

**BHARAT HEAVY ELECTRICALS LIMITED**

[A Government of India Undertaking]

Ramachandrapuram, Hyderabad, 502032, A.P. India  
Phone 040-23184526, 23182322 FAX:040-23021910, 1954**भारत हेवी इलेक्ट्रिकल्स लिमिटेड**

(भारत सरकार का उपक्रम)

रामचन्द्रपुरम, हैदराबाद, 502032 आंध्र प्रदेश, भारत

RFQ NO :

**PURCHASE DEPARTMENT****ENQUIRY****क्रय विभाग**

जांच (ई मेल : tenderbox@bhelhyd.co.in)

SHEET:1

OF :2

HY17001 C  
REV.NO.0Phone 091-40-23184526  
091-40-23182322FAX : 091-40-23021910  
091-40-23021954**PURCHASE DEPARTMENT**

GSTIN:

Enq/Collective No :E6A1U90280

Enq.Dt. : 31.03.2021

No.Of Items :8

DUE Dt. OF QUOTN. : 21.04.2021

**Office Copy**

Please submit your lowest quotation in sealed cover superscribed with Enquiry No./Collective No.(RFQ No ..... ) and due date subject to our terms and conditions attached ,for the materials mentioned below.Your offer has to reach us onor before due date by 11.00 Hours (IST) and will be opened at 14.00 Hours.(IST).If our Enquiry No./Collective No.(RFQ No ..... ) and tender due date are not super scribed on the tender cover , your offer shall be summarily rejected. Incomplete offers and late offers will not be considered.

SL NO	Purchase Req.no	item no	Material Code, HSN No.	Drg no - Ver , Rev & Spec - Ver , Rev,Spec-Var	Description	Unit	Qty	Delivery Date	Schedule Qty
1	8000095301	10	TC9764514359 8406	NA-,,TC64514,00,35	SGL STG STEAMTURBINE MECHSEAL 15/22KW	EA	1.000	10.11.2021	1.000
2	8000095302	10	TC9764514367 8406	NA-,,TC64514,00,36	STEAM INLET/EXHAUST PIPING+RED/EXP+FITT	SET	1.000	10.11.2021	1.000
3	8000095303	10	TC9764514375 8406	NA-,,TC64514,00,37	LEAK OFF/DRAIN&STEAMTRAPASSY FOR LOPDT	SET	1.000	10.11.2021	1.000
4	8000095304	10	TC9764514383 8406	NA-,,TC64514,00,38	COOLING WATER INLET& OUTLET FOR LOPDT	SET	1.000	10.11.2021	1.000
5	7000090280	10	TC9764514391 8406	NA-,,TC64514,00,39	SETOF DYN. BALANCED ROTOR+N2CYL OFLOPDT	SET	1.000	10.11.2021	1.000
6	7000090281	10	TC9764514405 8406	NA-,,TC64514,00,40	SET OF BEARINGS (DE & NDE) FOR LOPDT	SET	1.000	10.11.2021	1.000
7	7000090282	10	TC9764514413 8406	NA-,,TC64514,00,41	SET OF COMPLETE MECH SEALASSY FOR LOPDT	SET	1.000	10.11.2021	1.000
8	7000090283	10	TC9764514421 8406	NA-,,TC64514,00,42	SP.INSTRUMENTS AS PER ANNEX-VI FORLOPDT	SET	1.000	10.11.2021	1.000

Special Remarks

**CheckList of Quality Interventions:**TEST CERTIFICATE REQD: Y  
GUARANTEE REQ : Y  
SAMPLE REQD : N  
BID TYPE : TWO PARTFor and on-behalf of  
Bharat Heavy Electricals Limited.BHASKER REDDY K  
DY MANAGER

**BHEL reserves the right to enforce any or all of the following checks during execution of the order.  
There is no additional cost to the vendor on account of these checks.**

TEST CERTIFICATE REQD: Y  
GUARANTEE REQ : Y  
SAMPLE REQD : N  
BID TYPE : TWO PART

For and on-behalf of  
Bharat Heavy Electricals Limited.  
  
BHASKER REDDY K  
DY MANAGER

**SPECIAL CONDITIONS OF CONTRACT (SCC)**

Sl.No	Enquiry number: : E6A1U90280 date 31.03.2021	Supplier Acceptance	Remarks
	Confirm complete compliance to BHEL Specification and submit the following Filled signed and stamped		
	<b><u>Technical Specifications</u></b>		
1	(i) BHEL Spec. TC64514-R02 (ii) Annex-I to TC64514 (iii) Annex-II to TC64514 PTR (iv) Annex-III to TC64514 TDS (v) Annex-IV to TC64514 Price Schedule Rev 1 (vi) Annex-V to TC64514 Checklist (vii) Annex-VI Instrumentation -Spares (viii) 6-43-0042_Standard specification for general-purpose steam turbines._rev3 (ix) 6-44-0051 Rev. 6 Technical Notes For Pipes (x) 6-44-0052 Rev. 7 Technical Notes For Valves (xi) 6-44-0066-Rev 2 Tech notes for steam trap (xii) 6-81-0057_ITP for steam turbine (general purpose)_rev3 (xiii) B224-000-79-41-PLS-01 rev.5 Surface preparation & Protective Coating (xiv) B224-110-80-43-DS-1024_Mechanical Datasheet - Steam Turbin (General Purpose)_Rev 0 (xv) B224-110-80-43-ERP-1021_ERP Steam Turbin (General Purpose)_Rev A (xvi)Instrument specifications (xvii)PMI Std Spec 6-81-0001 Rev.3 (xviii)POLICY ON MAKE IN INDIA (xix)Pre-Qualification Criteria		
2	Evaluation of L1 bidder shall be Lumpsum lowest destination cost of all items & Service		<b>Information</b>
3	Price Bids shall be as per Annexure IV (Price Schedule) to purchase spec TC64514 . Vendor has to quote for all the items. Incomplete offers shall be liable for rejection. In case of any discrepancy in vlaue, per unit price quoted against each item shall be considered for evaluation and establishing L1 status.		<b>NON DEVIATABLE</b>
4	Packing & Forwarding charges (shall be inclusive in quoted material price)		
5	Terms of delivery shall be <b><u>i) FOR Destination for Indigenous Supplier</u></b> (Freight & Insurance shall be inclusive in material price & to be paid by supplier). All items shall be dispatched to BHEL Hyderabad 06 store. C note date or Date of submission of documents whichever is later shall be considered as delivery date incase documents are not submitted within 10 days from the dispatch of the material.		
	<b><u>ii) CIP Mumbai India for foreign supplier</u></b> a) As per Incoterm (latest). b) IGM date in bill of entry issued by customs shall be delivery date for the purpose of penalty. c) Exchange rate for Foreign Currency to INR shall be as per SBI Exchange rate (TT Seeling rate) as on Technical Bid Opening date. If the relevant day happens to be a bank holiday, then the forex rate as on the previous bank (SBI) working day shall be taken.		
6	Inspection & Certification by BHEL TPIA & CUSTOMER/CUSTOMER TPIA jointly as per Approved QP post ordering <b>i) For Indigenous vendor:</b> BHEL TPIA Inspection charges are in BHEL account.Vendor's offer will be loaded by appropriate percentage for evaluation. Currently it is 0.26% towards BHEL TPI inspection. All Inspections within Indian workplaces.		
	<b>ii) For Foreign vendors:</b> Inspection & Certification charges shall be in Suppliers account and all inspection & certification charges should be quoted within material price. Supplier has to arrange BHEL approved foreign TPIA-LLOYDS/TUV NORD/DNV/BV for all inspection and certification.		

**SPECIAL CONDITIONS OF CONTRACT (SCC)**

Sl.No	Enquiry number: : E6A1U90280 date 31.03.2021	Supplier Acceptance	Remarks
7	<p>Your offer shall be in two part bid system :</p> <p>a) Part-1 bid i.e,Techno commercial bid (with all technical and commercial tems and conditions.                      (i).Duly filled in Signed and stamped PQC along with all supporting documents and necessary confirmation as mentioned in Sl.No.1.                      (ii) Duly filled in signed and stamped copy of Instructions to Bidder (ITB) along with necessary enclosures i.e,Annexure-I,II,III &amp; IV(as applicable).                      (iii). Duly filled in signed and stamped copy of Special Contract Conditions (SCC).                      (iv). Documents /declarations in compliance with Annexure -V (Checklist).                      (v). Documents /declarations in compliance with Annexure -A&amp;B (as applicable)                      (vi). Signed copy of Priced Sheet i.e,Annexure-IV without price.                      b) Part-2 bid i.e, Price bid in separate sealed cover indicating our enquiry No. date and due date.                      Vendor shall quote prices strictly as per the price sechedule enclosed.</p>		
	<b>GUIDELINES REGARDING DEALINGS WITH INDIAN AGENTS OF FOREIGN SUPPLIERS:</b>		
	(i). It shall be incumbent on the Indian agent and the foreign principal to adhere to the relevant guidelines of Government of India, issued from time to time.		
	(ii). The Agency Agreement should specify the precise relationship between the foreign OEM / foreign principal and their Indian agent and their mutual interest in the business. All services to be rendered by agent/ associate, whether of general nature or in relation to the particular contract, must be clearly stated by the foreign supplier/ Indian agent. Any payment, which the agent or associate receives in India or abroad from the OEM, whether as commission or as a general retainer fee should be brought on record in the Agreement and be made explicit in order to ensure compliance to laws of the country.		
	(iii). Any agency commission to be paid by BHEL to the Indian agent shall be in Indian currency only.		
	(iv). Tax deduction at source is applicable to the agency commission paid to the Indian agent as per the prevailing rules.		
8	(v). In the absence of any agency agreement, BHEL shall not deal with any Indian agent (authorized representatives / associate / consultant, or by whatever name called) and shall deal directly with the foreign principal only for all correspondence and business purposes.		
	(vi). The "Guidelines for Indian Agents of Foreign Suppliers" enclosed at annexure -'A' shall apply in all such cases.		
	(vii). The supply and execution of the Purchase Order (including indigenous supplies/ service) shall be in the scope of the OEM/ foreign principal. The OEM/ foreign principal should submit their offer inclusive of all indigenous supplies/ services and evaluation will be based on 'total cost to BHEL'. In case OEM/ foreign principal recommends placement of order(s) towards indigenous portion of supplies/ services on Indian supplier(s)/ agent on their behalf, the credentials/ capacity/ capability of the Indian supplier(s)/ agent to make the supplies/ services shall be checked by BHEL as per the extant guidelines, before opening of price bids. In this regard, details may be checked as per Annexure-B (copy enclosed). It will be the responsibility of the OEM/ foreign principal to get acquainted with the evaluation requirements of Indian supplier/ agent as per SEARP available on www.bhel.com.		
	(viii). As per directives of CENTRAL VIGILANCE COMMISSION, GOVERNMENT OF INDIA, one agent can not represent two or more suppliers or quote on their behalf in a particular tender. If so found at any stage, BHEL Hyderabad is likely to cancel Enquiries / POs to such suppliers. Further, such Indian Agent is likely to be de-listed (Black listed for business from BHEL).		
9	<b>FINANCIAL STANDING:</b> <b>Indian Bidders:</b> Vendor to submit annual Financial Turnover during the Past 3 Years along with copy of 3 years Audited Balance Sheet. <b>Foreign Bidders:</b> Vendor to submit copy of latest D&B Report.		
10	<b>Revised offer / Price impact/Addition of non quoted item is NOT allowed after opening of Technical bid. Revised offer may be asked only in the event of change in techno-commercial terms/scope of supply made by BHEL having price impact.</b>		
11	The quoted rates are to be firm till the execution of order		
12	Vendor shall submit drawings,data sheets,QAP & Endorsement sheet if any for the approval of BHEL & for BHEL customer approval if required.		

**SPECIAL CONDITIONS OF CONTRACT (SCC)**

Sl.No	Enquiry number: : E6A1U90280 date 31.03.2021	Supplier Acceptance	Remarks
13	<p><b>Delivery:</b> Materials should be delivered within 26Weeks from the date of PO</p> <p><b>Note:</b> a)For delivery period longer than indicated above, quoted price shall be loaded by 0.5% per week during evaluation of offer.</p>		
14	<p><b>All equipment/goods supplied shall be guaranteed up to 31st DEC 2023 and shall be proved under normal operating conditions. Before guarantee period, if found of inadequate design, of defective material or of poor workmanship, in such event the guarantee period for the particular equipment/ material shall be another 12 months from the date of acceptance by PURCHASER/OWNER of such replaced/repared equipment /material. However, extended guarantee period shall have an upper limit till 31st DEC 2024".</b></p>		
15	<p><b>Terms and Conditions:</b> Vendor is requested to furnish all details of the offer in BHEL formats. In case of any discrepancy between information furnished here and those furnished elsewhere in the bid, the information furnished in this document only shall be considered, and those furnished else where which are contradictory to the terms agreed in BHEL formats shall be ignored.</p>		
16	<p>Reverse Auction:- "BHEL shall be resorting to Reverse Auction (RA) (Guidelines as available on www.bhel.com) for this tender. RA shall be conducted among the techno-commercially qualified bidders. Price bids of all techno-commercially qualified bidders shall be opened and same shall be considered for RA. In case any bidder(s) do(es) not participate in online Reverse Auction, their sealed envelope price bid along with applicable loading, if any, shall be considered for ranking."</p> <p>Details of RA representative like, Name,e-mail id,Mobile No.,Phone No.,etc shall be furnished.</p>		
17	<p>MSE suppliers can avail the intended benefits only if they submit Udyam registration along with the offer,. Non submission of such documents will lead to consideration of their bid at par with other bidders. No benefit shall be applicable for this enquiry if any deficiency in the above required document is not submitted before price bid opening. If the tender is to be submitted through e- procurement portal, then the above required document to be uploaded on the portal.</p>		
Note	<p>1) Vendor shall furnish all the offer details in SCC &amp; ITB only. Information furnished elsewhere if any, as to be consistent with details furnished in SCC &amp; ITB documents. In case of any discrepancy, information furnished in ITB &amp; SCC shall prevail and become final &amp; binding. ITB &amp; SCC shall be submitted by duly filled signed &amp; stamped.</p> <p>2) The bidders while submitting documents for registration or in response to NIT/Tender etc. are required to ensure that- Documents submitted with the offer shall be signed and stamped in each page by authorized representative of the bidder.</p>		

**Signature & stamp of vendor**

( Attachment to Enquiry No. E6A1U90280 Due on Date 21.04.2021 for submission by 11.00 hrs to open from 14:00 hrs.)			
INSTRUCTIONS TO BIDDER (ITB)			
NOTE: Bidder to confirm in affirmative by typing "YES" or "Applicable Data" in the response column. Deviations , if any shall be recorded in deviations/comments column (Separate sheet can be attached if needed). Non-Deviatable clauses are indicated as "Non-Deviatable".			
S. No.	DETAILED TERMS & CONDITIONS	VENDOR RESPONSE (YES/NO)	DEVIATIONS / COMMENT
<b>1</b>	<b>SCOPE OF SUPPLY:</b>		
	Signed & Sealed offers are invited for the Scope of Supply of goods and Services or both as detailed in the enquiry. Relevant enclosures/supporting documents / catalogue, if any shall be enclosed to the technical offer. Bidder can also submit offer through email at their own risk. The offer is to be submitted in two parts. Technical offer to be submitted to mail ID <a href="mailto:technicalbid_hyd@bhel.in">technicalbid_hyd@bhel.in</a> , and price bid to be submitted to mail ID <a href="mailto:pricebid_hyd@bhel.in">pricebid_hyd@bhel.in</a> as an attachment only. Interchanging the information in the mails may lead to rejection of the offer. Supplier shall have no claim on e-mail offers sent on any other e-mail ID. In case of e-mail offers, the mail subject should contain Enquiry No. Due date and Supplier name, Supplier address including contact details shall be mentioned in the content of the mail. Without these details offer is liable for rejection.		
<b>2</b>	<b>GENERAL INSTRUCTIONS:</b>		
A	The quotation should be neatly typed and free from over writing/ erasures. Any correction or addition must be authenticated. The offer including annexures and brochures should be submitted in English / Hindi. All Pages of Techno Commercial Bids (Main Pages), ITB should be signed and Stamped. If there is a conflict in case of bilingual submission, the submission in English will be final.		<b>Non-Deviatable</b>
B	In case of Single-Part bid Tender, the complete bid shall be submitted in a single sealed cover super subscribing the Tender number and due date. Incomplete offers are liable for rejection. E mail bids shall be sent to mail ID <a href="mailto:pricebid_hyd@bhel.in">pricebid_hyd@bhel.in</a> as an attachment only.		<b>Non-Deviatable</b>
C	Bidders to please note that the Terms & conditions contained in this document and Special conditions, if any, are to be read fully before submission of quotations.		<b>Non-Deviatable</b>
D	Vendors are advised to comply with specific conditions of the enquiry, Should there be any deviations (where deviations are permitted), it shall be entered in the deviation column. BHEL reserves the right to reject such offers or load the bid suitably for evaluation.		<b>Non-Deviatable</b>
E	Offers shall be submitted directly, only by the vendor or by their authorized representative / agent and the offer should be in line with the regulatory guidelines (i.e A valid Agency agreement between principal vendor and agent / representative shall be attached and the agreement shall cover the scope of services rendered by Agent, Agency Commission and any other information called for as per the regulatory guidelines). OEM / Mill details shall be provided if supplier is not a manufacturer. Bid envelops shall bear the name of Supplier. In case of submission through authorized representative/agent, the name of representative/agent should also be mentioned apart from supplier name.		<b>Non-Deviatable</b>
F	Offer received after the specified time and date of submission shall be rejected. No further correspondence shall be entertained.		<b>Non-Deviatable</b>
G	Unsolicited offers shall not be considered.		<b>Non-Deviatable</b>

( Attachment to Enquiry No. E6A1U90280 Due on Date 21.04.2021 for submission by 11.00 hrs to open from 14:00 hrs.)			
INSTRUCTIONS TO BIDDER (ITB)			
<b>3</b>	<b>OTHER PARTICULARS (Please indicate applicable data)</b>		
A	Name of the Bid currency (freely tradable foreign currency for imports and Indian Rupees for indigenous purchase).		
B	Name of the Port of loading and Port of Discharge (applicable to imports).		
<b>4</b>	<b>BID SUBMISSION PROCEDURE:</b>		
A.	<b>For Single Part Bids:</b> Offers addressed to DGM/CMM, Vendor Complex, BHEL, Hyderabad must be sent in a sealed cover on which tender enquiry number and the due date shall be super subscribed and sent by appropriate mode to above address or dropped in tender box located at vendor complex on or before the specified time and date of submission of offers, preferably in the bidder's envelope. For e-mail offers please follow the procedure mentioned in 2 (B).		<b>Non-Deviatable</b>
B.	<b>For two-Part Bids:</b>		
	<b>Two part bid consisting of</b> i) Techno-commercial Bid - ( Part-I), with all technical specification & scope including bill of material etc., EMD (where applicable) and unpriced bid with all applicable Commercial Terms and Conditions, rates of agency commission , duties, taxes and other charges, except the price, super scribing enquiry No. (Techno-Commercial Bid) and due date Signed and Stamped ITB and special conditions of contract, if any is required to be attached along with Techno-commercial Bid - (Part-1) AND ii) Price Bid (Part-II), containing ONLY the price (including agency commission, if any) and the applicable duties/taxes/other charges shall be kept in a separate sealed cover super subscribing Enquiry no. (Price bid) & due date. Both these covers shall be kept in a Third cover super subscribing Enquiry no. & due date. All techno commercial terms & conditions mutually agreed prior to price bid opening shall prevail and supersede any terms and conditions specified otherwise in price bid.		<b>Non-Deviatable</b>
ii	Techno-commercial Bid will be opened on the assigned date .Only the price bids of vendors whose techno commercial bids are accepted will be opened later on a specified date.		<b>Non-Deviatable</b>
iii	The bidders whose bids are techno commercially not accepted will be informed & EMD (Earnest Money Deposit) shall be returned wherever submitted.		
iv	Bidders will be allowed to submit the impact on their quoted prices due to changes in technical scope, specifications, and commercial terms/conditions as specified in NIT which in the opinion of BHEL warrant changes in prices.		<b>Non-Deviatable</b>
v	Bids shall be opened on due time and date in the presence of bidders who may like to be present. Only one representative of each bidder shall be permitted to attend the bid opening.		<b>Non-Deviatable</b>
<b>5</b>	<b>Delivery Instructions</b>		
A	Indigenous Purchase		
	Goods shall be delivered on FOR Destination basis to the named destination(s) or as specified in the enquiry, Insurance in the scope of supplier.		
B.	Imports		
	The goods shall be delivered on CIP-basis to port of discharge as mentioned in the purchase order.		
<b>6</b>	<b>Documentation:</b>		
A	Indigenous Purchase		
	Seller shall arrange to send to BHEL, Hyderabad along with all the required documents as detailed in Purchase Order, such as, Tax Invoice (Original for Recipient, Duplicate for Transporter), consignee copy of LR, Packing list , Pre-dispatch Inspection report, Test/ Guarantee/ Warranty certificate/ O&M manuals (as applicable) etc. immediately on dispatch of the goods. Any addition/ exclusion to such documents shall be as specified in the Purchase Order. In case of dispatches from vendor works to site, material receipt certified by site office / Customer shall be provided. Softcopies of the above documents shall be uploaded in Pradan portal <a href="https://web.bhelhyd.co.in/mm/">https://web.bhelhyd.co.in/mm/</a> immediately after dispatch of the material.		<b>Non-Deviatable</b>
B	Imports		

**( Attachment to Enquiry No. E6A1U90280 Due on Date 21.04.2021 for submission by 11.00 hrs to open from 14:00 hrs.)**

**INSTRUCTIONS TO BIDDER (ITB)**

<p>i) Seller shall inform the purchaser the readiness of material along with packing details well in 30 days advance from the date of delivery. Seller shall also upload soft copy of the dispatch documents consisting of BL / AWB, Invoice, Shipping list &amp; Test certificates and other documents as specifically indicated in the Purchase Order in PRADAN Portal (<a href="https://web.bhelhyd.co.in/mm/">https://web.bhelhyd.co.in/mm/</a>) within 3 days from the B/L date for sea shipment and 1 day from AWB date for Air shipment.</p>																										
<p>ii) In case of CIP shipments, seller shall also inform purchaser the information about discharge port agent details and ship arrival information within 7 working days from the date of Shipment.</p>																										
<p>iii) In case the material shipped in Full Containers(FCL), Seller shall ensure that the Bill of Lading should clearly spell out the following 1. Port of discharge -- "Nhavaseva"/chennai 2. Place of Delivery / Final Destination - "ICD Sanath Nagar". 3. For air consignment the port of discharge will be Hyderabad, India and consignee shall be BHEL.</p>																										
<p>iv) In case of Air shipment, the following dimensions of single package may be noted. a). Dimension of the cargo(ODC) -- &gt; 125" x 88" x 63" b).Weight of the cargo -- &gt;3.5 MT. If any package dimension or weight crosses the above set limits, it will be treated as Over Dimension Cargo (ODC) or Over Weight Cargo and seller shall inform BHEL well in advance of 20 days prior to the delivery date to enable BHEL to finalize the freight forwarder</p>																										
<p>(v). Recovery charges for non-submission of documents : Seller shall submit all the required documents to BHEL as prescribed in the Purchase order and NIT. If BHEL incurs any charges such as Penalty, demurrage, container detention, wharf age, storage, Ground rent etc., due to non - compliance / non - submission of documents prescribed in Purchase Order/Tender Document/Letter of credit , the same shall be recovered from the seller as under: 1. EUROPE/USA/Black Sea/ Far East/Middle East/South East sector A. For EX-WORKS / FCA/ FAS / FOB Sea Consignments: Penalty for late submission / negotiation of documents beyond 14 days shall be as under:</p> <table border="1"> <thead> <tr> <th rowspan="2">Sl. No</th> <th rowspan="2">Period (From Date of Bill of Lading)</th> <th colspan="2">Recoverable Charges</th> <th colspan="2">Recoverable Charges per day per container</th> </tr> <tr> <th>LCL per week/ Break bulk cargo per day</th> <th>20FT Container</th> <th>40FT Container</th> <th></th> </tr> </thead> <tbody> <tr> <td>i</td> <td>Upto 14th day</td> <td>Nil</td> <td>Nil</td> <td>Nil</td> <td></td> </tr> <tr> <td>ii</td> <td>15th day onward</td> <td>USD 10</td> <td>USD 50</td> <td>USD 105</td> <td></td> </tr> </tbody> </table> <p>B. For CIF / CFR / CIP / CPT Sea Shipments: For CIF / CFR / CIP / CPT Sea Shipments, Vendor shall provide rates for detention charges after free period at the time of offer itself in case of engagement of 20FT Container and 40FT category. In case of late presentation of documents to the bank recovery will be effected from the Vendor as per the rates quoted by the Vendor at the time of offer in this regard. In case of Break bulk cargo and LCL Demurrage/storage charges shall be recovered at rate of USD 10 per day and storage charges rate of USD 10 per week respectively shall be charged as late presentation charges.</p>					Sl. No	Period (From Date of Bill of Lading)	Recoverable Charges		Recoverable Charges per day per container		LCL per week/ Break bulk cargo per day	20FT Container	40FT Container		i	Upto 14th day	Nil	Nil	Nil		ii	15th day onward	USD 10	USD 50	USD 105	
Sl. No	Period (From Date of Bill of Lading)	Recoverable Charges		Recoverable Charges per day per container																						
		LCL per week/ Break bulk cargo per day	20FT Container	40FT Container																						
i	Upto 14th day	Nil	Nil	Nil																						
ii	15th day onward	USD 10	USD 50	USD 105																						
<p>(vi) Description of items in invoice, packing list, BL / AWB or LR shall be same as PO item description. Vendors shall ensure that invoice shall contain PAN nos. of both seller and buyer related numbers. BHEL PAN AAACB4146P and BHEL TAN HYDB00086C. Any other additional documents sought by the statutory authorities, the same shall be produced by the seller on priority basis.</p>																										
<p>(vii) Seller shall provide package details including number of packages, gross weight, net weight etc.</p>																										

( Attachment to Enquiry No. E6A1U90280 Due on Date 21.04.2021 for submission by 11.00 hrs to open from 14:00 hrs.)			
INSTRUCTIONS TO BIDDER (ITB)			
	<p>(viii) The seller shall provide the following documents at the time of submission of offer :</p> <p>a) No Business Connection in India declaration issued by the seller as per the format specified. (or)</p> <p>b) (i) No Permanent Establishment in India declaration issued by the seller as per the format specified. (ii) Tax Residence Certificate issued by the seller's tax authorities. (iii) Form 10F issued by the supplier.</p> <p>c) In case the seller has a Business Connection in India as per Section 9 of Income Tax Act or Permanent Establishment in India as per Article 5 of Double Taxation Avoidance Agreement India and the seller's country, the seller shall provide a withholding tax order issued by the Indian Income Tax authority for recovery of applicable tax.</p>		
7	Delivery Schedule		
A	<p>The tendered goods shall be delivered within the period stipulated in PO . Delivery <b>at BHEL</b> can be accepted at the earliest, 30 days prior to delivery date as mentioned in the Purchase order. Delivery <b>earlier than</b> 30 days of contractual delivery date may be accepted with the written permission of BHEL -Purchase department.</p> <p>Goods arriving after the delivery date will be accepted only with the prior written permission of BHEL otherwise they will not be allowed inside the factory. BHEL reserves the right to reject the material, if not delivered by scheduled Purchase Order Delivery Date. (In case of imports , the final entry date of Import General Manifest (IGM) will be reckoned as delivery completion date )</p>		<b>Non-Deviatable</b>
B	<p>Documents such as TC,GCs Inspection reports are to be submitted within 10 days of dispatch of these materials. C note date or Date of submission of documents whichever is later shall be considered as delivery date incase documents are not submitted within 10 days from the dispatch of the material. Supply of plant/ equipment/ stores shall not be considered complete until they have been inspected and accepted at the place and destination specified for delivery by the time stipulated under the terms &amp; conditions of the Order/ Contract. Mere payment by itself shall not constitute acceptance of the goods or materials in any manner, whatsoever.</p>		
	<b>Pricing Terms</b>		
8	Prices once quoted shall remain firm and valid during the execution of PO. Offers with PVC will be rejected outright except in cases where specifically called for in the NIT.		<b>Non-Deviatable</b>
	<b>PRICE VALIDITY :</b>		
9	<p>Unless otherwise specified, offer shall be valid for a period of 90 days from the date of bid opening (Technical bid /part-I in case of two part bid).</p> <p>However the prices quoted for spare parts of the Main equipment shall be kept valid for a period of 1 year from the date of Placement of PO for the main equipment.</p>		

( Attachment to Enquiry No. E6A1U90280 Due on Date 21.04.2021 for submission by 11.00 hrs to open from 14:00 hrs.)			
INSTRUCTIONS TO BIDDER (ITB)			
<b>10</b>	<b>Taxes &amp; Duties (RATE TO BE INDICATED by the bidder against the space provided )</b>		
A	Indigenous Purchase		
	The Taxes as applicable shall be quoted in the following manner.		
i	Vendor to indicate HSN of Goods or SAC of Services.		
ii	IGST/CGST/SGST/UTGST: Rate of Tax to be quoted as extra in %		
	NOTE: Bidders to ensure correct applicability of IGST/CGST/SGST/UTGST based on the Inter / Intra state movement of goods. Taxes prevalent on the contractual delivery date or the actual delivery date (in case of delay) which ever is lower shall be applicable paid. In case Bidder has opted for GST Composition Scheme, the same may be stated explicitly both in their technical and price bids.		
iii	Any other taxes & duties not covered anywhere above may be indicated separately.		
iv	Taxes deducted at source: TDS as per the extant statute shall be recovered. In case vendor does not provide PAN details/concessional certificates, the TDS deduction shall be at the maximum percentage stipulated as per the provisions of Income Tax Act.		<b>Non-Deviatable</b>
B.	Foreign Purchase ( Imports )		
i	The offered price shall be inclusive of all the Taxes and duties as applicable in country of bidder / country of dispatch for the quoted CIP price.		<b>Non-Deviatable</b>
ii	Taxes deducted at source: TDS as per the extant statute shall be recovered. In case vendor does not provide PAN details/concessional certificates, the TDS deduction shall be at the maximum percentage stipulated as per the provisions of Income Tax Act.		<b>Non-Deviatable</b>
<b>11</b>	<b>Payment Terms: Unless otherwise specified in Special Conditions, following shall be the terms of Payment.</b>		
A	<u>Indigenous:</u> 100% payment along with taxes, freight & insurance will be made within 75 days from the date of receipt of complete documentation as per PO. However payment would be done only after receipt of original documents, including site/ Customer acknowledgement on LR (MRC - Material Receipt Certificate at site) / GR clearance at BHEL Stores. For MSEs (covered under MSME Act) which are registered and periodically renewed with BHEL, this period will be 45 days* as prescribed in the relevant act. Adherence to the above time schedule of payment is contingent upon Vendor complying with GST provisions and availment of Input Tax Credit by BHEL before the date of payment. *The taxes that are reimbursed would be the ones applicable as on the contractual Purchase Order delivery date or the amount actually paid whichever is less. In case GST credit is delayed/ denied to BHEL, due to non/delayed receipt of goods and/or tax invoice or expiry of timeline prescribed in GST Law for availing such ITC, or any other reason not attributable to BHEL, GST amount shall be recoverable from Vendor along with interest levied/ leviable on BHEL.		
B	<u>Imports:-</u> i) 100% payment (less Indian Agency Commission, if any) shall be paid <b>through "Usance Letter of Credit / Cash Against Documents (CAD) / Wire Transfer" with a credit period of 60 days</b> ii) LC will be opened after successful completion of pre dispatch inspection prior to the scheduled / agreed delivery date <b>LC will be opened within 7 working days from the date of request.</b>		
C	Note: 1) No advance payment is acceptable. However, in exceptional/rare cases, BHEL at its discretion, may consider advance payment against Bank Guarantee valid up to receipt of material at BHEL for 110% of advance amount issued / confirmed by any of the BHEL consortium banks. 2) Wherever EMD (Earnest Money Deposit) is applicable, it may be noted that no interest will be paid on EMD and the EMD will be paid back to unsuccessful bidders within fifteen days after award of the contract. Successful bidder's EMD will be converted to SD (Security Deposit). <b>Tender Cost wherever applicable is not refundable.</b>		<b>Non-Deviatable</b>
D	No interest shall be payable by BHEL on earnest money or security deposit or any money due to the contractor by BHEL.		
<b>12</b>	<b>Penalty clause:</b> In the event of delay in supply of goods, penalty of 0.5% per week or part there of shall be levied on the undelivered portion subject to a maximum of 10% of the order value. Penalty amount so determined along with applicable GST thereon shall be recovered.		
<b>13</b>	<b>Excess materials</b> supplied beyond tolerance limit as specified in PO, will not be accounted for.		<b>Non-Deviatable</b>

( Attachment to Enquiry No. E6A1U90280 Due on Date 21.04.2021 for submission by 11.00 hrs to open from 14:00 hrs.)			
INSTRUCTIONS TO BIDDER (ITB)			
14	<p><b>Rejected materials</b>, if any, shall be collected by the vendor within 90 days of such communication to the vendor .Beyond 90 days a ground rent of 0.25 %of the value of the material per week will be levied for a maximum period of two weeks.. Beyond this period the supplier forfeits their right to the materials.</p>		<b>Non-Deviatable</b>
15	<p><b>Guarantee / Warranty Period :</b> (Deviation to this clause is not acceptable.) Wherever required, and so provided in the specifications/Purchase Order, the seller shall guarantee that the goods supplied shall comply with the specifications laid down, for materials, workmanship and performance. If within the guarantee period, the delivery is found to be non-complaint, the seller shall on his own account, replace repair, or re-execute the delivery at Purchaser's discretion on the purchaser's first request or within the mutually agreed period, without prejudice to Purchaser's other legal rights. If the seller continues to default on their obligations, purchaser has the right to proceed to replace, repair or re- execute the order at the seller's expense, with or without help from third parties. Purchaser shall notify the seller of the exercise of this right in advance where ever possible Unless otherwise specified, guarantee period shall be 12 months from the date of commissioning or 18 months from the date of supply/replacement whichever is earlier. For bought out packages which are intended to be incorporated in installations or systems the guarantee period shall not start until the time the installations or systems are commissioned, provided always that the period ends not later than 30 months after the date of supply of the goods. <b>The guarantee period shall be extended by the period during which the goods are not in compliance. A guarantee period as described above shall apply afresh to replaced, repaired or re-executed parts of a delivery.</b></p>		<b>Non-Deviatable</b>
<p><b>NOTE: Deviations (Commercial as well as Technical) from the tender specifications and conditions are generally not acceptable. However, deviation if any, shall be brought out clearly with proper justification in the offer. The deviation, if considered by BHEL, shall be loaded for comparison, while evaluating the offer. If a bidder unconditionally withdraws any deviation before price bid opening, the same shall not be loaded. Loading criteria in respect of major commercial conditions where deviations if any are accepted shall be as per clause No.16.</b></p> <p><b>The Vendors may specifically note the following.</b></p>			
16	<b>Evaluation and Loading Criteria:</b>		
A	Evaluation of prices shall be done item-wise unless otherwise specified in the enquiry. Evaluation shall be on the basis of delivered cost, i.e. "total cost to BHEL" w.r.t the finalized technical scope and commercial conditions (after considering incidence of applicable taxes and duties and loading). For evaluation, exchange rate (TT selling rate of State Bank of India) as on the date of bid opening (Part-I, in case of two-part bids) shall be considered. If the relevant day happens to be a bank holiday, then the forex rate as on the previous bank (SBI) working day shall be taken.		
B	In case of foreign bidders, the quoted CIP price shall be loaded by the following factors to arrive at the Delivered Cost:		
i	- Import duty as applicable at the time of <b>Technical/ Part-I bid opening</b> .		
ii	- Port handling/ clearing charges & inland freight and insurance: @ 5% of CIP value (10% for plates, pipes & structurals).		
iii	In other cases subject to acceptance by BHEL, loading for various factors (in addition to above) as the case may be will be done as follows: 0.5% for unloading at Port of Destination Marine Freight 4% and Marine Insurance 1% (9% and 1% towards Freight and Insurance respectively for Plates, Pipes, Rounds & Structurals)		
C	In case of Indigenous Bidders, Ex-works offers received (as against FOR Destination mentioned in enquiry) shall be loaded by 4% of Ex-works value (9% for plates, pipes, rounds & structurals) unless otherwise mentioned in enquiry.		
D	Deviated Penalty: Any loading on penalty clause shall be 10% or to the extent to which the vendor has opted for deviation.		
E	Deviated Payment Terms: Terms: In case BHEL considers any deviation in payment terms, the bids shall be loaded with 18% interest per annum to the extent of deviation.		
17	Procurement directly from the manufacturers/ suppliers shall be preferred. However, no agent shall be allowed to represent more than one manufacturer/ supplier in the same tender. Moreover, either the agent could bid on behalf of the manufacturer/ supplier or the manufacturer / supplier could bid directly but not both. In case bids are received from both from the manufacturer/ supplier and the agent, bid received from the agent shall be ignored.		
18	<b>RIGHT OF REJECTION /NON- PLACEMENT OF PO:</b> BHEL reserves the right to accept or reject any or all bid/s in full or part without assigning any reason whatsoever.		
19	<b>INTEGRITY PACT</b> Vendors shall have to enter into Integrity Pact with BHEL as per attachment - for order value of rupees five crores and above and shall be signed by the competent authority before the issue of purchase order, failing which vendor's offer will be rejected.		
20	<b>Public Procurement</b>		

( Attachment to Enquiry No. E6A1U90280 Due on Date 21.04.2021 for submission by 11.00 hrs to open from 14:00 hrs.)	
INSTRUCTIONS TO BIDDER (ITB)	
<b>A</b>	<p><b>Make in India</b> For this Procurement , the local content to categorize a supplier as a Class I local supplier / Class II local supplier / Non-Local supplier and purchase preference to Class I local supplier , is as defined in Public Procurement ( Preference to Make in India ) , Oct 2017 dated 04.06.2020 issued by DPIIT . In case of subsequent orders issued by the nodal ministry , changing the definition of local content for the items of the NIT , the same shall be applicable even if issued after issue of this NIT , but before opening of Part- II bids against this NIT. Proforma for self certification for minimum local content and auditor's certification is given in Annexure III .</p>
<b>B</b>	Any Bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with competent authority . <a href="https://www.mea.gov.in/">https://www.mea.gov.in/</a> to be referred for latest details of competent authority and exemptions. Proforma for self certification for compliance is given in Annexure IV
<b>21</b>	<b>Benefits earmarked for Purchase from Micro &amp; Small Enterprises (MSEs) – Indigenous Purchase</b>
<b>21A</b>	All Micro and Small Enterprises (MSEs) as defined in MSE Procurement Policy are exempt from Paying earnest money deposit . NSIC registered unit bidders shall submit NSIC Certificate along with bid documents. Date to be reckoned for determining the deemed validity will be the last date of Technical bid submission. Non- submission of such document will lead to consideration of their bid, at par with other bidders and MSE status of such bidders shall be shifted to Non- MSE Category till the supplier submits these documents
<b>21B</b>	In tender,if MSEs quoting price within price band of L1+15% shall also be allowed to supply a portion of requirement by bringing down their price to L1 price in a situation where L1 price is from someone other than a MSE and such MSE shall be allowed to supply up to 25% of total tendered value. In case of more than one such MSE, the supply shall be shared proportionately. Out of these 25% minimum 3% shall be earmarked for MSEs owned by women and 6.25% for MSEs owned by SC/STs who submit the bid along with relevant documents. This is applicable in case of item-level evaluation tenders and divisible tenders .
<b>21C</b>	If an enterprise falling under MSME category as defined in the Act, graduates to a higher category from its original category or beyond the purview of the Act, it shall continue to avail all non-tax benefits of its original category notified by the Ministry of Micro, Small and Medium Enterprise for a period of three years from the date of such graduation to the higher category.
<b>21D</b>	BHEL HPEP is registered with RXIL (TReDS) platform. MSE bidders are requested to get registered with RXIL (TReDS) platform to avail the facility as per the GOI guidelines
<b>22</b>	Startups : For Startups Medium Enterprises, Condition of prior turnover and prior experience in Public Procurement may be relaxed subject to meeting of Quality and Technical Specifications . Startups are exempt from paying earnest money deposit.
<b>23</b>	For Claiming Payments <b>for goods</b> received at BHEL works / Site from Vendors' Works) a) Original of Invoice marked as ORIGINAL FOR RECIPIENT b) Duplicate of Invoice marked as DUPLICATE FOR TRANSPORTER c) Packing List - clearly showing number of packages, gross weight and net weight. d) Warranty/Guarantee certificates (If applicable as per PO terms) e) Insurance certificate f) Third Party Inspection Certificates. g) LR Copy signed & stamped by Site incharge / Customer for site deliveries) (For material received at BHEL payment will be made against GR for accepted quantity)
<b>24</b>	Inspection Measuring and Test Equipment (IMTE) whether used by the Seller/ Contractor or sub-contractor shall be calibrated, maintained and controlled. Calibration shall be valid and IMTE maintained in sound condition during usage.
<b>25</b>	ISO-9001, ISO14001 and OHSAS 18001 shall be complied
<b>26</b>	Applicable Conditions :These General conditions of Contract for Purchase apply to all enquiries, tenders, request for quotations, orders and agreements concerning the supply of goods and the rendering of related services (hereinafter referred to as “deliverables”) to Bharat Heavy Electricals Limited, Ramachandrapuram , Hyderabad (hereinafter referred to as “BHEL” or the Purchaser) or its projects/customers. Any deviations from or additions to these General conditions of contract for Purchase’ require Purchaser’s express written consent. The general terms of business or sale of the Seller shall not apply to Purchaser. Orders, agreements and amendments thereto shall be binding if made or confirmed by the Purchaser in writing. Only the Purchasing department of the Purchaser is authorized to issue the Purchase order or any amendment thereof.
<b>27</b>	Being PMD Vendor, if you are not quoting against this tender enquiry, please send your regret letter positively for our reference with valid reasons for not participating in the tender enquiry. Repeated lack of response on the part of bidder may lead to deletion such PMD vendor from BHEL's approved vendor list. Vendor shall ensure that PAN details are available/updated with BHEL, else Vendor shall attach PAN details with enquiry failing which offer shall be liable for rejection.
<b>28</b>	Kindly quote your prices in figures and words both. In case of any discrepancy in value, the prices quoted in words shall be considered for evaluation and establishing L1 Status
<b>29</b>	Any discount / revised offer / bids submitted by a bidder on its own shall be considered, provided it is received on or before the due date and time of offer / bid submission (Part-1). Conditional discounts shall not be considered for evaluation of tenders.
<b>30</b>	The bidder whose bid is technically not accepted will be informed & EMD wherever submitted shall be returned after finalization of contract. EMD shall be forfeited in the event of bidder opting out after tender opening.

( Attachment to Enquiry No. E6A1U90280 Due on Date 21.04.2021 for submission by 11.00 hrs to open from 14:00 hrs.)	
INSTRUCTIONS TO BIDDER (ITB)	
<b>31</b>	In case of abnormal delays (beyond the maximum late delivery period as per Penalty clause) in supplies / defective supplies or non-fulfillment of any other terms and conditions given in Purchase Order, BHEL may cancel the Purchase Order in full or part thereof, and may also make the purchase of such material from elsewhere / equivalent market price at the risk and cost of the supplier. BHEL will take all reasonable steps to get the material from alternate source at optimum cost. If bidder does not agree to the above Risk Purchase Clause, BHEL reserves the right to reject the offer. Nonperformance of contract attracts penal provisions inline with BHEL's Suspension of Business dealings.
<b>32</b>	Any other terms and conditions of the bidder attached / referred against the tender enquiry will not be considered.
<b>33</b>	All drawings as also all patterns and tool supplied by BHEL or made at BHEL's expense are BHEL's property. These cannot be used or referred to any other party and must only be used in the execution of BHEL's orders.
<b>34</b>	Any amount payable by the consignor / supplier under any of the condition of this contract shall be liable to be adjusted against any amount payable to the consignor / supplier under any other work / contract awarded to him. This is without prejudice to any other action as may be deemed fit by BHEL.
<b>35</b>	The bids of the bidders who are on the banned list and also the bids of the bidders, who engage the services of the banned firms, shall be rejected. The list of firms banned by BHEL is available on BHEL web site www.bhel.com
<b>36</b>	Definitions
Throughout these conditions and in the specifications, the following terms shall have the meanings assigned to them, unless the subject matter or the context requires otherwise.	
<b>36A</b>	Purchaser' means BHEL-HPEP, Ramachandrapuram, Hyderabad-502 032 of Bharat Heavy Electricals Limited (A Govt. of India Undertaking) incorporated under the companies Act having its registered office at BHEL House, Siri fort, New Delhi-110049, India and shall be deemed to include its successors and assigns. It may also be referred to as BHEL.
<b>36 B</b>	'The seller' means the persons, firm, company or organization on whom the Purchase order is placed and shall be deemed to include the seller's successors, representatives, heirs, executors and administrator as the case may be. It may also be referred to as Contractor, supplier or vendor.
<b>36C</b>	'Contract' shall mean and include the Purchase order incorporating various documents viz., tender/offer, letter of intent/acceptance, the General Conditions of contract and special conditions of contract for Purchase, specifications, inspection/quality plan, schedule of prices and quantities, drawings, if any enclosed are to be provided by the Purchaser or his authorized nominee and the samples or patterns if any to be provided under the provision of the contract. In case of any inconsistency or contradiction between any of the documents, the order of precedence shall be Purchase Order, LOI/LOA followed by specific conditions, special conditions of contract and general conditions of contract for commercial conditions; and specific agreement on technical conditions, special technical conditions and general technical conditions, tender/ offer.
<b>37</b>	'Parties to the contract' shall mean the seller and the purchaser as named in the main body of the Purchase Order.
<b>38</b>	Ordering and confirmation of order
	The seller shall send the order acceptance in Toto within one week from the date of LOI/Purchase order or such other period as specified/agreed by the Purchaser. Purchaser reserves the right to revoke the order placed if the order confirmation differs from the original order placed. Purchaser shall only be legally bound if agreed explicitly in writing to be in agreement with the deviation. The acceptance of deliverables or supplies by Purchaser as well as payments made in this regard shall not imply acceptance of any deviations. The Purchaser order will be deemed to have been accepted if no communication to the contrary is received within one week (or the time limit as specified /agreed by the Purchaser) from the date of P.O. Purchaser, is at liberty to send signed P.O. through electronic media such as e-mail and the receipt of which shall be treated as receipt of order.
<b>39</b>	Execution
	The whole contract is to be executed in the most workman like manner, substantial and approved as per the contracted terms.
<b>40</b>	Progress Report
	The seller shall render such report as to the progress of work and in such form as may be called for by the Purchaser from time to time. The submission and acceptance of such reports shall not prejudice the rights of the purchaser in any manner. Seller shall communicate to BHEL immediately, change of address, ownership, contact person(s), the mobile numbers and e-mail of the dealing person concerned. Milestones shall be periodically updated by vendor/subcontractor through PRADAN Portal ( <a href="https://web.bhelhyd.co.in/mm/">https://web.bhelhyd.co.in/mm/</a> ). Non updation will adversely affect service rating of vendor performance.
<b>41</b>	Product information, Drawings and documents / Non-disclosure and Information Obligations

( Attachment to Enquiry No. E6A1U90280 Due on Date 21.04.2021 for submission by 11.00 hrs to open from 14:00 hrs.)	
INSTRUCTIONS TO BIDDER (ITB)	
	<p>Drawings, technical documents or other technical information received by one party shall not without the consent of the other party, be used for any other purpose than that for which they were provided. They may not, without the consent of the submitting party, otherwise be used or copied, reproduced, transmitted or communicated to third parties. All information and data contained in general product documentation, whether in electronic or any other form, are confidential and binding only to the extent that they are by reference expressly included in the contract.</p> <p>The seller shall, as per agreed date/s but not later than the date of delivery, provide free of charge any information and/or drawings which are necessary to permit the Purchaser to erect, commission, operate and maintain the product. Such information and drawings shall be supplied in the number of copies agreed upon or at least three copies of each.</p> <p>All intellectual properties, including designs, drawings and product information etc. exchanged during the formation and execution of the contract shall continue to be the property of the submitting party.</p> <p>The seller shall provide Purchaser with all information pertaining to the delivery in so far as it could be of importance to Purchaser. The seller shall not reveal confidential information to its own employees not involved with the tender/contract and its execution and delivery or to third parties, unless Purchaser has agreed to this in writing beforehand. The seller shall not be entitled to use the Purchaser's name in advertisements and other commercial publications including website without prior written permission from Purchaser.</p> <p>In the event of violation of the confidentiality as agreed, BHEL will take legal action as deemed fit. Non disclosure agreement to be entered as per <b>Annexure- II</b> wherever applicable.</p>
<b>42</b>	Inspection and Testing
<b>42 A</b>	<p>The goods and stores shall be manufactured by approved quality system and each part/component may be inspected and tested by the Purchaser prior to shipment and shall fully comply with relevant requirements of Purchaser.</p> <p>Purchaser has the right to inspect at any stage during manufacture/ delivery. In the event of rejection, Purchaser shall inform the seller accordingly and Purchaser shall be entitled to replacement or repair at his discretion or may proceed to terminate or cancel the agreement. All this, does not affect Purchaser's right to recover compensation.</p>
<b>42 B</b>	<p>Purchaser or his authorized representative shall be entitled at all reasonable times during execution to inspect, examine and test at the seller's premises the material and workmanship of all stores to be supplied under the contract, and if the part of the stores are being manufactured at other premises, the seller shall obtain for purchaser or his authorized representative permission to inspect, examine and test as if the said stores are being manufactured at the seller's premises. Such inspection, examination and testing, if made shall not release the seller from any obligation under the contract.</p> <p>For indigenous suppliers all costs related to first inspection request shall be borne by the purchaser and the cost of subsequent inspections due to non-readiness of material/rework/ rejections shall be borne by the seller. In case of imports all inspection charges including third party inspections if any shall be borne by the seller. The cost of inspection staff/third party specified by the Purchaser shall be borne by seller unless otherwise specifically agreed. Whether the contract provides for tests on the premises of the seller or any of his sub-contractor/s, seller shall be responsible to provide such assistance, labor, materials, electricity, fuels, stores, apparatus, instruments as may be required and as may be reasonably demanded to carry out such tests efficiently.</p> <p>Cost of any type test or such other special tests shall be borne by the seller unless otherwise specifically agreed in the contract. The Seller shall give the authorized representative of the purchaser reasonable notice in writing of the date on and the place at which any stores will be ready for inspection/ testing as provided in the Contract. Annexure - I may be strictly be complied with for the time lines. Any delay in submission of the documents by the vendor will not alter the delivery date.</p>
<b>43</b>	Quality and Condition of the Deliverables
	The seller shall be responsible for compliance with applicable technical, safety, quality, environmental requirements and other regulations in relation to his products, packaging and raw and ancillary materials.
<b>44</b>	Packaging and Dispatch
	<p>The seller shall package the deliverables safely and carefully and pack them suitably in all respects considering the peculiarity of the material for normal safe transport by sea/air/rail/road to its destination suitably protected against loss, damage, corrosion in transit and the effect or tropical salt laden atmosphere. The packages shall be provided with fixtures/hooks and sling marks as may be required for easy and safe handling by mechanical means. Special packaging conditions/ environmental conditions as defined in the enquiry shall be fully complied.</p> <p>Each package must be marked with consignee name, P.O. number Package No. gross weight &amp; net weight, dimensions (LxBxH) and seller's name. The packing shall allow for easy removal and checking of goods on receipt and comply with carrier's conditions of packing or established trade practices. Packing list of goods inside each package with P.O. item No. &amp; quantity must also be fixed securely outside the box to indicate the contents. If any consignment needs special handling instruction, the same shall be clearly marked with standard symbols/instructions. Hazardous material should be notified as such and their packing, transportation and other protection must confirm to relevant regulations.</p>
<b>45</b>	Delivery:
	Except as otherwise indicated in the Purchase order, delivery shall be FOR (Destination) for indigenous orders and CIP for imported orders. The delivery date (s) or delivery period (s) as stipulated in the agreement shall be firm and binding and shall apply to the entire delivery for each P.O. item. Partial shipments may however, be permitted by the purchaser on prior intimation from the Seller. Unless specifically agreed otherwise, transit insurance coverage will only be within India for imported consignments by BHEL. Accordingly, the seller shall send an intimation to the Purchase officer/Manager giving Purchase Order No., shipping particulars, Invoice value etc., immediately on dispatch of goods.
<b>46</b>	Penalty

( Attachment to Enquiry No. E6A1U90280 Due on Date 21.04.2021 for submission by 11.00 hrs to open from 14:00 hrs.)	
INSTRUCTIONS TO BIDDER (ITB)	
	<p>The time or period of delivery as stipulated in the schedule of delivery shall be deemed to be the essence of the contract. Should circumstances arise whereby the deadline for an agreed delivery date(s) or period(s) is expected to be exceeded, the seller shall inform Purchaser hereof without delay. If delay in delivery is caused by any of the circumstances mentioned in clause 54 (Force Majeure) or which are caused exclusively by the acts of Purchaser, the Purchaser shall extend the time for delivery by a period which is reasonable having regard to all the circumstances in the case.</p> <p>If the Seller delays beyond any agreed delivery date(s) or period(s), Purchaser shall levy penalty for such delay @ 0.5% per week (7 days) or part thereof on delayed portion of the order value subject to a maximum of 10% of the value of the Purchase Order. However, penalty for delayed delivery will be calculated on 100% of the purchase order value if the material supplied cannot be put to intended use.</p> <p>The penalty will be charged on the value of the purchase order excluding statutory levies, freight and insurance wherever not included in the price. Penalty amount so determined along with applicable GST thereon shall be recovered. Imposition, recovery or settlement of this penalty shall not affect Purchaser's right to performance, compensation and termination of the agreement.</p> <p>For delay analysis, period referred in Annexure-I will be considered as standard time lines for various major activities.</p>
<b>47</b>	<p><b>Transfer of Ownership and Risk</b></p> <p>The risk for the delivery remains with the seller until the goods are delivered at the agreed place. However ownership shall get transferred as per terms of purchase order in line with INCOTERMS.</p>
<b>48</b>	<p><b>Price, invoicing and payment</b></p> <p>The agreed prices are fixed prices in the currency as specified in the Purchase Order. They shall include packing, forwarding, loading and carriage to the place specified by the purchaser and are exclusive of all applicable taxes, duties etc., except for those specifically agreed by the Purchaser. Invoices shall be submitted bearing the Purchase Order number &amp; date, item number/s and supporting documents as called for in the Purchaser order.</p> <p>The direct payments (including LC/documents through Bank on collection basis), shall be made by E-payment mode and not by cheque /bank drafts except in special circumstances. Vendors shall furnish the E-payment particulars in the prescribed formats duly authenticated by their respective Bankers, If not got registered earlier with the Buyer.</p> <p>Invoice has to be raised quoting HSN Code of Goods or Accounting Code of Services. Invoice should mention BHEL-HPEPHYDERABAD GSTIN: 36AAACB4146P1ZG or GSTIN of BHEL Nodal Agency as mentioned in PO.</p> <p>Indian Agency commission if payable and so specified in the Purchase order shall be paid in Indian Rupees, considering the SBI TT selling exchange rate prevailing on the date of tender opening (part 1 in case of two part bid), after successful completion of the contract.</p> <p>If so stipulated in the order, the seller shall furnish, on receipt of the Purchase Order or along with order acknowledgement, the billing break-up of prices (BBU) for approval by the purchaser in respect of the major items/components going into the equipment. This BBU is required by the Purchaser for admitting the claims of the seller if part shipments are contemplated and also to facilitate custom clearance after payment of duties in case of imports.</p> <p>In case of delay in receipt of supporting document details, consequential demurrage/wharf age /detention charges shall be to the account of the seller.</p> <p>Payment does not imply in any respect whatsoever a waiver of Purchaser's right to performance of the agreement. Purchaser is entitled to set off claimable debts against claimable liabilities with the seller by means of a setoff Note.</p>
<b>49</b>	<p><b>Contract variations; Increase or decrease in the scope of supply</b></p> <p>Purchaser may vary the contracted scope during execution due to exigencies of project requirement. If the seller is of the opinion that the variation has an effect on the agreed price or delivery period, Purchaser shall be informed of this immediately in writing along with technical details, and in the event of additional work, submit a quotation with regards to the price and period involved, as well as the effect this additional work will have on the other work to be performed by the seller. Provided, that if unit rates are available in the contract, the same shall be applied to such additional work. The seller shall not perform additional work before purchaser has issued written instructions/amendment to the purchase order to that effect. The work which the seller should have or could have anticipated in terms of delivering the service (s) and functionality (ies) as described in this agreement should be executed by the vendor without any price implication.</p>
<b>50</b>	<p><b>Short shipments/ warranty/guarantee replacements</b></p> <p>In case of any short shipment during initial supply which is subsequently dispatched by the seller or any guarantee / warranty replacements shall be dispatched on "DDP-Delivered duty paid BHEL stores" basis for imported items and "FOR-BHEL Stores/designated destination" basis for indigenous items. Taxes, if any paid by indigenous vendor for short supply, guarantee /warranty replacement, repair activity shall be to vendor's account only. Vendor has to raise a credit note for short supplied quantity as per GST provisions.</p>
<b>51</b>	<p><b>Rejection/Replacement</b></p> <p>The seller shall arrange replacement / repair under its obligation under the contract within one month from the date of intimation or mutually agreed period. The rejected goods shall be taken away by the seller and replaced on DDP/FOR-BHEL Stores/designated destination basis within such period. In the event of the seller's failure to comply. Purchaser may take appropriate action including disposal of rejections, at the cost and risk of the seller. Vendor has to raise a credit note for rejected quantity as per GST provisions.</p> <p>In case defects attributable to seller are detected during processing of the goods at purchaser's / his subcontractor works, the seller shall be responsible for replacement /repair of the goods as required by the purchaser at seller's cost.</p>
<b>52</b>	<p><b>Export Administration Regulations</b></p>

( Attachment to Enquiry No. E6A1U90280 Due on Date 21.04.2021 for submission by 11.00 hrs to open from 14:00 hrs.)	
INSTRUCTIONS TO BIDDER (ITB)	
	If a delivery includes such technology and / or supply that is subjected to the export regulations the seller shall obtain due permissions, approvals, license etc.
<b>53</b>	<b>Cancellation / Termination of contract and risk purchase</b> Purchaser shall have the right to completely or partially terminate the agreement by means of written notice to that effect without prejudicing their other rights in the event that : - The seller is declared bankrupt, its business has been shut down or liquidated, a substantial part of its assets have been attached/destroyed, or the business has been transferred to a third party. - Any misrepresentation or hiding of material fact if detected at a later stage. - The delivery is rejected after inspection or re-inspection. - In the event of termination, the risk of the items already delivered but not of use to Purchaser, as determined by purchaser, remains with the seller. The items shall then be at the seller's disposal and they are to be collected by the seller. The seller shall refund any payments made by purchaser in terms of the terminated agreement immediately, not later than 30 days, - In the event of Cancellation/ termination of contract, BHEL reserves the right to procure the items which are not delivered as per PO and charge the excess cost from the defaulting seller. In case the excess cost is not repaid by or recovered from the defaulting seller within 30 days, apart from legal recourse for effecting such recoveries, Penal action in line with BHEL's Suspension of Business dealings will be taken.
<b>54</b>	<b>Force Majeure</b> The supplier shall not be considered in default if delay occurs due to causes beyond their control such as Acts of God, Natural calamities, Fire, Frost, Flood, Civil War, civil commotion, riot, Government Restrictions. Only those causes that have duration of more than seven days shall be considered cause of force majeure. Notification to this effect duly certified by local chamber of commerce/statutory authorities with supporting documents shall be given by the supplier to BHEL by registered letter/courier service immediately without loss of time. In the event of delay due to such causes the delivery schedule shall be extended for a length of time equal to the period of Force Majeure or at the option of BHEL the order may be cancelled. Such cancellation would be without any liability whatsoever on the part of BHEL. In the event of such cancellation the supplier shall refund any amount advanced or paid to the supplier by BHEL and deliver back any material issued to him by BHEL and release facilities, if any provided by BHEL.
<b>55</b>	<b>Non-waiver of Defaults</b> If any individual provision of the contract is invalid, the other provisions shall not be affected.
<b>56</b>	<b>Settlement of Disputes</b> (i) Except as otherwise specifically provided in the contract, all disputes concerning questions of the facts arising under the contract, shall be decided by the Purchaser, subject to written appeal by the seller to the purchaser, whose decision shall be final. (ii) Any disputes of differences shall to the extent possible be settled amicably between the parties thereto, failing which the disputed issues shall be settled through arbitration. (iii) The seller shall continue to perform the contract, pending settlement of disputes(s).
<b>57</b>	<b>Conciliation clause</b> <b>CONCILIATION CLAUSE FOR CONDUCTING CONCILIATION PROCEEDINGS UNDER THE BHEL CONCILIATION SCHEME, 2018:</b> The Parties agree that if at any time (whether before, during or after the arbitral or judicial proceedings), any Disputes (which term shall mean and include any dispute, difference, question or disagreement arising in connection with construction, meaning, operation, effect, interpretation or breach of the agreement, contract or the Memorandum of Understanding, penalty deduction, time extension), which the Parties are unable to settle mutually, arise inter-se the Parties, the same may, be referred by either party to Conciliation to be conducted through Independent Experts Committee to be appointed by competent authority of BHEL from the BHEL Panel of Conciliators. The proceedings of Conciliation shall broadly be governed by Part-III of the Arbitration and Conciliation Act 1996 or any statutory modification thereof and as provided in Procedure in <a href="http://www.bhel.com/index.php/story_details?story=2454">http://www.bhel.com/index.php/story_details?story=2454</a> . The Procedure together with its Formats will be treated as if the same is part and parcel hereof and shall be as effectual as if set out herein in this ITB.
	<b>ARBITRATION (WITH SOLE ARBITRATOR)</b>
	Except as provided elsewhere in this Contract, in case amicable settlement is not reached between the Parties, in respect of any dispute or difference; arising out of the formation, breach, termination, penalty deduction, validity or execution of the Contract; time extension, or, the respective rights and liabilities of the Parties; or, in relation to interpretation of any provision of the Contract; or, in any manner touching upon the Contract, then, either Party may, by a notice in writing to the other Party refer such dispute or difference to the sole arbitration . Sole arbitrator to be appointed by Head of the Unit - BHEL , HPEP .
	The Arbitrator shall pass a reasoned award and the award of the Arbitrator shall be final and binding upon the Parties.
	Subject as aforesaid, the provisions of Arbitration and Conciliation Act 1996 (India) or statutory modifications or re-enactments thereof and the rules made thereunder and for the time being in force shall apply to the arbitration proceedings under this clause. The seat of arbitration shall be Sangareddy / Hyderabad, Telangana. The language of arbitration shall be English and the documents shall be submitted in English.
	The cost of arbitration shall initially be borne equally by the Parties subject to the final apportionment of the cost of the arbitration in the award of the Arbitrator.
	Subject to the arbitration in terms of clause 57, the courts at Sangareddy, Telangana State shall have exclusive jurisdiction over any matter arising out of or in connection with this contract.

<b>( Attachment to Enquiry No. E6A1U90280 Due on Date 21.04.2021 for submission by 11.00 hrs to open from 14:00 hrs.)</b>	
<b>INSTRUCTIONS TO BIDDER (ITB)</b>	
	Notwithstanding the existence or any dispute or differences and/or reference for the arbitration, the Contractor shall proceed with and continue without hindrance the performance of its obligations under this Contract with due diligence and expedition in a professional manner except where the Contract has been terminated by either Party in terms of this Contract.
	<b>ARBITRATION FOR CONTRACT WITH PUBLIC SECTOR ENTERPRISE (PSE) OR A GOVERNMENT DEPARTMENT</b>
	In the event of any dispute or difference relating to the interpretation and application of the provisions of commercial contract(s) between Central Public Sector Enterprises (CPSEs/ Port Trusts inter se and also between CPSEs and Government Departments/Organizations (excluding disputes concerning Railways, Income Tax, Customs & Excise Departments), such dispute or difference shall be taken up by either party for resolution through AMRCD as mentioned in DPE 0M No 4(1)/2013-DPE(GM/FTS 1835 dated 22-05-2018
<b>58</b>	<b>Applicable Laws and jurisdiction of Courts</b>
	This agreement shall be construed and interpreted in accordance with the laws of India and shall have exclusive jurisdiction of Sangareddy/Hyderabad courts, Telangana, India.
<b>59</b>	<b>BHEL-Fraud prevention policy shall be adhered to.</b>
	The Bidder along with its associate/ Collaborators/ Sub-contractors/ sub-vendors/ consultants/ service providers shall strictly adhere to BHEL Fraud Prevention policy displayed on BHEL Website <a href="http://www.bhel.com">http://www.bhel.com</a> and shall immediately bring to the notice of BHEL management about any fraud or suspected fraud as soon as it comes to their notice.
	Fraud prevention policy and list of nodal officers is hosted on BHEL Hyderabad website <a href="http://web.bhelhyd.co.in">web.bhelhyd.co.in</a>
<b>60</b>	<b>Suspected Cartel Formation</b>
	The Bidder declares that they will not enter into any illegal or undisclosed agreement or understanding , whether formal or informal with other Bidder(s) . This applies in particular to prices , specifications ,certifications ,subsidiary contracts,submission or nonsubmission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process. In case, the Bidder is found having indulged in above activities , suitable action shall be taken by BHEL as per extant policies / guidelines .



Bharat Heavy Electricals Limited  
Ramachandrapuram: Hyderabad - 502032  
Purchase Department  
Product Division: Heat Exchangers & Fabrication  
Ph. No. 040 2318 2522/2103

ITB Annexure-I

Enquiry No. E6A1U90280 date 31.03.2021

Following major activity timelines shall be considered for Indigenous/Foreign purchases

S.NO	Activity	Agency	Timeline	Cumulative Weeks from the date of PO
1	PO acknowledgement	Vendor	01 Week from PO	01
2a	Submission of Drawings and QP (R00)	Vendor	02 Week from PO	02
2b	Approval/Review of Drawings and QP	BHEL/Customer	02 week from the date of submission	04
2c	Submission of Drawings and QP (R01)	Vendor	01 Week from the date of receipt of comment	05
2d	Approval/Review of Drawings and QP	BHEL/Customer	02 week from the date of resubmission	07*
3	Manufacturing & completion of job	Vendor	17 week from the date of approval of Document or Manufacturing clearance.	24
4	Inspection completion	Self/BHEL/Third party inspection agency	01 week from inspection call date	25
5	Dispatch Instructions	BHEL	00 week from inspection report	25
6	Receipt of Material	Vendor	01 week from Dispatch instructions	26

**Total: 26 weeks**

\* In case of Drawings and QP approval continued beyond Revision-01 by end customer, vendor need to revise & submit the documents within 03 days. Delay more than 03days will be in seller's account.

Bidder's Sign with date

(To be executed on Non- Judicial Stamp Paper for an appropriate value.  
To be stamped as an agreement)

(For Suppliers on Unit's / Division's PMD)

**ANNEXURE-II**

**Framework Confidentiality Agreement Cum Undertaking**

This Agreement made on this the \_\_\_\_\_ day of (month) \_\_\_\_\_ 20 \_\_\_\_  
("Effective Date") by and between M/s. BHARAT HEAVY ELECTRICALS LIMITED, having  
registered office at "BHEL House", Siri Fort, New Delhi – 110049 (India), acting through its  
\_\_\_\_\_ Unit (hereinafter may be referred to as "BHEL" or "the company").

And

M/s. \_\_\_\_\_ (address) \_\_\_\_\_  
represented by authorized representative Sri \_\_\_\_\_ (herein  
after referred to as the "Supplier").

The supplier and the company may, unless the context otherwise requires, hereinafter be  
collectively referred to as "Parties" or singly as the "Party".

**RECITALS**

Whereas, BHEL is engaged in the design, engineering, manufacturing, construction, testing,  
commissioning and servicing of a wide range of products, systems and services for the core  
sectors of the economy, viz. Power, Transmission, Industry, Transportation, Renewable  
energy, Oil & Gas and Defence and providing associated services to varied customers in  
relation to which BHEL / its affiliates own valuable information of a secret and confidential  
nature.

Whereas the Company may, in connection with contract(s) (as defined hereunder) placed  
or to be placed upon the supplier, or otherwise, from time to time, make available,  
Technical Information as is defined hereunder.

And Whereas BHEL is willing to provide such Technical Information to the Supplier from  
time to time and the Supplier understands and acknowledges that such Technical  
Information is valuable for the Company and as such is willing to protect confidentiality of  
such information, subject to the terms and conditions set out hereunder.

Now therefore, in view of the foregoing premises and in consideration of the mutual  
covenants and agreements hereinafter set forth, the parties agree as under:

**1. Definitions:**

Unless the context so requires, in this Agreement, the following terms will bear the  
meaning ascribed to the said term in this clause.

- A. **“Contract”** means the contract entered into with a supplier and includes a Purchase Order, or a Work Order for procurement of any goods or for provision of any services.
- B. **“Effective Date”** means the date of this Agreement as mentioned in the preamble of this Agreement.
- C. **“Supplier”** includes a Contractor or a Vendor of the Company whether for supplying of goods or for providing any services under a Contract or both.
- D. **“Technical Information”** includes Drawings, and / or Product Standards and / or Specifications and / or Corporate / Plant Specifications and / or Technological Process Sheets and / or Technical Data Sheets and / or Jigs & Fixtures and / or Pattern & Dies and / or Special Gauges and / or Tools etc. Belonging to or wherein the Company has acquired from a third party a right of user and includes any improvement thereto from time to time whether carried out by the Company or by the Suppliers.
- E. **“Intended Purpose”** means the purpose for which the Technical Information is provided to the supplier under or in connection with a contract.
- F. **“Improvement”** includes any modification made to, or adaptation of, the Technical Information which enhances or is calculated to enhance the performance (Whether in terms of effectiveness or in terms of efficiency or both) of the product and / or the service to be provided by the Supplier under a Contract.

2. This Agreement shall come into force / deemed to have come into force, as the case may be, on the Effective Date; or, on the first date when the Technical Information or any part thereof is provided by BHEL to the supplier; whichever is earlier.

3. **Agreement deemed to be incorporated in each contract:** Unless and to the extent otherwise stipulated in the Contract, the conditions of this Agreement are deemed to be incorporated in all Contracts which may be entered into between the Company and the Supplier. Further, unless otherwise stipulated, the obligations under this Agreement are and will be independent of the obligations under the Contracts and such obligations of the Supplier hereunder will remain of full effect and validity notwithstanding that the period of validity of the Contract has expired by efflux of time stipulated therein; or, the contract has been discharged by performance or breach; or, the termination of the Contracts for any reason whatsoever.

4. **Ownership:**

4.1 The Company may, from time to time, make available to the Supplier, Technical Information on a non-exclusive basis by way of loan.

4.2 The Supplier acknowledges and agrees that all Technical Information and copies thereof that are or may be provided by the Company to the Supplier, are and shall remain the property of BHEL or that of the concerned entity from whom BHEL has

obtained the Technical Information and such Technical Information are and shall constitute trade secrets of the BHEL. Nothing in this Agreement or in any disclosures made hereunder by or on behalf of the Company shall be construed as granting upon the Supplier any patent, copyright or design or any other intellectual property rights of whatsoever description that subsists or may hereinafter exist in the Technical Information. Furthermore, nothing in this Agreement or in any disclosures made hereunder by or on behalf of the Company shall be construed as granting upon the supplier any license or right of use of such patent, copyright or design or any other intellectual property rights of whatsoever description which may now or hereafter exist in the Technical Information except for use of the Technical Information strictly in accordance with this Agreement and the contract and / or as directed in writing by the Company, solely for the Intended Purpose under the Contract.

- 4.3 Neither party is obligated by or under this Agreement to purchase from or provide to the other party any service or product and that any such purchase / sale of any product and / or service by one party to the other party will be governed by the Contract if any, that may be entered into by and between the Company and the Supplier.
- 4.4 The Supplier is / has been made well aware and acknowledges that the Technical Information being / which may be shared with it by the Company has been either generated by the Company by incurring huge investment and cost or obtained from foreign collaborators under Technical Collaboration Agreement (TCA) with stringent confidentiality conditions.
- 4.5 The supplier agrees and undertakes to adhere to confidentiality requirements as applicable to BHEL under a TCA and also ensure that the confidentiality requirements are adhered to by all its concerned employees or sub-contractors /suppliers (where permitted to be engaged by BHEL). Any damages, losses, expenses of any description whatsoever, arising out of or in connection with a breach of the confidentiality requirements under a TCA owing to any act or omission on the part of the supplier or its employees or sub-contractors / suppliers that is claimed by a foreign collaborator from the Company shall be wholly borne by the Supplier and it shall keep BHEL fully indemnified in this behalf. The demand by the Company shall be conclusive upon the Supplier who shall thereupon forthwith pay to the Company without demur, dispute or delay the amount as demanded without demanding any further proof thereof.
- 4.6 The Supplier agrees and undertakes that unless so decided and advised by the Company in writing all rights / title to any Improvement to the Technical Information shall vest in the Company. The Supplier undertakes and agrees to inform forthwith to the Company of any such Improvement made to the Technical Information and transfer all drawings / documents or other materials connected with such Improvement to the Company and

also agrees to fully cooperate with the Company for protecting the Company's interests in such Improvements in the Technical Information including but not limited to obtaining necessary protection for the intellectual property rights in such improvement, if so desired by the Company. If a question arises whether a modification amounts to improvement to the Technical Information, the same shall be decided by the Company and such decision shall be final and binding upon the supplier.

**5. Use and Non – Disclosure:**

5.1 Unless otherwise stipulated by the Company, all Technical Information made available to the supplier, by the Company shall be treated as Confidential irrespective of whether the same is marked or otherwise denoted to be Confidential or not.

5.2 The Supplier undertakes and agrees that the Technical Information in its possession shall be held in strict confidence and will be used strictly in accordance with this Agreement and solely for the Intended Purpose under the Contract. Use of the Technical Information for any other purpose other than Intended Purpose is prohibited.

5.3 In particular, the Supplier shall not use Technical Information or any Improvement in its possession for the manufacture or procurement of the product(s) or components or parts thereof or use the Technical Information or any portion thereof or any modification or adaptation thereof in any form to provide any product and / or service to any third party, without the prior written consent of the Company.

5.4 The Supplier shall not disclose any of such Technical Information to any third party without the prior written consent of the Company. The Supplier agrees that without prior written consent of the Company, the supplier shall not disclose to a third party about the existence of this Agreement, or of the fact that it is / was in possession of or has experience in the use of any Technical Information nor shall the Supplier share in any manner whatsoever, with a third party, the name or details of any Contract(s) awarded by the Company to it or performed by the Supplier or the scope of work thereof or share any document or correspondence by and between the Company and the supplier in or in connection with this Agreement or such Contract(s). Notwithstanding what is stated elsewhere, the overall responsibility of any breach of the confidentiality provisions under this Agreement shall rest with the Supplier.

5.5 This Supplier undertakes and agrees not to make copies or extracts of and not to disclose to other any or all of the Technical Information in its possession, except as follows:

- (a) The Supplier may disclose the Technical Information to such of its officers and employees strictly to the extent as is necessary for such officer or employee for the Intended Purpose, provided that the Confidential Information (or copies thereof) disclosed shall be marked clearly as the confidential and proprietary information of Company and that such officers and employees shall similarly be bound by undertakings of confidence, restricted use and non-disclosure in respect of the Technical Information. The Supplier shall be responsible for any breach of such confidentiality provisions by such officers and employees.
- (b) With the prior written consent of Company, the supplier may disclose for the Intended Purpose such Technical Information as is provided for in such consent to such of its professional advisers: consultants, insurers and subcontractors who shall be similarly bound by undertakings of confidence, restricted use and non-disclosure in respect of such Technical Information.
- (c) The Supplier shall not be prevented to make any disclosure required by (i) order of a court of competent jurisdiction or (ii) any competent regulatory authority or agency where such disclosure is required by law, provided that where the supplier intends to make such disclosure, it shall first consult Company and take all reasonable steps requested by it to minimize the extent of the Technical Information disclosed and to make such disclosure in confidence and also shall cooperate with the Company in seeking any protective order or any other remedy from proper authority in this matter.

**6. Exceptions:**

The Obligations of the Supplier pursuant to the provisions of this agreement shall not apply to any Confidential Information that:

- a) was / is known to, or in the possession of the Supplier prior to disclosure thereof by the Company;
- b) is or becomes publicly known, otherwise than as a result of a breach of this agreement by the Supplier.
- c) is developed independently of the Disclosing party by the Supplier in circumstances that do not amount to a breach of the provisions of this Agreement or the Contract;
- d) is received from a third party in circumstances that do not result in a breach of the provisions of this Agreement.

- 7. The Obligation of maintaining confidentiality of the Technical Information on each occasion, shall subsist for the entire duration during which the Technical Information / equipment is in possession of the Supplier and shall thereafter subsist for a further period of \_\_\_\_\_ years from the date when the complete Technical Information has been returned in portions on different dates, the period of \_\_\_\_ years will be reckoned from the date when the last portion of the Technical Information has been returned.

Notwithstanding the expiry of the confidentiality obligation, the obligation of the Supplier under clause 5.4 shall continue to subsist for a further period of \_\_\_\_\_ years.

**8. Warranties & Undertakings:**

- a) The Supplier undertakes to ensure the due observance of the undertakings of confidence, restricted use and non-disclosure by its persons to whom it discloses or releases copies or extracts of the Technical Information.
- b) The Supplier shall keep the Technical Information or improvement made therein properly segregated and not mix up the same with any other material / documents belonging to him / it or to any other third party.
- c) The Supplier further undertakes that he / it shall not hypothecate or give on lease or otherwise alienate or do away with any of the Technical Information and / or equipment of the Company, made available to him / it, and undertakes that he / it shall hold the same as a trustee, in capacity of custodian thereof and use / utilise the same solely for the purpose of executing the contract awarded by the Company.
- d) The Supplier further undertakes that he / it shall return all the equipment and / or Technical Information as far as practicable in the same condition in which the same was made available to him / it by the Company together with any Improvement thereon and the documents connected with such Improvement, to the Company forthwith upon completion of the scope of work or contract for which such Technical Information was provided by the Company to it or as directed by the Company together with a confirmation by way of an affidavit or in such manner as directed by the Company that it has not retained any equipment and / or Technical Information / improvement thereof. In case any such equipment and / or Technical Information or thereof shall remain in his possession or is not capable of being returned, the retention and use of such Technical Information or improvement thereto shall continue to be governed by this Agreement.
- e) The Supplier undertakes to indemnify the Company for all the direct, indirect and / or consequential losses, damages, expenses whatsoever including any consequential loss of business, profits suffered by the Company owing to breach by the Supplier of its obligations under this Agreement and / or the confidentiality requirements, if any, contained in the Contract and that the Supplier hereby agrees that the decision of the Company in all such or any such matter/s shall be final and binding on the Supplier. On mere written demand of the Company, the Supplier shall forthwith and without demur or delay pay to the Company any such sum as determined by the Company as the amount of loss or damage or expense which has been suffered by the Company. The

Supplier agrees that the Company shall be entitled to withhold and appropriate any amount payable to the Supplier under any Contract then existing between the Company and the Supplier, in case the Supplier fails to make payment, in terms of the written demand, within 7 days thereof. Without prejudice to the forgoing actions, in respect to any breach of this Agreement, the Company shall be entitled to take any other action against the Supplier as per applicable laws, the Contract, Company's applicable policies, guidelines rules, procedures, etc.

9. Without prejudice to any other mode of recovery as may be available to the Company for recovery of the amount determined as due as per Clause 9 (f) hereinabove, the Company shall have a right to withhold, recovery and appropriate the amount due towards such losses, damages, expenses, from any amount due to the Supplier in respect of any other Contract (s) placed on him / it by any department / office / unit/ division of the said Company.

#### **10. Arbitration & Conciliation:**

1. Except as provided elsewhere in this contract, in case amicable settlement is not reached between the parties, in respect of any dispute or difference; arising out of the formation, breach, termination, validity or execution of the contract; or, the respective rights and liabilities of the parties; or, in relation to interpretation of any provision of the contract; or, in any manner touching upon the contract, then, either party may, by a notice in writing to the other party refer such dispute or difference to the sole arbitration of an arbitrator appointed by head of the BHEL unit issuing the contract.

The Arbitrator shall pass a reasoned award and the award of the Arbitrator shall be final and binding upon the parties.

Subject as aforesaid, the provisions of Arbitration and Conciliation Act 1996 (India) or statutory modifications or re-enactments thereof and the rules made thereunder and for the time being in force shall apply to the arbitration proceedings under this clause, the seat of arbitration shall be at Hyderabad.

The cost of arbitration shall be borne as per the award of the Arbitrator.

Subject to the arbitration in terms of clause 55, the courts at Sangareddy, Telangana State shall have exclusive jurisdiction over any matter arising out of or in connection with this contract.

Notwithstanding the existence or any dispute or differences and / or reference for the arbitration, the contractor shall proceed with and continue without hindrance the performance of its obligations under this contract with due diligence and expedition in a professional manner except where the contract has been terminated by either party in terms of this contract.

**In case of contract with Public Sector Enterprise (PSE) or a Government Department, the following shall be applicable:**

In the event of any dispute or difference relating to the interpretation and application of the provisions of the contract, such dispute or difference shall be referred by either party for arbitration to the sole arbitrator in the Department of Public Enterprises to be

nominated by the secretary to the Government of India in-charge of the Department of Public Enterprises. The Arbitration and Conciliation Act, 1996 shall not be applicable to arbitration under this clause. The award of the arbitrator shall be binding upon the parties to the dispute, provided, however, any party aggrieved by such award may make further reference for setting aside or revision of the award to the Law Secretary, Department of Legal Affairs, Ministry of Law and justice, Government of India. Upon such reference the dispute shall be decided by the Law secretary or the special Secretary or Additional secretary when so authorized by the Law secretary, whose decision shall bind the parties hereto finally and conclusively. The parties to the dispute will share equally the cost of arbitration as intimated by the arbitrator.

2. INTEREST CLAUSE:

In order to bring uniformity in all the contracts / agreements entered between BHEL and its contractors / vendors / suppliers / service providers etc., it is hereby advised to incorporate the following clause in all tenders and agreements.

**“No interest shall be payable by BHEL on earnest money or security deposit or any money due to the contractor by BHEL.”**

**11. Governing Law & Jurisdiction:**

This agreement shall be construed and interpreted in accordance with the laws of India and shall have exclusive jurisdiction of Sangareddy/Hyderabad courts, Telangana, India.

**SIGNATURE**

**WITNESSES**

**1**

**Name:**

**Address:**

**2**

**Name:**

**Address:**

### Annexure - III

**Proforma for self-certification by Supplier for minimum local content on their letter head for order value less than Rs 10 Crore**

**"We \_\_\_\_\_ (Name of Manufacturer) undertake that we meet the mandatory minimum Local Content (LC) requirement i.e. \_\_\_\_\_ (to be filled as notified in the policy) for claiming Purchase Preference linked with Local Contents under the Govt. policy against tender no. \_\_\_\_\_."**

**Auditor's certification with respect to minimum local content on the letter head of Statutory Auditor for order value above Rs.10 crore**

"We \_\_\_\_\_ the statutory auditor of M/s \_\_\_\_\_ (name of the bidder) hereby certify that M/s \_\_\_\_\_ (name of manufacturer) meet the mandatory Local Content requirements of the Goods and/or Services i.e. \_\_\_\_\_ (to be filled as notified in the policy) quoted vide offer No. \_\_\_\_\_ dated \_\_\_\_\_ against BHEL's tender No. \_\_\_\_\_ by M/s \_\_\_\_\_ (Name of the bidder)."

## Annexure - IV

### **Proforma for self-certification by Supplier for Compliance to Clause No 20 (B)**

I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India and I certify that M/s.... (Name of firm) is **not from such a country/is from such a country** (delete whichever is NOT applicable) and has been duly registered with the Competent authority (delete if NOT applicable) . I hereby certify M/s ..... fulfills all requirements in this regard and is eligible to be considered . ( where applicable , valid registration by the competent authority shall be attached )

Sd/-

Authorised Signatory with Stamp

**Corporate Materials Management  
BHEL New Delhi**

**AA:MM:Agency  
Dt. 06.08.2010**

**Guidelines regarding dealings with Indian Agents of Foreign Suppliers**

1. BHEL shall deal directly with the foreign original equipment manufacturers (OEM)/ Foreign Principal, for all its purchases which are imported.
2. Wherever the foreign OEM/ principal desires to avail the services of an Indian Agent, the dealings with Indian Agents are to be regulated. The guidelines of BHEL in this regard have been drafted as per CVC circular no. 007/VGL/033 dated 04.12.2007.

**Definition of Indian Agent**

3. An Indian Agent of foreign principal is an individual, a partnership, an association of persons, a private or public Company, that carries out specific obligation(s) towards processing of BHEL tender or finalization or execution of BHEL's contract on behalf of the foreign supplier.

**Recommendations**

4. All NITs shall have the following terms regarding Indian agents of foreign principals:
  - i. BHEL shall deal directly with foreign vendors, wherever required, for procurement of goods. However, if the foreign principal desires to avail of the services of an Indian agent, then the foreign principal should ensure compliance to regulatory guidelines - which require mandatory submission of an Agency Agreement.
  - ii. It shall be incumbent on the Indian agent and the foreign principal to adhere to the relevant guidelines of Government of India, issued from time to time.
  - iii. The Agency Agreement should specify the precise relationship between the foreign OEM / foreign principal and their Indian agent and their mutual interest in the business. All services to be rendered by agent/ associate, whether of general nature or in relation to the particular contract, must be clearly stated by the foreign supplier/ Indian agent. Any payment, which the agent or associate receives in India or abroad from the OEM, whether as commission or as a general retainer fee should be brought on record in the Agreement and be made explicit in order to ensure compliance to laws of the country.
  - iv. Any agency commission to be paid by BHEL to the Indian agent shall be in Indian currency only.
  - v. Tax deduction at source is applicable to the agency commission paid to the Indian agent as per the prevailing rules.
  - vi. In the absence of any agency agreement, BHEL shall not deal with any Indian agent (authorized representatives / associate / consultant, or by whatever name called) and shall deal directly with the foreign principal only for all correspondence and business purposes.
  - vii. The "Guidelines for Indian Agents of Foreign Suppliers" enclosed at annexure -'A' shall apply in all such cases.

- viii. The supply and execution of the Purchase Order (including indigenous supplies/ service) shall be in the scope of the OEM/ foreign principal. The OEM/ foreign principal should submit their offer inclusive of all indigenous supplies/ services and evaluation will be based on 'total cost to BHEL'. In case OEM/ foreign principal recommends placement of order(s) towards indigenous portion of supplies/ services on Indian supplier(s)/ agent on their behalf, the credentials/ capacity/ capability of the Indian supplier(s)/ agent to make the supplies/ services shall be checked by BHEL as per the extant guidelines of Supplier Evaluation, Approval & Review Procedure (SEARP), before opening of price bids. In this regard, details may be checked as per Annexure-B (copy enclosed). It will be the responsibility of the OEM/ foreign principal to get acquainted with the evaluation requirements of Indian supplier/ agent as per SEARP available on [www.bhel.com](http://www.bhel.com).

The responsibility for successful execution of the contract (including indigenous supplies/ services) lies with the OEM/ foreign principal. All bank guarantees to this effect shall be in the scope of the OEM/ foreign principal.

