint manufacturer for each batch and for each category of product for the following test items. Test to be witnessed & certified by third party inspection agency. All test results must mention clearly the batch no. and category of product tested. Tests to be conducted for following properties:

 - Infrared scan for Part A and B, each component
 - Specific Gravity
 - % solids by weight (% zinc content in case of inorganic or organic zinc primer)
 - b) Product information sheet Technical data sheet for each category of product.

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20. **METHOD OF SAMPLING & DISPATCH FOR LABORATORY TESTING**

(Pre-Qualification tests, Batch testing and Inspection testing)


Samples of coating materials should be submitted to the Govt. laboratory in sealed containers with batch no. and test certificate on regular format of manufacturer's testing laboratory. The sampling shall be certified and sealed by a certifying agency.

All test panels should be prepared by Govt. testing agency coloured photographs of test panels should be taken before and after the test and should be enclosed along with test report.

Sample batch no. and manufacturer's test certificate should be enclosed along with the report. Test report must contain details of observation and rusting if any, as per the testing code.

Manufacturers should intimate the company, details of sample submitted for testing, name of Govt. testing agency, date, and contact personnel of the govt. testing agency. At the end of the test the manufacturer should submit the test reports to the company for approval.


Coating systems for panel test shall be decided after discussion with Owner.

ANNEXURE 1A							
	BHARAT HEAVY ELECTRICALS LIMITED PROJECT ENGINEERING & SYSTEMS DIVISION RAMACHANDRAPURAM: HYDERABAD - 502 032						
	PRICE FORMAT (Rev00) FOR SWS ACID GAS KO DRUM PUMP SETs						
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						
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>							
Sl.No.	Item Description	Qty.	Unit	Weightage w.r.t Overall Price (In %)	Bidder's confirmation (Quoted/ Not Quoted)	HSN / SAC Code	GST (%)
I	MAIN OFFER						
A	MATERIAL SUPPLY: SWS ACID GAS KO DRUM PUMP SET [Material code: PY9751749042]						
1	Acid Gas KO Drum Pumps with motor along with all accessories including commissioning spares, special tools & tackles, O&M spares required during Defect Liability Period of equipment, first fill of consumables, erection material & documentation, instructions to vendors, data sheets etc. and other codes and standards attached or referred in the specification.	2	Sets	77.44%			
B	MANDATORY SPARES FOR SWS ACID GAS KO DRUM PUMP SET [Material code: PY9751749050]						
B.1	Spares of Pump			19.34%			
1	Set of impellers (Full dia) with wear rings fitted)	1	Sets				
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-a	Set of mechanical seals (complete assembly) With sleeve and gland plate (for cartridge seal)	1	Sets				
14-b	Set of mechanical seals (complete assembly) Without sleeve and gland plate (for cartridge seal)	1	Sets				
15-a	Set of mechanical seal parts: Seal faces (stationary + rotary)* *For bellow type seal, set of faces shall mean face along with bellow	3	Sets				
15-b	Set of mechanical seal parts: Secondary seal	3	Sets				
15-c	Set of mechanical seal parts: Gaskets/O-rings & Packings	4	Sets				
15-d	Set of mechanical seal parts: Springs and pins, screws	2	Sets				
16	Set of gland packings	3	Sets				
17-a	Set of bearing pads (if bearings are tilting pad type): Radial bearing pads	1	Sets				
17-b	Set of bearing pads (if bearings are tilting pad type): Thrust bearing pads	1	Sets				
18	Set of balance drum and balance sleeve insert (if provided)	1	Sets				
19	Set of interstage bushes	1	Sets				
20	Complete coupling (balanced) (only for multistage pumps- pumps with more than 2 stages)	1	Sets				
21	Flushing oil cooler in case of Plan 23	1	Sets				
B.2	Spares of Motor						
1	Set of bearings (DE & NDE both)	1	Sets				
2	Set of Terminal studs / bushing assembly	1	Sets				

B.3	Spares of FLANGES (All flanges including blind flanges)					
1	Gaskets	200% Extra				
2	Bolting	10% Extra				
B.4	Spares of Instruments					
1	Pressure / Temperature Gauges	20% (Subject to min. of 2) of each type, range, material of construction and rating.				
2	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)				
3	Orifice Plates	10% or minimum 1 of blind plates of each size, rating, thickness & material of construction				
4	SMART (4-20m A & 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.				
5	Valve manifolds	10% (subject to minimum of 1) of each type, size and material of construction.				
6	Guided wave Radar Level Instrument	10% or minimum one number of full set of transmitter				
7	Safety/ Thermal Relief Valves	A) 10%(subject to minimum 1 no.)				
C	Supervision charges for erection & commissioning at site [Material code:PY9751749069]					
1	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	3.22%			
	Grand total price for Sl.No. A, B and C (Inclusive of Packing & Forwarding and Freight)		100.00%			
Packing & Forwarding, Frieght, Insurance and GST :						
(I) For Supply:						
(i)	Packing & Forwarding :	In bidder's scope	Included	in basic price		
(ii)	Frieght:	In bidder's scope	Included	in basic price		
(iii)	Insurance:	In BHEL's scope	--			
(iv)	GST	Extra at actuals	Extra	at actuals		
(v)	Any other:	shall be included in basic price	Included	in basic price		
(II) For supervision of E&C:						
(i)	GST	Extra at actuals	Extra	at actuals		
(ii)	Any other:	shall be included in basic price	Included	in basic price		
Notes:						
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) Indian paise.					
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 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 (Grand Total Price as above) i.e. the total landed cost to BHEL for this enquiry.					
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	Main offer (Annexure-1B) consists of those items which will be part of main order after successful bidder is identified. Optional Items (Annexure-1B-I) consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under Main offer and Optional items as per the prescribed format.
11	Prices quoted by bidders for items under main offer : Sl. No.I(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 package 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 Supervision of 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 validity 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 to C shall be Weighed w.r.t Overall Price as mentioned above. No combined prices, common prices or any other format will be accepted and such bids may be liable for rejection. 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. 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 bidder's experience) and quoted by bidder. However commissioning spares indicated in the price bid format shall be quoted as minimum. 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: B366-088-PA-MR-5001 & annexures.
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	In case the systems are being supplied from outside India, 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