---X---

**Guidelines for Indian Agents of Foreign Suppliers**

- 1.0 There shall be compulsory registration of agents for all Global (Open) Tender and Limited Tender. An agent who is not registered with BHEL shall apply for registration in the registration form in line with SEARP.
  - 1.1 Registered agents will file an authenticated Photostat copy duly attested by a Notary Public/Original certificate of the Principal confirming the agency agreement and giving the status being enjoyed by the agent and the commission/ remuneration/ salary/ retainership being paid by the principal to the agent before the placement of order by BHEL.
  - 1.2 Wherever the Indian representatives have communicated on behalf of their principals and the foreign parties have stated that they are not paying any commission to the Indian agents, and the Indian representative is working on the basis of salary or as retainer, a written declaration to this effect should be submitted by the party (i.e. Principal) before finalizing the order.
- 2.0 Disclosure of particulars of agents/ representatives in India, if any.**
- 2.1 Tenderers of Foreign nationality shall furnish the following details in their offers:
    - 2.1.1 The Bidder(s)/ Contractor(s) of foreign origin shall disclose the name and address of the agents/ representatives in India if any and the extent of authorization and authority given to commit the Principals. In case the agent/ representative be a foreign Company, it shall be confirmed whether it is existing Company and details of the same shall be furnished.
    - 2.1.2 The amount of commission/ remuneration included in the quoted price(s) for such agents/ representatives in India.
    - 2.1.3 Confirmation of the Tenderer that the commission/ remuneration, if any, payable to his agents/ representatives in India, may be paid by BHEL in Indian Rupees only.
  - 2.2 Tenderers of Indian Nationality shall furnish the following details in their offers:
    - 2.2.1 The Bidder(s)/ Contractor(s) of Indian Nationality shall furnish the name and address of the foreign principals, if any, indicating their nationality as well as their status, i.e. whether manufacturer or agents of manufacturer holding the Letter of Authority of the Principal specifically authorizing the agent to make an offer in India in response to tender either directly or through the agents/ representatives.
    - 2.2.2 The amount of commission/ remuneration included in the price (s) quoted by the Tenderer for himself.
    - 2.2.3 Confirmation of the foreign principals of the Tenderer that the commission/ remuneration, if any, reserved for the Tenderer in the quoted price(s), may be paid by BHEL in India in equivalent Indian Rupees on satisfactory completion of the Project or supplies of Stores and Spares in case of operation items.
  - 2.3 In either case, in the event of contract materializing, the terms of payment will provide for payment of the commission/ remuneration, if any payable to the agents/ representatives in India in Indian Rupees on expiry of 90 days after the discharge of the obligations under the contract.
  - 2.4 Failure to furnish correct and detailed information as called for in paragraph 2.0 above will render the concerned tender liable to rejection or in the event of a contract materializing, the same liable to termination by BHEL. Besides this there would be a penalty of banning business dealings with BHEL or damage or payment of a named sum.

---X---

**Annexure-B**

This format is applicable only to Indian Suppliers/ Agents supplying indigenous portion of Foreign Purchases.

\* In all other cases, extant guidelines of SEARP, 2010 are to be followed.

<b>SEARP (SRF) Clause No</b>	<b>Detail</b>
	<b>Name &amp; address of the firm</b>
<b>1.0</b>	<b>Products/ Systems / Services being considered for</b>
<b>2.0</b>	<b>General Information</b>
2.2	Name of Chief Executive
2.3	Details of authorized signatory
<b>3.0</b>	<b>Ownership Information</b>
3.1	Type of firm
3.2	Nature of Business <ul style="list-style-type: none"> <li>• <i>Attach <b>authorization letter</b> and <b>agency agreement</b> from Principal ( from whom capital equipment is procured)</i></li> <li>• <i>Attach copy of declaration from Foreign Principal for <b>total guarantee/ warranty of indigenous supplies</b></i></li> </ul>
3.3	Year of establishment
3.4	Year of commencement of business
<b>4.0</b>	<b>Registration particulars</b>
4.1	Permanent Account No.
4.2 / 4.3	Sales Tax / TIN no
4.6	Service tax no. (in case of E&C)
<b>5.0</b>	<b>Organisational strength</b>
<b>6.0</b>	<b>Other particulars</b>
6.1	If the company is already registered with other units
6.2	Directors/ Partners, if related to any BHEL Employee
6.9	If any Ex BHEL Personnel employed by the Company
6.12	Details of pending legal issues with BHEL
6.13	Bank Account information
<b>9.0</b>	<b>Financial information</b>
9.6	Sales/ Turnover details of last 3 years (or from the date of incorporation whichever is less )

---X---

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05  
Dated: 08.03.2021

---

## 1.0 Scope

This document describes the guidelines to be followed by each Unit/ Division/ Region for conducting Reverse Auction (RA) for procurement of material/ works/ services. These guidelines will be applicable for all purchases/ contracts to be awarded under Purchase/ Works policy and the RA shall follow the philosophy of English Reverse (No ties). Based on these guidelines, Units/ Divisions/ Regions (hereinafter referred as 'units') may issue their own Departmental Procedures without changing the intent and spirit of the guidelines contained in this document. These guidelines will supersede earlier guidelines issued vide AA:SSP:RA:04 dated 04.03.2020.

English Reverse (No ties) is a type of auction where the starting price and bid decrement are announced before start of online reverse auction. The interested bidders can thereupon start bidding in an iterative process wherein the lowest bidder at any given moment can be displaced by an even lower bid of a competing bidder, within a given time frame. The bidding is with reference to the current lowest bid in the reverse auction. All bidders will see the current lowest quoted price and their rank. The term 'No ties' is used since more than one bidder cannot give an identical price, at a given instant, during the reverse auction. In other words, there shall never be a tie in the bids.

## 2.0 Intent of Reverse Auction

To derive maximum benefit in cost savings through competitive bidding.

## 3.0 Upfront declaration in NIT

Wherever it is felt that procurement may be done through Reverse Auction, the bids shall be invited in two parts/ three parts or single part bid (Price Bid) where Techno-Commercial MoU already exists. Wherever, the evaluation is done for individual line item, separate sealed envelope price bid for each line item shall be taken.

Decision to go for RA would be taken before floating of the tender. In case it is decided to go for RA, same shall be declared upfront in NIT by inserting the following **clause**:

*"BHEL shall be resorting to Reverse Auction (RA) (Guidelines as available on [www.bhel.com](http://www.bhel.com)) for this tender. RA shall be conducted among the techno-*

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05  
Dated: 08.03.2021

---

*commercially qualified bidders.*

*Price bids of all techno-commercially qualified bidders shall be opened and same shall be considered for RA. In case any bidder(s) do(es) not participate in online Reverse Auction, their sealed envelope price bid along with applicable loading, if any, shall be considered for ranking.”*

## **4.0 Aspects to be considered for RA**

Following aspects may be considered by the competent authority (empowered to approve the ordering) to decide before floating of the tender if RA is to be conducted for that particular tender:

- a) Number of techno-commercially qualified bidders in previous tender for same/ similar class of item
- b) Price volatility of the item(s) under consideration
- c) Past purchase experience of similar item(s)
- d) Tender Value of the item(s) under procurement
- e) Any other aspect which may be specific to tender

Note: Decision to go for RA or not will be on case to case basis with recorded reasons.

## **5.0 RA Committee**

Purchase/ Tender committee, if already in place, shall also act as RA committee. Purchase representative will be the convener. In case Purchase/ Tender committee has not been formed, the Product Manager/ MM Head/ Department Head, shall constitute RA committee consisting of representatives (*rank as per DoP of tender/ negotiation committee*) from departments of Engineering/ Indenter/ User, Purchase and Finance. This committee will work for a specific tender. The role of RA committee shall be as below:

- To vet the comparative statement comprising sealed envelope price bids received, MSE status, qualification against Public Procurement (Preference to Make in India), Order 2017 (PPP-MII, Order 2017) of all techno-commercially qualified bidders, loading etc. before sending it to the service provider for RA.
- To decide and record the 'Start-Price' and 'Bid Decrement'.
- To observe the RA process and declare RA as successful.

## 6.0 Business rules for RA

Model Business rules (annexure I) and other annexures II to VI are attached. MM shall prepare and fill in the required details in the annexures at appropriate places like:

- Enquiry/ Request for Quotation (RFQ) number
- Name and Addresses of the bidders
- Items description, quantities/ weight, Specification
- Date and time of opening and closing of RA
- Extension conditions
- Loading Criteria/ Formulae
- Foreign Exchange (FE) rates for evaluation
- Taxes & Duties
- Freight & Insurance
- Bidders' training, if required, etc.

The calculation sheet e.g. excel sheet (which will help to arrive at 'Total Cost to BHEL') which is communicated to respective bidders of RA, will be prepared by MM and vetted by Finance. This calculation sheet will be finalized based on the evaluation criteria specified in the NIT and will be same based on which sealed envelope price bids have been evaluated.

MM shall issue a mandate (annexure II) to the service provider covering business rules etc. and inform about event, calculation sheet etc. to all techno-commercially accepted bidders.

## 7.0 Role of Service Provider

- Acknowledge the receipt of mandate from BHEL.
- Contact the bidders, provide business rules and train them, as required.
- Get the process compliance form (annexure III) signed by all the participating bidders before RA event.
- Conduct the event as per the contract and business rules.
- Submit the Login Reports, Results, History sheet and authorized final bid from the bidders.
- To obtain price breakup from successful bidder and submit the same to BHEL.

## 8.0 Start price for RA shall be lowest of sealed envelope price bid.

Note: Wherever more than one lowest sealed envelope price bids are identical, RA committee shall declare the start price by reducing the lowest sealed envelope price bid by maximum of one decrement.

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05  
Dated: 08.03.2021

---

## 9.0 Witnessing Auction

Access to witness the RA shall be available to the concerned officials of BHEL (Indenter/ Finance Officials/ Purchase Officials), nominated by Head MM/ Purchase/ Contracts.

## 10.0 Reverse Auction Process

10.1 Reverse Auction will be conducted if two or more bidders are techno-commercially qualified. However, in case of six or more qualified bidders are available, RA would be conducted amongst first 50% of the bidders arranged in the order of prices from lowest to highest. Number of bidders eligible for participating in RA would be rounded off to next higher integer value if number of qualified bidders is odd (e.g. if 7 bids are qualified, then RA will be conducted amongst lowest four bidders). However, there will be no elimination of qualified bidders who are MSE or qualifying under PPP-MII, Order 2017.

10.2 The lowest bidder in sealed envelope price bid shall be shown as current L1 automatically by the system. System shall have the provision to indicate this bid as current L1 for further bidding. This price can be displaced by an even lower bid of a competing bidder.

If the start price is lower than the lowest sealed envelope price bid (in line with clause 8.0), on acceptance of such start price by any bidder this bid would be indicated as current L1 for further bidding. However, if no bidder accepts the start price, RA shall be treated as cancelled for the respective line item(s) and the tender shall be processed accordingly.

In case of no further bidding, RA will be deemed to have been successful with current L1 bidder.

During RA, all bidders will see their rank and current L1 price on the screen. Once the RA is done, the ranking status would be based on the last quoted price of the bidder(s) irrespective of the quote received in RA or sealed envelope price bid.

10.3 No bidder shall be allowed to lower its bid below the current L1 by more than 5 decrements at one go.

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05  
Dated: 08.03.2021

---

## 11.0 Processing of case after RA

- 11.1 Wherever the evaluation is done on total cost basis, after Reverse Auction, prices of individual line items shall be reduced on pro-rata basis.
- 11.2 In case of splitting requirement, bidders who were removed from participation in RA may also be considered for counter offer if the pre-stated (NIT) numbers of suppliers do not accept the counter offer. However, principle of splitting to N-1 bidder shall be maintained in line with extant Purchase Policy/ Work Policy.
- 11.3 Reasonability of rates received through RA to be ascertained as per extant Policy provisions.

## 12.0 Payment to the Service Provider

Payment shall be made as per the agreed terms of the Framework Agreement with the service provider based on the mandate issued and service provider's invoice certified by the respective MM.

If the RA event is conducted as per the mandate given by BHEL and agreed procedure, payment shall be made to the service provider irrespective of the auction outcome.

## 13.0 Others

- 13.1 If RA is being conducted for multiple line items and L1 is to be decided for individual items, number of items in single screen be restricted to 10 (ten) to avoid scrolling by the bidders.
- 13.2 In case of enquiry through e-Procurement, the sealed electronic price bid (e-bid) is to be treated as sealed envelope price bid.
- 13.3 BHEL will inform bidders the details of service provider who will provide business rules, all necessary training and assistance before commencement of online bidding.
- 13.4 Bidders will be advised to read the 'Business Rules' indicating details of RA event carefully, before reverse auction event.
- 13.5 Model annexures are enclosed. However, to suit specific requirement of the Units changes in the annexures may be done with the approval of respective MM Head of Unit. Such changes shall specifically be communicated to the service provider before the RA event.

---XXX---

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05

Dated: 08.03.2021

## Business Rules for Reverse Auction

### Annexure – I

---

This has reference to tender no **{tender number....date...}**. BHEL shall finalise the Rates for the supply of **{item name}** through Reverse Auction mode. BHEL has made arrangement with M/s. **{Service provider}**, who shall be BHEL's authorized service provider for the same. Bidders should go through the instructions given below and submit acceptance of the same.

The technical & commercial terms are as per (a) BHEL Tender Enq. No. {...} dated {...}, (b) Bidders' technical & commercial bid (in case of two part bid) and (c) subsequent correspondences between BHEL and the bidders, if any.

#### 1. Procedure of Reverse Auctioning

- i. Price bids of all techno-commercially qualified bidders shall be opened.
- ii. **Reverse Auction:** The 'bid decrement' will be decided by BHEL.
- iii. The lowest bidder in sealed envelope price bid shall be shown as current L1 automatically by the system and no acceptance of that price is required. System shall have the provision to indicate this bid as current L1.
- iv. Bidders by offering a minimum bid decrement or the multiples thereof can displace a standing lowest bid and become "L1" and this continues as an iterative process. However, no bidder shall be allowed to lower its bid below the current L1 by more than 5 decrements at one go.
- v. After the completion of the reverse auction, the Closing Price shall be available for further processing.
- vi. Wherever the evaluation is done on total cost basis, after Reverse Auction, prices of individual line items shall be reduced on pro-rata basis.

**2. Schedule for reverse auction:** The Reverse Auction is tentatively scheduled on **{date}**: **{start time}**: **{Close Time}**: **}**.

**3. Auction extension time:** If a bidder places a bid in the last {...} minutes of closing of the Reverse Auction and if that bid gets accepted, then the auction's duration shall get extended automatically for another {...} minutes,

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05  
Dated: 08.03.2021

## Business Rules for Reverse Auction

### Annexure – I

---

for the entire auction (i.e. for all the items in the auction), from the time that bid comes in. Please note that the auto-extension will take place only if a bid comes in those last {...} minutes and if that bid gets accepted as the lowest bid. If the bid does not get accepted as the lowest bid, the auto-extension will not take place even if that bid might have come in the last {...} minutes. In case, there is no bid in the last {...} minutes of closing of Reverse Auction, the auction shall get closed automatically without any extension. However, bidders are advised not to wait till the last minute or last few seconds to enter their bid during the auto-extension period to avoid complications related with internet connectivity, network problems, system crash down, power failure, etc.

The above process will continue till completion of Reverse Auction.

Complaints/ Grievances, if any, regarding denial of service or any related issue should be given in writing thru e-mail/ fax to M/s. {Service provider} with a copy to BHEL within 15 minutes prior to initial closing time of Reverse Auction.

4. **Bid price:** The Bidder has to quote the {...} Price inclusive of Packing & Forwarding charges, all the routine & type tests as per tender scope, taxes, duties, freight and insurance as specified in tender document, including loading (if indicated by BHEL due to deviations in technical/ commercial terms) for the Items specified. Details are as shown in Excel Sheet for calculation of total cost to BHEL (To be specified by Unit as per NIT conditions).
5. **Bidding currency and unit of measurement:** Bidding will be conducted in *Indian Rupees per Unit* of the material as per the specifications {...}

In case of foreign currency bids, exchange rate (TT selling rate of State Bank of India) as on scheduled date of tender opening (Part-I bid) shall be considered for conversion in Indian Rupees. If the relevant day happens to be a Bank holiday, then the forex rate as on the previous bank (SBI) working day shall be taken.

6. **Validity of bids:** Price shall be valid for {... days} from the date of reverse auction. These shall not be subjected to any change whatsoever.

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05  
Dated: 08.03.2021

## Business Rules for Reverse Auction

### Annexure – I

- 
7. **Lowest bid of a bidder:** In case the bidder submits more than one bid, the lowest bid at the end of Reverse Auction will be considered as the bidder's final offer to execute the work.
  8. Unique user IDs shall be used by bidders during bidding process. All bids made from the Login ID given to the bidders will be deemed to have been made by the bidders/ bidders' company.
  9. **Post auction procedure:** BHEL will proceed with the Lowest Bid in the Reverse Auction for further processing.
  10. Any commercial/ technical loading shall be separately intimated to respective bidders prior to RA. The excel sheet provided in this regard shall cover all these aspects. Commercial/ technical loading if any, shall be added by the respective bidder in its price during Reverse Auction. Modalities of loading & de-loading shall be separately intimated to the bidders. The responsibility for correctness of total cost to BHEL shall lie with the bidders.
  11. Reverse auction shall be conducted by BHEL (through M/s {Service Provider}), on pre-specified date, while the bidders shall be quoting from their own offices/ place of their choice. Internet connectivity shall have to be ensured by bidders themselves.

During the RA process if a bidder is not able to bid and requests for extension of time by FAX/ email/ phone then time extension of additional 15 minutes will be given by the service provider provided such requests come before 5 minutes of auction closing time. However, only one such request per bidder can be entertained.

In order to ward-off contingent situation of connectivity failure bidders are requested to make all the necessary arrangements/ alternatives whatever required so that they are able to circumvent such situation and still be able to participate in the reverse auction successfully. Failure of power or loss of connectivity at the premises of bidders during the Reverse auction cannot be the cause for not participating in the reverse auction. On account of this, the time for the auction cannot be extended and neither BHEL nor M/s. {Service provider} is responsible for such eventualities.

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05

Dated: 08.03.2021

## Business Rules for Reverse Auction

### Annexure – I

---

- 12.** Proxy bids: Proxy bidding feature is a pro-bidder feature to safe guard the bidder's interest of any internet failure or to avoid last minute rush. The proxy feature allows bidders to place an automated bid in the system directly in an auction and bid without having to enter a new amount each time a competing bidder submits a new offer. The bid amount that a bidder enters is the minimum that the bidder is willing to offer. Here the software bids on behalf of the bidder. This obviates the need for the bidder participating in the bidding process until the proxy bid amount is decrementally reached by other bidders. When proxy bid amount is reached, the bidder (who has submitted the proxy bid) has an option to start participating in the bidding process.

The proxy amount is the minimum amount that the bidder is willing to offer. During the course of bidding, the bidder cannot delete or change the amount of a proxy bid.

Bids are submitted in decrements (decreasing bid amounts). The application automates proxy bidding by processing proxy bids automatically, according to the decrement that the auction originator originally established when creating the auction, submitting offers to the next bid decrement each time a competing bidder bids, regardless of the fact whether the competing bids are submitted as proxy or standard bids. However, it may please be noted that if a manual bid and proxy bid are submitted at the same instant manual bid will be recognized as the L1 at that instant.

In case of more than one proxy bid, the system shall bid till it crosses the threshold value of 'each lowest proxy bid' and thereafter allow the competition to decide the final L1 price.

Proxy bids are fed into the system directly by the respective bidders. As such this information is privy only to the respective bidder(s).

- 13.** Bidders are advised to get fully trained and clear all their doubts such as refreshing of Screen, quantity being auctioned, tender value being auctioned etc from M/s {Service provider}.
- 14.** M/s. {Service provider}, shall arrange to demonstrate/ train the bidder or bidder's nominated person(s), without any cost to bidders. M/s. {Service provider}, shall also explain the bidders, all the business rules related to the
-

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05

Dated: 08.03.2021

## Business Rules for Reverse Auction

### Annexure – I

---

Reverse Auction. Bidders are required to submit their acceptance to the terms/ conditions/ modalities before participating in the Reverse Auction in the process compliance form as enclosed. Without this, the bidder will not be eligible to participate in the event.

15. Successful bidder shall be required to submit the final prices (L1) in prescribed format (Annexure – VI) for price breakup, quoted during the Reverse Auction, duly signed and stamped as token of acceptance without any new condition (other than those already agreed to before start of auction), after the completion of auction to M/s. {Service provider} besides BHEL within two working days of Auction without fail.
16. Any variation between the final bid value and that in the confirmatory signed price breakup document will be considered as tampering the tender process and will invite action by BHEL as per extant guidelines for suspension of business dealings (as available on [www.bhel.com](http://www.bhel.com)).
17. Bidders' bid will be taken as an offer to execute the work/ supplies the item as per enquiry no. {...} dt. {...}. Bids once made by the bidder, cannot be cancelled/ withdrawn and bidder shall be bound to execute the work as mentioned above at bidder's final bid price. Should bidder back out and not execute the contract as per the rates quoted, BHEL shall take action as per extant guidelines for suspension of business dealings (as available on [www.bhel.com](http://www.bhel.com)).
18. Bidders shall be able to view the following on their screen along with the necessary fields during Reverse Auction:
  - a. Leading (Running Lowest) Bid in the Auction (only total price of package)
  - b. Bid Placed by the bidder
  - c. Start Price
  - d. Decrement value
  - e. Rank of their own bid during bidding as well as at the close of auction.
19. BHEL's decision on award of contract shall be final and binding on all the Bidders.
20. BHEL reserves the right to extend, reschedule or cancel the Reverse Auction process at any time, before ordering, without assigning any reason, with

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05  
Dated: 08.03.2021

## Business Rules for Reverse Auction

### Annexure – I

---

intimation to bidders.

21. BHEL shall not have any liability to bidders for any interruption or delay in access to the site irrespective of the cause. In such cases, the decision of BHEL shall be binding on the bidders.
22. Other terms and conditions shall be as per bidder's techno-commercial offers and other correspondences, if any, till date.
23. If there is any clash between this business document and the FAQ available, if any, in the website of M/s. {*Service provider*}, the terms & conditions given in this business document will supersede the information contained in the FAQs. Any changes made by BHEL/ service provider (due to unforeseen contingencies) after the first posting shall be deemed to have been accepted if the bidder continues to access the portal after that time.
24. Bidder shall not divulge either his Bids or any other exclusive details of BHEL to any other party. If the Bidder or any of his representatives are found to be involved in Price manipulation/ cartel formation of any kind, directly or indirectly by communicating with other bidders, action as per extant BHEL guidelines for suspension of business dealings (as available on [www.bhel.com](http://www.bhel.com)), shall be initiated by BHEL.

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05  
Dated: 08.03.2021

## Mandate to Service Provider

### Annexure – II

**Ref :**

To,

M/s. {Service provider}

Sub: Providing of Services for Reverse Auction.

Ref: No {...} date {...}

**Date :**

Dear Sir,

Please conduct Reverse Auction as per the following details:

- **Scope:** Auction event management with training of BHEL and its bidders.
- Seek process compliance form from all the bidders provided by BHEL before start of RA event. In case of postponement of event to some other date, ensure acknowledgement from each bidder.
- Price: Rs. {.....}/- . No other duties, Taxes, levies etc. except service tax @ {.....}% shall be payable for conducting reverse auction. This price is firm.
- Payment Terms: 100% payment after successful completion of Auction.
- Start Price: L1 as per the CST (Comparative statement) of the envelope sealed bid shall be marked as L1 automatically by the system at the start of the auction, provided the L1 bidder participates in the RA by submitting the process compliance form. In case the Process Compliance form is not submitted by the L1 bidder, still its price has to be mapped as start price of RA for further bidding in RA.

Wherever there are more than one L1 in CST, the start price shall be the L1 price reduced by one decrement and the same shall be accepted by the interested bidder(s) for start of RA process.

- Completion of Auction Process: The auction process shall be deemed to have been successfully completed on receipt and acceptance of final report including hard copy/ email of the final bid with price break up, duly signed by the successful bidder who has participated in the reverse auction. The bill shall be submitted along with the completion report to the undersigned.
- Business Rules of the Reverse Auction are as per Annexure – I.
- The list of bidders with their contact details is given in Annexure – IV. and the details of the item (s) to be Reverse Auctioned are as per Annexure – V.
- Please acknowledge receipt of this letter order and also confirm that final report (duly signed and stamped by M/s. {Service provider}) including hard copy/ email of the final bid with breakup of prices duly signed by the successful bidder (duly endorsed by M/s. {Service provider}) shall be submitted within **four** working days of conclusion of auction.

**Yours sincerely,**

(for and on behalf of BHEL)

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05  
Dated: 08.03.2021

## Mandate to Service Provider

## Annexure – II

**Note:**

If the event has been conducted as per mandate, you shall be paid irrespective of RA outcome.

<b>Buyer Name</b>	<ul style="list-style-type: none"><li>- Name of BHEL Unit</li><li>- Full postal address</li><li>- Fax:</li><li>- Phone:</li><li>- Email:</li><li>- Contact person name:</li><li>- Phone:</li><li>-</li></ul>
<b>Auction to be conducted by</b>	<ul style="list-style-type: none"><li>- Name of Service provider</li><li>- Full postal address</li><li>- Fax:</li><li>- Phone:</li><li>- Email:</li><li>- Contact person name:</li><li>- Phone:</li><li>-</li></ul>
<b>Date of Auction</b>	<ul style="list-style-type: none"><li>- Date of Auction</li><li>- Reverse auction time:</li><li>- Auction website:</li><li>-</li></ul>
<b>Documents Attached: (To be sent to the bidders)</b>	<ol style="list-style-type: none"><li>1) Business rules for Reverse Auction (<u>Annexure-I</u>)</li><li>2) Process Compliance Form (<u>Annexure-III</u>)</li><li>3) Details of item (s) to be Reverse Auctioned (<u>Annexure-V</u>)</li><li>4) Post RA Price confirmation by bidder (<u>Annexure-VI</u>)</li></ol>

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05

Dated: 08.03.2021

## Process Compliance Form

### Annexure – III

---

**(The bidders are required to print this on their company's letterhead and sign, stamp before RA)**

To

- M/s. {Service provider}
- Postal address}

### **Sub: Agreement to the Process related Terms and Conditions**

Dear Sir,

This has reference to the Terms & Conditions for the Reverse Auction mentioned in the RFQ document for {Items} against BHEL enquiry/ RFQ no.{.....} dt. {.....} This letter is to confirm that:

- 1) The undersigned is authorized official/ representative of the company to participate in RA and to sign the related documents.
- 2) We have studied the Reverse Auction guidelines (as available on www.bhel.com), and the Business rules governing the Reverse Auction as mentioned in your letter and confirm our agreement to them.
- 3) We also confirm that we have taken the training on the auction tool and have understood the functionality of the same thoroughly.
- 4) We also confirm that, in case we become L1 bidder, we will FAX/ email the price confirmation & break up of our quoted price as per Annexure - VI within **two** working days (of BHEL) after completion of RA event, besides sending the same by registered post/ courier both to M/s. BHEL and M/s. {Service provider.}

We, hereby confirm that we will honor the Bids placed by us during the auction process.

With regards

Signature with company seal

Name –

Company / Organization

Designation within Company / Organization

Address of Company / Organization

- **Sign this document and FAX/ email it to M/s {Service provider} at {.....} prior to start of the Event.**

## Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05

Dated: 08.03.2021

### List of bidders and their address/ contact person details

#### Annexure – IV

---

<b>Sl. No.</b>	<b>Address</b>	<b>Contact Person</b>
1	<ul style="list-style-type: none"><li>- Name of bidder</li><li>- Full postal address</li><li>- Fax:</li><li>- Phone:</li><li>- Email:</li></ul>	<ul style="list-style-type: none"><li>- Contact person name:</li><li>- Phone:</li><li>- Email:</li></ul>
2		
3		
..		
..		

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05  
Dated: 08.03.2021

## Details of item (s) for Reverse Auction

Annexure – V

---

1. *{Details of items including quantity, specification, Enquiry no. & date*

- 1.
- 2.
- ..
- ..
- ..
- ..
- }

# Guidelines for Reverse Auction – 2021

Doc. No. AA:SSP:RA:05  
Dated: 08.03.2021

## RA price confirmation and breakup (To be submitted by L1 bidder after completion of RA)

Annexure – VI

---

**To**

- M/s. Service provider
- Postal address

CC: M/s BHEL  
{Unit-  
Address-}

Sub: **Final price quoted during Reverse Auction and price breakup**

Dear Sir,

We confirm that we have quoted.

**Rs. {\_\_\_ in value & in words \_\_\_} for item(s) covered under tender enquiry  
No. {...} dt. {...}**

Total price of the items covered under above cited enquiries is inclusive of {Packing & forwarding, GST, E.D., C.S.T., freight and insurance charges up to {.....} District, {.....} State and Type Test Charges etc., (exclusive of service tax), other as per NIT}

as our final landed prices as quoted during the Reverse Auction conducted today {date} which will be valid for a period of {\_\_\_ in nos. & in words \_\_\_} days.

The price break-up is as given below.

Total =====  
- Rs. **in value & in words**  
=====

Yours sincerely,

For \_\_\_\_\_

**Name:**  
**Company:**  
**Date:**  
**Seal:**



HYDERABAD

**PRODUCT STANDARD**  
**INDUSTRIAL TURBINES AND COMPRESSORS**

**TC 6 4514**

Rev. No: 02

Page 1 of 11

**SINGLE STAGE HORIZONTAL STEAM TURBINE FOR LUBE OIL PUMP**

**1.0.0 SCOPE :**

This standard specifies the requirements of single stage horizontal steam turbine used for driving Centrifugal / Screw pumps of lube oil systems of Industrial Turbo sets and Compressor drives.

**2.0.0 TECHNICAL REQUIREMENTS :**

**2.1.0 General:**

**2.1.1** Turbines shall be of the single - stage axial flow impulse type, designed for 3 years continuous operation and 20 years minimum service life. They shall be sufficient and economical in operation, substantially free of vibration and capable of being started automatically and quickly from cold condition.

**2.1.2** The design shall be strictly as per API - 611 ( Latest Edition). Customer / consultant documents are as per Annexure-I of purchase specification TC64203. Any deviation from the standard shall be indicated during quotation stage only.

**2.2 DESIGN PHILOSOPHY / CRITERIA – GENERAL:**

Selection of rotating equipment shall be based upon the following consideration.

- Suitability of the specified duty conditions.
- Standard models under vendor’s regular range of manufacture.
- Proven track record in similar service.
- Optimum operating and maintenance costs.
- Maximum interchangeability of parts.
- Ease of operation and maintenance.

**2.3 THE ORDER OF PRECEDENCE IS TO BE FOLLOWED:**

- Customer / consultant Project orientated Turbine data sheets.
- Customer / consultant standard specification sent along with enquiry.
- BHEL purchase specifications.
- API standards.
- Applicable codes, standards

For design aspects not specifically covered by data sheets, specifications, codes and standards or regulations, the design shall be based on good engineering practices.

Vendor shall make all possible efforts to comply strictly with the requirements of this design basis. In case deviation is considered essential by the vendor (after exhausting all possible efforts), these shall be clearly brought out and consolidated under technical exception chapter at offer stage. However vendor specific deviation (if any) to applicable codes / specifications shall be subject to Customer / consultant’s approval during detail engineering.

Data sheets of auxiliaries indicating operating parameters, performance requirements, construction features, Instrumentation & controls, Inspection & testing etc. using respective API data sheet formats.

FORMAT  
TD-201  
REV-01

PREP..BY : **M.S.Kumar**

APP. BY : **M.V.S. Raju**

DATE: **03.08.2016**

**COPY RIGHT AND CONFIDENTIAL**

The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.

**REF-DOC**



HYDERABAD

**PRODUCT STANDARD**  
**INDUSTRIAL TURBINES AND COMPRESSORS**

**TC 6 4514**

Rev. No: 02

Page 2 of 11

- 2.3.0 **Technical requirements:**
- 2.3.1 The Turbine shall have the following features:
- 2.3.1.1 Stainless steel nozzle
- 2.3.1.2 Low friction carbon sleeves
- 2.3.1.3 Stainless steel stationary and rotating blades.
- 2.3.1.4 5000 hr-L. 10 life bearings.
- 2.3.1.5 Manual governor speed adjustments.
- 2.3.1.6 Separate trip and Throttle valve.
- 2.3.1.7 Built in removable steam strainer.
- 2.3.1.8 Suitable for **Automatic start-up with out warmup.**
- 2.3.1.9 Self-contained oil ring lubrication with water cooling.
- 2.3.2 The Turbine shall be suitable **for auto start, rapid start** and shall be in a position to accelerate with 10 seconds from cold condition to operating speed and full load. Hence at the stand still condition of turbine, the turbine Trip and control valves shall be in open and ready to start – condition.
- The auto start scheme used by the purchaser shall be as shown in sheet no.4 of specification. Vendor has to confirm the suitability of the turbine. The auto start equipment shall be in BHEL scope.**
- 2.3.3 Site conditions : [x] Hazardous [-] Non Hazardous
- 2.3.4 Area of Classification : Zone 2, Gas Group IIC Temperature class T3
- 2.3.5 Ambient temperature in °C : Max. 50
- Type of Turbine required : [X] Horizontal [-] Vertical
- 2.3.6 Inlet Steam pressure in Kg/cm<sup>2</sup>(g) : As per variant table.  
Min / Normal / Max / Design
- 2.3.7 Inlet Steam temperature in °C) : As per variant table.  
Min / Normal / Max / Design
- 2.3.8 Exhaust Steam pressure in Kg/cm<sup>2</sup>(g) : As per variant table.
- 2.3.9 Min / Normal / Max / Design
- 2.3.10 Output Power required : As per variant table.
- 2.3.11 Maximum power : As per variant table.
- 2.3.12 Normal continuous operation : As per variant table.
- The turbine shall be capable of delivering power at the min. inlet pressure and max. Exhaust pressure, also the turbine shall be capable of delivering 10% extra power over the rated power by opening valve.**
- 2.3.13 Speed in RPM : **1450**
- 2.3.14 Direction of rotation when viewing : **Clockwise (CW)**  
from Governor end.
- 2.3.15 Exhaust & inlet nozzle orientation : **Right hand side when viewed from coupling end.**  
Installation : [-] Indoor [x] Outdoor  
[-] Heated [x] Unheated  
**[-] With roof [x] without proof**
- 2.3.16 Inspection Agency : [x] BHEL[x] EIL or Customer appointed agency.  
**M/s Lloyds is the approved Inspection agency, if the item is procuring from imported organization. The Inspection charges shall be included in main equipment price.**

FORMAT  
TD-202  
REV-01

**COPY RIGHT AND CONFIDENTIAL**

The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.



HYDERABAD

**PRODUCT STANDARD**  
**INDUSTRIAL TURBINES AND COMPRESSORS**

**TC 6 4514**

Rev. No: 02

Page 3 of 11

- 2.3.17 Governor Type No. (Woodward) : Hydraulic, NEMA Class:A TG 13
- 2.3.18 End Seals & Make : **Mechanical seals(As per the approved vendor list)**
- 2.3.19 Manufacturer's serial number and year of manufacture : Vendor to specify

**Materials:**

2.4.0 Materials shall be selected as per design requirement. However, materials indicated below are minimum requirement.

**Part description**

**Material**

Steam chest, Exhaust casing , Trip valve and Governor valve bodies : Cast steel based on operating pressure and Temperatures

Shaft : Alloy steel, hard chrome plated

2.4.1 Nozzles, Hand valves : Stainless steel

Wheel : Steel

2.4.2 End seals : **Mechanical Seal**

2.4.3 Strainer screen, Governor and Trip valve

2.4.4 seats : Stainless steel

2.4.4 All materials are used shall of copper free type.

2.4.5 Interstage seals : Labyrinth

2.4.6

2.4.7 **Scope of Inspection:** [x] As per API 611 (Latest edition)  
[x] As per Customer / consultant Project orientated Turbine data sheets

2.5.0 Manufacturer's Name : Vendor to specify

Turbine model number : Vendor to specify

Inlet flange size and rating : Vendor to specify

2.6.0 Outlet flange size and rating : Vendor to specify

2.7.0 Steam consumption rate in : Vendor to specify

2.7.0 Kg/KW/Hr

2.8.0 Cooling water : [ ] Required [ ] Not required

2.9.0 Quantity : Vendor to specify

2.10.0 Temperature in °C : Vendor to specify

Tachometer model & make : Vendor to specify

**NOTES:**

2.11.1 Vendor to fill the project orientated Customer / consultant Turbine data sheets sent along with enquiry and submit the same along with offer.

2.11.2 Shaft end seals shall be mechanical seals (Manufacturer's standard). The same shall be past proven.

2.12.0 Steam turbine with open valve in normal operating condition is not acceptable.

2.13.0 Pressure drops in suction strainer, control valve and flow element in Turbine inlet line shall be subjected to EIL / customer approval during detail engineering stage.

2.13.1 For inlet casing design: MAWP shall not be less than 24 Kg/cm<sup>2</sup>(g) /FV @ 285°C. Vendor to indicate the standard MAWP of the offered steam turbine model

2.13.2 For Outlet casing design: MAWP shall not be less than 10 Kg/cm<sup>2</sup>(g) /FV @ 225°C. Vendor to indicate the standard MAWP of the offered steam turbine model

2.13.3

2.13.4 Hydro test pressure shall be 1.5 times the standard casing MAWP.

FORMAT  
TD-202  
REV-01

**COPY RIGHT AND CONFIDENTIAL**

The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.



HYDERABAD

**PRODUCT STANDARD  
INDUSTRIAL TURBINES AND COMPRESSORS**

**TC 6 4514**

Rev. No: 02

Page 4 of 11

- 2.13.6 Turbine shall be designed to operate with entire range of inlet and exhaust conditions.
- 2.13.7 Steam turbine shall be fixed speed, back pressure type with Mechanical seals. Any instrumentation, control etc, required to ensure the same is in vendor's scope of supply.
- 2.13.8 The steam turbine companion flanges, piping components and other instrumentation items shall be IBR certified
- 2.13.9 Vendor to furnish completely filled in ERP (if applicable) meeting all requirements of customer/EIL specification (If applicable) for BHEL/ EIL / customer approval / acceptance during offer stage.
- 2.13.10 Proper marking shall be provided for all loose parts.
- 2.13.11 General arrangement drawing to be submitted by connecting all loose parts supplying along the aux steam turbine.
- 2.13.12 Vendor to strictly follow the MAWP of Inlet & Outlet casing as per project specific datasheet(If applicable)

**3.0.0 SCOPE OF SUPPLY :**

- 3.1.1 Lube oil pump drive turbine along with inlet & outlet connections terminating with counter flanges.
- 3.1.2 Individual vent/leakoff & drain connections along with valve terminating with flange & counter flange connections.
- 3.1.3 Steams trap assembly including Isolation & by-pass valves.
- 3.1.4 Suction strainer with counter flanges.
- 3.1.5 Self-powered Digital tacho meter.
- 3.1.6 Necessary reducers/expanders, elbows & flanges along with counter flanges for suction & discharge to match with the variant table.
- 3.1.7 Required Instrumentation recommended by OEM.
- 3.1.8 Necessary fasteners along with gaskets for fixing loose items at BHEL's works.
- 3.1.9 Pressurized Lubrication system required for Turbine by using the Mechanical seal is in vendors Scope of supply.

**3.2.0 SCOPE OF SUPPLY FOR COMMISSIONING SPARES (If Applicable):**

- 3.2.1 Spare set of Gaskets & "O" rings for lube oil pump drive turbine.

**3.3.0 SCOPE OF SUPPLY FOR MADATARY SPARES (If Applicable) :**

- 3.3.1 Spare set of Mandatory spares for lube oil pump drive turbine.
  - 3.3.1.1 Spare set of Complete Turbine Rotor assembly dynamically balanced and overspeed tested -1No.
  - 3.3.1.2 Spare set of Journal Bearings(DE ) for Lop drive turbine – 1Set
  - 3.3.1.3 Spare set of Journal Bearings(NDE ) for Lop drive turbine – 1Set
  - 3.3.1.4 Spare set of Thrust Bearings(NDE ) for Lop drive turbine – 1Set
  - 3.3.1.5 Spare set of Gaskets & O Rings for Lop drive turbine – 1Set

FORMAT  
TD-202  
REV-01

**COPY RIGHT AND CONFIDENTIAL**

The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.



HYDERABAD

**PRODUCT STANDARD**  
**INDUSTRIAL TURBINES AND COMPRESSORS**

**TC 6 4514**

Rev. No: 02

Page 5 of 11

3.3.1.6 Spare Set of Mechanical seal--- 1Set

**Note:** Vendor to clearly specify the non-applicable of the items specified above in the offer.

3.4.0 **2-YEAR NORMAL OPERATIONAL SPARES :**

Vendor to submit offer for 2-year normal operational spares for lube oil pump drive turbine & its control equipment along with offer. The prices shall be quoted individually in the price format. Un priced bid format shall be sent along with offer.

The validity of spare price shall be one year after placement of main equipment order. The spare prices are to be considered while evaluating price comparative statement by BHEL

4.0.0 **RATING PLATES**

A rating plate of non-corrosive material upon which shall be engraved manufacturer's name, Turbine type, Turbine model, Serial no. of Turbine, Rating in KW, Speed in RPM, Steam consumption at operating condition, Inlet steam parameters, Exhaust steam parameters, Inlet steam temperature, Exhaust steam temperature and the essential parameters required. These rating plates shall be of White non-hygroscopic material with engraved black lettering.

5.0.0 **CLEANING & PREPARATION FOR COATING:**

5.1.1 All coated surfaces shall be protected against abrasion impact, discoloration any other damages.

5.1.2 All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. The shaft ends of Turbine shall be properly sealed with suitable devices to protect them from damage The parts which are likely to get rusted due to exposure to whether, should also be properly treated and protected in a suitable manner. All primers / paints / coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be.

5.2.0 **PRESERVATIVE SHOP COATING:**

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces that will not be easily accessible after the shop assembly shall be treated beforehand and protected for the life of the equipment.

FORMAT  
TD-202  
REV-01

**COPY RIGHT AND CONFIDENTIAL**

The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.



HYDERABAD

**PRODUCT STANDARD**  
**INDUSTRIAL TURBINES AND COMPRESSORS**

**TC 6 4514**

Rev. No: 02

Page 6 of 11

All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and pre heated in the shop.

The surfaces that are to be finish painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer.

All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of Customer / BHEL.

**PAINT AND FINISH**

5.3.0

5.3.1 Turbine external parts shall be finished and painted to produce a neat and durable surface, which would prevent rusting, and corrosion. The equipment shall be thoroughly degreased, all rust, sharp edges and scale removed and treated with one coat of primer and finished with two coats of final paint. The final paint shade will be informed during detailed engineering stage.

5.3.2 Material shall be properly packed to withstand mechanical damage and rust during transit. Vendor to submit the cleaning & painting specification along with offer.

6.0.0 **SPECIAL NOTES:**

6.1.1 Final documents as per clause 6.2.1 & 6.2.2 of BHEL specification TC 6 4203 Rev 00 shall also be furnished in C.D compatible for using in AutoCAD (Latest)  
O & M manuals shall also be furnished in C.D compatible for using in MS-Word (Latest).

6.1.2

7.0.0 **DOCUMENTATION:**

The list of engineering data would be a comprehensive one including all engineering data / drawings / information for all brought out items and manufacturing items

All the drawings/ documents submitted by the vendor during detailed engineering stage shall be stamped "For Approval" or For Information" prior to submission.

After the approval of the drawing, further work by the vendor shall be in strict accordance with these approved drawings and no deviations shall be permitted without the written approval of customer.

All manufacturing, fabrication and execution of work in connection with the equipment / system. Prior to the. Shall be at the vendor's risk. The vendor is expected not to make any changes in the design of the approval of the drawings equipment / system, once they are approved by customer.

FORMAT  
TD-202  
REV-01

**COPY RIGHT AND CONFIDENTIAL**

The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.



HYDERABAD

**PRODUCT STANDARD**  
**INDUSTRIAL TURBINES AND COMPRESSORS**

**TC 6 4514**

Rev. No: 02

Page 7 of 11

However, if some changes are necessitated in the design of equipment / system at a later date. The vendor may do so, but such changes shall promptly be brought to the notice of customer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the technical specification.

The no of copies / prints/CD/manuals to be furnished as follows:

Drawings, Data sheets, Curves for Information / approval ..... 3 prints & 1 CD

Final Drawings, Data sheets, Curves for Information / approval .... 3 prints & 1 CD

Performance and functional guarantee test reports .... 10 prints & 1 CD

**7.1.0 DRAWINGS, DATA TO BE FURNISHED**

**7.1.1 Documents to be sent along with offer ( 2 copies)  
(Without following data, offers will not be considered.)**

7.1.1.1 Technical data required as per BHEL & EIL Specifications.

7.1.1.2 General arrangement drgs. / Catalogues giving with full sectional views. (Including basic dimensions, flange & shaft end details, inlet, exhaust, drains, leak-off, and bearing housing connections.)

7.1.1.3 Cross-sectional drawing with bill of material.

7.1.1.4 Filled in EIL/ Customer data sheet of LOP drive Turbine.

7.1.1.5 *Performance curve of the Turbine.*

7.1.1.6 *Quality assured plan.*

7.1.1.7 *Experience Record Performa.*

7.1.1.8 *Mechanical seal GA drawing.*

7.1.1.9 *Foundation & fixing details.*

7.1.1.10 *Turbine allowable forces & moments / Thermal moment.*

7.1.1.11 *Turbine piping & Instrument diagram.*

7.1.1.12 Supplier's painting program, including surface preparation, primer and paint material, and components affected, shall be described completely including preservation of the Consignment

7.1.1.14 Vendor to strictly submit the duly signed and stamped Annexure –I to TC64514 Rev00 along with offer

7.1.2

**7.1.2.1 Documents to be sent after placement of order ( 3 copies)**

*General arrangement drawings giving with full sectional views. (Including basic dimensions, flange & shaft end details, inlet, exhaust, drains, leak-off, and bearing housing connections.)*

7.1.2.2 Cross-sectional drawing with bill of material of LOP drive Turbine.

7.1.2.3 Filled in EIL/ Customer data sheet of LOP drive Turbine.

7.1.2.4 Performance curve of the Turbine.

FORMAT  
TD-202  
REV-01

**COPY RIGHT AND CONFIDENTIAL**

The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.



HYDERABAD

**PRODUCT STANDARD**  
**INDUSTRIAL TURBINES AND COMPRESSORS**

**TC 6 4514**

Rev. No: 02

Page 8 of 11

- 7.1.2.5 Quality assured plan.
- 7.1.2.6 Mechanical seal GA drawing.
- 7.1.2.7 Foundation & fixing details.
- 7.1.2.8 Turbine allowable forces & moments / Thermal moment.
- 7.1.2.9 Turbine piping & Instrument diagram.
- 7.1.2.10 Detailed installation diagrams with dimensional details.
- 7.1.2.11 Calibration sheets & records.
- 7.1.2.12 Inspection & test procedures including material certificates.
- 7.1.2.13 Supplier's painting program, including surface preparation, primer and paint material, and components affected, shall be described completely including preservation of the consignment.

7.1.3.0 **Documents to be sent along with consignment ( 5 copies)**

- 7.1.3.1 General arrangement drawings giving with full sectional views. (Including basic dimensions, flange & shaft end details, inlet, exhaust, drains, leak-off, and bearing housing connections.)
- 7.1.3.2 Material Code wise Boxes indicating the items as per the order.
- 7.1.3.3 Test & Guarantee certificates.
- 7.1.3.4 Material test certificates.
- 7.1.3.5 O&M manuals for all the items covered in vendor's scope of supply.
- 7.1.3.6 Check list to start the lube oil pump drive turbine.

8.0.0 **TESTS & GUARANTEE CERTIFICATES:**

8.1.0 **TESTS CERTIFICATES:**

3 copies of performance test certificate of turbine & control equipment shall be supplied for each item of the consignment quoting BHEL Standard number, purchase order number and manufacturer's identification serial number.

8.2.0 **GUARANTEE CERTIFICATES:**

- 8.2.1 A guarantee certificate for 18 months of trouble free performance from the date of shipment or 12 months from the date of commissioning whichever is earlier shall be supplied.
- 8.2.2 If any mal-performance or defects occur during the guarantee period, the vendor shall make all necessary alteration, repairs, or replacement free of charge

9.0.0 **PACKING:**

The equipment shall be properly packed to withstand mechanical damage and rust during transit. Packing and shipment shall be as per API - 611 Clause 4.4. Packing shall be suitable for 24 months storage period.

FORMAT  
TD-202  
REV-01

**COPY RIGHT AND CONFIDENTIAL**

The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.



HYDERABAD

**PRODUCT STANDARD**  
**INDUSTRIAL TURBINES AND COMPRESSORS**

**TC 6 4514**

Rev. No: 02

Page 9 of 11

10.0.0 **MARKING:**

10.1.0 In addition to the marking as per API - 611, BHEL 12 digit material code number shall be provided at suitable place.  
All the items shall be properly marked with tag number provided the sketch enclosed to this specification.

10.2.0 The following details shall be marked on the packing case for each consignment.

- a) Manufacture's Name
- b) BHEL Order number.
- c) BHEL Standard Number
- d) BHEL Material Code Number.
- e) Description of the item

11.0.0 **Enclosures to be followed:**

Refer Annexure –I to Purchase Specification TC64514

FORMAT  
TD-202  
REV-01

**COPY RIGHT AND CONFIDENTIAL**

The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.



**PRODUCT STANDARD**  
**INDUSTRIAL TURBINES AND COMPRESSORS**

**TC 6 4514**

Rev. No: 02

Page 10 of 11

42	SP.INSTRUMENTS AS PER ANNEX-VI FORLOPDT					TC9764514421
41	SET OF COMPLETE MECH SEALASSY FOR LOPDT					TC9764514413
40	SET OF BEARINGS (DE & NDE) FOR LOPDT					TC9764514405
39	SETOF DYN. BALANCED ROTOR+N2CYL OFLOPDT					TC9764514391
38	COOLING WATER INLET& OUTLET FOR LOPDT					TC9764514383
37	LEAK OFF/DRAIN&STEAMTRAPASSY FOR LOPDT					TC9764514375
36	STEAM INLET/EXHAUST PIPING+RED/EXP+FITT					TC9764514367
35	SGL STG STEAMTURBINE MECHSEAL 15/22KW					TC9764514359
	15 / 22	14.6/15.8/17.2/ 20.4 FV	270/285/310/350	4.1/4.5/5.0/6.5	B224-110-80-43- DS-1024-R0	

09	CARBON RING ASEMBLY, IOCL PARADEP BFPDT					TC9764514090
08	LEAK OFF/ DRAIN ALONG WITH COUNTER FLANGES & STEAM TRAP ASSY FOR LOPDT					TC9764514081
07	EXPANDER/REDUCER & PIPE FITTINGS ALONG WITH COUNTER FLANGES TO SUIT THE INLET & EXHAUST SIZES OF LOPDT AS PER ANNEXURE – VI TO TC64514					TC9764514073
06	SELF POWERED DIGITAL TACHOMETER FOR LOPDT					TC9764514065
05	SET OF GASKETS & O RINGS FOR LOPDT					TC9764514057
04	SPARE SET OF BEARINGS FOR LOPDT					TC9764514049
03	SPARE SET OF MECHANICAL SEAL FOR LOPDT					TC9764514030
02	SPARE SET OF DYNAMICALLY BALANCED ROTOR FOR LOPDT					TC9764514022
01	22 / 37	10.7/11.7/13.7/ 20	230/250/280/350	5.2/5.7/6.2/7.5	A609-000-82-41- DS-0007	TC9764514014
<b>Var No</b>	<b>Nor/M ax Power in KW</b>	Inlet Steam pressure in Kg/cm <sup>2</sup> (g) Min / Normal / Max / Design	Inlet Steam temperature in °C) Min / Normal / Max / Design	Exhaust Steam pressure in Kg/cm <sup>2</sup> (g) Min / Nor / Max / Design	<b>EIL data sheet number</b>	<b>BHEL material code</b>

FORMAT  
TD-202  
REV-01

**COPY RIGHT AND CONFIDENTIAL**

The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.





TD-106-1

Rev. 5

Form No.



HYDERABAD

**Annexure - I to purchase specification TC64221**  
**Project: HRRL RECYCLE GAS COMPRESSOR BARMER**  
**TURBINES AND COMPRESSORS**

REV 00

Page 1 of 4

COPYRIGHT AND CONFIDENTIAL

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

COMP. FILE NAME

TC 5 4362-R00

Ref. Doc.

**1.0 In case of any conflict between BHEL spec TC 54221 Rev 00 and other enquiry documents, the following preferential order shall govern.**

- 1) EIL Datasheet: **B224-109-80-43-DS-102-R00 Turbine data sheet**
- 2) EIL Specification 6-43-0042 Rev. 3 Std spec for GP ST
- 3) TC64514
- 4) Annexures-I, II, III, IV, V, VI of TC64221
- 5) International standards/codes/recommended practices as applicable.

**2.0 The following are to be considered by vendor before offer:**

- 2.1 Compliance with this specification shall not relieve the vendor of the responsibility of furnishing equipment and auxiliaries of proper design, materials and workmanship to meet the specified operating conditions.
- 2.2 Noise level of the complete package shall be restricted within **85 dbA** at any point located **1 m** away from the equipment. If the noise level exceeds the specified value, necessary modifications to meet the noise level criteria, shall be provided by the vendor without any cost/time implications.
- 2.3 The selected equipment shall satisfy the requirement of Equipment qualification criteria as per clause 5.4 of **6-43-0042 Rev. 3**
- 2.4 Aux. steam turbine shall be back pressure type with MP inlet and LP exhaust.
- 2.5 Auxiliary steam turbine shall be equipped with Mechanical seals.
- 2.6 The Steam Turbine (General Purpose) model offered shall be from the existing Steam Turbine model series (EIL approved model series only) and shall be from the regular standard manufacturing range of the vendor from EIL approved manufacturing unit/works. The offered Steam Turbine model shall have proven track record (PTR) of similar operating conditions (prototypes are not acceptable).
- 2.7 The turbine shall be capable of delivering 110% of rated power of the pump (19 KW) power at the minimum inlet pressure and maximum exhaust pressure
- 2.8 Turbine & spare rotor must be packed for an outdoor storage period of 12 months.
- 2.9 Performance correction curve shall be provided for aux. steam turbine.
- 2.10 Painting scheme to be followed shall be strictly in line with - "Table-5: SL.No.5.2 of Project Painting specification – "Job Specification for Surface Preparation and Protective Coating **B224-000-79-41-PLS-01**" attached. Final shade of Turbine shade shall be Aluminium.
- 2.11 Sourcing of any raw material or finish good products, any testing and processing on product from China is not allowed.
- 2.12 Vendor shall submit the valid PESO/CCOE certificate for the applicable instruments.

Rev. No.	Revisions	Prepared:	Reviewed:	Approved	Date
00	Issue	K BHARATH	SUNIL JIWTODE	P D MAHULIKAR	17.10.2020



**Annexure I to purchase specification TC64221 R00**

**TURBINES AND COMPRESSORS**

**HYDERABAD**

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

COMP. FILE NAME  
 TC 5 4362-R00

Ref. Doc.

2.13 Solenoid valve shall be of universal and continuous rated type. It shall be **24V DC**. Solenoid valves body material shall be SS 316 & insulation class shall be H. Vent port of all solenoid valves are to be provided with SS/ Brass bug screens, to prevent blockage of port because of bugs and to save the port from dust.  
**Solenoid valve shall be explosion proof with area of classification ZONE 1 GAS GR IIC, T3 type and shall be as per IEC 60085/IS1271. Solenoid valve shall be SIL-3 Certified and vendor shall submit the CCOE & PESO certificate for the same.**

2.14 Electrical Area classification: Zone 2, Gas Group IIC

2.15 Instrumentation Area classification: Zone 1, Gas Group IIC, Temp class T3

2.16 **All the instruments and valves shall comply the clause 4.0 of customer specification B224-000-16-51-SP-0001 Rev D Guideline for INST.**

2.17 The make of instruments, solenoid valve, ON-OFF valve, its actuators, etc. shall be as per the vendor list- Att-1 **Vendor List Rev 3**

2.18 **Warranty requirement for HRRL VGO RGC package is:**

2.19 All equipment/goods supplied shall be guaranteed up to 31st DEC 2023 and shall be proved under normal operating conditions. Before guarantee period, if found of inadequate design, of defective material or of poor workmanship, in such event the guarantee period for the particular equipment / material shall be another 12 months from the date of acceptance by PURCHASER/OWNER of such replaced/repared equipment /material. However, extended guarantee period shall have an upper limit till 31st DEC 2024".

**Therefore, the above clause is applicable in place of clause 8.2.0 of TC64514.**

3.0 **Scope of supply:**

3.1 SGL STG STEAMTURBINE MECHSEAL 15/22KW, 1450 rpm for the driver of lube oil pump without governor; Material code TC9764514359

(Lube oil pump drive turbine along with Mechanical seal, sentinel valve, Pressure gauge for Nozzle Ring with Local gauge board/Instrument rack for mounting along with junction box of solenoid valve and proximity switch, Metal Insulation cover, Remote trip solenoid, Remote start solenoid).

3.2 Steam Inlet & Exhaust Piping including reducer & expander with counter flanges; Material code TC9764514367; Qty- 1 Set

3.3 Leak off/Drain piping with counter flanges & Steam Trap Assy for LOPDT; Material code TC9764514375; Qty- 1 Set

3.4 Cooling water inlet & outlet piping with counter flanges for LOPDT; Material code TC9764514383; Qty- 1 Set

3.5 Spare set of dynamically balanced rotor for LOPDT with N2 container; Material code TC9764514391; Qty- 1 Set

(With Permanent metal storage container for Vertical storage – provided with pressure indicator and nitrogen cylinder for ensuring recommended positive pressure).

3.6 Spare set of Bearings (DE & NDE) for LOPDT; Material code TC9764514405; Qty- 1 Set

3.7 Spare set of complete mechanical seal assembly for LOPDT; Material code TC9764514413; Qty- 1 Set

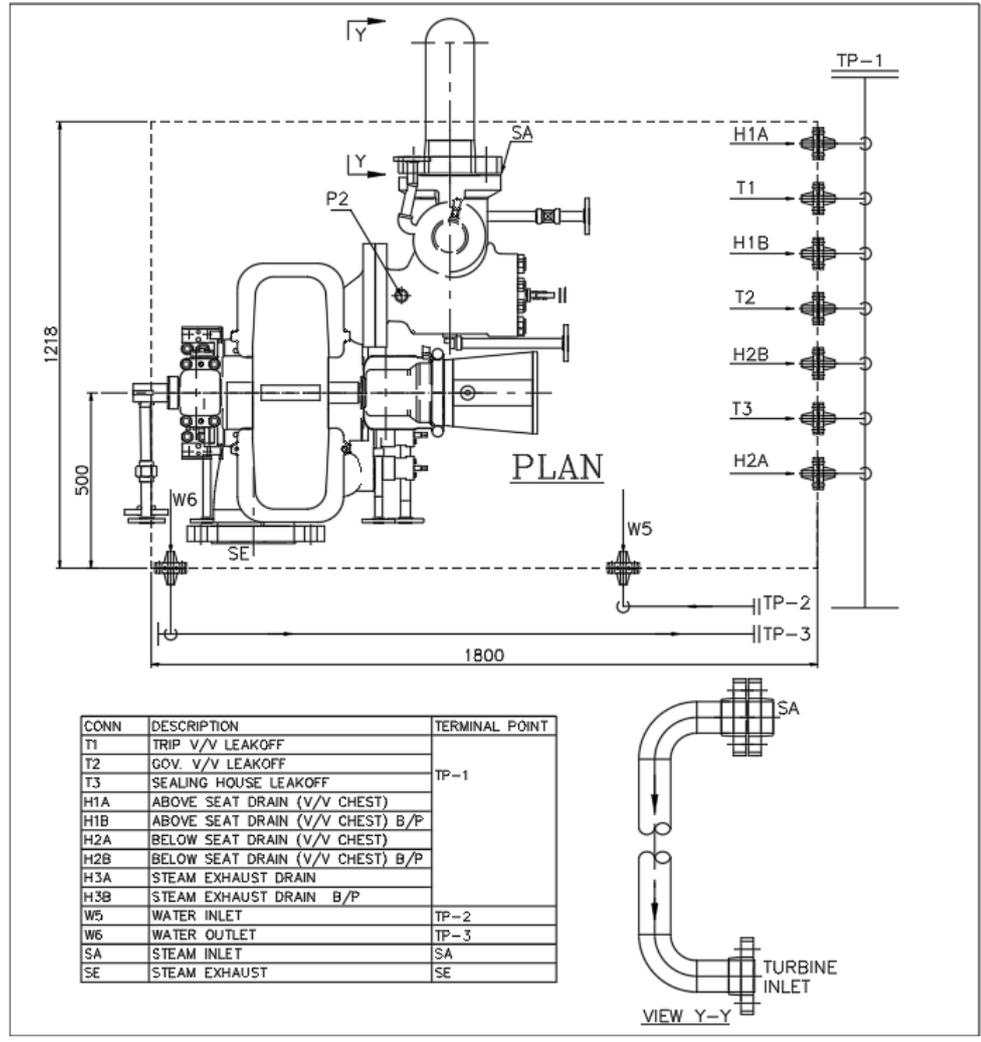
3.8 Set of spare instruments as per Instrumentation Spares philosophy as per attached ANNEXURE VI: SPARE PHILOSOPHY; Material code TC9764514421; Qty- 1 Set



**Annexure I to purchase specification TC64221 R00**  
**TURBINES AND COMPRESSORS**  
**HYDERABAD**

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

**4.0 TERMINAL POINTS DETAILS:**



CONN	DESCRIPTION	TERMINAL POINT
T1	TRIP V/V LEAKOFF	TP-1
T2	GOV. V/V LEAKOFF	
T3	SEALING HOUSE LEAKOFF	
H1A	ABOVE SEAT DRAIN (V/V CHEST)	TP-1
H1B	ABOVE SEAT DRAIN (V/V CHEST) B/P	
H2A	BELOW SEAT DRAIN (V/V CHEST)	
H2B	BELOW SEAT DRAIN (V/V CHEST) B/P	
H3A	STEAM EXHAUST DRAIN	TP-1
H3B	STEAM EXHAUST DRAIN B/P	
W5	WATER INLET	TP-2
W6	WATER OUTLET	TP-3
SA	STEAM INLET	SA
SE	STEAM EXHAUST	SE

**5.0 Approved vendor makes:**

a. Approved vendors of Pressure Gauge shall be,  
The make of Pressure Gauge shall be as per specification B224-000-16-51-0001 Rev. D – PG

b. Approved vendors of Temperature Gauge shall be,

- BADOTHERM PROCESS INSTRUMENTS B.V. NETHERLANDS
- WIKA ALEXANDER WIEGAND & CO GMBH GERMANY
- AN INSTRUMENTS PVT LTD INDIA
- GAUGES BOURDON (I) PVT. LTD. (GEN.INST) INDIA
- PRECISION MASS PRODUCTS PVT. LTD. INDIA
- BAUMER BOURDON HAENNI SAS
- GOA INSTRUMENTS INDUSTRIES PVT. LTD. INDIA
- WALCHANDNAGAR INDUSTRIES LTD (TIWAC INDIA DIVN)
- BAUMER TECHNOLOGIES INDIA PVT.LTD INDIA
- WIKA INSTRUMENTS INDIA PVT LTD INDIA

c. Approved vendors of Solenoid Valve shall be,  
ASCO JOUCOMATIC SA FRANCE  
ASCO NUMATICS (INDIA) P. LIMITED INDIA  
VERSA BV NETHERLANDS

COMP. FILE NAME  
TC 5 4362-R00

Ref. Doc.

TD-106-1  
Rev. 5

Form No.



**Annexure I to purchase specification TC64221 R00**

**TURBINES AND COMPRESSORS**

**HYDERABAD**

HERION WERKE GERMANY  
 ASCO JOUCOMATIC LTD UNITED KINGDOM  
 ROTEX AUTOMATION LTD. INDIA  
 AVCON CONTROLS PVT. LTD. INDIA  
 SCHRADER DUNCAN LIMITED INDIA  
 ALCON ALEXANDER CONTROLS LIMITED UNITED KINGDOM  
 PRECISION INSTRUMENT COMPANY INDIA  
 THOMPSON VALVES LTD UNITED KINGDOM

**6.0 ENCLOSURES:**

- 6.1 EIL Datasheet: **B224-109-80-43-DS-102-R00 Turbine data sheet**
- 6.2 EIL Specification 6-43-0042 Rev. 3 Std spec for GP ST
- 6.3 EIL Specification 6-81-0057 Rev 3 ITP for ST API 611
- 6.4 EIL Specification B224-109-80-43-ERP-1021 ERP
- 6.5 EIL Specification 6-81-0001 Rev. 3 PMI
- 6.6 EIL Specification 6-44-0066-Rev 2 Tech notes for steam trap
- 6.7 EIL Specification 6-44-0051 Rev. 6 Technical Notes for Pipes
- 6.8 EIL Specification 6-44-0052 Rev. 7 Technical Notes for Valves
- 6.9 EIL Specification B224-000-79-41-PLS-01 Surface Preap and Prot Coat
- 6.10 EIL Policy make in India Annexure-1 to job specification (doc. no.: B224-109-80-43-SP-5020)
- 6.11 TC64514-R02
- 6.12 Annexures-I, II, III, IV, V, VI of TC64514
- 6.13 PMI Std Spec 6-81-0001 Rev.3

**COPYRIGHT AND CONFIDENTIAL**

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

COMP. FILE NAME

TC 5 4362-R00

Ref. Doc.

**ANEXURE II to Purchase Specification TC64541**

**Project: MCA-1059 HRRL VGO RGC**

BHEL Enquiry Ref No \_\_\_\_\_ Date \_\_\_\_\_

Vendor offer Ref No \_\_\_\_\_ Date \_\_\_\_\_

The vendor shall complete the experience record proforma as per below to prove that the equipment offered meets the EQC for technical acceptance. The EQC – EQUIPMENT QUALIFICATION CRITERIA shall be as per clause 5.4 of EIL Standard spec for General-purpose steam turbine 6-43-0042 Rev. 3.

Vendor may furnish additional information to justify that the EQC is being met. In addition, manufacturer's catalogue and general reference list for all the below equipment's shall also be furnished along with the proposal.

**PROVEN TRACK RECORD FOR THE MODEL BEING OFFERED (FOR MORE THAN 8000 HOURS/Complete one year)**

<b>SL.NO</b>	<b>PLANT NAME /LOCATION</b>	<b>CLIENT</b>	<b>MODEL/INLET/OUTLET STEAM PARAMETERS/KW/SPEED/MATERIAL</b>	<b>YEAR OF COMMISSIONING</b>	<b>NO. OF RUNNING HOURS LOGGED</b>

Signature and stamp of vendor

**Annexure-III (TDS) to Purchase Specification TC64514**

**Project: MCA-1059 HRRL VGO RGC**

**Technical Deviation Sheet (TDS Sheet):**

**Deviations to all of the enquiry documents**

<b>Sl. No</b>	<b>Spec No</b>	<b>Description of Spec</b>	<b>Deviation</b>	<b>Reason</b>

**Vendor's Signature**

**Vendor's Company seal**

TD-106-1  
Rev. 5

Form No.



HYDERABAD

**Annexure-IV to purchase specification TC64514  
Project: MCA-1059 HRRL VGO RGC BARMER  
TURBINES AND COMPRESSORS**

REV 1

Page 1 of 2

**PRICE SCHEDULE**

Enquiry ref. No:  
Offer ref no.

Date:  
Date:

Sl. No	Description	Mat. code	Qty	Price/qty	Total Price
1.0					
1.1	SGL STG STEAMTURBINE MECHSEAL 15/22KW (Lube oil pump drive turbine along with Mechanical seal, sentinel valve, Pressure gauge for Nozzle Ring with Local gauge board/Instrument rack for mounting along with junction box of solenoid valve and proximity switch, Metal Insulation cover, Remote trip solenoid, Remote start solenoid).	TC9764514359	1 No		
1.2	STEAM INLET/EXHAUST PIPING+RED/EXP+FIT Steam Inlet & Exhaust Piping including reducer & expander with counter flanges	TC9764514367	1 Set		
1.3	LEAK OFF/DRAIN&STEAMTRAPASSY FOR LOPDT (Leak off/ drain along with counter flanges. All Tie in's to be terminated up to skid base plate with counter flanges. Attached sketch of Turbine connections overview to be referred).	TC9764514375	1 Set		
1.4	COOLING WATER INLET& OUTLET FOR LOPDT.	TC9764514383	1 Set		
1.5	SETOF DYN. BALANCED ROTOR+N2CYL OFLOPDT. (With Permanent metal storage container for Vertical storage – provided with pressure indicator and nitrogen cylinder for ensuring recommended positive pressure).	TC9764514391	1 Set		
1.6	SET OF BEARINGS (DE & NDE) FOR LOPDT	TC9764514405	1 Set		
1.7	SET OF COMPLETE MECH SEALASSY FOR LOPDT	TC9764514413	1 Set		
1.8	SP.INSTRUMENTS AS PER ANNEX-VI FORLOPDT. Items as per attached ANNEXURE VI: SPARE PHILOSOPHY	TC9764514421	1 Set		

**COPYRIGHT AND CONFIDENTIAL**

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

COMP. FILE NAME

Ref. Doc.

Rev. No.	Revisions	Prepared:	Reviewed:	Approved	Date
01	Clause 2.0 modified & Note 1 revised	SHEKHAR	K BHARATH	SUNIL B J	16.03.2021
00	Issue	K BHARATH	SUNIL JIWTODE	P D MAHULIKAR	17.10.2020



HYDERABAD

**Annexure-IV to purchase specification TC64221**  
**Project: HRRL RECYCLE GAS COMPRESSOR BARMER**  
**TURBINES AND COMPRESSORS**

REV 1

Page 2 of 2

<b>2.0</b>	Requirement of Services from vendor during functional testing of Lube oil pump at BHEL works & SITE Commissioning activity at HRRL BARMER RAJASTHAN Site			
2.1	# Two-day stay at HRRL BARMER RAJASTHAN site including to and fro charges & accommodation (If Required)	-----	Per day	
2.2	# Charges for additional stay per day at HRRL BARMER RAJASTHAN Site other than above (If Required)	-----	Per visit	
2.3	# One-day stay at BHEL works including to and fro charges & accommodation	-----	Per day	

Notes:

- 1) **Prices of Sl. No 1.0 and 2.0** of above shall be considered for lowest vendor (L1) price evaluation.
- 2) Any additional requirements, which are essential for proper functioning of LOP but not indicated in Specification shall be included in the main offer.
- 3) Service charges of Sl. No. 2.0 shall be valid up to one-year post warranty period. Service order will be placed, if requirement arises.

**Vendor's Signature**

**Vendor's Company seal**



HYDERABAD

**Annexure-V to purchase specification TC64514 Rev 00**

Project: MCA-1059 HRRL VGO RGC

**TURBINES AND COMPRESSORS**

Page 1 of 1

**Table 1: Check List****(TO BE FILLED BY THE VENDOR AND SUBMITTED ALONG WITH THE OFFER WITH OUT WHICH OFFER WILL NOT BE CONSIDERED)**

S. No.	Description	Vendor's Confirmation (Yes/No)
1	Compliance for BHEL specification TC64514-R02	
2	Compliance to EIL Datasheets <b>B224-110-80-43-DS-1024-R00</b>	
4	Compliance to EIL Specification 6-43-0042 Rev. 3 Std spec for GP ST	
5	Compliance to EIL Specification 6-81-0057 Rev 3 ITP for ST API 611	
6	Compliance to EIL Specification B224-109-80-43-ERP-1021 ERP	
7	Compliance to EIL INST Specifications	
8	Compliance to EIL specification 6-81-0001 Rev. 3 PMI; 6-44-0066-Rev 2 Tech notes for steam trap; 6-44-0051 Rev. 6 Technical Notes for Pipes; 6-44-0052 Rev. 7 Technical Notes for Valves; EIL Policy make in India Annexure-1 to job specification (doc. no.: B224-109-80-43-SP-5020)	
9	Compliance to Annex-I to purchase spec TC64514 R02	
10	The Scope of supply is detailed in Annex-I to purchase spec TC64514 R02, Same to referred and if in doubt shall be discussed during Pre-Bid clarifications.	
11	Price Schedule as per Annexure IV & signed filled copy of Price schedule (without prices) enclosed with technical offer.	
12	Deviations if any to submitted offer mentioned in Annex-III Technical Deviation Sheet.	
13	Proven Track Record as per Annexure II of purchase spec TC 64514 Rev02. Without which offer cannot be evaluated.	
14	Painting scheme to be followed shall be strictly in line with - "Table-5: SL.No.5.2 of Project Painting specification – "B224-000-79-41-PLS-01 Surface Preap and Prot Coat" attached. Final shade of Turbine shade shall be Aluminum.	
15	Compliance to project specific warranty clause (Refer Clause 3.1 of Annex-I)	
16	Recommended commissioning spares for Turbine during commissioning operation as per clause 3.2.0 of specification TC64514. These are to be clearly specified in the offer & these prices are to be included in the equipment price by BHEL.	
17	Recommended spares for two years of normal operation for Turbine & control equipment: The list for all the items with item wise prices to be specified. The offer shall be valid for one year after placement of order and these shall be ordered as required later. These prices are <b>not to be</b> included in the equipment price by BHEL.	
18	Any additional requirements which are essential for proper functioning of the equipment included in the offer.	
19	Vendor shall confirm that the bill of material furnished along with offer is only indicative and the final BOM, which shall be furnished during detailed Engineering (after order placement) for the approval of BHEL. The additional items, if any required at later stage for complying BHEL specification or for the satisfactory working of the equipment shall be supplied by vendor without any price/delivery implications.	

Rev. No.	Revisions	Prepared:	Reviewed:	Approved	Date
00	Issue	K BHARATH	SUNIL JIWTODE	P D MAHULIKAR	17.10.2020

**COPYRIGHT AND CONFIDENTIAL**

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

COMP. FILE NAME

Ref. Doc.

TD-106-1  
Rev. 5  
Form No.



**PRODUCT STANDARD**  
**TURBINES AND COMPRESSORS**  
**HYDERABAD**

TC 5 4362  
Rev No.: 00  
Page 2 of 33

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

COMP. FILE NAME  
TC 5 4362-R00

Ref. Doc.

Vendor's Signature

Vendor's Company seal

Plant <b>BPCL Mahul Refinery</b>	Client <b>BPCL</b>	Contract Code <b>DHT Integration with New KHT</b>	Document ID <b>6717-INS-G00-EC-0001</b>	Contract No. <b>66-6717</b>
	<b>GENERAL ENGINEERING SPECIFICATION INSTRUMENTATION</b>			
Rev		<b>02</b>	Page	<b>49</b> of <b>57</b>

## ANNEXURE VI : SPARE PHILOSOPHY

Rev-01:- Clause 5.3 in scope in material code TC9754015120

- INSTRUMENTATION**

S. No.	Part Description	Quantity Required	Quoted yes/no
	Mandatory spares shall be quoted and included in base price as follows:		
<b>1</b>	<b>FIELD INSTRUMENTS</b>		
1.1	Pressure Gauges	10% (Subject to min. of 2 No) of each model, range, material of construction and rating, whichever is higher.	YES
<del>1.2</del>	<del>Draft Gauges</del>	<del>10% (Subject to min. of 1 No) of each model, range, material of construction and rating, whichever is higher.</del>	
<del>1.3</del>	<del>Temperature Gauges</del>	<del>5% (Subject to min. of 1 No) of each model, range, material of construction and rating, whichever is higher.</del>	
<del>1.4</del>	<del>Level Gauges</del>	<del>A) For transparent gauges, 10% of illuminators with holder and reflector and 50% of bulbs</del>	
		<del>B) In case of magnetic type level gauges, 10% of bi-color rollers for each gauge to be provided in addition to above.</del>	
		<del>C) 10% subject to minimum one number of glass of each type, size along with pair of Gaskets ( Cushion &amp; Wet Gaskets), whichever is higher.</del>	
		<del>D) 10% subject to minimum one number of Gaskets for Gauge Cocks/Valves Bonnet / Packing.</del>	
<del>1.5</del>	<del>SMART &amp; FF Transmitters for Pressure, Flow (DP), Level(DP) and temperature etc</del>	<del>10% (subject to minimum of 1 No) of each model, range, make and material of construction, whichever is higher.</del>	
1.6	Displacer Type Level Transmitters	a) 10% (subject to minimum of 1) of Head assembly for each type, range and make, whichever is higher	
		b) 10% (subject to minimum of 1) of torque tube, pull rod, gasket spindle for mechanical zero adjustment, whichever is higher	
1.7	Ultrasonic / Radar instrument / Guided wave radar	A) 10% Sensor/Antenna(Subject to minimum 1) for each type range and make, whichever is higher. B) 10% (Subject to minimum of 1) number	

Plant <b>BPCL Mahul Refinery</b>	Client <b>BPCL</b>	Contract Code <b>DHT Integration with New KHT</b>	Document ID <b>6717-INS-G00-EC-0001</b>	Contract No. <b>66-6717</b>	
	<b>GENERAL ENGINEERING SPECIFICATION INSTRUMENTATION</b>				
	Rev	<b>02</b>	Page		<b>50</b>

		<del>B) Electronic assembly with head for each type, range and make, whichever is higher.</del>	
1.8	Temperature Elements	<del>5% (subject to minimum of 1 no) of each model, range, length and make of Thermocouple whichever is higher. Same philosophy to be followed for multi-point thermocouples also but without thermo-wells. For reactor special thermocouple, spares as per vendor recommendation.</del>	
1.9	RTDs	<del>5% (subject to minimum of 1 No) of each length of RTD with Thermowell, whichever is higher.</del>	
1.10	<del>Skin Type Thermocouple</del>	<del>10% (subject to minimum of 1 no) of each length &amp; type of skin Thermocouple, whichever is higher.</del>	
1.11	Thermowell	<del>5% (subject to minimum of 1 no) for each type of Special MOC.</del>	
1.12	<del>Variable Area Flowmeter (Rotameters)</del>	<del>5% or minimum one no. float &amp; set of Packing for each type, size, rating and material, whichever is higher. Spare glass of enclosure/indicating box</del>	
1.13	<del>Vortex Flow Meter</del>	<del>A) One set of gasket and Packing for each type and Size</del>	
	-	<del>B) 10% or minimum one number of each type of electronic cards whichever is higher.</del>	
1.14	<del>PH &amp; conductivity Transmitter</del>	<del>A) Electrode - 10 % or minimum 1 Nos.</del>	
	-	<del>B) PCB Transmitter - 10 % or minimum 1 No.</del>	
	-	<del>C) Power PCB - 10 % or minimum 1 No.</del>	
	-	<del>D) PH preamplifier card - 10 % or minimum 1 No.</del>	
	-	<del>E) Rotameter for high temperatures entry cooler</del>	
1.15	<del>Electromagnetic flow meter, mass flow meter and ultrasonic meter</del>	<del>10% or minimum one number of each type of electronic cards whichever is higher.</del>	

Plant <b>BPCL Mahul Refinery</b>	Client <b>BPCL</b>	Contract Code <b>DHT Integration with New KHT</b>	Document ID <b>6717-INS-G00-EC-0001</b>	Contract No. <b>66-6717</b>
	<b>GENERAL ENGINEERING SPECIFICATION INSTRUMENTATION</b>			
	Rev	<b>02</b>	Page	

1.16	<del>Pump Seal Instruments</del>	<del>10% or min one no each type of instrument.</del>	<del>The spares can be sourced from the pump/seal vendor. same shall be included in pump package MR.</del>
------	----------------------------------	---	--

<b>2</b>	<b>IN-LINE INSTRUMENTS</b>		
<del>2.1</del>	<del>Control Valves &amp; Shutdown Valves</del>	<del>A) Minimum 1 No of each type, size, rating of Trim set consisting of seat, seat ring / seal ring, plug with stem, cage (wherever applicable).</del> <del>B) 10% (subject to minimum of 1) of Positioners(FF, Smart or pneumatic) with links of each type and make, whichever is higher.</del> <del>C) 5% (subject to minimum of 1) of limit switch box, SOV of each type</del> <del>D) 5% (subject to minimum of 1) of Air filter regulators along with gauges of each type, whichever is higher</del> <del>E) 5% (subject to minimum of 1) of Bonnet Gaskets/gland packings, piston O-rings, bearing &amp; liner (for all types of valves)</del> <del>F) 5% (subject to minimum of 1) of any special accessories provided along with the control valve like boosters, position transmitters (wherever applicable), proximity switches, I/P converters, quick exhaust valves, temp dependant fuses etc whichever is higher.</del> <del>G) Actuator spare kit for Piston Operated Valve.</del>	
<del>2.2</del>	<del>Pressure control Valve (Self-actuating valve)</del>	<del>A) Repair kit consisting of (orifice, plug, spring, gasket, diaphragm, O-ring for each type, size &amp; rating of the valve.</del> <del>B) Minimum 1 no of each type/size, rating etc. of Trim set consisting of seat, seat ring / seal ring, plug with stem, cage (wherever applicable), packing material for each valve to be provided as spare.</del>	
<del>2.3</del>	<del>PRDS &amp; De-superheater unit</del>	<del>Same as those of Control Valves and Shut Down valves and additionally</del>	
-	-	<del>A) Gaskets for actuator per unit</del>	
-	-	<del>B) Gaskets for valve and connections per unit (if such gaskets are special and supplied by PRDS/De-Superheater vendor)</del>	
-	-	<del>C) Spray nozzle - 1 No. of each size, type &amp; rating.</del>	
<b>3</b>	<b>ANALYSER</b>	<del>(Spare for each type &amp; model of analyzer)</del> <b>Item Not Applicable</b> <del>Note: Analyser spares shall be decided case to case basis during evaluation. Below spares can be considered to start with.</del>	<del>Sample handling components like filters, Special DP gauges, regulators, coolers, rotameters, Pressure relief valves, NRV etc shall be considered in</del>

Plant <b>BPCL Mahul Refinery</b>	Client <b>BPCL</b>	Contract Code <b>DHT Integration with New KHT</b>	Document ID <b>6717-INS-G00-EC-0001</b>	Contract No. <b>66-6717</b>
	<b>GENERAL ENGINEERING SPECIFICATION INSTRUMENTATION</b>			
	Rev	<b>02</b>	Page	

	<del>A) Modules</del>	<del>5% or minimum 1 no. module of each type (processor module, I/O module, communication module, power supply module etc.) being used inclusive of those used in consoles. This shall include spare modules for hardwired instruments also</del>	
	-	<del>10% or minimum 2 nos. of Safety Barriers, Signal Converters, Trip Amplifiers etc. FF power modules, diagnostic modules etc.</del>	
	-	<del>20% or minimum one no. of each type of set of fuses, Fused terminals, MCBs, Auxiliary relays etc.</del>	
	-	<del>2 Nos. of bulk power supply unit of each rating.</del>	
	-	<del>10% or minimum 2 nos. of communication system components such as hubs, switches, routers, etc. whichever is higher.</del>	
	-	<del>5% or minimum 1 no. of Disks, disk drives, CRT, switches, lamps, push buttons, etc., whichever is higher.</del>	
	<del>B) Consumables</del>	<del>a) Consumable spares including Laser printer cartridges, Paper or any other consumable items supplied along with the system required for a minimum of 6 months duration after system acceptance. b) 3 Nos. Cabinet exhaust fans of each type</del>	
	<del>C) Miscellaneous</del>	<del>1) 10% or minimum one no of each type of interposing relays and contactors, SIL relays, TUV relays etc 2) One set of Operator Console PC with monitor and One set of Engineering server PC with monitor 3) 5 Nos. Cabinet exhaust fans of each type 4) 5% or minimum 2 numbers of fan failure and detection unit assembly 5) 5% or minimum 2 numbers of temperature sensing units of system cabinets 6) 5% or minimum of 10 numbers of fully wired foundation field bus junction boxes with FF barriers</del>	
<b>5</b>	<b>OTHER ITEMS</b>		
5.1	Snubber, Syphon, Gauge Saver, etc.	5% (subject to minimum of 1) of each item used, whichever is higher	Yes
<del>5.2</del>	<del>Loop powered indicators</del>	<del>10% (subject to minimum of 2) of Loop powered indicators used, whichever is higher.</del>	
5.3	Solenoid Valves	10% or minimum 2 nos. of solenoid valves of each type used.	Yes
<del>5.4</del>	<del>MCT Block</del>	<del>20 % of each type of MCT Block used.</del>	
5.5	Instrument Valves / Tube Fittings	10% for each type	Yes
<del>5.6</del>	<del>Panel mounted instruments</del>	<del>5% or minimum one no. whichever is Higher of each components like lamps, push buttons, selector switches, indicators, pneumatic horn, vortex coolers etc.</del>	-

### **ANNEXURE-3: POLICY ON MAKE IN INDIA**

The bidder (Indian as well as Foreign) in order to qualify has to offer equipment with proven track record (PTR) (i.e. proto-type models are not acceptable) and meeting the technical specifications laid out in the Material Requisition.

In order to encourage indigenous vendors to enhance their portfolio and manufacturing capabilities in engagement with their principals and in line with Government of India's policy on "Make in India", EIL offers the following qualification criteria for such subsidiaries which do not have the PTR for the offered equipment, but can get qualified based on either their Foreign Principal or another subsidiary of the Foreign Principal or the holding company of the Foreign Principal, meeting the PTR requirement.

In case, the bidder is an Indian manufacturer who is a subsidiary (Principal holding at least 51% shares) of a Foreign Principal and the qualification criteria is met by the Foreign Principal or another subsidiary of the Foreign Principal or of the Foreign Principal's holding company:

*(a) Qualification Criteria for Foreign Principal or another subsidiary of Foreign Principal (Principal holding at least 51% shares) hereinafter called "Group Company" of the Foreign Principal or for the Foreign Principal's Holding Company:*

1. The Principal or the Group Company shall be in the business of manufacturing of the offered product line (for at least last five years) for which the Indian Manufacturer is seeking to bid.
2. The Principal or the Group Company, whose PTR is being considered, shall already be enlisted either with EIL OR is in Licensor's vendor list, for the same product line<sup>1</sup>.
3. The Principal or the Group Company shall have executed at least TWO orders for the same product line<sup>1</sup>, within the last five years, reckoned from the bid due date.

*Note: All the above criteria shall be met by the same company (either the Principal or the Group Company).*

*(b) Qualification Criteria for Indian Manufacturer (hereinafter called the bidder):*

1. The Bidder must be a subsidiary of the Foreign Principal (Principal holding at least 51% shares) for at least last one year, reckoned from the bid due date.
2. Scope/activity matrix between the Bidder and Principal or the Bidder and the Group Company, shall be submitted to EIL along with the bid. However, the bidder must also note that EIL shall reserve the right to mandate certain activity (ies) or sourcing to be from identified sources only, (#) depending upon the product line under consideration and its criticality. The bidder shall not claim any extra payment on account of any change in sourcing inline with EIL's requirement.

<sup>1</sup>Same Product Line for Principal or Group Company: Same type of Equipment being sought in the inquiry [e.g. Centrifugal pump (Horizontal) (Special purpose process) having equal or higher driver power vis a vis offered driver power].

<sup>2</sup>Same Product Line for Indian manufacturer: Same type of Equipment being sought in the inquiry [e.g. Centrifugal pump (Horizontal) (Special purpose process) having at-least 50% of the offered driver power].