	<p align="center">BHARAT HEAVY ELECTRICALS LIMITED PROJECT ENGINEERING & SYSTEMS DIVISION RAMACHANDRAPURAM: HYDERABAD - 502 032</p>						
<p align="center">PRICE FORMAT (Rev00) FOR SWS ACID GAS KO DRUM PUMP SETs</p>							
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						
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>							
Sl.No.	Item Description	Qty.	Unit	Bidder's confirmation (Quoted/ Not Quoted)	HSN / SAC Code	GST (%)	
II	OPTIONAL ITEMS						
A	RECOMMENDED SPARES						
	<p>Two Years spares (O & M Spares) beyond Defect Liability Period: 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. (List with price break up to be enclosed) (1 set stands for quantity required for the replacement of one pump, drive (or) accessories)</p>	1 Set	Set				

PRE-QUALIFICATION CRITERIA (PQC)

Item	SWS ACID GAS KOD PUMPS
Project	525 TPD STANDBY SRU PROJECT IOCL PARADIP REFINERY, ODISHA, INDIA
Customer	M/s INDIAN OIL CORPORATION LIMITED PARADIP REFINERY PROJECT, PARADIP, ODISHA
Customer's Consultant	M/s TECHNIP ENERGIES
ESC of BHEL	M/s ENGINEERS INDIA LIMITED

A) Technical Qualification Criteria:

Bidder to meet following requirement as mentioned in Sl. No. (1) & (2) below:

1. Bidder should have designed, manufactured, tested and supplied from the proposed manufacturing plant, at least TWO (2) Nos. of Pumps of the proposed model offered in the last FIFTEEN (15) years from initial bid submission due date and of which at least ONE pump should have completed successful operation in the field for at least 8000 hours individually without major problem from initial bid submission due date.

To assess the above qualification, bidder to furnish the supporting documents along with technical offer as below:

- a) Purchase Order / LOI / Invoice / LR copy / IRN copy AND
 - b) Satisfactory Performance Certificate / Customer's Letter of appreciation for pump operation of the above reference to establish successful operation of the pump at site for 8000 hours. In case bidder is unable to furnish any supporting documents, alternatively bidder to furnish PO / LOI / Invoice / IRN / LR copy dated at least 3 years before initial bid submission due date.
2. The references furnished by the bidder against Sl. No. (1) should also meet all the following criteria w.r.t offered model:
 - i. Rated flow and head of pump for the reference project should be at least 50% of the flow (Rated Flow + Min. recirculation flow, if offered by the bidder as per specification requirements) and Rated head of pump offered for this enquiry.

To assess the above qualification, bidder to furnish the supporting documents along with technical offer as below, such as, final Pump documents (Datasheet, GA drawing, Test reports etc.) indicating the pump details (Pumping Fluid, Flow & Head, Model Number, Speed etc).

Bidder also to furnish reference list in enclosed format –Annexure-1 to PQC.

**EXPERIENCE RECORD PROFORMA
CENTRIFUGAL PUMP (HORIZONTAL)**
ITEM NO. / SERVICE: _____

Document No.
B366-088-80-42-ER-5001 Rev.-A
Page 1 of 2

NOTES TO BIDDERS:

1. Prototype pump model/ model series shall not be considered.
2. It is mandatory that all references furnished for pump model/ model series should have similar parameters and in similar fluid (liquid) service.
3. **Vendor shall furnish only those references which have completed 1 (one) year of operation, as on bid due date.**

DESCRIPTION OF MODEL DESIGNATION SYSTEM: _____

S. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS		REMARKS
			Ref.-1	Ref.-2	
1	GENERAL				
1.1	Model Number				
1.2	Type of Driver / Driver Rating (kW)				
1.3	Rated Speed (rpm)				
1.4	Shop where pump is designed, manufactured, packaged, tested & supplied				
2	OPERATING CONDITIONS				
2.1	Service / Fluid handled / Fluid temperature (deg C)				
2.2	Rated Capacity (m ³ /hr) & Rated Diff. Head (m)				
2.3	NPSHR (m) / Efficiency (%)				
2.4	No. of stages / Impeller Dia. (Max/Rated/min.) (mm)				
2.5	Maximum Suction pressure (kg/cm ² g)				

Place:
Date:

[Signature of Authorized Signatory]*

Name:
Designation:
Seal:

*: To be authenticated in-line with provisions indicated in Commercial Section (in NIT, in case of press enquiries)

[To be submitted in original, along with bid]

S. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS		REMARKS
			Ref.-1	Ref.-2	
2.6	Type of lubrication system				
2.7	Type of Bearings / Bearing span (mm)				
2.8	Shaft Diameter under Bearing (mm)				
2.9	Casing MAWP (15°C / PT / Design Temperature)				
3	MATERIAL OF CONSTRUCTION				
3.1	Casing / Impeller / Shaft				
4	OTHER INFORMATION ON INSTALLATIONS				
4.1	Date of supply / commissioning				
4.2	Purchaser's Name, Address, Contact No. & email ID				

Place:
Date:

[Signature of Authorized Signatory]*

Name:
Designation:
Seal:

*: To be authenticated in-line with provisions indicated in Commercial Section (in NIT, in case of press enquiries)

[To be submitted in original, along with bid]