3. The bidder shall source critical components **OR** the bare tested machine from the Principal or the Group Company or directly from the manufacturers supplying the same to the Principal or the Group Company (a certificate to this effect shall be provided by the Principal or the Group Company) and source non critical components / auxiliary components supplies himself (**subject to # above**).
4. The bidder shall have the necessary engineering, manufacturing capability and adequate infrastructure comprising of space, manpower, equipment corresponding to matrix cited above, duly approved by the Principal or the Group Company, as the case may be, for the product line under consideration.
5. As a minimum, the Principal or the Group Company as the case may be, shall carry out the following activities:
  - Design / Application engineering
  - Approval of sourcing of components
  - Approval of Quality Assurance Plans (QAP) identifying Hold, Check & Witness stages (by Principal)
  - Responsibility Matrix
6. The bidder shall have Manufacturing, Assembly and Testing facility for the proposed scope. However, in the remote case of the Manufacturer not having testing facility at all or not having appropriate testing facility, the Manufacturer shall outsource testing to another independent testing facility subject to acceptance by EIL.
7. The Bidder shall have an established service facility in India (either his own or an approved service provider) which must be approved by Principal or the Group Company, as the case may be.
8. The Bidder shall have executed and supplied minimum two orders in the same product line<sup>2</sup>.
9. The Bidder shall be enlisted with EIL for the same product line<sup>2</sup>.
10. In order to ensure commitment from the Bidder and adequate & continued support and Back up by the Principal or the Group Company from designing to commissioning of the product, the bidder shall provide a Contract cum Equipment Performance Bank Guarantee for 15% (i.e. additional 5%) of the order value within one month of receipt of the order, from an Indian scheduled bank or the Indian branch of a foreign bank.

In addition, the Principal or the Group Company shall furnish a "Corporate Guarantee" along with a Board resolution from an authorized signatory committing their continued support to the bidder, till defect liability period, to ensure that Buyer's interests are protected.

11. The Bidder shall provide extended warranty of 12 months over & above guarantee/ warrantee period specified in the GPC.

**Manufacture: "Manufacture" includes any process:**

- i. **Incidental or ancillary to the completion of a manufactured product.**

- ii. **Which is specified in relation to any goods in Central Excise Tariff Act (CETA) as amounting to the manufacture.**

**Documentation required (along with the bid and in single lot)**

1. General reference list of Principal or the Group Company for the same product line, for the last five years as well as General reference list of the bidder for the same product line.
2. Scope / Activity Matrix
3. Certificate of Incorporation of the Bidder.
4. Documents for establishing the bidder as a subsidiary of the Foreign Principal (Principal holding at least 51% shares)
5. Documents for establishing the relationship of the group company, if applicable.
6. Corporate Guarantee of the Principal or the Group Company (in the format provided by EIL)

*[Note: The bidder may carry these documents during pre-tender / pre-bid meeting, in case they desire to seek some clarification from EIL. However, formal submission of documents shall only be with bid submission.]*

## सामान्य प्रयोजन स्टीम टर्बाइनो के लिए मानक विनिर्देश

## STANDARD SPECIFICATION FOR GENERAL PURPOSE STEAM TURBINES

3	16.07.18	REVISED & ISSUED AS STANDARD SPECIFICATION	PM	NK	SM	RKT
2	13.02.13	ISSUED AS STANDARD SPECIFICATION (Superseding EIL Spec. 6-43-0042 Rev.1)	JSD	TK	DB	DM
1	13.05.08	REAFFIRMED & ISSUED AS STANDARD SPECIFICATION	JSD	NK	VKM	VC
0	24.07.03	ISSUED AS STANDARD SPECIFICATION (Superseding EIL Spec. 6-41-0042 Rev.1)	NK	KDS	RK	SKG
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
						Approved by

**Abbreviations:**

ISA	:	Instrument Society of America
P&ID	:	Piping & Instrumentation Diagram
VDR	:	Vendor Data Requirements

**Rotating Equipment Standards Committee**

**Convenor:** Mr. Sanjay Mazumdar

**Members:** Mr. Nalin Kumar  
Mr. Tarun Kumar  
Mr. Anukul Mandal  
Mr. J S Duggal  
Mr. Mahesh Easwaran  
Mr. Abhay Kumar  
Mr. M Azim (Projects)

CONTENTS

	Page No.
<b>A</b>	<b>GENERAL..... 4</b>
1	SCOPE.....4
2	NORMATIVE REFERENCES.....4
<b>5</b>	<b>REQUIREMENTS</b>
5.4	QUALIFYING CRITERIA.....4
<b>6</b>	<b>BASIC DESIGN..... 5</b>
6.1	GENERAL..... 5
6.3	PRESSURE CASINGS ..... 6
6.5	CASING CONNECTIONS ..... 6
6.9	DYNAMICS..... 6
6.10	BEARING AND HOUSING..... 6
6.11	LUBRICATION ..... 6
6.12	MATERIALS ..... 6
6.13	NAME PLATES AND ROTATION ARROWS.....6
<b>7</b>	<b>ACCESSORIES ..... 7</b>
7.2	COUPLING AND GUARDS .....7
7.3	MOUNTING PLATES..... 7
7.4	CONTROL AND INSTRUMENTATION.....7
<b>8</b>	<b>INSPECTION AND TESTING ..... 7</b>
8.1	GENERAL..... 7
8.2	INSPECTION ..... 7
8.3	TESTING..... 7
8.4	PREPARATION FOR SHIPMENT ..... 7
<b>9</b>	<b>VENDOR'S DATA ..... 8</b>
9.1	GENERAL..... 8

## A GENERAL

- (i) This specification together with attendant data sheets and other specifications/attachments to the inquiry/order covers the minimum requirements for General-Purpose Steam Turbines. These requirements include basic design, materials, related lubrication systems, controls, auxiliary equipment and accessories.
- (ii) Except as modified herein, the general purpose steam turbines and their auxiliaries shall be designed, fabricated, tested and supplied strictly in accordance with the **API Standard - 611, Fifth Edition, March 2008, "General Purpose Steam Turbines for Petroleum, Chemical and Gas Industry Services"**.
- (iii) Except for new paragraph, the number and title of the paragraphs in this Specification correspond to the respective sections and paragraphs of the above standard. Paragraphs not addressed in this specification shall be strictly in accordance to **API Standard 611, Fifth Edition, March 2008**. The word in parenthesis following the number or title of a paragraph indicates the following:
- |                |   |  |
|----------------|---|--|
| (Addition)     | : | An addition to a part, section or paragraph referred to  |
| (Modification) | : | Amplification or rewording has been made to a part of the corresponding section or paragraph but not a substitution replacing the entire section or paragraph. |
| (Substitution) | : | A substitution has been made for the corresponding section or paragraph of the standard in its totality.   |
| (New)          | : | A new section or paragraph having no corresponding section or paragraph in the Standard.   |
| (Deleted)      | : | This paragraph is deleted.   |

### 1 SCOPE (Modification)

In addition to criteria specified in API, General Purpose Steam turbines may also be used, subject to market availability & manufacturer's past experience for cases all the following conditions exists.

1. Inlet Pressure  $\leq$  60 bar(g)
2. Inlet Temperature  $\leq$  475 deg C
3. Speed  $\leq$  6000 rpm
4. Turbine Rating  $\leq$  1500 kW and
5. Driven equipment is usually spared or is in noncritical service.

## 2 NORMATIVE REFERENCE

- 2.1 (Addition)  
Vendor shall take all the measure to comply with any state or local codes, statutory regulation, ordinances or rules that are applicable to equipments.

## 5 REQUIREMENTS

- 5.1 (Modification)  
All data, drawing, hardware and equipment supplied to this standard shall be in SI system of measurement.

### 5.4 QUALIFYING CRITERIA (New)

- 5.4.1 The vendor shall be a manufacturer of API 611 General-Purpose Steam Turbines having adequate design, engineering, manufacturing and testing facilities for the same.
- 5.4.2 The Steam Turbine model offered shall be from the existing steam turbine model series and shall be from the regular manufacturing range of the vendor. The offered steam turbine

model shall meet the minimum service & manufacturing experience requirements specified in Clause 5.4.3 below.

- 5.4.3 Steam turbine shall be identical in frame size (Model Number) and similar in terms of Power rating, Rated Speed, Steam Flow, Steam Inlet Conditions, Steam Exhaust Conditions, Roto-dynamics, Bearing Span, Mechanical Design and Materials as compared to at least ONE (1) unit designed, engineered, manufactured, tested and supplied from the proposed manufacturing plant and the reference unit shall have completed ONE (1) year of satisfactory operation at site, as on the bid due date.

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

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

- 5.4.4 The vendor shall complete the Experience Record Proforma as enclosed in the inquiry specification to amply prove that the Equipment offered meets the qualifying criteria, for technical acceptance. In addition, manufacturer's catalogue and general reference list for all the above equipment shall also be furnished.

## 6 BASIC DESIGN

### 6.1 GENERAL

#### 6.1.11 (Substitution)

Unless otherwise specified, Table-1 Design criteria & specification for cooling water system shall be designed for the following condition:

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

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

Note: TSV set pressure (in CW isolatable circuits) shall not exceed the design pressure of purchaser's CW header.

#### 6.1.12 (Modification)

Unless otherwise specified, the maximum sound pressure level of the turbine shall not exceed 88 dBA measured at 1 meter from the equipment surface for the recommended range of operation. Vendor shall supply his recommended type of sound attenuation device (i.e insulated metal cover or blanket type insulator) to achieve the same.

#### 6.1.13 (Modification)

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

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

6.1.17 (Addition)  
Unless specified otherwise, all back pressure steam turbines shall be provided with desuperheater if the exhaust temperature of turbine at any operating condition, including no load exhaust temperature exceeds the exhaust steam header design temperature.

### 6.3 PRESSURE CASINGS

6.3.10 (Substitution)  
On all turbines, the vendor shall provide automatic draining system using thermodynamic type steam traps.

### 6.5 CASING CONNECTIONS

6.5.6 (Addition)  
When a common baseplate is supplied by the turbine supplier; the steam chest, steam ring, casing drains and other drains shall be routed to the edge of the baseplate and terminated in a common drain header having a blind flange at purchaser's interface.

6.5.10(g) (Modification)  
The words 'if specified' stand deleted.

### 6.6 EXTERNAL FORCES & MOMENTS

(Substitution)  
Turbines shall be designed to withstand external forces & moments 1.85 times the values of NEMA SM23.

### 6.9 DYNAMICS

6.9.4.4 (Modification)  
The word 'if specified' stands deleted.

### 6.10 BEARINGS AND HOUSINGS

6.10.4.2.2 (Modification)  
The word 'if specified' stands deleted.

### 6.11 LUBRICATION

6.11.3 (Modification)  
The word 'Unless specified otherwise' stands deleted.

### 6.13 NAMEPLATES AND ROTATION ARROWS

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

**7 ACCESSORIES**

**7.2 COUPLING AND GUARDS**

7.2.7 (Modification)  
The word 'if specified' stands deleted.

**7.3 MOUNTING PLATES**

**7.3.1 General**

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

7.3.2.14 (Substitution)  
Anchor bolts shall be furnished by the vendor having unit responsibility.

**7.4 CONTROLS AND INSTRUMENTATION**

7.4.4.9.4 (Modification)  
Thermal relief valves shall be provided for accessories or cooling jackets that can be blocked-in by isolation valves and same shall be furnished by the vendor having unit responsibility.

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

**8 INSPECTION AND TESTING**

**8.1 GENERAL**

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

**8.2 INSPECTION**

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

**8.3 TESTING**

8.3.1.2 (Substitution)  
Notice period shall be as per paragraph 8.1.6 above.

8.3.3.1(b) (Modification)  
The words 'If specified' stand deleted.

**8.4 PREPARATION FOR SHIPMENT**

8.4.1 (Modification)  
The preparation shall be suitable for at least 12 months of outdoor storage from the time of shipment unless specified otherwise in the inquiry or order. If any extra precaution is to be taken by the Purchaser for storage beyond 12 months the same shall be explicitly indicated in the operation and maintenance manuals.

**9 VENDOR'S DATA**

**9.1 GENERAL**

**9.1.1 (Modification)**

Drawings & data to be submitted by the vendor shall be as specified in purchaser's Vendor Data Requirements.

# पाइपों के लिए तकनीकी टिप्पणियाँ

## TECHNICAL NOTES FOR PIPES

6	25.09.14	REVISED AND ISSUED AS STANDARD SPECIFICATION	<i>SH</i>	<i>AK</i>	<i>RN</i>	<i>ATD</i>	<i>SC</i>
5	31.12.13	REVISED AND ISSUED AS STANDARD SPECIFICATION	UK	SH	AK	RN	SC
4	04.07.08	REVISED AND ISSUED AS STANDARD SPECIFICATION	RN	SC	DM	VC	
3	15.03.00	REVISED AND ISSUED AS STANDARD SPECIFICATION	RN	BRB	NS	AS	
2	04.04.94	HYDROTEST & I.G.C. TEST CLAUSES REVISED	AKG	BPV	GRR	AS	
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman	Approved by

### Abbreviations:

ANSI	:	American National Standards Institute
API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society for Testing & Materials
BHN	:	Brinell Hardness Number
BIS	:	Bureau of Indian Standards
E.FS.W	:	Electric Fusion Weld
E.R.W	:	Electric Resistance Weld
HAZ	:	Heat Affected Zone
HIC	:	Hydrogen Induced Cracking
IBR	:	Indian Boiler Regulations
IGC	:	Inter Granular Corrosion
IS	:	Indian Standard
LT	:	Low Temperature
MR	:	Material Requisition
NACE MR	:	National Association of Corrosion Engineers : Material Requirement
NB	:	Nominal Bore
NPT	:	Nominal Pipe Thread
PMI	:	Positive Material Identification
PR	:	Purchase Requisition
SMYS	:	Specified Minimum Yield Strength
SS	:	Stainless Steel

### Piping Standards Committee

**Convenor :** Mr. R. Nanda

**Members :** Mr. M. Ismaeel  
Mr. Amrendra Kumar  
Mr. G. Balaji  
Mr. K.J. Harinarayanan (HMTD)  
Mr. P P Lahiri / Mr. S. Ghoshal (SMMS)  
Mr. S. Mukherjee (Construction)  
Mr. K.V.K. Naidu (Projects)

---

CONTENTS

1.0	GENERAL .....	4
2.0	IBR PIPES .....	6
3.0	ACCEPTABLE DEVIATIONS .....	7
4.0	HYDROSTATIC TEST .....	7
5.0	MARKING AND DESPATCH .....	10
6.0	REFERENCES.....	10

## 1.0 GENERAL

1.1 All pipes and their dimensions, tolerances, chemical composition, physical properties, heat treatment, hydrostatic test and other testing and marking requirements shall conform to the latest codes and standards specified in the material requisition (MR). Supplier shall strictly comply with MR/PR stipulations and no deviations shall be permitted. Post Order Concession/Deviation Permit 5-0000-0180-F1 as mentioned in Cl. 5.18 of Specification for Quality Management System Requirements from Bidders (6-78-0001) is not applicable.

## 1.2 Testing

1.2.1 Test reports shall be supplied for all mandatory tests as per the applicable material specifications. Test reports shall also be furnished for any supplementary tests as specified in the MR & Clauses 1.10 & 1.11.

1.2.2 Material test certificates (physical property, chemical composition & heat treatment report) shall also be furnished for the pipes supplied.

1.2.3 PMI shall be performed as per the scope and procedures as defined in the spec for PMI at Supplier's Works (6-81-0001).

1.2.4 Refer to specification nos. 6-81-0002 and 6-81-0003 for Inspection & Test plans for welded pipes and seamless pipes respectively.

## 1.3 Manufacturing Processes

1.3.1 Steel made by acid Bessemer process shall not be acceptable.

1.3.2 All longitudinally welded pipes should employ only automatic welding.

1.4 Pipe shall be supplied in single or double random length of 4 to 7 and 7 to 14 meters respectively.

1.5 a. Seamless and E.R.W. pipes shall not have any circumferential seam joint in a random length. However, in case of E.F.S.W pipe, in one random length one welded circumferential seam of same quality as longitudinal weld is permitted. This weld shall be at least 2.5 m from either end. The longitudinal seams of the two portions shall be staggered by 90°. Single random length in such cases shall be 5 to 7 m.

b. Unless otherwise mentioned in the respective material code, E.F.S.W pipes < 36" shall not have more than one longitudinal seam joint and E.F.S.W pipes ≥ 36" shall not have more than two longitudinal seam joints.

1.6 Pipe with screwed ends shall have NPT external taper pipe threads conforming to ASME/ANSI B1.20.1 up to 1.5" NB & IS 554 for 2" to 6" NB.

- 1.7 Pipe with beveled ends shall be in accordance with ASME B16.25. Weld contours shall be as follows:

Material	Wall Thickness	Weld Contour
Carbon Steel (Except Low Temp. Carbon Steel)	Up to 22 mm	Figure 2 Type A
	> 22 mm	Figure 3 Type A
Alloy Steel, Stainless Steel & Low Temp. Carbon Steel	Up to 10 mm	Figure 4
	> 10 mm & Up to 25 mm	Figure 5 Type A
	> 25 mm	Figure 6 Type A

- 1.8 Galvanized pipes shall be coated with zinc by hot dip process conforming to IS 4736 / ASTM A 153.

- 1.9 All austenitic stainless steel pipes shall be supplied in solution annealed condition. All types of 321 or 347 stainless steel pipes shall be in a stabilized heat treated condition. Stabilizing heat treatment shall be carried out subsequent to the normal solution annealing. Soaking time & holding temp. for stabilizing heat treatment shall be 4 hrs & 900°C respectively.

#### 1.10 I.G.C. Test for Stainless Steels

- 1.10.1 For all austenitic stainless steel pipes inter-granular corrosion test shall have to be conducted as per following:

ASTM A262 Practice “B” with acceptance criteria of “60 mils/year (max.)”.

OR

ASTM A262 Practice E with acceptance criteria of no cracks at 20X magnification and microstructure to be observed at 250X magnification shall ensure the absence of any cracks/fissures. When testing is conducted as per practice 'E' photograph of microstructure shall be submitted for record.

- 1.10.2 When specifically asked for in MR for high temperature application of some grades of austenitic stainless steel (eg. SS 309, 310, 316, 316H etc.) ASTM A262 Practice “C” with acceptance criteria of “15 mils/year (max.)” shall have to be conducted.

- 1.10.3 For the IGC test as described in 1.10.1 & 1.10.2, two sets of samples shall be drawn from each solution annealing lot; one set corresponding to highest carbon content and the other set corresponding to the highest pipe thickness.

- 1.11 All welded pipes indicated as ‘CRYO’ & ‘LT’ in MR shall be impact tested per requirement & acceptance criteria of ASME B31.3. The impact test temperature shall be -196°C & -45°C for stainless steel and carbon steel respectively unless specifically mentioned otherwise in MR.

#### 1.12 NACE/HIC Requirements

- 1.12.1 Pipes under “NACE” category and those designated as “HIC1” shall meet the requirements given in NACE MR-0103 unless mentioned otherwise.

- 1.12.2 Pipes made from plates and designated as “HIC1” shall meet the HIC requirements of EIL specification 6-79-0013 unless mentioned otherwise.

- 1.13** Specified heat treatment for carbon steel and alloy steel and solution annealing for stainless steel pipes shall be carried out after weld repairs. Number of weld repairs at the same spot shall be restricted to maximum two by approved repair procedure.
- 1.14** For black or galvanized pipes to IS 1239, the minimum percentage of elongation shall be 20%.
- 1.15** All 1Cr-½Mo and 1¼Cr-½Mo seamless pipes shall be normalised and tempered.
- 1.16** For all welded alloy steel pipes with mandatory requirement of heat treatment and radiography, radiography shall be performed after heat treatment.
- 1.17** For Hydrogen service pipes following special requirements shall also be met:
- 1.17.1 All carbon steel pipes having wall thickness 9.53 mm (0.375") and above shall be normalised. Cold drawn pipes shall be normalised after the final cold draw pass for all thicknesses.
- 1.17.2 All alloy steel (Cr-Mo) pipes shall be normalised and tempered. The normalising and tempering shall be a separate heating operation and not a part of the hot forming operation. The maximum room temperature tensile strength shall be 100,000 psig.
- 1.17.3 For carbon steel Pipes, hardness of weld and HAZ shall be 200 BHN (max.). For alloy steel Pipes, hardness of weld and HAZ shall be 225 BHN (max.).
- 1.17.4 For all austenitic stainless steels, the weld deposit shall be checked for ferrite content. A Ferrite No.(FN) not less than 3% and not more than 10% is required to avoid sigma phase embrittlement during heat treatment. FN shall be determined by Ferritescope prior to post weld heat treatment.
- 1.17.5 For all Carbon steel and Alloy steel pipes with wall thickness over 20mm, Charpy-V Notch impact testing shall be carried out in accordance with paragraph UG-84 of ASME Section VIII, Div-1 for weld metal and base metal from the thickest item per heat of material and per heat treating batch. Impact test specimen shall be in complete heat treated condition and accordance with ASTM A370. Impact energies at 0°Celsius shall average greater than 27J (20 ft-lb) per set of three specimens, with a minimum of 19J (15 ft-lb).
- 1.18** For dual grades of SS where specified, chemical composition and mechanical properties of both grades specified shall be ensured.

## **2.0 IBR PIPES**

### **2.1 IBR Documentation**

- 2.1.1 Pipes under purview of IBR shall be accompanied with IBR certificate original in Form III-A duly approved and countersigned by IBR authority/local authority empowered by the Central Boiler Board of India(Photocopy of the original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance) or Form III-D [for well known pipe manufacturers as per IBR] signed by Manufacturer's authorized representative. Well known pipe manufacturers, as recognized by IBR, shall submit a duly attested copy of Form XVI-G along with Form III-D.
- 2.1.2 For materials 1¼Cr - ½Mo (ASTM A335 Gr.P11 / A691 Gr.1¼Cr), 2¼Cr - 1Mo (ASTM A335 Gr.P22 / A691 Gr.2¼Cr) & 9Cr -1Mo-V (A335 Gr.P91/A691 Gr.91), Form III-A approved by IBR shall include the tabulation of Et, Sc & Sr values for the entire temperature range given below. Et, Sc & Sr values shall be such that throughout the temperature range

$$\begin{array}{l} E_t / 1.5 \geq \\ S_r / 1.5 \geq \\ S_c \geq \end{array} \left| S_A \right.$$

where ,

- $S_A$  : Allowable stress at the working metal temperature.  
 $E_t$  : Yield point (0.2% proof stress at the working metal temperature)  
 $S_c$  : The average stress to produce elongation of 1%(creep) in 100000 hrs at the working metal temperature.  
 $S_r$  : The average stress to produce rupture in 100000 hrs at the working metal temperature and in no case more than 1.33 times the lowest stress to produce rupture at this temperature.

S <sub>A</sub> (psi)												
Temp(°F) Material	500	600	650	700	750	800	850	900	950	1000	1050	1100
A335 Gr.P11	17200	16700	16200	15600	15200	15000	14500	12800	9300	6300	4200	2800
A691 Gr.1¼Cr	18900	18300	18000	17600	17300	16800	16300	15000	9900	6300	4200	2800
A335 Gr.P22 / A691 Gr.2¼Cr	17900	17900	17900	17900	17900	17800	14500	12800	10800	7800	5100	3200
A335 Gr.P91/ A691 Gr.91	28100	27700	27300	26700	25900	24900	23700	22300	20700	18000	14000	10300

Note : S<sub>A</sub> values shall be as per the latest edition prevailing.

**2.2** For carbon steel pipes under IBR the chemical composition shall conform to the following:

- Carbon (max) : 0.25%  
 Others (S, P, Mn) : As prescribed in IBR.

The chemical composition as indicated in this clause is not applicable for pipes other than IBR services.

**3.0 ACCEPTABLE DEVIATIONS**

- 3.1** Pipes to IS 3589 Gr.410 are acceptable in place of IS 3589 Gr.330.  
**3.2** Pipes of Grades SS317 of corresponding material are acceptable in place of Grades SS316 or SS316(2.5 Mo min.).  
**3.3** Pipes of Grades SS317L of corresponding material are acceptable in place of Grades SS316L or SS316L(2.5Mo min.).  
**3.4** Seamless pipes are acceptable in place of welded pipes except in the case of welded SS321/SS321H pipes with nominal thickness greater than 9.53mm.

**4.0 HYDROSTATIC TEST**

- 4.1** All pipes shall be hydrostatically tested.

4.2 The mill test pressure shall be as follows:

4.2.1 Seamless, E.R.W. & Spiral Welded

a) Carbon Steel

Material Std.	Test Pressure Std.
ASTM A106 Gr.B	ASTM A530
API 5L Gr.B, Seamless	API 5L
API 5L, E.R.W.	API 5L
API 5L, Spiral	API 5L
ASTM A333 Gr.3 & 6, Seamless	ASTM A530
ASTM A333 Gr.3 & 6, E.R.W.	ASTM A530

b) Seamless Alloy Steel

Material Std.	Test Pressure Std.
ASTM A335 Gr.P1, P12, P11, P22, P5, P9	ASTM A530
ASTM A268 TP 405, TP410	ASTM A530

c) Seamless Stainless Steel

Material Std.	Test Pressure Std.
ASTM A312 Gr.TP 304, 304L, 304H, 316, 316L, 316H, 321, 347	ASTM A999

d) Seamless Nickel Alloy

Material Std.	Test Pressure Std.
ASTM B161 UNS No. 2200	ASTM B161
ASTM B165 UNS No. 4400	ASTM B165
ASTM B167 UNS No. 6600	ASTM B167
ASTM B407 UNS No. 8800	ASTM B407

e) Welded Nickel Alloy

Material Std.	Test Pressure Std.
ASTM B725 UNS No. 2200,4400	ASTM B725
ASTM B517 UNS No. 6600	ASTM B517
ASTM B514 UNS No. 8800	ASTM B514

#### 4.2.2 Electric Fusion Welded

##### a) Carbon Steel & Alloy Steel E.FS.W (16" & above)

Material Std.	Test Pressure Std.
API 5L Gr.B ASTM A671 Gr.CC65, 70 (Cl.32) ASTM A672 Gr.C60, 65, 70 (Cl.12,22) ASTM A671 Gr.CF60, 65, 66, 70 (Cl.32) ASTM A691 Gr.½Cr, 1Cr, 1¼Cr, 2¼Cr, 5Cr, 9Cr (Cl.42)	P = 2ST/D S = 90% of SMYS Except for API 5L Gr.B S = 85% of SMYS For API 5L Gr.B T = Nominal Wall Thickness D = O.D of Pipe

##### b) Stainless Steel E.FS.W (2" to 6")

The hydrostatic test pressure in kg/cm<sup>2</sup> for the following materials shall be as given below :

Material Gr.1 :ASTM A312 TP 304 / 304H / 316 / 316H / 321 / 347 welded.

Material Gr.2 :ASTM A312 TP 304L / 316L welded.

Size	Pipe Schedule : 10S		Pipe Schedule : 40S		Pipe Schedule : 80S	
	Material Gr. 1	Material Gr.2	Material Gr.1	Material Gr.2	Material Gr.1	Material Gr.2
2"	100	80	155	130	230	190
3"	80	60	155	130	230	190
4"	80	50	155	130	230	190
6"	65	35	90	75	155	130

##### c) Stainless Steel E.FS.W (8" and above).

Material Std.	Test Pressure Std.
ASTM A358 TP 304L, 304, 304H, 316L, 316, 316H, 321, 347 (Classes 1, 3 & 4)	P = 2ST/D S = 85% of SMYS T = Nominal Wall Thickness D = O.D of Pipe
ASTM A358 TP 304L, 304, 304H, 316L, 316, 316H, 321, 347 (Classes 2 & 5)	P = 2ST/D S = 72% of SMYS T = Nominal Wall Thickness D = O.D of Pipe

#### 4.2.3 Carbon Steel Pipes to BIS Standards

Material Std.	Test Pressure Std.
IS 1239	IS 1239
IS 3589	IS 3589

#### 4.3 Hydrostatic pressure testing shall be performed using iron free water, which is clean and free of silt. Maximum chloride content in water for hydrostatic testing for SS piping shall be 50 ppm.

## 5.0 MARKING AND DESPATCH

5.1 All pipes shall be marked in accordance with the applicable codes, standards and specifications. In addition the purchase order number, the item code & special conditions like “IBR”, “CRYO”, “NACE”, “H2” etc. shall also be marked.

5.2 Pipes under “IBR”, “CRYO”, “NACE” & “H2” shall be painted with one circumferential stripe of colour red, light purple brown, canary yellow & white respectively for easy identification. Width of stripe shall be 12mm for pipe sizes less than 3” and 25mm for pipes 3” and above.

5.3 Paint or ink for marking shall not contain any harmful metal or metallic salts such as zinc, lead or copper which cause corrosive attack on heating.

5.4 Pipes shall be dry, clean and free from moisture, dirt and loose foreign materials of any kind.

5.5 Pipes shall be protected from rust & corrosion.

5.6 Rust preventive used on machined surfaces to be welded shall be easily removable with a petroleum solvent and the same shall not be harmful to welding.

5.7 Both ends of the pipe shall be protected with the following material:

Plain end	:	Plastic cap
Bevel end	:	Wood, Metal or plastic cover
Threaded end	:	Metal or plastic threaded cap

5.8 Pipes may be provided with plastic push-fit type end caps/ steel caps without belt wire.

5.9 Steel end protectors to be used on galvanized pipes shall be galvanized. Plastic caps can also be used as end protectors for galvanised pipe ends.

## 6.0 REFERENCES

6.1 6-81-0001: Specification for Positive Material Identification (PMI) at Supplier’s Works.

6.2 6-81-0002: Inspection & test plan for welded pipes.

6.3 6-81-0003: Inspection & test plan for seamless pipes.

6.4 6-79-0013: Material requirements for carbon steel components used in sour service for petroleum refinery environments

वाल्वों के लिए तकनीकी टिप्पणियाँ

## TECHNICAL NOTES FOR VALVES

7	13.07.17	REVISED AND ISSUED AS STANDARD SPECIFICATION	 PK	 SH	 MI	 RN
6	04.08.10	REVISED AND ISSUED AS STANDARD SPECIFICATION	RN	ATD	SC	DM ND
5	04.07.08	REVISED AND ISSUED AS STANDARD SPECIFICATION	RN	SC	DM	VC
4	15.11.00	REVISED AND ISSUED AS STANDARD SPECIFICATION	RN	BRB	NS	MI
3	04.04.94	ISSUED IN LINE WITH GENERAL REVISION	AKG	NS	GRR	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

**Abbreviations:**

AARH :	Arithmetic Average Roughness Height
ANSI :	American National Standards Institute
API :	American Petroleum Institute
ASME :	American Society of Mechanical Engineers
ASTM :	American Society for Testing & Materials
BGO :	Bevel Gear Operator
BHN :	Brinell Hardness Number
BIS :	Bureau of Indian Standards
BS :	British Standard
BVIS :	Bureau Veritas Industrial Services
BW :	Butt Weld
CAT :	Category
CEIL :	Certification Engineers International Limited
CS :	Carbon Steel
DFT :	Dry Film Thickness
DNV :	Det Norske Veritas
DP :	Dye-Penetrant
eDMS :	Electronic Document Management System
IBR :	Indian Boiler Regulations
IGC :	Inter Granular Corrosion
IS :	Indian Standard
LT :	Low Temperature
LTCS :	Low Temperature Carbon Steel
MOV :	Motor Operated Valve
MP :	Magnetic Particle
MR :	Material Requisition
NDT :	Non Destructive Testing
PMI :	Positive Material Identification
PO :	Purchase Order
PR :	Purchase Requisition
RFQ :	Request for Quotation
SCRD :	Screwed
SS :	Stainless Steel
SW :	Socket Weld

**Piping Standards Committee**

**Convenor :** Mr M. Ismaeel

**Members :** Mr. Amrendra Kumar  
Mr. G. Balaji  
Mr. Udayan Chakravarty  
Mr. K.J. Harinarayanan (S&ME)  
Mr. S. Ghoshal (Process-2)  
Mr. G.K. Iyer (Projects)  
Mr. Pankaj Kumar Rai (Construction)

CONTENTS

1.0	GENERAL .....	4
2.0	DOCUMENTATION.....	4
3.0	DESIGN AND CONSTRUCTION.....	5
4.0	OPERATION .....	9
5.0	INSPECTION AND TESTING .....	9
6.0	RADIOGRAPHY OF CAST VALVES.....	10
7.0	IBR CERTIFICATION.....	11
8.0	MARKING.....	11
9.0	DESPATCH.....	11
10.0	ATTACHMENTS .....	12
11.0	REFERENCES.....	12

## 1.0 GENERAL

1.1 Vendor shall supply valves in accordance with the valve specification sheets along with auxiliaries, if any, such as gear operator, bypasses, drains, locking arrangements etc. wherever specified in the specification sheets, subject notes and other enclosures to the material requisition (MR).

1.2 Vendor shall quote in strict accordance with the valve data / specification sheets, subject technical notes and all other enclosures to the MR. For 'Cat-I valves', no deviations whatsoever shall be accepted. Post Order Waiver/ Deviation format 5-0000-0180-F1 as mentioned in Cl. 5.17 of specification for Quality Management System Requirements from Bidder (6-78-0001) is not applicable for Cat-I valves. For Cat-II Valves, if exceptions/ deviations become absolutely must, the same shall be requested as explained in clause 2.3.6 giving reasons for seeking such exceptions/ deviations.

1.3 All codes and standards for manufacture, testing, inspection etc. shall be of latest editions as on issue date of RFQ.

## 2.0 DOCUMENTATION

2.1 All document submissions to EIL shall be through EIL eDMS.

2.2 For 'Cat-I' valves, no documents shall be submitted with the offer.

2.3 For 'Cat-II' valves, vendor shall submit the following documents with the offer:

2.3.1 Manufacturer's complete descriptive and illustrative catalogue / literature.

2.3.2 Detailed dimensioned cross section drawing with parts / material lists, weight etc.

2.3.3 Drawings for valves with accessories like gear operator, hydraulic / pneumatic operator, motor, extension bonnet, extended stems with stands, bypass etc. giving major salient dimensions.

2.3.4 One copy of the valve specification sheets signed as "Accepted" by the manufacturer. Deviations, if any shall be marked as applicable on the valve specification sheet.

2.3.5 If the valve is regretted or has no deviation, the manufacturer shall write clearly on valve specification sheets as "Regret" or "No Deviation".

2.3.6 For 'CAT-II' valves, if there is any deviation, the same shall be listed clausewise.

2.3.7 On failure to submit documents as specified in clauses 2.1.1 to 2.1.6 above, the offer is likely to be rejected.

2.4 The following documents shall be submitted through eDMS of EIL after placement of the order:

2.4.1 For Cat-I valves to manufacturers' standard specified in MR/valve specification sheet, detailed dimensioned cross section drawing with parts, materials, weight, etc. shall be submitted for records/information.

- 2.4.2 For 'Cat-II' valves, Vendor shall submit for review drawings mentioned in clauses 2.1.2 & 2.1.3 before start of manufacture. No other drawings shall be submitted for review.
- 2.4.3 Test report shall be supplied for all mandatory tests as per the applicable code. Test reports shall also be furnished for any supplementary tests as specified in clauses 3.13, 3.14 & 3.15.
- 2.4.4 Material test certificates (physical properties, chemical composition & heat treatment report) of the pressure containing parts shall be furnished for the valves supplied. Material test certificates for the other parts shall also be furnished for verification during inspection.
- 2.5 In addition to submissions through EIL eDMS, Catalogues/Drawings shall be in submitted in hard copies (6 sets) and soft copies (2 CDs/DVDs) along with delivery for Purchaser's record for all categories/types of valves.

### 3.0 DESIGN AND CONSTRUCTION

- 3.1 Valve shall be designed, manufactured, tested, inspected and marked as per the manufacturing standards, design codes and standards indicated in the respective valve specification sheets. Any conflict between the requisition, enclosures, specification sheets and referred standards/codes shall be brought to the notice of the purchaser for clarifications and resolution, before proceeding with the manufacture. The purchaser's decision shall be final and binding to the vendor. The drawings submitted for review shall not include any deviations except as communicated in writing in Deviation permits. The Drawings shall be reviewed only for design and construction features.
- 3.2 All flanged valves shall have flanges integral (except forged valves) with the valve body. Flange face finish shall be normally specified in the valve specification sheet as 125 AARH etc. The interpretation for range of face finish shall be as follows:

Stock Finish	:	1000 $\mu$ in AARH max.
125 AARH	:	Serrations with 125 to 250 $\mu$ in AARH
63 AARH	:	32 to 63 $\mu$ in AARH

- 3.3 For all weld end valves with bevel end as per ASME B16.25, the contour of bevel shall be as follows:

Material	Wall Thickness	Weld Contour
Carbon Steel (Except Low Temp. Carbon Steel)	Upto 22 mm	Figure 2 Type A
	> 22 mm	Figure 3 Type A
Alloy Steel, Stainless Steel & Low Temp. Carbon Steel	Upto 10 mm	Figure 4
	> 10 mm & Upto 25 mm	Figure 5 Type A
	> 25 mm	Figure 6 Type A

Valve ends shall match thickness of the connecting pipe. Sloping of inside contour of valves shall be done wherever necessary to achieve this.

3.4 For flanged valves with ring joint flanges the hardness shall be as follows:

Flange Material	Min. Hardness of Groove (BHN)
Carbon Steel	140
1% Cr to 5% Cr, 9% Cr	150
Type 304, 316, 321, 347	160
Type 304L, 316L	140

3.5 Following requirements for check valves shall be met over and above the valve specification sheet requirements:

3.5.1 Unless specified otherwise in the data sheet all check valves 3" & above (except in 900#, 1500# & 2500# rating) shall have a drain boss at location "G" (Refer Fig.No.1 of ASME B16.34) where pocket is formed in valve body. A tapped drain hole with plug shall be provided as per ASME B16.34. Threads shall be as per ASME B1.20.1 (Taper) NPT.

3.5.2 For heavy check valves, provisions shall be available for lifting by way of lugs, eye bolts and other such standard devices.

3.6 If an overlay weld-deposit is used for the body seat ring seating surface, the corrosion resistance of the seat ring base material shall be at least equal to the corrosion resistance of the material of the shell.

3.7 Following valve bypass requirements shall be met:

3.7.1 By-pass requirement for Gate valves shall be as follows unless otherwise mentioned.

ASME 150 Class	On sizes 26" and above
ASME 300 Class	On sizes 16" and above
ASME 600 Class	On sizes 6" and above
ASME 900 Class	On sizes 4" and above
ASME 1500 Class	On sizes 4" and above
ASME 2500 Class	On sizes 3" and above

3.7.2 The by-pass piping arrangement shall be such that clearance between main valve body and by-pass assembly shall be the minimum possible for layout reasons. Vendor shall follow the sketch enclosed in Specification No. 6-44-0052-A1.

3.7.3 By-pass valve shall be a globe valve. The sizes shall be as under:

On main valve $\leq$ 4"	:	1/2"
On main valve 6" to 8"	:	3/4"
On main valve 10" & above	:	1"

By-pass piping shall be of same metallurgy as main valve. The by-pass piping, fittings and valve tag numbers shall be as specified in Specification No. 6-44-0052-A2. In case details of by-pass arrangement for any Valve tag number is missing, Vendor shall bring the same to notice of EIL and provide by-pass as per details specified.

3.7.4 Vendor shall supply the by-pass valve duly tested and fitted to the main valve. Valves with by-pass shall have the direction of flow marked on the main valve. By-pass attachment to the

- main valve body shall not be screwed. All fillet welds for by-pass installation shall be 100% examined by DP/MP test and Butt-weld joints shall be 100% examined by radiography.
- 3.8** Valve body / bonnet shall be forged / cast as specified. Forgings are acceptable in place of casting but not vice-versa.
- 3.9** Stem shall be forged or machined from forged / rolled bar. No casting is permitted. However, integral stem of cast material is acceptable for Plug valves.
- 3.10** Stellite / hardfacing by deposition, shall be minimum 1.6 mm.
- 3.11** Renewable seat rings shall be seal welded for valves of size 3" and above to prevent loosening in service.
- 3.12** For Low Temperature & Cryogenic valve requirements, refer Specification.No.6-44-0052-A3 unless otherwise specified.
- 3.13** For Hydrogen service valve requirements, refer Specification.No.6-44-0052-A4 unless otherwise specified.
- 3.14** Valves under 'NACE' category shall meet the requirements specified in MR-0103 unless otherwise specified.
- 3.15** For all austenitic stainless steel valves Inter Granular Corrosion (IGC) test shall be conducted as per the following:
- 3.15.1 ASTM A262 Practice 'B' with acceptance criteria of '60 mils/year (max.)' for all materials - forged, rolled, wrought and casting.
- Or
- ASTM A262 Practice 'E' with acceptance criteria of 'No cracks as observed from 20X magnification' for all materials other than castings. 'Microscopic structure to be observed from 250X magnification' in addition.
- 3.15.2 When specifically asked for in MR for high temperature application of some grades of austenitic stainless steel (eg. SS309, 310, 316, 316H etc.) ASTM A262 Practice 'C' with acceptance criteria of '15 mils/year (max.)' shall be conducted.
- 3.15.3 For the IGC test as described in Clauses 3.15.1 & 3.15.2, two sets of samples shall be drawn from each solution annealing lot. One set shall correspond to the highest Carbon content and the other to the highest pressure rating. When testing is conducted as per practice 'E', photograph of the microscopic structure shall be submitted for record.
- 3.16** All types of 321 or 347 stainless steel valves shall be in a stabilised heat treated condition. Stabilising heat treatment shall be carried out subsequent to the normal solution annealing. Soaking temperature and holding time for stabilising heat treatment shall be 900°C and 4 hours respectively.
- 3.17** Spiral wound bonnet gaskets are to be provided with inner/outer ring except when encapsulated gaskets type body-bonnet joints are employed. Outer ring may be avoided in case of non-circular spiral wound gasket used in 150# valve provided the outermost layer of spiral touches the bolts ascertaining the centering.
- 3.18** All Stainless Steel Castings shall be solution heat treated.

**3.19** Only normalized and tempered material shall be used in the following specifications :

**Castings** : A217 Gr.WC1, A217 Gr.WC4, A217 Gr.WC5, A217 Gr.WC6, A217 Gr.WC9, A217 Gr.C5, A217 Gr.C12

**Forgings** : A182 Gr.F11 Cl.2, A182 Gr.F12 Cl.2

**3.20 Ball / Plug / Butterfly Valves**

3.20.1 As a prequalification, fire safe test as per API 607 / API 6FA / BS EN ISO 10497 (Supersedes BS 6755 Part II) shall be carried out on soft seated ball, plug & butterfly valves and also on lubricated plug valves. The test shall be witnessed and certified by a third party inspection agency like Lloyds, BVIS, DNV or EIL/ CEIL unless otherwise specified. The vendor has to submit test certificate for the particular design of the valve offered, if fire safe design is required as per the Valve Material Specification sheet..

3.20.2 Each valve shall be supplied with a lever / wrench except for gear operated / motor operated valves.

3.20.3 Soft-seated ball, plug & butterfly valves shall be supplied with antistatic devices.

3.20.4 BW / SW end ball valves shall have a 100 mm long seamless pipe nipple welded to each end of the valve. Nipples are to be welded prior to assembling Teflon seats / seals. Specifications of the nipples shall be as indicated in the MR.

3.20.5 The face-to-face dimensions of all ball valves shall be same as those of gate valves of the corresponding ANSI class (except 10" onwards in Class 150 where the face-to-face dimensions shall be as per API 6D long pattern).

3.20.6 The ball of ball valve shall not protrude outside the end flanges of valve.

3.20.7 Ball valves shall be of floating ball/trunnion mounted type as per following:

150#	8" & below	Floating ball
	10" & above	Trunnion mounted
300#	4" & below	Floating ball
	6" & above	Trunnion mounted
600# & above	1.5" & below	Floating ball
	2" & above	Trunnion mounted

3.20.8 Unless otherwise specified in the data sheets, bore of all reduced bore ball valves shall be limited to one size lower than the nominal bore.

**3.21** The MOVs are to be installed in an open area and the actuators shall be suitable for all weather conditions. The testing of complete assemblies of MOVs along with the actuators shall be done by the supplier at his works.

**3.22** Ends of flanged valves of 22" size shall match corresponding flanges to MSS-SP44 unless otherwise specified.

**3.23** Yoke material shall be same as bonnet material where maximum temperature specified is more than 427°C.

#### 4.0 OPERATION

4.1 Gear operation shall be provided as under:

Valve Type	Class	Size Requiring Gear-Operator
Gate Valve, Globe Valve & Diaphragm Valve	150 Class	12" and larger
	300 Class	12" and larger
	600 Class	10" and larger
	900 Class	6" and larger
	1500 Class	3" and larger
	2500 Class	3" and larger
Ball Valve / Plug Valve (Other than pressure balance plug valves)	150 Class	6" and larger
	300 Class	6" and larger
	600 Class	4" and larger
	900 Class	3" and larger
	1500 Class	3" and larger
Butterfly Valve	150, 300 Class	6" and larger

For sizes lower than these ranges, hand wheel / lever / wrench shall be provided. For pressure balance plug valves manufacturer's recommendation shall be acceptable provided the requirements specified in clause 4.6 are met.

4.2 Gear operator shall be provided, with position indicators for open / close positions and with limit stops. (Limit stops are not applicable for gate and globe valves).

4.3 Where gear operator is not called for as per Clause 4.1 but vendor recommends a gear operator, the same shall be highlighted.

4.4 Gear operator shall be so designed as to operate effectively with the differential pressure across the closed valve equal to the cold non-shock pressure rating.

4.5 Ball, plug and butterfly valves, shall have "Open" position indicators with limit stops.

4.6 Hand wheel diameter shall not exceed 750mm and lever length shall not exceed 500mm on either side. Effort to operate shall not exceed 35 Kg at handwheel periphery. However, failing to meet the above requirements, vendor shall offer gear operated valve and quote as per clause 4.3.

#### 5.0 INSPECTION AND TESTING

5.1 Every valve shall be subjected to all the mandatory tests and checks called in the respective codes / data sheet by EIL inspection or any third party as approved by the purchaser. For IBR valves refer clause 7.0.

5.2 Every valve, its components and auxiliaries must be subjected to all the mandatory tests and checks called for in the respective codes, data sheets etc. by the manufacturer.

5.3 Though the extent of inspection shall be as under, exact extent with hold points shall be decided by EIL regional inspection office and recorded in the form of inspection plan. In case of third party inspection, the inspection plan shall be approved by the purchaser.

Forged Valves:

1. Visual and dimensional inspection.
2. Review of material test certificates.
3. Any mandatory or supplementary test.
4. Hydrostatic test on 10% valves selected on random basis.
5. Strip check is required for 1% of total ordered quantity of Gate & Globe valves (min. 1 No.) for each Valve sheet no., however, strip check is not required for CS/ Brass/ Bronze material valves with 13% Cr/ Brass/ Bronze trims.

Cast Steel Valves:

1. Visual and dimensional inspection.
2. Review of material test certificates.
3. Review of radiographs/radiographic reports or any other NDT tests wherever applicable as per data sheet.
4. Any mandatory or supplementary test.
5. Hydrostatic test 100% for body, 10% other test.
6. Strip check is required for 1% of total ordered quantity of Gate & Globe valves (min. 1 No.) for each Valve sheet no., however, strip check is not required for CS/ Brass/ Bronze material valves with 13% Cr/ Brass/ Bronze trims.

Samples for strip check shall be selected at random and shall generally be in the highest size in the lot.

- 5.4 In case of motor operated or actuator operated valves, functional / operational checks as per the requirements of the specifications shall be made on each valve.

**6.0 RADIOGRAPHY OF CAST VALVES**

- 6.1 Valve castings shall undergo radiographic examination as specified below.

Material	Rating	Size Range	Radiography
All	150#	24" and below	NIL**
		26" and above*	100%
	300#	16" and below	NIL**
		18" and above	100%
	600# & above	All sizes	100%

\* No radiography is required for valves of size 26" and above in cooling water service.

\*\*For sizes 24" & below in 150# and 16" & below in 300#, radiography percentage if specifically mentioned in individual valve material spec sheet shall govern.

Radiography specified as random 10% or 20% etc. in the respective valve data sheet implies 10% or 20% etc. of number of valves ordered against each item number with a minimum of one valve against each item.

- 6.2 Radiography procedure, areas of casting to be radiographed shall be as per ASME B16.34 and acceptance criteria shall be as per ASME B16.34 Annexure-B. However for areas of casting to be radiographed for types of valves not covered in ASME B16.34, vendor shall radiograph castings in line with ASME B16.34.
- 6.3 For random radiography wherever specified in individual data sheets, the sampling shall be per size of the quantity ordered for each foundry.
- 6.4 Radiography wherever specified in the data sheets or as per clause 6.1 shall be done by X-ray /  $\gamma$ -ray to get the required sensitivity.

## 7.0 IBR CERTIFICATION

- 7.1 For valves described "IBR", valves shall be in accordance with the latest IBR (Indian Boiler Regulation) including the requirements specified in the specification.
- 7.2 For SW / BW end carbon steel valves under IBR, the chemical composition shall conform to the following:

Carbon (Max)	:	0.25%
Others (S, P, Mn)	:	As per IBR

- 7.3 Valves coming under the purview of "IBR"(Indian Boiler Regulations) shall each be individually accompanied by IBR certificate original in Form III-C duly approved by IBR authority / local authority empowered by the Central Boiler Board of India. Photocopy of original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance.
- 7.4 All "IBR" valves shall be painted red in body-bonnet / body-cover joint.

## 8.0 MARKING

- 8.1 Valve markings, symbols, abbreviations etc. shall be in accordance with MSS-SP-25 or the standard referred in specification sheet as applicable. Vendor's name, valve rating, material designation, nominal size, direction of flow (if any) etc. shall be integral on the body.
- 8.2 Each valve shall have a corrosion resistant tag giving size, valve tag / code no., securely attached to the valve body.
- 8.3 Paint or ink for marking shall not contain any harmful metal or metal salts such as zinc, lead or copper which cause corrosive attack on heating.
- 8.4 Carbon Steel / Alloy Steel valves shall be painted with one coat of inorganic zinc silicate (minimum DFT 65 to 75 microns).

## 9.0 DESPATCH

- 9.1 Valve shall be dry, clean and free from moisture, dirt and loose foreign materials of any kind.
- 9.2 Valves shall be protected from rust, corrosion and any mechanical damage during transportation, shipment and storage.

9.3 Rust preventive on machined surfaces to be welded shall be easily removable with a petroleum solvent or shall not be harmful to welding.

9.4 Each end of valve shall be protected with the following materials:

Flange Face	:	Wood or Plastic Cover
Bevelled End	:	Wood or Plastic Cover
SW & SCR.D. End	:	Plastic Cap

9.5 End protectors of wood / plastic to be used on flange faces shall be attached by at least three bolts and shall not be smaller than the outside diameter of the flange. However, plastic caps for SW & SCR.D end valves shall be press fit type.

9.6 End protectors to be used on bevelled end shall be securely and tightly attached.

9.7 For special service valves additional requirement for despatch shall be as prescribed in data sheet.

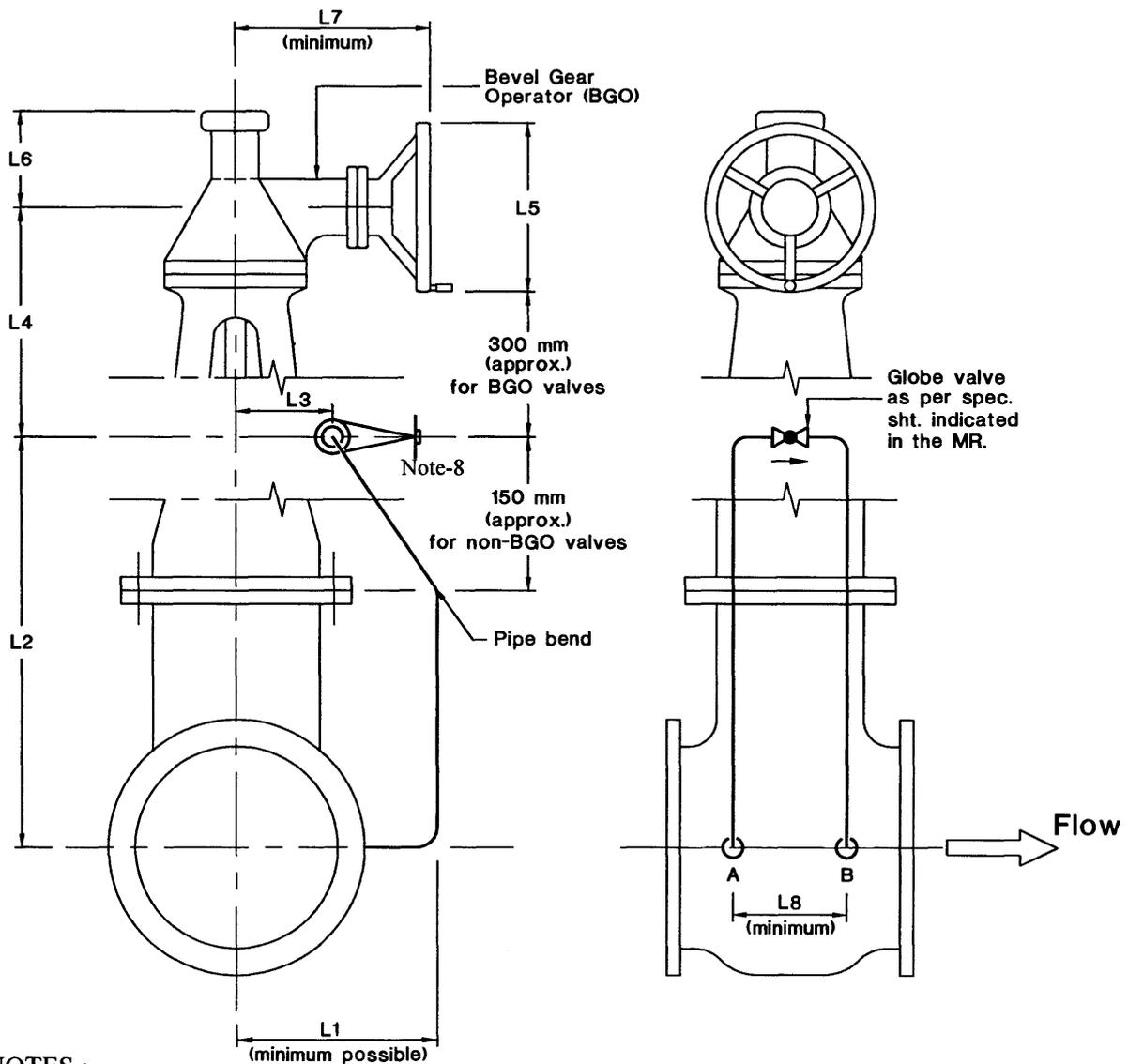
#### 10.0 ATTACHMENTS

6-44-0052-A1	:	Bypass Piping Arrangement
6-44-0052-A2	:	Specifications for Bypass Piping, Fittings and Valves
6-44-0052-A3	:	Special Requirements for Low Temperature and Cryogenic Valves
6-44-0052-A4	:	Special Requirements for Hydrogen Service Valves

#### 11.0 REFERENCES

6-78-0001	:	Specification for Quality management system requirements from bidders
6-78-0003	:	Specification for documentation requirements from suppliers
6-81-0001	:	Specification for Positive Material Identification (PMI) at Supplier's Works
6-81-0004	:	Inspection and Test plan for Valves

BYPASS PIPING ARRANGEMENT



NOTES :

1. The orientation & location of handwheel of bevel gear operator & the bypass arrangement shall be strictly as per this sketch.
2. The bypass connection ends shall be socket welded upto 600# and butt welded for 900# and above rating.
3. The bypass arrangement shall be properly clamped to & supported by the body of the main valve.
4. Basic design of bypass shall be to MSS-SP-45.
5. Material of bypass pipe & 90° elbows shall be same or equivalent to the body material as indicated in Specification No. 6-44-0052-A2.
6. This sketch is applicable for both BGO & NON-BGO Valves.
7. Vendor shall furnish dimensions L1 to L8.
8. Stem shall not be horizontal in the case of CRYO Valves

**SPECIFICATIONS FOR BYPASS PIPING, FITTINGS AND VALVES**

Class (Main Valve Sht.no.)	Pipe	Fittings	Bypass Valve Sht.no.
A1A(51301), A3A(51321), A9A(51301), A10A(51301), A11A(51301), A33A(51301), B1A(51401), B9A(51401), D1A(51501), D9A (51501)	ASTM A106 Gr.B (SMLS) 0.5"-0.75": S160 1.0"-1.5" : XS	ASTM A105 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52001
A6A(51301), B6A(51401)	ASTM A106 Gr.B (SMLS) 0.5"-0.5" : XXS 0.75"-1.5" : S160	ASTM A105 0.5"-0.5" : SW 9000# 0.75"-1.5" : SW 6000#	52001
A13A(51301), B13A(51401)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : XXS	ASTM A105 0.5"-1.5" : SW 9000#	52001
A2A(51302), B2A(51402), D2A (51502)	ASTM A106 Gr.B (SMLS)- IBR 0.5"-0.75": S160 1.0"-1.5" : XS	ASTM A105 - IBR 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52002
A4A (51303), B4A (51403), D4A (51503)	ASTM A333 Gr.6 (SMLS)- LT 0.5"-0.75": S160 1.0"-1.5" : XS	ASTM A350Gr.LF2- LT 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52003
A5A (51304), B5A (51404), D5A (51504)	ASTM A106 Gr.B (SMLS) -H2 0.5"-0.75": S160 1.0"-1.5": XS	ASTM A105 - H2 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52004
A7A (51307)	ASTM A106 Gr.B (SMLS) 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A105 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52007
A16A (51311), B16A (51411), D16A (51511)	ASTM A106 Gr.B (SMLS) - NACE 0.5"-0.5" : XXS 0.75"-1.5": S160	ASTM A105 - NACE 0.5"-0.5" : SW 9000# 0.75"-1.5": SW 6000#	52011
A19A (51313), B19A (51413), D19A (51513)	ASTM A106 Gr.B (SMLS) 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A105 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52013
E1A (51601), F1A (51701)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : S160	ASTM A234 Gr.WPB/ ASTM A105 0.5"-1.5" : BW, S160	52101
E2A (51602), F2A (51702)	ASTM A106 Gr.B (SMLS) - IBR 0.5"-1.5" : S160	ASTM A234 Gr.WPB/ ASTM A105 - IBR 0.5"-1.5" : BW, S160	52102
E5A (51604), F5A (51704)	ASTM A106 Gr.B (SMLS) - H2 0.5"-1.5" : S160	ASTM A234 Gr.WPB/ ASTM A105 - H2 0.5"-1.5" : BW, S160	52104
E9A (51605), F9A (51705)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : SCH XXS	ASTM A234 Gr.WPB/ ASTM A105 0.5"-1.5" : BW, SCH XXS	52105
E19A (51613), F19A (51713)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : SCH XXS	ASTM A234 Gr.WPB/ ASTM A105 0.5"-1.5" : BW, SCH XXS	52113

Class (Main Valve Sht.no.)	Pipe	Fittings	Bypass Valve Sht.no.
A5Y (51384), A33Y (51384)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : S160	ASTM A105 0.5"-1.5" : SW 6000#	52085
A1D (51330), B1D (51430), D1D (51530)	ASTM A335Gr.P11(SMLS) 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F11Cl.2 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52030
D2D (51531)	ASTM A335Gr.P11 (SMLS) - IBR 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F11Cl.2 - IBR 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52031
B5D (51432), D5D (51532)	ASTM 335Gr.P11(SMLS)- H2 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F11Cl.2 - H2 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52032
B1E (51433)	ASTM A335Gr.P22(SMLS) 0.5"- 0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F22Cl.3 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52033
D5E (51534)	ASTM A335Gr.P22(SMLS) - H2 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F22Cl.3 - H2 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52034
A4F (51336), B4F (51436)	ASTM A335 Gr.P5(SMLS) 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F5 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52036
B3F (51436)	ASTM A335 Gr.P5(SMLS) 0.5"-1.5" : XXS	ASTM A182 Gr.F5 0.5"-1.5" : SW 9000#	52036
A4G (51339), B4G (51439)	ASTM A335 Gr.P9(SMLS) 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F9 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52039
F2D (51731)	ASTM A335 Gr.P11 (SMLS) - IBR 0.5"-1.5" : S160	ASTM A234Gr.WP11Cl.1/ A182 Gr.F11Cl.2 - IBR 0.5"-1.5" : BW, S160	52131
E5E (51634)	ASTM A335 Gr.P22(SMLS) - H2 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A234Gr.WP22Cl.1/ A182 Gr.F22Cl.3 - H2 0.5"-0.75" : BW, S160 1.0"-1.5" : BW, XS	52134
A1K (51345), A3K (51345), B1K (51445), D1K (51545)	ASTM A312 TP304(SMLS) 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F304 0.5"-1.5" : SW 3000#	52045
A2K (51346), B2K (51446), D2K (51546)	ASTM A312 TP304(SMLS) - CRYO 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F304 - CRYO 0.5"-1.5" : SW 3000#	52046
B4K (51448), B5K (51448)	ASTM A312 TP304H (SMLS) 0.5"-1.5" : 80S	ASTM A182 Gr.F304H 0.5"-1.5" : SW 3000#	52048

Class (Main Valve Sht.no.)	Pipe	Fittings	Bypass Valve Sht.no.
A6K (51350), B6K (51450)	ASTM A312 TP304L (SMLS) 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F304L 0.5"-1.5" : SW 3000#	52050
A1M (51361), B1M (51461)	ASTM A312 TP316(SMLS) 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F316 0.5"-1.5" : SW 3000#	52061
B5M (51462)	ASTM A312 TP316H (SMLS) - H2 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F316H - H2 0.5"-1.5" : SW 3000#	52062
B3M (51463)	ASTM A312 TP321(SMLS) 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F321 0.5"-1.5" : SW 3000#	52063
A1N (51366), B1N (51466)	ASTM A312 TP 316L (SMLS) 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F316L 0.5"-1.5" : SW 3000#	52066
B6N (51471)	ASTM A312 TP316L (SMLS) 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F316L 0.5"0.5"-1.5" : SW 3000#	52071

## SPECIAL REQUIREMENTS FOR LOW TEMPERATURE & CRYOGENIC VALVES

### 1.0 SCOPE

All valves of Low Temperature Carbon Steel (LTCS) and all grades of austenitic SS (CRYO) material are categorized as cryogenic valves. All these valves shall have extended bonnet as per BS 6364 except check valves.

Following qualification criteria shall be met by the valve vendors to quote valves for cryogenic services:

### 2.0 QUALIFICATION CRITERIA

- i) Both cryogenic test (clause 2.1) and reference list (clause 2.2) together shall be considered for vendor qualification and vendor shall furnish the same, along with his offer.
- ii) Vendors who do not have cryogenic test reports and reference list covering valves of all sizes, materials and ratings required by MR, should confirm / furnish the following for consideration of their offer:
  - a. Evidence of having conducted successfully at least one cryogenic test as per BS 6364. Test certificate shall be furnished with the offer.
  - b. Vendor shall confirm to conduct cryogenic test per clauses 2.1 & 2.3 for the remaining valves not later than 12 weeks from the date of purchase order.
  - c. Vendor shall also furnish reference list for valves supplied for non-cryo service if reference list referred in 2.2.1 does not cover all the sizes of MR.

Offers of vendors who do not comply with above requirements would be rejected.

### 2.1 Cryogenic Test

Vendors to furnish copies of cryogenic test certificate for tests conducted as per details given below:

- 2.1.1 Test shall be as per BS 6364.
- 2.1.2 Test temperature, unless specifically called for otherwise in the individual MR, shall be -45°C for LTCS and -196°C for all grades of austenitic stainless steel.
- 2.1.3. Tests carried out on a particular size of one type of valve, pressure rating and material shall qualify all sizes equal to and below the test valve size for the same type, pressure rating and material. In case of austenitic SS any one grade would qualify for all other grades of austenitic SS.
- 2.1.4. Tests should have been witnessed and certified by any one of the following third party inspection agencies; M/s Lloyd, BV, DNV, TUV or EIL/ CEIL.
- 2.1.5. Cryogenic test need not be conducted for every order. Test conducted previously and witnessed by inspection agencies listed above shall be considered acceptable and need not be repeated.

## 2.2 Reference List

Vendor shall furnish reference list for valves supplied for cryogenic service indicating the name of client, year of supply, size, material, pressure rating, type of valve and quantity.

## 2.3 Post Order Testing Procedure

2.3.1. Before conducting post order testing, vendor shall submit the following for approval:

- a. Test procedure (as per BS 6364).
- b. Cross-section drawing of the valve with material of construction.
- c. Schematic of test rig (as per BS 6364) with complete details.

2.3.2. Test has to be conducted irrespective of the service on largest size for each type of valve and for each material and class rating. Vendor shall offer one, two or three valves for selection of test valve by inspector depending upon whether quantity of largest valve in the order is one, two or three and more than three respectively.

In the event of failure of the test valve to meet the specification requirements, the vendor shall conduct test on two more valves. These two valves which pass test successfully, are of lower size, then the qualification will be valid only to sizes upto which test has been conducted successfully.

2.3.3. In case of non-conductance of cryogenic test(s) within 12 weeks or failure in the test(s) conducted after receipt of order, the owner reserves the right to invoke any of the provisions of the purchase order including cancellation of the purchase order at the risk and cost of vendor.

3.0 Bonnet extension, wherever specified in the valve sheet to BS 6364 shall be for “non cold box application” unless otherwise specified in the MR. Even if not called for in valve sheet, valves indicated as “LT” or “CRYO” shall be supplied with bonnet extension.

4.0 Bonnet and Gland extension joints shall be of butt welded/integrally cast construction.

5.0 Repair welding procedure for austenitic stainless steel valves in “CRYO” service shall have to be qualified for impact test as per ASME B31.3. Minimum acceptable impact energy shall be 20 J or lateral expansion of 0.38 mm at temperature of -196°C.

6.0 Wherever impact test of SS studs / nuts is called for in the data sheet, the impact value shall be 27 J at the intended service temperature specified in the data sheets.

## SPECIAL REQUIREMENTS FOR HYDROGEN SERVICE

### 1.0 GENERAL

- 1.1 These requirements are applicable for valves used in Hydrogen service. These are in addition to the requirements described in "Technical Notes for Valves" Spec. No. 6-44-0052, and shall be read in conjunction with this specification.
- 1.2 All cast valve flanges & bodies with flange rating of Class 900 or greater shall be examined in accordance with paragraphs 7.2 through 7.5 of Appendix-VII of ASME SEC-VIII, DIV.1, regardless of casting quality factor.
- 1.3 Body / bonnet / cover joints & stuffing box of all valves shall have low emission. One valve per metallurgy, per rating, per size shall be helium leak tested as per ASME Sec.V, Subsection A, Article 10 (Detector Probe Technique), Appendix IV at a minimum of 25% of the allowable (rated) cold working pressure. Selection of valves for helium leak test shall be at random. Test duration shall be as follows:

Test Duration in Minutes					
Nominal Size	Pressure Class				
	Upto 300	600	800 & 900	1500	2500
Upto 2"	3	6	9	12	12
3" to 6"	6	9	12	15	18
8" to 16"	9	9	12	15	18
18" to 24"	9	12	15	18	21

The valve shall show no leakage. No leakage is defined as a total leakage rate of less than 0.0001 ml/s of helium.

- 2.0 Only normalized and tempered material shall be used in the following specifications:

**Castings** : A217 Gr.WC1, A217 Gr.WC4, A217 Gr.WC5, A217 Gr.WC6, A217 Gr.WC9, A217 Gr.C5, A217 Gr.C12

**Forgings** : A182 Gr.F11 Cl.2

### 3.0 CS & AS VALVES

- 3.1 Bend test and Magnetic Particle inspection of the entire surface of body and bonnet casting shall be in accordance with ASTM A217. Supplementary requirement S3 & S4 evaluation of magnetic particle, inspection shall be in accordance with MSS-SP-53 except that no linear discontinuities shall be allowed.
- 3.2 The Brinell hardness of heat treated casting shall not exceed 200 BHN for carbon steel & 225 for alloy steel.
- 3.3 Repair to defective casting shall be outlined in writing to the purchaser before repair starts. Repair method to be approved prior to welding.
- 3.4 Casting shall be preheated to a minimum of 400°F prior to welding and all Chromium-Molybdenum alloys shall be postweld heat treated after welding is complete. Stress relieving is essential for welds.

- 3.5 Carbon steel shall be normalised and alloy steels shall be normalised & tempered.
- 3.6 Dye Penetrant test of welds shall be in accordance with ASTM B165 Procedure B-2. Interpretation as per Appendix-8 of ASME-VIII Div.1.
- 3.7 The tensile stress for AS shall be less than 100,000 psi.
- 3.8 Charpy V-notch impact testing is to be done for valve material (average 20 ft-lb for set of 3 [minimum value 15 ft-lb] at 30°F).
- 3.9 For radiography and acceptance criteria for valve castings, refer Cl. 4.2.
- 4.0 **SS VALVES**
- 4.1 Valve casting shall be in solution heat treated and pickled condition.
- 4.2 Critical body and bonnet casing section typically defined by ASME B16.34 shall be radiographed and shall meet ASTM E446 (upto 2" thick) Category A, B & CA Level 2, Category CB, OC & CD Level 3, Category D, B & F Level 0. For wall thickness 2" to 4.5" comparable plates of ASTM E186 shall be used. ASTM E94 and ASTM E142 shall be used for recommended practice & controlling quality of radiography as guide. The entire surface of all castings shall be dye-penetrant inspected after pickling.
- 4.3 Welds shall be 100% radiographed and evaluated in accordance with paragraph 344.5 of ASME B31.3 with a minimum casting quality factor of 0.95. Dye Penetration test shall be as per ASTM E165 Procedure B-2, Interpretation as per Appendix-8 of ASME-VIII Div.1.

वाष्प एवम् वायु ट्रैप्स हेतु  
मानक विनिर्देश

TECHNICAL NOTES FOR  
STEAM AND AIR TRAPS

2	23/09/14	REVISED AND ISSUED AS STANDARD SPECIFICATION	SH	AK	RN	ATD	SC
1	30/06/09	REVISED & ISSUED AS STANDARD SPECIFICATION	PK	RN	SC	ND	
0	22/04/04	ISSUED AS STANDARD SPECIFICATION	AK	BRB	MRC	SKG	
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman	Approved by

### Abbreviations:

AARH :	Arithmetic Average Roughness Height
AISI :	American Iron and Steel Institute
ASME :	American Society of Mechanical Engineers
ASTM :	American Society for Testing and Materials
BHN :	Brinell Hardness Number
BW :	Butt Weld
DP :	Dye Penetrant
IBR :	Indian Boiler Regulations
MOC :	Material of Construction
MP :	Magnetic Particle
PMI :	Positive Material Identification
Rc :	Rockwell C Hardness
SCRD :	Screwed
SS :	Stainless Steel
SW :	Socket Weld
WN :	Weld Neck
eDMS :	Electronic Document Management System

### Piping Standards Committee

**Convenor :** Mr. R. Nanda

**Members :** Mr. M. Ismaeel  
Mr. Amrendra Kumar  
Mr. G. Balaji  
Mr. K.J. Harinarayanan (HMTD)  
Mr. P P Lahiri / Mr. S. Ghoshal (SMMS)  
Mr. S. Mukherjee (Construction)  
Mr. K.V.K. Naidu (Projects)

CONTENTS

Sr.No	Description	Page No.
1.0	PURPOSE & SCOPE	4
2.0	DESIGN AND CONSTRUCTION	4
3.0	IBR REQUIREMENTS	5
4.0	ACCEPTABLE DEVIATIONS	6
5.0	DOCUMENTATION	6
6.0	TEST AND INSPECTION	6
7.0	MARKING AND DESPATCH	7
8.0	ATTACHMENTS FOR MR	7
9.0	REFERENCES	7

## 1.0 PURPOSE & SCOPE

This specification covers the design and construction, IBR requirements, documentation, testing, inspection, marking and dispatch requirements for Traps. Vendor shall supply Traps in accordance with the technical notes and details specified in the data sheet for steam/air traps. Supplier shall strictly comply with MR/PR stipulations and no deviations shall be permitted. Post order Concession/ Deviation format 5-0000-0180-F1 as mentioned in Cl. 5.18 of Specification for Quality Management System Requirements from Bidders (6-78-0001) is not applicable.

## 2.0 DESIGN AND CONSTRUCTION

2.1 All Codes and Standards for manufacture, testing and inspection etc. shall be of latest editions.

2.2 The material of construction shall be as per the data sheet; for parts not mentioned in the datasheet, vendor shall guarantee the material used for the service conditions specified. For flanged traps, MOC of end flanges shall correspond to the material specified in the data sheet.

For welding of dissimilar materials required for trap assembly, welder qualification procedure shall be done prior to welding.

2.3 The material composition, physical properties, heat treatment & mandatory test reports, dimensions and tolerances shall conform to the applicable codes/standards/specifications as specified in the requisition.

2.4 All traps shall be designed with back pressure up to 80% of upstream pressure unless otherwise specified in the datasheet.

2.5 All traps shall have an integral strainer which can be serviced and its material shall be SS304/SS316. However, Ball Float and Inverted Bucket traps may be supplied with separate strainer of trap or line size, but vendor should quote composite price for the same. Trap and strainer shall be supplied in assembled condition having strainer in the upstream. This strainer shall be of Y-type having 40mesh size and material of construction for body and internals shall be same as that of trap.

2.6 Thermodynamic traps shall have seat integral or seal-welded to the body & central entry with respect to the disc. The seat and disc shall be differentially hardened to Rc 45-50 and Rc 40-45 respectively maintaining a minimum difference of Rc 5 to ensure wear on the disc.

2.7 Thermostatic traps shall be designed with subcool temperature setting as per data sheet. If nothing is specified in data sheet, subcooling of 10 Deg C should be considered by default.

2.8 Upto 300 Class rating, Composite Impulse cum Thermodynamic type steam trap with two integral strainers in place of Thermodynamic and Thermostatic trap is also acceptable.

2.9 Inverted bucket steam trap shall be of horizontal entry & exit type.

2.10 For flanged end traps, weld-on flanges are also acceptable. However, the type of flange shall be WN.

2.11 Ends shall be as specified in the data sheet. The applicable dimension standards are:

Flanged ends	:	ASME B16.5
SW ends	:	ASME B16.11
SCRD ends	:	ASME B16.11
BW ends	:	ASME B16.25

2.12 Bevel end details for BW steam traps shall be as per ASME B16.25. Contour of bevel end shall be as follows :

Material	Wall Thickness	Weld Contour
Carbon Steel (Except Low Temp. Carbon Steel)	Upto 22 mm	Figure 2 Type A
	> 22 mm	Figure 3 Type A
Alloy Steel, Stainless Steel & Low Temp. Carbon Steel	Upto 10 mm	Figure 4
	> 10 mm & Upto 25 mm	Figure 5 Type A
	> 25 mm	Figure 6 Type A

2.13 Flanged end face finish shall be normally specified in the data sheet. The interpretation for range of face finish shall be as follows:

Stock Finish	:	1000 $\mu$ in AARH max.
Serrated/Smooth Finish/125 AARH	:	Serrations with 125 to 250 $\mu$ in AARH
Extra Smooth/63 AARH	:	32 TO 63 $\mu$ in AARH

2.14 For traps with ring joint type flanged ends the hardness shall be as follows :

Flange Material	Min. Hardness of Flange Groove (BHN)	Max. Gasket Hardness (BHN)
Carbon Steel	140	90
1% Cr to 5% Cr, 9Cr	150	130
Type 304, 316, 321, 347	160	140
Type 304L, 316L	140	120

2.15 For traps with flanged ring type joint ends, the hardness shall be recorded in the test report.

## 3.0 IBR REQUIREMENTS

### 3.1 IBR Documentation

3.1.1 Traps coming under the purview of IBR (Indian Boiler Regulations) shall be accompanied with IBR Certificate original in Form III C duly approved and countersigned by IBR authority / local authority empowered by Central Boiler Board of India. Photocopy of original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance.

3.2 For carbon steel traps described as "IBR", chemical composition for all carbon steel components shall conform to the following :

Carbon (max.) : 0.25% (C=0.30% for A182 Gr. F1)  
Others (S, P, Mn) : As prescribed in IBR Regulation

#### 4.0 ACCEPTABLE DEVIATIONS

4.1 Following alternative body materials are acceptable :

- AISI 420/AISI 410/A743 Gr.CA40/A743 Gr.CA15 in lieu of ASTM A105.
- A182 F22 in lieu of A182 F11.
- AISI 420/A182 F11 in lieu of A182 F1.

4.2 Cast traps including strainer with integrally cast flanges are also acceptable in lieu of equivalent forged material. All castings offered in place of forgings shall be radiographed.

4.3 Forgings of equivalent material shall be acceptable in place of castings.

4.4 For traps where capacity has been specified in the datasheet, and if the trap meets the capacity requirement, in these cases trap of same type but of lower size is also acceptable. End connection size and type shall be same as that specified in datasheet.

4.5 Bimetallic traps of same capacity are acceptable in place of Balanced Pressure Thermostatic traps but not vice versa. Suitability of trap for design conditions shall be ensured.

#### 5.0 DOCUMENTATION

5.1 No documents shall be submitted with the offer.

5.2 Detailed dimensioned cross section drawing with parts, materials, weight, etc. shall be submitted through EIL eDMS for records/information.

#### 6.0 TESTS AND INSPECTION

6.1 IBR steam traps shall be hydrostatically tested as per IBR regulations (latest edition). Other steam traps shall be hydrostatically tested to twice the design pressure for which the traps are suitable. For air traps test pressure shall be 1.5 times the design pressure.

6.2 Radiography of BW joints shall be as follows :

- a. For carbon steel and stainless steel upto 600 Class rating, 10% of joints shall be radiographed, with a minimum of 1 number against each type, size, rating and material. Joints for weld-on flanges shall be 100% radiographed.
- b. For all ratings in alloy steel and 900 Class ratings and above in carbon steel/stainless steel, BW joints shall be 100% radiographed.

6.3 Positive Material Identification (PMI) shall be performed as per the scope and procedures as defined in the 'Standard Specification for Positive Material Identification (PMI) at Supplier's Works' (No. 6-81-0001).

6.4 Test reports shall be supplied for all mandatory tests as per the relevant material specifications/requisition. Test reports shall also be furnished for hydrotest and any other supplementary tests as specified in the requisition.

6.5 Material test certificates (physical properties, chemical composition & heat treatment report) of the pressure containing parts shall be furnished for the steam traps supplied. Material test certificates for the other parts shall also be furnished for verification during inspection.

6.6 EIL/Client's authorised representatives reserve full right to witness stagewise inspection of all mandatory/applicable supplementary tests. However, for IBR items, the tests/inspection shall be by IBR authority or IBR authorized representative.

6.7 Refer Specification 6-81-0134 for Inspection & Test Plan for Steam Traps.

## 7.0 MARKING AND DESPATCH

7.1 Vendor shall securely attach on the body a metal tag stamped with item code, Tag no. (If mentioned in requisition), size, rating and special conditions like 'IBR'. Wherever nameplate is provided, marking can be done on the same.

7.2 Paint or ink for marking shall not contain any harmful metal or metallic salts such as zinc, lead or copper which cause corrosive attack on heating. IBR traps shall be painted with red stripes (25mm width).

7.3 All traps shall be dry, clean and free from moisture, dirt and loose foreign material of any kind.

7.4 All items shall be protected from rust, corrosion and mechanical damage during transportation, shipment and storage.

7.5 Rust preventive on machined surfaces to be welded shall be easily removable with a petroleum solvent and shall not be harmful to welding.

7.6 Each end of trap shall be protected with the following materials :

Flange Face	:	Wood or Plastic Cover
Bevelled End	:	Wood or Plastic Cover
SW & SCRD End	:	Plastic Cap

7.7 End protectors of wood / plastic to be used on flange faces shall be attached by at least three bolts and shall not be smaller than the outside diameter of the flange. However plastic caps for SW & SCRD end steam traps shall be press fit type. End protectors to be used on bevelled end shall be securely and tightly attached.

## 8.0 ATTACHMENTS FOR MR

Format No 3-16-43-0094	:	Data Sheet for Steam Traps
-	:	Job Specific Process data sheet for Process steam trap/Air trap (as applicable)

## 9.0 REFERENCES

6-81-0001	:	Specification for PMI at Supplier's Works
6-81-0134	:	Inspection and Test Plan for Steam Traps
6-78-0001	:	Specification for Quality Management System Requirements from Bidders

सामान्य सेवा हेतु स्टीम टर्बाइन  
के लिये  
निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN  
FOR STEAM TURBINE (GENERAL PURPOSE)

Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
3	09.09.13	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	10.04.12	REVISED AND RE-ISSUED	SK	SCG	AKC	DM
1	21.01.08	REVISED AND RE-ISSUED	CS	SS	MVKK	VC
0	06.08.02	ISSUED FOR IMPLEMENTATION	VKJ	TVD	AKB	SB

**Abbreviations:**

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

**Inspection Standards Committee**

**Convenor :** Mr. S C Gupta

**Members:**

Mr. R.K. Singh	Mr. Rajeev Kumar	Mr. Himangshu Pal
Mr. Neeraj Mathur	Mr. T Kamalakannan	Mr. Deepak Gupta (Project)
Mr. Mayank Jain		

INSPECTION AND TEST PLAN  
FOR STEAM TURBINE (GENERAL PURPOSE)

**1.0 SCOPE:**

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

**2.0 REFERENCE DOCUMENTS:**

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

**3.0 INSPECTION AND TEST REQUIREMENTS:**

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
<b>1.0</b>	<b>Procedures</b>						
1.1	MRT, NDT and other Procedures (As applicable)	Documented procedures.	100%	Procedure documents	-	H	R
<b>2.0</b>	<b>Material Inspection</b>						
2.1	Incoming Material Casing, Bearing Housing	Chemical Properties Physical Properties	All Heats	MTC	H	R	R
2.2	Incoming Material Rotor Shaft, Gear Blanks and Disc Material	Chemical Properties Physical Properties	All Heats	Manufacturer's TC or Lab Report	H	R	R
2.3	Hardware Items Gaskets, Fasteners, Gland-Packing	Chemical & Physical properties	100%	Inspection Report	W	R	-
<b>3.0</b>	<b>In Process Inspection</b>						

INSPECTION AND TEST PLAN  
FOR STEAM TURBINE (GENERAL PURPOSE)

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.1	NDT of Casing , Rotor shaft, Gear Blank Disc & Bearing Housing (As applicable)	Defects	100%	Test Records	-	H	R
3.2	NDT of Weld Joint	Soundness of Weld Joint	100%	Manufacturer's Inspection and Test Records	-	H	R
3.3	Turbine casing	Leak tightness	Each Turbine	Manufacturer's Inspection and Test Records	-	H	R
3.4	Balancing of Rotor Assembly	1) Unbalance 2) Run Out	Each	Manufacturer's Inspection and Test Records	-	H	R
<b>4.0</b>	<b>Final Inspection</b>						
4.1	Testing Assembled Turbine	<ul style="list-style-type: none"> <li>•MRT</li> <li>•Vibration</li> <li>•Bearing Temperature Rise</li> <li>•Governing</li> <li>•Over Speed Trip</li> </ul>	Each Turbine	Manufacturer's Inspection and Test Records	-	H	H
4.2	Testing Dismantled Bearings	Strip Examination	Each Turbine	Inspection and Test Records	-	H	R

INSPECTION AND TEST PLAN  
FOR STEAM TURBINE (GENERAL PURPOSE)

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.3	Testing Auxiliary Piping	Leak Tightness	Each Set	Manufacturer's Inspection and Test Records	-	H	W
4.4	Instruments	Document Review	Each Test Report	MTC	W	H	R
<b>5.0</b>	<b>Documentation &amp; IC</b>						
5.1	Final stamping, review of inspection documents and issue of IC	Verifying stamping details and review of inspection documents	100%	IC / Inspection reports	-	H	H
5.2	Final documents as per PR	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier	-	H	H

**Legend:** H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% ( min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

**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 (unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.



# JOB SPECIFICATION FOR SURFACE PREPARATION AND PROTECTIVE COATING

5	10-05-2019	ISSUED AS A JOB SPECIFICATION	SM	SS	SG
4	09-05-2019	ISSUED AS A JOB SPECIFICATION	SM	SS	SG
3	19-02-2019	ISSUED AS A JOB SPECIFICATION	SM	SS	SG
2	07-02-2019	ISSUED AS A JOB SPECIFICATION	SM	SS	SG
1	11-01-2019	ISSUED AS A JOB SPECIFICATION	SM	SS	SG
0	29-10-2018	ISSUED AS A JOB SPECIFICATION	SM	SS	SG

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

**Abbreviations:**

AS	:	Alloy Steel
ASTM	:	American Society for Testing and Materials
AWWA	:	American Water Works Association
CS	:	Carbon Steel
DFT	:	Dry Film Thickness
GI	:	Galvanized Iron
ID	:	Internal Diameter
ISO	:	International Organization for Standardization
LTCS	:	Low temperature Carbon Steel
MS	:	Mild Steel
MR	:	material requisition
NB	:	Nominal Bore
NA	:	Not applicable
OD	:	Outside Diameter
OSHA	:	Occupational Safety and Health Act
RCC	:	Reinforced Cement Concrete
RH	:	Relative humidity
SS	:	Stainless Steel
SOR	:	Schedule of Rate
SSPC	:	Steel Structure Painting Council
WFT	:	Wet Film Thickness

Sl. No.	CONTENT	PAGE NO.
1.0	General	4
2.0	Scope	4
3.0	Reference codes & standards	5
4.0	Equipment	6
5.0	Surface preparation, shop primer, coating application, repair and documentation	7
6.0	Paint materials	15
7.0	Coating systems	22
8.0	Storage	36
9.0	Colour code	36
10.0	Identification of vessels, piping	42
11.0	Painting for civil defense requirements	42
12.0	Quality control, inspection and testing	43
13.0	Guarantee	45
14.0	Qualification criteria of painting CONTRACTOR/sub CONTRACTOR	45
15.0	Qualification/acceptance criteria of paint coating system	45
16.0	Method of sampling & dispatch for laboratory testing	48

## 1.0 GENERAL

1.1 This technical specification shall be applicable for the work covered by the contract and without prejudice to the provisions of various international codes of practice, standard specifications etc. It is understood that the CONTRACTOR shall carry out the work in all respects with the best quality of materials and workmanship and in accordance with the best engineering practice and instructions of Engineer-In-Charge.

1.2 Wherever it is stated in the specification that a specific material is to be supplied or a specific work is to be done, it shall be deemed that the same shall be supplied or carried out by the CONTRACTOR.

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

1.3 This specification covers the requirement for protective coating for new construction.

## 2.0 SCOPE

2.1 Scope of work covered in the specification shall include, without being limited to, the following:

This specification defines the requirements for surface preparation, selection and application of primers and paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, external & internal protection of storage tanks for all services and chimneys, if any. The items listed in the heading of tables of paint systems are indicative only. However, the CONTRACTOR is fully responsible for carrying out all the necessary painting, coating and lining job on external and internal surfaces as per the tender requirement.

### 2.2 Extent of work

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

- All un-insulated carbon steel & alloy steel equipment like vessels, columns, storage tanks, exchangers, parts of boilers etc.
- All un-insulated carbon steel and low alloy plant and related piping, fittings and valves (including painting of identification marks), furnace ducts and stacks.
- All insulated parts of vessels, boilers, chimneys, stacks, piping and steam piping and other insulated items present, if any.
- All items contained in a package unit.
- All structural steel work, pipes, structural steel supports, walkways, handrails, ladders, platforms etc.

- Flare lines, external surfaces of MS chimney with or without refractory lining and internal surfaces of MS chimney without refractory lining.
- Identification of colour bands on all piping, as required, including insulated aluminium clad, galvanized, SS and nonferrous piping.
- Identification lettering/ numbering on all painted surfaces of equipment/piping insulated aluminium clad, galvanized, SS and non-ferrous piping.
- Marking / identification signs on painted surfaces of equipment and piping including hazardous service.
- Supply of all primers, paints and all other materials required for painting (other than OWNER supplied materials)
- Application 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.
- 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).

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

- a. Un-insulated austenitic stainless steel.
- b. Plastic and/or plastic coated materials.
- c. Non-ferrous materials like aluminum, Cu-Ni alloys, galvanized steel.

In general Galvanized steel doesn't require painting. However if painting is required due to OWNERs instructions, contractual or for colour coding requirement then coating system in Table 4.0 shall be followed.

2.3 Unless otherwise instructed, final paint coating (i.e. application of field primer, intermediate and top coats) on pre-erection/ shop primed equipment shall be applied at site, only after all welding, testing on systems are completed as well as after completion of steam purging.

### 3.0 REFERENCE CODES & STANDARDS

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

ISO-12944 : Corrosion protection of steel structures by protective paint system.

ASTM-Vol. 6.01&6.03	:	American standard test methods for paints and coatings.
IS-101	:	Methods of sampling and test for paints, varnishes and related products.
IS-5	:	Colours for ready mixed paints and enamels.
RAL DUTCH	:	International standard for colour shade (Dutch standard).
IS-2379	:	Indian standard for pipe line identification-colour code

### 3.2 Surface preparation standards

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

- 3.2.1 ISO 8501-1 / SIS-05 59 00: ISO standard for preparation of steel substrates before application of paints and related products. This standard contains photographs of the various standards on four different degrees of rusted steel and as such is preferable for inspection purpose by the Engineer-In-Charge.
- 3.2.2 Steel Structures Painting Council, U.S.A. (surface preparation specifications SSPC-SP).
- 3.2.3 National Association of Corrosion Engineers (NACE), U.S.A.
- 3.2.4 Various international standards equivalent to Swedish standard for surface preparations are given in Table-1.
- 3.3 The CONTRACTOR shall arrange, at his own cost, to keep a set of latest edition of above mentioned standards and codes at site.
- 3.4 The paint manufacturers' instructions shall be followed as far as practicable at all times for the best results. Particular attention shall be paid to the following:
  - a. Instructions for storage to avoid exposure as well as extremes of temperature.
  - b. Surface preparation prior to painting shall be followed as per Table-4 to 13 of this standard.
  - c. Mixing and thinning.
  - d. Application, recommended limit on time intervals in between coats & DFT.

### 4.0 EQUIPMENT

- 4.1 All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning, all equipment, scaffolding materials, shot & grit blasting equipment, air compressors etc. required shall be suitable for the work and shall be arranged by the CONTRACTOR in sufficient quantity at the site. The manufacturers test certificates / data sheets for all the above mentioned items shall be reviewed by Engineer-In-Charge at site before start of the work.
- 4.2 Mechanical mixer shall be used for paint mixing operations in case of two pack systems except in case of specific requirement; the Engineer-In-Charge may allow the hand mixing of small quantities at his discretion for touch up work only.

## **5.0 SURFACE PREPARATION, SHOP PRIMER / COATING APPLICATION, REPAIR AND DOCUMENTATION**

### **5.1 General**

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

- a. Abrasive blast cleaning
- b. Mechanical or power tool cleaning

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

Before surface preparation by blast cleaning, the surface shall be degreased by aromatic solvent to remove all grease, oil etc as per SSPC-SP-1.

5.1.3 Irrespective of whether external or internal surface to be coated, blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity >85%. In case of internal coating of storage tanks, dehumidifier shall be used to control humidity level below 60%. Dehumidifier should depress the dew point of air in the enclosed space, sufficient enough so as to maintain it 3°C below the metal substrate temperature during 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, dehumidifier unit should be in continuous operation to ensure that no condensation occurs on the 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 psychrometric data should be collected by the CONTRACTOR for the given site conditions, before starting operation of dehumidifier, to ensure that desired values of dew point and moisture content in enclosed space is achieved.

Dehumidification to be maintained round the clock for surface preparation and painting till the total coating application is over.

Dehumidifier shall not be stopped under any condition till the entire blasted surface is primed to the satisfaction of the technical representative of the paint manufacturer. In case the dehumidifier breaks down in middle of the job, the same shall be replaced at the risk and cost of the CONTRACTOR.

- 5.1.4 The Engineer in-Charge shall have the right to disallow usage of dehumidifier if the performance is not meeting the specified requirements. Under such circumstances, the CONTRACTOR shall remove the equipment and replace the same with another equipment to provide satisfactory results without any additional cost to the OWNER.
- 5.1.5 Irrespective of the method of surface preparation, the first coat of primer must be applied by airless spray/ air assisted conventional spray, if recommended by the paint manufacturer, on dry surface. This should be done immediately and in any case within 4 hours of cleaning of the surface. However, at times of unfavorable weather conditions, the Engineer-In-Charge shall have the liberty to control the time period, at his sole discretion and/or to insist on re-cleaning before primer application is taken up. In general, during unfavorable weather conditions, blasting and painting shall be avoided as far as practicable.
- 5.1.6 The external surface of R.C.C. chimney to be painted shall be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed by scrubbing with soft wire brush. Acid etching with 10-15% HCl solution for about 15 minutes shall be carried out. The surface must be thoroughly washed with water to remove acid and loose particles and then dried completely before application of paint.

## 5.2 Procedure for surface preparation

### 5.2.1 Air blast cleaning with abrasives

The surfaces shall be blast cleaned using one of the abrasives such as  $Al_2O_3$  particles, chilled cast iron or steel grit, copper slag or nickel slag at a pressure of  $7.0 \text{ kg/cm}^2$  and at an appropriate distance & angle depending on nozzle size maintaining constant velocity and pressure. Chilled cast iron or steel shall be in the form of shot or grit of size in the range of G16 – G42 conforming to SSPC AB1 and S250 grade size of steel shots (maximum) to obtain a desired surface profile of 35-50 microns trough to peak. For all other abrasives, size shall be in the range of G16 – G24. The combination of steel grits and shots shall be normally in the ratio of 3:1. The quality of abrasives shall be free from contaminants and impurities and shall meet the requirements of SSPC AB1. The compressed air shall be free from moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the material for liners. Nozzle 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 or 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. If there is dew on the metal surface, it shall be cleaned. The surface profile shall be uniform to provide good adhesion (i.e. 35 to 50 microns) to the paint. If possible, a vacuum collector shall be installed to collect and recycle the abrasives.

## 5.2.2 Mechanical or power tool cleaning

Power tool cleaning shall be done by mechanical striking tools, chipping hammers, grinding wheels or rotating steel wire- brushes. Excessive burnish of the 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/steam and thoroughly dried with compressed air jet before application of paint.

## 5.3 Non-compatible shop coat primer

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 the paint manufacturer. If the shop coat is in satisfactory condition showing no major defect upon arrival at site, the shop coat shall not be removed.

5.4 Shop coated equipment (coated with primer & finishing coat) should not be repainted unless paint is damaged. Repair shall be carried out as per Table-3 of paint systems depending upon the compatibility of paint.

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

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

## 5.7 Coating procedure and application

All coatings shall be applied by airless spray except for the following special cases, where application can be carried out by brush subject to suitability of the application of the paint product by brush.

- Spot repair
- Stripe coating on edges
- Small bore parts not suitable for spray application

Irregular surfaces such as sharp edges, welds, small brackets, and interstices may stripe coated to ensure specified DFT is achieved. Paint manufacturer recommendation should be followed before deciding for brush application.

5.7.1 Surface shall not be coated in rain, wind or in an environment where injurious airborne elements exist, when the steel surface temperature is less than 5 °F above dew point, when the relative humidity is greater than 85%, when the temperature is below 40°F and when the ambient/substrate temperature is below the paint manufacturers 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.

- 5.7.2 Blast cleaned surface shall be coated with complete application of primer as soon as practicable but in no case later than 4 hours the same day.
- 5.7.3 To the maximum extent practicable, each coat of paint shall be applied as a continuous film with uniform thickness and free of probes. Any spots or areas missed in application shall be re-coated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.
- 5.7.4 Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for re-coating 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's instructions shall be followed for inter coat interval.
- 5.7.5 When the successive coat of the same colour have been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate the complete coverage of the surface. The tinting material shall be compatible with the material underneath and shall not be detrimental to its service life and shall be recommended by the original paint manufacturer.
- 5.7.6 Airless spray application shall be in accordance with the following procedure:  
As per steel structure paint manual Vol.1 & Vol.2 by SSPC, USA. Airless spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor, issued to operate a pump to produce pressures of 1000 to 6000 psi paint, is delivered to the spray gun at this pressure through a single hose within the gun. A single paint stream is divided into separate streams, which are forced through a small orifice resulting in atomization of paint without the use of air. This results in more rapid coverage with less over spray. Airless spray usually is faster, cleaner, more economical and easier to use than conventional air spray.

Airless spray equipment is mounted on wheels, and paint is aspirated in a hose that sucks paint from any container, including drums. The unit shall have in-built agitator that keeps the paint uniformly mixed during the spraying. The unit shall consist of in-built strainer. Usually, a very small quantity of thinning is required before spray. In case of high build epoxy coating (two packs), 45:1 pump ratio and 0.020-0.023" tip size will provide a good spray pattern. Ideally, fluid hoses should not have ID less than 3/8" and not longer than 50 ft. to obtain optimum results.

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

- 5.7.7 Brush application of paint shall be in accordance with the following:
- Brushes shall be of a style and quality that will enable proper application of paint.

- b. Round or oval brushes are most suitable for rivets, bolts, irregular surfaces, and rough/ pitted steel. Wide flat brushes are suitable for large flat areas but they shall not have width over 5 inches.
  - c. Paint shall be applied into all corners.
  - d. Any runs or sags shall be brushed out.
  - e. There shall be a minimum of brush marks left in the applied paint.
  - f. Surfaces not accessible to brushes shall be painted by spray, daubers, or sheepskin.
- 5.7.8 For each coat, the painter should know the WFT corresponding to the specified DFT and standardize the paint application technique to achieve the desired WFT. This has to be ensured in the qualification trial.

## 5.8 Drying of coated surfaces

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

## 5.9 Spot repair of damaged primer

- 5.9.1 Where pre-erection/shop primer has been damaged at isolated localized spots during handling and transportation or after erection / welding, its repair shall be done as given below and as per the Table-3 of this specification.
- 5.9.2 Surface preparation: Quickly remove the primer from damaged area by mechanical scraping and emery paper conforming to SSPC-SP-3 to expose the white metal. Blast clean the surface, if possible. Feather the primed surface, over the intact adjacent surface surrounding the damaged area, by emery paper.
- Primer coating: One coat of F-9 shall be applied wherever damage was observed on pre-erection / pre fabrication or shop primer of inorganic zinc silicate coating (F-9). Similarly one coat of F-12 shall be applied wherever damage observed on pre-erection / pre-fabrication/shop primer of silicone aluminium (F-12).
- 5.9.3 If damaged areas are found to be extensive and spread over large areas, then entire pre-erection/pre-fabrication/shop primer shall be removed by blasting to

achieve SSPC-SP-10 and entire blasted surface shall be primed again with F-9 or F-12, as applicable, for the intended design temperature. (See note of Table-3).

#### **5.10 Assessment of painting requirement**

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

- Identify the environment from area classification details and choose the appropriate table.
- Identify the design temperature from the technical documents.
- Identify the specific field paint system and surface preparation requirement from the above identified table and temperature range.
- Identify the shop priming requirement from based on compatibility of the above paint system.
- Identify the need of repair of shop primer and execute as per Table-3.

#### **5.11 Documentation / records**

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

The coating applicator must maintain a job record consisting of all the information as per 5.11.2 -5.11.7 above as well as the approved procedure of work (5.11.1 above). The job record consisting of information in accordance to 5.11.2 – 5.11.7 shall be entered on daily basis and should be daily signed by Engineer-in-charge.

**TABLE-1: SURFACE PREPARATION STANDARDS**

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

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

## 6.0 PAINT MATERIALS

Typical characteristics and codes of various paint materials used in this specification are as follows.

**TABLE-2: PAINT MATERIALS**  
(Refer to *general notes* at the end of this table)

DESCRIPTION	P-6	P-7	P-4
Technical name	Epoxy Zinc Phosphate Primer	Cold Galvanizing product	Etch Primer/Wash Primer
Type and composition	Two component polyamine cured epoxy resin medium, pigmented with zinc phosphate.	One pack synthetic resin based zinc galvanizing containing min 92% of electrolytic zinc dust of 99.95% purity.	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.
Volume solids % Minimum	49	37	9
DFT per coat, μ	40-50	40-50	8-10
Theoretical covering capacity in m <sup>2</sup> /coat/ litre	8-10	4m <sup>2</sup> /kg	8-10
Weight per litre in Kg/litre	1.4±0.05	2.67 kg at 15 <sup>0</sup> C	1.2±0.05
Touch dry at 30 <sup>0</sup> C (max.)	30 min.	10 min.	2 hrs.
Hard dry at 30 <sup>0</sup> C (max.), hrs	8	24	24
Over-coating interval, hrs	Min. 8	Min. 4	Min. 4-6
Pot life at 30 C for two component paints, hrs	6 - 8	NA	NA
Adhesion (ASTM D 4541)	>7	NA	NA

Temperature resistance (min) ° C (ASTM D 2485) *Note 8	80 (Method A)	50 (Method A)	NA
--	------------------	------------------	----

**TABLE- 2: PAINT MATERIALS (Contd.)**

DESCRIPTION	F-2	F-3	F-6A/B	F-6C
Technical name	Acrylic Polyurethane finish paint	Chlorinated rubber based finish paint	Epoxy-High Build coating	Solvent less epoxy coating
Type and composition	Two-pack aliphatic isocyanate cured acrylic finish paint (free of alkyd/polyester resins).	Single pack plasticized chlorinated rubber based medium with chemical and weather resistant pigments.	F-6A Two-Pack Aromatic polyamine cured epoxy resin medium suitably pigmented. F-6B: polyamide cured epoxy resin medium suitably pigmented with MIO.	Two pack, cured with Amine Adduct; catalyzed epoxy resin suitably pigmented
Volume Solids % Minimum.	40	36	57	98
DFT per coat, μ	30-40	30-40	100-125	250-500
Theoretical covering capacity in m <sup>2</sup> /coat/litre	10-15	11-15	5-6	2-3
Weight per liter in Kg/litre	1.15±0.03	1.15±0.03	1.42±0.03	1.40±0.03
Touch dry at 30 °C (max)	30 min.	30 min.	3 hrs	3 hrs
Hard dry at 30 °C (max.), hrs	8	8	16	16
Full cure at 30 °C (for immersion/ high temperature service)	NA	NA	5 days	5 days

Over-coating Interval, hrs	Min.12.	Min. Overnight	Min. Overnight Max. 5 days	Min. 8. Max. 48
Pot life (approx.) at 30 ° C for two component paints, hrs	5-8	NA	3-6	0.5
Adhesion (ASTM D 4541)	>5	>4	>7	>8
Abrasion Resistance (ASTM D4060) For 1000 g load	<300 mg /1000 cycles/CS17 or <100 mg /1000 cycles/CS10	NA	NA	NA
Temperature resistance (min.) ° C (ASTM D 2485) *Note 8	80 (Method A)	60 (Method A)	80 (Method A)	120 (Method A)

**TABLE- 2: PAINT MATERIALS (Contd.)**

DESCRIPTION	F-7	F-8	F-9 (primer)	F-11	F-12
Technical name	High build coal tar epoxy coating.	Self priming type surface tolerant high build epoxy coating (complete rust control Coating)	Inorganic zinc silicate Coating	Heat resistant synthetic medium based two pack Aluminium Paint suitable up to 250°C dry temp.	Heat resistant silicone Aluminium Paint suitable up to 540°C dry temp.
Type & composition	Two pack polyamide cured epoxy resin blended with coal tar medium, suitably pigmented	Two pack epoxy resin based suitable pigmented and capable of adhering to manually prepared surface and old coating.	A two pack air drying self curing solvent based inorganic zinc silicate coating with minimum 80% zinc content on dry film. The final cure of the dry film shall pass the MEK rub test as per ASTM D4752.	Heat resistant synthetic medium based two pack Aluminium paint suitable up to 250°C.	Single pack silicone resin based medium with Aluminium flakes.
Volume Solids % Minimum.	62	75	57	35	18
DFT per coat in $\mu$	100-125	100-125	65-75	15-20	15-20
Theoretical covering capacity in M <sup>2</sup> /coat/ litre	5.2-6.5	6.0-7.2	8-9	10-12	8-10
Weight per liter in Kg/litre	1.40±0.03	1.41±0.03	2.3±0.03	0.95±0.03	1.00±0.03
Touch dry at 30°C (maximum), hrs	4	3	0.5	3	0.5
Hard dry at 30°C (maximum), hrs	48	24	12	12	24
Full cure 30°C (for immersion /high temperature service)	5 days	5 days	NA	NA	NA

Over-coating interval, hrs	Min. 24 hrs max.5days	Min. 10	Min. 12 hrs at 20°C & 50% RH	Min. 24	Min. 24
Pot life at 30°C for two component Paints, hrs	4-6	1.5	4-6	NA	NA
Adhesion MPa (ASTM D 4541)	>5	>5	>5	NA	NA
Temperature resistance° C (min) (ASTM D 2485 method B)	80 Dry service	80 Dry service	400 Dry service	250 Dry service	540 Dry service
Temperature resistance (min.) ° C (ASTM D 2485) *Note 8	80 (Method A)	80 (Method A)	400 (Method B)	250 (Method A)	540 (Method B)

**TABLE- 2: PAINT MATERIALS (Contd.)**

DESCRIPTION	F-14	F-15	F-16	F-17	F-20
Technical name	Polyamine cured coal tar epoxy	Two-component Epoxy phenolic coating cured with Polyamine adduct hardener	Inert polymeric matrix coating suitable for under insulation for CS and SS.	Novolac epoxy phenolic coating cured with Polyamine adduct hardener	Glass flake reinforced vinyl ester coating.
Type & composition	Specially formulated polyamine cured coal tar epoxy suitable for application under insulation	Two pack ambient temperature curing epoxy phenolic coating system suitable for application under insulation	Suitable for high temperature service and under insulation coating for CS, alloy steel and SS	Novolac epoxy phenolic coating cured with Polyamine adduct hardener	Two component glass flake filled vinyl ester lining for under immersion services up to 90 deg. C.
Volume Solids % Minimum.	67	67	50	98	98
DFT per coat in microns	100-125	75-100	100-125	300-450	500-600
Theoretical covering capacity in M <sup>2</sup> /coat/ litre	5-8	4-5	3 minimum	6.5 – 8	1.6 minimum
Weight per liter in Kg/litre (mix paint)	1.45±0.03	1.65±0.03	>1.3	1.7	>1.2
Touch dry at 30°C (max) , hrs	4	3	1	2	2
Hard dry at 30°C (max), hrs	24	24	16	24	4

Full cure 30°C (for immersion / high temp service)	168 hrs (7 days)	168 hrs (7 days)	NA	168 hrs (7 days)	96 hrs (4 days )
Over-coating interval	Min. 6 hrs Max.5 days	Min. 36 hrs Max.21 days	Min.6 hrs Max. Not applicable	Min. 16 hrs Max.21 days	Min. 4 hrs Max.3 days
Pot life at 30°C, hrs (for two component paints)	4	4-6	1	1	50 min-1 hr
Adhesion, MPa (ASTM D 4541)	>6	>7	NA	>8	>7, Tensile strength >20N/mm <sup>2</sup> (ASTM D 638)
Temperature resistance (min.) ° C (ASTM D 2485) *Note 8 & 9	125 (Method A)	150 (Method A)	650 (Method B)	150 (Method A)	90 (Method A)

**General notes for TABLE-2:**

1. Covering capacity and DFT achieved per coat depends on method of application. Covering capacity specified above is theoretical. For estimation of actual quantity of paints required, include the losses during application. Minimum specified DFT should be maintained in any case.
2. All primers and finish coats should be ambient temperature curing and air drying unless otherwise specified.
3. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured. Wherever a deviation is noticed from the specification in manufacturer data sheet, more stringent one between the data sheet and the specification shall prevail e.g. if this specification recommends Sa 2 ½ and the manufacturer data sheet requires Sa3, the surface preparation shall be done as per Sa 3. However in another case if this specification requires the surface preparation of Sa 2 ½ and the manufacturer data sheet recommends only Sa 2 as minimum, the surface preparation shall be done as per Sa 2 ½.
4. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
5. Higher specific gravity of F-9 is also acceptable.
6. Internationally recognized & acceptable testing method shall be used for lab testing wherever testing standards are not mentioned.
7. Touch dry, hard dry, pot life, full cure period, & over coating interval shall be as per manufacturer's data sheets and no testing is required. Slight variation in the values of these parameters along with weight per liter may be permissible with the discretion of engineer-in-charge only.

8. Temperature resistance tests (ASTM D2485) shall be carried out for minimum required temperature resistance indicated.
9. Wherever ASTM D 2485 method B is applicable, test results of the panels subjected to salt spray (ASTM B 117) after muffle furnace exposure shall be submitted for pre-qualification purpose.
10. F-6A shall be suitable for immersion services in line with recommendations in tables-7 to 9.
11. F-6C shall be suitable for immersion services of hydrocarbons and DM water ( in line with recommendations in table-9)
12. F-7 shall be suitable for immersion service of hydrocarbons & underground service up to 80 Deg C minimum.
13. F-14 shall be suitable for under insulation service up to 125 deg C.
14. F-15 shall be suitable for high temperature immersion & under insulation services in line with recommendations from table-8 to 13.
15. F-17 shall be suitable for high temperature immersion service and underground services as recommended in table-9 to 10.

## 7.0 COATING SYSTEMS

The coating system should be selected based on the plant location as given below:

### Classification based on plant location:

- a) Plant located in inland area (more than 50 km from coast).  
Environment classification – Industrial
  - For offsite areas: Table-5 to be followed.
  - For all process unit areas including DM, CPP and Cooling tower: Table-6 to be followed.
- b) Plant located on sea coast or within 50 km from sea coast.  
Environment classification- Industrial marine
  - For offsite areas, process unit areas including DM, CPP, Cooling tower etc.: Table-6 to be followed.
- c) For external surface of above ground tanks, Table-8 to be followed for all locations (inland or coastal)

### **General notes for clause 7.0:**

1. Coating systems (primers, finish paints etc.) based on area classification/environments/applications are tabulated in Table-4 to Table-13
2. Repair of pre-erection/pre-fabrication & shop priming after erection/ welding shall be done as per Table-3.

**TABLE-3: REPAIR OF PRE-ERECTION/PRE-FABRICATION OR SHOP PRIMER AFTER ERECTION/WELDING**

(For all un-insulated CS, LTCS & low allow steel items in all environments)

Sl. No.	Design Temp. in °C	Surface Preparation	Coating System	Total DFT in Microns (min.)	Remarks
3.1	-45 to 400	SSPC-SP-3	1 coat of F-9	65-75	See Note-1 below and clause 5.9.3
3.2	401 to 550	SSPC-SP-3	1 coat of F-12	20	

**Notes for Table-3:**

**Note-1:** The application and repair of pre-erection/pre-fabrication or shop primer given in above tables shall be done for all the items to be painted. In case the damages 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 F-9 or F-12 as applicable.

**TABLE-4: COATING SYSTEM FOR GI HAND RAILS & GI ITEMS**

(Refer clause 2.2.2)

Sl. No.	Design Temp. in °C	Coating System	Total DFT in Microns (min.)	Remarks
4.1	Up to 60	Hot Dip Galvanizing to 80-85 microns (600-610 gm/m <sup>2</sup> ) as per IS 4759, 2629, 4736, 2633 + 1 coat of P-6 @ 40µ DFT/coat + 1 coat of F-2 @ 40 microns DFT/coat	80 of finish coat (excluding the thickness of galvanizing )	-

**General notes for Table-4:**

- No galvanized specimen shall have thickness less than 80 microns.
- Repair of the damaged areas 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 the repair.
- After repair of damaged galvanized coating by cold galvanization (P-7), the repaired area shall be top coated with paint system as given in table-4 above (i.e. 1 coat of P-6 @ 40µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat).
- Suggested cold galvanizing manufacturers are ZINGA, LOCTITE or Z.R.C.
- Galvanized gratings don't require painting in general until otherwise specified elsewhere or as per the requirement of the OWNER. Ladders, stairways & hand rails require painting to meet the colour coding requirement of the OWNER. Contractor has to ensure the applicable colour coding prior to application of coating as per this clause.

**TABLE-5: COATING SYSTEM FOR NORMAL CORROSIVE AREAS (OFFSITES)**  
(For all un-insulated above ground CS, LTCS & low allow steel piping, equipment, structures, valves, vessels & columns etc.)

Sl. No	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
5.1	-45 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	-	None	65-75	No over-coating shall be done on F-9
5.2	-16 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	1 coat of P-6 @ 40 µ DFT/coat	1coat of F-6B @ 100 µ DFT/coat+ 1 coat of F-2 @ 40µ DFT/coat	245-255	
5.3	81 to 250	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	-	2 coats of F-11 @ 20µ DFT/coat (2x20=40)	105-115	F-12 shall be ambient temperature curing type
5.4	251 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	-	2 coats of F-12 @ 20µ DFT/coat (2x20=40)	105-115	
5.5	>400	SSPC-SP-10; 1coat of F-12 @ 20µ DFT/coat	-	2 coats of F-12 @20µ DFT/coat (2x20=40)	60	This system is suitable up to 540° C

**General notes for Table-5:**

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The CONTRACTOR is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
2. Flare line within unit or offsite areas shall be coated as per clause 6.3 of Table-6.
3. If the application of pre-erection/pre-fabrication/shop primer has already been completed, the same shall not be repeated in the field. In case the damages to the primer coat are severe and are spread over large areas, the Engineer-In-Charge may decide & advise re-blasting and re-application of the primer coat. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table-3.
4. In case of paint systems as per sl. nos. 5.4 and 5.5, the colour bands shall be applied over the aluminum paint as per the colour coding requirement for specific service of the piping.
5. All coating system including surface preparation, primer, intermediate and finish coat for piping is recommended to be done at field only until otherwise specified.
6. For equipment, vessels, columns & valves etc scope of surface preparation, application of primers to finish coat including repair shall be as per applicable contractual documents like SOR, MR and PR etc.

**TABLE-6: COATING SYSTEM FOR CORROSIVE AREAS (PROCESS UNITS, COOLING TOWER, DM AND CPP)**

(For all un-insulated above ground CS, LTCS & low allow steel piping, equipment, structures, valves, vessels & columns etc.)

Sl. No.	Design Temp. °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
6.1	-45 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/ coat	-	-	65-75	a)No over coating on F-9 is allowed b) F-12 shall be ambient temperature curing type
6.2	-16 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/ coat	1 coat of P-6 @ 40 μ DFT/ coat	2 coats of F-6B @ 100 μ DFT/coat + 1 coat of F-2 @ 40μ DFT/coat (2x100 + 40= 240)	345-355	
6.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/ coat	-	2 coats of F-12 @ 20μ DFT/coat 2x20=40	105-115	
6.4	>400	SSPC-SP-10; 1coat of F-12 @ 20-25μ DFT/coat	-	2 coats of F-12 @ 20-25μ DFT/coat (2x20=40)	60	
<b>Coating system for furnace stacks</b>						
6.5	Up to 200	SSPC-SP-10 1coat of F-9 @ 65-75μ DFT/ coat	---	3 coats of Silicone acrylic (black) @40 μ DFT/coat	185-195	

**General notes for TABLE-6:**

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The CONTRACTOR is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated as per tender document and scope of work.
2. If the application of pre-erection/pre-fabrication/shop primer has already been completed, the same shall not be repeated in the field. In case the damages to the primer coat are severe and spread over large areas, the Engineer-In-Charge may decide & advise re-blasting and re-application of the primer coat. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table-3.
3. For external surface of RCC Chimney, 2 coats of F-6 B@ 100 $\mu$  DFT/coat to obtain a total DFT of 200  $\mu$  shall be applied after proper surface preparation as per guidelines in 5.1.6.
4. In case of paint systems as per sl. Nos. 6.3 and 6.4, the colour bands shall be applied over the aluminum paint as per the colour coding requirement for specific service of piping given in clause 9.0.
5. For piping, equipment, vessels, columns & valves etc, scope of surface preparation, application of primers to finish coat including repair shall be as per applicable contractual documents like SOR, MR, and PR etc.

**TABLE-7: COATING SYSTEMS FOR EFFLUENT TREATMENT PLANT (ETP)**

Sl. No.	Design Temp. in °C	Surface Preparation	Coating system		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
7.1	For external surfaces of C.S./M.S. items: screens, walk way bridges, baffles, dual media filters, vertical pumps, piping in treated effluent sump, bio sludge pump, screw pump and pump house, CS tanks, sumps and vessels.					
	-14 to 80	SSPS-SP-10	1 coat of F-9 @ 65-75 $\mu$ DFT/coat	2 coats of F-6A @100 $\mu$ DFT/coat + 1 coat of F-2 @ 40 $\mu$ DFT/coat (2x100+40=240)	305-315	-
7.2	For internal surfaces of CS/MS Items: bio-sludge sump, filter feed sump, process sump, sanitary sump, transfer sump, sludge, slop oil tank, scrapping mechanism in clarifier.					
	-14 to 80	SSPS-SP-10	1 coat of F-6A @ 65-100 $\mu$ DFT/coat.	2 coats of F-6A @100 $\mu$ DFT/coat (2x100=300)	300	Note-1
7.3	All R.C.C./concrete surfaces exposed to effluent water / liquid such as tanks, structures, drains etc. in process sump, TPI separator (process and oil), aeration tank and transfer sump etc.					

	-14 to 80	Blast cleaning to SSPC-SP guide lines and acid etching with 10-15% HCl acid followed by thorough water washing.	Epoxy screed lining	3000	Epoxy screed lining shall be applied as per manufacturer and Engineer-In-Charge instructions
7.4	CS dual media filters, chemical dosing tanks – internal surface				
	Up to 60	SSPC-SP-10	1 coat of clear two component solvent free vinyl ester primer @ 100 $\mu$ DFT/ Coat + 2 coats of F-20 @ 500 $\mu$ DFT/ Coat	1100	-

**TABLE-8: EXTERNAL COATING SYSTEMS FOR CARBON STEEL AND LOW ALLOY STEEL STORAGE TANKS**

Sl. No.	Design Temp. in °C	Surface Preparation	Coating system (Note-1)		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
8.1	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.					
8.1.1	-14 to 80	SSPC-SP-10	1coat of F-9 @ 65-75 $\mu$ DFT/coat + 1coat of P-6 @ 40 $\mu$ DFT/ coat	2 coats of F-6B @ 100 $\mu$ DFT /coat + 1 coat of F-2 @ 40 $\mu$ DFT/ coat	345-355	F-6 should be suitable for occasional water immersion
8.1.2	81 to 150	SSPC-SP-10	1 coat of F-15 primer @ 80 $\mu$ DFT/ coat + 1 coat of F-15 intermediate coat @ 80 $\mu$ DFT/coat	1 coat of F-15 finish coat @80 $\mu$ DFT/ coat + 1coat of F-2 @ 40 $\mu$ DFT/ coat	280	-

8.1.3	151 to 400	SSPC-SP-10	1 coat of F-9 @ 65-75 $\mu$ DFT/coat	2 coats of F-12 @20 $\mu$ DFT/ coat or 1 coat of F-16 @ 125 $\mu$ DFT / coat	105-115 or 190-200	For higher design temperatures, system as per 8.2.3 of this table is applicable
8.2	External surfaces of bottom plate (in contact with soil) for all storage tanks.					
8.2.1	-14 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75 $\mu$ DFT/ coat	3 coats of F-7@ 100 $\mu$ DFT/coat (3x100=300)	365-375	F-7 should be suitable for immersion service
8.2.2	81 to 150	SSPC-SP-10	1 coat of F-17 primer @ 400 $\mu$ DFT/ coat	1 coat of F-17 finish coat @ 400 $\mu$ DFT/ coat	800-825	-
8.3	For underside of the bottom plate (not in contact with soil ) (in case tank is not lifted during PWHT) (Note- 2)					
8.3.1	-29 to 400 (CS)	SSPC SP-10	1 coat of inert polymeric matrix coating @ 125 $\mu$	1 coat of inert polymeric matrix coating @ 125 $\mu$	250-300	-

**Notes for TABLE-8:**

1. All paint coating application including primer for tanks shall be carried out at field after erection and completion of entire welding.
2. For underside of bottom plate :
  - a) Painting shall be carried out before laying the bottom plate for tanks with non-Post Weld Heat Treatment (PWHT).
  - b) For tanks with PWHT, painting shall be carried out after PWHT.
  - c) In case tank is not lifted during PWHT then painting shall be applied before laying the bottom plate, clause no.8.3.1 shall be followed.

**TABLE-9: INTERNAL COATING SYSTEMS FOR CARBON STEEL AND LOW ALLOY STORAGE TANKS**

Sl. No.	Design Temp. in °C	Surface Preparation	Coating system		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
9.1	Crude oil, ATF, turpentine oil, lubricating oil: 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.					
9.1.1	-14 to 90	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat	240	-
9.2	Petroleum products & intermediates like LDO, HSD, gas oil, feeds of FCC-PC, FCC-LCO, VGO-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.					
9.2.1	-14 to 45	SSPC-SP-10	1 coat of F-9 @ 65-75 µ DFT/coat	-	65-75	-
9.2.2	46 to 90	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat	240	-
9.3	Potable, Raw & Fire water All internal surfaces, accessories and roof structures of cone and dome roof tanks					
9.3.1	-14 to 60	SSPC-SP-10	1 Coat of F-6A @ 100 µ DFT/coat	2 Coats of F-6A @ 100µ DFT/ Coat (2x100=200)	300	Note-1
9.4	De-mineralized (DM) water & Condensates etc.: All internal surfaces, accessories and roof structures of cone and dome roof tanks.					
9.4.1	-14 to 60	SSPC-SP-10	1 Coat of F-6A @ 100µ DFT/coat	2 coats of F-6C @ 200µ DFT/ coat (2x200=400)	500	Single coat of F-6C @ 400 µ is also acceptable

9.4.2	61 to150	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	1 coat of F-15 intermediate coat @ 80μ DFT/coat + 1 coat of F-15 finish coat @ 80μ DFT/ coat (80+80=160)	240	-
9.5	Hydrochloric acid (HCl) 10 %: All internal surfaces, accessories and roof structures of cone and dome roof tanks					
9.5.1	-14 to 60	SSPC-SP-10	1 Coat of clear two component solvent free vinyl ester primer @ 100μ DFT/ Coat	2 Coats of F-20 @ 500μ DFT/ Coat	1100	-
9.6	Aggressive solvents like hexane, exane, benzene, xylene and toluene: All internal surfaces, accessories and roof structures of cone and dome roof tanks					
9.6.1	-14 to 65	SSPC-SP-10	1 coat of F-9 @ 65-75μ DFT/ coat	-	65-75	-
9.7	Ethylene glycol tanks: Internal shell-full height, bottom plate, underside of roof and all accessories					
9.7.1	All	SSPC-SP-10	-	3 coats of vinyl chloride co-polymer @ 75μ /Coat; (3x75=225)	225	-
9.8	Inside pontoon and inside of double deck of all floating roofs					
9.8.1	-14 to 80	SSPC-SP-3	1 coat of F-8 @ 100μ DFT/coat	1 coat of F-8 @ 100μ DFT/coat	200	-
9.8.2	81 to150	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	1 coat of F-15 intermediate coat @ 80μ DFT/coat + 1 coat of F-15 finish coat @ 80μ DFT/ coat (80+80=160)	240	-
9.9	Wet slops, amine solutions, sour water , water draw off: All internal surfaces, accessories and roof structures of cone and dome roof tanks					
9.9.1	-14 to 90	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	1 coat of F-15 intermediate coat @ 80μ DFT/coat + 1 coat of F-15 finish coat @ 80μ DFT/ coat (80+80=160)	240	-

9.10	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					
9.10.1	Up to 150°C	SSPC-SP-10		1 coat of F-17 @ 375µ DFT/coat	375-425	-
9.11	Alkalis up to 50 % concentration: All internal surfaces, accessories and roof structures of cone and dome roof tanks					
9.11.1	Up to 60°C	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	2 Coats of F-6 A @ 100µ DFT/coat (2x100=200)	280	-

**Notes for TABLE-9:**

1. F-6 A shall be suitable for drinking water service and should have competent authority certification.

**TABLE-10: COATING SYSTEMS FOR EXTERNAL SIDE OF UNDERGROUND CARBON STEEL PLANT PIPING AND VESSELS**

Sl. No.	Design Temp. in °C	Surface Preparation & Shop Primer	Coating system		Total DFT in Microns (min.)	Remarks
			Surface Preparation & Primer	Finish Coat		
10.1	Underground carbon steel plant piping					
10.1.1	25 to 80	-	As per document B224-000-79-41-PLS-04	3layer polyethylene (3LPE) coating as per document B224-000-79-41-PLS-04	3.5mm Min.	--
10.1.2	81 to 150	-	SSPC-SP-10; 1 coat of F-17 primer @400 µ DFT/ coat	1 coat of F-17 @ 400 DFT/coat	800 Min.	Note-2
10.2	External side of underground storage vessels					
10.2.1	-45 to 80	SSPC-SP -10; 1 coat of F-9 @ 65-75µ DFT/ coat	-	3 coats of F-7 @ 100µ DFT/coat	365-375	-

10.2.2	81 to 150	SSPC-SP-10	1 coat of F-17 primer @400 μ DFT/ coat	1 coat of F-17 @400μ DFT/ coat	800 Min.	Note-2
--------	-----------	------------	--	--------------------------------	----------	--------

**Notes for TABLE-10:**

- 1 For underground vessels, scope of surface preparation, application of primers to finish coat including repair shall be as per applicable contractual documents like SOR, MR, PR etc.
- 2 This coating system can be used for the lines/equipment/vessels which have operating temperature between ambient and 150 °C (normal operating temperature) with occasional rise in the temperature up to 200 °C (design temperature).

**TABLE-11: COATING SYSTEMS FOR UNDER INSULATION (ALL UNIT AREAS & OFFSITES)**

(For insulated piping, equipment, storage vessels, tanks, columns etc. of CS, LTCS, Low alloy steel & stainless steels in all environments.)

Sl. No.	Design Temp. °C	Surface Preparation & Pre-erection/Shop Primer	Coating system		Total DFT Microns (min.)	Remarks
			Primer	Finish paint		
11.1	Carbon steel, LTCS and Low alloy steel Piping, Storage tanks, Vessels, Equipments etc					
11.1.1	-45 to 125	SSPC-SP-10; 1coat of F-15 @ 75μ DFT/coat	None	2 coats of F-15 @75μ DFT/coat	225	
11.1.2	126 to 450 (CS)	SSPC-SP-10; 1 coat of F-16 @ 125μ DFT/coat	None	1 coat F-16 @ 125μ DFT/coat	250	
11.2	Stainless Steel, Alloy Steel, Alloy-20 Piping, Tanks, Vessels & Equipments					
11.2.1	-45 to 125	SSPC-SP-7; (15-25μ surface profile) 1 coat of F-15 @75 μ DFT/coat	None	2 coats of F-15 @75μ DFT/coat	225	
11.2.2	126 to 550	SSPC-SP-7; (15-25μ surface profile) 1 coat of F-16 @125μ DFT/coat	None	1 coat of F-16 @125μ DFT/coat	250	

11.3	Cyclic service of CS, LTCS, SS, & Alloy Steels (Note-1)					
11.3.1	-45 to 150 (Note-1)	SSPC-SP-10 For CS, LTCS & low Alloy steel. SSPC-SP-7 for SS; (15-25 $\mu$ surface profile) 1 coat of F-15 @75 $\mu$ DFT/coat	None	2 coats of F-15 @75 $\mu$ DFT/coat	225	Note-2
11.3.2	-29 to 400 (CS)  -180 to 400 (SS)  -29 to 650 (LAS)	SSPC-SP-10 for CS, LTCS & Alloy steel. SSPC-SP-7 for SS (15-25 $\mu$ surface profile) 1 coat of F-16 @ 125 $\mu$ DFT/coat	None	1 coat of F-16 @ 125 $\mu$ DFT/coat	250	Note-3

#### Notes

1. In case of overlapping of cyclic temperature ranges as mentioned in 11.3.1 and 11.3.2 then clause 11.3.1 shall be followed.
2. Alternatively, for this temperature range, 1 coat of F-17 @ 400  $\mu$  is also acceptable.
3. The coating system applicable for any other temperature range shall be reviewed if it is encountered.

#### General notes for TABLE-11:

1. "Cyclic Service" is characterized by rapid or periodical temperature fluctuation or temperature cycles.
2. The blasting abrasives for SS and alloy steels shall be aluminum oxide or garnet only.
3. For insulated vessels & equipment scope of surface preparation, application of primers to finish coat including repair shall be as per applicable contractual documents like SOR , MR, PR etc.

**TABLE-12: COATING SYSTEMS (INTERNAL PROTECTION) FOR CARBON STEEL COMPONENTS OF COOLERS/CONDENSERS WITH FRESH COOLING WATER SERVICE**

Sl. No.	Design Temp. in $^{\circ}$ C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
12.1	Up to 80	SSPC-SP-10	1 coat of F-15 @ 80 $\mu$ DFT/coat	2 coats of F-15 @ 80 80 $\mu$ DFT/coat	240	-
12.2	81 to 150	SSPC-SP-10	---	2 coats of F-17@ 500 $\mu$ /coat	1000	-

**TABLE-13: COATING SYSTEM (INTERNAL PROTECTION) FOR GALVANIZED OR NON FERROUS OR STAINLESS STEEL/ DUPLEX STAINLESS STEEL COMPONENTS OF COOLERS/ CONDENSERS WITH FRESH COOLING WATER SERVICE**

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
13.1	Up to 80	Sweep Blasting	1 coat of F-15 @ 80µ DFT/coat;	2 coats of F-15 @ 80µ DFT/coat;	240	-
13.2	81 to 150	Sweep Blasting	-	2 coat of F-17@ 500µ/coat	1000	-

**Note:**

Coating systems in Table – 12 & 13 are applicable only as per the requirement specified in the data sheets of the respective exchangers/equipment.

**8.0 STORAGE**

8.1 All paints and painting materials shall be stored in rooms only which are 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. Manufacturers' recommendation shall be followed for storage of paint materials.

**9.0 COLOUR CODE**

The colour coding system as per Table-14 shall be followed.

**TABLE-14: COLOUR CODING**

SR. No.	SERVICE	RECOMMENDED COLOUR FOR PAINT SYSTEM	RAL COLOUR CODE	
			BASE COLOUR	BAND COLOUR
<b>HYDROCARBON LINES (UNINSULATED)</b>				
1	CRUDE SOUR	Dark Admiralty grey with 1 orange band	7012	2011
2	CRUDE SWEET	Dark Admiralty grey with 1 red	7012	3001

		band		
3	LUBE OILS	Dark Admiralty grey with 1 green band	7012	6010
4	FLARE LINES	Heat Resistant Aluminium	9006	
5	LPG	Orange with 1 oxide red band	2011	3009
6	PROPYLENE	Orange with 2 blue bands	2011	5013
7	NAPHTHA	Orange with 1 green band	2011	6010
8	M.S.	Orange with 1 dark admiralty grey band	2011	7012
9	AV.GASOLINE (96 RON)	Orange with 1 band each of green, white and red bands	2011	6010
			9010	3001
10	GASOLINE (regular, leaded)	Orange with 1 black band	2011	9005
11	GASOLINE (premium, leaded)	Orange with 1 blue band	2011	5013
12	GASOLINE (white)	Orange with 1 white band	2011	9010
13	GASOLINE (Aviation 100/130)	Orange with 1 red band	2011	3001
14	GASOLINE (Aviation 115/145)	Orange with 1 purple band	2011	4006
15	N-PENTANE	Orange with 2 blue bands	2011	5013
16	DIESEL OIL (White)	Oxide red with 1 white band	3009	9010
17	DIESEL OIL (Black)	Oxide red with 1 yellow band	3009	1023
18	KEROSENE	Oxide red with 1 green band	3009	6010
19	HY.KEROSENE	Oxide red with 2 green bands	3009	6010
20	DISUFIDE OIL (EX-MEROX)	Oxide red with 1 black band	3009	9005
21	M.T.O	Oxide red with 3 green bands	3009	6010
22	DHPPA	Oxide red with 2 white bands	3009	9010
23	FLUSHING OIL	Oxide red with 2 black bands	3009	9005
24	LAB FS	Oxide red with 2 dark admiralty grey bands	3009	7012
25	LAB RS	Oxide red with 3 dark admiralty grey bands	3009	7012
26	LAB (Off. Spec)	Oxide red with 1 light grey band	3009	7035
27	N-PARAFFIN	Oxide red with 1-blue band	3009	5013
28	HEAVY ALKYLATE	Oxide red with red band	3009	3001
29	BLOW DOWN, VAPOR LINE	Off white / Aluminum with 1-Brown band	9006	8004
30	BLOWDOWN	Off white / Aluminum with 2 brown bands	9006	8004
31	A.T.F.	Leaf brown with 1 white band	8003	9010
32	TOULENE	Leaf brown with 1 yellow band	8003	1023
33	BENZENE	Leaf brown with 1 green band	8003	6010
34	LAB PRODUCT	Leaf brown with 1 blue band	8003	5013
35	FUEL OIL	Black with 1 yellow band	9005	1023
36	FULE OIL (Aromatic rich)	Black with 2 yellow bands	9005	1023
37	ASPHALT	Black with 1 white band	9005	9010
38	SLOP AND WASTE	Black with 1 orange band	9005	2011

	OILS			
39	SLOP AROMATICS	Black with 2 orange bands	9005	2011
<b>CHEMICAL LINES</b>				
40	TRI-SODIUM PHOSPHATE	Canary yellow with 1 violet band	1012	5000
41	CAUSTIC SODA	Canary yellow with 1 black band	1012	9005
42	SODIUM CHLORIDE	Canary yellow with 1 white band	1012	9010
43	AMMONIA	Canary yellow with 1 blue band	1012	5013
44	CORROSION INHIBITOR	Canary yellow with 1 Aluminum band	1012	9006
45	HEXAMETA PHOSPHATE	Canary yellow with 2 black bands	1012	9005
46	ACID LINES	Golden Yellow with 1 red band	1004	3001
47	RICH AMINE	Canary yellow with 2 blue bands	1012	5013
48	LEAN AMINE	Canary yellow with 3 blue bands	1012	5013
49	SOLVENT	Canary yellow with 1 green band	1012	6010
50	LCS	Canary yellow with 1 smoke grey	1012	7031
<b>WATER LINES</b>				
51	RAW WATER	Sky blue with 1 black band	5015	9005
52	INDUSTRIAL WATER	Sky blue with 2 signal red band	5015	3001
53	TREATED WATER	Sky blue with 1 oxide red band	5015	3009
54	DRINKING WATER	Sky blue with 1 green band	5015	6010
55	COOLING WATER	Sky blue with 1 light brown band	5015	1011
56	SERVICE WATER	Sky blue with 1 signal red brown	5015	3001
57	TEMPERED WATER	Sky blue with 2 green bands	5015	6010
58	DM WATER	Sky blue with 1 aluminum band	5015	9006
59	DM WATER ABOVE 150°F	Sky blue with 2 black bands	5015	9005
60	SOUR WATER	Sky blue with 2 yellow bands	5015	1013
61	STRIPPED WATER	Sky blue with 2 blue bands	5015	5013
62	ETP TREATED WATER	Sky blue with 2 oxide red bands	5015	3009
<b>FIRE PROTECTION SYSTEM (ABOVE GROUND)</b>				
63	FIRE WATER FOAM & EXTINGUISHERS	Post office red		3002
<b>AIR &amp; OTHER GAS LINES (UNINSULATED)</b>				
64	SERVICE AIR	Yellow green with 1 signal red band	6018	3001
65	INSTRUMENT AIR	Yellow green with 1 black band	6018	9005
66	NITROGEN	Yellow green with 1 orange band	6018	2011
67	FREON	Yellow green with 1 yellow band	6018	1023

68	CHLORINE	Canary yellow with 1 oxide band	1012	3009
69	SO <sub>2</sub>	Canary yellow with 2 white bands	1012	9010
70	H <sub>2</sub> S	Orange with 2 red oxide bands	2011	3009
71	GAS (Fuel)	Orange with 1 aluminum band	2011	9006
72	GAS (Sour)	Orange with 2 aluminum bands	2011	9006
73	GAS (Sweet)	Orange with 2 signal red band	2011	3001
74	HYDROGEN	Orange with 1 light green band	2011	6021

**STEAM AND CONDENSATE LINES (UNINSULATED)**

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

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

**INSULATED HYDROCARBON PIPING**

82	IFO SUPPLY	1 Black ground colour with 1 yellow band in centre	9005	1023
83	IFO RETURN	Black ground colour with 1 green band in centre	9005	6010
84	HPS	Black ground colour with 1 red band in centre	9005	3001
85	BITUMEN	Black ground colour with 2 red bands in centre	9005	3001
86	CLO	Black ground colour with 1 brown band in centre	9005	8004
87	VB TAR	Black ground colour with 2 brown bands in centre	9005	8004
88	VR AM (BITUMEN / VBU FEED)	1 Black ground colour with 1 blue band in centre	9005	5013
89	VR BH	1 Black ground colour with 2 blue bands in centre	9005	5013
90	VAC. SLOP	1 Black ground colour with 1 white band in centre	9005	9010
91	SLOP	1 Black ground colour with 1 orange band in centre	9005	2011
92	CRUDE SWEET	1 Dark admiralty grey ground colour with 1 red band in centre	7012	3001

93	CRUDE OIL	1 Dark admiralty grey ground colour with 1 orange band in centre	7012	2011
94	VGO / HCU	1 Oxide red ground colour with 2 steel grey bands in centre	3009	7011
95	OIL FEED / FCCU FEED	1 Oxide red ground colour with 2 steel grey bands in centre	3009	7011

**UNINSULATED EQUIPMENT, TANKS AND STRUCTURES**

96	HEATER STRUCTURE	Steel grey	7011
97	HEATER CASING	Heat resistant aluminium	9006
98	VESSELS & COLUMNS	Aluminium	9006
99	HYDROGEN BULLETS	Pink	3014
100	LPG VESSELS	Oxide red	3009
101	SO <sub>2</sub> VESSEL	Canary yellow	1012
102	HEAT EXCHANGER	Heat resistant aluminium	9006
103	FO TANK AND HOT TANKS	Black	9005
104	<b>ALL OTHER TANKS</b>	<b>Aluminum / Off white</b>	<b>9006</b>
105	CAUSTIC / AMINE / ACID TANKS	Golden yellow	1004
106	SOUR WATER	Sky Blue	5015
107	OUTER SURFACE IN BOILER HOUSE	Heat resistant aluminum	9006
108	<b>COMPRESSORS AND BLOWERS</b>	<b>Dark admiralty grey</b>	<b>7012</b>
109	<b>PUMPS</b>	<b>Navy blue</b>	<b>5014</b>
110	<b>MOTORS &amp; SWITCH GEAR</b>	<b>Bluish green</b>	<b>5024</b>
111	HAND RAILING	Signal red	3001
112	STAIRCASE, LADDER AND WALKWAYS	Black	9005
113	LOAD LIFTING EQUIPMENT AND MONORAILS ETC	Leaf brown	8003
114	GENERAL STRUCTURE	Black	9005
115	FLUE GAS STACK	Black	9005

**PIPES AND FITTINGS OF ALLOY STEEL AND SS MATERIAL IN STORE**

115	IBR	Signal red	3001
116	9Cr-1Mo	Verdigris green	6021
117	5Cr-0.5Mo	Satin blue	5012
118	2 <sup>1</sup> / <sub>4</sub> Cr-1 Mo	Aircraft yellow	1026
119	1 <sup>1</sup> / <sub>4</sub> Cr- <sup>1</sup> / <sub>2</sub> Mo	Traffic Yellow	1023
120	SS-304	Dark blue grey	5008
121	SS-316	Dark violet	4005
122	SS-321	Navy blue	5014

SAFETY COLOUR SCHEMES				
123	DANGEROUS OBSTRUCTION	Black and alert orange band	9005	2008
124	DANGEROUS OR EXPOSED PARTS OF MACHINERY	Alert orange	2008	

**General notes for table-14:**

1. All LPG service PSVs shall be painted deep blue.
2. All drains & vents shall be painted in main line colour.
3. The colour code scheme is for identification of piping service group. It consists of a ground colour and 1 / 2 colour bands.

**9.1 Identification**

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

**9.2 Ground colour**

On un-insulated pipes, the entire pipe has to be painted in ground colour. On metal clad insulated lines, minimum 2 m long portion should be painted.

**9.3 Colour bands**

9.3.1 Location of colour bands:

- a. At battery limits.
- b. Intersection points & change of direction points in piping.
- c. Midway of piping section, near valves, across culverts.
- d. At 50 m interval on long stretch pipes.
- e. At starting and termination points.

9.3.2 Minimum width:

<u>NB</u>	<u>Width</u>
3" and below	75 mm
Above 3" to 6"	NB X 25 mm
Above 6" to 12"	NB X 18 mm
Above 12"	NB X 15 mm

For insulated pipes, NB indicates OD of the insulation.

Sequence: Colour bands shall be arranged in sequence as shown above and the sequence follows the direction of flow. The width of the 1<sup>st</sup> Band to 2<sup>nd</sup> band is 4:1.

Wherever deemed required by process department or safety, pipes handling hazardous substances will be given hazard marking of 30 mm wide diagonal stripes of black and golden yellow as per IS : 2379.

#### 9.4 Special camouflage painting for un-insulated crude and product storage tanks

Coating system shall be as per this standard.

Camouflage painting scheme for defense requirement in irregular patches will be applied with 3 colours.

Dark green	:	Light green	:	Medium brown
5	:	3	:	2

- The patches shall be irregular and asymmetrical and inclined at 30 to 60 degrees.
- Patches should be continuous at surface meeting lines / points.
- Slits / holes shall be painted in dark green shade.
- Width of patches shall be 1 to 2 m.

#### 9.5 Identification markings on equipment/piping

Equipment tag numbers shall be stenciled/neatly painted using normal 'Arial' lettering style on all equipment and piping (both insulated & un-insulated) after completion of all paint works. Lettering colour shall be either black or white, depending upon the background, so as to obtain good contrast.

Operations group shall specify the location of the marking.

Size of the making shall be as follows:

Columns, vessels, heaters	:	150 mm
Pumps and other M/c-machinery	:	50 mm
Piping	:	OD / 2 with maximum 100 mm
Storage tanks	:	(as per drawings)

#### 9.6 Colour coding for control valve

- |                      |   |               |
|----------------------|---|---------------|
| Carbon steel body    | : | Light grey    |
| Alloy steel body     | : | Canary yellow |
| Stainless steel body | : | Natural       |
- The actuator of the control valve shall be painted as:
 

Direct action (open on air failure) valves	:	Green
Reverse acting (close on air failure) valves	:	Red

The painting status shall be comprehensively updated every 6 months for compliance.

#### 10.0 IDENTIFICATION OF VESSELS, PIPING ETC.

- Equipment number shall be stenciled in black or white on each vessel, column, equipment & machinery (insulated or un-insulated) after painting. Line number in black or white shall be stenciled on all the piping of more than one location as directed by Engineer-In-Charge. Size of letter printed shall be as below:

Column & vessels	:	150 mm (high)
------------------	---	---------------

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

## 10.2 Identification of storage tanks

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

## 11.0 PAINTING FOR CIVIL DEFENCE REQUIREMENTS

11.1 The following items shall be painted for camouflaging, if required by the client:

- a. All columns
- b. All tanks in offsite
- c. Large vessels
- d. Spheres

11.2 Two coats of selected finishing paint as per defence requirement shall be applied in a particular pattern as per clause 11.3 and as per the instructions of Engineer-In-Charge.

### 11.3 Method of camouflaging

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

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

11.3.2 The patches should be asymmetrical and irregular.

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

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

11.3.5 The patches should not coincide with the corners.

11.3.6 Slits and holes shall be painted in dark shades.

11.3.7 Width of patches should be 1 to 2 m.

## 12.0 QUALITY CONTROL, INSPECTION AND TESTING

12.1 All painting materials including primers and thinners brought to site by CONTRACTOR for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturers' test certificates. Paint formulations without certificates are not acceptable (see section 14.0 & 15.0).

12.2 The CONTRACTOR must produce test certificate from pre qualified paint manufacturer for various tests as detailed out in section 15.0 of this document. The Engineer-In-Charge shall have the right to test wet samples of paint at random for verifying quality of paint supplied. CONTRACTOR shall arrange to have such tests, when required by Engineer-in-Charge, performed at his cost at any one of the NABL accredited laboratories.

Samples for the test will be drawn at random in presence Engineer-In-Charge or his 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
- Storage stability (pot life)

Test methods for above tests shall be as per relevant ASTM or ISO Standard.

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

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

**Following tests are to be carried out during surface preparation:**

- Test for presence of oil/grease and contamination

The steel substrate after degreasing as per SSPC-SP-1 shall be tested as per following procedure to validate absence of oil and grease contamination:

- a) Visual inspection - continue degreasing until all visible signs of contamination are removed.
- b) Conduct a solvent evaporation test by applying several drops or a small splash of residue-free tri-chloromethane on the suspect area especially pitting, crevice corrosion areas or depressed areas. An evaporation ring formation is indicative of oil and grease contamination. Continue degreasing and inspection till test is passed.
  - Tests for surface finish of blasted surface shall be done by visual inspection using SSPC-VIS1. Clear cellophane tape test as per ISO 8502-3 shall be used to confirm absence of dust on blasted surface. Checks shall be done on each component at least once per 200 m<sup>2</sup> of blasted surface and a minimum of 3 checks per shift.
  - Test for presence of soluble salt as per method ISO 8502-9. Maximum allowable salt content shall be considered 20 mg/m<sup>2</sup>. Checks shall be done on each component at least once per 200 m<sup>2</sup> of blasted surface and minimum of 3 checks per shift. In case salt exceeds specified limit, the contaminated surface shall be cleaned by method as per Annexure-C of IS 12944-4 (water cleaning). After cleaning, surface shall be retested for salt after drying.

**Blast Profile Measurement:** (In-Process testing during actual production before application coating)

The angular profile depth measurement shall be done by profile tape as per method NACE Standard RP 0287 or ASTM D 4417 method B (Profile depth gauge micrometer). Spot measurement shall be carried out every 15m<sup>2</sup> of blasted surface.

At each spot three measurements shall be taken over an area of 10 cm<sup>2</sup> and average of measurements to be recorded and reported.

If profile is <65 microns blasting shall continue till grater than 65 microns depth profile is achieved.

#### **Tests for blasting media, blasting air**

**Blasting Media** (For every fresh batch of media and one random test during blasting)

Blasting Media shall be visually inspected for absence of contamination and debris using 10 X magnification.

- a) Inspection for the absence of oil contamination shall be conducted using following procedure :
  - Fill a small clean 200 ml bottle half full of abrasive.
  - Fill the bottle with potable water, cap and shake the bottle.
  - Inspect water for oil film/slick. If present, the blasting media is not to be used.
- b) Soluble salt contamination if suspected shall be verified by method ASTM D 4940. If present, media to be replaced.
- c) Clean blasting equipment, especially pot and hoses, and then replace blasting media and retest.

**Test for Blasting Air** (Once Daily before start of blasting and once at random during blasting)

The air for blasting shall be free from moisture and oil. The compressor air shall be checked for oil and water contamination per ASTM D 4285.

In addition to above, record should include type of shop primer already applied on equipment e.g. zinc silicate or zinc rich epoxy or zinc phosphate. 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 rectifying any defects found during final inspection/guarantee period/defect liability period as defined in general conditions of the 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.

#### **12.4 Final inspection of finished coating shall consist of the following:**

- 1) **Coating dry film thickness check:** DFT measurement shall be as per ISO 2808. Type II electromagnetic gauges should be used for ferrous substrates. DFT gauge calibration, number of measurement shall be as per SSPC-DA-2. Measured DFT shall be within + 10% of the dry film thickness, specified in the specifications.

**2) Adhesion testing:** Adhesion of the primer to the steel substrate and inter-coat 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 destructive and tested areas shall be repaired afterward using the spot repair procedure. Alternatively, the applicator may perform the adhesion test on a steel panel coated using the same surface preparation and coating application procedure as the work piece. Adhesion testing shall be carried out for each component at least once per 200 m<sup>2</sup> of coated surface.

**3) Holiday detection check:** 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.

### 13.0 GUARANTEE

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

### 14.0 QUALIFICATION CRITERIA OF PAINTING CONTRACTOR/SUB-CONTRACTOR

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

### 15.0 QUALIFICATION/ACCEPTANCE CRITERIA FOR PAINT COATING SYSTEM

#### 15.1 Pre-qualification of paint coating manufacturer and his products

Paint manufacturer meeting the following requirements shall be considered by the CONTRACTOR for supply of the paint products.

- 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, petrochemical, fertilizer. Chemical 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, petrochemical, fertilizer. Chemical processing industry or offshore platforms.
- 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.

CONTRACTOR shall procure the paint materials from the qualified manufacturer meeting above requirements and after obtaining prequalification testing approval as per requirements mentioned in clause 15.2 below.

## 15.2 Pre-Qualification Testing procedure:

The paint manufacturer engaged by the mechanical contractor shall carry out the tests in NABL accredited government laboratories like national test house (NTH), as a part of qualification. Paint manufacturer shall provide the paint samples to laboratory for testing of the parameters mentioned in Table-2 (typical characteristics) and Table-15 (tests on coating systems) of this specification. The testing laboratory will confirm the compliance of the paint material with respect to the acceptance criteria mentioned in the respective tables. Contractor shall furnish these test certificates along with all necessary supporting documents/information to EIL site for approval/ acceptance. The paint manufacturer will be qualified and approved by EIL site for supply of paints after review/assessment of the submissions made by the contractor. Test certificates which are more than 3 years old will not be considered. Paint manufacturers are advised to carryout pre-qualification testing accordingly for paints supply to EIL projects.

**TABLE-15: PRE-QUALIFICATION TESTING**

SYSTEM No.	COATING SYSTEM	REFERENCE CLAUSE (from table-3 to 12)	TOTAL DFT $\mu$ (min)
1.	F-9+P6+F6B+F2	6.2	345
2.	F12+F12+F12	6.4	60
3.	F15+F15+F15	9.1.1	240
4.	F16+F16	8.3.1	250
5.	F17	9.10.1	375
6.	F8+F8	9.8.1	200
7.	F20+F20	9.5.1	1100
8.	F6A+F6C+F6C	9.4.1	500
9.	F6A+F6A+F6A	9.3.1	300

S. No.	TEST	FOR SYSTEM NUMBER	DURATION	ACCEPTANCE CRITERIA
1.	<u>Cyclic Test</u> Salt Spray : 72 hrs. Drying in air: 16 hrs. UV-A340 nm weather meter: 80 hrs. One cycle: 168 hrs. (25 cycles at 168 hrs. each cycle) (ASTM D5894)	1	4200 hrs	Shall pass. No chalking, cracking, flaking, blistering or peeling shall be observed.

2.	Chemical Resistance Test (ASTM D543)			
2a.	10% & 40% NaOH	3,5,7 & 9*  *H <sub>2</sub> SO <sub>4</sub> solution pH = 5.0 to 5.5 for system 10	1000 hrs	Shall pass. No cracking, discoloration, blistering, peeling or softening of film shall be observed.
2b.	5% H <sub>2</sub> SO <sub>4</sub>		168 hrs	
2c.	Xylene		4 weeks	
2d.	Acetone		4 weeks	
2e.	Ethanol		4 weeks	
2f.	Kerosene		4 weeks	
2g.	Sea water		2000 hrs	
3.	Immersion in DM/DI water @90° (ASTM C868)	3,5 & 7	30 days	No softening, blistering or film damage.
4.	Resistance to DM water using water immersion. (ASTM D870)	8	2000 hrs	Shall pass. No chalking, cracking, flaking, blistering or peeling.
5.	100% Humidity Test (ASTM D2247)	1 to 9 (except system-2 )	1440 hrs	Shall pass
6.	Thermal Shock Resistance Test; 5 cycles @ 30 minutes in furnace at 120 ° C and 15 minutes in water after quenching in water for each cycle. (ASTM D2485 method A)	2,3 & 4  (For system-2, testing to be done after heating the panels at 175°C for 2 hrs.)	-	Shall pass
7.	Cathodic Disbondment Test (ASTM G8 @60°C)	3&5	-	Shall pass

Each coating product to be qualified shall be identified by the following:

- 1) Specific gravity of Base and curing agent (Ref. ISO 2811)
- 2) Ash content (ASTM D1650), 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.

### 15.3 Information to be furnished during delivery of paint materials:

CONTRACTOR along with delivery of paint material has to furnish following information from paint manufacturer to EIL for acceptance/approval of products:

a) Batch test certificates:

Along with paint products delivery to site from the pre-qualified coating manufacturer, CONTRACTOR has to produce test certificate (from paint manufacturer) for each category of product for the following test items. All test results must mention clearly the batch no. and category of product tested. Tests to be conducted for following properties:

- 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.

The contractor shall be fully responsible for the quality of the paints products as per prequalification testing. After the paint materials are supplied to site, the supplier shall organize random sampling and testing in a NABL laboratory as per discretion of the Engineer-in-charge. Failing to meet the specified quality requirements may cause rejection of the paint products.

### 16.0 METHOD OF SAMPLING & DISPATCH FOR LABORATORY TESTING

(Pre-Qualification tests (sec. 15.2), Batch testing (sec. 15.3) and Inspection testing (sec. 12.0))

- 16.1 Samples of coating materials should be submitted to the laboratory in sealed containers with batch no. and test certificate on regular format of manufacturer's testing laboratory.
- 16.2 All test panels should be prepared by testing laboratory. Surface preparation for a system shall be done in accordance with this specification. For individual products testing, minimum shall be Sa 2.5. Colour 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.
- 16.3 Manufacturers should intimate EIL, details of sample submitted for testing, name of testing agency, date, and contact personnel of the testing agency.

GENERAL											
1											
2	Project: <b>RRP</b>				Job No.: <b>B224</b>						
3	Owner: <b>HRRL</b>				Site: <b>BARMER, RAJASTHAN</b>						
4	Purchaser:				Unit:		Unit No.:				
5	No. Required:	Working:	Standby:	Driven Equipment:							
6	Applicable to	<input checked="" type="checkbox"/> Proposal	<input type="checkbox"/> Purchase	<input type="checkbox"/> As-Built							
7	Note: <input checked="" type="checkbox"/> Scope Option & Information specified by Purchaser <input type="checkbox"/> Information required from & options left to vendor Vendor to cross( <input checked="" type="checkbox"/> )the selected Option										
8	Manufacturer:				Model:						
9	<b>APPLICABLE CODES &amp; STANDARDS</b>										
10	<b>API Standard 611 &amp; job Specifications</b>										
11	<b>OPERATING CONDITIONS</b>				<b>PERFORMANCE</b>						
12	<b>Operating Point</b>	<b>Power (kW)</b>	<b>Speed (RPM)</b>	<b>Operating Point / Steam Condition</b>		<b>No. of Hand Valves Open</b>		<b>Steam Rate, kg/kW-hr</b>			
13	Normal (Rated BkW of Driven Eqp.)			Rated BkW of Driven Equip. (Normal inlet, Normal Exhaust)							
14											
15	Rated (Turbine Rating)			Rated BkW (Turbine Rating) / (Normal inlet, Normal Exhaust)							
16											
17	Other			Rated BkW (Turbine Rating) / (Min. Inlet, Max. Exhaust)							
18											
19	<b>SITE / INSTALLATIONS DATA</b>										
20	Rated BkW of Driven Equip. (Min. Inlet, Max. Exhaust)										
21	Application (Spared, Unspared):				<b>CONSTRUCTION FEATURES</b>						
22	<input type="checkbox"/> Wide Speed Range		<input type="checkbox"/> Rapid start		Turbine Type		<input checked="" type="checkbox"/> Horiz.		<input type="checkbox"/> Vertical		
23	<input type="checkbox"/> Slow Roll Required		<input type="checkbox"/> Hand Valves Req.		<input type="checkbox"/> No of Stages		Wheel Dia.(mm)				
24	<input checked="" type="checkbox"/> Duty: <input checked="" type="checkbox"/> Continuous		<input type="checkbox"/> Standby		Rotor <input type="checkbox"/> Builtup Up <input type="checkbox"/> Solid <input type="checkbox"/> Overhung		<input checked="" type="checkbox"/> Between Brgs.				
25	<input type="checkbox"/> Unattended Auto Start				Blading		<input type="checkbox"/> 2		<input type="checkbox"/> 3 Row <input type="checkbox"/> Re-entry		
26	Location		<input type="checkbox"/> Indoor <input checked="" type="checkbox"/> Outdoor		Casing Split		<input type="checkbox"/> Radial				
27	<input type="checkbox"/> Heated <input checked="" type="checkbox"/> Unheated		<input type="checkbox"/> Underroof <input checked="" type="checkbox"/> W/o Roof		Casing Support		<input checked="" type="checkbox"/> Centerline		<input type="checkbox"/> Foot		
28	Ambient Temp. °C		Min. Max.		<input type="checkbox"/> Vert. Jackscrews						
29	Unusual Conditions <input type="checkbox"/> Dust <input type="checkbox"/> Salt Atm. <input checked="" type="checkbox"/> Refinery Atm.				Vert. Turbine Flange <input type="checkbox"/> NEMA "P" base <input type="checkbox"/> Others						
30	Elect. Area Class		Group: Div.		Trip Valve		<input type="checkbox"/> Integral		<input type="checkbox"/> Separate		
31	<input type="checkbox"/> Non-Hazardous		<input checked="" type="checkbox"/> Hazardous		Interstage Seals		<input type="checkbox"/> Labyrinth		<input type="checkbox"/> Carbon		
32	Control Power V _____ Ph. _____				End Seals: <input type="checkbox"/> Mechanical		<input type="checkbox"/> Carbon Ring, No./Box				
33	Aux. Motor V _____ Ph. _____						<input type="checkbox"/> Labyrinth <input type="checkbox"/> Material				
34	Allow. Sound Press Level		85 dBA @ 1m		<input type="checkbox"/> Mechanical Seal Mfr :						
35	<b>UTILITY DATA</b>				<input type="checkbox"/> Type Radial Bearings <input type="checkbox"/> Type Thrust Bearing						
36	Cooling Water: Press, kg/cm <sup>2</sup> g		ΔP, kg/cm <sup>2</sup>		<input type="checkbox"/> Cal. Thrust Load: kg/cm <sup>2</sup> <input type="checkbox"/> Brg's Mfr. Ultimate Rating						
37	Flow, m <sup>3</sup> /h		ΔT, °C		Thrust Collar		<input type="checkbox"/> Replaceable <input type="checkbox"/> Integral <input type="checkbox"/> None				
38	<b>Remarks:</b>				<input type="checkbox"/> Turbine Suitable for autostart without warmup						
39					<input type="checkbox"/> Lube Oil Viscosity ISO Grade:						
40	<b>STEAM CONDITIONS@ Steam Turbine Inlet &amp; Outlet Flange (Refer P&amp;ID)</b>				Lubrication <input type="checkbox"/> Ring Oiled <input type="checkbox"/> Pressure <input type="checkbox"/> Grease						
41	<b>STEAM</b>		<b>MIN</b>	<b>NORMAL</b>	<b>MAX</b>	<b>DESIGN</b>	Oil Mist <input type="checkbox"/> Purge Oil Mist <input type="checkbox"/> Pure Oil Mist				
42							<input type="checkbox"/> Brg. Housing Oiler Type:				
43	Inlet Press (kg/cm <sup>2</sup> g)						<input type="checkbox"/> CASING DESIGN		INLET OUTLET		
44	Inlet Temp. (°C)						Max. Allow. Press,(kg/cm <sup>2</sup> G)				
45	Exhaust Press (kg/cm <sup>2</sup> g)						Max. Allow. Temp., °C				
46	<input type="checkbox"/> Steam Containments				Hydro Test Press(kg/cm <sup>2</sup> G)(1.5 X MAWP)						
47	<b>CONNECTIONS</b>										
48	<b>TURBINE DATA</b>						Size	Rating	Facing	Position	Mating Parts furnished
49	<input type="checkbox"/> Allow Speed, RPM		Max.: Min.:								
50	<input type="checkbox"/> Max. Cont. Speed, RPM						Inlet				
51	<input type="checkbox"/> Trip Speed, RPM		Blade Tip Vel.,(mm/s)				Exhaust				
52	<input type="checkbox"/> First Critical Speed,RPM						Drains				
53	<input type="checkbox"/> Exh.Temp. °C		Normal No Load		<b>STEAM CONTROL</b>						
54	<input type="checkbox"/> Potential Max. Power,KW				Governor Type		<input checked="" type="checkbox"/> Hydr. <input checked="" type="checkbox"/> Electronic		<input type="checkbox"/> Oil Relay <input type="checkbox"/> Other		
55	<input type="checkbox"/> Max. Nozzle Steam Flow,kg/hr				NEMA Class: <b>D</b>						
56	Rotation Facing Governor End		<input type="checkbox"/> CCW <input type="checkbox"/> CW		Speed Changer		<input checked="" type="checkbox"/> Manual <input type="checkbox"/> Pneum <input type="checkbox"/> Elect.				
57	<input type="checkbox"/> Driven Equipment Thrust (Vertical Turbine)				Mfr. Model						
58	<input checked="" type="checkbox"/> Water Piping Furn. By		<input checked="" type="checkbox"/> Vendor <input type="checkbox"/> Others		Controlled Variable		Operating Range		Controlled Signal		
59	<input type="checkbox"/> Oil Piping Furn. By		<input type="checkbox"/> Vendor <input type="checkbox"/> Others		Speed		To rpm		To kg/cm <sup>2</sup> /mA		
60	(\$): Mechanical design conditions						To rpm		To kg/cm <sup>2</sup> /mA		

MATERIALS						ACCESSORY EQUIPMENT BY VENDOR			
62	<input type="checkbox"/> High Pressure Casing					<input checked="" type="checkbox"/> Remote Trip <input checked="" type="checkbox"/> Solenoid <input type="checkbox"/> Remote Start <input type="checkbox"/> Solenoid			
63	<input type="checkbox"/> Exhaust Casing					<input type="checkbox"/> Vacuum Breaker <input type="checkbox"/> Automatic steam sealing System			
64	<input type="checkbox"/> Nozzles					<input type="checkbox"/> Gland Vacuum Device <input type="checkbox"/> Water Eductor <input type="checkbox"/> Steam Ejector			
65	<input type="checkbox"/> Blading <input type="checkbox"/> Wheels					<input checked="" type="checkbox"/> Sentinel Warning Valve			
66	<input type="checkbox"/> Shaft					<input checked="" type="checkbox"/> Insulation Type <input checked="" type="checkbox"/> Metal Insulation Jacket			
67	<input type="checkbox"/> Shaft Coating Under Packing: <input type="checkbox"/> Material					<input checked="" type="checkbox"/> Tachometer Type: Self Powered			
68	Application Method <input type="checkbox"/> Thickness					MFR.: _____ Model: _____			
69	<input type="checkbox"/> Gov. Valve Trim <input checked="" type="checkbox"/> Inlet Strainer SS					Mounted By: _____ <input type="checkbox"/> Thermal Relief Valves			
70	<input type="checkbox"/> Coupling Spacer Hubs <input type="checkbox"/> Diaphragm (Disks)					<input type="checkbox"/> Shut off valves for Shut Down Sensors <input type="checkbox"/> Vent silencer			
71	COUPLINGS					<input checked="" type="checkbox"/> Local Gauge Board With Following Pressure Gauges:			
72	Turbine- Driven Equipment					<input checked="" type="checkbox"/> Throttle		<input type="checkbox"/> First Stage	
73						<input checked="" type="checkbox"/> Nozzle		<input checked="" type="checkbox"/> Exhaust	
74	Manufacturer					<input type="checkbox"/> Liquid Filled Type Gauges			
75	Model					<input checked="" type="checkbox"/> Instrument Panel(Local) <input checked="" type="checkbox"/> Base Mount <input type="checkbox"/> Free Standing			
76	Rating (kW / 100 RPM)					<input type="checkbox"/> Safety Switches & Control Devices by Vendor			
77	Lubrications					<input checked="" type="checkbox"/> Auto Drain Traps <input checked="" type="checkbox"/> Blow off piping with silencer			
78	Limited End Float					EXTERNAL LUBE OIL SYSTEM			
79	Spacer Length					<input type="checkbox"/> Circulating		<input checked="" type="checkbox"/> Pressure	
80	Service Factor					Vendor System as per API 611 for:		<input checked="" type="checkbox"/> Turbine	
81	Turbine Vendor Mounts half					<input type="checkbox"/> Other			
82	Coupling					Oil System To be: Common Force feed lubrication system for Compressor and Steam turbine			
83	Dynamic Balance: <input type="checkbox"/> AGMA Class 8 <input type="checkbox"/> Other					<input type="checkbox"/> Mounted On Baseplate <input checked="" type="checkbox"/> Console Type			
84	Turbine Shaft: <input type="checkbox"/> Taper <input type="checkbox"/> Straight <input type="checkbox"/> Hydr. Fit Hub					Oil System To Include Following Equipment:			
85	ENGINEERING REQUIREMENTS					<input checked="" type="checkbox"/> Standby Oil Pump: <input checked="" type="checkbox"/> Type Driver			
86	<input checked="" type="checkbox"/> Supply Engr. Data For Lateral/Torsional Analyses					<input checked="" type="checkbox"/> Low Oil Pressure Alarm Switch <input checked="" type="checkbox"/> Low Oil Pressure Trip Switch			
87	<input type="checkbox"/> Calcs. AND/OR Data For Separation Margin					<input checked="" type="checkbox"/> Heater <input checked="" type="checkbox"/> Electric <input type="checkbox"/> Steam			
88	<input type="checkbox"/> Train Torsional Vibration Analysis					<input type="checkbox"/> Oil Drain Site Flow Indicators <input type="checkbox"/> Hand operated standby pump			
89	<input type="checkbox"/> Residual Unbalance Check					Bearing Housing Temperature Monitoring:			
90	<input type="checkbox"/> Electrical And Mechanical					Bearing metal temp. Sensors/monitors for <input type="checkbox"/> Radial brgs <input type="checkbox"/> Thrust			
91	<input type="checkbox"/> Gears, When Furnished, Shall Conform To					VIBRATION AND POSITION DETECTORS			
92	<input type="checkbox"/> API-677 <input type="checkbox"/> Other					<input type="checkbox"/> Furnish Provisions For Mounting Non-Contacting			
93	Integral Gear Type: <input type="checkbox"/> Single Helical					Vibration Probes			
94	<input type="checkbox"/> Double Helical <input type="checkbox"/> Epicyclic					<input checked="" type="checkbox"/> Furn. Axial Position Probes		<input checked="" type="checkbox"/> 2 No. Of Probes	
95	<input checked="" type="checkbox"/> Submit Campbell And Goodman Diagrams					<input type="checkbox"/> Mfr. _____		<input type="checkbox"/> Model _____	
96	Remarks:					<input checked="" type="checkbox"/> Furn. Radial Probes		<input checked="" type="checkbox"/> 2 No. Of Probes Per Bearing	
97	SHOP INSPECTION & TESTING (Also refer ITP)					<input type="checkbox"/> Mfr. _____		<input type="checkbox"/> Model _____	
98	<input type="checkbox"/> 100% Ultrasonic Inspect. After Rough Machining					<input type="checkbox"/> Furn. Vel/Acc Transducers		<input type="checkbox"/> No. Per Bearing	
99	<input checked="" type="checkbox"/> Special NDT Inspection Of Following Parts:					<input type="checkbox"/> Mfr. _____		<input type="checkbox"/> Model _____	
100	Casting Surface Inspection		<input type="checkbox"/> MSS SP-55 <input type="checkbox"/> Other			Vib./Axial Monitors:		Turbine Vendor Eqpt. Driven Equipment Purchaser	
101	<input checked="" type="checkbox"/> Weld Inspection		<input type="checkbox"/> Special Inspection			Furnished By		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
102	COMPONENT	MAG.	DYE	<input type="checkbox"/>	<input type="checkbox"/>	OBS	WITD	Mounted By	
103	PART.	PENET	GRAPHIC TEST	TEST				MOUNTING PLATES	
104	<input type="checkbox"/> T & T Valve	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Type: <input checked="" type="checkbox"/> Base Plate <input type="checkbox"/> Sole Plate	
105	<input type="checkbox"/> STM Chest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Furn. By: <input type="checkbox"/> Turbine Vendor <input checked="" type="checkbox"/> Driven Eqpt Vendor	
106	<input type="checkbox"/> Casing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Equip. To Be Mounted: <input checked="" type="checkbox"/> Turbine <input type="checkbox"/> Gear <input checked="" type="checkbox"/> Pump	
107	<input type="checkbox"/> Piping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> UngROUTED Baseplate <input type="checkbox"/> Suitable for Column Mounting	
108	<input type="checkbox"/> Rotor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Turbine Vendor Furnishes Subplates	
109		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	WEIGHTS (kg)	
110	TESTS			Require	Witnessed	Observed	<input type="checkbox"/> Turbine: _____ <input type="checkbox"/> Rotor: _____		
111	Hydrostatic			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Turbine upper half casing: <input type="checkbox"/> Baseplate:		
112	Mech. Run (both main and spare rotor)			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> T&T valve:		
113	Bearing Oil Flow			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Max. Maintenance weight: <input type="checkbox"/> Misc:		
114	Performance			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Total shipping weight:		
115	Complete unit			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PREPARATION FOR SHIPMENT		
116	Gear			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Turbine Auxiliary Equipment And Spare Rotor Prepared For:		
117	Sound Level			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Domestic Shipment - <input checked="" type="checkbox"/> Export Shipment		
118	Aux. Equipment			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Turbine Prepared For Extended Storage ___12___ Months		
119	Unitization at pump vendor's shop (Refer pump datasheet)			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Spare Rotor Prepared For Extended Storage ___12___ Months		

120	<b>Remarks:</b>
121	1. Refer site and utility data attached elsewhere in Tender
122	2. Refer electrical specification.
123	3. Refer job spec attached elsewhere in Tender
124	4. Turbine manufacturer shall supply trip valve either integral or separate type based on his recommendation.
125	5. NDT shall be performed as per the manufacturer standard practice.
126	6. The turbine shall be designed to deliver 110% of the pump rated BkW at its corresponding speed with minimum steam inlet condition and maximum steam exhaust condition. Turbine rating shall not be lower than motor rating of the standby pump unit. Any pressure losses due to vendor supplied line mounted instruments to be accounted for by vendor during steam turbine sizing.
127	7. Shaft end seals shall be Mechanical seals.
128	8. For acceptable makes of the steam turbine (general purpose), refer vendor list attached elsewhere in the MR.
129	9. Hydrotest pressure shall be 1.5 times the standard casing MAWP.
130	10. Turbine shall be designed to operate with entire range of inlet and exhaust conditions.
131	11. All equipment necessary to condense external leakage of sealing steam shall be provided. This equipment shall be sized to handle at least twice the steam leakage calculated for labyrinth seal clearance at retirement value or twice initial clearance whichever is greater.
132	12. The steam turbine companion flanges, piping components and other instrumentation items like pressure safety valve, Thermo well, Shutoff valve shall be IBR certified. Please refer to Instrumentation specification for further requirements.
133	13. Companion flanges along with complete set of bolts, nuts, gaskets etc. for steam turbine inlet and exhaust connection are in vendor's scope of supply.
134	14. Vendor shall supply steam turbine complete with all associated instrumentation as per Instrumentation specification & P&ID attached elsewhere.
135	15. This is typical datasheet. Contractor shall fill the datasheet for each items separately for preparation of enquiry documents and Owner/PMC's approval.

**EXPERIENCE RECORD - STEAM TURBINE (GENERAL PURPOSE)**

SERVICE :

ITEM NUMBER. :

VENDOR. :

**INSTRUCTIONS TO BIDDERS:**

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

**Description of Model designation system :**

EXPERIENCE RECORD PROFORMA  
STEAM TURBINE (GENERAL PURPOSE)

ITEM NO.: \_\_\_\_\_

SL. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS			REMARKS
			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
1	<b>GENERAL</b>					
1.1	Cross reference to manufacturer's Standard Reference list	----				
1.2	Model Number					
1.3	Type (Condensing / Backpressure)					
1.4	Number of stages					
1.5	Number of units supplied					
1.6	Type of drive arrangement (Direct / Thru gear box etc.)					
1.7	Type of driven equipment					
1.8	Type of lubrication system : API 611 / API 614					
1.9	Shop where turbine is designed, manufactured & tested with location & complete address					
2	<b>OPERATING CONDITIONS</b>					
2.1	Inlet pressure: rated/design (kg/cm <sup>2</sup> A)					
2.2	Inlet temperature: rated/design (EC)					
2.3	Exhaust pressure: rated/design (kg/cm <sup>2</sup> A)					
2.4	Exhaust temperature: rated/design (EC)					
2.5	Turbine rating (kW)					
2.6	Rated speed of turbine (rpm)					
2.7	Turbine efficiency (%)					
2.8	MAWP (kg/cm <sup>2</sup> G)					
2.9	Hydrostatic test pressure (kg/cm <sup>2</sup> g)					
3	<b>CONSTRUCTION</b>					
3.1	Casing Split: Axial/radial split					

SL. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS			REMARKS
			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
3.2	Casing support: Centerline/Foot					
3.3	Wheels: Simply supported / Overhung					
3.4	Wheel diameter (mm)					
3.5	Rotor: Solid / Built up					
3.6	Number of blades per stage					
3.7	Tip speed (m/s)					
3.8	Bearings Type: Journal: Thrust:					
3.9	Type of bearing lubrication: Ring oiled/Pressurised					
3.10	Span between bearing centres (mm)					
3.11	Shaft diameter under Bearings (mm)					
3.12	Whether quoted model and reference model : a. has identical mechanical design b. has identical thermodynamic design					
4	<b>MATERIALS OF CONSTRUCTION</b>					
4.1	Casing : Inlet / Exhaust					
4.2	Stationary Blading					
4.3	Moving Blading					
4.4	Shaft					
4.5						
5	<b>OTHER INFORMATION ON INSTALLATIONS</b>					
5.1	Date of supply of entire unit					
5.2	Date of commissioning of entire unit					

**EXPERIENCE RECORD PROFORMA  
STEAM TURBINE (GENERAL PURPOSE)**

ITEM NO.: \_\_\_\_\_

SL. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS			REMARKS
			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
5.3	No. of operating hours completed as on the date of issue of material requisition					
5.4	Major Problems encountered					
5.5	Name of plant					
5.6	Purchaser's Name and Address					
	Name (Company / Organization)					
	Name of Contact Person					
	Address					
	Telephone No.					
	Fax No.					
	email-id					

विक्रेता कार्यशाला में  
सकारात्मक सामग्री पहचान  
के लिए मानक विनिर्देश

STANDARD SPECIFICATION  
FOR  
POSITIVE MATERIAL  
IDENTIFICATION  
(PMI)  
AT SUPPLIER'S WORKS

3	19.09.16.	REVISED AND RE-ISSUED	TKK	HP	RKS	RN
2	20.10.11	REVISED AND RE-ISSUED	RKS	SCG	AKC	DM
1	15.07.08	REVISED AND RE-ISSUED	NKR	SSL	SKP	VC
0	07.12.00	ISSUED AS STANDARD SPECIFICATION	AKC	AKB	AKB	MI
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

**Abbreviations:**

API	:	American Petroleum Institute
AS	:	Alloy Steel
HIC	:	Hydrogen Induced Cracking
LSTK	:	Lump Sum Turn Key
NACE	:	National Association of Corrosion Engineers
PMI	:	Positive Material Identification
RTJ	:	Ring Type Joint
Sch	:	Schedule
SS	:	Stainless Steel
TPI or TPIA	:	Third Party Inspection Agency

**Inspection Standards Committee**

**Convenor:** Mr.R K Singh

**Members:** Mr. Rajeev Kumar  
Mr. Himangshu Pal  
Mr. Neeraj Mathur  
Mr. T Kamalakannan  
Mr. Mahendra Mittal  
Mr. Deepak Gupta (Project)

CONTENTS

1.0	SCOPE.....	4
2.0	REFERENCE DOCUMENTS.....	4
3.0	DEFINITIONS.....	4
4.0	PMI EXAMINATION.....	5
5.0	ACCEPTABLE METHODS FOR PMI.....	5
6.0	EXTENT OF PMI EXAMINATION.....	6
7.0	ACCEPTANCE CRITERIA.....	6
8.0	REJECTION CRITERIA.....	8
9.0	RECORDING AND DOCUMENTATION.....	7
10.0	MARKING.....	7

## 1.0 SCOPE

- 1.1 This specification applies to the requirements for Positive Material Identification (PMI) to be performed at the Supplier's works on Metallic Materials procured either directly by the Owner/EIL/ LSTK contractor or indirectly through the sub-Suppliers.
- 1.2 This specification covers the procedures and methodology to be adopted to assure that the chemical composition of the material is consistent with the material specifications as specified in purchase documents using 'Alloy Analyzer' at the time of final inspection before dispatch.
- 1.3 The scope of this specification shall include but shall not be limited to Positive Material Identification (PMI) to be performed on Materials listed below:
- 1.3.1 For alloy Steel materials as below:
- Alloy Steel Pipes including Clad Pipes
  - Alloy Steel Flanges & Forgings
  - Alloy Steel Fittings including Clad Fittings
  - Alloy Steel Fasteners
  - Alloy Cast & Forged steel valves
  - Alloy Steel Instrumentation Items (Control Valves, Safety Valves etc.)
  - Longitudinal Pipe & Fittings Welds.
  - Gaskets (for Ring Type Joints)
- 1.3.2 For Carbon Steel materials as below:
- All Carbon Steel Piping items under NACE or HIC or H<sub>2</sub> or Wet Hydrogen Sulfide (H<sub>2</sub>S), Hydrofluoric acid (HF), Sulfuric acid (H<sub>2</sub> SO<sub>4</sub>) services etc.
  - Carbon Steel flanges and valves (Rating 900# and above)

Following items shall be excluded from scope of PMI examination.

- Gaskets other than for Ring Type Joints
  - Internal Components of Valves
- 1.4 All grades of material supplies including Stainless Steels shall be liable for PMI test at site. In case of any defective materials being found at site, the Supplier shall be responsible to effect replacement of such defective materials at project site without any delays to the satisfaction of EIL site RCM (Resident Construction Manager).

## 2.0 REFERENCE DOCUMENTS

- 2.1 API Recommended Practice 578 (First Edition, May 1999) - Material Verification Program for New and Existing Alloy Piping Systems.

## 3.0 DEFINITIONS

- 3.1 **Supplier:** Any Supplier or Manufacturer on whom an order is placed for the supply of referred items. This definition shall also include any sub-Supplier or manufacturer on whom a sub-order is placed by the Supplier.
- 3.2 **Inspection Lot:** A group of items offered for inspection covered under same size, Heat and Heat treatment lot.
- 3.3 **Alloy Material:** Any metallic material (including welding filler materials) that contains alloying elements such as Chromium, Nickel, Molybdenum or Vanadium, which are intentionally added to enhance mechanical or physical properties and/or corrosion resistance.

#### **4.0 PMI EXAMINATION**

- 4.1** The Supplier shall submit a procedure of PMI to comply with the requirements of this Specification. Approval of PMI Procedure shall be obtained from Owner / EIL / TPIA prior to commencing manufacture / inspection of product.
- 4.2** PMI examination of materials is independent of any certification, markings or colour coding that may exist and is aimed at verifying that the alloy used are as per specified grades.
- 4.3** The Supplier shall identify all incoming alloy materials and maintain full traceability of all alloy materials, including all off-cuts. Transfer of identification marks shall be undertaken prior to cutting to ensure maintenance of identification on off-cuts.
- 4.4** The Supplier shall ensure that all alloy materials are segregated and stored in separately identified locations to prevent the mix up of materials of different alloy specifications or alloy material with carbon steel. Non ferro-magnetic materials shall be segregated at all times from ferro-magnetic materials.
- 4.5** PMI examination is subject to surveillance inspection by Owner / EIL / TPIA.

#### **5.0 ACCEPTABLE METHODS FOR PMI**

- 5.1** The method used for PMI examination shall provide a quantitative determination of the alloying elements like Chromium, Nickel, Molybdenum or Vanadium in Alloy Steel items.
- 5.2** Instruments or methods used for PMI examination shall be able to provide quantitative, recordable, elemental composition results for positive identification of alloying elements present.
- 5.3** The acceptable instruments for alloy analyzer shall be either "Portable X-Ray fluorescence" or "Optical Emission" type each capable of verifying the percentage of alloy elements within specified range.
- 5.4** Chemical spot testing, magnets, alloy sorters and other methods using eddy current or triboelectric testing methods are not acceptable for PMI examination.
- 5.5** The PMI instrument used shall have the sensitivity to detect the alloying elements in the specified range.
- 5.6** All PMI instruments shall have been serviced within a 6 month period of the time of use to verify the suitability of batteries, sources etc., and the data of the last service shall be stated on the PMI Report Form (Sample enclosed).
- 5.7** Each analyzer must be calibrated according to the manufacturer's specification at the beginning and end of each shift. Instrument must be checked against known standard for each alloy type to be inspected during the shift.
- 5.8** Certified samples, with full traceability, of a known alloy materials shall be available for use as a random spot check on the instrument calibration.
- 5.9** The surfaces to be examined shall be prepared by light grinding or abrasive paper and solvent cleaner. Evidence of Arc burn resulting from examination shall be removed by light grinding or abrasive paper. No permanent marks, which are injurious to the usage of product in service, are acceptable.

- 5.10 Alloy Steel ring type joint Gaskets shall be inspected by using portable X-Ray fluorescence instrument.
- 5.11 Testing shall be done as per the procedures outlined by the manufactures of alloy analyzer being used. Modification of these procedures if any must be approved by Owner/EIL.
- 5.12 The persons performing PMI shall demonstrate their capabilities to the satisfaction of Owner/EIL/TPIA visiting engineer. If the Supplier has qualified operator on their rolls, he may perform the examination. Otherwise PMI examination shall be sub-contracted to an independent testing agency approved by EIL.
- 5.13 Whenever material is identified as not meeting requirements by the visiting engineer a rejection note shall be issued.

**6.0 EXTENT OF PMI EXAMINATION**

Following sampling plans shall be applicable for PMI examination of various items.

A.	Flanges, Fittings Valves, RTJ Gaskets	-	100%
B.	Pipes	-	100% (for pipes procured from traders).  2 random samples drawn from each Size/Heat/Lot (for pipes procured directly from mills)
C.	Fasteners	-	
	<b><u>Lot Size</u></b>		<b><u>Sample Size</u></b>
	Upto 100		2% (Min 2)
	101 to 500		1% (Min 3)
	501 and above		0.5% (Min 5)

**Note:**

- a. For Welded Pipes and Fittings, PMI shall be performed on Base Metal as well as weldments.

**7.0 ACCEPTANCE CRITERIA**

**7.1 Base Metal**

PMI test results showing presence of characteristic elements upto 10% less than the minimum specified value in the material specification and upto 10% more than the maximum specified value in the material specification shall be acceptable.

**7.2 Deposited Weld Metal**

For deposited weld metal using welding consumables matching with base metals, the recorded presence of characteristic elements upto 12.5% less than the minimum specified value in the welding consumable specification and upto 12.5% more than the maximum specified value in the welding consumable specification shall be acceptable.

## 8.0 REJECTION CRITERIA

- 8.1 If PMI test results fall outside the acceptable range as specified in 7.0 above, the supplier shall obtain a quantitative check analysis performed by a laboratory acceptable to Owner / EIL / TPIA for a complete chemical analysis. Alternatively, the item can be tested with a spark analyser for verification. Results of this analysis shall be submitted to Owner / EIL / TPIA for final decision.

Decision of Owner / EIL / TPIA shall be final in this regard.

- 8.2 If any sample drawn to PMI test on the basis of percentage selection as per 6.0 above, fails to meet specification requirements, 100% of items of lot shall be tested for PMI by supplier. Any failure thereafter during sample check shall mean rejection of whole lot.

## 9.0 RECORDING AND DOCUMENTATION

The results of PMI examination shall be recorded in a Report Format as enclosed with this specification.

## 10.0 MARKING

- 10.1 All alloy materials tested by PMI shall be identified using either of the following methods by indicating "PMI OK"
- a) Bar Code/Hologram Sticker
  - b) A low stress stamp marking

POSITIVE MATERIAL IDENTIFICATION REPORT BULK MATERIALS							Page	of
Project:	Client					Job No.		
PMI Report No.	Supplier/Sub-Supplier							
Purchase Order No.	Testing Agency							
Purchase Requisition No:	PMI Location							
Bulk Item Type (as per Requisition)								
Material Specification/Grade								
Number of items in Lot								
Requisition Item No./ Description	Major content, Weight Percent						Remarks Accept/Reject	
Element	Cr	Ni	Mo	V	Ti*	Cb / Nb **		
Specified Range								
Actual observations								
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
Instrument Type / ID								
Last Service Date	Inspection Agency					Witnessed By		

\* To be reported in case of SS321 Material

\*\* To be reported in case of SS347 Material

# GUIDELINE FOR INSTRUMENTATION

D	17.05.19	Revised & Reissued	NA	RK	SB
C	18.04.19	Revised & Reissued	NA	RK	SB
B	20.11.18	Revised & Issued based on Client Comments	NA	RK	SB
A	29.10.18	ISSUED AS GUIDELINE.	NA	SG	SB
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

**Abbreviations:**

AARH	:	Arithmetic Average Roughness Height
AC	:	Alternating Current
AWG	:	American Wire Gauge
CPU	:	Central Processing Unit
CRCA	:	Cold Rolled Cold Annealed
DCS	:	Distributed Control System
DPDT	:	Double Pole Double Throw
DPST	:	Double Pole Single Throw
DTM	:	Device Tool Manager
DVD	:	Digital Versatile Disc
EDDL	:	Electronic Device Description Language
FDT	:	Field Device Tool
FF	:	Foundation Fieldbus
FISCO	:	Fieldbus Intrinsically Safety Concept
FNICO	:	Fieldbus Non-Incendive Concept
HART	:	Highway Addressable Remote Transducer
HIC	:	Hand Indicating controller
HMI	:	Human Machine Interface
HT	:	High Tension
I/O	:	Input /Output
IP	:	Ingress Protection
IU	:	Interface Unit
LAS	:	Link Activity Scheduler
LED	:	Light Emitting Diode
LT	:	Low Tension
MAWP	:	Maximum Allowable Working Pressure
MCB	:	Miniature Circuit Breaker
MCC	:	Motor Control Center
MR	:	Material Requisition
MCCR	:	Main Control Room Refinery
MCRP	:	Main control room Petrochemical
NB	:	Nominal Bore
NC	:	Normally Close
NO	:	Normally Open
NPT	:	National Pipe Threads
NPTF	:	National Pipe Threads Female
NPTM	:	National Pipe Threads Male
P&ID	:	Piping and Instrumentation Diagram
PID	:	Proportional, Integral and Derivative
PLC	:	Programmable Logic Controller
PTC	:	Performance Test Code
PTFE	:	Poly Tetra Fluoro Ethylene
PVC	:	Poly Vinyl Chloride

RAM	:	Random Access Memory
RB	:	Rockwell Hardness in B Scale
RTD	:	Resistance Temperature Detector
RTU	:	Remote Terminal Unit
SOV	:	Solenoid Valve
SPDT	:	Single Pole Double Throw
TFT	:	Thin Film Transistor
TMR	:	Triple Modular Redundant
UPS	:	Uninterrupted Power Supply
URV	:	Upper Range Value
WC	:	Water Column

## CONTENTS

1.0	GENERAL .....	5
2.0	DESIGN PHILOSOPHY .....	10
3.0	SPARES PHILOSOPHY .....	17
4.0	GENERAL SPECIFICATION OF INSTRUMENTS .....	18
5.0	GAS DETECTION SYSTEM .....	44
6.0	DISTRIBUTED CONTROL SYSTEM .....	49
7.0	PROGRAMMABLE LOGIC CONTROLLER .....	49
8.0	MATERIAL SELECTION CHART .....	53

## 1.0 GENERAL

### 1.1 Scope

1.1.1 This Guideline covers the design and engineering of instruments, control systems, accessories and materials, along with special test equipments for instrumentation. This guideline is general for all instruments/systems.

1.1.2 All items shall be field proven and should have completed trouble free satisfactory operation for a period of minimum 6 months, unless otherwise specified for respective item, on the bid due date in the similar application with the process conditions similar to those as specified in the purchaser's data sheets. Items with proto-type design or items not meeting provenness criteria specified above shall not be offered.

### 1.2 Applicable National/International Standards:

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

AGA	American Gas Association, Gas Measurement Committee Report No.3 Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids – Concentric, Square-Edged Orifice Meters Report No.7 - Measurement of Natural Gas by Turbine Meter
AG181	Foundation Fieldbus System Engineering Guidelines
ASME	American Society of Mechanical Engineers. B 1.20.1 Pipe Threads. B 16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard B 16.47-B Large diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard B 16.20 Ring Joint Gaskets and Grooves for Steel Pipe Flanges.
ANSI/FCI	American National Standards Institute/Fluid Controls Institute 70.2 Control valve seat leakage classification.
API	American Petroleum Institute RP 520 Sizing, Selection and Installation of Pressure Relieving System in Refineries. Part-I - Sizing and Selection Part-II - Installation RP 521 Guide for Pressure Relieving and Depressurising Systems. RP 526 Flanged Steel Safety Relief Valves. RP 527 Seat Tightness of Pressure Relief Valves. MPMS Manual of Petroleum Measurement Standards. RP 551 Process Measurement Instrumentation. Part 1 - Process Control and Instrumentation. RP 552 Transmission Systems RP 554 Process Instrumentation and Control RP 555 Process Analysers S 2000 Venting Atmospheric and low pressure storage tank. S 670 Machinery Protection Systems
ASME	American Society of Mechanical Engineers.

	-	ASME Boiler and Pressure Vessel Code (BPVC), Section VIII, Division 1: Rules for Construction of Pressure Vessels.
		PTC 19.3 TW : <b>Latest Version</b> & ERATA 2012
	-	THERMOWELLS Performance Test
	MFC-3M	Measurement of Fluid Flow in Pipes using Orifice, Nozzle and Venturi
	MFC-14M	Measurement of Fluid Flow in Pipes using Small Bore Precision Orifice Meters
ASTM		American Society for Tests and Materials
BS		British Standards
	EN 50288-7	Multi Element Metallic Cables used in Analogue and Digital Communication and Control – Part-7 : Sectional specification for Instrumentation and Control cables
EN 10204		Inspection Document for Metallic Products
IBR		Indian Boiler Regulations.
IEC		International Electrotechnical Commission.
	60079	Electrical Apparatus for Explosive Gas atmosphere.
	60085	Electrical Insulation – Thermal Evaluation and Designation
	60332	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 Parts and Sections
	60529	Classification of degree of protection provided by enclosures.
	60534-2	Industrial Process Control Valves-Flow capacity.
	60584-2	Thermocouples – Tolerances
	60751	Industrial Platinum Resistance Thermometer and Platinum Resistance Sensors
	61285	Industrial Process Control Safety of Analyser Houses
	61000-4	Electromagnetic compatibility for Industrial Process measurement and Control equipment
	61158	Foundation Fieldbus Specifications
	61804-3	Functional blocks for process control – part 3 Electronic Device Description Language (EDDL)
IS		Indian Standard
	5	Colours for ready mixed paints.
	319	Specification for free cutting Brass bars, rods and sections
	1239	Mild steel tubes, tubulars and other wrought steel fittings
	1271	Specification of Thermal Evaluation and Classification of Electrical Insulation
	1554	PVC insulated (heavy duty) electric cables-working Part I voltage upto and including 1100V
	2074	Ready mixed paints, air drying, red oxide- zinc chrome.
	3624	Specification for pressure and vacuum gauges
	5831	PVC insulation and sheath of electric cables
	7358	Specifications for Thermocouples
	8784	Thermocouple compensating cables
ISA		International Society of Automation
	S-5.2	Binary logic diagrams for process operations.
	S 7.0.01	Quality standard for Instrument Air

	S-75.xx	Standards related to Control Valves
ISO 5167		Measurement of fluid flow by means of orifice plates, nozzles and venturi tubes inserted in circular cross-section conduits
ITK		Interoperability Test Kit (latest version)
NACE		National Association of Corrosion Engineers
NEC		National Electric Code
NEMA		National Electrical Manufacturer's Association
NFPA-496		National Fire Protection Association - Purged and pressurised enclosures for electrical equipment
OSHA		Occupational Safety and Health Authorit.
SAMA		Scientific Apparatus Maker's Association

### 1.3 Drawing and Data

1.3.1 Detailed drawings, data and catalogues required from the vendor shall be as per Vendor Data Requirement attached elsewhere in the Tender. All drawings and datasheets shall be prepared in SPI software version 16. Contractor shall handover the as built data in SPI Format. The same shall be uploaded in Purchaser supplied licensed software being procured separately.

1.3.2 The minimum requirements expected from the various documents listed in Vendor Data Requirement shall be as follows:

#### 1.3.2.1 Document Control Index (DCI)

This document lists out all drawings and documents prepared and/or submitted by vendor to purchaser after placement of order through vendor portal. Following information shall be available in this document:

- a) Name and number of each drawing and document listed.
- b) Expected and Actual date of submission to purchaser.
- c) Review category of the documents

#### 1.3.2.2 Instrument Index

Instrument Index lists out all instruments appearing on the P&ID without any exception. It is a basic instrument document which is necessary for the smooth execution of a job and is also a reference document after the completion of job. Instrument Index shall be prepared in EIL Format. In case, any other format is used, it must contain all information as listed in this format as a minimum.

#### 1.3.2.3 Sub Vendor List (for Instruments and Accessories)

This document shall list out all instrument items and accessories including control system along with the name of the sub-vendors from whom vendor is likely to procure these items. Instrument Sub-vendor shall meet the enlistment conditions of EIL approval at the time of placing the order on sub-vendor for the Project Approved Vendor List. The EIL approval conditions are available with the Sub-Vendors. Vendor shall follow the approval requirement.

For Instruments / items not covered in the vendor list, Vendor shall get approval from purchaser/ owner for the vendors proposed, prior to the placement of order. In such cases the sub-vendors suggested shall be manufacturer of repute and it shall meet the provenness criteria specified in this document.

#### 1.3.2.4 Instrument Sizing Calculations

Instrument sizing calculations provide information regarding sizing (as per standards specified else-where in this document), type, selection and other related information. Following sizing calculations shall be applicable, in general, duly approved by the authority indicated in Vendor's Standard Quality Plan;

- a) Control valve including noise and velocity.
- b) Pressure relief valves/pilot operated pressure relief valves/rupture disc/breather valve/flame arrester.
- c) Flow element including orifice plates, averaging pitot tubes, venturi, flow nozzle etc.
- d) Utility consumption calculation including power supply (UPS/Non UPS), Instrument air, steam for tracing, cooling water, nitrogen etc.
- e) Cable sizing calculations for power cables.
- f) Intrinsically safe loop calculation for proper selection of cables considering various entity parameters.
- g) Segment loading calculations.
- h) Thermowell wake frequency calculations as per ASME PTC 19.3 TW-2010

#### 1.3.2.5 Utility Requirements

This document lists out the following information regarding utilities required by the vendor;

- a) List of utilities required i.e. Power (UPS, Non UPS), Instrument air, Cooling water, steam for tracing, Nitrogen, Electric power for tracing as identified in P&ID, etc.
- b) Location and estimated/actual requirement at each location. The requirement shall be listed as minimum/normal/maximum.
- c) In case of AC power, the In-rush current with duration and power factor shall also be indicated for each location.
- d) In case of cooling requirement of any instrument/equipment, vendor shall provide the detail of pressure/flow requirement with location.

#### 1.3.2.6 Nozzle Elevation for Level Instruments

Nozzle elevation for level Instruments represent the nozzle elevation, nozzle sizes and rating, requirement of stand-pipes, type of level instrument etc. for all the vessels, columns, exchangers and tanks.

#### 1.3.2.7 Purchase Requisition (PR)

Purchase Requisition shall contain following information as a minimum but updated in line with the finally accepted offer of the successful vendor including:-

- a) Instrument specifications including detailed instrument data sheet and special requirements, if any
- b) Testing and Inspection requirements
- c) Vendor data requirements

d) Other related documents like Standard Specifications, Quality Assurance requirements etc.

#### 1.3.2.8 Functional Schematics

Functional Schematics details out the functionality of all the loops shown on the P&ID including their correlation. The schematic shows all the hardware necessary to configure a loop including their physical location, their interconnection and important software blocks as applicable to make a loop complete. Similar loops may be combined under the same functional schematic.

#### 1.3.2.9 Logic Diagrams

Logic diagram is a logic representation of process interlock and shutdown system and details out the functionality, in a schematic form, as either process cause and effect table shown on the P&ID or in a separate write-up. The schematic shall be prepared based on ISA S5.2 – A Binary Logic Diagrams for Process Operations and shall show the physical location of Input/output devices, their interconnection with functional blocks, bench status of all electrical devices etc. The schematic shall also be supplemented with operational requirements like startup and process bypasses, reset and shut down push buttons, selector switches, status lamp etc.

#### 1.3.2.10 Segment Drawing

The FF segment drawing provides the complete segment design details indicating all the devices of a segment, the Tag names, device control/monitoring functional requirements, spur length, FF Junction box barriers connectivity, termination details, location of JB etc. Spare segment shall also be shown in the drawing.

#### 1.3.2.11 Instrument Loop drawings

Each loop shall have a separate Instrument Loop drawing which shall show each component from field device to final receiver including physical location; initiating device, its terminal number; junction box with its terminal number; cable number with pair number/polarity; receiver instrument terminals/cabinet terminals; system functional blocks of loop in simplified manner (without configuration details). Fuse rating shall be provided for each loop in the drawing.

#### 1.3.2.12 Control Room Layout

Control room layout drawing shall show the location of control panels, system cabinets, marshalling racks and other auxiliary cabinets, consoles with monitors, hard wired consoles, printers, non-system panels/cabinets including panels/cabinets for packages, LEL panel, fire alarms panels or any other equipment required to be installed in control room. The layout shall be prepared on control room architectural drawing and shall also show layout of equipment in engineering room/computer room etc.

#### 1.3.2.13 Panel Front Arrangement

This drawing shall show the arrangement of panel mounted instruments like indicating instruments, alarm annunciator, indicating lamps, push buttons/switches, etc. including their approximate sizes, tag numbers and their mounting locations.

#### 1.3.2.14 Configuration Diagram

This drawing is a graphical representation of all major hardwares required in a configurable control system which are necessary to meet all the expected functional requirements.

### 1.3.2.15 Dynamic Graphic Display Drawings

These drawings provide a graphic representation of P&ID's arranged in a sequence which when displayed on the HMI, shall provide easy and logical operational views.

### 1.3.2.16 Input/ Output Assignment

This document indicates the physical assignment of various I/O modules and their respective channels to various physical inputs and outputs.

### 1.3.2.17 Instrument Duct/ Tray/ Trench Layout

Instrument duct/tray trench drawing shows the routing of main instrument duct/tray trench in the unit/plant. The drawing shall be prepared on plot-plan/ Equipment layout and shall show the size, cross-section at various locations, general notes, symbols, reference drawings and the control room entry.

### 1.3.2.18 Instrument Location Plans

Instrument Location Plans shall show the location of instruments, location of tapping points, location of local panels, junction boxes, main cable duct, instrument air distribution scheme etc. These drawings are prepared on equipment layout drawings in 1:50 or 1:100 scale depending on density of instruments.

### 1.3.2.19 Instrument Cable Schedule

The instrument cable schedule shall show all instrument and power cables required for complete instrumentation. The document shall show tag number, cable number, type, length and size of cables, type of junction box, identity of local panel, control room panel/cabinet location etc. The document shall also show the size of terminals considered for power junction boxes and the dimensions of cable considered by the contractor.

The cable schedule document shall include all single & multi pair cables indicating terminations of instruments, field junction boxes and respective termination in satellite rack room cabinets. The instrument cable schedule shall be prepared on EIL format.

### 1.3.2.20 3D Modelling:

Whenever 3D modeling is included in package vendor's scope, it shall include the following instrumentation items as a minimum:

- a. Instrument Cable Duct.
- b. Analyser shelter/ cabinet.
- c. Local Control Panels.
- d. Prefabricated Hook-ups
- e. Gas Detectors, **hooters/beacons**
- f. CCTV
- g. Instrument Junction Boxes
- h. Instrument Stanchions and Canopy
- i. **Wireless instruments/ Network coverage /Access points.**
- j. **All instruments (except local gauges)**
- k. **Cable trays greater than or equal to 300mm.**

## 2.0 DESIGN PHILOSOPHY

2.1 Instrumentation shall be complete in every respect in accordance with latest approved P&IDs for the safe, efficient and easy operation, start up and shut down of the plant.

2.2 All instruments and equipments shall be suitable for use in a hot, humid and tropical industrial climate in which corrosive gases and/or chemicals may be present. As a minimum, all instruments and enclosures in field shall be metallic construction, dust proof and weatherproof to IP-65 as per IS/IEC-60529 and secure against the ingress of fumes, dampness, insects and vermin. All external surfaces shall be suitably treated to provide protection against corrosive plant atmosphere.

2.3 The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4 'Electromagnetic compatibility for Industrial Process measurement and Control equipment.

### 2.4 Instrument Requirements for Classified Area:

- a) Certified Intrinsically Safe (IS) equipment as per IEC-60079-11 shall be used, in general, in hazardous area, for conventional loops.
- b) Field instruments in fieldbus loops shall be designed and certified as per the hazardous area protection specified in Job Specification.
- c) In case intrinsically safe equipment is not available, flameproof enclosures as per IEC-60079-01 may be considered.
- d) Junction boxes, cable glands and accessories required for flameproof instruments shall also be certified flameproof. Intrinsic SS JB shall be provided for IS signals.
- e) All non flameproof panels and cabinets installed in classified area shall be purged as per requirements specified in NFPA-496, as a minimum.
- f) Other type of protection specified in IEC-60079 shall not be used.

### 2.5 Statutory Approvals

- a) Contractor shall be responsible for obtaining all statutory approvals, as applicable, for all instruments and control systems.
- b) In addition, equipments/instruments/systems located in the hazardous area shall be certified by the local statutory authorities for their use in the area of their installation. In general following certification shall be given:
  - i) For all intrinsically safe/ FISCO/FINICO/ explosion proof/flameproof equipments/ instruments/systems or equipments with any other type of protection allowable as per this package which are manufactured abroad and certified by any statutory authority like Laboratoire Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres (Baseefa), Canadian Standards Association (CSA), Factory Mutual(FM), Underwriters laboratories(UL) etc. for compliance to ATEX directives or other equivalent standards. All these equipments/ instruments/systems shall additionally have the approval of Petroleum and Explosives Safety Organisation (PESO)/ Chief Controller of Explosives (CCE), Nagpur, if installed in INDIA and the same is mandatory.
  - ii) For all flame proof equipments manufactured locally (indigenously), the testing shall be carried out by any of the approved test house like Central Institute of Mining & Fuel research (CIMFR)/ Electronics Regional Testing Laboratory (ERTL) etc. The equipment shall in addition bear the valid approval from

Petroleum and Explosives Safety Organisation (PESO)/ Chief Controller of Explosives (CCE), Nagpur and a valid BIS license.

iii) For all intrinsically safe equipment manufactured locally (indigenously), the testing shall be carried out by any of the approved test house like Central Institute of Mining & Fuel research(CIMFR)/ Electronics Regional Testing Laboratory(ERTL) etc. The equipment shall in addition bear the valid approval from Petroleum and Explosives Safety Organisation (PESO)/ Chief Controller of Explosives (CCE), Nagpur.

- c) Approvals other than above shall neither be offered nor will these be acceptable.
- d) All CCOE certified equipment shall have CCOE number marked on the outside of enclosure as per CCOE guideline.

2.6 Engineering units shall be selected in line with BEDB section 2.5. In general following units of measurement shall be applicable, unless indicated specifically in BEDB / Licensor package:

Flow	Liquid	:	m <sup>3</sup> /h
	Steam	:	kg/h
	Gas & Vapour	:	Nm <sup>3</sup> /h
Pressure/Vacuum	Gauge	:	kg/cm <sup>2</sup> g
		:	mm of H <sub>2</sub> O
	Vacuum	:	kg/cm <sup>2</sup>
		:	mm of H <sub>2</sub> O
Temperature		:	°C
Level		:	% & m for tankages
Analysis		:	%
		:	ppm
Conductivity		:	micro siemens
Viscosity		:	mPa.s (cP)

2.7 Local control loops shall be avoided. In case these are unavoidable, these shall be electronic field mounted manual loading station only.

2.8 Ranges for instruments shall be selected in general, such that in normal process operation the indication is between 35% to 65% of the range i.e. middle 30% of the full working range.

2.9 Field mounted direct actuated Flow and Temperature switches shall not be used. Instead, transmitters shall be used along with flow element/temperature element. Process switches shall not be considered unless its use is unavoidable and the same shall be subject to purchaser's approval. In case switch has been considered, same shall be provided with sealed micro switch contacts rated for the specified application. Also contacts shall be SPDT type unless otherwise specified. Contacts used in intrinsically safe applications shall be suitable for the application. Tuning fork switch can be used in catalytic services if recommended by licensor.

## 2.10 Intrinsically Safe System Requirements (for Non Fieldbus Instruments)

Following points must be considered while designing an intrinsically safe system;

- a) All intrinsic safety barriers shall be active type isolating barriers only, with three port isolation. Barriers shall not be board mounted. All PLC barriers shall be SIL3 certified.
- b) Barriers must be selected based on entity concept. Cable parameters shall also be considered while matching entity parameters.
- c) Each instrument in the hazardous area and the intrinsic safe barrier shall be certified for intrinsic safety by any statutory authority. Barrier shall be used for all input and output whether device in hazardous or safe area. Isolators shall not be used.
- d) Each input and output in a loop shall have separate barrier. No barrier shall be shared between two loops or input/outputs.
- e) Any device required to be connected to any intrinsically safe loop in the hazardous side permanently or temporarily shall also be certified intrinsically safe.
- f) Configuration tools whenever required for any intrinsically safe item, which forms part of the intrinsically safe item, shall also be certified intrinsically safe.

## 2.11 Power Supplies and their Distribution

- a) Power supply shall be made available at the following voltage levels, unless otherwise specified:
  - For Instruments, Control Systems, Analyzers 110V AC
  - Solenoid Valves 24VDC / 110 V AC UPS
  - Input interrogation voltage 24V DC
  - Panel/cabinets lighting/Air conditioning 240V AC Non-UPS  $\pm 10\%$
  - Analyzer shelter HVAC 415 V AC -3 Phase
  - In rack/ in row precision AC for servers and system panels 415V AC-3 Phase

In case 24 V DC is required for Input interrogation, relays and lamps, any other vendor supplied instruments/ electronics), same shall be considered by the vendor using dual redundant power packs (110 V AC to 24 V DC converter). 24 V DC feeders shall not be provided by Purchaser unless indicated specifically in the job specifications. For details refer EDB.

SOV shall be 24 VDC powered, if same is not possible due to distance limitation in OM&S or elsewhere then 110VAC SOV shall be considered.

- b) All instruments, control systems (PLC and DCS) and analyser system shall be able to operate at the following UPS specification:

Voltage level : 110V AC  $\pm 10\%$   
 Frequency : 50 Hz  $\pm 3$  Hz  
 Switch over time : 5 milli seconds.

- c) Power feeders shall be supplied to the vendor at only one location. All further distribution within the package shall be taken care of by the vendor. Number and size of power feeders shall be informed during detail engineering. Vendor shall provide adequate number and size of terminals and cable glands required.
- d) Instrument power circuits shall be individually protected and isolated from fault with the help of fuses and DPST switches. Power supply to the individual instrument shall

be disconnected with the help of DPST switch and protected with the help of fuses. Miniature circuit breakers (MCB's) may be selected in place of switch fuse unit in case protection is provided for overload protection.

## 2.12 Alarm Philosophy

- a) Alarms shall be provided to give audible and visual warning of any process and machine malfunction in the package.
- b) All trips shall have a pre-trip warning alarm in addition to alarm at the trip condition.
- c) Package alarms including pre-trip warning alarms and trip alarms (shutdown alarms) shall be annunciated on the local panel as per approved P&ID.
- d) Rotating equipments shall have the status indication provided on the local panel as per approved P&ID.
- e) 'Fail-safe' type with normally closed alarm contacts shall be used.

2.13 All line or equipment mounted instruments like control valves, pressure relief valves, thermo-wells, orifice flanges, level instruments etc., installed on pipes and vessels under IBR shall be certified by IBR or their authorized representative.

2.14 Location of process connections shall be from the side or from the top of the process equipment but not from the bottom. This requirement is applicable to both pipes and vessels. The location of lower side connection for level measurement when necessary shall be extended inside the equipment with the approval of purchaser to prevent plugging due to dirt or other suspended solids. In addition, the connections shall be short, vertical or horizontal and without any pockets.

2.15 Material of construction of instruments shall be as per the material selection chart, attached as Annexure I of this specification, as a minimum. However vendor is responsible to ensure that the selected material is consistent with temperature, pressure, corrosion conditions and other process requirements.

## 2.16 Field Transmitters

2.16.1 SMART Field Transmitters:

2.16.1.1 The field transmitters in all conventional loops shall be smart type only unless specified otherwise. Field transmitters for flow, pressure, temperature, differential pressure and level applications shall be yoke mounted type unless specified otherwise. Meter electronics used for flow measurement etc. shall include all the associated items like pre-amplifier, converter, transmitter, integrator, integral output meter etc.

2.16.1.2 Field transmitter shall be intrinsically safe and meter electronics shall be intrinsically safe, in general. In case, intrinsically safe is not available from the approved vendor list enclosed with this MR/tender, flameproof enclosure is acceptable. In case sensor/ pick up coil is intrinsically safe, suitable barrier shall be provided and installed in flameproof enclosure.

2.16.1.3 These transmitters shall be 2 wire systems having 4 - 20 mA DC output with superimposed digital signal having simultaneous analog and digital communication with HART communication protocol, unless otherwise specified.

2.16.1.4 The transmitter shall be microprocessor based and it shall incorporate a non-volatile memory which shall store complete configuration data of transmitter and sensor characterization. All necessary signal conversions, including conversion to produce output with the required protocol shall be carried out in the transmitter electronics. The configuration data of the instruments shall be stored in a non-volatile memory such that this remains unchanged

because of power fluctuations or power off condition. In case vendor standard instrument has battery backed RAM, vendor to ensure that battery drain alarm is provided as diagnostic maintenance message.

2.16.1.5 Transmitter shall also run complete diagnostic subroutines and shall provide diagnostic alarm messages for sensor as well as transmitter healthiness. In the event of detection failure, the output shall be driven to a predefined value, which shall be field configurable.

2.16.1.6 Universal hand held configurator / terminal for the configuration and maintenance of instruments with HART & FF output shall be provided for all HART based smart instruments /FF instruments. Portable field Configurator shall also be considered which shall be able to communicate with transmitter in case power is not available from DCS/PLC.

2.16.2 Fieldbus Field Transmitter and devices:

2.16.2.1 Fieldbus transmitters/ devices shall be provided, if specified, in fieldbus loops.

2.16.2.2 Fieldbus based transmitter/ devices shall meet the following requirements;

- a) All instruments must satisfy the requirements of the fieldbus registration laboratory with applicable checkmark like foundation fieldbus, profibus etc as specified in Job Specification.
- b) All instruments shall be polarity in-sensitive. Also transmitter shall be LAS capability. Line plugging detection facility shall be provided, whenever specified in data sheet.
- c) All instruments shall have Analog Input (AI) block and Proportional, Integration and Differential (PID) control block, as a minimum.
- d) All instruments must be interoperable and shall have valid interoperability test clearance like ITK latest version for foundation fieldbus or equivalent for profibus PA, as applicable.
- e) The fieldbus instruments shall support peer to peer communication with two wire communication and bus powered supply.
- f) All instruments shall support EDDL or FDT/DTM requirements.
- g) Internal software shall be configured by the vendor including the following information such as serial number, Device Tag (Tag Number) and Process description
- h) All instruments shall be capable of supporting incremental Device descriptor (DD) for extra functionality and /or software revisions in device memory.
- i) Soft copy of the Device Descriptor (DD) files for configuring the FF device parameters and common file format (CFF) files for integrating the device into the system shall be provided by the bidder for offline configuration by System vendor immediately after despatch.
- j) Fieldbus based field indicator shall be able to indicate all signals available in the fieldbus segment, selectively.
- k) Lightning and surge protection shall be considered for FF field transmitters
- l) Line plugging facility is required in all catalytic services and congealing services. However for CCR, PFCCU, DCU units shall be considered for all transmitters

2.16.2.3 The fieldbus / devices provided shall be able to communicate with latest universal fieldbus communicator.

2.16.3 Accuracy of transmitters (Pressure & Differential pressure), smart as well as fieldbus based shall be as follows:

Type of Transmitter	Range of Transmitter	Accuracy for the rangeability of 1:10
Direct	760 mm WC and above	Equal to or better than $\pm 0.04\%$
Direct	Less than 760 mm WC	Equal to or better than $\pm 0.15\%$
Diaphragm seal	500 mm WC and above	Equal to or better than $\pm 0.25\%$
Diaphragm seal	Less than 500 mm WC	Equal to or better than $\pm 0.5\%$

The accuracy is defined as the combined effect of repeatability, linearity and hysteresis.

2.16.4 Transmitter shall update the output at least 8 times a second unless otherwise specified.

Unless specified otherwise in purchaser's specification, transmitter response time shall be as follows:

- For transmitter range of 760 mm WC and above, the response time shall be equal to or better than 500 milliseconds.
- For transmitter range below 760mm WC, the response shall be equal to or better than 1 second.

The response time of the transmitter shall be considered as the sum of dead time and 63.2% step response time of the transmitter.

2.16.5 Unless specified otherwise, the over-range/static pressure protection of the transmitter shall be as follows;

Range of Transmitter	Over range/ static pressure <N1>	
	Pressure Transmitter (kg/cm <sup>2</sup> )	Differential Pressure Transmitter (kg/cm <sup>2</sup> )
0 < ® < 250 mm WC	20	20
250 < ® < 1000 mm WC	40	100
1000 < ® < 10000 mm WC	40	160
10 < ® < 25 kg/cm <sup>2</sup>	52	160
25 < ® < 100 kg/cm <sup>2</sup>	160	160
> 100 kg/cm <sup>2</sup>	200	210

<N1> However if the Over range/ static pressure value specified above is less than the maximum/ design pressure of service conditions, offered instrument shall be suitable for the maximum/ design pressure.

2.16.6 Diaphragm seal DP transmitters in flow measurement with a DP of less than 250 mmWC shall be avoided and alternate type of flow meters shall be provided for such cases suitable to the process condition.

2.16.7 All transmitters shall have vent and drain facility and the same shall be provided with metallic plugs. All the cable entries shall also be provided with metallic plugs.

- 2.16.8 Remote sensor type differential pressure transmitter based on digital calculation shall be used for impulse lines greater than or equal to 5 meters.

Transmitter with impulse line plugging detection shall be used in congealing, high viscosity and wherever solid/catalyst likely to come in impulse lines, mandatory in PFCC, DCU, SRU,CCR, Petrochemical units. (Wherever indicated in P&ID /PDS)

- 2.16.9 All pressure, differential pressure instruments shall be considered with 0.2% stability for 10 years.

## 2.17 Instrument Connections

- 2.17.1 The connections of instruments installed on vessels, tanks, standpipes and piping shall be as per following EIL Standards.

- a) 7-52-0001 Instrument Connections on Vessels and tanks.
- b) 7-52-0002 Instrument connection on Piping.
- c) 7-52-0010 Instrument connection on Fired Heaters.

- 2.17.2 Pneumatic instrument connections for signal and air supply shall be 1/4" NPT (F).

- 2.17.3 Electrical cable entry connection shall be 1/2" NPT (F)/ 3/4" NPT (F) as per the cable size. Suitable cable gland shall be used.

- 2.17.4 End connections shall meet the following, unless, otherwise specified:

- a) Threaded end connection shall be NPT as per ASME B1.20.1.
- b) Flanged end connection shall be as per ASME B16.5 or ASME B16.47B or AWWA C207 CI D as per related Piping Specification.
- c) When Flanges are Raised Face (RF) type, the face finish shall be as per ASME B 16.5 and shall be as follows:  
125 AARH : 125 to 250 microinch AARH  
63 AARH : 32 to 63 micro inch AARH
- d) Grooves of ring type joint flanges shall be octagonal as per ASME B 16.20 and groove finish shall be as follows:  
63 AARH : 32 to 63 micro inch AARH

## 2.18 Instrument Air Supply

- 2.18.1 Air supply at pressure specified elsewhere shall be made available to the vendor at the battery limit for distribution to the instruments.

- 2.18.2 Pneumatic Instruments shall operate on air supply of 1.4 kg/cm<sup>2</sup>g and shall have transmission and output signal of 0.2 to 1.0 kg/cm<sup>2</sup>g.

- 2.18.3 Instrument air quality shall be as per ISA- S 7.0.01 and free from corrosive, hazardous and toxic contaminants.

## 2.19 Interface with Main Control Room

- 2.19.1 Wherever applicable, instrument junction boxes shall be provided as interface between purchaser and vendor. Marshalling details between purchaser-vendor cabling shall be shown with corresponding junction box termination number allocated against appropriate

purchaser's/vendor's instrument tag number in the format provided by purchaser. Push in TBs shall be provided in JB.

All junction boxes supplied by the bidder shall be provided with self locking type allen screws (SS 316 make) type fasteners and hinges. Junction boxes shall have tag numbers engraved on front cover with CCOE certificate nos.

#### 2.19.2 Direct signals from package/package skid

All signals from package skid/battery limit to purchaser's control room shall be terminated in the junction boxes located at the battery limit. Separate junction boxes shall be used for the following type of signals:

- Fieldbus based Signals
- Intrinsically Safe Analog Inputs/Outputs (4-20mA)
- Non -intrinsically Safe Analog Inputs/Outputs (4-20mA)
- Intrinsically Safe Thermocouple Inputs
- Intrinsically Safe RTD Inputs
- Intrinsically Safe contact Inputs
- Non-Intrinsically Safe contact Inputs
- Intrinsically safe contact Outputs
- Non-Intrinsically Safe contact Outputs

DCS and PLC signals shall be further segregated and shall in no case be mixed up.

#### 2.19.3 Repeat Signals from Package Local Panel

- a) Where signals as indicated in Clause 2.19.2 is less in number and do not justify separate junction boxes, all such signals may be routed via local control panel.
- b) All such signals shall be terminated on separate terminal strips in the local control panel. The terminal strips shall be segregated as per Clause 2.19.2.
- c) Intrinsically safe barriers for all such signals, wherever required, shall be provided.

The above shall only be considered with prior approval from purchaser.

### 3.0 SPARES PHILOSOPHY

Mandatory Spares, Commissioning Spares, Consumable spares, Engineering Spares and Spares for 2 years normal operation shall be as defined in Engineering design basis

### 4.0 GENERAL GUIDELINES/ SPECIFICATION OF INSTRUMENTS

#### 4.1 Panel Board Instruments

- 4.1.1 Alarm Annunciator shall either be solid state type or microprocessor based programmable type with plug in modules and integral power supply. Window display shall be back lighted incandescent lamps or cluster LED type integral power supply. For window display with back lighted incandescent lamps two numbers of incandescent lamps of minimum 5 watt each shall be provided for each window. For cluster type LED display, the number of LED's in the cluster matrix windows shall be sufficient to provide illumination level of at least 150 lumens. The circuit shall be designed in such a way that removal/failure of one lamp or LED from a window/ cluster shall not hamper functioning of that particular window/display. The annunciator lamps shall be replaceable from the front of the enclosure

panel. In general, dedicated alarm logic module shall be used for each alarm input. However, when micro processor based alarm Annunciator is offered failure of one microprocessor shall not affect more than four alarm windows.

Intrinsically safe annunciator circuit, when used, shall have power supply unit in a safe area. Annunciator alarm sequence shall be as per F3A of ISA.

Alarm annunciator shall be SIL certified. Redundant card shall be used for annunciator and failure of one card shall not cause failure of indication.

Annunciator service & maintenance shall be from front & Rear both without any special tools/requirements.

The design of the alarm annunciator system shall be such that transient alarms of less than 330 milliseconds duration shall be automatically rejected.

## 4.2 Panel Design

4.2.1 All panels shall be supplied in pre-tubed/pre-wired condition and shall be completely tested at manufacturer's works prior to dispatch.

4.2.2 Panels shall be free standing type. Panels with instruments mounted on the front shall be fabricated from 3 mm thick cold rolled steel sheet. If the same is not available, 4 mm thick hot rolled steel sheet shall be used. All other panels shall be fabricated from 2mm thick cold rolled steel sheet. Angle iron framework shall use a minimum section of 50 x 50 x 4 mm angle. Panel painting procedure shall include blast cleaning, grinding, chemical cleaning, surface finishing by suitable filler and two coats of high grade lacquer with wet blasting wherever required. Two coats of paint in the panel colour shall be provided for non-glossy high satin finish. Final coat shall be given after assembly at site.

Unless otherwise specified, exterior/interior portion of all panels and closed cabinets shall have a colour as per RAL-7035. Channel base shall be of black colour.

4.2.3 Panel shall be enclosed cubicle type with each section of typically 2100 mm high, 1200 mm wide and 800 mm deep mounted on 100 mm channel base.

4.2.4 Enclosed cubicle panels shall have removable hinged doors for easy maintenance and accessibility of the instruments. Doors shall be double leaved type with handle and shall be provided with lock and key. Adequate illumination shall be provided inside the panel. All light fittings shall be suitable for 240 V, 50 Hz AC. Power supply greater than 240 V shall also not enter the control panel.

All panel shall be provided with 180 degree hinges. Server panel and system panel shall be black color RAL9005. Hinges of panel shall be SS. Panels left door shall be latched type from inside and right door shall be latched with lock from outside.

Door locks shall be four point comfort locking type.

4.2.5 All cable entries to the panel shall be from panel bottom only using cable glands of adequate size. Cable gland plate thickness shall be a minimum of 3 mm cold rolled cold annealed (CRCA) as a minimum. All unused cable entries must be plugged.

4.2.6 Space heater shall be provided where condensation is expected. The space heater provided shall be with temperature cut off and manual control.

All field mounted panels/cabinets shall be provided with vortex cooler to maintain inside temperature in order to avoid failure of its components

4.2.7 The design of panel shall incorporate provision for expansion by installing adequate spare capacity. Each panel shall be designed to accommodate the following additional equipment, as a minimum:

- a) 20% of panel front/inside mounted instruments including lamps, push buttons, switches, relays etc.
- b) 20% additional power feeders each provided with switch fuse assembly.
- c) 20% additional spare windows in alarm annunciators.
- d) 20% spare cable entry points.

4.2.8 Panel layout shall be designed considering ease of operation. No push button or hand switch shall be located below 600 mm. Instrument mounting heights, in general, shall be as follows:

- |    |  |            |         |
|----|--|------------|---------|
| a) | Electronic Instruments                         | Bottom row | 1100 mm |
|    |  | Middle row | 1350 mm |
|    |  | Top row    | 1600 mm |
| b) | Annunciators                                   | -          | 1950 mm |
| c) | Electric push buttons/<br>switches, lamps etc. | -          | 700 mm  |

4.2.9 The internal panel layout shall be designed considering proper approach for instruments, terminals and other accessories for maintenance, easy removal and online calibration. No instrument, terminals, power distribution box etc shall be mounted on the panel side plates inside the panel.

4.2.10 All lamps, status as well as alarm, shall be provided with lamp test facility. One single lamp test push button shall be used for each panel. Logic for lamp test shall not be implemented through relay logic in the panel.

#### 4.2.11 Colour Scheme

- a) Status Lamps
 

On/Open/Permissive	:	Green
Off/Close/Emergency	:	Red
- b) Alarms
 

Normal/Pre-trip alarms	:	Amber
Shutdown alarms	:	Red
- c) Push/Pull buttons
 

On/Open	:	Green
Off/Close	:	Red
Emergency shut-down (ESD)	:	Red

(Push-button with cover/  
Mushroom push button)

#### 4.2.12 Panel Piping and Tubing

4.2.12.1 The instrument air header shall be adequately sized with 1/2" branches, SS packless isolation valves and shall be complete with suitable dual filter-cum-air reducing station.

4.2.12.2 Panel tubing from the bulk head to the panel instruments and instrument air supply to the panel instruments shall be of 6 mm x 1mm thick SS 316L tubing.

4.2.12.3 The tubing shall be laid in plastic slotted ducts. Panel air header and tube fittings shall be of SS 316.

4.2.12.4 Each tube shall be identified at both the terminating ends.

#### 4.2.13 Panel Wiring

4.2.13.1 Open terminals shall generally be avoided. Terminal strips shall preferably be mounted in an enclosure. Fused terminal may be used wherever necessary. All terminals shall be of mechanical screw clamp/screwless type with pressure plates as per the job specification. Self-insulating crimping wire lugs shall be used for all terminations on terminal blocks, whereas forked tongue type or lug with eyehole type shall be used for termination on screwed terminals such as on relays, push buttons, lamp etc. Terminal blocks shall be rated for 600 V. Pushin type with termination indicating lever shall be considered.

4.2.13.2 A minimum of 1 mm<sup>2</sup> multi stranded PVC insulated copper conductor shall be used in general. All wiring shall be laid in the PVC troughs. No trough shall be more than 70% full.

4.2.13.3 Wires carrying measurement signals associated with thermocouples, resistance thermometers and other low level signals shall be routed in separate troughs/wire ways and not alongwith power cables. Power wiring and control wiring shall be separated by not less than 150 mm. The crossing, if unavoidable, shall be as close to right angles as possible.

4.2.13.4 Extension cables/wires shall be used for all thermocouple inputs. These wires shall be routed in separate troughs/wire-ways.

4.2.13.5 All intrinsically safe wires shall be routed in separate wire ways from non-intrinsically safe and power wiring. Intrinsically safe wiring and terminals shall be light blue in colour and shall be separated from non-intrinsically safe terminals atleast by 50 mm.

4.2.13.6 All incoming power feeders shall be terminated on separate terminals suitable for the incoming feeder size. These shall be located at the bottom of the panel and shall be suitably covered for protection against accidental shorting and for human safety.

4.2.13.7 Power supply shall be made available at one point. Further power distribution network shall be designed such that a single power fault in any instrument branch system shall not cause a trip of the entire system. Each consumer shall be provided with a separate switch and fuse for isolation and protection of the system.

#### 4.2.14 Electrical Wiring

All the cabinets, consoles and panels shall be completely wired. Interconnections shall preferably be done with the help of pre-tracked cables. Vendor may follow their standard wiring practices, however the requirements specified herein must be complied.

- a) All wiring shall conform to API RP 552- Transmission Systems. Different signal level cables shall be routed with separation distances as recommended by code.
- b) All wiring inside racks, cabinets, and back of the panels shall be housed in covered, non-flammable plastic raceways arranged to permit easy assembly to various instruments for maintenance, adjustments, repair and removal.
- c) All wiring in the raceways shall be properly clamped. All incoming cable shall be terminated by vendor at marshalling rack with cable glanding including supply of

cable glands. Total wiring cross-sectional area shall not exceed 50% of the raceway cross sectional area.

- d) Separate wiring raceways shall be used for power supply wiring, DC and low level signal wiring, and intrinsically safe wiring. Parallel runs of AC and DC wiring closer than 300mm shall be avoided.
- e) Vendor can alternately offer prefabricated cables for interconnection between different cabinets and panels.
- f) Wire termination shall be done using self-insulating crimping lugs. More than two wires shall not be terminated on one side of single terminal. The use of shorting links for looping shall not be done.
- g) No splicing is allowed in between wire / cable straight run.

#### 4.2.15 Terminals and Terminal Blocks

- a) Terminals shall be non-hygroscopic type made up of unbreakable, fire-retardant, safe extinguishable, halogen free polyamide compound.
- b) Terminals shall be suitable for wires up to 2.5 sq. mm base solid or stranded conductor in general. For power cables, higher size terminals shall be used.
- c) The metal parts of terminals shall be of high quality (pure electrolytic) copper and shall be tin or nickel plated (of thickness up to 15 micron).
- d) The spring material for all terminals shall be chrome nickel spring steel of high tensile strength and of excellent corrosion resistance. All terminal / terminal blocks shall be DIN Rail mounted type and shall be easily removable. The size of the terminal blocks / terminals of different types shall be consistent and identical.
- e) All terminal blocks shall be mounted on suitable anodised metallic or plastic stand-off.
- f) Terminal strips shall be arranged group-wise for incoming and outgoing cables separately. Terminal blocks for intrinsically safe wiring shall be separate. 20% spare terminals shall be provided, as a minimum, preferably in each terminal strip.

#### 4.2.16 Following design philosophy shall be followed while deciding the internal layout of panels, as a minimum;

- a) Distance between terminal strip and side of the panel upto 50 terminals : 100 mm (min.)+ trough width
- b) Distance between two adjacent terminal strips : 100mm (min.)+trough width
- c) Distance between gland plate and bottom of the strip : 300mm (min.)
- d) Distance of terminal strip from instrument/trough/panel top : 100mm (min.)

### 4.3 Local Control Panel (LCP)

- 4.3.1 Local control panel for the package units shall be installed within the battery limit of the package considering operational and maintenance requirements and accessibility. In case of skid mounted packages, panel shall be located away from the skid.

In case local control panel is housed outdoor i.e. not in a local control room, it shall be designed to meet IP-55 requirements. In addition, panel must be provided with a rain cum sun shade/canopy. Local control panel shall be of SS316 with all the supports and frames shall be of SS.

4.3.2 Local control panel/panels shall be totally enclosed cubicles. Panel sizing shall be carried out based on equipment being installed keeping in view the maintenance clearances and easiness of operation. Although the panel dimensions shall be guided by the actual requirements, typical dimensions shall be 2100 mm height x 1200 mm width x 1000 mm depth. In any case, vendor shall not proceed with panel manufacturing before getting prior approval from the purchaser.

4.3.3 Local control panels located in the hazardous area shall either be flame proof Ex'd' or weather proof with Ex'd' components such as lamps, push buttons, switches and intrinsically safe alarm annunciators, intrinsically safe HMI etc. as specified in job specification. Purge panel shall be avoided.

In case pressurized panels are specified the same shall be purged and pressurized as per NFPA 496 requirements to render space within the panel non hazardous. For panels located in IEC Zone 2, hazardous area type Z purging shall be used with a purge fail alarm in main control room. In case, panels are located in Zone 1, the power shall be cut off on perssurisation failure as per x-purge requirements of NFPA-496.

An alarm shall be provided on local panel and a contact shall be provided for remote annunciation, whenever the panel pressurization falls below 2.5 mm of H<sub>2</sub>O. A protective device to protect the panel from over pressure must be provided.

Non-purge/Non-pressurize panels shall be provided with vortex cooler to maintain inside temperature in order to avoid failure of its components.

4.3.4 If unavoidable, Panel pressurisation with start-up panel purging scheme shall be fully automatic however it shall be started manually from a push button. Solenoid valves and differential pressure switch required for panel purging shall be flameproof, however other items like relays, switches/pushbuttons, timers etc. shall be located in a flameproof housing. Other items like valves, restriction orifice plates, dual filter regulators, pressure gauges, rotameters etc required for pressurization shall also be located in the non-pressurized section of the panel.

4.3.5 It shall be possible to switch off incoming power to panel from panel front. All such power on/off switches shall be flameproof type.

In addition, all those devices and terminals, which cannot be powered off from on/off switches shall also be located inside flameproof enclosures.

4.3.6 All hinges, screws and other non-painted metallic parts shall be of stainless steel material. Hinges shall be 180 degrees. Hinges shall be of SS.

4.3.7 All other requirements as specified in clause 4.2 of this specification shall also be applicable for local control panels.

4.3.8 Whenever weatherproof local panel is provided by vendor for classified area, the Alarm Annunciator shall be intrinsically safe and push button, lamps; selector switches shall be flame-proof "Exd" type mounted on LCP.

All components shall be IS type in panel and non IS shall be mounted in flameproof enclosures. Purging shall not be provided.

IS Barriers/ relays for IS alarm annunciator shall be supplied by vendor along with IS annunciator and potential free non-flameproof contact for the same shall be considered from the PLC / DCS/ control systems. The IS power supply module for alarm annunciator shall be installed in a flameproof box in local panel by bidder. For Lamps, wet contact shall be considered from the PLC/ control system and the lamp test logic shall be realised in PLC/ control system. The Power supply distribution box inside the Local Panel shall also be flame-proof "Exd". IS PCs for display of loop powered indicators shall be used in weather-proof local panels in case no. of tag local display more than Five tags. The same IS PC can also be used for local display of vibration and temperature monitoring system parameters at field instead of separate display unit at field. For 5 or less number of tags for local indication, normal IS loop powered indicators shall be provided on weather proof local panel.

Intrinsically Safe (IS) type with minimum 15" Display (Remote interactive PC terminal) unit certified suitable for the hazardous area shall be mounted on the panel front of local control panel of the package, wherever IS PC is considered. All local control panel mounted field remote output indicators, wherever required as per approved P&IDs, shall be displayed in this remote PC. Single serial interface (RS 485 with Modbus RTU protocol) corresponding to these signals from control system shall be considered and vendor's scope shall include all necessary converters, power supply module, connectors at both ends along with serial communication cables for connecting to serial interface cards.

The PC terminal shall be equipped with necessary keyboard suitable for specified hazardous area.

#### 4.4 Local Gauge Board

- 4.4.1 Local gauge board shall be used to install skid-mounted instruments like pressure gauges, temperature gauges and transmitters.
- 4.4.2 Location of local gauge boards, when provided, shall be decided to allow easy access at the rear and front for all instruments and accessories for maintenance and operation.
- 4.4.3 Gauge board shall be constructed from 3 mm stainless steel sheet with other necessary SS supporting structure.
- 4.4.4 Local gauge board shall be supplied with all instruments installed and completely in tubed/wired condition before shipment.
- 4.4.5 All pressure transmitters and gauges shall be provided with block and bleed valves securely fastened. Identification tags shall be securely fastened for easy identification. Wherever local temperature indicator is required with temperature transmitter, Loop powered indicator shall be provided.

#### 4.5 Temperature Instruments

- 4.5.1 Thermowells
  - a) All temperature elements shall be provided with thermowells fabricated out of bar stock of minimum SS 316 material as per EIL Standard 7-52-0035. The base of the thermowells shall be chosen to fit the instrument without air gap for minimizing measurement lag.
  - b) Built-up thermowells shall be used in low pressure and low velocity services like in fired heaters and also where thermowell immersion lengths greater than 1000 mm are required.

- c) Immersion length of thermowells shall be as follows:

Line Size	Immersion length
From 4" to 6"	280 mm
From 8" to 20"	320 mm
>20" and Vessels / columns	400 mm

In special applications, not covered above, vendor shall decide the immersion length based on actual requirements. Immersion length is based on 200 mm length between flange face and outer wall of pipe and 200 mm length between flange face and outer wall of the vessel. Unsupported length may change suitably to meet vibration analysis.

- d) Any pipe line less than 4" nominal bore shall be blown to 4" size to install thermowell. However blowing up is not required, wherever skin thermocouple is considered.
- e) Thermowell flange and well material shall be 316SS or better to suit the service conditions.
- f) The vibration analysis shall be carried out as per PTC 19.3 TW:2010 (latest version) and corrective measures shall be taken as necessary.

Twisted thermowell can also be used in congealing and dirty services or to meet vibration analysis

#### 4.5.2 Temperature Gauges

- a) Local temperature gauges shall be in general bimetallic type upto operating temperature of 350°C. The gauge connection shall be all angles adjustable. Gas filled type shall be used for underground locations, sump, high temperature (above 350°C operating temperature), vibration services, thermowell length exceeds 1000 mm (builtup thermowell). Mercury filled type temperature gauge shall not be used.
- b) All local temperature gauges shall have 150 mm dial size. The bulb size shall be selected to suit the thermowell.
- c) Cases shall be minimum 304 SS.
- d) Temperature gauges shall have accuracy of  $\pm 1\%$  URV (upper range value).
- e) Bimetallic type dial thermometers shall be avoided where excessive vibrations are encountered, such as reciprocating compressor discharge. Only filled type with capillary extension shall be used in such cases. Capillary tubing shall be a minimum of 304 SS with stainless steel flexible armouring, and PVC covering over armour. Filled type gauges shall be manufactured as per relevant SAMA class.
- f) Thermometer stem adjustable gland with union connection and bushing shall be suitable for 1/2" NPTF connection.

#### 4.5.3 Temperature Elements

- a) Thermocouple assemblies shall be furnished with weatherproof screw type heads as per EIL Standard 7-52-0036.

- b) Thermocouples shall be as per IEC-60584-2 and shall have a wire size of 18 AWG for single and 20 AWG for duplex thermocouples. These shall be magnesium oxide (MgO) filled grounded type, unless necessary otherwise. The type of thermocouple shall be selected based on temperature. The selection of type shall be as per following guidelines:

Copper-Constantan (ISA-Type-T)	:	(-) 200 to 200 <sup>0</sup> C
Chromel-Constantan (ISA-Type-E)	:	(-) 200 to 600 <sup>0</sup> C
Iron- Constantan (ISA-Type-J)	:	0 to 600 <sup>0</sup> C
Chromel-Alumel (ISA-Type-K)	:	600 to 1200 <sup>0</sup> C
Platinum Rhodium-Platinum (ISA Type-S)	:	600 to 1600 <sup>0</sup> C

- c) The design of thermocouple assemblies shall be such that replacement on line is possible.
- d) RTD (Resistance Temperature Detector) shall be platinum element 3 wire type with 100 ohms resistance at 0<sup>0</sup>C calibrated as per IEC 60751. RTD shall be used within a temperature range of -200 to 650<sup>0</sup>C. Three-wire system shall be adopted in connecting the element.
- e) RTD shall be used where accuracies of the order of 0.25% or better and smaller measuring spans are required. RTD shall be with class A accuracy.
- f) Duplex element sensors shall be supplied. Two separate cable entries shall be provided with plugs. Dual element thermocouple/RTD with dual pair cable between element and transmitter shall be used.
- g) Heater skin thermocouples shall generally be extraction type with sheath material of SS446/416 upto 600<sup>0</sup>C unless specified otherwise. All skin thermocouples shall be provided with heat shield assembly

#### 4.5.4 Temperature Transmitter

- a) Temperature transmitters shall have a built-in linearising function to produce an output linear to temperature range.
- b) The Temperature transmitters with RTD shall have an accuracy of 0.075% of URV as a minimum for range above 350<sup>0</sup> C, 0.15% of URV for temperature range 350<sup>0</sup> C to 150<sup>0</sup> C and 0.25% for calibrated range below 150<sup>0</sup> C.

The Temperature transmitters with cold junction compensation for thermocouple shall have an accuracy of 0.25% of URV as a minimum for range above 350<sup>0</sup> C, 0.5% of URV for temperature range between 350<sup>0</sup> C to 150<sup>0</sup> C and 0.75% for calibrated range below 150<sup>0</sup> C.

- c) Transmitters shall be provided with dual compartment and dual redundant configuration. Dual element thermocouple/RTD with dual pair cable between element and transmitter shall be used. Transmitters shall be provided with hot back up feature.

4.5.5 Burn out protection must be provided with temperature transmitters. Upscale or downscale protection shall be decided based on its application to ensure fail-safe operation.

#### 4.6 Pressure Instruments

#### 4.6.1 Pressure Gauges

- a) Pressure gauge dial shall be white with black figures. The dial face shall be marked with pressure element material. Pointers shall have micrometer adjustment.
- b) Pressure gauges shall be weatherproof with dial size of 150 mm and shall have features like over range protection (at least 130% of max. operating pressure) and blowout discs. Glass shall be shatter proof. Pressure gauge sensing element shall be of SS 316 and movement of SS 304, as a minimum.
- c) Pressure gauges shall have an accuracy of  $\pm 1\%$  of URV as a minimum. Differential pressures gauges, diaphragm seal pressure gauges and draft gauges may have an accuracy of  $\pm 2\%$  of URV.
- d) Over range protector and pulsation dampener, whenever used, shall be of SS 304, as a minimum. Pulsation damepner shall be used for all pulsating services. It shall be floating pin type, externally mounted and externally adjustable.
- e) Pressure gauges with range more than 0-60 kg/cm<sup>2</sup>g shall have safety type solid front case.
- f) Connection shall normally be 1/2" NPTM bottom.
- g) Cases shall be minimum 304 SS.
- h) Ranges shall be so specified that the gauge normally operates in the middle third of the scale and shall conform to IS-3624 standard dials, wherever possible.
- i) Diaphragm seals shall be furnished where plugging of the element may occur or where suitable material is not available in highly corrosive services. When chemical seals are required, they shall be of the clean out type with flushing connection.
- j) Where vibrations and pressure fluctuations are expected, glycerin filled type and snubber shall be used.
- k) Receiver pressure gauges for local transmitter output indication shall have 100 mm dial with stainless steel element and 1/4" NPTM connection.
- l) The pressure element shall be bourdon, diaphragm or bellows depending upon process condition. Single diaphragm type Differential pressure gauges shall not be considered, Instead double diaphragm type or bellows shall be considered.
- m) Remote surface mounting pressure gauges shall be considered for services of higher operating temperature  $\geq 120^{\circ}\text{C}$ .

#### 4.6.2 Pressure/Differential Pressure Transmitters

- a) Pressure/differential pressure transmitter shall have electronic state-of-art capacitance or any other type of sensor meeting all functional specifications as per clause 2.16. Element material for transmitters shall be 316 SS, as a minimum.
- b) All transmitters shall have an integral output meter. Remote mounted meters may be provided if required in addition.
- c) Diaphragm seal element with capillary shall be used for congealing, corrosive and highly viscous services.

- d) Remote sensor type shall be used for range greater than 5 meters i.e impulse length greater than 5 m.

#### 4.6.3 Pressure Switches

- a) Process switches shall not be considered unless its use is unavoidable and the same shall be subject to purchaser's prior approval.
- b) Pressure switches shall have either diaphragm or bellow type of process element with SS 316 material of construction as a minimum. Switch type shall be sealed micro-type with contact rating suitable for specific application. Also contacts shall be SPDT type unless otherwise specified. Contacts used in intrinsically safe applications shall be suitable as per the process condition.
- c) Pressure switches shall be blind type with 1/2 NPTF process connection and shall be operative in full-specified range. The switch differential shall be selected as per operating conditions.
- d) Pressure switches shall have repeatability of  $\pm 0.5\%$  of URV, as a minimum. Pressure switch shall have over range protection of at least 130% of maximum working pressure. The set pressure shall fall in the middle third (between 35% to 65%) of the adjustable range in general. Set point shall be field adjustable.

### 4.7 Level Instruments

#### 4.7.1 Level gauges

- a) Preferably all level gauges shall be Magnetic type .However if required or absolutely necessary gauge glasses shall be steel armoured reflex or transparent type with body and cover material of forged carbon steel as a minimum and shall have tempered borosilicate glass with asbestos or other suitable gasket. Transparent type of gauges shall be provided with integral illuminators operating at 240 V 50 H z supply and shall be suitable for electrical area classification specified. All gauge glasses must have a rating equal to or more than the vessel design pressure and temperature.
- b) Reflex type will be used for clean and colourless liquids, except liquids level interface. For low temperature, low boiling point service, large chamber type will be used. Transparent type will be used on acid, caustic, dirty or viscous, coloured liquids and liquid interface. Transparent type with Mica or Kel-F shields shall be used for treated water, boiler and condensate services, and for corrosive liquids, which will attack glass. Tubular gauge glasses shall, in general, not be used in Hydrocarbon/hazardous services. They may be used for non-hazardous services at ambient temperature and low pressures (less than 10 kg/cm<sup>2</sup>g operating).
- c) Large chamber gauges with frost shields shall be provided for cold services below 0<sup>o</sup> C. Heating jacket shall be provided for viscous liquids with 1/2" flanged connection.
- d) All gauges shall have top and bottom chamber connections, unless otherwise specified. However side-side chamber connection is acceptable where nozzle installation is a constraint. In addition each gauge shall be provided with ball check valves and pipe union.
- e) The visible range of level gauge shall be selected to cover the complete operating level as well as measuring range of the other level instruments provided for the same purpose. In general, the visible length and C to C distance of the top and bottom level gauges shall be selected from the following:

Visible length	Centre to Centre Length
220	470
470	720
720	970
980	1230
1230	1480
1490	1740

For side-side level gauge C to C distance shall be 10 mm less than visible length.

- f) For level gauging in very viscous, corrosive liquids, liquids with crystals and high pressure service, float operated magnetic gauges with 2" (50 mm) flanged end connections, shall be used. C to C length of single magnetic level gauge shall not be more than 2500mm.
- g) All level gauges shall be provided with vent/drain valves with plug or connected to closed drain/vent as per P&ID.

#### 4.7.2 Level Transmitter

- a) Guided Wave Radar type instruments with external cage and side-side connections shall normally be used for level and for interface level measurement upto 2700 mm. Guided wave radar inst shall have  $\pm 3$ mm accuracy
- b) Displacer type of level instruments shall be used for the interface applications where guided wave radar type level instruments are not suitable. All displacer type of level transmitters shall be of torque tube material of inconel, as a minimum.
- c) Differential pressure transmitter shall be used for level measurement above 2700 mm, for services requiring purge or where liquid might boil in external portion.
- d) Differential Pressure transmitters for use on corrosive or fouling service shall generally be diaphragm wafer with extended filled capillary type. Flush or extended diaphragm type differential pressure transmitter shall be considered for special applications only. Diaphragm material shall normally be stainless steel or any other special alloy.
- e) For sump levels, Guided wave radar or non- contact type radar level instrument shall be used depending on the application within accuracy  $\pm 5$ mm.
- f) Generally for top mounted level transmitters, internal guided wave radar type instruments shall be used for level measurement upto 3000mm. Above that non-contact type radar shall be used.
- g) DP Type Level transmitters shall meet all requirements specified in clause 2.16.

4.7.3 Other Special types of level instruments like ultrasonic, hydrostatic, nucleonic, capacitance, conductivity type shall be used as necessitated by application requirements.

4.7.4 For high pressure steam drum application at least one number conductivity type (Hydrastep or equivalent) level instrument shall be provided. Also level gauges shall be of bi-color type for such application.

4.7.5 For solid level measurement, type of instrument shall be ultrasonic/ capacitance/ nucleonic/ non-contact type radar as per the process condition. The actual type selection shall be carried out based on the provenness of the selected type for similar type of application.

4.7.6 Level transmitter shall be used instead of level switches. Vibration Fork Type Level Switches may be used for Catalyst services and Tank high level detection application.

#### 4.8 Tank Level Instruments

- a) Each tank shall be provided with minimum 2 types of tank level instruments operating on different principles like one servo and other one radar (Antenna) type.
- b) Radar type transmitter shall be provided with  $\pm 3$  mm accuracy for storage tanks and  $\pm 1$  mm for custody transfer. Whenever  $\pm 3.0$  mm accuracy is required, process connection on vessel/ tank/ equipment for non-contact radar gauge can be 4" with 4" Carbon Steel / Stainless Steel (depending on the pipe schedule requirement) still well. However wherever  $\pm 1.0$  mm accuracy is required (e.g. in custody application), process connection on vessel/ tank/ equipment for non-contact radar gauge shall be 8" with 8" Carbon Steel / Stainless Steel (depending on the pipe schedule requirement) still well. For viscous service, nozzle connection shall be 24".
- c) Servo type instruments shall have 6" process connection with 12" diameter still well, with accuracy  $\pm 3$  mm for storage tanks and  $\pm 1$  mm for custody transfer. Raising or lowering of displacer for calibration shall be possible on-line with the design of still-well.
- d) The wetted material like float, displacer, tape, wire etc. shall generally be 316 SS.
- e) The accessories for servo-controlled level gauge shall include isolation ball valves for pressurized tanks and calibration/maintenance chamber for all tanks. Each calibration chamber shall be provided with a viewable window of blast proof glass. The calibration chamber can be either integral to the instrument or separate. Whenever calibration chamber is separate i.e. not integral to the tank level instrument, the material of construction of calibration chamber shall be stainless steel. The calibration chamber shall also permit insertion / removal of displacer for maintenance without removing the instruments.
- f) Servo and Radar type instruments shall be capable of providing serial output as per vendor standard protocol or fieldbus protocol as per IEC-61158 in addition to analog 4-20 mA DC current output. These instruments shall also be capable of accepting input from multi element tank temperature sensors (thermocouple/ RTD), water cut probes and transmit the same as a part of serial signal from the transmitter. Multi-element tank temperature sensors when used shall be provided with 3" stillwell and 3" process connection.

#### 4.9 Flow Instruments

The selection of flow measurement instruments shall be based on the requirement of accuracy, repeatability, location, physical properties of the flowing fluids handled, pressure drop and ease of maintenance.

In-line flow instruments shall have a direction of flow indication clearly marked and easily visible in the final installed position.

Flow switches shall not be used without prior approval from the purchaser.

##### 4.9.1 Orifice Plates

- a) Flow measurement shall normally be carried out by using thin square edged concentric orifice plate mounted between a pair of weld neck flanges of minimum 300 pounds ANSI rating for line size 2" and above. For 300# rating, Flange taps shall be used for

line sizes upto 14" while D-D/2 taps shall be used for line sizes more than 14". For 600# rating and above, Flange taps shall be used for line sizes upto 12" while D-D/2 taps shall be used for line sizes more than 12" The material of the orifice plates shall be normally 316 SS, as a minimum.

Quadrant edge or quarter circle orifice plates shall be used for highly viscous liquids and for pipe Reynold number below 10,000.

Conical entrance type of orifice plates shall preferably be used for very highly viscous liquids upto throat Reynolds number of 250. These plates shall be fabricated as per Flow Measurement Hand Book by RW Miller.

Vent and Drain holes shall be provided for bore dia above 25.4 mm.

- b) Sizing of orifice plate shall be carried out in accordance with ISO-5167 (Latest Edition). For orifice plates not covered in ISO 5167, sizing methods shall be ASME MFC-14M (latest Edition) or AGA Report No. 3 or 'Flow measurement-Engineering Handbook' by RW Miller.
- d) Honed metering runs or integral orifice type transmitter shall be used in line size with 1.5" (40 mm) nominal diameter or below.
- e) Upstream and downstream straight length shall be provided based on maximum d/D ratio of 0.75, in general. Where it is difficult to meet this requirement, the actual d/D ratio can be considered for reducing the straight length as permitted by the codes. Flow straighteners are to be considered, where straight runs are difficult to achieve otherwise.
- f) Meter taps shall be horizontal for liquids, condensible vapours and steam. The taps shall be on top for gas, non-condensable vapour, or liquids which boil at or below the maximum design ambient temperature at operating pressure. Where piping clearances are a factor, taps may be located upto 45 degree below the horizontal center line for condensible vapour and liquid. The taps may be located upto 60 degree from vertical for gas, non-condensable vapour and steam.

#### 4.9.2 Venturi Flowmeters

- a) Venturi shall be designed and constructed as per ISO 5167-4 (Latest Edition) or ASME MFC-3M.
- b) The Venturi Flow element shall be classical, machined, non truncated type.
- c) Impulse piping connection for venturi tubes shall be provided with 1/2" NPTF connection, unless otherwise specified in the data sheet.
- d) Venturi tube shall be forged/cast construction in general. However fabricated construction shall also be acceptable, wherever allowed as per ISO-5167.
- e) Venturi tube shall be provided with Annular chamber / Piezo-metric Ring. Material of construction of Annular chamber / Piezo-metric Ring shall be same as material of Venturi tube.
- f) Material of construction of Venturi tube shall be SS316 as a minimum. Material of construction for Throat, Divergent section and Convergent section shall also be SS316 as a minimum. Flanges shall be provided as per the material specified in the datasheet.

- g) Flow calibration for those Venturi tubes, which are necessitated due to their installations outside the limits as defined in ISO 5167 for D (Pipe Inside Diameter), beta and Reynolds numbers shall be considered in the base quote

#### 4.9.3 Averaging Pitot Tube

Averaging pitot tube in general shall not be considered unless specifically required by the purchaser. Averaging pitot tube shall meet the following requirements:

- a) The flow sensor shall be continuous averaging velocity head producing type of pitot tube with four or more equal averaging pitot tube sensing ports or continuous slots to suit line velocity profile. The sensor shall also incorporate a rear port for the measurement of line static pressure.
- b) Averaging pitot tube shall be of 3" flanged connection with isolation ball valve.
- c) The insert retract mechanism shall be provided to allow on line removal and insertion of the average Pitot tube under maximum pressure and flow condition.
- d) Vibration analysis for each averaging pitot tube element shall be done for the indicated flow condition to ensure that the averaging pitot tube is of sufficient thickness and strength to withstand the vibration effects created due to Karman vortex shedding in the fluid stream.
- e) The free end of the averaging Pitot tube shall be pressure supported at the pipe wall. However, for the large pipe sizes and where vibration analysis recommends the requirement of end support, the end support/weld cap support shall be provided.
- f) The offered averaging pitot tubes shall have  $\pm 1\%$  accuracy of actual value and repeatability of  $\pm 0.1\%$  of actual value.

#### 4.9.4 Variable area Flow Meters

Variable area flow meters or rotameters shall be provided as per the P&ID or where rangeability in flow precludes the use of an orifice. Variable area flow meters shall be as per ISA-RP 16.1, 16.2, 16.3, 16.4, 16.5 and 16.6. Metal tube rotameters shall be used for all fluids. External devices for indicating or transmitting shall be magnetically coupled to the float or extension.

Glass tube rotameters shall not be used unless it is necessitated for low range or for low pressure utility services for local indication and where line size is 1-1/2" (40mm) or less with the approval of purchaser.

Reducer shall be considered, in case the size of the flowmeter is less than the line size.

##### Performance Requirements

Unless otherwise specified, the variable area flow meter shall meet the following performance specifications:

- Purge flow meter Accuracy better than  $\pm 5\%$  of full scale
- Metal tube/Glass Tube flow meter Accuracy : better than  $\pm 2\%$  of full scale
- Flow meter Transmitter Accuracy better than  $\pm 2\%$  of full scale
- Repeatability better than  $\pm 0.5\%$  of full scale

#### 4.9.5 Mass Flow Meters

The mass flow meters shall meet the following requirement:

- a) Flow meter shall be of in-line mounting design and shall be of flanged body construction with stainless steel as minimum material of construction.
- b) The mass flow meter shall be provided with the external flow tube housing. In all such cases, the flow tube housing shall have provision to monitor housing pressure continuously.
- c) The mass flow meter shall have high vibration immunity.
- d) The meter electronics shall be protected against transients induced by lightning and power supply surges. Transient protection electronics shall preferably be provided in the terminal block.
- e) Flow meter electronics shall be microprocessor based and shall include pre-amplifier, converter, transmitter electronics and integral output meter. The indication on the output meter shall be digital with engineering units.
- f) The mass flow meter shall be capable of computing field density and shall incorporate temperature sensor flow fluid temperature measurement. Whenever required, the flow meter electronics shall have capability to compute volumetric flow rates.
- g) The meter electronics shall be protected against transients induced by lightning and power supply surges. Transient protection electronics shall preferably be provided in the terminal block. The transient protection shall meet the requirements specified in IEC-60587.
- h) Mass flow meter Direction, make/model, max. temperature withstand shall be mentioned on meter.
- i) Unless specified otherwise in the job specification, the performance requirements for the mass flow meter shall be as follows:
  - i. Flow meter accuracy:  $\pm 0.2\%$  of mass flow rate for liquid service.  
 $\pm 0.5\%$  of mass flow rate for gas / vapour service.
  - ii. Flow meter repeatability:  $\pm 0.1\%$  of mass flow rate for liquid service.  
 $\pm 0.25\%$  of mass flow rate for gas / vapour service.

The performance requirements specified above excludes the effect of zero stability of the flow meter on these parameters.

Flow accuracy shall be maintained between the minimum and maximum flow. Where only normal flow is specified, the maximum and minimum flows considered for the purpose of sizing shall be:

Maximum flow = 1.4 times the normal flow

Minimum flow = 0.4 times the normal flow

When only maximum flow is specified minimum flow shall be considered as 0.2 times the maximum flow for sizing the meter.

The maximum pressure drop at meter maximum shall not exceed the allowable pressure drop across the meter specified in the data sheet.

The meter shall be selected such that both accuracy and allowable pressure differential across the meter are complied.

#### 4.9.6 Ultrasonic flowmeter

Ultrasonic flow measurement shall be considered where non-intrusive flow measuring is required.

The Ultrasonic flow meter shall be based on transit time technology. Ultrasonic flowmeter shall be atleast two path.

SS Ball Valve shall be provided for online removal of sensor if sensor is in contact of fluid.

The design used shall provide maximum reliability, maximum on-line performance and minimum maintenance. It shall be immune to other impurities in the fluid stream.

Ultrasonic flow meters and the meter runs/flow conditioners shall be rated for the maximum design pressure.

Spool piece type Ultrasonic flow meters shall have flanged end connections. Weld joints, if any, shall be of radiographic quality.

Meter Sizing:

Selected meter size shall ensure that flow meter operates within 85% of their standard range considering density and viscosity of the fluid. Extended range shall not be referred for the meter selection.

Vendor to ensure the velocity in the Ultrasonic flow meter and meter run shall not exceed maximum permissible velocity.

4.9.7 Target meters shall be considered for highly viscous hydrocarbon streams such as asphalt, tar, polymers etc.

4.9.8 Vortex meter shall be considered where high rangeability is the prime requirement. Vortex flow meter shall be considered wherever indicated in P&ID .

4.9.9 Differential Pressure type flow transmitter shall meet all the requirements specified in clause 2.16.

4.9.10 Wedge flow meter shall be considered in slurry services or where powder deposits may form. However, Diaphragm seal type DP transmitter shall be provided along with wedge flow meter duly calibrated with both sensor and the transmitter.

4.9.11 Thermal mass flow meter to be used for stack flue gas measurement.

#### 4.10 Control Valves

4.10.1 Control valves shall normally be globe type. For clean services, guiding shall be top and bottom/cage type. For highly viscous, dirty and congealing services, cage guiding shall be avoided.

Control valve in dirty or congealing service up to 10" shall be eccentric rotary plug type valve. For greater than 10" eccentric rotary plug or segmental ball valve design both are acceptable.

Ball valves shall be considered for services where solids in suspension, high rangeability, low pressure drops, and tight shut-off are required. Butterfly valves shall be considered for services where solids in suspension, low pressure drops and high capacities are required.

For low differential pressure application ( $<0.5\text{Kg/cm}^2$ ) flow control valve, valve design shall be "vendor to decide" between globe and butterfly type.

Bellows Seal type valve shall be used for H<sub>2</sub>S service or H<sub>2</sub> service or wherever specified by licensor.

4.10.2 Control valve sizing shall be carried out as per ISA 75.01.01. The valve shall permit upto 150% of normal flow or 110% of maximum flow, whichever is higher. In general, control valves shall be sized so that the valve opening is as noted below:

At max. flow : about 90% open

At normal flow : about 75% open

At minimum flow : about 20% open.

4.10.3 Flanged control valves shall be used. Body material, body rating and flange rating shall be as per piping specifications. However body and flange rating shall be minimum 300#. Lug valves acceptable in nitrogen PPU.

4.10.4 Minimum control valve body size shall be 1" in general. Reduced trims can also be considered.

4.10.5 For globe valves trim characteristics shall be equal percentage type unless required otherwise. Control valve plugs shall be heavy top guided for single seated valves. Cage guiding may be used in clean applications.

4.10.6 Anti-cavitation trim shall be selected wherever cavitation is expected in the valve. For flashing services and hardened trim shall be used and anti-cavitation trim shall not be provided.

4.10.7 Noise from control valve during operation shall be limited to OSHA specified level or better. The maximum allowable noise is 85 dBA SPL (Sound Pressure Level). Source treatment for noise may be performed by using special trims like low noise trims, in case noise exceeds the specified level. Other methods based on merit are also permissible.

4.10.8 Valve seat leakage shall be minimum class IV as per ANSI/FCI 70.2 unless tight shutoff requirement is required as per the P&ID.

4.10.9 Flanged bolted type gland packing boxes shall be used. Packing shall normally be PTFE on liquid and gas service up to 200°C (design). Graphite/graphite shall be used above 200°C (design) temperature. Asbestos based packing material shall not be used.

4.10.10 Bellows seal shall be used where it is required to isolate the packing from the process fluid or where no leakage to atmosphere can be tolerated like toxic, explosive and precious fluids.

4.10.11 Material used for trim shall be minimum SS 316, with guide bushing of hardened stainless steel like 440 C, 17-4 PH. For higher pressure drops (more than 10 kg/cm<sup>2</sup>) or erosive and slurry services and in general for all steam services, flashing and cavitating services, plug and seat shall be stellite.

Special cases may require 17-4 PH seat ring and 440 C solid plugs or other materials like Hastelloy, Monel etc.

4.10.12 Valve actuator shall be pneumatic spring opposed diaphragm type, in general. Piston type actuators may be used for very high shut off pressure requirements. Additional equipment including volume bottle necessary to meet fail safe condition shall also be included in case double acting piston type actuator is selected. In either case, actuator shall be able to withstand maximum shut-off pressure (1.5 times of design pressure) with the minimum instrument air pressure specified.

- 4.10.13 Whenever limit switches are specified as inductive proximity type, these shall meet NAMUR (DIN-19234) requirements.
- 4.10.14 Solenoid valves, wherever used, shall be universal and continuous rated type with class H coil insulation. These shall be SS body as a minimum.
- 4.10.15 Self-actuating regulators for flow, pressure and temperature shall be used where loads are constant and requirements of precision and accurate controls are not stringent.
- 4.10.16 The actuator shall be painted as below:

Direct action (open on air failure) valves	-	Green
Reverse acting (close on air failure) valve	-	Yellow
Actuator for shutdown valves	-	Red

Items like air volume tanks etc., supplied as an accessory along with the actuators, shall be painted as per corresponding actuator.

#### 4.11 ON-OFF VALVE

- 4.11.1 On-off valves shall have flanged end connections integral to the valve body. Top entry valve design shall not be offered unless specifically indicated. Body rating of valve shall be minimum 300#.

For Size up to 6", valve shall be Ball type whereas for 8" and above Triple offset Butterfly design can be considered. Minimum rating shall be 300#.

Lug type body design for butterfly type of on-off valve body size more than 6 inches shall be considered.

- 4.11.2 For on-off valves with fire safe design, flanged body construction shall only be acceptable.
- 4.11.3 For all services where full port valves are specified, following shall apply:
- Port size shall be equal to line size for rating up to ASME Class 1500.
  - Port size shall not be less than one size than the line size for rating ASME Class 2500 and above.
- 4.11.4 For steam jacketed valves, the body and port size shall be one size lower than the on-off valve end connections.
- 4.11.5 On-off valve body, bonnet, bottom flange, line flanges and other pressure containing assemblies shall be of the same material of construction as specified for valve body.
- 4.11.6 In case of ball-type of on-off valves;
- The valve design shall ensure valve seat and body protection against thermal expansion of the entrapped fluid when the on-off valve is fully close.
  - For size up to 4" and rating up to ASME Class 300, the on-off valve shall have floating ball design. For ratings ASME Class 600 and above, floating ball is acceptable for sizes less than 2". For higher sizes trunion mounted ball design shall be provided.

c) For dirty service, Trunnion type Ball Valve (above 2") may not be suitable because of presence of slurry or particles. For such applications like Column bottom, Slurry Service, catalyst applications etc, floating type Ball Valve to be considered

- 4.11.7 Rotary type on-off valves like Ball valves, butterfly valves etc. shall have blow out proof shaft guiding design. Stem shearing safety factor shall be 2 in rotary valves.
- 4.11.8 Guide bushing shall be of a sufficiently hard material to resist side thrust on the plug or shaft.
- 4.11.9 Vendor shall be responsible for trim design and selection of the on-off valve. However, it must meet the following minimum requirements:
- a) The valve characteristics shall be quick-opening (on-off) type.
  - b) Vendor shall select proper material pairs, surface finish, hardness and clearances to avoid galling.
  - c) Valves operating under extreme temperature conditions, vendor shall consider increased clearances at room temperature and seal welding of threaded seat rings etc whenever required. Hard facing of trim including guide bushing shall be considered for all valves operating at high temperatures (i.e. temperature more than 200°C). For very low temperature application, material used shall have adequate cold impact strength.
  - d) For all on-off valves including 3-way type of valves, stem and plug shall be detachable and shall be attached together by suitable threaded design secured with a pin to avoid plug rotation during operation.
- 4.11.10 Trim material and actuator colour shall be as specified for the control valve.
- 4.11.11 Leakage class of on-off valves shall be as specified in data sheet, where no class is specified it shall be Class IV.
- 4.11.12 For on-off valves specified with Class VI / bubble tight (as per API) leakage class, vendor shall select the soft seat (elastomer) material suitable for the process conditions i.e., shut off pressure, maximum temperature and process fluid. Metal seated on-off valves meeting the leakage class shall also be acceptable.
- 4.11.13 For application in vacuum service, vendor to provide inverted packing design suitable for vacuum service. For pressure-cum-vacuum service, the on-off valve shall have dual packing design suitable for the application. Dual packing design shall also be provided for on-off valves in toxic service, with a facility to connect inert fluid between the packings.
- 4.11.14 Valve actuator shall be designed to move the valve to the failure position as specified. For failure position specified as 'fail-locked', vendor shall provide air reservoir with all required accessories to meet the fail lock position of the valve.
- 4.11.15 Whenever double acting springless type of actuator is unavoidable, all accessories like pilot valves, booster relays, non-return valve, pressure gauge, volume tank etc. shall be provided to ensure desired action on air failure.

All accessories shall be of minimum SS316. PG body shall be SS. AFR filter shall be of 5 um or less. AFR body shall also be SS

- 4.11.16 The volume tank shall be of SS construction and sized as per ASME Section VIII with design pressure of  $10\text{kg/cm}^2\text{g}$  as a minimum. Each volume bottle shall be sized for a minimum of 3 valve strokes
- 4.11.17 The actuator casings and diaphragms shall be designed for minimum twice the maximum pneumatic operating pressure of the on-off valve.
- 4.11.18 Vendor shall be fully responsible for sizing and selection of correct actuator, while sizing the actuator vendor shall consider minimum actuator thrust equal to two times (2) the total force induced by shut off condition and the force required to overcome packing friction.
- 6" & above valve shall be with scotch & yoke actuator.
- 4.11.19 Wherever the valves are indicated as fire safe, they shall be tested for fire safe as per API 607 (6<sup>th</sup> edition or later).
- 4.11.20 Wherever fire safe actuator and controls have been asked for, actuators and all accessories such as solenoid valves, air volume bottles etc. shall meet the fire proof requirement to ensure normal valve operation even during and after exposure to fire. Vendor shall clearly define the schemes they propose to achieve the above requirements and ensure that the proposed schemes shall meet the requirement in terms of type of exposure and exposure time of the testing procedure given in API 607.
- 4.11.21 Vendor shall furnish type test certificate duly witnessed by third party inspection agency like M/S LRIS, BV, DNV, TUV etc. for fire safe testing of valve, actuator and controls for the offered models.
- 4.11.22 All control valves connected to flare line shall be TSO; i.e. leakage class VI, except for Metal seated valves required in high pressure and temperature application. For On Off valves (ball /butterfly) TSO requirement shall be as per API 598.

#### 4.12 Smart Type and Fieldbus Type Positioners

Digital smart positioners or fieldbus type of positioners with diagnostic capabilities shall be provided as per job specific requirement. These shall meet the following minimum requirements:

- a) Control valve shall be with contact less positioner except in utility, boot drain and battery limit service. Linkageless positioner is also acceptable i.e no physical link between valve stem and positioner. For Damper and valves in PSA positioner shall be contactless / linkage less.
- b) The positioner sensor and sensing mechanism shall be rugged and shall not be affected by the line/valve vibration. The performance of the positioners shall be immune to above vibration.
- c) The positioner's output and input range shall be field adjustable without any hardware modification. The output from the positioners shall be available for both single acting as well as double acting actuator.
- d) Each positioner shall be operable, configurable and accessible through HART compatible hand held configurator/fieldbus configurator as applicable. Smart positioners shall also have dedicated buttons for the above functions.

- e) Control valve's operating signatures in the form of hard copy and soft copy for each control valve provided with smart positioners shall be supplied. The necessary software for advanced control valve diagnostics like seat ring condition, gland packing condition, actuator leakage etc. shall also be included.
- f) Fieldbus positioner shall have the capability to perform functions like PID etc.
- g) All positioners shall have metallic casing and cover.
- h) Control valve and on off valve positioner shall have separate compartment for cable termination. Pressure gauges shall be inside or outside positioner housing. Control valve positioner shall be with capability of converting to I/P converter in case the position feedback fails to prevent spurious trips. Positioner in partial stroke testing scenario shall not cause spurious trip in case of positioner failure or power failure of positioner.

### 4.13 Pressure Relief Valves and Rupture Discs

#### 4.13.1 Pressure Relief Valves

4.13.1.1 All pressure relieving devices shall be designed in accordance with ASME code for 'Boilers and Pressure Vessels', API-521 and Indian Boiler Regulations. The pressure relief valve sizing shall be as per API 520. For mixed phase fluids, sizing shall be as per Leung-Omega method (or Diers) sizing shall be followed. The orifice sizing, area and designation, valve size and rating shall be as per API RP 526.

4.13.1.2 Pressure relief valves shall be full nozzle full lift type except for thermal relief valves.

4.13.1.3 Conventional valves shall be specified for constant back pressure while bellows seal type valves shall be specified for variable back pressure. Pilot operated pressure relief valves shall be used when Back pressure is greater than 50% of set pressure or when the difference between operating pressure and set pressure is within 10% of the set pressure.

4.13.1.4 Lifting lever shall be specified for steam, air or water above 65 degree service. Open bonnet shall be used for steam service.

4.13.1.5 The percentage accumulation in case of pressure relief valves/safety valves shall be as follows:

- a) Steam Service
  - ASME SEC I(steam generation/consumption) 3%
  - IBR (Before steam let-down station) 5%
  - IBR (Distribution & utilities) and 10%

ASME Section VIII
- b) Gas, Vapour or liquid for process service 10%
- c) Liquid for thermal Relief 25/ 10% (as per Process requirement)
- d) Fire exposure on unfired vessels 21%

4.13.1.6 3/4" x 1" threaded (NPT) modified nozzle type valves with typically 0.38 cm<sup>2</sup> orifice size shall be specified for thermal relief. However, if discharge is connected to flare or with

variable back pressure more than 10% of set pressure, 1D2 flanged valves as per API-526 as a minimum to be provided.

4.13.1.7 The body material shall, as a minimum, be as per piping specifications. Nozzle and disc material shall be SS 316 as a minimum with machined stainless steel guide and spindle. Whenever semi nozzle designs are unavoidable, body material shall be atleast same as nozzle and disc material.

4.13.1.8 The spring material of pressure relief valves shall be as follows unless otherwise necessary because of process conditions;

(-29<sup>0</sup> C to 230<sup>0</sup> C : Carbon steel with weather protective coating.

above 230<sup>0</sup> C : Tungsten alloy steel.

Below (-)29<sup>0</sup> C : 316 Stainless Steel

4.13.1.9 Flanged connection shall be for standard sizes 1" or larger.

4.13.1.10 Where permissible, screwed connections shall be used on sizes 3/4" and below.

#### 4.13.2 Rupture Disc

4.13.2.1 Rupture discs shall be reverse buckling type, in general and shall be supplied in pre-torqued holder assembly, which shall fit inside the inner diameter of the bolt circle of standard flanges. Disc material shall be compatible with the vessel contents and shall be consistent with the bursting requirements. Inconel discs shall be used above 100<sup>0</sup>C if compatible with the process fluid.

4.13.2.2 When rupture disc is used upstream of a pressure relief valve, a pressure gauge shall be provided on the downstream of the disc to indicate any rupture of the disc in addition to an excess flow check valve. In addition combination capacity factor of 0.9 shall be used for sizing unless the combination has been tested and approved for any other combination capacity factor.

4.13.2.3 The bursting tolerance of the rupture disc shall be 5% of the specified bursting pressure or less, unless otherwise specified.

4.13.2.4 Vendor shall consider 5 nos. rupture discs (1 for testing + 1 for installation + 3 nos. spare) of the same specifications.

#### 4.14 Interlock and Shutdown System

4.14.1 Interlock and Shutdown System shall be an independent system with its own dedicated primary element except for orifice flow measurement. For orifice flow element, separate set of tapping for each flow transmitter for shut down / interlock shall be considered.

4.14.2 The system shall be designed fail safe and shall meet the following requirements, as a minimum:

a) All initiating contacts shall be close (except limit switches for which contact shall close when the limit reaches) under normal conditions and shall open under abnormal conditions.

b) All relays and solenoid valves shall be energised under normal conditions and shall de-energize under abnormal conditions.

- c) If desired, because of operational or maintenance requirements, adequate trip by-pass facilities are to be provided with warning lights to indicate that the trip has been bypassed. Trip bypass alarms shall be provided.

4.14.3 Each shutdown circuit and solenoid valve shall be provided with a switch-fuse unit separately.

#### 4.15 Instrumentation for Rotating Equipments

Rotating Equipment vendor shall be completely responsible for providing adequate instrumentation for safe and efficient operation of the machine. The commonly used instruments are being detailed out in the following clauses, however this does not absolve the vendor of providing additional instrumentation, if required.

##### 4.15.1 Anti surge and performance control system (ASC)

- a) Vendor shall be fully responsible for the complete design of Anti surge/performance control system (ASC) including selection of type of flow element, controller Algorithm, type of explosion protection, type and operating timings of final control element. Vendor shall guarantee the performance of machine with the offered ASC system. Wherever required, ASC system shall be designed in such a way that it is capable of correcting the compressor operating point so as to avoid surge in order to protect machine from possible damage, to minimize process upsets and to minimize recirculation.
- b) ASC system shall typically consist of but not limited to flow element, flow transmitter, differential pressure transmitter, ASC controller, control valve and other accessories as felt necessary by the vendor.
- c) Vendor shall supply all the hardware and software related to the operation and safety of the equipment. This shall include but not limited to the following;
  - i. Design and operation of surge control loop scheme based on offered equipment performance.
  - ii. Supply of all hardwares in antisurge control loop including dedicated controller, transmitters, measuring elements, final control element etc.
  - iii. Fast response transmitter and control valve etc. as required.
  - iv. Algorithm required for antisurge/ Performance control application.
- d) The ASC shall be a dedicated single loop controller on proprietary Hardware Platform or single/multi loop controllers of common hardware platform such as PLC. The single loop controller shall be dedicated controller for each Anti-surge or Performance control application/Tag. Dedicated panel mounted facia shall be provided. The ASC system when provided on common hardware platform shall be with redundant configuration as minimum viz-dual processor, dual input/output, redundant communication & dual power supply system. The multiloop controller/system shall be dedicated for Anti-surge/Performance applications/Tags of each machine/each machine tag. Unless specified otherwise dedicated panel facia for each application shall be provided to mount on hardwired console in control room
- e) It should be able to accept 4-20 mA signal from field or from HIC at purchaser DCS or at LCP as a manual override to anti-surge control system with bump less transfer.
- f) Auto-manual operation with bump less transfer shall be provided.

- g) The controller response time (total time to read input, processing time and output) shall be as per the machine dynamics and safety and shall be of the order of max. 40-milisc. Any faster response required based on machine dynamics shall be considered by vendor. The input sampling interval shall be as per machine dynamics within the controller response time as above. The processor cycle time shall be considered to meet the overall response time.
- h) The ASC shall be field proven, specific to the make of machine and for the similar application in hydrocarbon industries. Vendor shall provide the proven track record for the offered ASC meeting the above.
- i) The anti surge/performance control algorithm shall be implemented using standard firmware in the controller/processor system.
- j) The algorithm developed by vendor shall be specific for given application, surge control, performance, load sharing etc. and shall be field proven for the compressor make.
- k) The algorithm implemented in the system shall be protected against any modifications/changes.
- l) The configuration shall be stored in non-volatile memory or battery back-up for configuration shall be provided (minimum 48 hours) in case of volatile memory along with battery drain indication.
- m) In case of ASC on common hardwired platform separate configurator with necessary hard ware/ soft ware shall be provided for application programming.
- n) Anti surge controller shall not be used for performing any other machine related inter locks/logics.
- o) All the instruments (transmitters, Positioner and temperature elements and / or transmitters) connected with anti-surge control loop shall be flame proof "EExd" type suitable for the area as specified. The suitability of smart transmitter/ Positioner shall be confirmed by vendor and to be provided accordingly.
- p) The ASC system vendor shall be fully responsible for the sizing and selection of the anti-surge valve. Vendor to provide the sizing calculations duly vetted by ASC system manufacturer.
- q) LED lights and cooling fans shall be provided for cabinet by the bidder
- r) Bidder shall provide hardwares, modules etc. for this interface including RS 422/485 converters at both ends to avoid mismatch of converter make and model

#### 4.15.2 Machine Monitoring System (MMS)

Machine Monitoring system shall be provided for continuous monitoring and indication of machine parameters like vibration & axial displacement, bearing and winding temperature, key-phasor etc. MMS shall have hardwired connection to PLC for interlocks and serial link to DCS.

- 4.15.2.1 Vibration and displacement monitoring system shall be as per API-670. The extent and type of monitoring shall be as defined elsewhere. However, vendor shall furnish any additional requirements for monitoring deemed essential by them with reasons. Two probes at 90

degree apart for each location shall be provided and connected to same dual channel monitor for vibration monitoring. Separate JB's shall be provided for temperature & vibration signals

4.15.2.2 The machine monitoring system shall be provided with preferably built in intrinsically safe barrier and shall be duly mounted in separate panel. However, separate terminal blocks shall be provided for terminating the field cables for maintenance purpose. Direct cable termination on modules shall not be considered. Push in type TB's shall be provided in JB's & LCP's.

4.15.2.3 For MMS the display unit shall be provided at local control panel with necessary statutory certification. Alternatively purged enclosure is also acceptable with necessary certification. All instruments/components shall be intrinsic safe type and purged enclosure shall be avoided.

4.15.2.4 The sensing probe shall be accessible for adjustment, repair and replacement without dismantling the machine.

4.15.2.5 Vendor shall provide hardwired Voted contact output of each parameter for Pre trip and trip alarms for alarms/ interlock in purchaser's control system. The alarms/trips of the channels within each monitor/ Module can be grouped together and common pre-trip alarm and common trip contact for each monitor/ Module shall be provided. 4-20 mA signals from Vibration & Temperature Monitoring System racks to DCS system are not required separately, unless specified and vendor to ensure that all the parameters are available through serial interface. For multi racks, vendor shall provide common serial interface through multi drop link.

4.15.2.6 In addition to this, it shall be provided with necessary hardware (communication gateway module) including the cable for serial data communication from monitoring system to purchaser's DCS for machine monitoring through purchaser's DCS via redundant serial data interface. This serial link shall be RS 422 / RS 485 with MODBUS RTU/ TCP IP protocol. Vendor shall furnish all details like pin configuration and tag number wise MODBUS address mapping list etc. for smooth interfacing of this communication link with DCS. Vendor shall also provide necessary hardware and software for providing raw data to conditioning monitoring system for each rack.

4.15.2.7 Vendor shall also supply one common laptop based configuration unit for the package unit with required configuration software (refer clause 4.17) and hardware for configuration of MMS system including the serial communication cable required between configuration unit (laptop) & MMS monitors.

#### 4.15.2.8 **Key Phasor**

Key phasor system shall be provided by vendor for performing analysis of vibration signals to determine machine malfunctions. It shall consist of a proximity probe and transmitter, extension cable etc. and other accessories to make the system complete. Vendor shall provide necessary reference on the shaft to determine one-per-turn occurrence.

#### 4.15.2.9 **Vibration and Axial Displacement Monitoring**

Monitors shall be four channel types and shall meet the following specifications as a minimum:

- a) Continuous channel monitoring with each channel input from one probe. Readout scale shall read higher of the sensors.

- b) Each channel shall have two independent alarm levels one for pre trip alarm and one for each trip and that can be set continuously over measurement range. Two relay contacts for each pre-trip alarm and trip alarm per channel shall be provided.
- c) Broken sensor failure detection without causing shut down.
- d) LED lamps on monitor front for each channel to indicate pre-trip alarm, trip-alarm and circuit fault conditions.
- e) Selector switches on monitor front to read vibration/ displacement pre-trip alarm and trip set points for each channel shall be provided.

#### 4.15.2.10 Bearing & Winding Temperature Monitoring

- a) Sensor shall be three wires RTD element of platinum having 100 ohms resistance at 0°C.
- b) The temperature sensor, cables, terminal heads, junction boxes etc. shall be capable of withstanding the mechanical vibration and environment of a rotating machinery atmosphere.
- c) Bearing and Winding temperature shall be monitored by means of a temperature monitor. It shall meet following requirements:
  - i. Accept RTD inputs (platinum, 100ohm at 0°C).
  - ii. Continuous six channel monitoring with each channel input from each RTD. Read out scale shall read higher of the six temperatures.
  - iii. Each channel shall have two independent alarm levels one for pre-trip alarm and one for trip alarm and that can be set continuously over measurement range.
  - iv. Broken sensor failure detection without causing shut down.
  - v. Selector switches on monitor front, to read temperature, pre-trip alarm and trip set points for each channel shall be provided.
  - vi. Analog output 4-20 mA DC isolated signals shall be provided for each channel for remote indication, if specified.

4.15.2.11 Wherever MMS is not specified, vendor shall provide suitable transmitter for all the vibration and axial displacement, temperature, key phasor to provide 4-20mA signal to purchaser's control system.

#### 4.15.3 Speed Governor System

4.15.3.1 Digital microprocessor based system mounted in standalone cabinet and located in rack room shall be provided. Fault tolerant triple modular redundant (TMR) system shall be supplied unless otherwise specified in Job Specification.

4.15.3.2 HMI for operator interface shall be supplied loose with all mounting accessories for mounting this HMI in purchaser's hardwired console in general. This shall include all basic features of governor to enable operator to do all control and monitoring operations from console itself.

4.15.3.3 This shall include features like assignable speed range, adjustable speed set point, remote speed set point input, digital speed indication, adjustable speed ramp, override for testing the external over speed trip system etc.

4.15.3.4 It should be able to accept 4-20 mA signal from HIC at purchaser's DCS or LCP as a manual override to governor and pass on the same, after a bump less auto / manual selection and local / remote selector switches configured in speed governor (shall be possible through HMI) to governor valve as manual control.

4.15.3.5 Vendor shall provide all hardware & software in the system (including the cable for serial data communication from system to purchaser's DCS) for serial communication link for all data transfer from governor to purchaser's DCS. This serial link shall be RS 422 / RS 485 with MODBUS RTU protocol, vendor shall furnish all details like pin configuration and tag number wise MODBUS address mapping list etc. For smooth interfacing of this communication link with DCS.

#### 4.15.4 Accumulator of Lube Oil System

4.15.4.1 If accumulators are used with nitrogen for lube oil dampening at the desired pressure to meet the system requirement the following instrumentation with the accumulator to be provided by vendor:

- a) Accumulator shall have charge kit with isolation valves and connection hoses.
- b) Standard nitrogen cylinders available in India are at pressure of 140 kg/cm<sup>2</sup>g with standard connection sizes. Vendor shall provide the complete regulator system with protection for charging nitrogen from nitrogen cylinder to accumulator at the desired pressure. Regulator shall be suitable for the inlet pressure variation of 140 to 150 kg/cm<sup>2</sup>g while charging with suitable inlet connection to match the Nitrogen cylinder connection. Regulator system shall have pressure indicator, regulator, relief valve, needle valve etc. as a minimum. Material of construction shall be stainless steel.

4.15.5 The compressor loading-unloading scheme for reciprocating compressors shall be provided as per the minimum requirements specified in the job specifications. Manual as well as automatic schemes shall be provided.

4.15.6 Emergency switch shall be provided in the local panel/local. All such switches shall have a protective cover to avoid inadvertent shutdown. All ESD switches on LCPs shall be push to normal & pull to trip type and of red colour.

4.15.7 Vendor shall provide the following common alarms for purchaser:

- a) Common machine pre-trip alarms.
- b) Common machine trip alarm.

4.15.8 LED lights and cooling fans shall be provided for cabinet by the bidder

#### 4.16 System Cabinets, Racks and Consoles

4.16.1 All system cabinets, marshalling racks and hardwired consoles shall be free standing and enclosed cubicles type. All these items shall have bottom cable entry. Cable entry shall be through MCT.

4.16.2 Cabinets shall be fabricated from cold rolled steel sheet (CRCA) of minimum 2.0mm thickness suitably reinforced to prevent warping and buckling. Doors shall be fabricated out of 1.6 mm thick CRCA sheet. Cabinets having modular construction and with basic frame structure of heavy duty aluminium shall also be acceptable.

4.16.3 Cabinet/Console finish shall include sand blasting, grinding, chemical cleaning, surface finishing by suitable filler and two coats of high-grade lacquer with sanding between coats.

Two coats of paint in the cabinet colour and a final coat after assembly at site, shall be given for non-glossy high satin finish.

- 4.16.4 In order to remove dissipated heat effectively vent louvers backed by wire fly screen shall be provided. Further, ventilation fans shall be provided wherever required. High temperature annunciation shall be provided on operator console.
- 4.16.5 Illumination shall be provided for all cabinets by Led lamps, which shall be operated by door switch.
- 4.16.6 All cabinets/racks/consols shall be adequately sized to avoid any congestion. Wiring shall be done as per guidelines provided in clause 4.2.14 of this specification.
- 4.16.7 The height and colour of the cabinets shall be inline with other equipments being installed in the control room.
- 4.16.8 All panel shall be provided with 180 degree hinges. Server panel and system panel shall be black color RAL9005. Hinges of panel shall be SS. Panels left door shall be latched type from inside and right door shall be latched with lock from outside. Door locks shall be four point comfort locking type.

#### 4.17 System software / License

Systems (like PLC, ASC, Speed Governor etc.) software shall include the operating system and application program. The application program shall include software for performing functions like interlock and shutdown logic, programming/program modification, documentation etc. Two copies of application program and two sets of licensed system software shall be supplied. The program language shall be English.

The licenses and application program shall allow:

- Monitoring of system program for troubleshooting purpose.
- Carrying out any modifications to the PLC/system program if need arises (engineering license with proper validity)
- Troubleshooting of any system related failures.
- Monitoring of the system healthiness

The system shall be supplied with programming tools and related accessories.

#### 4.18 WIRELESS MONITORING

- 4.18.1 The wireless monitoring system shall comprise of following hardware components as a minimum:  
Wireless signal Processing module, Wireless Signal Repeater, Routers, Antennas / Access points, Gateways, interconnecting cables and network switches etc.
- 4.18.2 All the instruments and electronics supplied which are to be mounted in hazardous area should be suitable for the area classification of its location of installation and minimum IP 65 rated. For wireless instruments non-metallic enclosures are also acceptable.
- 4.18.3 All wireless devices and its accessories in the network shall comply to WIRELESS HART as per IEC62591 or ISA100.11a. The Wireless devices network shall be designed in such a way that continuous communications with gateways are established. Adequate amount repeaters in field for wireless network design shall be considered for ensuring multiple communication paths.
- 4.18.4 Gateway shall have capability of ISA100 as well as Wireless HART

In case the system is designed only with battery power, it shall be provided with battery status like end of life etc. indications and/or alarms provision in HMIs.

## 5.0 GAS DETECTION SYSTEM

### 5.1 Gas Detectors

5.1.1 All gas detectors shall be suitable for outdoor installation certified for use in electrically hazardous area. The detectors shall be weather proof to IP65 in accordance with IS/IEC60529, as a minimum and certified flameproof (EExd) or certified intrinsically safe (EEx i) in accordance with IS/IEC 60079 for the area classification specified in purchaser's data sheet.

5.1.2 All gas detectors shall be provided with dust guard and splashguard.

5.1.3 All gas detectors shall be provided with terminal box for terminating incoming cabling. Flying leads shall not be acceptable. The cable entry in the terminal box shall be 3/4" NPTF.

5.1.4 Open path gas detectors shall be considered for group of pumps, compressor etc.

Gas detectors shall have an integral transmitter, which shall provide 4-20mA outputs with HART (latest version). Gas Detectors with HART protocol shall be capable of implementing commands from universal Hand Held HART Communicator. RS485 MODBUS (RTU) etc. shall be offered when Smart detectors or Addressable detectors are specified in the purchaser's data sheets.

5.1.5 All detectors shall be supplied with local LED/ LCD digital display, which shall provide currently detected gas concentration. In case separate local display unit is offered, the same shall be loop powered type and shall be supplied complete with proper terminal blocks housing suitable for mounting in hazardous area classification. Removal/disconnection of local indicator shall not affect performance of the meter.

5.1.6 Mounting accessories like mounting bracket (Stainless Steel / GI) required for the installation of gas detectors for 2" pipe mounting shall be supplied by the vendor.

5.1.7 For 'EExd' detectors, intrinsically safe port shall be provided for connecting the Hand Held Communicator.

#### 5.1.8 Flammable Gas Detectors (Hydrocarbon)

5.1.8.1 Flammable Hydrocarbon gas sensors shall be Non-Selective Infra-Red (IR) type. "Dual beam" with heated optics or other suitable arrangements to overcome environmental effects of fogging/fouling shall be provided.

5.1.8.2 Flammable gas detector including terminal box shall have Stainless Steel body / casing.

5.1.8.3 Detectors installed in pressurized lines e.g. HVAC duct etc., shall be provided with in-situ calibration facility (facility to calibrate the gas detectors externally without removing from the duct).

5.1.8.4 IR detector lamp shall be replaceable type. Detector shall be compensated for lamp intensity variation due to dust, humidity, sun-light, wear & tear etc.

5.1.8.5 Aspirator shall be supplied wherever specified in the data sheet.

5.1.8.6 Range

- a) The range of the Flammable gas detectors shall be as follows:

Point detector: 0-100% LEL

Open-path detector: 0-5 LEL meters

(LEL meter is equal to %LEL/100 x length of gas cloud).

The gas detectors shall have an over range protection in case of sudden exposure to large quantity of Hydrocarbon gases

- 5.1.8.7 Detector failure/sensor failure alarms shall be provided. In addition, the infrared detector shall provide diagnostic alarms for dirty or misaligned optics and blocked beam.

- 5.1.8.8 Performance requirements:

The flammable gas detectors shall meet the following performance requirements:

Repeatability:  $\pm 2\%$  of full scale

Response time (T90): Less than 30 seconds with splash guard and dust guard.

- 5.1.8.9 The minimum life expectancy of flammable gas detectors shall be five (5) years.

### 5.1.9 Flammable gas detectors (Hydrogen)

- 5.1.9.1 Flammable gas sensor for hydrogen shall be poison resistant catalytic diffusion type and shall be specific for hydrogen gas only.

- 5.1.9.2 Catalytic type detector shall incorporate a plug-in type sensor and metallic flame arrestor.

- 5.1.9.3 The flammable gas detector shall meet all requirements specified in clause 5.1.8.2, 5.1.8.3, 5.1.8.6, 5.1.8.8.

### 5.1.10 Toxic gas detectors

- 5.1.10.1 The toxic gas sensor for Hydrogen Sulphide shall be Electrochemical type.

- 5.1.10.2 The Electrochemical cell requiring replenishment of electrolyte shall not be offered.

- 5.1.10.3 The field life of electrochemical type of sensor shall be 2 years as a minimum. The cell shall be able to be replaced in-situ.

- 5.1.10.4 The semiconductor type sensor shall be the thin film MOS type. Life expectancy shall be a minimum of five years. Zero and span adjustment shall be automatic.

- 5.1.10.5 Toxic gas detector and its terminal box shall preferably have Stainless Steel body. Alternately vendor's standard material of construction shall also be acceptable.

- 5.1.10.6 Range

- a) Unless otherwise specified in purchaser's data sheet, the range of the toxic gas detectors for Hydrogen Sulphide shall be 0-100ppm.

- 5.1.10.7 Performance Requirements

- a) The toxic gas detector for Hydrogen Sulphide shall meet the following performance requirements:

Repeatability:  $\pm 2$  ppm

Response time (T90): Less than 60 seconds with splashguard and dust guard.

#### 5.1.11 Toxic gas detectors (Chlorine and others)

5.1.11.1 The toxic gas detectors for Chlorine and other Toxic gases shall be of electrochemical cell type.

5.1.11.2 The detectors shall meet all the requirements specified in clauses 5.1.10.2, 5.1.10.3, 5.1.10.4 and 5.1.10.5 of this specification.

5.1.11.3 Range

- a) Unless otherwise specified in the purchaser's data sheets, the range of toxic gas detectors shall be as follows:

Chlorine detectors: 0-10ppm

Other detectors: As per purchaser's data sheet

5.1.11.4 Performance Requirements

The offered toxic gas detectors shall meet the following performance requirements:

Repeatability:  $\pm 2$  % of full scale

Response time (T90): Less than 60 seconds with splashguard and dust guard.

The performance of the sensor shall not be affected by the presence of other gases like Methane or Hydrogen.

#### 5.1.12 Addressable gas detectors

5.1.12.1 Addressable detectors, when specified, shall be similar in mechanical construction, range and performance requirements of detectors specified in clauses 5.1.1 to 5.1.10 as applicable. These detectors, in addition, shall provide two-way communications with the gas detection system.

5.1.12.2 Addressable gas detectors shall be connected over a system communication bus with each detector having a unique address code, which shall be programmed on each device. The detector address shall be programmable from the gas detection system.

5.1.12.3 The communication protocol for data transfer between detector and host shall be deterministic. The protocol shall ensure reliable data transfer and verify the data integrity using parity data bit error checking subroutines for address code and check sum routine for the data transmission.

5.1.12.4 All addressable devices shall have capability of being disabled or enabled individually.

5.1.12.5 It shall be possible to replace failed detector on-line with a similar device without any specific tools and without data interruption.

5.1.12.6 The addressable system digital communication network shall be continuously monitored for detection and isolation of network communication failure and shall also provide an alternative path in case of a single failure of a gas detector in the network.

### 5.1.13 Fire detector at Field

5.1.13.1 Flame detector shall be of UV/IR type.

5.1.13.2 The flame detector shall meet all requirements specified in clause 5.1.8.2, 5.1.8.3, 5.1.8.6, 5.1.8. as applicable.

## 5.2 Portable Calibrator

5.2.1 Portable purge calibrators (one each for Hydrocarbon, Hydrogen, H<sub>2</sub>S, each type of toxic gas) each consisting of a volume bottle containing a known gas/air mixture, a pressure regulator, a flexible hose, adapter cap (to fit the sensing head) and carrying case shall be supplied to enable calibration of the sensors in the field without dismantling them.

5.2.2 Calibration range for all sensors will be 0-100% LEL for Hydrocarbon, 0-100 ppm for Hydrogen Sulfide, 0-100% LEL for Hydrogen and as per job specifications for toxic gases.

5.2.3 Vendor to furnish quantity of calibration gas required for calibration of detector. Volume of calibration gas cylinder and no. of calibration gas cylinders shall be based on the requirements specified below:

a) Sufficient quantity of calibration gas cylinders shall be supplied to enable calibration of all sensing heads at least thrice considering minimum 3 minutes for each detector. Vendor to ensure that the composition and stability of the calibration gas provided in the gas cylinders shall be suitable for minimum six months periods.

b) In case vendor's standard product requires higher calibration time, vendor to indicate the same and calculate the gas quantity accordingly.

Gas cylinders, self-regulating valves, pressure gauges, hose, interconnecting tubing, fittings etc. shall be supplied by the vendor. The delivery of gas cylinders shall be staggered in such way that the composition and stability of gas do not deteriorate. Date of supply shall be intimated to the bidder and shall be prior to commissioning.

Expiry date of gas shall be mentioned on each type of gas cylinder supply.

5.2.4 All detectors shall be supplied pre-calibrated at vendor's works either with the gas to be reused or by applying cross sensitivity factors.

5.2.5 HC Detectors shall be calibrated for gas that they are least sensitive. Vendor shall indicate the gas with which the gas detectors shall be calibrated.

5.2.6 Gas detector sensors shall be capable of non intrusive calibration.

5.2.7 Vendor to furnish calibration procedure for HC, H<sub>2</sub>S, H<sub>2</sub>, O<sub>2</sub> & Cl<sub>2</sub> detectors along with make/model no. with catalogue/technical details of calibration kit.

## 5.3 Portable Gas Detectors

5.3.1 The portable gas detectors shall be supplied for Hydrocarbon, Hydrogen, H<sub>2</sub>S and other toxic gas detectors complete with its controller, audio-visual alarm. The portable gas detectors shall be suitable (preferably flameproof) for use in hazardous area specified. These units shall be supplied with rechargeable batteries and 240 V, 50 Hz AC battery chargers.

Sufficient number of battery charger/number of points per charge shall be provided based on quantity of such portable units. These units shall be supplied complete with its accessories like carrying case, maintenance kit, calibration kit etc.

#### 5.4 Beacon and Hooter

5.4.1 Beacon and Hooter shall be supplied by the vendor as per the requirements specified in the purchaser's data sheets

5.4.2 Unless otherwise specified, the Beacons and Hooter shall meet the following functional requirements:

a) The Beacon colour shall be 'ORANGE' for flammable gas detection while 'BLUE' for Toxic gas detection.

b) Beacon light shall follow the following sequence:

Gas leakage detected	- Flashing Beacon light
	- Hooter continuous
Field Acknowledge	- Flashing Beacon light
	- Hooter off
Gas leakage stops	- Flashing Beacon light
	- Hooter continuous
Field reset	- Beacon off
	- Hooter off

Reset shall be activated only after acknowledge and leakage stop.

5.4.3 The beacon shall be of stroboscopic type and shall be of sufficient intensity to provide visibility and clear contrast during full daylight.

5.4.4 The hooter shall be electronic type and shall have sound intensity of 100dBA, as a minimum. Different tones shall be provided for Flammable gas and Toxic gas releases.

5.4.5 Both Beacon and hooter units shall operate at 110V AC / 110 V DC / 24 V DC as specified in the data sheet and shall be certified explosion proof (flame proof) when installed in hazardous area.

5.4.6 Hooter/ Beacon shall be flameproof and shall be supplied with test / Acknowledge / reset push-buttons which shall be rated for 110V AC, 0.5 A / 110V DC, 0.5 A/ 24V Dc, 2 A as per the requirement specified in the data sheets.

#### 5.5 Gas Detection System

All the gas detectors shall be connected to the Main plant PLC. No separate gas detection system is required. Dedicated F&G PLC is not envisaged.

#### 6.0 DISTRIBUTED CONTROL SYSTEM

The system shall be microprocessor based having functional distribution and data base distribution sub-system wise. The extent of sub-system wise data base distribution shall be as specified in the requisition. The system design shall ensure that:

a) All the functions defined in this specification are performed in an integrated manner.

- b) The access to the distributed data base is available system-wide.

This system shall also have networking capability with other systems distributed geographically in the various units of a plant, over a plant wide information network such as Ethernet or other industrially recognized open networks.

The system shall be of modular construction and expandable in future by adding additional modules. The type of modules shall be kept to the minimum possible in order to have interchangeability and low inventory. The distributed control system shall be a fully integrated control system. Foreign devices like shutdown system (Safety Instrumented System, F&G), analyser system, third party equipment (like compressors etc.) etc. shall be fully and functionally integrated with the distributed control system

For detailed specification refer standard specification for DCS (6-52-0055).

## 7.0 PROGRAMMABLE LOGIC CONTROLLER (PLC)

Programmable logic controller shall be microprocessor based system which shall be used to execute all the process and safety shut-down logic of the plant. When specified, it shall also execute plant interlock logics and sequence operation and analog control. Programmable logic controller shall be an independent unit and shall not depend on any of its functionality on any other system including Distributed Control System.

PLC Configuration shall be TMR or Quad, SIL-3 certified for all the process units as per IEC61508. For package vendor supplied PLC, PLC shall be DMR, TMR, QUAD as specified. SIL-3 PLC shall be considered where SIL-3 loops are applicable for corresponding package.

In case of common engineering database for DCS and PLC, engineering data for DCS and PLC shall be segregated and the data access shall be through respective engineering stations of DCS and PLC only. Such configuration shall meet the SIL3 compliance by third party certifying agency like TUV/ EXIDA etc

Moreover, wherever exchange of safety parameters between the different PLC sub-systems is required for interlock execution, separate communication network shall be provided between these PLC sub-systems. For SIL certified PLCs, this communication network between PLC nodes shall also be SIL 3 certified.

Passivation of signals (Latching of signals to last value due to unwanted issues like IOP/out of range/ damage or cutting of signal cables etc.) shall not be considered for PLC systems including Package PLCs.

For package PLCs detailed specification, refer standard specification 6-52-0040.

## 8.0 MATERIAL SELECTION CHART

SL. NO	PIPING CLASS	CONTROL VALVE		PRESSURE RELIEF VALVE		
		Body	Trim	Body / Bonnet	Nozzle / disc	Bellow
1.	A1A, A3A, A5A, A6A, A8A, A9A, A10A, A14A, A19A, A22A, A28A, B1A, B5A, B6A, B9A, B13A, B19A, B28A	A216 Gr. WCB	SS 316	A216 Gr. WCB	SS 316	SS 316L
2.	A16A, A23A, A26A, A68A, B16A, B23A, B24A, B26A, B68A	A216 Gr. WCB *	SS 316L*	A216 Gr. WCB *	SS 316L *	Inconnel *
3.	D23A, D26A	A216 Gr. WCB *	SS 316L Stellited*	A216 Gr. WCB *	SS 316L *	Inconnel *
4.	A2A, B2A, B21A, D1A, D9A, D19A, D2A, D5A, E1A, E2A, F1A, F2A, F5A	A216 Gr. WCB	SS 316 Stellited	A216 Gr. WCB	SS 316	SS 316L
5.	A4A, B4A, D4A	A352 Gr. LCB	SS 316	A352 Gr. LCB	SS 316	SS 316L
6.	A1B, B1B, D1B, D2B	A217 Gr. WC1	SS 316 Stellited	A217 Gr. WC1	SS 316 stellited	SS 316L
7.	A1D, B1D, B5D, D1D, D2D, F2D	A217 Gr. WC6	SS 316 Stellited	A217 Gr. WC6	SS 316 stellited	SS 316L
8.	A4F, B3F, B4F	A217 Gr. C5	SS 321	A217 Gr. C5	SS 321	SS321
9.	A4G, B4G	A217 Gr. C12	SS 321	A217 Gr. C12	SS 321	SS 321
10.	D4G	A217 Gr. C12	SS 321 Stellited	A217 Gr. C12	SS 321	SS 321
11.	A1H, B1H, D1H	A352 Gr. LC3	SS 316 Stellited	A352 Gr. LC3	SS 316 stellited	SS 316L
12.	A1K, A2K, A3K, A22K, B1K, B2K, D2K	A351 Gr. CF8	SS 316	A351 Gr. CF8	SS 316	SS 316L
13.	D2K	A351 Gr. CF8	SS 316 Stellited	A351 Gr. CF8	SS 316	SS 316L
14.	B25K	A351 Gr. CF3	SS 316L Stellited	A351 Gr. CF3	SS 316L stellited	SS 316L
15.	B18K, D18K	A351 Gr. CF8	SS316	A351 Gr.CF8	SS316	SS 316L
16.	A1M, B1M	A351 Gr. CF8M	SS 316	A351 Gr. CF8M	SS 316	SS 316L
17.	A1N, B1N, B6N	A351 Gr. CF3M	SS 316L	A351 GrCF3M	SS 316L	SS 316L
18.	A26N	A351 Gr. CF3M*	SS 316L*	A351 GrCF3M*	SS 316L*	Inconnel *
19.	D26N	A351 Gr. CF3M*	SS 316L Stellited*	A351 GrCF3M*	SS 316L*	Inconnel *
20.	B4K, B5K	A351 Gr. CF10M	SS 304H Stellited	A351 Gr. CF10M	SS 316	SS 316L
21.	A70M, A74M, B70M, B74M	A351Gr. CF8C	SS 321	A351Gr. CF8C	SS 321	SS 321
22.	D25M	A351Gr. CF8C	SS 347 Stellited	A351Gr. CF8C	SS 347 Stellited	SS 347
23.	A11K, B11K	A351Gr. CF3	SS316L	A351Gr CF3	SS316L	SS 316L

**MATERIAL SELECTION CHART**

S. NO	PIPING CLASS	ORIFICE/SENIOR ORIFICE		FIELD TRANSMITTER	
		Flange/Body	Plate	Body	Sensor
1.	A1A, A3A, A6A, A8A, A9A, A10A, A14A, A19A, A22A, B1A, B21A, B6A, B9A, B13A, B19A, D1A, D9A, D19A, E1A, F1A,	A105	SS 316	SS 316	SS 316L
2.	A16A, A23A, A26A, A68A, B16A, B23A, B24A, B26A, B68A, D23A, D26A	A105 *	SS 316L*	SS 316*	SS 316L*
3.	A2A, B2A, D2A, E2A, F2A,	A105	SS 316	SS 316	SS 316L
4.	A4A, B4A, D4A	A350 GrLF2	SS 316	SS 316	SS 316L
5.	A1B, B1B, D1B, D2B	A182 GrF1	SS 316	SS 316	SS 316L
6.	A1D, B1D, B5D, D1D, D2D, F2D	A182 GrF11	SS 316	SS 316	SS 316L
7.	A4F, B3F, B4F	A182 GrF5	SS 321	SS316	SS321 or Hastelloy-C
8.	A4G, B4G, D4G	A182 GrF9	SS 321	SS316	SS321 or Hastelloy-C
9.	A1H, B1H, D1H	A350 GrLF3	SS 316	SS 316	SS 316L
10.	A1K, A2K, A3K, A22K, B1K, B2K, D2K	A182 GrF304	SS 316	SS 316	SS 316L
11.	B25K	A182 GrF304L	SS 316L	SS 316	SS 316L
12.	B18K, D18K	A182 GrF304	SS 316	SS 316	SS 316L
13.	A1M, B1M	A182 GrF316	SS 316	SS 316	SS321 or Hastelloy-C
14.	A1N, A26N*, B1N, B6N, D26N*	A182 GrF316L	SS 316L	SS 316	SS 316L
15.	A5A, B5A, D5A, F5A, F25A Note-1	A105	SS316	SS 316	SS316L with gold plated
16.	B4K, B5K	A182 GrF304H	SS 316	SS 316	SS 316L
17.	A70M, A74M, B70M, B74M	A182GrF321	SS321	SS316	SS321 or Hastelloy- C
18.	D25M	A182GrF347	SS347	SS316	SS316L with gold plated
19.	A11K, B11K	A182GrF304L	SS316L	SS316	SS316L

**MATERIAL SELECTION CHART**

S. NO	PIPING CLASS	THERMOWELL		LEVEL INSTRUMENT
		Flange	Well	Cage/ Chamber
1.	A1A, A3A, A6A, A8A, A10A, A14A, A19A, A22A, B1A, B21A, B6A, B9A, B13A, B19A, D1A, E1A, F1A, A5A, B5A, D5A, D9A, D19A, F5A	A105	SS 316	A106 Gr. B
2.	A16A, A23A, A26A, A68A, B16A, B23A, B24A, B26A, B68A, D23A, D26A	A105 *	SS 316L	A106 GrB*
3.	A2A, B2A, D2A, E2A, F2A	A105	SS 316	A106 GrB
4.	A4A, B4A, D4A	A350 GrLF2	SS 316	A333 Gr6
5.	A1B, B1B, D1B, D2B	A182 GrF1	SS 316	A335 GrP1
6.	A1D, B1D, B5D, D1D, D2D, F2D	A182 GrF11	SS 316	A335 GrP11
7.	A4F, B3F, B4F,	A182 GrF5	SS 321	A335 GrP5
8.	A4G, B4G, D4G	A182 GrF9	SS 321	A335 GrP59
9.	A1H, B1H, D1H	A350 GrLF3	SS 316	A333, Gr3
10.	A1K, A2K, A22K, A3K, B1K, B2K, D2K	A182 GrF304	SS 316	A312 GrTP304
11.	B25K	A182 GrF304L	SS 316L	A312 GrTP304L
12.	B18K, D18K	A182 GrF304	SS 316	A312 GrTP304
13.	A1M, B1M	A182 GrF316	SS 316	A312 GrTP316
14.	A1N, B1N, B6N, A26N*, D26N*	A182 GrF316L	SS 316L	A312 GrTP316L
15.	B4K, B5K	A182 GrF304H	SS 304H	A312 GrTP304H
16.	A70M, A74M, B70M, B74M	A182 GrF321	SS321	A312 GrTP321
17.	D25M	A182 GrF347	SS347	A312 GrTP347
18.	A11K, B11K	A182 GrF304L	SS316L	A312 GrTP304L

**MATERIAL SELECTION CHART**

SL. NO	PIPING CLASS	LEVEL GAUGE			PRESSURE, DIFFERENTIAL PRESSURE AND VACUUM GAUGE	
		Chamber	Cock Body	Cock Trim	Sensing Element / Socket	Diaphragm
1.	A1A, A3A, A6A, A8A, A10A, A14A, A19A, A22A, B1A, B6A, B9A, B13A, B19A, B21A, D1A, D9A, D19A, E1A, F1A, A5A, B5A, D5A, F5A	A105	A105	SS 316	SS 316	SS 316
2.	A16A, A23A, A26A, A68A, B16A, B23A, B24A, B26A, B68A, D23A, D26A	A105*	A105*	SS 316L*	SS 316*	SS 316L*
3.	A2A, B2A, D2A, E2A, F2A	A105	A105	SS 316	SS 316	SS 316
4.	A4A, B4A, D4A	A350 GrLF2	A350 GrLF2	SS 316	SS 316	SS 316
5.	A1B, B1B, D1B, D2B	A182 GrF1	A182 GrF1	SS 316	SS 316	SS 316
6.	A1D, B1D, B5D, D1D, D2D, F2D	A182 GrF11	A182 GrF11	SS 316	SS 316	SS 316
7.	A4F, B3F, B4F	A182 GrF5	A182 GrF5	SS 321	SS 316	SS 321 or Hastelloy or Inconel
8.	A4G, B4G, D4G	A182 GrF9	A182 GrF9	SS 321	SS 316	SS 321 or Hastelloy or Inconel
9.	A1H, B1H, D1H	A350 GrLF3	A350 GrLF3	SS 316	SS 316	SS 316
10.	A1K, A2K, A22K, A3K, B1K, B2K, D2K	A182 GrF304	A182 GrF304	SS 316	SS 316	SS 316
11.	B25K	A182 GrF304L	A182 GrF304L	SS 316L	SS 316	SS 316
12.	B18K, D18K	A182 GrF304	A182 GrF304	SS 316	SS 316	SS 316
13.	A1M, B1M	A182 GrF316	A182 GrF316	SS 316	SS 316	SS 321 or Hastelloy or Inconel
14.	A1N, B1N, B6N, A26N*, D26N*	A182 GrF316L	A182 GrF316L	SS 316L	SS 316	SS 316L
15.	B4K, B5K	A182 Gr. F304H	A182 GrF304 H	SS 304H	SS 316	SS 316
16.	A70M, A74M, B70M, B74M,	A182Gr. F321	A182Gr F321	SS321	SS 316	SS 321 or Hastelloy or Inconel
17.	D25M	A182Gr. F347	A182Gr F347	SS347	SS 316	SS 347 or Hastelloy or Inconel
18.	A11K, B11K	A182Gr. F304L	A182Gr F304L	SS316L	SS 316	SS 316L

**Notes:**

- \* Material shall be hardness controlled and shall comply with NACE MR-0103 latest edition.
- 1. For Hydrogen service wetted part material for switches, transmitters shall be SS 316L gold plated, base material Hastelloy shall be avoided
- 2. SS 316L, SS 316Ti are also acceptable in place of SS316.

**LIST OF ENGINEERING / INSTALLATION  
STANDARDS  
(INSTRUMENTATION)  
FOR  
HPCL RAJASTHAN REFINERY LIMITED  
RAJASTHAN REFINERY PROJECT AT  
PACHPADRA, RAJASTHAN, INDIA**

**BIDDING DOCUMENT FOR  
VACUUM GASOIL HYDRO TREATING UNIT (VGO  
HDT) & REFINERY OFF GAS PSA  
EPCC – 10 PACKAGE  
(TENDER NO. – B224-110-86-41-PM-T-7210)**

---

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	25.02.19	ISSUED FOR BIDS	SA	RK	SB

---

**LIST OF ENGINEERING / INSTALLATION STANDARDS**

SL. NO.	DESCRIPTION	DOCUMENT NO.	REV.	No. of Sheets
	<b>Flow</b>			
1.	Flow instruments DP type liquid & cond. vapour service meter below without Integral Manifold	7-52-0401	5	1
2.	Flow instruments DP type liquid & cond. vapour service meter below high pressure	7-52-0404	1	1
3.	Flow instruments DP type gas service meter above without Integral Manifold	7-52-0405	5	1
4.	Flow instrument DP type liquid & cond. vapour service integral manifold meter below	7-52-0406	5	1
5.	Flow instrument DP type gas service meter above-high pressure	7-52-0409	1	1
6.	Flow instrument DP type gas service integral manifold meter above	7-52-0410	5	1
7.	Flow instrument DP type Averaging Pitot Tube gas service integral manifold meter above	7-52-0420	0	1
8.	Flow instrument diaphragm seal type	7-52-0421	5	1
9.	Flow instrument DP type liquid & cond. vap. Service (d-d/2) intg. manifold meter below	7-52-0422	0	1
10.	Flow instrument DP type gas services (d-d/2) intg. manifold meter above	7-52-0423	0	1
	<b>Pressure &amp; Differential Pressure</b>			
11.	Pressure gauge liquid/ gas service high pressure	7-52-0430	0	1
12.	Pressure gauge steam service high pressure	7-52-0431	0	1
13.	Pressure gauge liquid / gas service	7-52-0432	5	1
14.	Pressure gauge steam service	7-52-0433	5	1
15.	Pressure Instrument/Gauge Dia. Seal Type On Vessel/Line with spacer ring	7-52-0436	0	1
16.	Pressure instrument liquid & cond. vapour service meter below on pipe	7-52-0437	5	1
17.	Pressure instrument (PT & PG) diaphragm seal type vessel mounted	7-52-0440	0	1
18.	Pressure instrument gas service meter above on pipe	7-52-0441	5	1
19.	Pressure instrument gas service meter below on vessel	7-52-0447	3	1
20.	Pressure instrument gas service meter above on vessel	7-52-0448	3	1

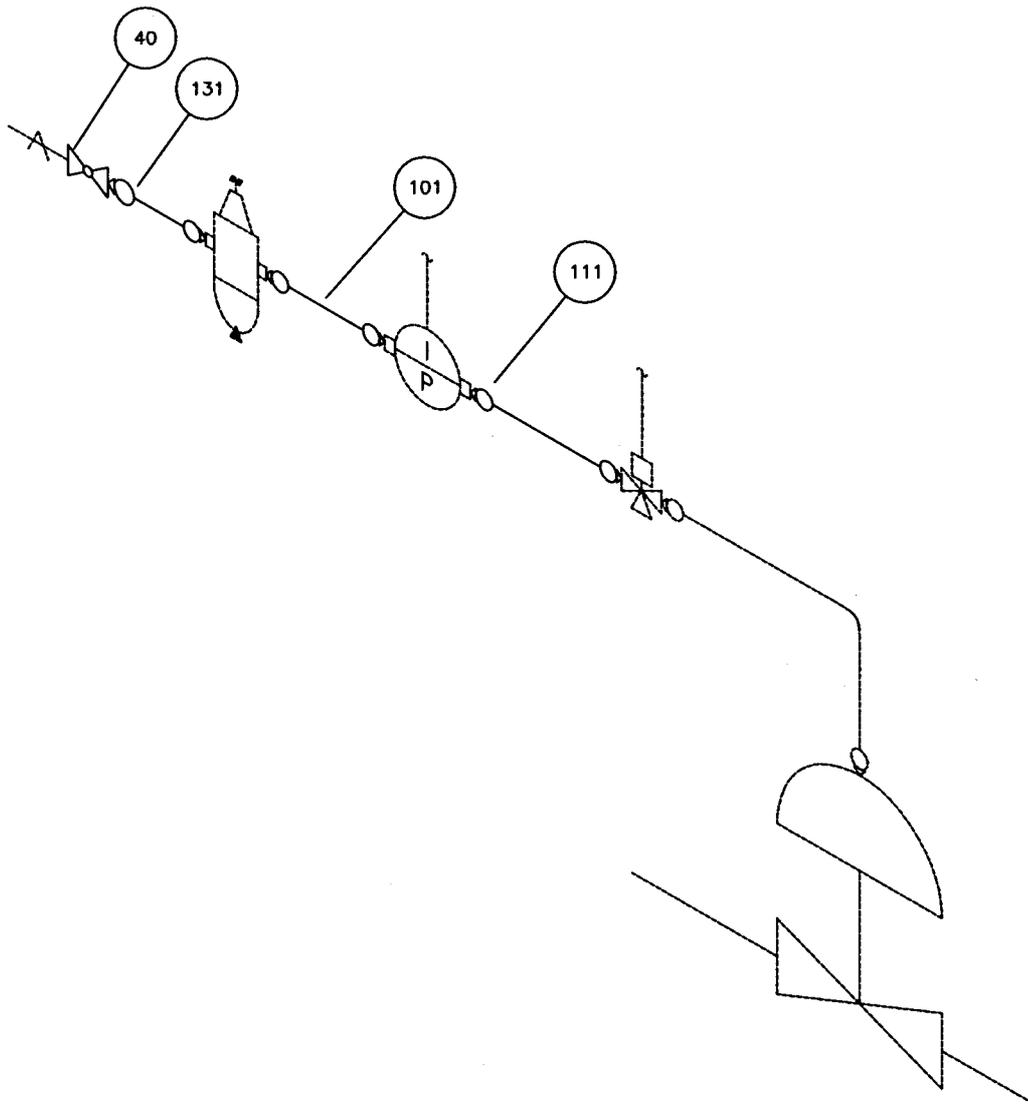
SL. NO.	DESCRIPTION	DOCUMENT NO.	REV.	No. of Sheets
21.	Differential pressure instrument DP - type meter below	7-52-0452	5	1
22.	Differential pressure instrument with one side diaphragm seal	7-52-0454	5	1
23.	Pressure instrument pressure transmitter & pressure gauge draft	7-52-0456	0	1
24.	Pressure Instrument Liquid & Cond. Vap. Service Meter Below (High Pressure)	7-52-0457	0	1
25.	Pressure Gauge high temperature remote mounted	7-52-0459	0	1
26.	Differential pressure instrument with both side diaphragm seal (on vessel/ pipe) with spacer ring	7-52-0462	0	1
27.	Pressure Gauge on clad vessel	7-52-0541	3	1
	<b>Level</b>			
28.	Displacer level instrument side-side connection	7-52-0463	5	1
29.	Level instrument diaphragm seal type with spacer ring	7-52-0468	5	1
30.	Level / Diff. Press. Instrument DP type on vessel meter below	7-52-0469	6	1
31.	Level / Diff. Press. Instrument DP type on Standpipe meter below	7-52-0473	5	1
32.	Level instrument guided wave radar on vessel / standpipe	7-52-0475	0	1
33.	Level Gauge On Vessel	7-52-0481	5	1
34.	Level Gauge On Standpipe	7-52-0483	3	1
35.	Level gauge magnetic type on vessel / standpipe	7-52-0484	0	1
	<b>Purging</b>			
36.	Purge for Instrument double line	7-52-0499	5	1
37.	Purge for Instrument single line	7-52-0500	5	1
	<b>Valves</b>			
38.	Tubing Hook-Up Control Valve With SOV	7-52-0207	5	1
39.	Tubing Hook-Up Control Valve & SOV and I/P converter (or Positioner)	7-52-0208	5	1
40.	Tubing Hook-Up Control Valve With Positioner	7-52-0211	5	1
41.	Tubing Hook-Up Control Valve With Smart Positioner	7-52-0212	1	1
	<b>Steam Tracing</b>			
42.	Steam tracing diff. pressure instrument.	7-52-00505	5	1
43.	Steam tracing pressure instruments.	7-52-00506	5	1
44.	Steam tracing level instruments.	7-52-00507	5	1

SL. NO.	DESCRIPTION	DOCUMENT NO.	REV.	No. of Sheets
	<b>Pre Fab Hook up</b>			
45.	Flow Instrument DP Type – Direct Installation (General Service)	B224-000-16-51-IS51	0	1
46.	Flow Instrument DP Type – Extended Installation (High Temp. Service)	B224-000-16-51-IS52	0	1
47.	Pressure Instrument (Direct Installation)	B224-000-16-51-IS57	0	1
48.	Pressure Instrument – Extended Installation (High Temp. Service)	B224-000-16-51-IS58	0	1
49.	Pressure Instrument On Vessel	B224-000-16-51-IS59	0	1





TUBING HOOK-UP  
CONTROL VALVE WITH  
SOLENOID VALVE AND I/P CONVERTER



LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
40	BALL VALVE	1/2"	TH	1	Nø	101	TUBE	6 mm	OD	A/R	m
						111	MALE CONNECTOR	1/4" X 6 mm	TH X OD	5	Nø
						131	MALE CONNECTOR	1/2" X 6 mm	TH X OD	1	Nø

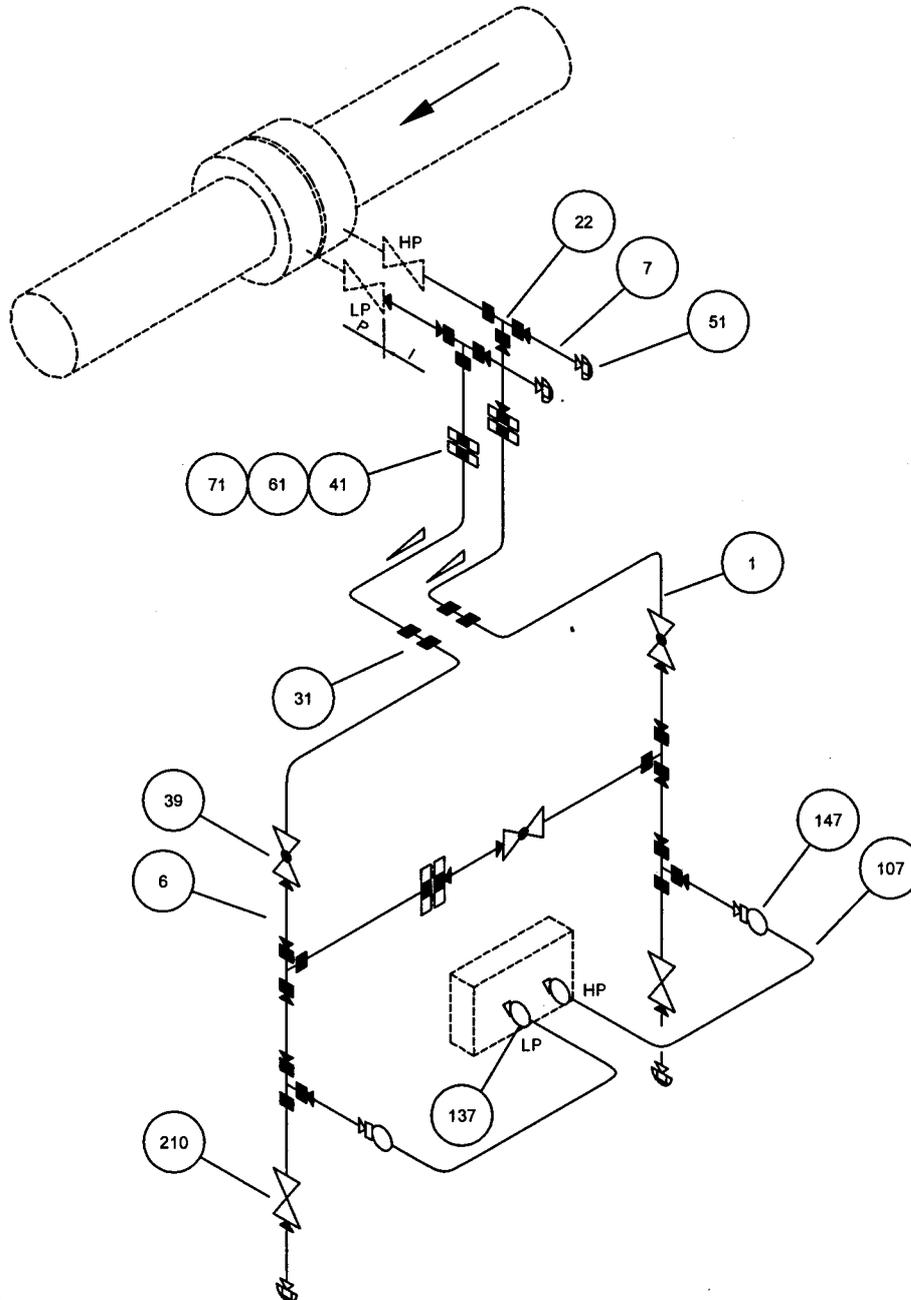
5	24.10.16	Reaffirmed & Reissued	Manoj	MN	RG	RN
4	07-11-11	Reaffirmed and Reissued	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						







FLOW INSTRUMENT DP TYPE  
LIQUID & COND. VAP. SERVICE  
METER BELOW



P - BY PIPING  
I - BY INSTRUMENTATION

THIS DRAWING SHALL NOT BE REFERRED FOR TAPPING ORIENTATION.

\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	7	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	6	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	6	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	3	Nø						
41	FLANGE	1/2"	SW	6	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FLG.		3	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		3	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

5 26-08-16

Revised & Reissued

Manoj

MN/RKG

RG

RN

4 01-08-11

Revised & Reissued

Manoj

RG

RP/JMS

DM

Rev.  
No.

Date

Purpose

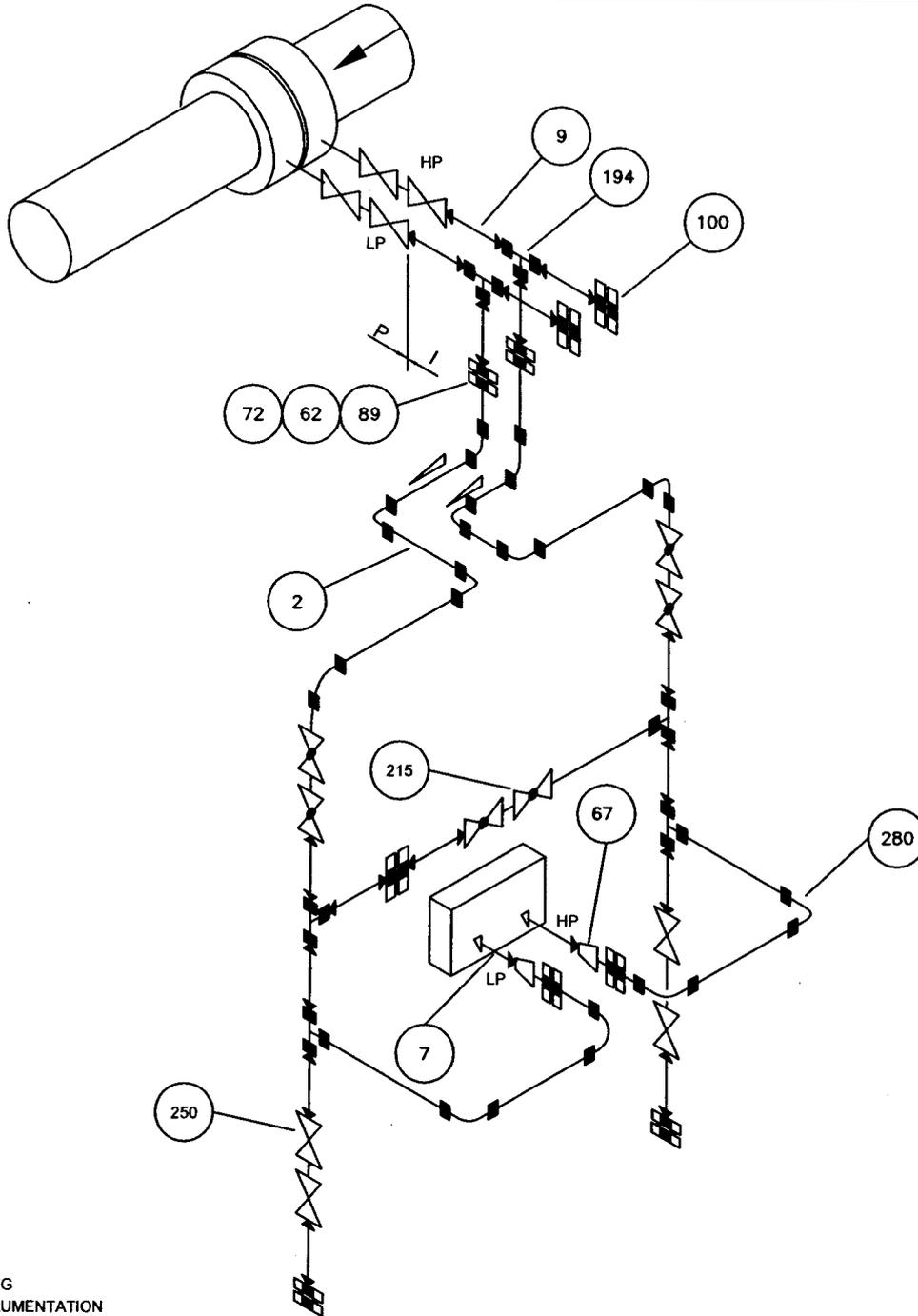
Prepared  
by

Checked  
by

Stds. Committee  
Convenor

Stds. Bureau  
Chairman

Approved by

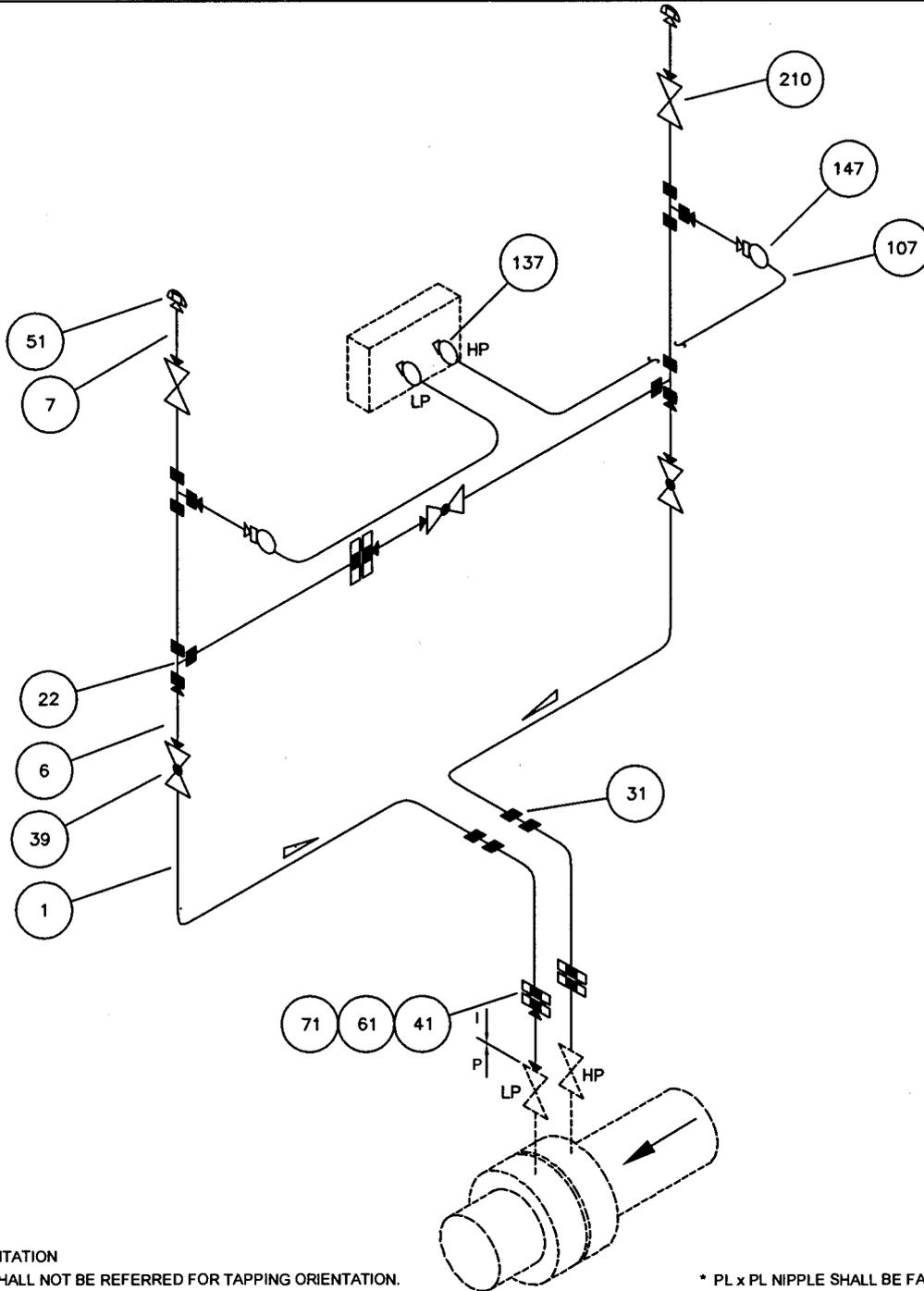


P - BY PIPING  
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL		A/R m						
7	NIPPLE	1/2"	TH X PL	2	Nø						
9	NIPPLE	3/4"	PL X PL	16	Nø						
62	GASKET	FOR 3/4" FL		9	Nø						
67	REDUCER	3/4" x 1/2"	BW	2	Nø						
72	STUDS & NUTS	FOR 3/4" FL		9	Set						
89	FLANGE	3/4"	WN	14	Nø						
100	BLIND FLANGE	3/4"		4	Nø						
194	EQUAL TEE	3/4"	BW	6	Nø						
215	GLOBE VALVE	3/4"	BW	6	Nø						
250	GATE VALVE	3/4"	BW	4	Nø						
280	ELBOW	3/4"	BW	12	Nø						

1	25-04-18	REAFFIRMED & REISSUED	Manoj	MN	RG	RP/JMS	RN
0	07-02-13	ISSUED AS STANDARD	Manoj	RG	RP/JMS	DM	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman	Approved by



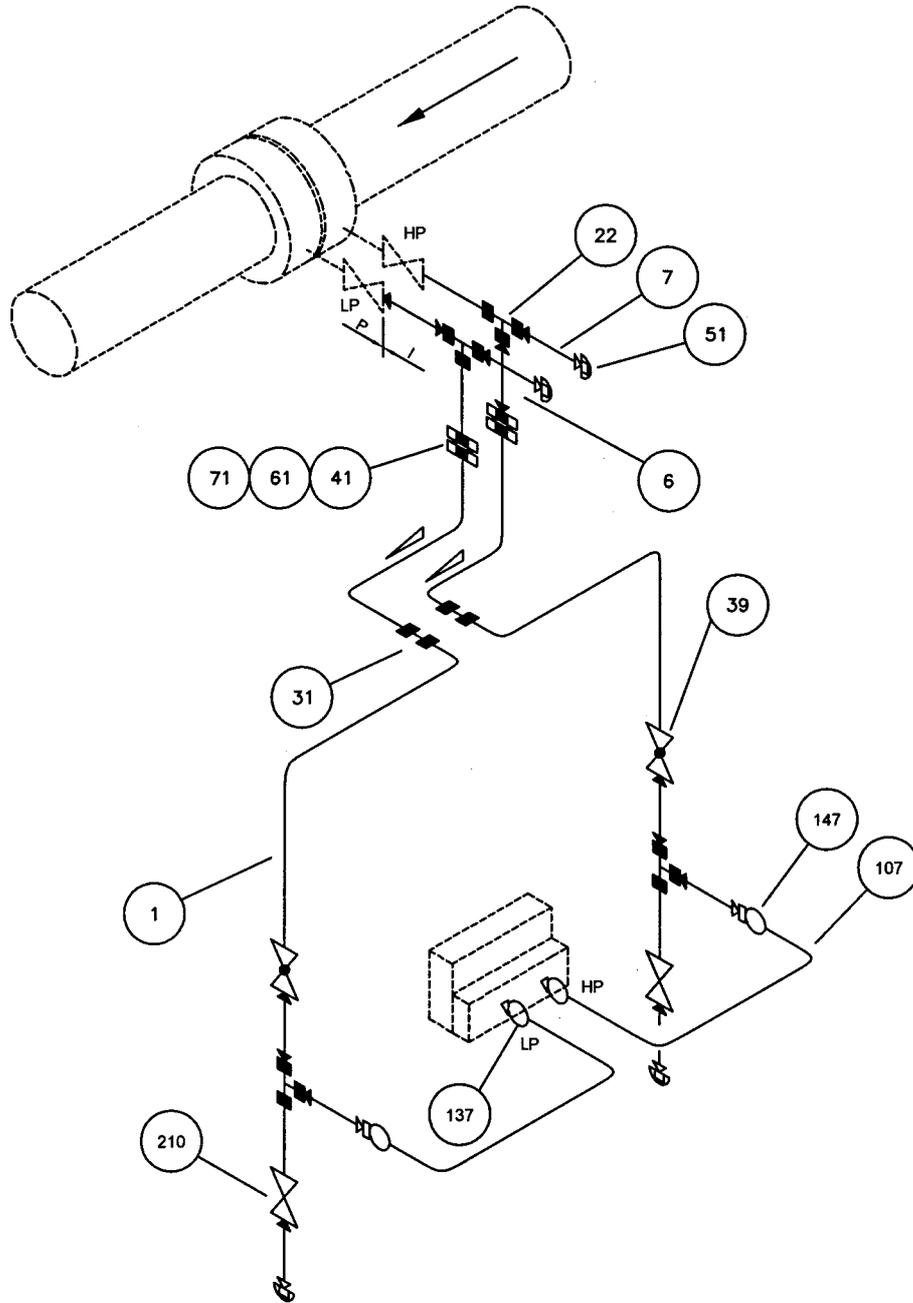
P - BY PIPING  
I - BY INSTRUMENTATION  
THIS DRAWING SHALL NOT BE REFERRED FOR TAPPING ORIENTATION.

\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	4	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	4	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	3	Nø						
41	FLANGE	1/2"	SW	6	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		3	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		3	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

5	26-08-16	Revised & Reissued	Manoj	MN/RKGD	RG	RP/JMS	RN
4	01-08-11	Revised & Reissued	Manoj	RG	RP/JMS	DM	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman	Approved by



P - BY PIPING

I - BY INSTRUMENTATION

THIS DRAWING SHALL NOT BE REFERRED FOR TAPPING ORIENTATION.

\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	4	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	6	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		2	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

5 26-08-16

Revised & Reissued

Manoj

MN/RKG

RP/JMS

DM

4 01-08-11

Revised & Reissued

Manoj

RG

RP/JMS

DM

Rev.  
No.

Date

Purpose

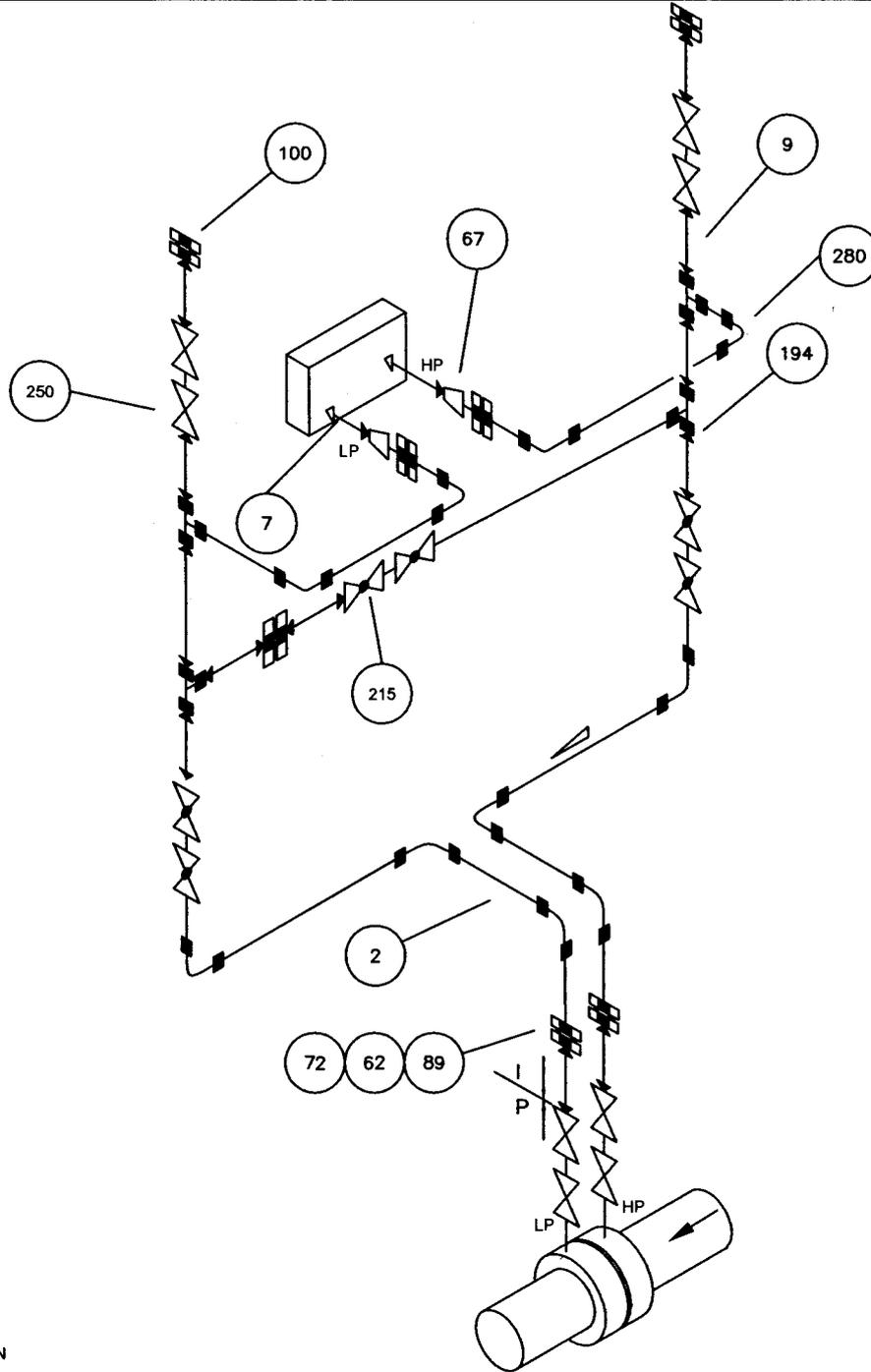
Prepared  
by

Checked  
by

Stds. Committee  
Convenor

Chairman

Approved by

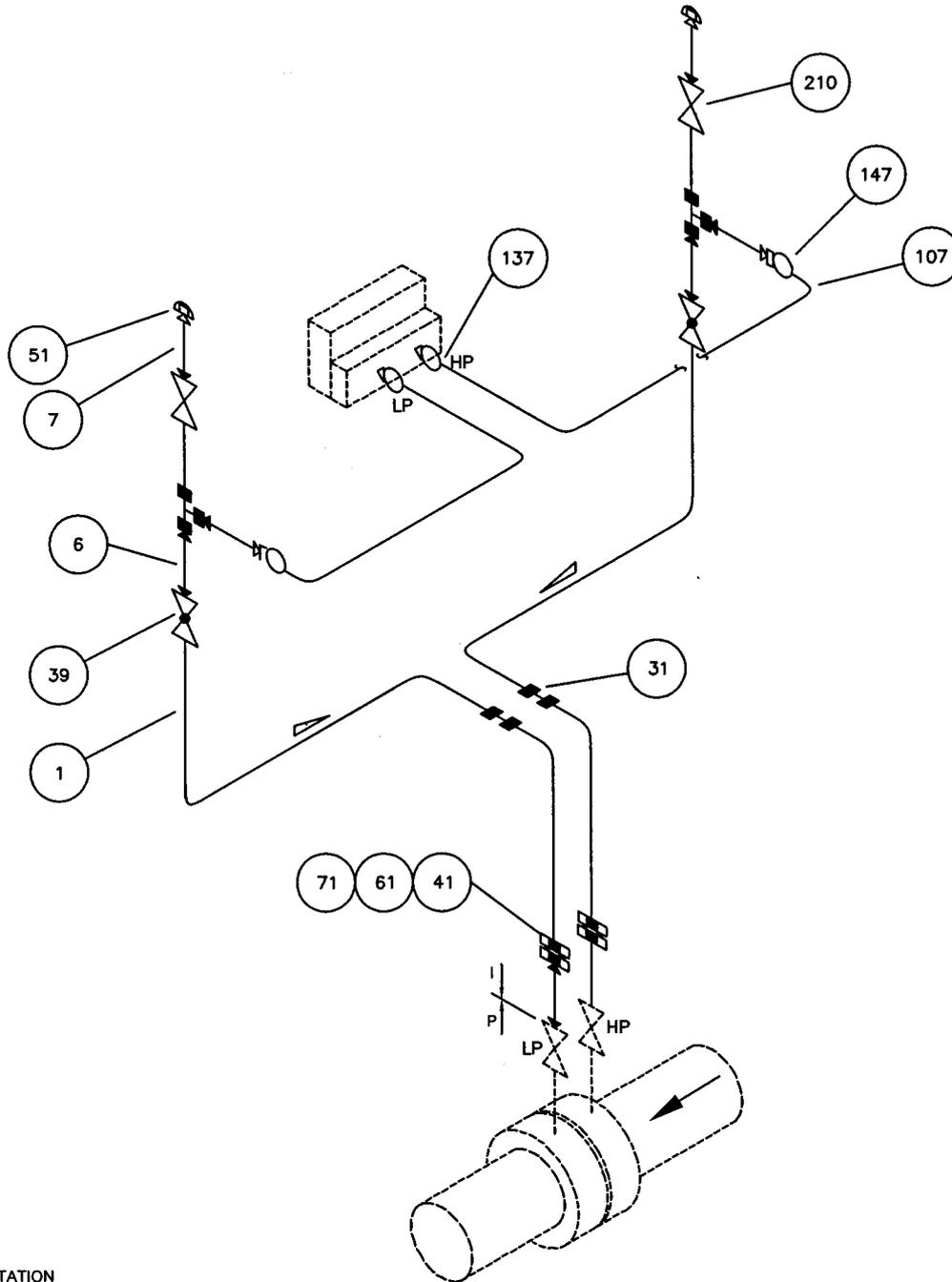


P - BY PIPING  
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL	A/R	m						
7	NIPPLE	1/2"	TH X PL	2	No						
9	NIPPLE	3/4"	PL X PL	12	No						
62	GASKET	FOR 3/4" FL		7	No						
67	REDUCER	3/4" x 1/2"	BW	2	No						
72	STUDS & NUTS	FOR 3/4" FL		7	Set						
89	FLANGE	3/4"	WN	12	No						
100	BLIND FLANGE	3/4"		2	No						
194	EQUAL TEE	3/4"	BW	4	No						
215	GLOBE VALVE	3/4"	BW	6	No						
250	GATE VALVE	3/4"	BW	4	No						
280	ELBOW	3/4"	BW	10	No						

1	25-04-18	REAFFIRMED & REISSUED	Manoj	MN	RG	RN
0	07-02-13	ISSUED AS STANDARD	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman



P - BY PIPING

I - BY INSTRUMENTATION

THIS DRAWING SHALL NOT BE REFERRED FDR TAPPING ORIENTATION.

\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	3	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	4	Nø	147	MALE CONNECTDR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FDR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		2	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

5 26-08-16

Revised & Reissued

Manoj

MN/RKG

RG

RN

4 01-08-11

Revised & Reissued

Manoj

RG

RP/JMS

DM

Rev.  
No.

Date

Purpose

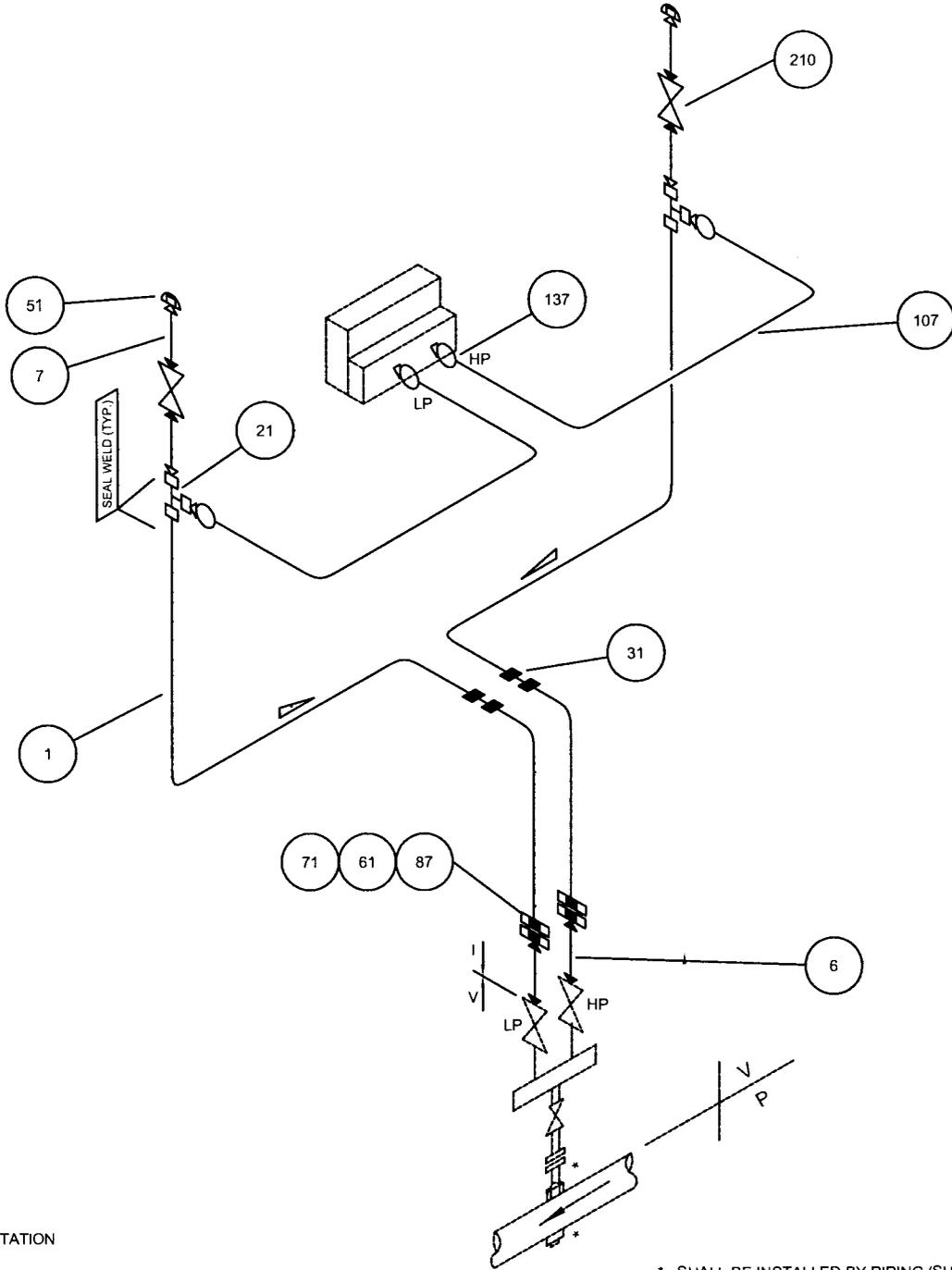
Prepared  
by

Checked  
by

Stds. Committee  
Convenor

Stds. Bureau  
Chairman

Approved by



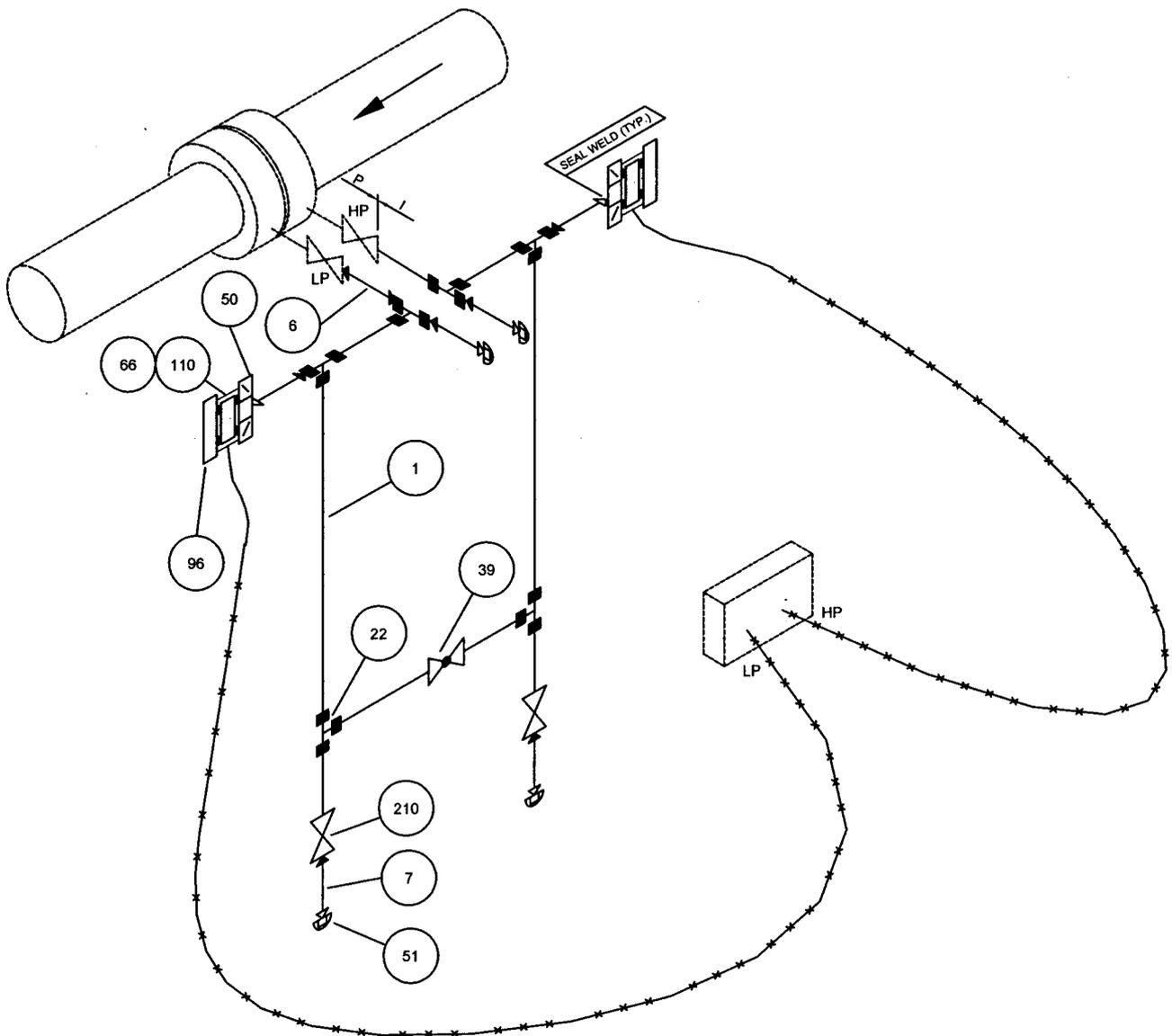
P - BY PIPING  
I - BY INSTRUMENTATION  
V - BY VENDOR

\* SHALL BE INSTALLED BY PIPING (SUPPLIED BY VENDOR)

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE	1/2"	PL X PL	2	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	4	Nø
7	NIPPLE	1/2"	TH X PL	4	Nø						
21	EQUAL TEE	1/2"	TH	2	Nø						
31	COUPLING	1/2"	SW	2	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		2	Set						
87	FLANGE	1/2"	WN	4	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						

0	07-08-14	Issued As Standard	Manoj	RKG	CRG	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
Approved by						



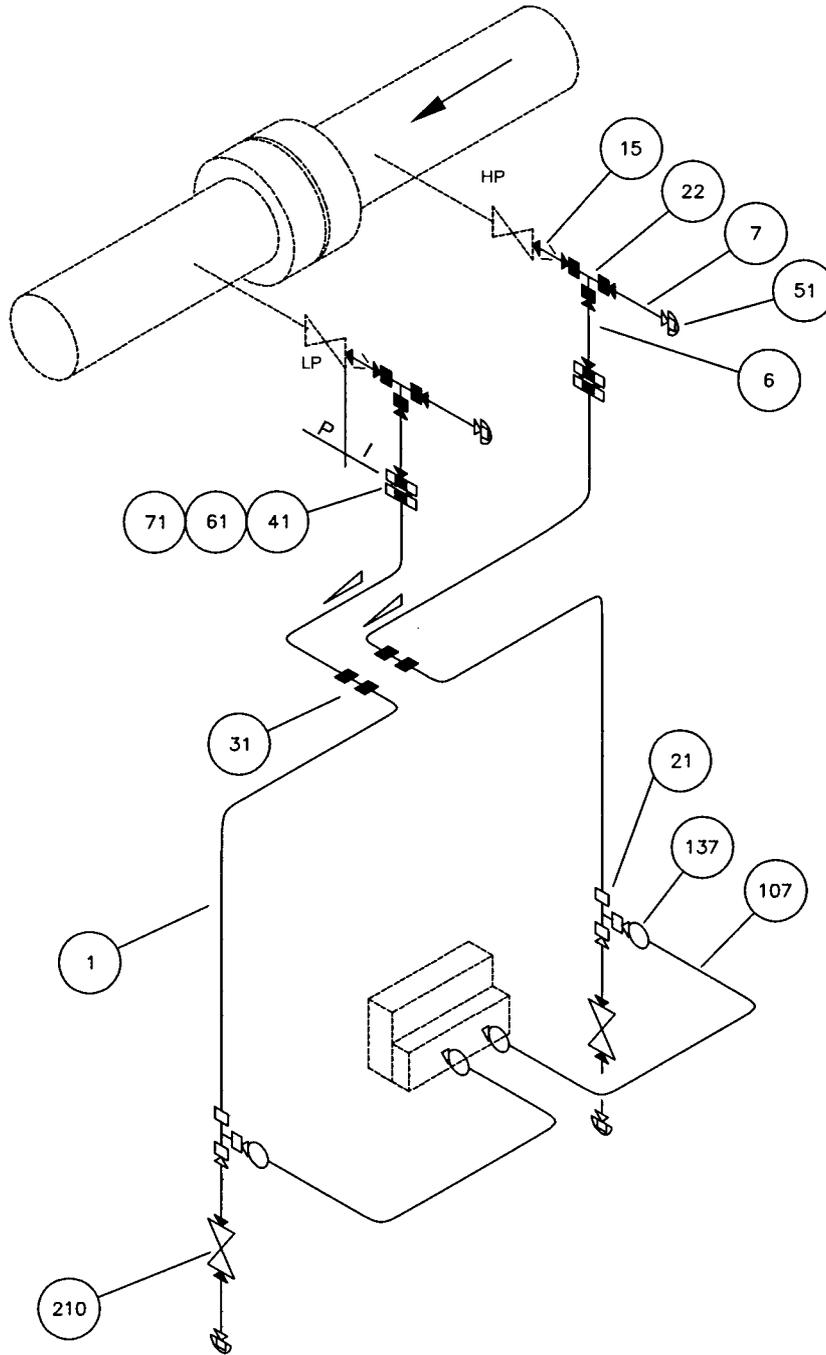
P - BY PIPING  
I - BY INSTRUMENTATION

\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m						
6	NIPPLE *	1/2"	PL X PL	1	Nø						
7	NIPPLE	1/2"	TH X PL	6	Nø						
22	EQUAL TEE	1/2"	SW	6	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
50	FLANGE	3" X 1/2"	FL X TH (Red)	2	Nø						
51	CAP	1/2"	TH	4	Nø						
66	GASKET	FOR 3" FL		4	Nø						
96	BLIND FLANGE	3"		2	Nø						
110	STUDS & NUTS	FOR 3" FL	LONG	2	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

5	27.02.18	Revised & Reissued	Manoj	MN	RG	RN
4	12-10-11	Revised & Reissued	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
Approved by						



P - BY PIPING  
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE	1/2"	PL X PL	2	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	4	Nø
7	NIPPLE	1/2"	TH X PL	6	Nø						
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	2	Nø						
21	EQUAL TEE	1/2"	TH	2	Nø						
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		2	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

0 07-08-14

Issued As Standard

Manoj

RKG

RG

SC

Rev.  
No.

Date

Purpose

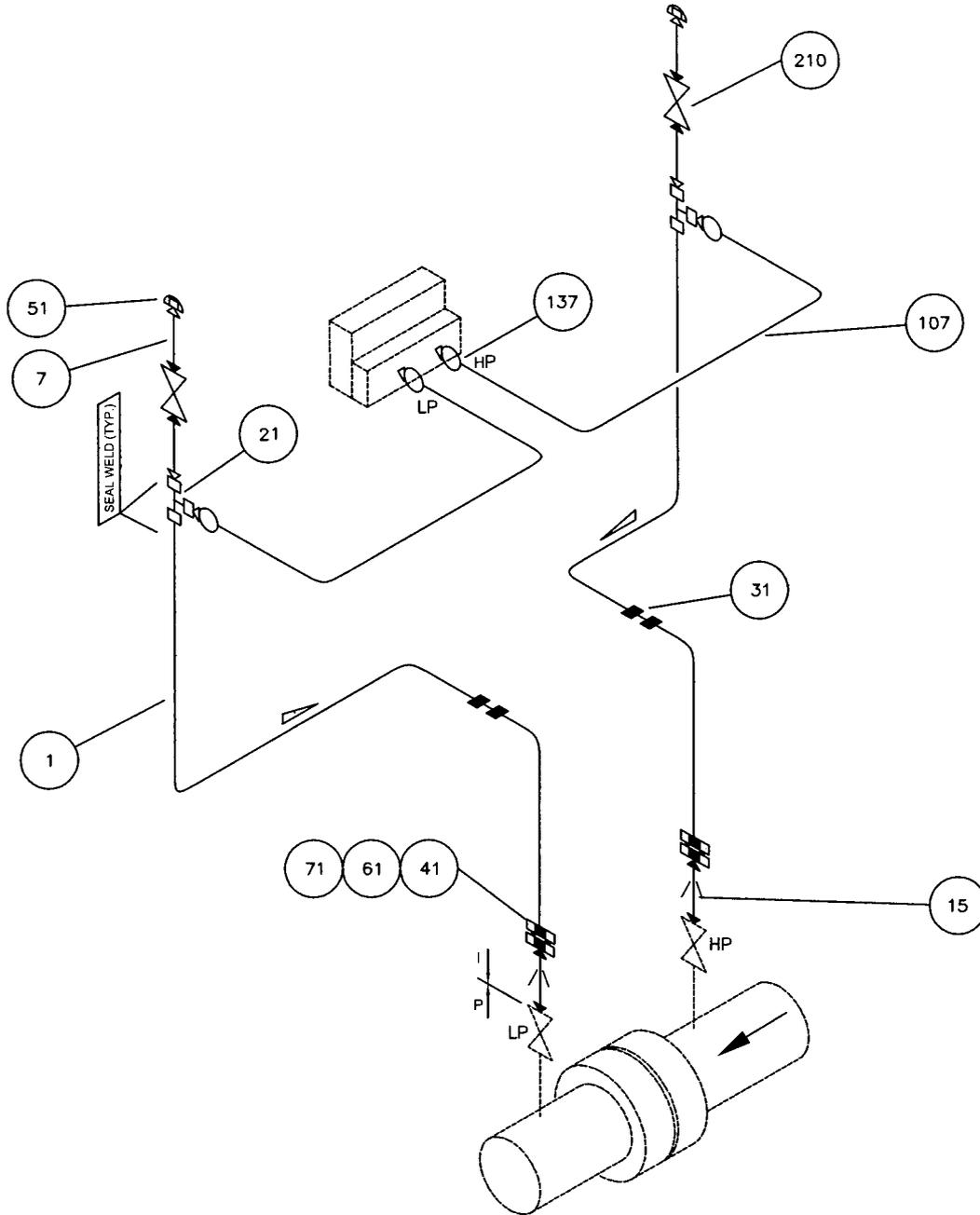
Prepared  
by

Checked  
by

Stds. Committee  
Convenor

Stds. Bureau  
Chairman

Approved by

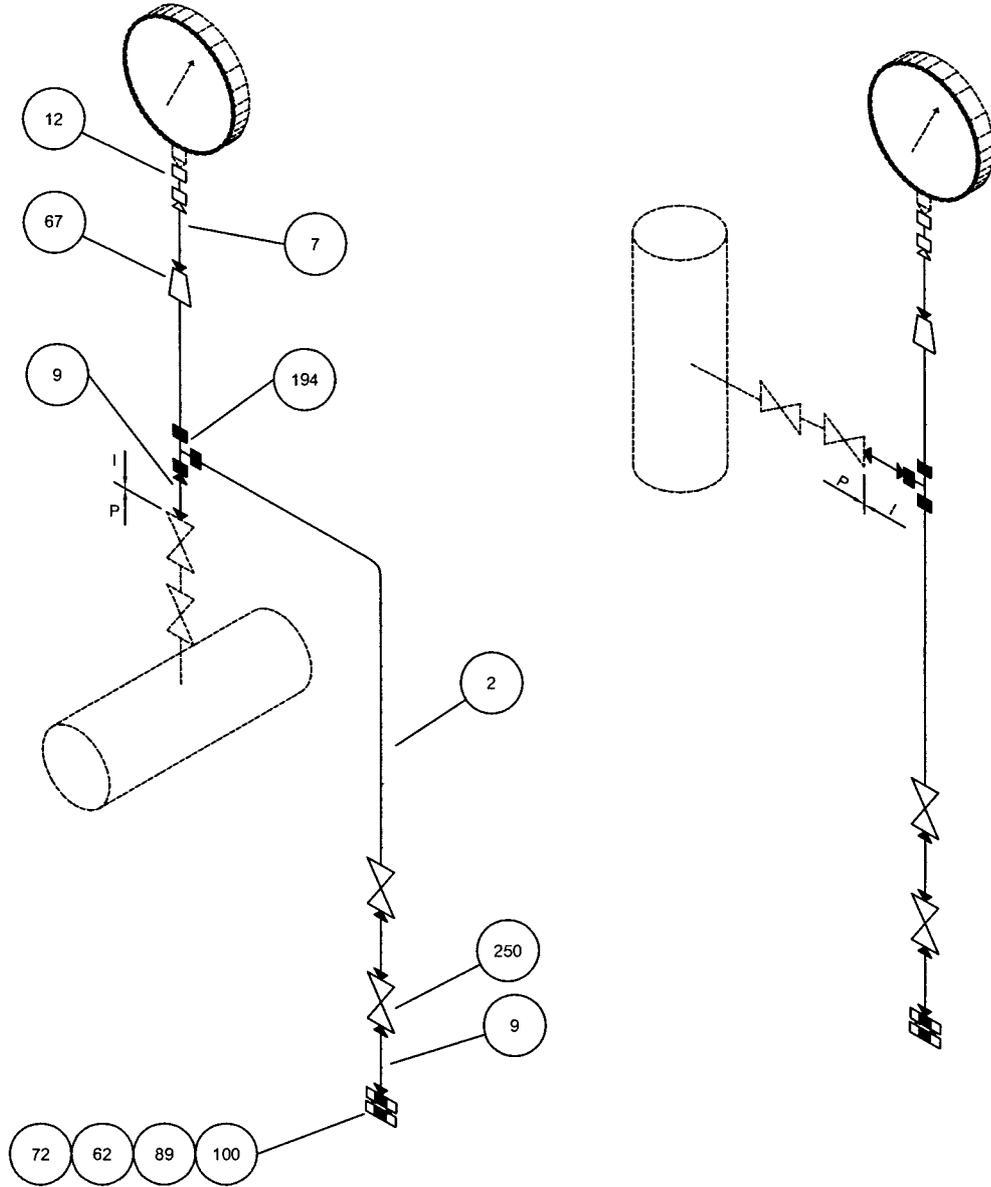


P - BY PIPING  
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
7	NIPPLE	1/2"	TH X PL	4	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	4	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	2	Nø						
21	EQUAL TEE	1/2"	TH	2	Nø						
31	COUPLING	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		2	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

0	07-08-14	Issued As Standard	Manoj	RKS	ARG	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
Approved by						



P - BY PIPING  
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL	A/R	m						
7	NIPPLE	1/2"	TH X PL	1	Nø						
9	NIPPLE	3/4"	PL X PL	3	Nø						
12	COUPLING	1/2"	TH	1	Nø						
62	GASKET	FOR 3/4" FL		1	Nø						
72	STUDS & NUTS	FOR 3/4" FL		1	Set						
67	REDUCER	3/4" X 1/2"	BW	1	Nø						
89	FLANGE	3/4"	WN	1	Nø						
100	BLIND FLANGE	3/4"		1	Nø						
194	EQUAL TEE	3/4"	BW	1	Nø						
250	GATE VALVE	3/4"	BW	2	Nø						

0 07-08-14

Issued As Standard

Manoj

Checked by

RG

SC

Rev.  
No.

Date

Purpose

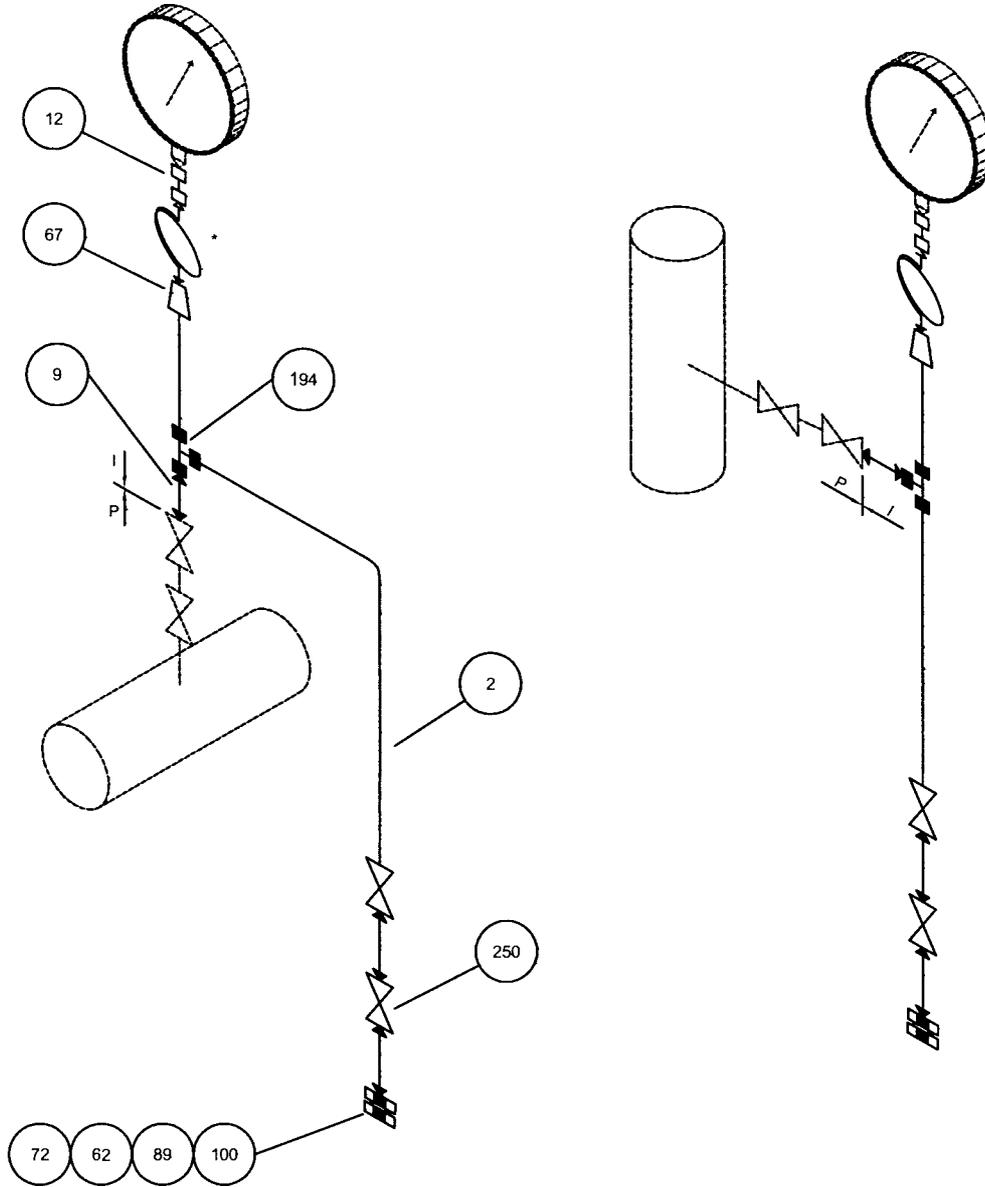
Prepared  
by

Checked  
by

Stds. Committee  
Convenor

Stds. Bureau  
Chairman

Approved by



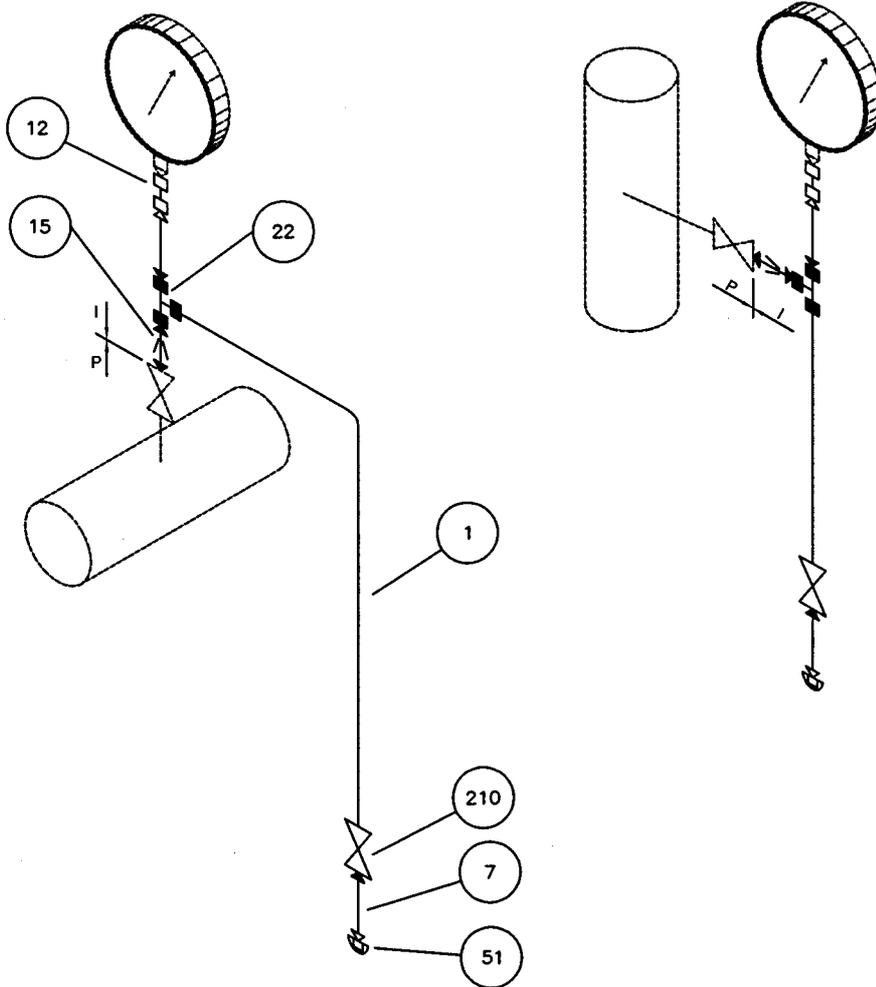
P - BY PIPING  
I - BY INSTRUMENTATION

\* SYPHON SITE FABRICATED

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL	A/R	m						
9	NIPPLE	3/4"	PL X PL	3	Nø						
12	COUPLING	1/2"	TH	1	Nø						
62	GASKET	FOR 3/4" FL		1	Nø						
72	STUDS & NUTS	FOR 3/4" FL		1	Set						
67	REDUCER	3/4" X 1/2"	BW	1	Nø						
89	FLANGE	3/4"	WN	1	Nø						
100	BLIND FLANGE	3/4"		1	Nø						
194	EQUAL TEE	3/4"	BW	1	Nø						
250	GATE VALVE	3/4"	BW	2	Nø						

0	07-08-14	Issued As Standard	Manoj	RKG	RG	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convener	Std. Bureau Chairman
Approved by						

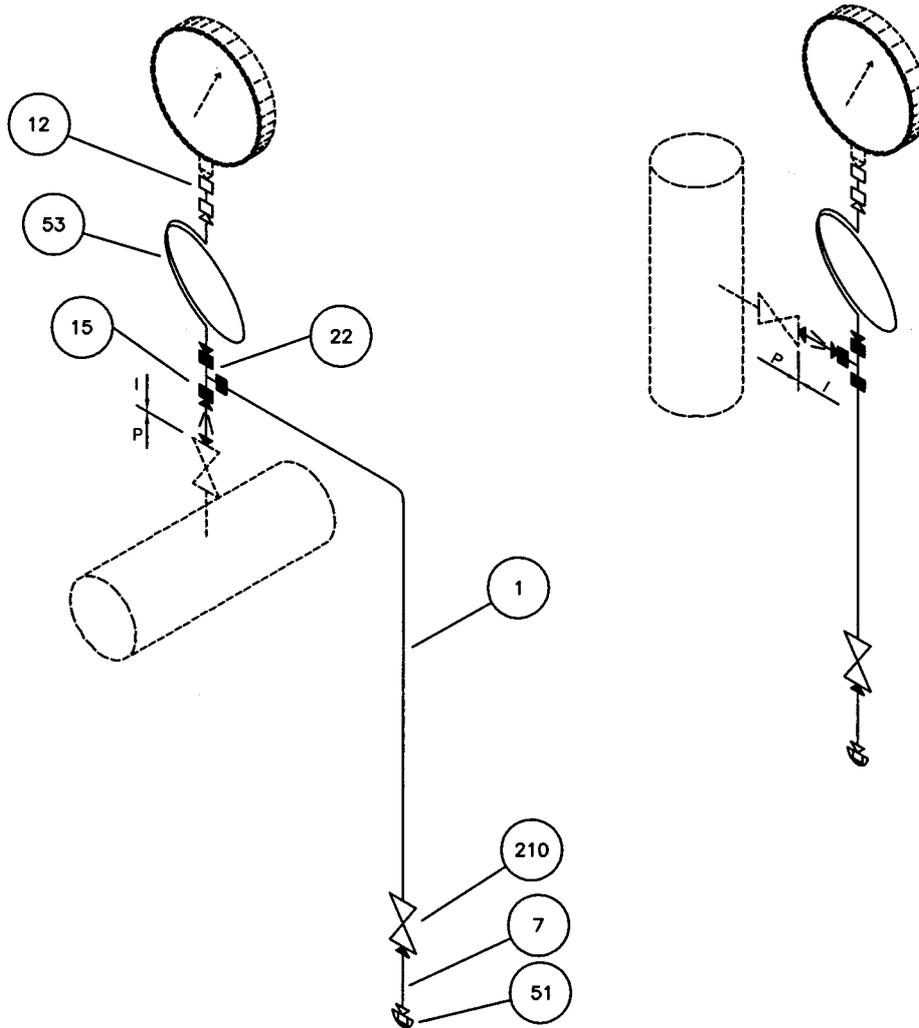


P - BY PIPING  
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m						
7	NIPPLE	1/2"	TH X PL	2	Nø						
12	COUPLING	1/2"	TH	1	Nø						
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	1	Nø						
51	CAP	1/2"	TH	1	Nø						
210	GATE VALVE	1/2"	SW	1	Nø						

5	26-08-16	Revised & Reissued	Manoj	MN/RKG	RG	RP/JMS	RN
4	01-08-11	Revised & Reissued	Manoj	RG	RP/JMS	DM	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman	Approved by



P - BY PIPING  
I - BY INSTRUMENTATION

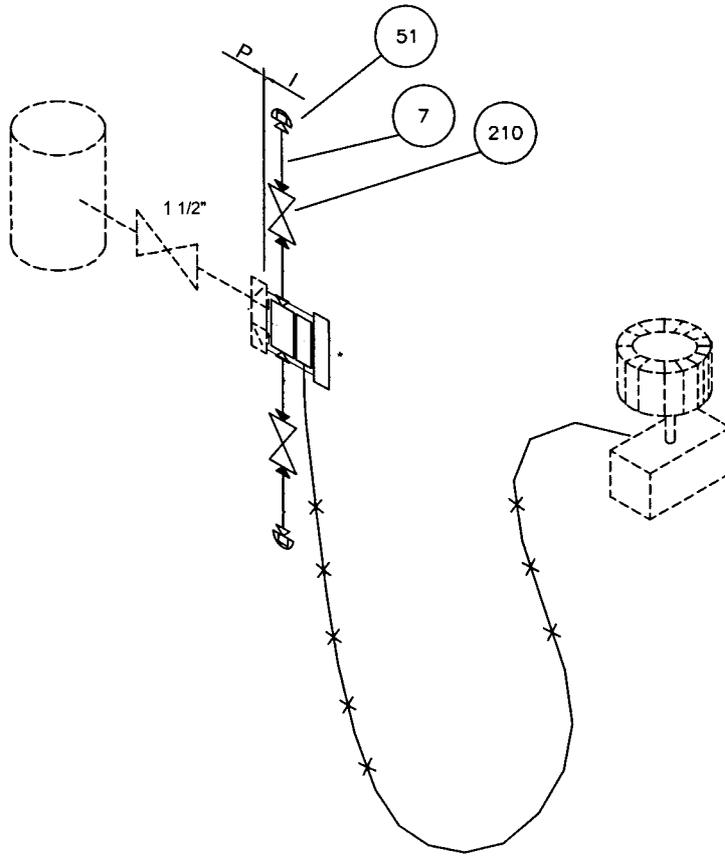
LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m						
7	NIPPLE	1/2"	TH X PL	1	Nø						
12	COUPLING	1/2"	TH	1	Nø						
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	1	Nø						
51	CAP	1/2"	TH	1	Nø						
53	SYPHON C-TYPE	1/2" X 1/2"	TH(Ext) X PL	1	Nø						
210	GATE VALVE	1/2"	SW	1	Nø						

5 26-08-16 Revised & Reissued Manoj MN/RKG RG RN

4 01-08-11 Revised & Reissued Manoj RG RP/JMS DM

Rev. No. Date Purpose Prepared by Checked by Stds. Committee Convenor Stds. Bureau Chairman Approved by



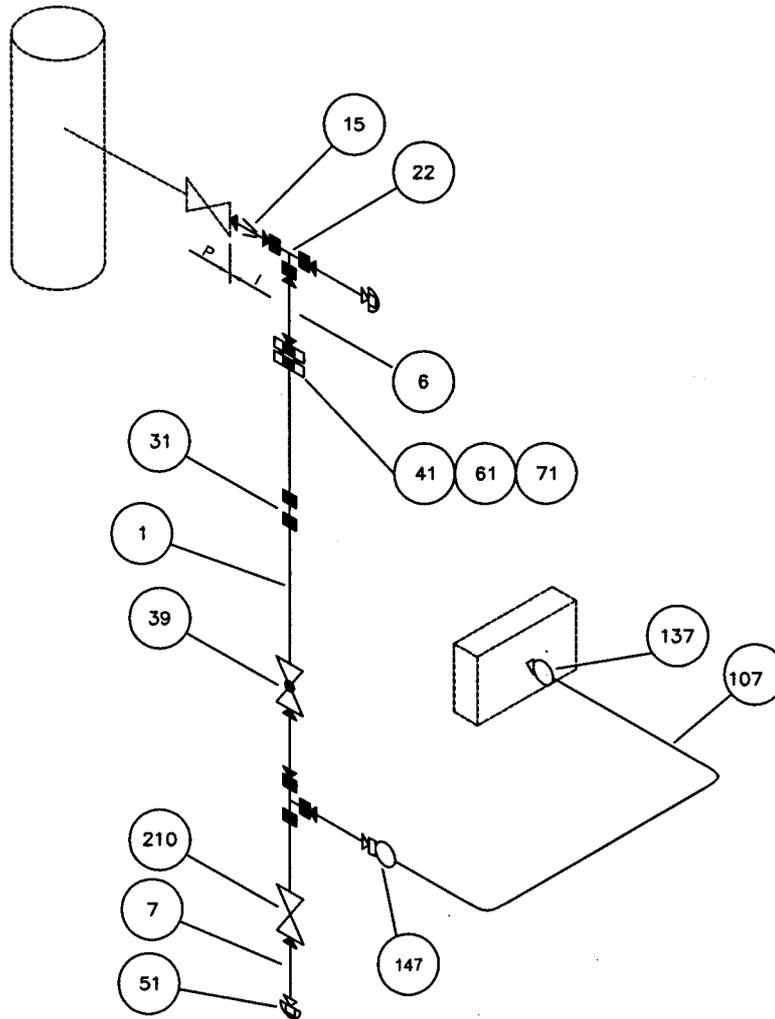
P - BY PIPING  
I - BY INSTRUMENTATION

\* DRIP RING WITH BLIND FLANGE (1 1/2"), GASKET, STUDS & NUTS (EXTRA LONG) BY VENDOR

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	4	Nø						
51	CAP	1/2"	TH	2	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						

0	07-08-14	Issued As Standard	Manoj	RKG	RG	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



P - BY PIPING  
I - BY INSTRUMENTATION

\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

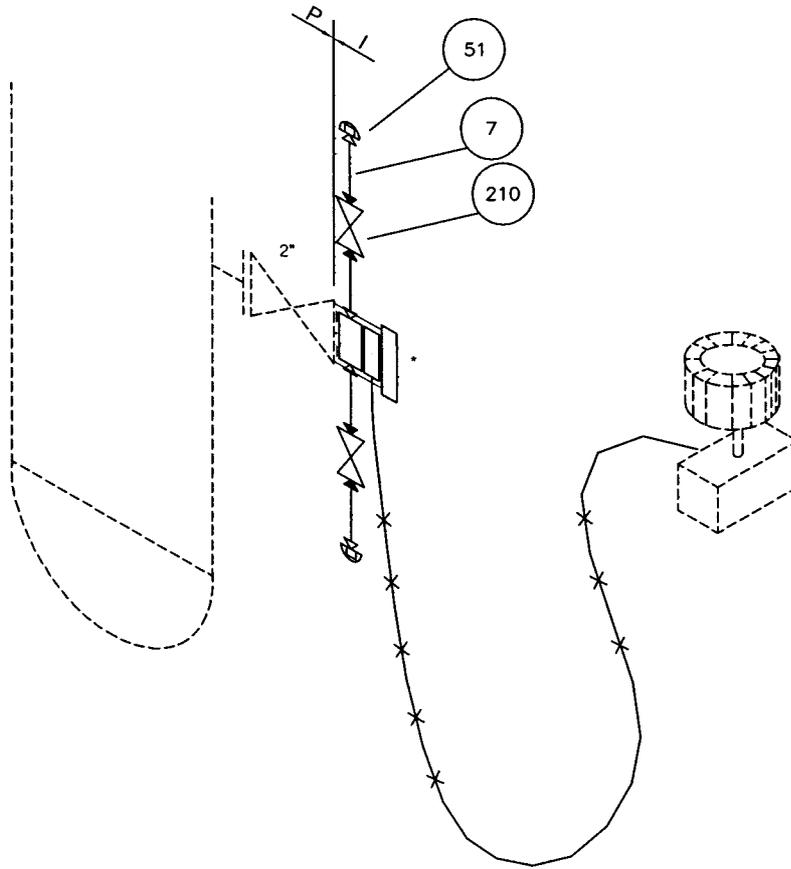
LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	DD	A/R	m
6	NIPPLE *	1/2"	PL X PL	2	Nø	137	MALE CDNECTDR	1/2" X 1/2"	TH X DD	1	Nø
7	NIPPLE	1/2"	TH X PL	3	Nø	147	FEMALE CDNECTDR	1/2" X 1/2"	TH X DD	1	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	2	Nø						
31	CDUPLING	1/2"	SW	1	Nø						
39	GLDBE VALVE	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	2	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FDR 1/2" FLG.		1	Nø						
71	STUDS & NUTS	FDR 1/2" FLG.		1	Set						
210	GATE VALVE	1/2"	SW	1	Nø						

5 26-08-16 Revised & Reissued Manoj MN/RKG RP/JMS RN

4 01-08-11 Revised & Reissued Manoj RG RP/JMS DM

Rev. No. Date Purpose Prepared by Checked by Stds. Committee Convenor Stds. Bureau Chairman Approved by



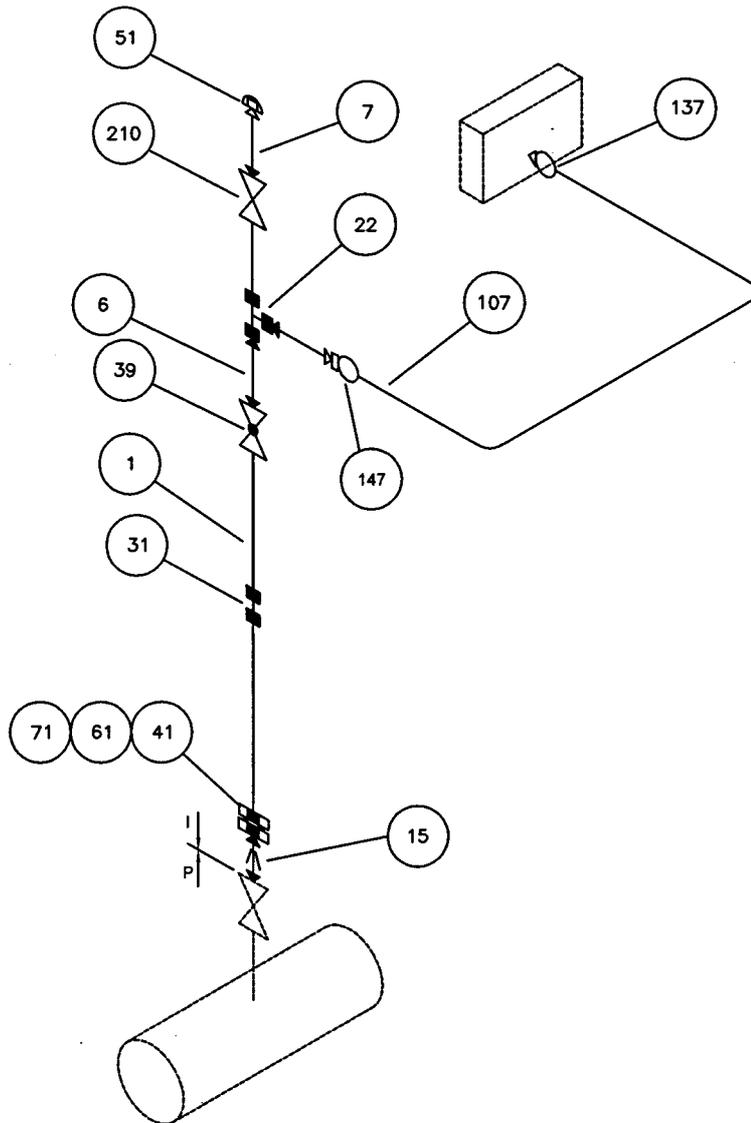
P - BY PIPING  
I - BY INSTRUMENTATION

\* DRIP RING WITH BLIND FLANGE (2"), GASKET, STUDS & NUTS (EXTRA LONG) BY VENDOR

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	4	Nø						
51	CAP	1/2"	TH	2	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						

0	07-08-14	Issued As Standard	Manoj	ARKG	ARG	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



P - BY PIPING  
I - BY INSTRUMENTATION

\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

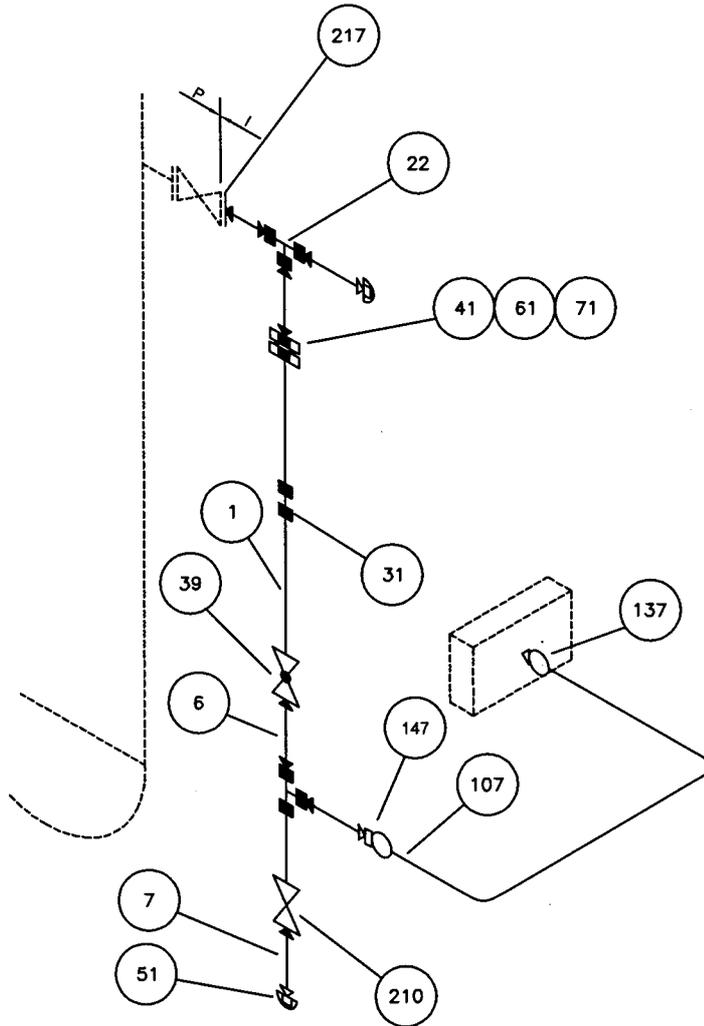
LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	1	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
7	NIPPLE	1/2"	TH X PL	2	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	1	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	2	Nø						
51	CAP	1/2"	TH	1	Nø						
61	GASKET	FOR 1/2" FLG.		1	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		1	Set						
210	GATE VALVE	1/2"	SW	1	Nø						

5 26-08-16 Revised & Reissued Manoj MN/RKG RP/JMS RN

4 01-08-11 Revised & Reissued Manoj RG RP/JMS DM

Rev. No. Date Purpose Prepared by Checked by Stds. Committee Convener Stds. Bureau Chairman Approved by



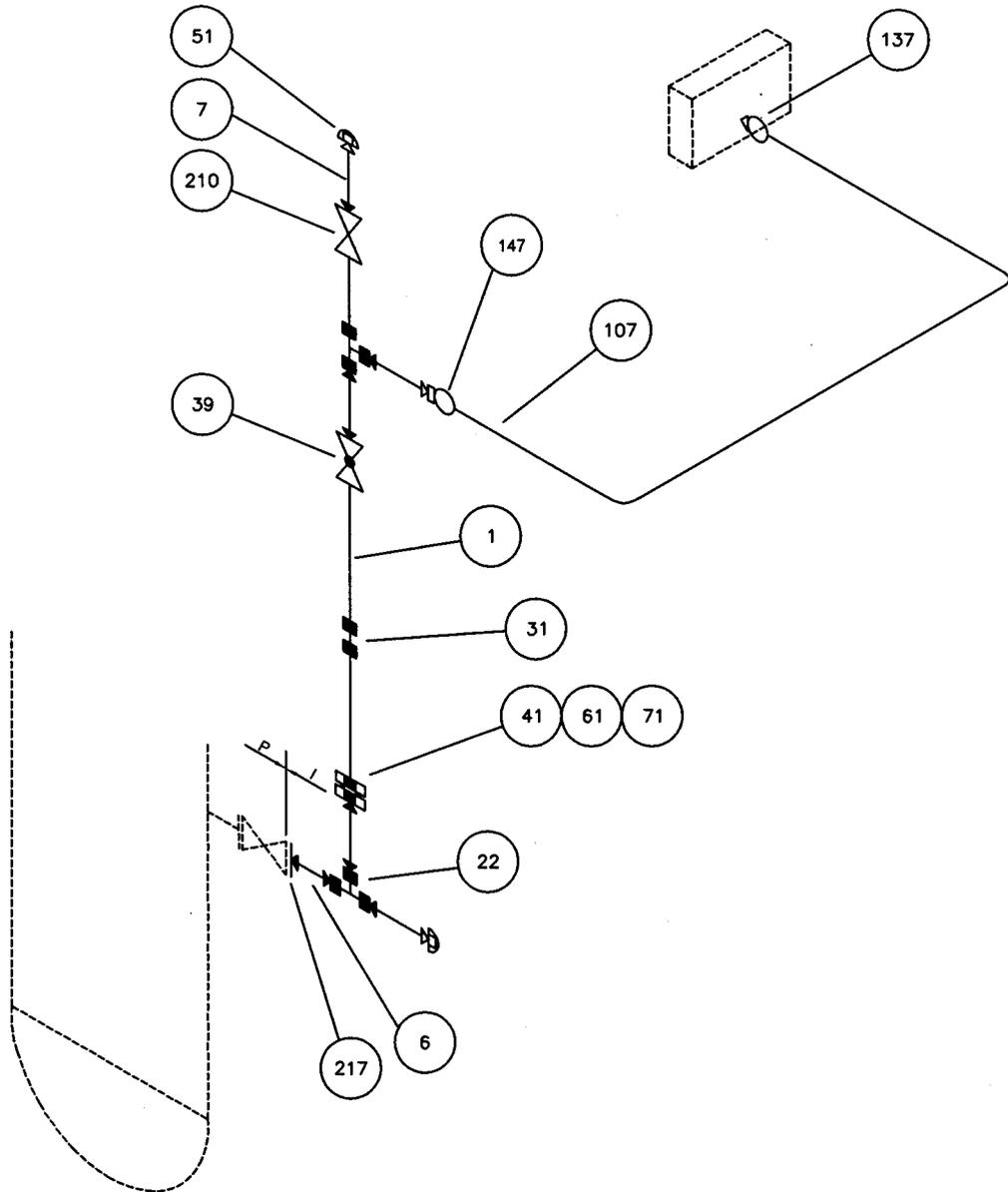
P - BY PIPING  
I - BY INSTRUMENTATION

\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	3	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
7	NIPPLE	1/2"	TH X PL	3	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
22	EQUAL TEE	1/2"	SW	1	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	2	Nø						
217	FLANGE	2" X 1/2"	FL X SW (Red)	1	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		1	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		1	Set						
210	GATE VALVE	1/2"	SW	1	Nø						

3	26-08-16	Revised & Reissued	Manoj	RG	RP/JMS	RN
2	01-08-11	Revised & Reissued	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
						Approved by



P - BY PIPING  
I - BY INSTRUMENTATION

\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	3	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
7	NIPPLE	1/2"	TH X PL	3	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	2	Nø						
217	FLANGE	2" X 1/2"	FL X SW (Red)	1	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		1	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		1	Set						
210	GATE VALVE	1/2"	SW	1	Nø						

3 26-08-16

Revised & Reissued

Manoj

MN/RKG

RP/JMS

DM

2 01-08-11

Revised & Reissued

Manoj

RG

RP/JMS

DM

Rev. No.

Date

Purpose

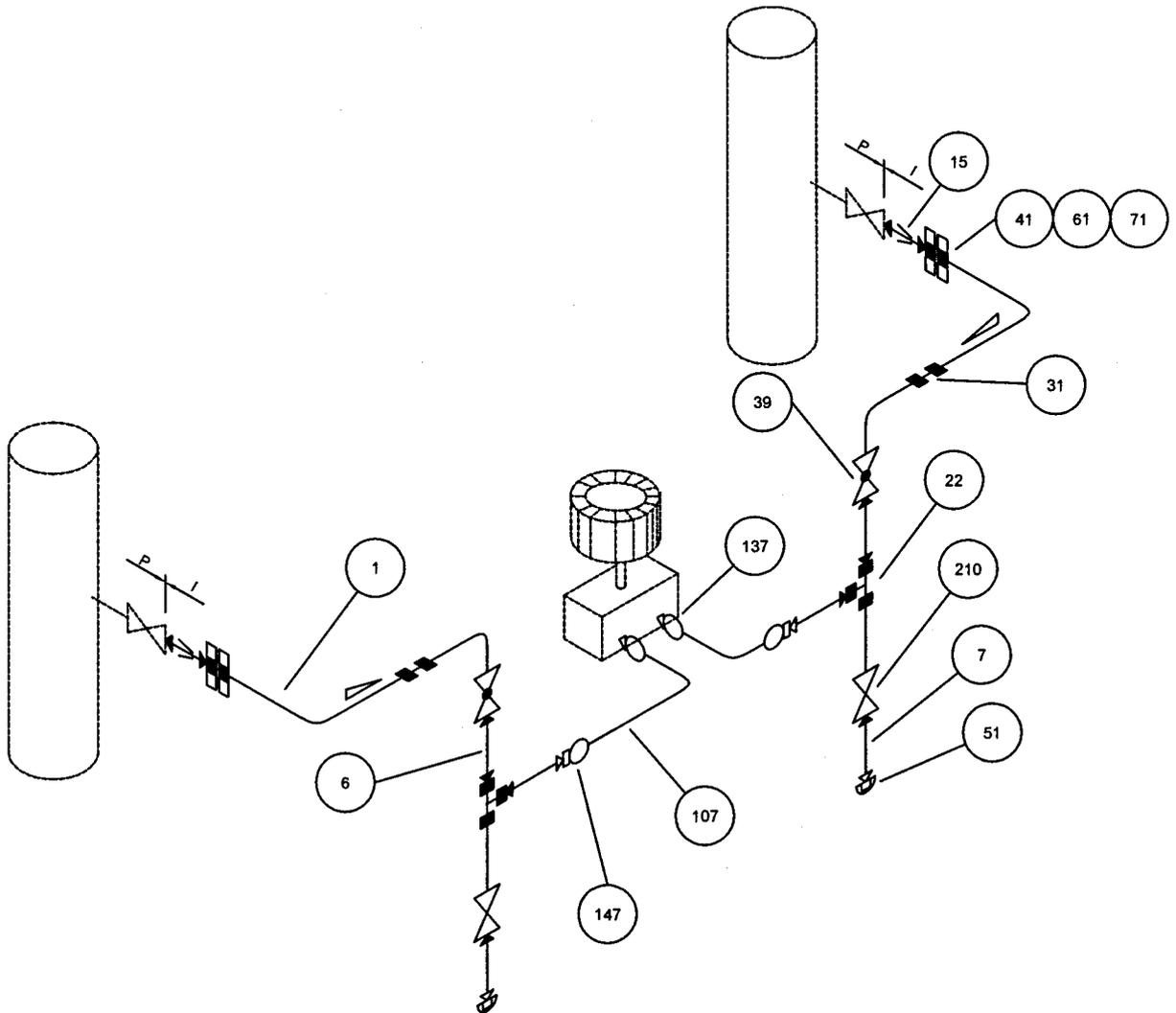
Prepared by

Checked by

Stds. Committee Convener

Stds. Bureau Chairman

Approved by



P - BY PIPING  
I - BY INSTRUMENTATION

\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	2	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	4	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	2	Nø						
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		2	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

5 26-08-16

Revised & Reissued

Manoj

MN/RKG

RN

4 01-08-11

Revised & Reissued

Manoj

RG

RP/JMS

DM

Rev.  
No.

Date

Purpose

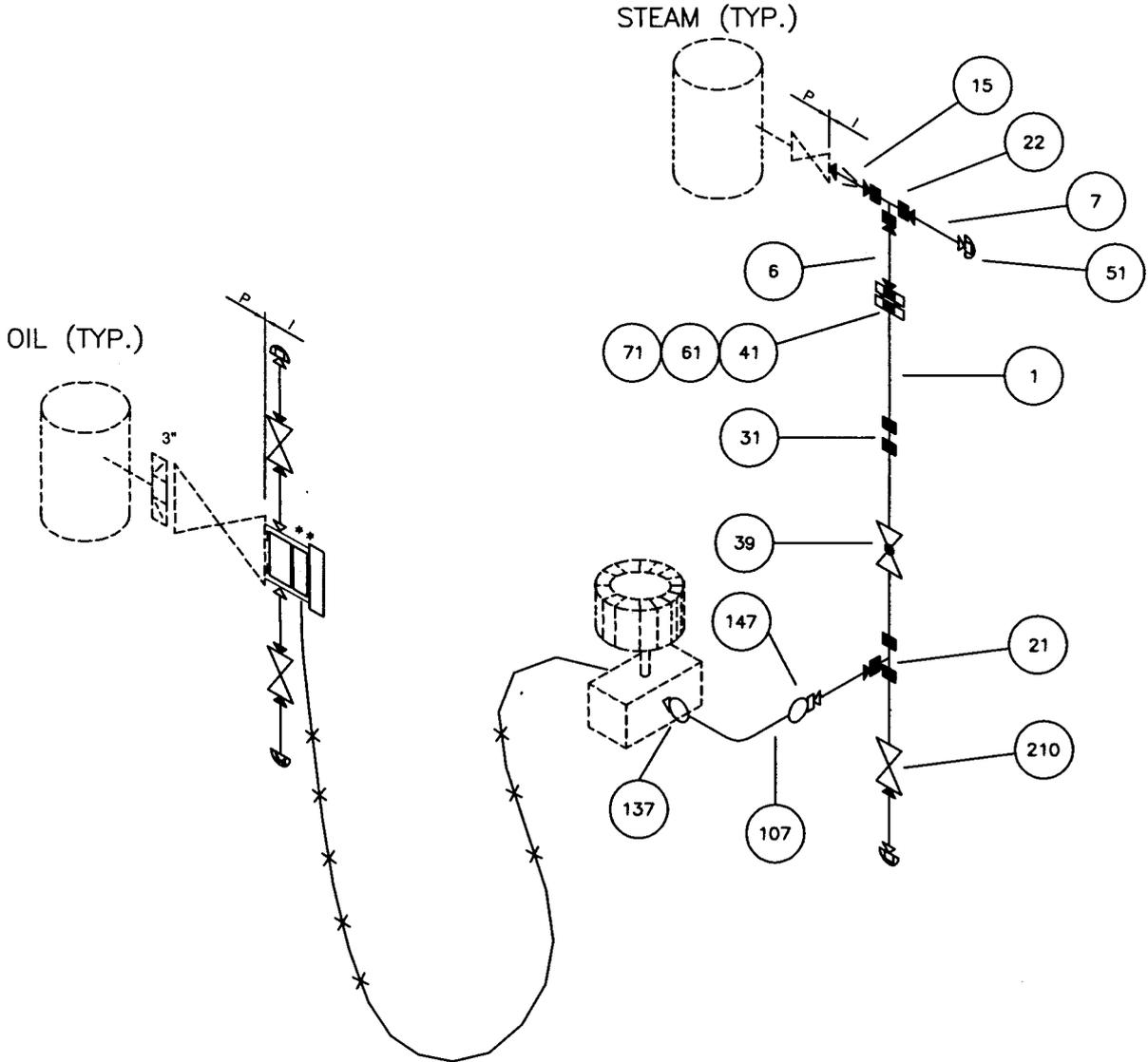
Prepared  
by

Checked  
by

Stds. Committee  
Convenor

Stds. Bureau  
Chairman

Approved by



P - BY PIPING  
I - BY INSTRUMENTATION

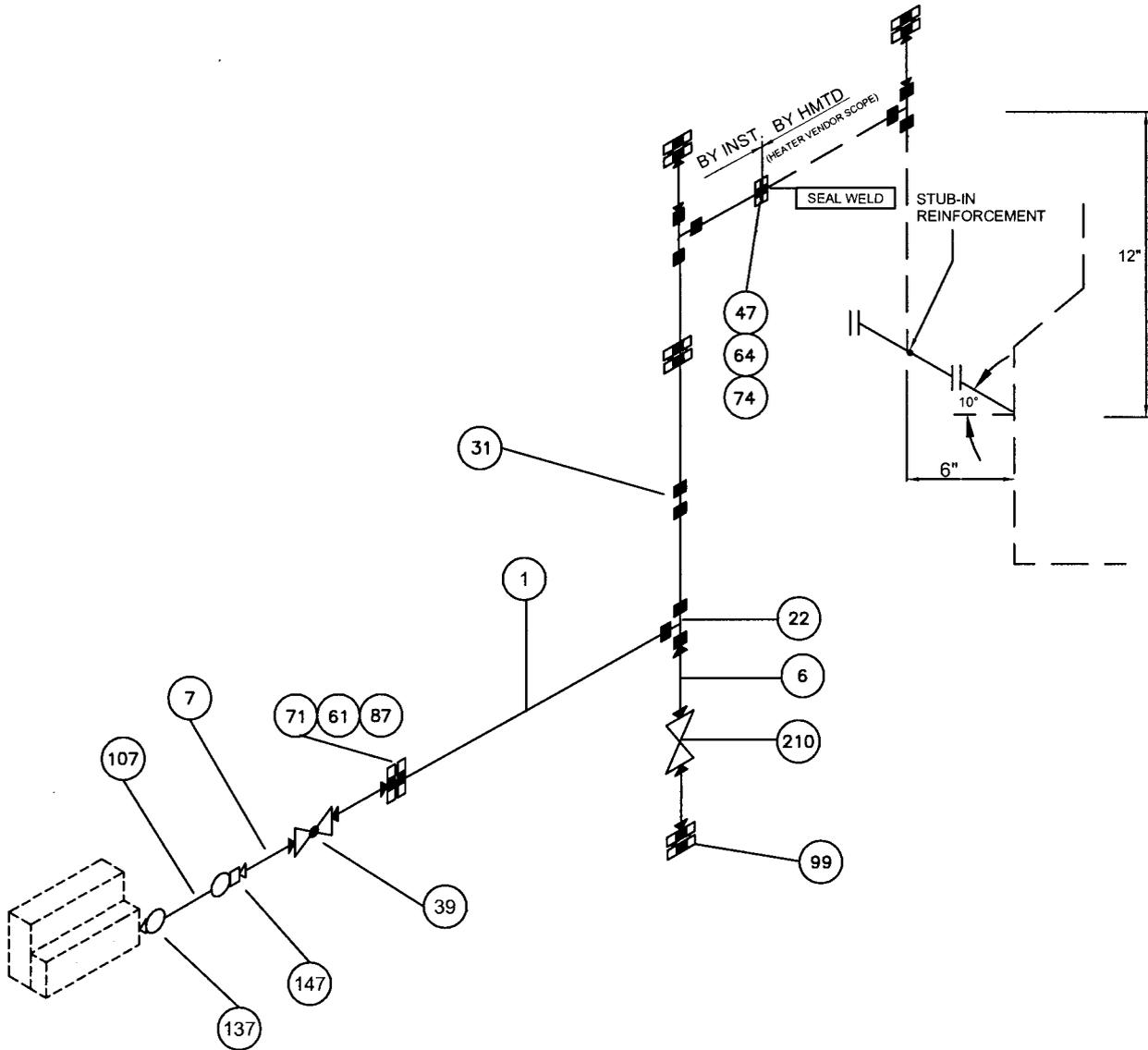
\*\* DRIP RING WITH BLIND FLANGE (3"), GASKET, STUDS & NUTS (EXTRA LONG) BY VENDOR

\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	1	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
7	NIPPLE	1/2"	TH X PL	7	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1							
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	2	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FL		1	Nø						
71	STUDS & NUTS	FOR 1/2" FL		1	Set						
210	GATE VALVE	1/2"	SW	3	Nø						

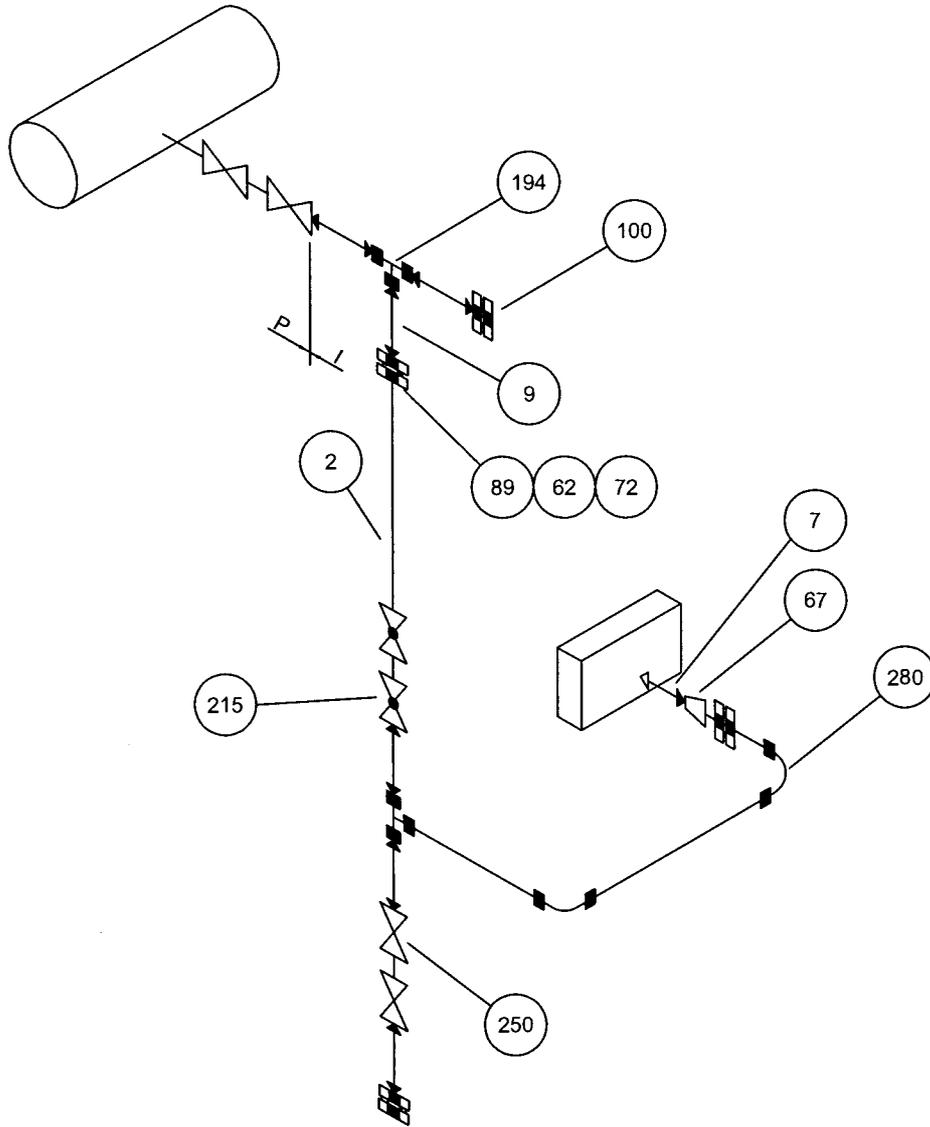
5	24.10.16	Revised & Reissued	Manoj	MN	RG	RN
4	12-10-11	Revised & Reissued	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	87	FLANGE	1/2"	WN	6	Nø
6	NIPPLE	1/2"	PL x PL	4	Nø	99	BLIND FLANGE	1/2"		2	Nø
7	NIPPLE	1/2"	PL x TH	1	Nø	210	GATE VALVE	1/2"	SW	1	Nø
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø	107	TUBE	1/2"	OD	A/R	m
47	FLANGE	1 1/2" x 1/2" TH	FL x TH (Red)	1	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
61	GASKET	FOR 1/2" FLG.		4	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
64	GASKET	FOR 1 1/2" FLG.		1	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		4	Set						
74	STUDS & NUTS	FOR 1 1/2" FLG.		1	Set						

0	01-09-14	Issued As Standard	Manoj	RKG	RG	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
Approved by						

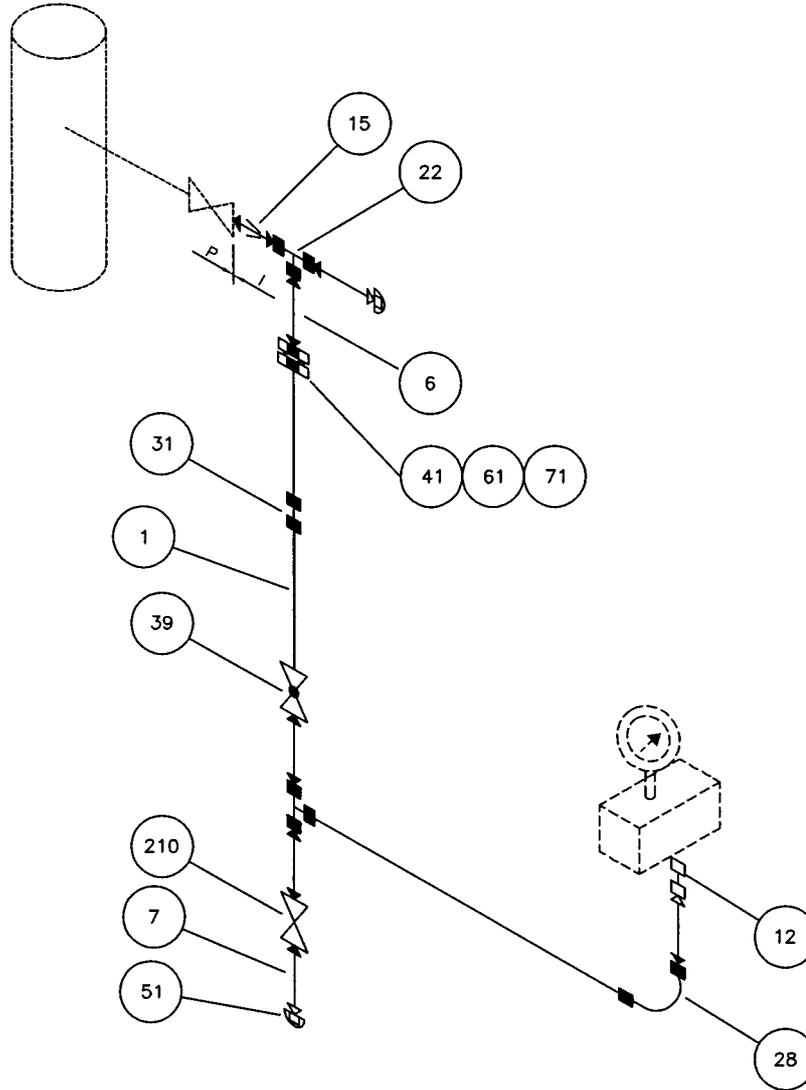


P - BY PIPING  
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL	A/R	m						
7	NIPPLE	1/2"	PL X TH	1	Nø						
9	NIPPLE	3/4"	PL X PL	9	Nø						
62	GASKET	FOR 3/4" FL		4	Nø						
72	STUDS & NUTS	FOR 3/4" FL		4	Set						
67	REDUCER	3/4" x 1/2"	BW	1	Nø						
89	FLANGE	3/4"	WN	6	Nø						
100	BLIND FLANGE	3/4"		2	Nø						
194	EQUAL TEE	3/4"	BW	2	Nø						
215	GLOBE VALVE	3/4"	BW	2	Nø						
250	GATE VALVE	3/4"	BW	2	Nø						
280	ELBOW	3/4"	BW	2	Nø						

0	01-09-14	Issued As Standard	Manoj	RKG	RG	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman



P - BY PIPING  
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	71	STUDS & NUTS	FOR 1/2" FLG.		1	Set
6	NIPPLE	1/2"	PL X PL	3	Nø	210	GATE VALVE	1/2"	SW	1	Nø
7	NIPPLE	1/2"	TH X PL	3	Nø						
12	COUPLING	1/2"	TH	1	Nø						
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	2	Nø						
28	ELBOW	1/2"	SW	1	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	2	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		1	Nø						

0 01-09-14

Issued As Standard

Manoj

RKG

RG

SC

Rev.  
No.

Date

Purpose

Prepared  
by

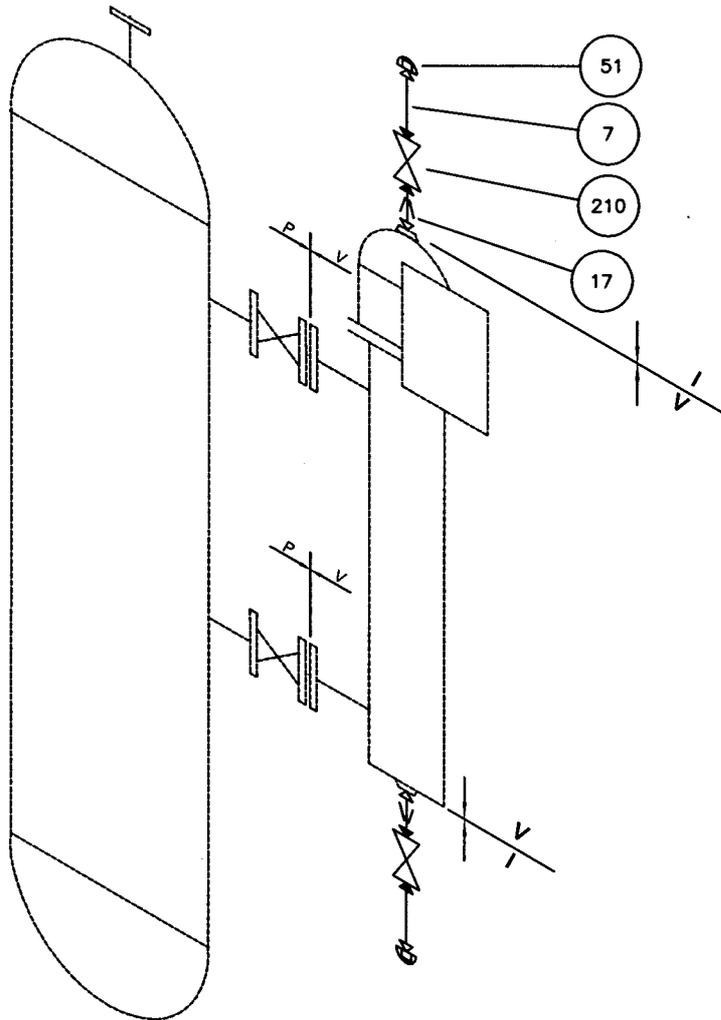
Checked  
by

Stds. Committee  
Convenor

Stds. Bureau  
Chairman

Approved by



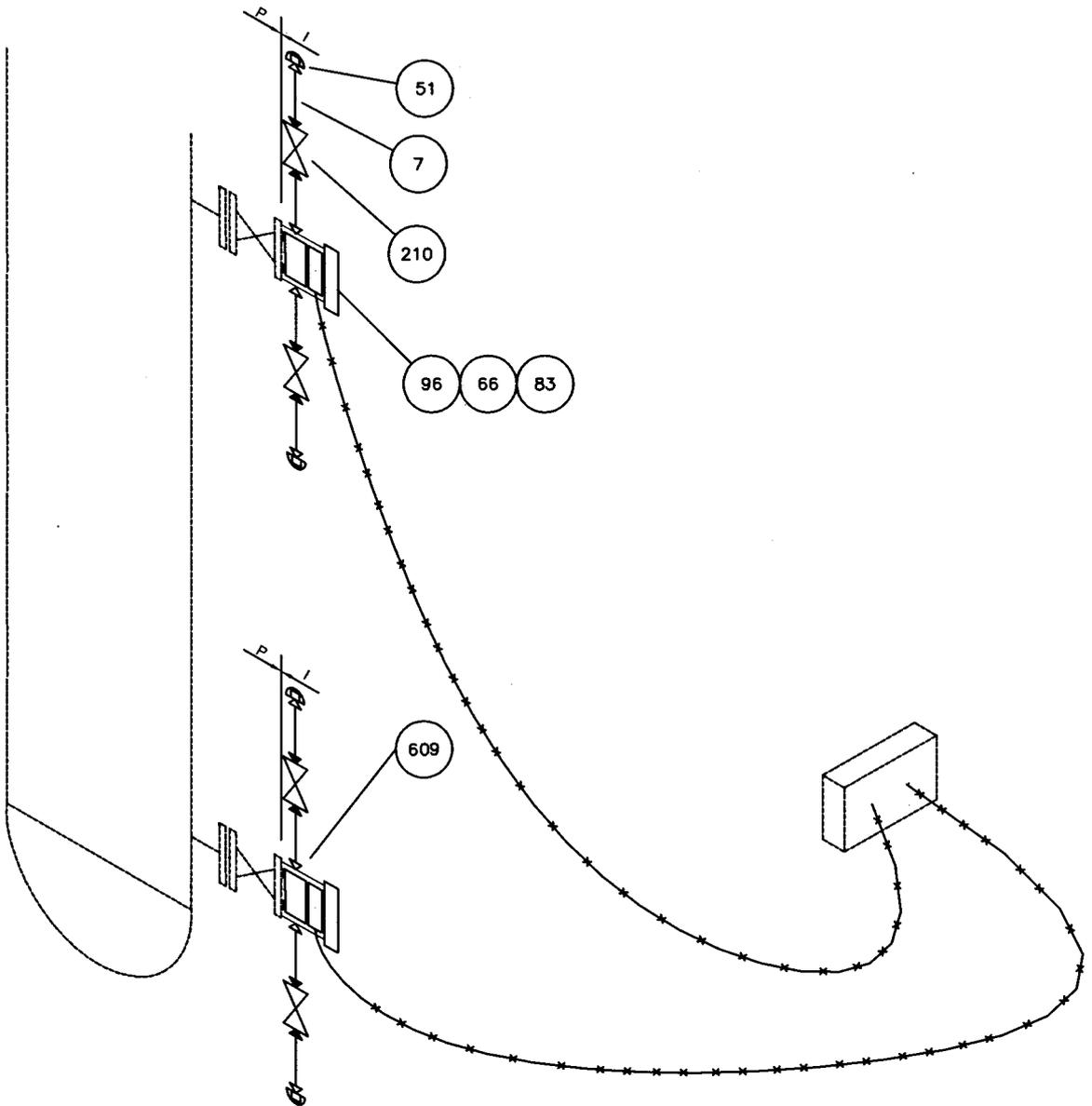


P - BY PIPING  
I - BY INSTRUMENTATION  
V - BY INSTRUMENT VENDOR

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	2	Nø						
17	SWAGE NIPPLE	3/4" X 1/2"	TH X PL	2	Nø						
51	CAP	1/2"	TH	2	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						

5	24.10.16	Reaffirmed & Reissued	Manoj	MN	RG	RN
4	12-10-11	Revised & Reissued	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Sds. Committee Convener	Sds. Bureau Chairman
						Approved by

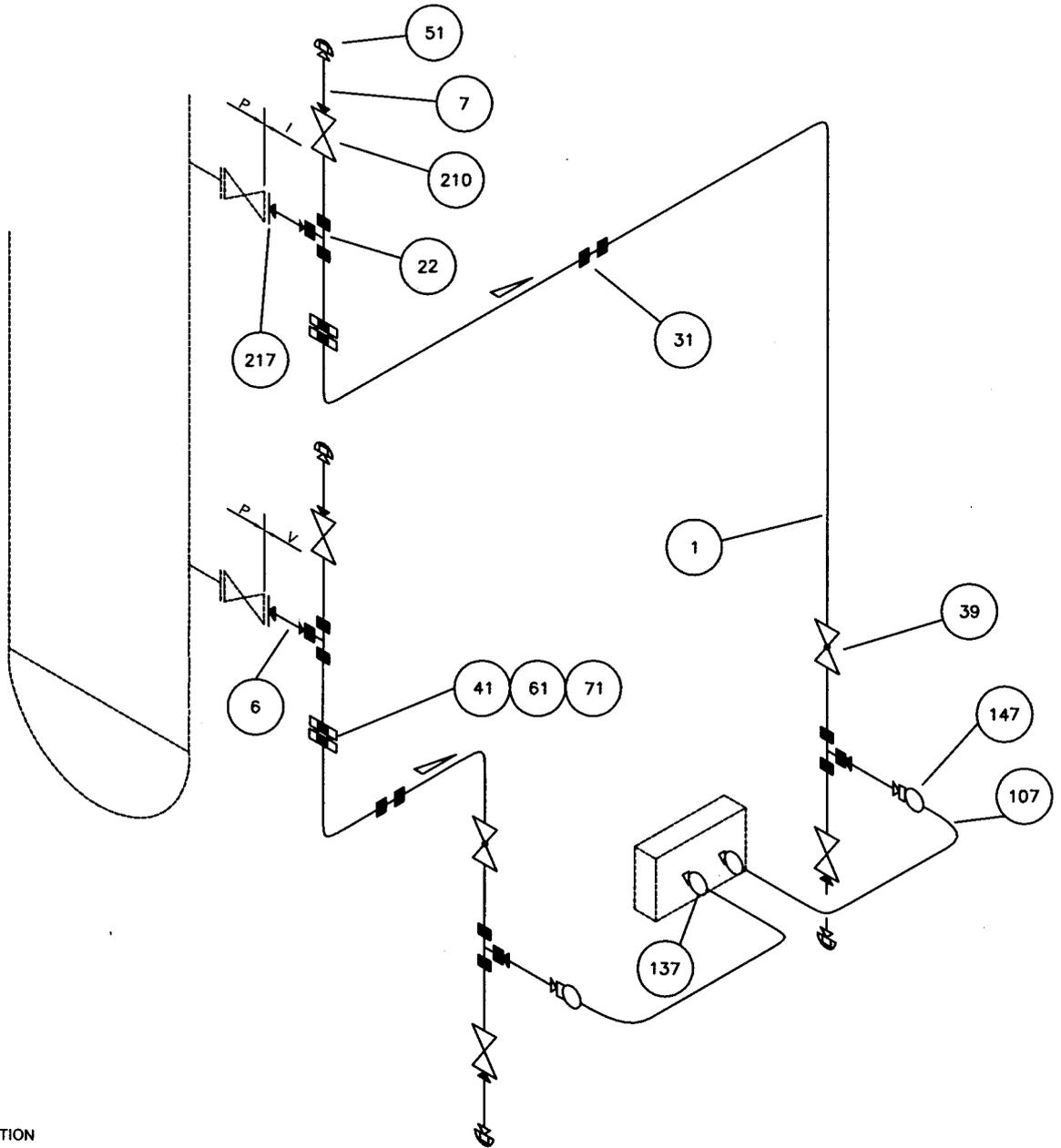


P - BY PIPING  
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	8	Nø	609	DRIP RING (2 TAPS)	3" X 1/2"	FL X TH	2	Nø
51	CAP	1/2"	TH	4	Nø						
66	GASKET	FOR 3" FL		6	Nø						
83	STUDS & NUTS	FOR 3" FL	LONG (EXTRA)	2	Set						
96	BLIND FLANGE	3"		2	Nø						
210	GATE VALVE	1/2"	SW	4	Nø						

5	25.07.16	Reaffirmed & Reissued	Manoj	MN	RG	RP/JMS	RN
4	12-10-11	Revised and Reissued	Manoj	RG	RP/JMS	DM	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman	Approved by



P - BY PIPING  
I - BY INSTRUMENTATION

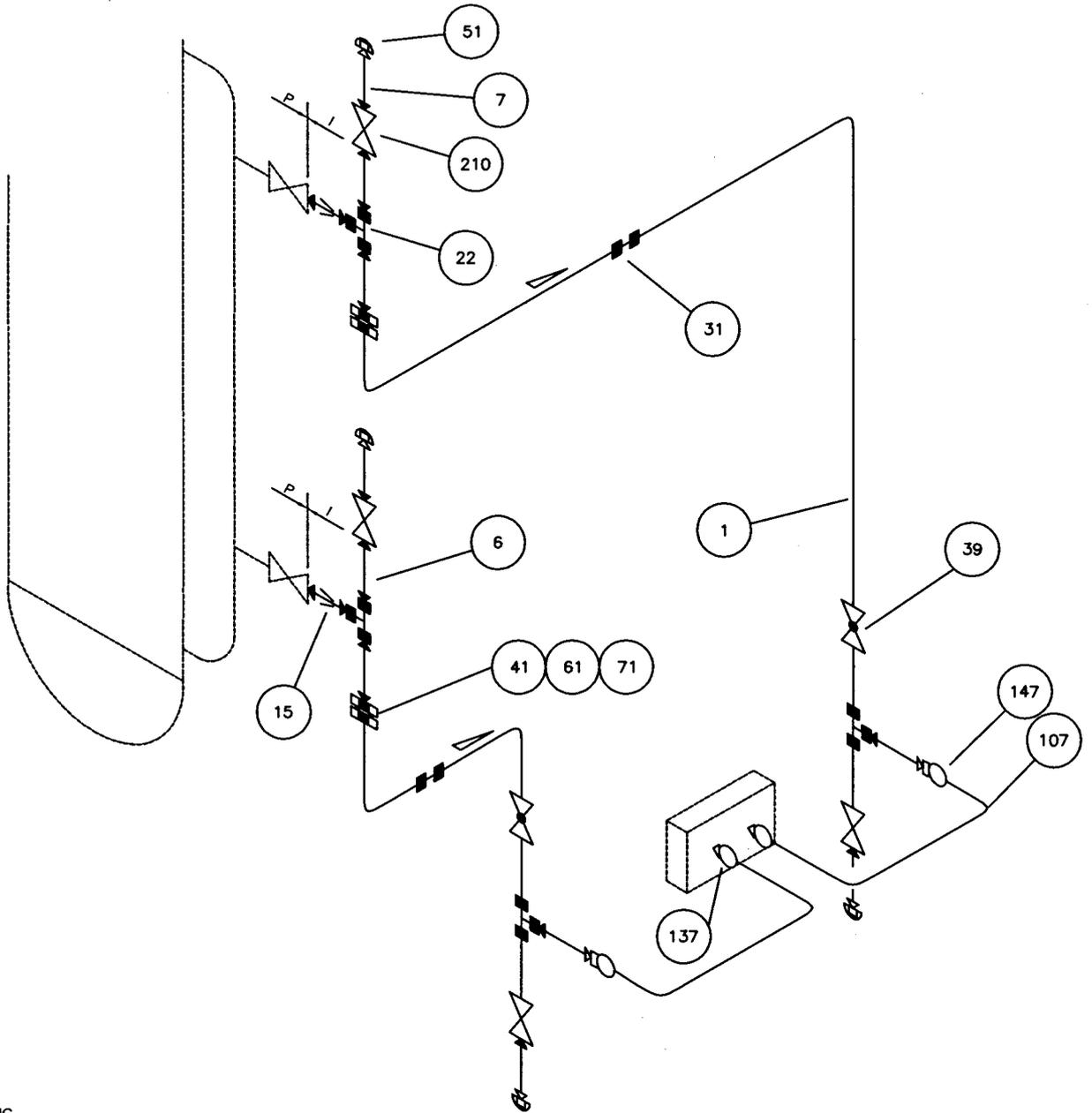
\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	2	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	6	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		2	Set						
210	GATE VALVE	1/2"	SW	4	Nø						
217	FLANGE	2" X 1/2"	FL X SW (Red)	2	Nø						

6	24-10-16	Revised and Reissued	Manoj	MN	RG	RN
5	12-10-11	Revised and Reissued	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
Approved by						

LEVEL INSTRUMENT  
DP TYPE ON STANDPIPE  
METER BELOW



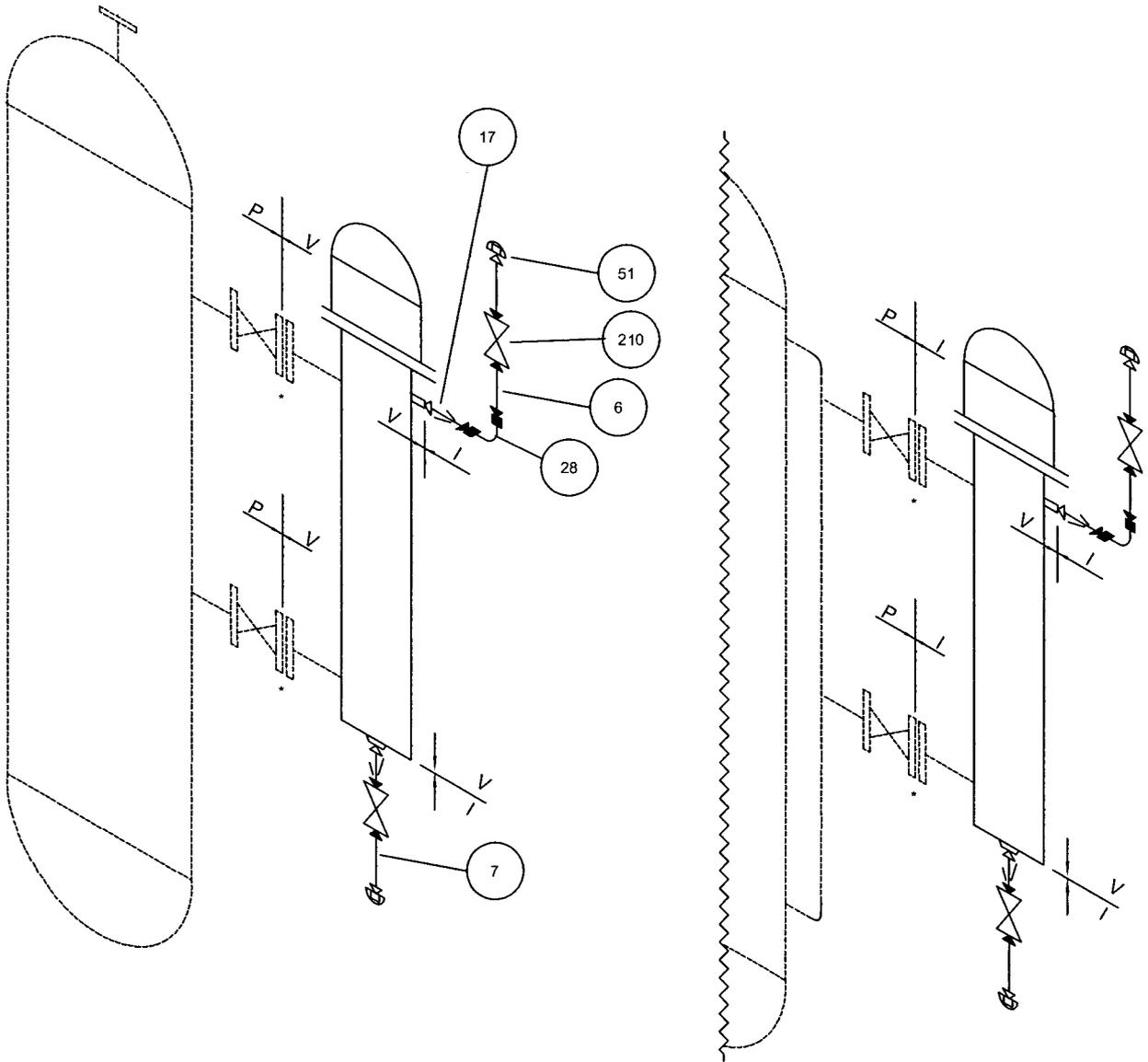
P - BY PIPING  
I - BY INSTRUMENTATION

\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	4	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	6	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	2	Nø						
22	EQUAL TEE	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	4	Nø						
210	GATE VALVE	1/2"	SW	4	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		2	Set						

5	24-10-16	Revised and Reissued	Manoj	MN	RG	RP/JMS	RN
4	12-10-11	Revised and Reissued	Manoj	RG	RP/JMS	DM	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman	Approved by



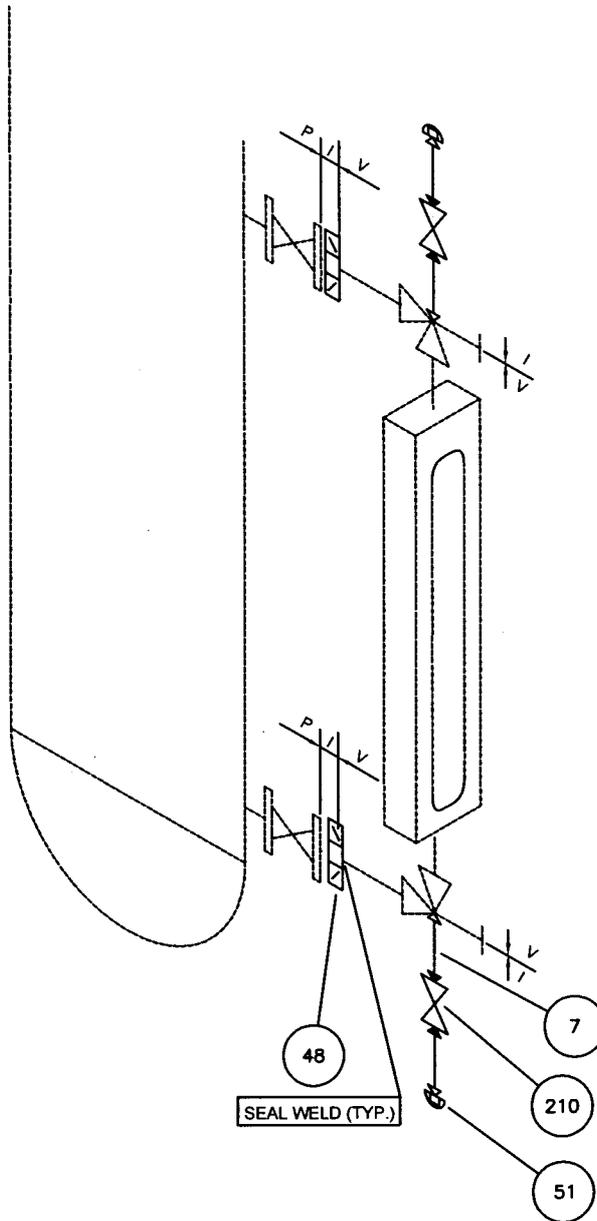
P - BY PIPING  
I - BY INSTRUMENTATION  
V - BY INST. VENDOR

\* - STUD NUTS & GASKET BY PIPING

**LIST OF ITEMS**

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
6	NIPPLE	1/2"	PL X PL	1	No						
7	NIPPLE	1/2"	TH X PL	2	No						
17	SWAGE NIPPLE	3/4" X 1/2"	TH X PL	2	No						
28	ELBOW	1/2"	SW	1	No						
51	CAP	1/2"	SCRD	2	No						
210	GATE VALVE	1/2"	SW	2	No						

0	01-09-14	Issued As Standard	Manoj	RKG	RG	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
Approved by						

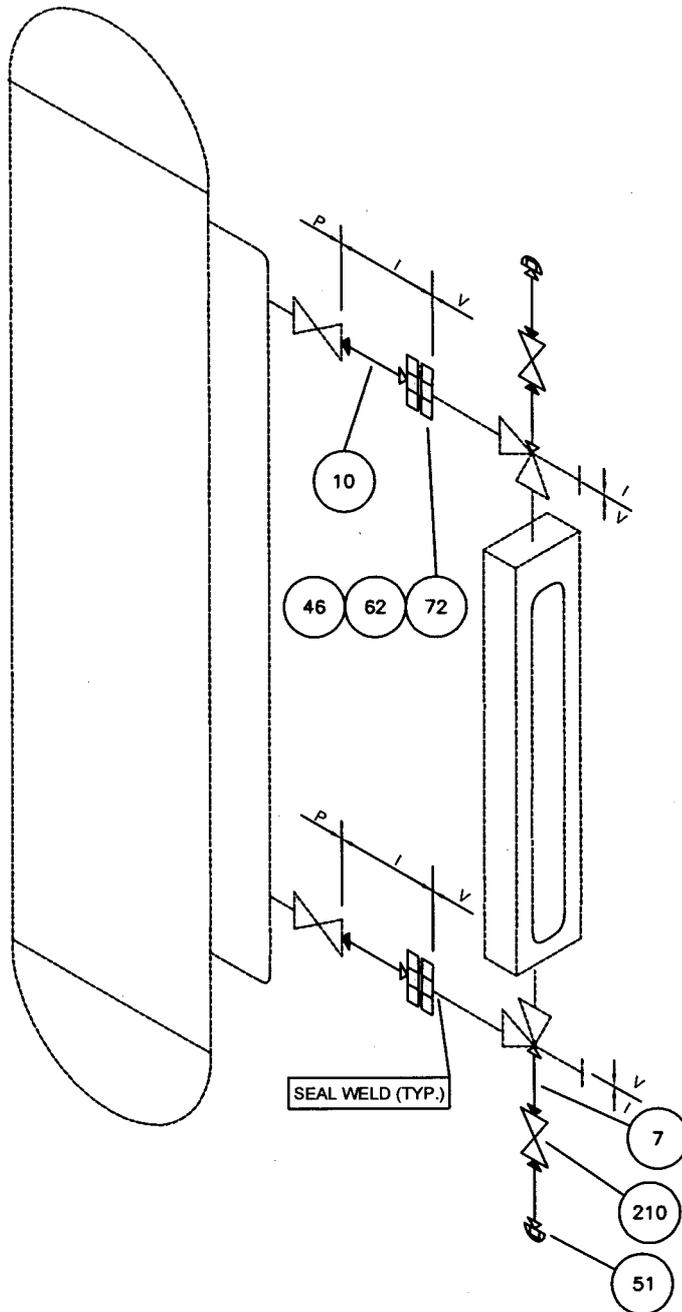


P - BY PIPING  
 I - BY INSTRUMENTATION  
 V - BY INSTRUMENT VENDOR

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	4	Nø						
48	FLANGE	2" X 3/4"	FL X TH (Red)	2	Nø						
51	CAP	1/2"	TH	2	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						

5	24.10.16	Reaffirmed Reissued	Manoj	MN	RG	RN
4	12-10-11	Revised and Reissued	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	

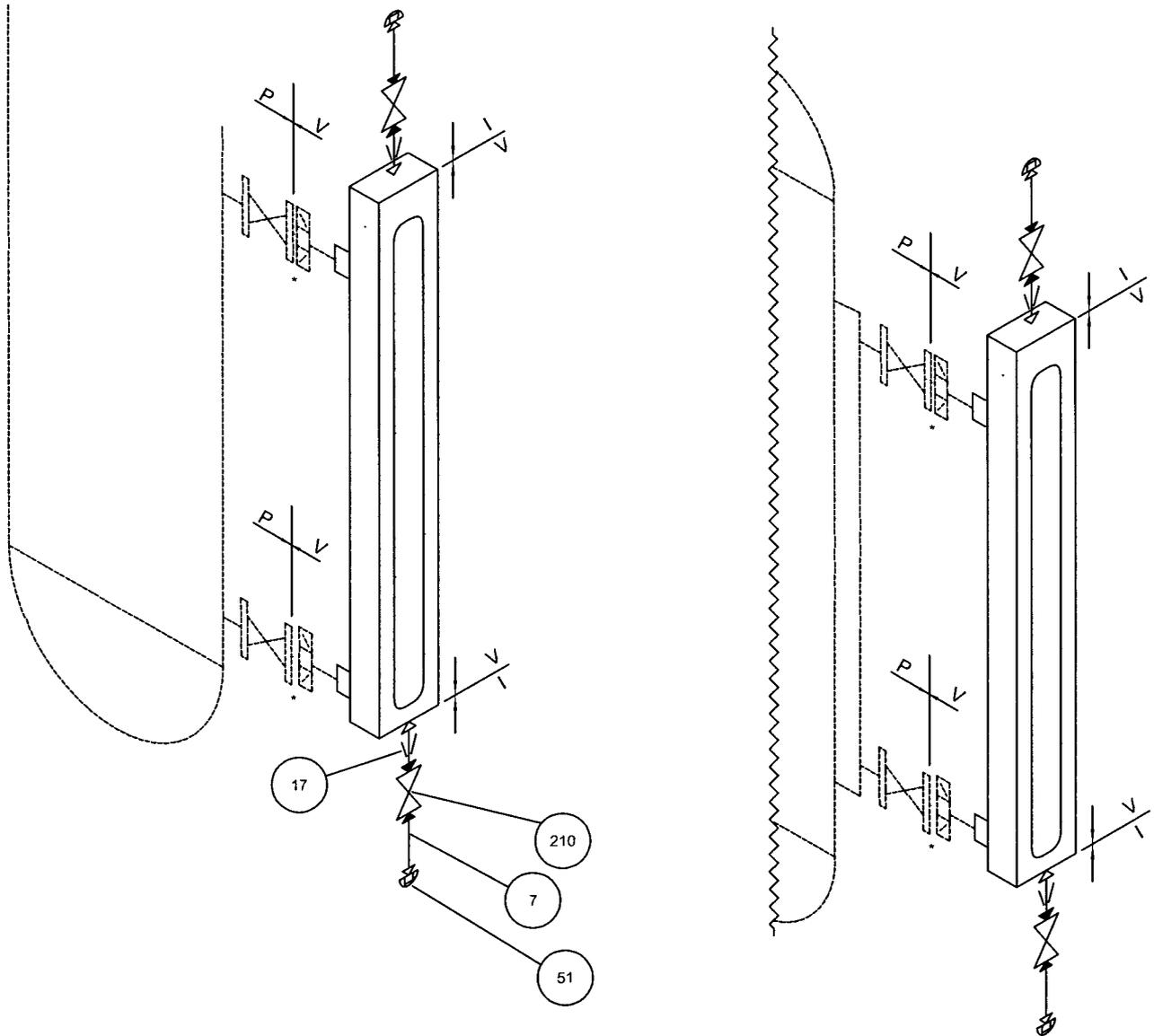


P - BY PIPING  
 I - BY INSTRUMENTATION  
 V - BY INSTRUMENT VENDOR

**LIST OF ITEMS**

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	4	Nø						
10	NIPPLE	3/4"	TH X PL	2	Nø						
46	FLANGE	3/4"	TH	4	Nø						
51	CAP	1/2"	TH	2	Nø						
62	GASKET	FOR 3/4" FL		2	Nø						
72	STUDS & NUTS	FOR 3/4" FL		2	Set						
210	GLOBE VALVE	1/2"	SW	2	Nø						

5	24.10.16	Reaffirmed & Reissued	Manoj	MN	RG	RN
2	12-10-11	Revised and Reissued	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
					Approved by	



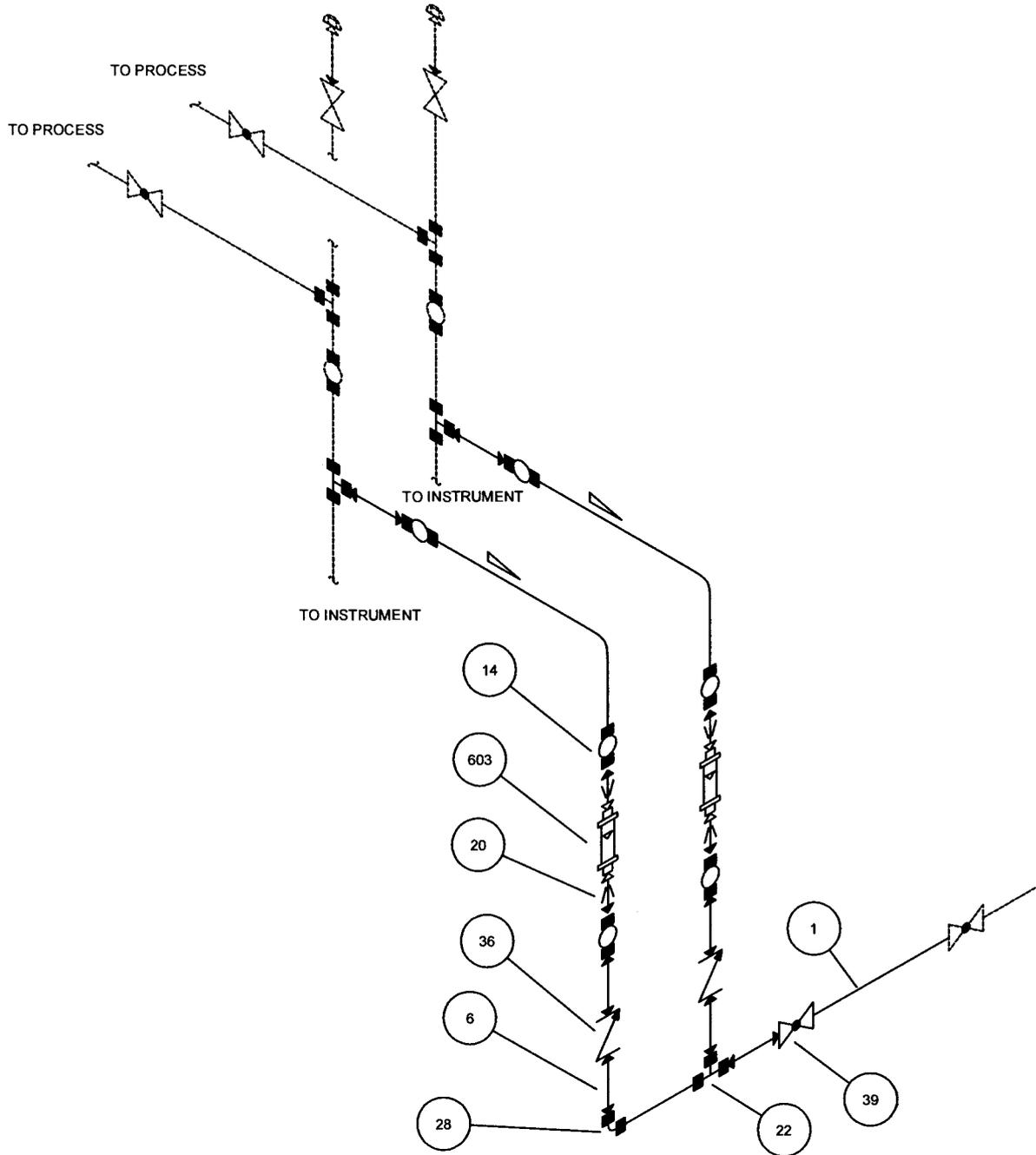
P - BY PIPING  
I - BY INSTRUMENTATION  
V - BY INST. VENDOR

\* - STUD NUTS & GASKET BY PIPING

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	3/4"	PL X TH	2	Nø						
17	SWAGE NIPPLE	3/4" x 1/2"	TH X PL	2	Nø						
51	CAP	1/2"	TH	2	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						

0	01-09-14	Issued As Standard	Manoj	RKG	RG	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
					Approved by	



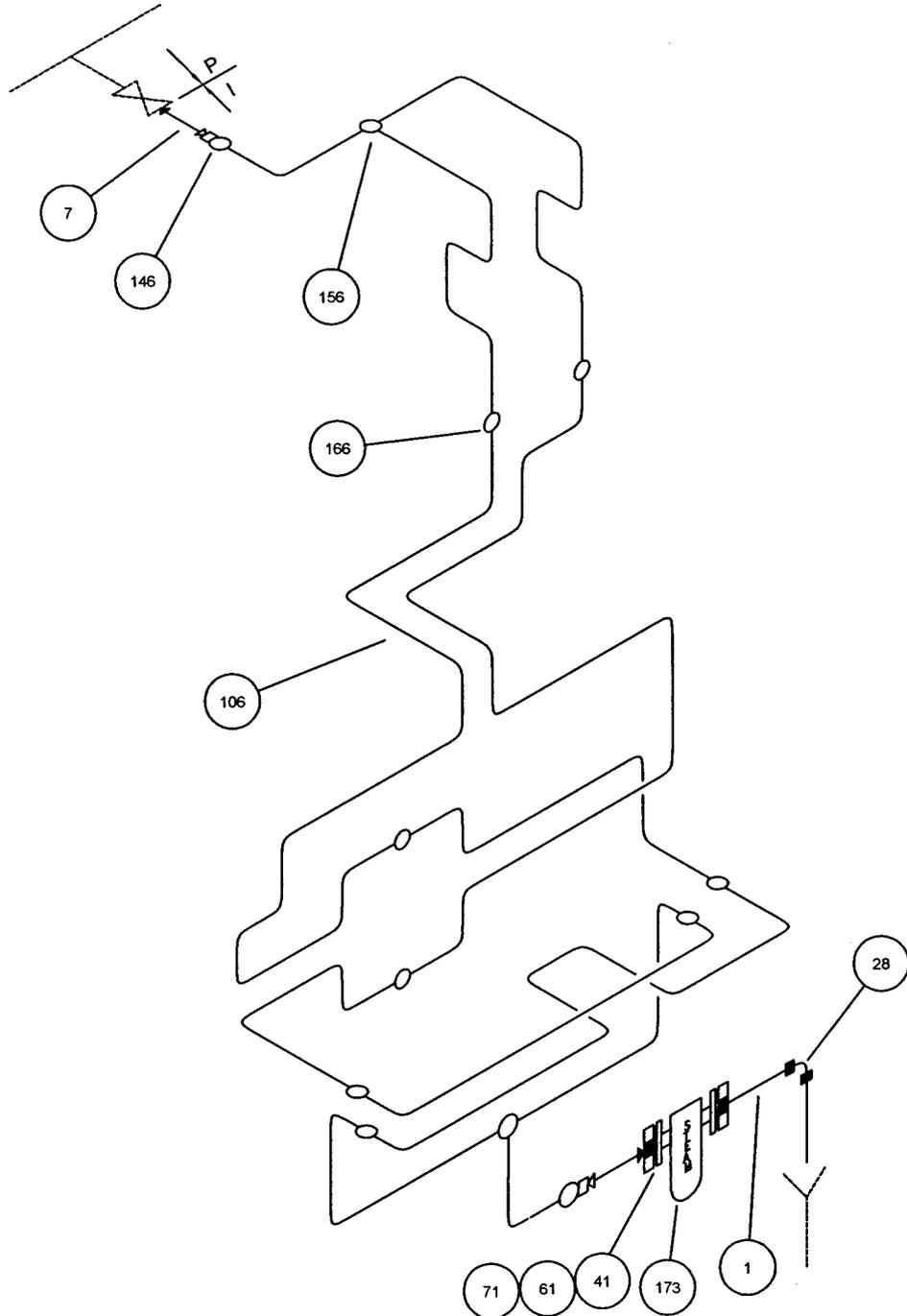
LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	603	PURGE ROTAMETER	1/4"	TH (Int)	2	Nø
6	NIPPLE *	1/2"	PL X PL	7	Nø						
14	UNION	1/2"	SW	6	Nø						
20	SWAGE NIPPLE	1/2" X 1/4"	PL X TH	4	Nø						
22	EQUAL TEE	1/2"	SW	3	Nø						
28	ELBOW	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
36	CHECK VALVE	1/2"	SW	2	Nø						

\* PL X PL NIPPLE SHALL BE FABRICATED FROM PIPE

5	28-03-17	Revised & Reissued	Manoj	MN	RP/JMS	RN
4	02-01-12	Reaffirmed and Reissued	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
					Approved by	

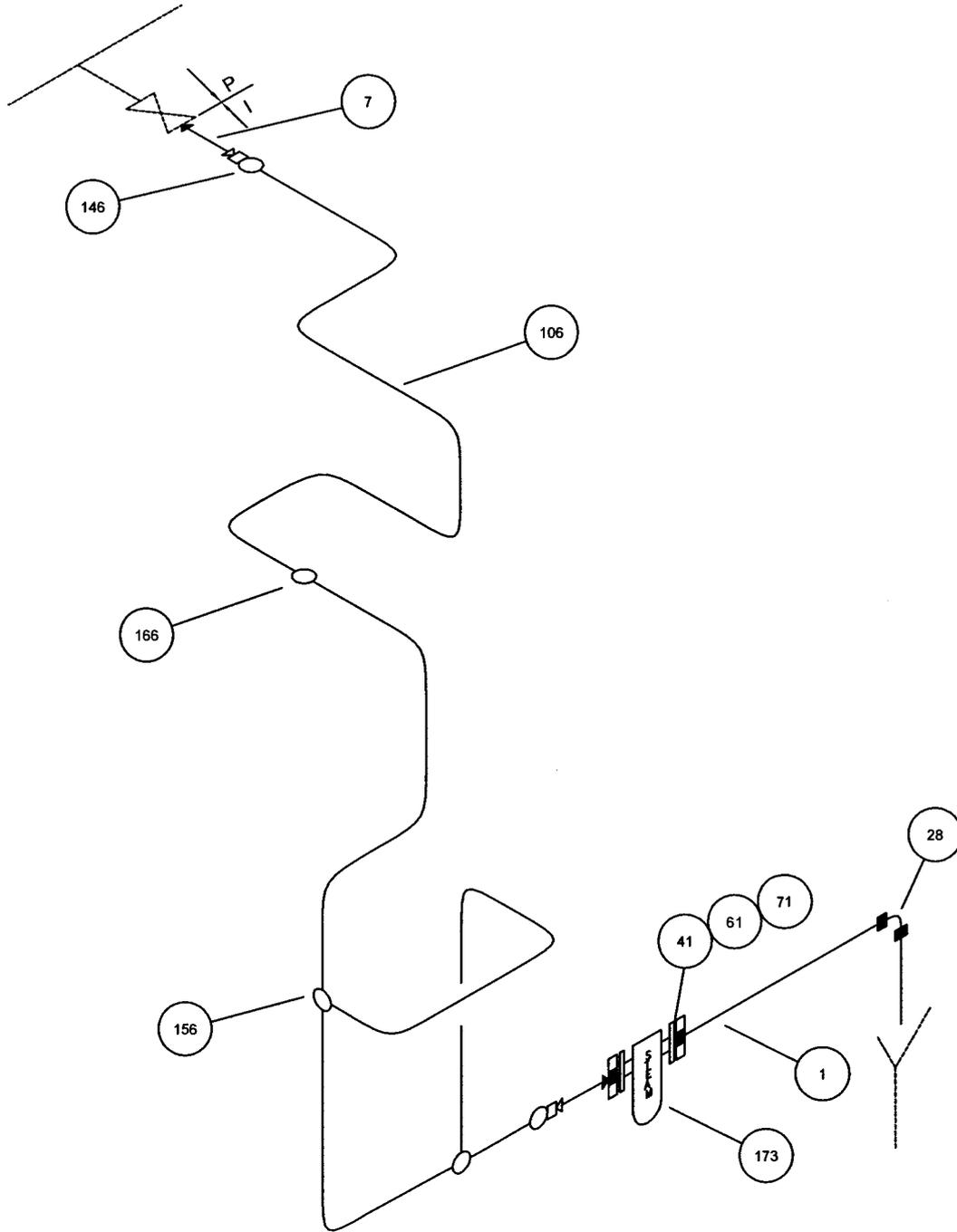




LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	106	TUBE	3/8"	OD	A/R	m
7	NIPPLE	1/2"	TH X PL	2	Nø	146	FEMALE CONNECTOR	1/2" X 3/8"	TH X OD	2	Nø
28	ELBOW	1/2"	SW	1	Nø	156	UNION TEE	3/8"	OD	2	Nø
41	FLANGE	1/2"	SW	2	Nø	166	TUBE UNION	3/8"	OD	8	Nø
61	GASKET	FOR 1/2" FL		2	Nø	173	STEAM TRAP	1/2"	FL	1	Nø
71	STUDS & NUTS	FOR 1/2" FL		2	Set						

5	28-03-17	Reaffirmed and Reissued	Manoj	MN	RG	RP/JMS	RN
4	02-01-12	Revised and Reissued	Manoj	RG	RP/JMS	DM	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman	Approved by



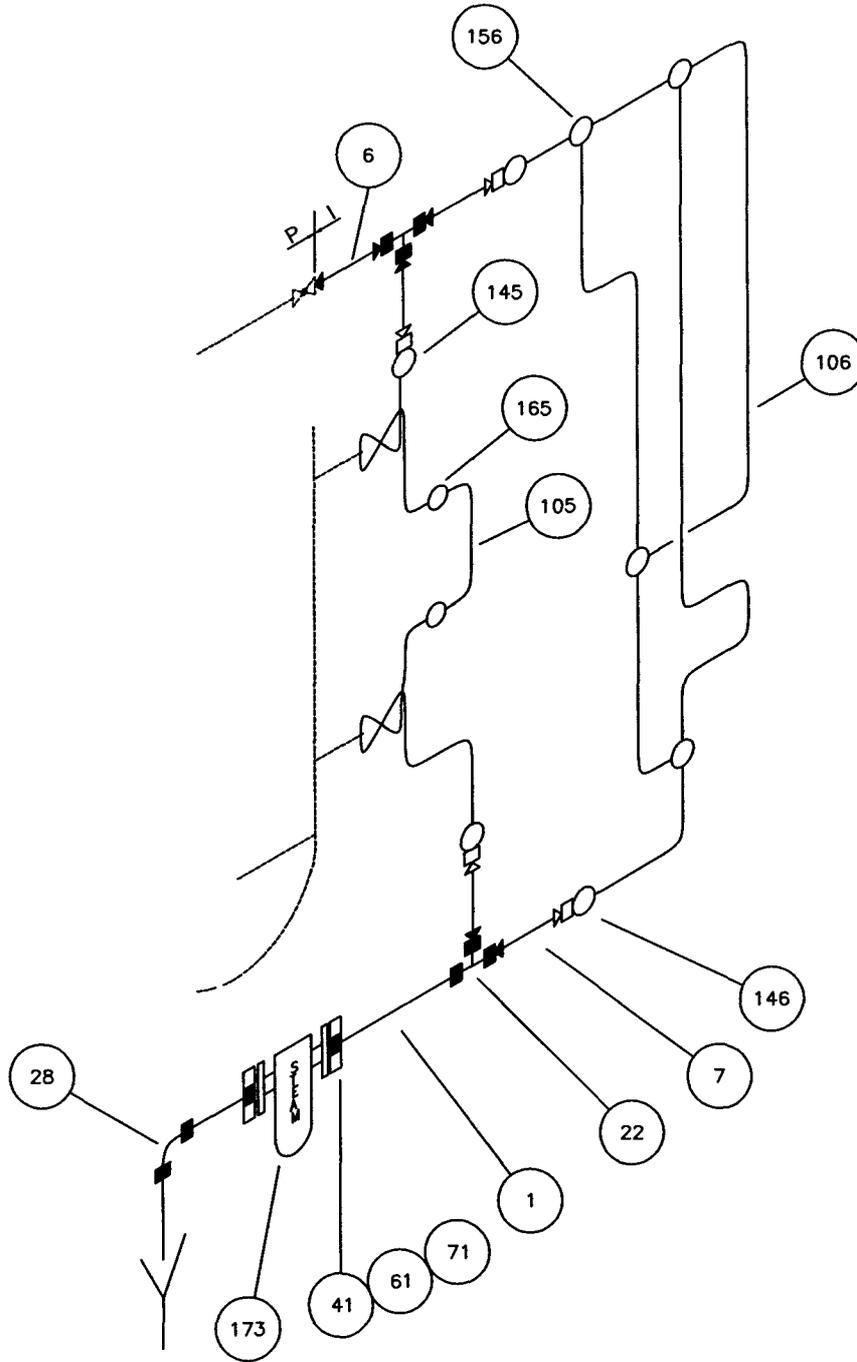
LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	106	TUBE	3/8"	OD	A/R	m
7	NIPPLE	1/2"	TH X PL	2	Nø	146	FEMALE CONNECTOR	1/2" X 3/8"	TH X OD	2	Nø
28	ELBOW	1/2"	SW	1	Nø	156	UNION TEE	3/8"	OD	2	Nø
41	FLANGE	1/2"	SW	2	Nø	166	TUBE UNION	3/8"	OD	1	Nø
61	GASKET	FOR 1/2" FL		2	Nø	173	STEAM TRAP	1/2"	FL	1	Nø
71	STUDS & NUTS	FOR 1/2" FL		2	Set						

5	28-03-17	Revised and Reissued	Manoj	MN	RG	RN
4	02-01-12	Revised and Reissued	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
					Approved by	



STEAM TRACING  
LEVEL INSTRUMENT

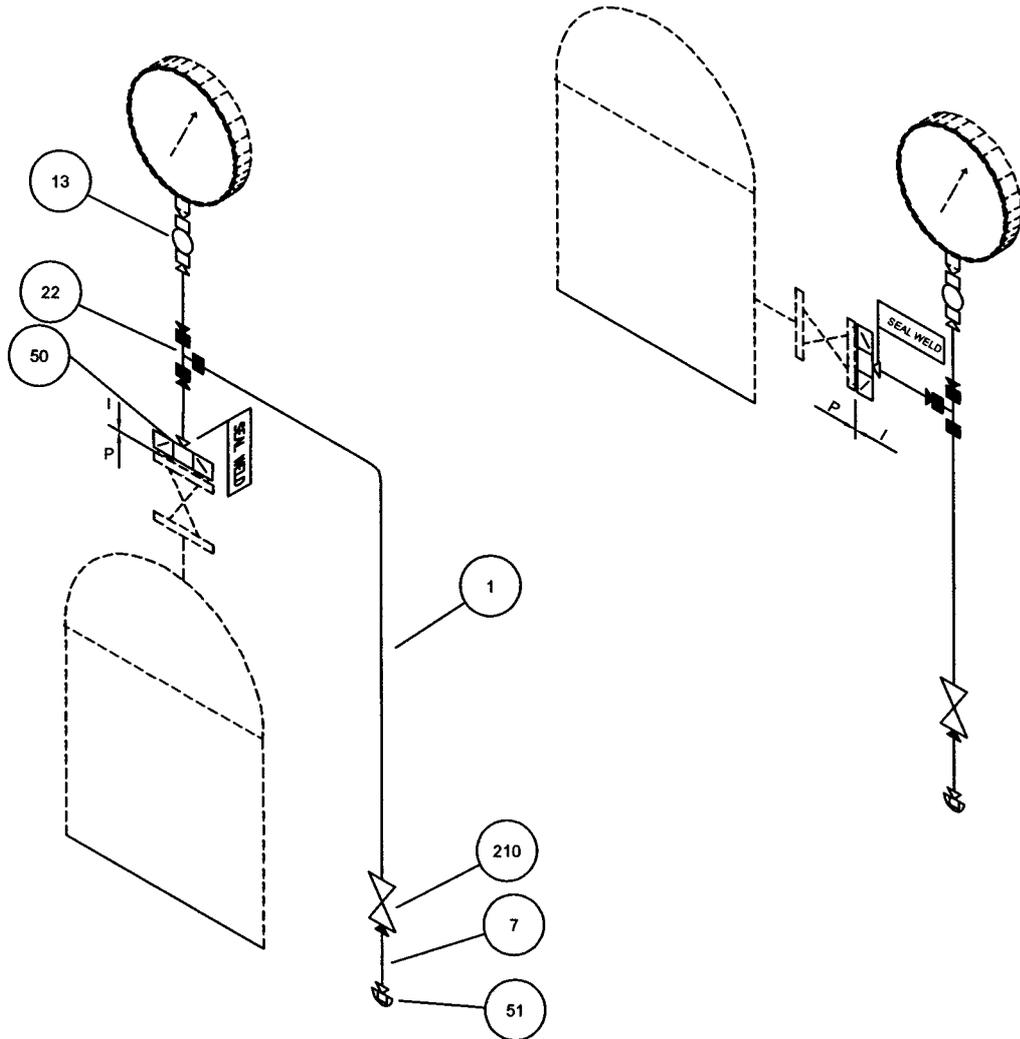


\* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	105	TUBE	1/4"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	1	Nø	106	TUBE	3/8"	OD	A/R	m
7	NIPPLE	1/2"	TH X PL	4	Nø	145	FEMALE CONNECTOR	1/2" X 1/4"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	2	Nø	146	FEMALE CONNECTOR	1/2" X 3/8"	TH X OD	2	Nø
28	ELBOW	1/2"	SW	1	Nø	156	UNION TEE	3/8"	OD	4	Nø
41	FLANGE	1/2"	SW	2	Nø	165	TUBE UNION	1/4"	OD	2	Nø
61	GASKET	FOR 1/2" FL		2	Nø	173	STEAM TRAP	1/2"	FL	1	Nø
71	STUDS & NUTS	FOR 1/2" FL		2	Set						

5	28-03-17	Revised and Reissued	Manoj	MN	Chaudhary	RN
4	02-01-12	Revised and Reissued	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
						Approved by



P - BY PIPING  
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m						
7	NIPPLE	1/2"	TH X PL	3	Nø						
13	UNION	1/2"	TH	1	Nø						
22	EQUAL TEE	1/2"	SW	1	Nø						
50	FLANGE	3" X 1/2"	FL X TH (Red)	1	Nø						
51	CAP	1/2"	TH	1	Nø						
210	GATE VALVE	1/2"	SW	1	Nø						

3	28-03-17	Revised and Reissued	Manoj	MN	RP/JMS	RN
2	14-02-12	Revised and Reissued	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
					Approved by	











**JOB SPECIFICATIONS  
(INSTRUMENTATION)  
FOR  
HPCL RAJASTHAN REFINERY LIMITED  
RAJASTHAN REFINERY PROJECT AT  
PACHPADRA, RAJASTHAN, INDIA**

**BIDDING DOCUMENT FOR  
VACUUM GASOIL HYDRO TREATING UNIT (VGO  
HDT) & REFINERY OFF GAS PSA  
EPCC – 10 PACKAGE  
(TENDER NO. – B224-110-86-41-PM-T-7210)**

---

B	22.04.2019	REVISED & REISSUED FOR TENDER	SA	RK	SB
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

---

S. NO.	CONTENTS
1.0	GENERAL
2.0	TYPE & LOCATION OF INSTRUMENTS & CONTROL SYSTEM
3.0	LOCAL PANEL REQUIREMENT
4.0	POWER SUPPLY REQUIREMENT
5.0	INSTRUMENT AIR REQUIREMENT
6.0	CABLES & CABLE GLANDS
7.0	JUNCTION BOXES
8.0	INSTALLATION REQUIREMENT
9.0	MISCELLANEOUS
10.0	SPARES
11.0	INSPECTION & TESTING
12.0	TRAINING
13.0	WARRANTY
14.0	LOGISTIC SUPPORT
15.0	LIST OF ATTACHMENTS
16.0	CPWAMC
17.0	LICENSOR SPECIAL REQUIREMENT

S. No.	JOB SPECIFICATION (INSTRUMENTATION) EPCC-10 PACKAGE	
1.0	<b>GENERAL</b>	
	Specification given below shall be read in conjunction with the Licensor's process package. The type of instruments shall be as per requirements of process package, engineering design basis, standards, specifications and drawings enclosed with this tender.	
1.1.	Location of field equipments/ instruments	Hazardous area
1.2.	Area classification	Zone & Gas group as per Electrical section of tender, Temp. Class-T3
1.3.	Operational requirements	Control Room : RMCR (Refinery Main Control Room) , Satellite Rack Room : SRR#2 (with columnless design in rack room, engineering room)  Local panels: As applicable
1.4.	Type of instrumentation	Electronic
1.5.	Logic representation	ISA
1.6.	Distance between field equipments and SRR	700 meters (approx.). This average length is indicative only and actual shall be as per site conditions.
1.7.	Distance between SRR equipments and Control Room (Refinery MCR)	1000 meters (approx.). This average length is indicative only and actual shall be as per site conditions.
1.8.	Order of priority in case of any conflict between tender documents	Generally order of priority as follows: a) Licensor drawings / documents, b) This Job Specification, c) Instrumentation Design Basis & Design Guideline, d) Other drawings and specifications. However, in case of any discrepancy, contractor shall bring up the discrepancy to PMC/ Owner for resolution before proceeding.
2.0	<b>TYPE &amp; LOCATION OF CONTROLS &amp; INSTRUMENTS</b>	

	All instruments shall be supplied as per Licensor Data sheets and specifications requirements.	
2.1.	Type of control system	DCS (With FOUNDATION fieldbus)
2.2.	Interlock & shutdown	PLC (Note-1)
	<p><b>Note-1:</b> All interlocks &amp; shutdown shall be executed in main plant PLC (By Owner) except for some special interlocks in package PLCs by package vendors. Such systems shall be serially interfaced to plant DCS. Necessary signals shall also be hard wired to plant main DCS / PLC as per approved P&amp;IDs. GPS synchronization shall be done for the Plant GPS. GPS system shall be supplied by Owner. Control system supplied by Bidder shall be capable for the same. For this Digital output will be given by Purchaser. Bidder shall consider DI for the same at their end.</p>	
2.2A	Contractor shall furnish all engineering drawings and documents for implementation of Instrumentation and Control of the units in Owner's DCS / PLC. Contractor shall review DCS / PLC vendor's drawings & documents pertaining to units covered in this tender which are prepared based on contractor's engineering drawings/ documents.	
2.2B	Contractor to note that for flow elements having safety interlock involving 2oo3 voting for input signal as well as control or monitoring across same sensor element, contractor shall consider 4 nos. of transmitters. Three nos. 4 – 20 mA + HART Transmitters shall be for 2oo3 interlock for implementation in safety PLC and 1 no. additional FOUNDATION fieldbus or 4-20 mA + HART transmitter depending upon the type of loop in DCS for control or monitoring. <b>(Note-4)</b> .	
2.2C	Contractor to note that wherever single transmitter is indicated in P&ID for both interlock and DCS indication / control, it shall be replaced with two transmitters, one 4-20 mA + HART transmitter for interlock and one additional FOUNDATION fieldbus / 4-20 mA + HART transmitter (as per P&ID) for DCS indication / control.	
2.2D	<p>The additional transmitters required in 2.2. B / C above shall be installed on equipments / process lines as follows:</p> <ul style="list-style-type: none"> <li>i) Level Transmitters: Additional Transmitters for indication/control to be installed on Standpipe of Level Gauge (LG). Level Transmitters for interlock shall be from independent tapping (for 2oo3 all three LTs shall be from independent tapping directly on equipment).</li> <li>ii) Temperature Transmitter: Separate Temperature element (T/C, RTD), TW shall be considered.</li> <li>iii) Flow Transmitter with Orifice Plate: Using additional set of tapping on orifice flange in case where only one transmitter is indicated as indicated in 2.2C. In case of 2.2B, individual set of tappings for each transmitter shall be considered on orifice flange (4 set of tappings for 4Tx). Installation standard shall be developed accordingly.</li> <li>iv) Pressure Transmitter: Separate tapping for each transmitter.</li> </ul>	
2.2E	All the above modification shall be incorporated by Contractor in P&IDs during	

	detail engineering and P&IDs shall be updated accordingly.	
2.2F	Package PLC (wherever applicable) supplied by contractor	<p>Located in SRR #2</p> <p>Installation in field/ any other location (as per PMC / Owner's instructions) ##</p> <p>Soot Blower PLC, wherever applicable, shall be located in SRR.</p>
	<p>## If Package PLC is located in local panel in the field, PLC shall be suitable for combined effect of heating due to maximum ambient temperature and current carrying for installation in LCP. PLC shall be suitably mounted to meet the hazardous area classification requirement of the location. Vendor shall confirm with catalogue / document mentioning ambient temperature rating of PLC. In case PLC ambient temperature rating is not adequate, local panel shall be provided with explosion proof air conditioning system suitable for the certified hazardous area classification.</p> <p>Vortex cooling is also acceptable (instruments air shall not be provided for vortex coolers, contractors shall consider ambient air with dual blowers for this purpose.)</p> <p>Local panel shall be provided with Pre-fabricated FRP canopy.</p>	
2.3.	Repeat alarms in local panels	As specified in P&IDs, equipment data sheets and elsewhere in the tender.
2.4.	Start/ Stop/ trip commands for MCC	Shall be hardwired in DCS, PLC Marshalling cabinets (DCS, PLC RIO cabinet) kept in substation (S/S-5).
2.5.	Signal interface between MCC and Purchaser's DCS/ PLC	<p>Shall be hardwired in Marshalling cabinets (RIO cabinet) kept in substation (S/S-5). All hardwired signal between MCC and PLC/DCS shall be through remote I/O of PLC/DCS and shall be located in substation (S/S-5).</p> <p>All running/ status indication from MCC to DCS shall be hardwired to DCS RIO (except which are used in interlocks shall be hardwired to PLC RIOs).</p> <p>Current indications from MCC to DCS, speed control signals for VFD from DCS to MCC etc. shall be hardwired to/ from DCS RIO.</p>
2.6.	Start/ Stop commands, Local/ Remote selection for all electrical drives from local control stations in field	Shall be directly wired to MCC, unless otherwise shown in process licensor in P&IDs.

2.7.	<b>Machine monitoring system</b>	
a)	Vibration Probes for pumps and Motor bearing & winding temperature measurement	Vibration probes for pumps wherever required shall be as specified elsewhere in the tender.  Motor bearing & winding temperature shall be measured at the points as specified elsewhere in this tender.
b)	Machine Monitoring system	Shall be provided wherever specified for compressors, pumps, blowers, turbines.
c)	Monitors/ racks mounted in panel/ cabinet	Located in SRR, with LCD display unit located in local panels (purged enclosure). Intrinsically safe PC can also be provided in local panel for display.
d)	Machine Monitoring system (Other Requirements)	In addition to above, contractor must ensure the following for the MMS supplied by them:  a) 4 channel vibration modules, 6 channel temperature modules shall be provided as per requirement. b) All signals from individual machine monitoring equipments required for machine shut down shall be hardwired to main plant PLC. Contractor shall provide relay module with programmable relays in each rack. Common pre-trip & trip signal shall be provided using programmable relays for connecting to main plant DCS / PLC. c) All alarms and related data shall be interfaced to DCS using serial interface. Dual redundant serial data interface shall be provided by Bidder from Machine Monitoring System to purchaser's DCS through Modbus RTU protocol via RS 422/ 485 interfaces. Bidder shall provide all required hardware, modules etc. for this interface including RS 422/485 converters at both ends to avoid mismatch of converter make and model. Bidder shall provide Modbus Address Mapping List for this interface to purchaser's DCS vendor for configuring the interface.  Clause no. b) above shall be implemented as mentioned below : i. The signals from individual Machine Monitoring equipment shall be connected hardwired to MMS. ii. The voting logic for the signals shall be configured and executed in the MMS. iii. The common pretrip and trip signals shall be made available on the relay module of the MMS.

		<p>iv. The common pretrip signal shall be hardwired from the MMS relay module to the main plant DCS.</p> <p>v. The Common trip signals shall be hardwired for the MMS relay module to the main plant ESD PLC.</p>
e)	Requirement of connectivity with Condition Monitoring System	<p>Bidder shall ensure the following for connectivity with Condition Monitoring System (in case CMS is used in future):</p> <p>(i) Bidder shall provide hardware like communication processors in each rack.</p> <p>(ii) Enabling software required if any for connecting to Condition Monitoring System for acquisition of raw data from various monitors with respect to each sensor shall be provided by Bidder.</p> <p>(iii) Individual monitors shall have provision for giving raw data (hardwired) to the Condition Monitoring System.</p>
f)		Dedicated racks and panels shall be considered for each package.
2.8.	Process instrument type for alarm/ shutdown	<p>Transmitter (switch action generated through control system).</p> <p>Field switch only where categorically specified by licensor, with PMC / owner's prior approval.</p> <p>Contact Rating for field mounted process switches: 24VDC, 2 Amp.</p>
2.9.	Ingress protection for instruments and enclosures in field	Weatherproof to IP65 as a minimum.
	All field mounted instruments shall be suitable for ambient conditions specified elsewhere in the tender.	
2.10.	Hazardous area protection for instruments <b>(Note-3)</b>	<p>Intrinsically safe type shall be used in general.</p> <p>Field barriers shall be used for FOUNDATION fieldbus loops. Trunk shall be increased safety (EExe) and spurs shall be intrinsically safe. FOUNDATION fieldbus devices shall be intrinsically safe (entity) certified.</p> <p>Canopy shall be provided by Contractor for all Analysers panels/ racks. Solenoid valves shall be intrinsically safe type for 24V DC (<math>\leq 700</math> M cable</p>

		length) and flameproof type for 110V AC (>700 M cable length). Field switches, wherever applicable, shall be flameproof. Limit switches shall be intrinsically safe type. Junction boxes and cable glands for flameproof instruments shall be flameproof. FFJBs (Fieldbus Junction boxes) shall be increased safety (EExe) type certified. Cable glands in junction box for FF field barrier assembly shall be flameproof type. For non-FOUNDATION fieldbus instruments including junction boxes and cable glands, increased safety/ non-incentive concept not acceptable.
	<p><b>Note-3:</b> Certification for use in hazardous area shall be as follows:</p> <p>Certificates from statutory authorities like Baseefa, FM, PTB, UL, ATEX, CENELEC etc. for items of foreign origin, and from CMRI, ERTL etc. for items of Indian origin.</p> <p>Approval certificate from Petroleum Explosives Safety Organization (PESO)/ CCE (Chief Controller of Explosives) for items to be installed in India, irrespective of country of origin and the same is mandatory. In case PESO/ CCE certificate is not available at the time of quotation, contractor shall confirm that the certificate shall be furnished before shipment.</p> <p>For all flameproof equipment manufactured locally (within India), the testing shall be carried out by any of the approved testing houses - PESO/Central Mining Research Institute (CMRI) / ERTL etc. The item shall in addition bear the valid approval certification from PESO / CCE and also the manufacturer shall hold a valid Bureau of Indian Standards (BIS) license.</p>	
2.11.	Transmitters	
2.11.1	Monitoring loops and Control Loops DCS only	<p>FF (Foundation FOUNDATION fieldbus) type for open loops, simple close loops.</p> <p>4-20mA + HART for critical/ complex loops. <b>(Note-4)</b></p> <p>Wireless devices with routers, repeaters and gateways <b>(Note-4)</b></p>
	<p><b>Note-4</b> – Refer approved P&amp;IDs, Licensor recommendation and Design Basis.</p> <p>Instruments for which FF type transmitters are not available, 4-20 mA + HART type can be provided with prior approval from PMC/ Owner.</p> <p>Wherever in Licensor P&amp;IDs, data sheets / specifications indicates FF or prohibits FF, the same shall be complied.</p> <p>Wireless instruments shall be used as per Engineering Design Basis/ P&amp;Ids.</p> <p><b>Wireless instruments shall also be used for Acoustic sensors to measure</b></p>	

	<b>leak through PSV connected to flare and TSO valves connected to flare.</b>	
2.11.2	Interlock & Shutdown system (PLC) loops,	4-20 mA with HART protocol (latest version).
2.11.3	Integral LCD type output meter	Required
2.11.4	ERS (Electronic Remote Seal )	For diaphragm seal type Level Transmitters and Differential Pressure Transmitters where required capillary length is very long, preferably ERS type transmitters shall be considered.
2.12.	Temperature transmitter	Required. Field mounted remote type (head mounted type is not acceptable)
2.13.	Universal type intrinsically safe dust-proof hand held communicator/ calibrator for FF and 4-20mA + HART transmitter & control valve positioner and wireless transmitter	Required along with battery and battery charger: 4 nos. (Note-5) + 2 no. for wireless transmitter
	<b>Note-5:</b> Hand held communicators/ calibrators shall be suitable for all make / model nos. of transmitters and positioners. Otherwise, 2 nos. hand held configurators shall be provided for each different type of instruments.	
2.14.	<b>FOUNDATION fieldbus devices</b>	
a)	Peer to Peer communication for FOUNDATION fieldbus instruments	Required. All devices shall support peer-to-peer communication
b)	Interoperability test clearance for FOUNDATION fieldbus instruments	Required. ITK latest Version (6.0 or later).
	Approved devices list maintained on FF website shall be referred. All devices shall be supplied with file and firmware revisions.  Contractor shall furnish a list of all fieldbus instruments in excel format as per format attached in Annexure-I with the job specification including the following information for Fieldbus instruments. i) Tag Number ii) FF registered product code iii) Device Type	

	iv) Manufacturer ID number v) ITK Revision vi) Firmware Revision vii) Device Revision viii) DD File Revision ix) CF File Revision	
c)	Power supply for FOUNDATION fieldbus field devices	FF devices shall be Bus powered, suitable for use with field barriers. No FOUNDATION fieldbus device shall be polarity sensitive.
d)	Integral output meter	Required (Display output in user configurable engineering units).
e)	Diagnostics as real time instrument status	Required for each transmitter
f)	Current drawn by FOUNDATION fieldbus field devices	$\leq 20$ mA. For special devices requiring $> 20$ mA, prior approval from owner/ PMC shall be required.
g)	Damping feature over and above sensor response time (Pr./ Diff. Pr. Transmitter)	Required (user selectable from 0 to 36 seconds, as a minimum).
h)	Function blocks (Pr./ Diff. Pr. Transmitter)	Each transmitter shall have capability to provide input and control function blocks such as AI and PID, as a minimum.
i)	Temperature transmitter input	Any of thermocouple or RTD. T/C input shall have automatic cold junction compensation. Shall be able to accept both grounded and ungrounded sensors.  (Built-up thermowells shall be used in low pressure and low velocity services like in fired heaters and also where thermowell immersion lengths greater than 1000 mm are required.)
j)	Function blocks (Temperature transmitter)	Each transmitter shall have capability to provide input and control function blocks such as AI and PID, as a minimum.
k)	Function Block execution time	Function Block execution time shall be within the following values:  AI: 30 ms  PID: 45 ms

		AO: 95 ms  However, where Licensor specified Control Response Period for close loops, Function Block execution time shall be selected to meet Control Response Period given by licensor.
l)	Incremental DD/ S/w revisions:	Field devices shall be capable of supporting incremental DD for extra functionality and / or software revisions in device memory.
2.15.	Transmitter accuracy (PT, PDT, FT, DP LT)	As given in Guideline for Instrumentation (B224-000-16-51-SP-0001 ) or in licensor specifications, whichever is superior
2.16.	Temp. Transmitter accuracy (with cold junction compensation with thermocouple element)	As given in Guideline for Instrumentation (B224-000-16-51-SP-0001 ) or in licensor specifications, whichever is superior
2.17.	Temp. Transmitter accuracy (with RTD element)	As given in Guideline for Instrumentation (B224-000-16-51-SP-0001 ) or in licensor specifications, whichever is superior
2.18.	Remote Indicator/ Indicator in local panel wherever required (other than vibration monitoring)	
a)	Remote Indicator in field	FOUNDATION fieldbus Remote Indicator type irrespective of transmitter type as separate output.
b)	Indicator in local panel	Microprocessor based, intrinsically safe, Loop powered type (MTL 600 series or equivalent).
2.19.	Valve Positioner & Accessories	
2.19.1	Positioner	
a)	Type	FF (Foundation FOUNDATION fieldbus) type for simple loops and 4-20 mA + HART for critical/ complex loop. <b>(Note-4)</b> .  Positioner shall be contactless type. Linkage-less is also acceptable.
b)	PID control block and capability of implementing	Required in each FF positioners.

	universal commands.	
c)	Output	Actual valve stem travel, input current, actuator pressure, travel direction, accumulated travel, cycle counter etc.
d)	Diagnostic information	Valve signature data with seat load, bench set and valve friction, dynamic error and dynamic linearity of control valve, diagnostic graphics with adequate resolution shall be provided.
	When mounted on control valve, the factory valve signature test report shall be provided in the Soft Copy Form in Hard Disk / Pen Drive.	
e)	Vibration effect	Shall have minimum vibration effect when mounted on the control valve, which shall be less than 1% of output span as per SAMA PMC 31.1.
f)	Positioner enclosure	Metallic
g)	Advanced diagnostic software DCS compatibility	<p>The advanced diagnostics software shall be used to diagnose control valve performance problems from DCS Asset Management system of any one of the following makes:</p> <p>a) M/s ABB b) M/s Emerson c) M/s Honeywell d) M/s Schneider (formerly M/s Invensys) e) M/s Yokogawa</p> <p>Accordingly, positioner advanced diagnostic software shall be capable of seamlessly integrated with the above make DCS.</p>
2.19.2	Accessories	
a)	Air Filter Regulator filter size	5 micron
b)	Solenoid valve insulation class	Class H
	For solenoid valves with Field Manual Reset, reset shall be through separate push button (i.e. not integral reset with solenoid valve).	
	Where solenoid valves are shown in 2 out of 2 configuration, on-line maintenance facility shall be provided with following.	

	<ul style="list-style-type: none"> <li>• Complete arrangement with manifold (not external tubing)</li> <li>• Isolation facility for individual solenoid valves</li> <li>• Visual indication for solenoid valve isolation status</li> <li>• Locking arrangement for each solenoid valve isolation facility</li> <li>• Whole assembly shall be SIL-2 certified.</li> </ul>	
c)	Fire Safe Valve	<p>Fire safe valve shall be type tested as per API 607 (6<sup>th</sup> edition or later).</p> <p>Fire safe valve with fire safe actuator shall be equipped with all accessories including volume bottle. Contractor shall provide fire resistant blanket / jacket.</p> <p>The fire blanket / jacket shall enclose the valve actuator, all valve accessories, volume bottle as well as tubing between the valve actuator and volume bottle.</p> <p>In case, the type of protection is not specified by licensor, contractor can consider fire resistant blanket / jacket type of protection as per API. Contractor shall refer 6-52-0061 for fire resistant blanket/ jacket specification. The fire jackets shall preferably be transported separately and installed at site to prevent damage during valve handling and storage.</p> <p>Also all branch cables associated with these valves shall be Flame retardant and Fire resistant type.</p>
2.20.	On-off / Shut-down valve limit switches	<p>Proximity type, intrinsically safe. Each limit switch shall have 2 separate cable entries one for open and one for close positions.</p> <p>Instead of Proximity switches, Restrictive dry magnetic proximity switches can be used for high temp, for high vibration &amp; corrosive atmosphere with hermetically sealed.</p>
2.21.	Thermocouple	
a	Type	Duplex, Generally K type. Other type (e.g. E/ T/ S) as per licensor specification, range & process conditions.
b	Grounded/ ungrounded	Un-Grounded type (only skin T/C Grounded)
c	Element thickness	20 AWG

	<p>Unless otherwise specified, thermocouple sheath shall be Inconel 600 for process temperature above 600 °C and upto 870 °C.</p> <p>Skin temperature elements shall be Retractable type.</p>	
2.22.	Terminal blocks	<p>Internal terminal block for all instruments, anti-vibration type. Flying leads are not acceptable.</p> <p>Only spring loaded screw-less terminals blocks shall be used.</p> <p>TBs shall have lever indicating termination of wire.</p>
2.23.	Terminals	Clamp-on (Screw less type) as per vendor list attached in tender.
2.24.	Barriers (wherever applicable)	Intrinsically safe barriers: 3-port galvanically isolating type , as per vendor list (Item-Interface devices) attached in tender
2.25.	FFPS (Foundation FOUNDATION fieldbus Power Supply)	FFPS (FOUNDATION fieldbus Power Supply) shall be provided by purchaser, duly mounted in racks in SRR#2.
2.26.	IBR, H2, NACE, special service testing requirements	Required, wherever applicable
2.27.	SS Tag plate	Required for all instruments, gauge board, and local panel.
2.28.	Rotameter	<p>Rotameter shall be metal tube type.</p> <p>Rotameter shall have an accuracy class of 1.6 or better as per VDI/VDE 3513/2.</p>
2.29.	Flow Element	<p>As per P&amp;ID, process package and Licensor recommendation.</p> <p>For Venturi, throat materials shall be minimum SS316.</p> <p>All flowmeters shall be of minimum 300# rating (flanged &amp; body).</p>
2.30.	Pressure Relief Valve	<p>Pressure relief valve type shall be contractor's responsibility suitable for the system.</p> <p>In general the following guidelines shall be used for safety valve sizing and selection.</p>

		<p>Conventional valves shall be selected if maximum operating pressure <math>\leq 90\%</math> of Set pressure and</p> <p>Either</p> <ul style="list-style-type: none"> <li>a. Fluid state is steam</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>b. Back Pressure is constant and <math>\leq 90\%</math> of set-pressure or</li> <li>c. Back pressure is variable and <math>\leq 10\%</math> of set-pressure, Subject to: Maximum Operating Pressure <math>&lt; 90\%</math> of [Set Pressure - Back Pressure].</li> </ul> <p>Balanced Bellow seal valves shall be selected if maximum operating pressure <math>\leq 90\%</math> of Set pressure and</p> <p>Either</p> <ul style="list-style-type: none"> <li>a. Back pressure is variable and <math>\leq 10\%</math> of set pressure but <math>90\%</math> of [set pressure – back pressure] is <math>\leq</math> Maximum operating pressure.</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>b. Back Pressure is variable and greater than <math>10\%</math> and <math>\leq 50\%</math> of set pressure.</li> </ul> <p>Pilot Operated Pressure Safety valve is selected if</p> <ul style="list-style-type: none"> <li>a. [Set Pressure] * <math>0.9</math> is less than Maximum operating pressure</li> <li>b. Back pressure is variable and greater than <math>50\%</math> of set pressure.</li> </ul> <p>Pressure Relief Valve shall have flanged connections for sizes <math>1"</math> and above and shall have screwed connection for sizes <math>3/4"</math> and below. Thermal Relief Valve shall have screwed connection with <math>0.38 \text{ cm}^2</math> orifice size and inlet outlet shall be of <math>3/4"</math> NPT (M) X <math>1"</math> NPT (F) sizes.</p>
2.31.	<b>PROGRAMMABLE LOGIC CONTROLLER (As applicable for Packages as per Licensor, approved P&amp;IDs and equipment data sheets/ specifications)</b>	

2.31.1	PLC Make	As per project approved vendor list attached elsewhere in this tender.
2.31.2	Location	SRR #2 (Unless any other location is specified)
2.31.3	PLC Configuration	PLC shall be DMR, TMR, Quad as specified. SIL-3 PLC shall be considered where SIL-3 loops are applicable for corresponding package. PLC shall be equipped with Dual redundant communication modules, dual redundant power supplies and dual I/Os with auto testing.
2.31.4	PLC panels/ cabinets	<p>PLC Hardware, Marshalling, barrier, power supply distribution, cabinets shall be supplied by the contractor for installation.</p> <p>Installation by contractor under supervision of package PLC vendor arranged by contractor.</p> <p>Commissioning by package PLC vendor arranged by contractor.</p>
2.31.5	Programming / Engineering terminal	One number Core i7 or equal PC for Engineering and programming with 21" TFT with backlit LED screen shall be supplied with keyboard, hard disk, CD/ DVD R/W , USB port shall be supplied. The Interconnecting cable between PC and PLC shall be supplied by Contractor.
<b>2.31.6</b>	<b>Interface with purchaser's DCS/ PLC</b>	
2.31.6.1	Hardwired interface	Hardwired signal interface between Package PLC and purchaser's DCS/ PLC shall be as per approved P&IDs and as per equipment data sheets/ specifications. Contractor shall provide all necessary hardware (I/O cards, signal multipliers, isolators, relays etc.) in PLC cabinets wired up to terminal racks. Interface signals shall be isolated 4-20 mA DC or potential free contacts.
2.31.6.2	Serial interface	All hardware/ software required for connecting package PLC to purchaser's DCS at SRR#2 through MODBUS RTU protocol through RS422 / 485 or MODBUS TCP protocol over Ethernet along with details such as Address Mapping list etc. shall be supplied by Contractor. Contractor shall provide the necessary converters. Serial link shall be dual redundant. Coordination and commissioning of this

		serial link at site with purchaser's DCS is contractor's responsibility. Serial link cable shall be in contractor's scope.
2.31.7	Scan time	Less than or equal to 250 msec.
2.31.8	Interlock & shutdown scheme	Contractor shall provide the interlock and shutdown scheme complete for package as will be incorporated in the package PLC and main plant ESD PLC in the form of :  a) Logic diagram as per ISA S 5.2  b) Logic write up including Sequence of start-up, shutdown & normal operation for purchaser's information.  c) Line monitoring shall be considered for DOs of F&G Output which are non fail safe (e.g. deluge valves)
2.32	Corrosion Monitors	Corrosion coupon, probes and transmitters as per final approved P&IDs shall be supplied and installed by contractor.
2.33	Ultrasonic flow meter	Ultrasonic flow meter shall be provided with minimum two paths. In case more number of paths required to meet accuracy, same shall be provided. Probe shall be inline / insertion type and shall be provided with online retractable assembly.  Clamp-on type ultrasonic flow-meter shall not be considered.
2.34	Oxygen Analysers in Heaters	a) The Tunable Diode Laser Spectroscopy (TDLS) type O <sub>2</sub> analysers are required for Continuous, Rapid Measurement of volumetric Oxygen concentration inside fired Heaters.  b) O <sub>2</sub> analysers shall be in-situ Cross Duct type over the heater nozzles one each for Source and Detector unit in the Field with Online Validation Facility.  c) It shall be suitable for area classification as specified elsewhere, having HART and 4-20mA Output with Temp and Pressure inputs for compensation. In case HART output is not available, then the necessary diagnostic alarms shall be transferred to the Plant DCS through serial communication (MODBUS RTU RS-485).

		<p>d) The source and detector unit shall be enclosed in a metal weatherproof housing with suitable gaskets, Quartz viewing windows and Sensitivity adjustment mechanism.</p> <p>e) Instrument shall be suitable for the weather conditions at site.</p> <p>f) Instrument shall be suitable for the heater service conditions.</p>
2.35	Space for installation/ removal / maintenance	Contractor shall ensure sufficient space is provided for installation/ removal/ maintenance of instruments like analyser probes, long insertion length temperature elements etc.
2.36	Field Instrument Mounting Bracket	Mounting bracket shall be Universal type suitable for mounting on both Vertical & Horizontal stanchion.
2.37	SIL Loops	Instruments in SIL loops shall be accordingly SIL level certified and with PFD values suitable to meet PFD of the complete loop as per SIL classification.
2.38	Fugitive emissions requirements for valves	Valve bonnet design/ packing shall be such that it complies with fugitive emission requirement as per leakage class C of ISO 15848-1. Type test certificate shall be furnished by the Vendors.
<b>3.0</b>	<b>LOCAL PANEL REQUIREMENT</b>	
3.1.	Construction details	Free standing structure
3.2.	Enclosure	Flameproof pushbuttons, selector switches, lamps, junction boxes shall be used.
3.3.	Purged enclosure (if required)	Other instrument items for which housing is not available in flameproof enclosures may be installed in a purged enclosure protected by type X purging as per NFPA 496 if it becomes unavoidable to install it in Zone-1.
3.4.	Material for all hinges, screws and other non-painted metallic parts	Stainless steel
3.5.	Alarm annunciator in local panel	Explosion proof type.  For compressors and big pumps, Local Panel design can be optimized by considering all alarms display in IS PC and only common annunciator points hardwired in Local Panel such that detail annunciation point can

		be traced in IS PC after common alarm buzzer and lamps display in field. IS PC (minimum 15" size) can be used for local display of vibration and temperature monitoring system parameters at field in place of separate MMS display unit. The IS Display configuration shall be in slave mode only and the communication with DCS shall be provided through Modbus RTU protocol via RS 485 interfaces.
3.6.	Cable entry	Bottom. ET Threads shall not be used.
3.7.	Incoming switch, MCB & fuse	Required
3.8.	Power indication on panel front	Required
3.9.	Lamp test facility	Required
3.10.	Type of Stop/ Trip Push buttons in local panel	Guarded type
3.11.	Installed spares	Contractor shall include 20% spare status lamps/ windows in alarm annunciator/ switches/ push buttons/ terminals in local control panel.
4.0	<b>POWER SUPPLY REQUIREMENT</b>	
4.1.	Instruments & control system	110 V AC UPS
4.2.	Interlock & shutdown	110 V AC UPS
4.3.	Interrogation voltage for contact input	24 V DC
4.4.	Solenoid valve	24 V DC (upto 700M cable distance), 110 V AC UPS (above 700M cable distance)
4.5.	Intrinsically safe transmitters (loop powered)	24 V DC
4.6.	Proximity type limit switches	24 V DC
4.7.	Panel lighting	240 V AC

	<p>Contractor shall provide 56 KVA feeders of 110 V AC UPS power supply for owner supplied equipments (DCS/PLC, CCTV system etc.) in SRR (This excludes loads for contractor supplied panel/ cabinets in SRR and field instrumentation, for which UPS to be provided by contractor as per contractor's requirement). 110 V AC UPS power supply for contractor supplied instruments/ panel/ cabinets is by contractor. Contractor to note that 110 VAC UPS feeders for owners equipments shall be redundant. Contractor shall also consider redundant UPS feeders for contractor supplied system oriented items.</p> <p>Contractor shall provide 230 V AC power supply feeders dedicated for owner supplied DCS / PLC, CCTV system cabinets in SRR in addition to the 230 V AC power supply feeder for contractor supplied panel / cabinets in SRR/ Field. Refer typical drawings for power supply distribution attached with the tender. All power cables and control cables from SRR to field, including laying and termination of cables shall be in contractor scope.</p> <p>Details of 110VAC UPS feeders and 230VAC non-UPS feeders for owner supplied DCS/ PLC/ CCTV will be provided during detail engineering. Number of feeders shall be governed by Electrical design criteria. For estimation purpose, following can be considered.</p> <p>For DCS/ PLC: 3 sets of redundant feeders of 12.5 KVA each (i.e total 37.5 KVA)</p> <p>For CCTV system: 2 sets of redundant feeders of 4 KVA each. (i.e total 8 KVA)</p> <p>For other owner use: 1 set redundant feeder of 4 KVA, 2 sets of redundant feeder of 3 KVA each and 1 set of redundant feeder of 0.5 KVA. (i.e total 10.5 KVA).</p> <p>All these feeders for owner's equipments shall be provided from UPS ACDB.</p> <p>For, 240VAC Non UPS Power supply, Bidder shall provide 3 nos. of dedicated feeders of 5KVA each. Exact no. of feeders maintaining the total load of 15 KVA shall be finalized during detailed engineering.</p>	
5.0	<b>INSTRUMENT AIR REQUIREMENT</b>	
	Minimum Pressure	As per Process package
	Normal Pressure	As per Process package
	Maximum Pressure	As per Process package
	Design Pressure	As per Process package

	<p>All pneumatic devices shall be able to operate with 0.5 kg/cm<sup>2</sup> less than minimum air supply pressure given in process package.</p> <p>Owner will provide Instrument Air tapping at one point near the battery limit, further distribution shall be by Contractor.</p> <p>Instrument air header shall be minimum SS-316 and with SS-316 X-mas tree like distribution pots (instrument air distribution manifolds). Further distribution of instrument air from the instrument air distribution manifolds to the individual valves shall be through SS316L tubing.</p> <p>Air supply tubing shall have size of 1/4" OD with 0.049" wall thickness &amp; 1/2"OD with 0.049" wall thickness where valve requires higher size.</p> <p>Steam/ Electrical tracing tubing shall have size of 3/8" OD with 0.049" wall thickness.</p> <p>Impulse tubing shall have size of 1/2" OD with 0.049" wall thickness.</p> <p>This overrides the tubing dimensions specified in mm in engineering design basis.</p>	
6.0	<b>CABLES &amp; CABLE GLANDS</b>	
6.1.	Type (single pair as well as multipair)	<p>1.5 mm<sup>2</sup> twisted in pair individually and overall shielded with aluminium Mylar tape with drain wire and armoured. Triad cables shall be used for RTDs and Gas detectors.</p> <p>Cable between temperature element and temperature transmitter shall be 2 Pair / 2 Triad.</p>
6.2.	Foundation FOUNDATION fieldbus cables	<p>FOUNDATION fieldbus cables shall be twisted in pair, armoured type. FF trunk cables shall be minimum 16 AWG, and FF spur cables shall be minimum 18 AWG. Other parameters shall be as per Type A defined in IEC-61158-2.</p> <p>2 Pair Trunk cables with 1 spare pair shall be provided. Trunk cable shall be orange with black longitudinal stripes, spur cables shall be orange with light blue longitudinal stripes. Minimum three equidistant stripes shall be provided.</p>
6.3.	Control Cables for Solenoid	<p>1.5 mm<sup>2</sup> (minimum) twisted in pair individually and overall shielded with aluminium Mylar tape with drain wire and armoured. Contractor shall carry out voltage drop calculation based on cable distance. In case 2.5 mm<sup>2</sup> cable is required for longer distances, same shall be considered.</p>

6.4.	Power supply cable to field instruments	Minimum 2.5 mm <sup>2</sup> armoured.
6.5.	Flame retardant and Low Smoke	Required, flame retardant as per IEC 60332 Cat. A.
6.6.	Flame retardant and Fire resistant cable	Required for branch cable for Fire Safe Valves with Fire safe Actuators
6.7.	Cable glands	Stainless Steel, double compression type suitable for armoured cables. Flameproof for flameproof instruments/ junction boxes.
6.8.	Slipper type PVC sleeves (cable shrouds)	Required (over cable glands for all cable entries in instruments and junction boxes) & shall be heat shrinkable type.
6.9.	Cable entries	Generally 1/2" NPTF for signal, 3/4" NPTF for power, temperature elements (duplex), 1" NPTF for 6 pair cable, 1.5" NPTF for 12 pair.
7.0	<b>JUNCTION BOXES</b>	
7.1.	Separate JBs for signals connected to DCS and PLC	Yes
7.2.	Separate JBs for different type of signals.	Yes.  Example: separate JBs for signals for Intrinsically safe & flameproof instruments,  a) 4-20 mA DC signals (IS) b) 4-20 mA DC signals (non-IS) c) FOUNDATION fieldbus signals d) Thermocouples (wherever used) e) RTDs (wherever used) f) Contact signals (Field switches, push buttons etc.) g) Interlock and shutdown signals (Solenoid valves) h) Limit switches (IS) i) Power supply to various instruments j) Signals from probes for Vibration & temperature monitoring system.
7.3.	Type of JBs	Suitable for 6 pair or 12 pair or 8 triad (for RTDs and gas detectors) signal cables.
7.4.	FFJB (Foundation Fieldbus Junction Boxes)	FFJB with field barrier assembly/ assemblies shall be provided with suitable cable glands with PVC shroud and plugs by DCS vendor. Housing shall be of SS316, IP65 (tested for water ingress) and EExe

		<p>certificate. All cable entries shall be from bottom.</p> <p>Cable glands shall be Stainless steel, double compression type suitable for armoured cables &amp; explosion proof (EEx'd'). Number of fieldbus segments in each FFJB shall be either 1 or 2. Separate trunk cable shall be used for FFJBs with 2 segments.</p> <p>Adequate space shall be provided in the FFJB for termination of all cables and mounting of field barrier assemblies, short circuit protectors, terminators etc. Each FFJB shall be provided with 1no. Surge protector for each trunk.</p> <p>FFJB shall be mounted vertically. Each FFJB shall have a data pocket &amp; ground stud. FFJB shall have a label mentioning "No switching off of Trunk connections allowed without prior permission".</p> <p>For more than one field barrier assembly in a FFJB with single segment, built in terminator of any field barrier assembly shall not be used. External terminator shall be provided in such FFJB.</p> <p>For segment design, contractor shall consider that minimum 28 V DC, 500 mA shall be available at output of FFPS (Foundation Fieldbus Power Supply), provided by DCS vendor at SRR. The FFPS will be provided by DCS vendor based on above design considerations.</p> <p>The make of the field barrier assemblies installed within the FF junction boxes shall be same as or compatible with the fieldbus power supply devices provided by DCS vendor.</p> <p>During the pre-commissioning checks, if any segment has to be modified, this shall be done without any cost and time implication. Accordingly the drawings shall be revised.</p>
7.5.	Field barrier assembly	<p>Field barrier assemblies in a segment shall be multi-dropped (shall not be daisy chained on a trunk). Only one closed loop can be considered per segment. Remaining spur connections in the segment can be used for open loop. Each spur shall be galvanically isolated from trunk.</p> <p>Not more than 12 spurs shall be connected in one junction box. 25% spare connections for field devices shall be provided in each segment.</p>

		<p>Contractor shall provide DIN rail mounted terminal in junction box for terminating the spare pair of trunk cable. One field barrier assembly shall contain:</p> <ul style="list-style-type: none"> <li>• Isolation switch for isolating the field barrier assembly from fieldbus trunk, which can be integral type.</li> <li>• Clamp on terminals (screw less type),</li> <li>• Not more than one field device in each spur connection,</li> <li>• Integral short circuit protection for each spur (short circuit current <math>\leq 50</math> mA),</li> <li>• LED indicator for each spur short circuit,</li> <li>• LED indicator for trunk voltage.</li> </ul>
7.6.	Segment cable length	Maximum segment length (trunk length plus all spur lengths) shall be 1900 meters
7.7.	Spur cable length	Maximum spur cable length shall be 120 meters
7.8.	Segment Design Guidelines	<p>(i) Drawing, documents to be referred: P&amp;IDs, instrument location plans, FFJB locations, control response period of different type of loops.</p> <p>(ii) Segment design guidelines:</p> <ol style="list-style-type: none"> <li>a) Separate segments for unrelated equipments; so that maintenance of devices for one equipment does not affect operation of other equipments.</li> <li>b) Separate segments for parallel process streams/ trains: To ensure that one process stream can be shut down, while parallel stream remain operating.</li> <li>c) Same segment for all field devices in the same loop: This includes interactive or cascade loops. However, while doing this, limitation of maximum field devices on the segment shall not be violated.</li> <li>d) Different segments for field devices used for same functions in same location/ equipment: To ensure that in case of problem in one segment, some information can be available from devices in other segments.</li> </ol>
8.0	<b>INSTALLATION REQUIREMENT</b>	
8.1.	Instrument impulse lines	For Non-congealing Hydrocarbon services as well as utility services, <u>except steam, very high pressure (Pressure rating above 600#) and temperature (Design temperature above 325 °C)</u> , standard bought out Pre-fabricated (with 5 valve manifold for flow and

		<p>2 valve manifold for PT) and pretested hook-up for all flow (dP) transmitters, Pressure transmitters shall be used.</p> <p>These hook-ups shall be basically close coupled instrument hook-up integral type complete with instrument root valve, equalizing valves, oval flange adaptors, vent, drain pre-tested and pre-engineered ready for installation. Accessibility for Prefab in 3D model shall be ensured. If access is not available, same shall be remote type.</p> <p>For remote installation, Hybrid piping hook-ups shall be used <b>(Note-6)</b>.</p> <p>For high pressure service , full Piping for all hydrocarbon service <b>(Note-6)</b>.</p>
	<p>Maximum working pressure and hydrostatic test pressure for tubing shall be as below :-</p>	

Sr. No.	Size of Tube (OD)	Material	Line Pressure Class (lbs per sq. inch)	Thickness	Maximum Working Pressure	Hydrostatic Test Pressure
1	1/8", 3mm	Stainless Steel	≤ Class 600	0.028" (0.8mm)	102 Kg/cm <sup>2</sup> g	153 Kg/cm <sup>2</sup> g
2	1/4", 6mm	Stainless Steel	≤ Class 600	1.00mm	102 Kg/cm <sup>2</sup> g	153 Kg/cm <sup>2</sup> g
			≥ Class 900 to ≤ Class 1500	0.065" (1.65mm)	253 Kg/cm <sup>2</sup> g	383 Kg/cm <sup>2</sup> g
3	5/16", 8mm	Stainless Steel	≤ Class 600	0.049" (1.2mm)	102 Kg/cm <sup>2</sup> g	153 Kg/cm <sup>2</sup> g
4	3/8", 10mm	Stainless Steel	≤ Class 600	0.049" (1.2mm)	102 Kg/cm <sup>2</sup> g	153 Kg/cm <sup>2</sup> g
5	1/2", 12mm	Stainless Steel	≤ Class 600	0.049" (1.2mm)	102 Kg/cm <sup>2</sup> g	153 Kg/cm <sup>2</sup> g
			≥ Class 900 to ≤ Class 1500	0.065" (1.65mm)	253 Kg/cm <sup>2</sup> g	383 Kg/cm <sup>2</sup> g
6	3/4", 20mm	Stainless Steel	≤ Class 600	0.049" (1.2mm)	102 Kg/cm <sup>2</sup> g	153 Kg/cm <sup>2</sup> g
			≥ Class 900 to ≤ Class 1500	0.065" (1.65mm)	211 Kg/cm <sup>2</sup> g	317 Kg/cm <sup>2</sup> g
7	1", (25mm)	Stainless Steel	≥ Class 900 to ≤ Class 1500	0.095" (2.5mm)	211 Kg/cm <sup>2</sup> g	317 Kg/cm <sup>2</sup> g
8	3/8", 10mm	Copper	≤ Class 300	0.049" (1.2mm)	53 Kg/cm <sup>2</sup> g	80 Kg/cm <sup>2</sup> g
9	1/4", 6mm	Copper	≤ Class 300	1.00mm	53 Kg/cm <sup>2</sup> g	80 Kg/cm <sup>2</sup> g
<p><b>Note-6:</b> Remote for hydrocarbons, small tubing portion near the instrument shall be used. For high pressure (≥ 900#), impulse line shall be complete piping with minimum size 3/4" and fittings of 3/4" size.</p>						
8.2.	Piping material used in installation hook up		As per Piping Material specifications. However Instrument Air line and pipe fittings shall be of SS316 minimum.			
8.3.	Spacer Ring for diaphragm seal installation with vent/drain connection with valves and plugs		Required			

8.4.	Instrument connection sizes	<p>Shall be as per 7-52-0001, 7-52-0002 and 7-52-0010 attached with the tender.</p> <p>However special requirements of minimum 300# rating as specified in Job Spec and higher connection sizes as per process BEDP part B shall be followed.</p>
8.5.	<p>Typical EIL installation standards are attached with the tender. Based on these typical EIL installation standards, contractor shall develop and submit Installation standards (hook-up) for all instruments supplied and installed by the contractor, for owner's review.</p>	
8.6.	Instrument valve manifold	<p>Fabricated type. Instrument valve manifolds shall be H-type or other based on process requirements.</p> <p>3-Way 2 Valve manifolds :-</p> <ol style="list-style-type: none"> <li>1. The manifold body shall be either straight or angle type as specified in the data sheet.</li> <li>2. The valve shall be a needle type.</li> <li>3. The body material shall be 316 Stainless Steel, unless otherwise specified.</li> </ol> <p>5-Valve manifold :-</p> <ol style="list-style-type: none"> <li>1. 5-valve manifold shall be designed for direct coupling to differential pressure transmitters having 2 bolt flanges with 54mm (2-1/8") centre-to-centre connections and 41.3mm (1-5/8") bolt-to-bolt distance.</li> <li>2. 5-Valve manifold shall contain two main line block valves and a combination double block and bleed for the bypass line. The valve shall of needle type or special ball with bleed hole.</li> </ol> <p>Integral manifold shall not be used for high pressure application. Site fabricated manifold shall be used for high pressure and Steam applications.</p>
8.6a	<p>Instrument Air Distribution: Contractor shall refer instrument air supply distribution scheme attached with the tender.</p>	
8.7.	Heat tracing & insulation	<p>Heat tracing &amp; insulation of line mounted/ equipment mounted instruments, instrument impulse lines shall be carried out as per line/ equipment specifications.</p>
8.8.	Jacketed instruments	<p>Instruments mounted on jacketed lines/ equipments</p>

		shall be jacketed only unless otherwise specified by licensor. In place of jacketing of any particular instrument; heat tracing may be selected with prior approval from owner.
8.9.	Steam trap	For instruments with steam tracing/ steam jackets dedicated steam trap shall be provided. Steam trap shall preferably be located on ground level with its outlet connected to drain funnel or as advised elsewhere in the package.
8.10.	Instrument Electrical tracing	Wherever electrical tracing is applicable same must be suitable for the line temperature rating.  Specific tracing temperature requirement shall be maintained as specified.
8.11.	Radiography, IBR testing, NACE, Post Weld Heat Treatment, Stress relieving requirement	As per Piping Material Specifications/ licensor specifications.
8.12.	Cable routing	Contractor shall provide cable trays, overhead duct (wherever required) for cable routing with in unit battery limit and up to SRR#2. Cable ducts, trays, trenches shall be provided for laying of cables inside SRR.  No Electrical power cable shall share the instrument cable tray/ duct.  Instrument cable duct shall be maintained at a distance of 1 meter from the electrical cable tray/ duct.
8.12.1	Cable Duct and tray	Instrument cable duct, cable trays, fittings and accessories shall be fabricated from Fibre-glass reinforced plastic (FRP). Bolts and nuts for Duct/cable trays shall be of 316SS material.  Cable ducts shall be supported at the bottom longitudinally on both edges, throughout its length by means of MS channels (minimum 100 mm) to avoid sagging due to cable weight.  Walk ways are to be provided longitudinally along the cable ducts.  The duct fabrication drawing (7-52-0254) shall be

		referred. However, referred drawing is for GI Duct. Contractor shall develop suitable drawing for FRP duct based on it. The FRP ducts shall be designed to withstand the load of cables with 100% capacity as per the respective duct sizes.
8.12.2	Cable Trench	Cable trenches shall not be used, except in solid floor rooms inside SRR.
8.13.	Spare space in cable ducts, trays	Cable ducts, trays shall have at least 20% spare space.
8.14.	Laying of all type of Instrumentation cables between field and SRR	Shall be laid by contractor in cable ducts.
8.15.	Fire proofing of cable duct, trays	Within plant battery limit, 100% Instrument cable ducts and 10% cable trays shall be fireproofed (refer attached Typical Drawing B224-000-16-51-SK-10). Cable trays requiring fireproofing will be identified during detail engineering.
8.15a	Contractor shall be responsible for providing fire protection system for cable ducts and cable trays in the plant battery limit (in compliance to OISD STD164). The system provided shall be readily removable and re-installable type on-line without the use of any elaborate procedure, need of structure and damaging the blanket used.	
8.15b	3M endothermic mat for fire proofing of instrument cable duct and trays shall be considered. The design selected should be able to prevent any ingress of water and dust into the system.	
8.15c	The system supplied shall be able to provide fire coverage of minimum half an hour of hydrocarbon fire to cable ducts / trays without damaging the cables. Contractor to ensure that the mat thickness and 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.	
8.15d	Contractor to ensure that the selected system should have undergone type fire test as per UL1709/ASTM E 1529 for hydrocarbon fire. The type testing should have been carried out / witnessed either by any recognized testing authority or test house such as Under Writers Lab. Certification of the same shall be provided as per UL1709/ASTM E 1529 fire test standard.	
8.15e	Contractor shall decide the number of layers of blanket required, longitudinal and transversal overlap and the clamping procedure for the desired fire rating. The blanket shall be removable from the duct / tray top side and shall be reusable. All clamps shall be reusable and easily removable type. The material of construction of clamps shall be minimum SS304.	

8.15f		Contractor shall furnish calculations of actual thickness, density and the number of layers of blanket provided to meet the fire coverage requirement as specified above.
8.16.	MCTs (Multi Cable Transit)	<p>Cable entry into the SRR, control rooms, analyser rooms/shelters, any other room shall be through Multi Cable Transit Blocks (MCT).</p> <p>MCT of Standard RGB type of Brattberg or G type of Roxtec or equivalent as per the make indicated in vendor list. The MCT shall be provided complete with insert blocks, spare blocks, stay plates, end packing etc. MCT blocks shall be provided with centre core with adjustable OD with peeling off arrangement.</p>
8.16.1	MCTs for cable entry to SRR,	For instrument cable entry to SRR, contractor shall provide minimum 2 Nos. RGB 8+8X10 or equivalent for Field cables and minimum 1 No. RGB 8+8X2 or equivalent for cables from SRR to RMCR (Refinery main control room)/ Substation RIO (Remote I/O) panel or equivalent with MCT blocks and accessories.
8.16.2	MCT Sizing	MCTs shall be sized considering 50% spares for each cable size/ O.D. In addition to installed spares contractor shall also provide 30% spare insert blocks in each cable size/ O.D as loose supply.
8.16.3	Separation of cables	Power cables for Instruments shall be suitably separated from the other cables and shall be routed through separate MCT blocks. In general the MCT frame considered for instruments shall not be used for electrical cables.
8.16.4	MCT Installation	<p>As per recommended practice of supplier. No spare space shall be left uncovered in the frame.</p> <p>Suitable cut-out and structural supports for installation of MCT frames on the walls of SRR is in contractor scope of works and supply.</p>
8.17.	Ferruling inside instrument JBs	Heat shrinkable printed sleeve type.
8.18.	Accessibility of instruments	Any instrument not accessible from grade / platform shall be provided with accessing platform.
8.19.	Instrument drain points connection	Shall be connected to common drain pipe to be routed to the nearest drain header

8.20.	Analysers	<p>Supply of all process analysers, Stack analysers etc. as indicated in P&amp;IDs and attached specifications.</p> <p>Stack analysers shall be mounted in the analyser panel located in the field. Other analysers shall be mounted in local panels/ cabinets/ shelter. Analyser shelter, panels, cabinets shall be suitable for the respective area classification.</p> <p>pH/ Conductivity analysers can be mounted in plate/ yoke.</p> <p>Contractor to refer standard specifications for process stream analyser (6-52-0035) and analyser shelter (6-52-0087) for further details.</p> <p>Analysers shall be mounted in local panels/ cabinets. Shelter. Analyser Shelter/ panels, cabinets shall be suitable for the respective area classification. Analyser cabinets wherever applicable shall be provided with vortex coolers (instruments air shall not be provided for vortex coolers, contractors shall consider ambient air with dual blowers for this purpose.)</p>
8.21.	FLUE GAS (STACK) ANALYSERS	<p>Flue gas monitoring system shall be used for monitoring continuous emission of stack and heaters. Type of analysers shall be considered NDIR type as indicated in <b>Instrument Design Basis section 3.5.14</b> and quantity on the basis of final approved P&amp;IDs and as per statutory regulations.</p> <p><b>Stack Analysers</b> shall be installed Analyser panel with suitable purging for the Hazardous Area and vortex cooling.</p> <p>Analysers shelters wherever applicable shall be provided with HVAC, as per specs. attached</p> <p>All electrical components and sample handling components shall be certified for hazardous area classification.</p> <p>Contractor shall provide connectivity of Stack analyser system(s) with Pollution Control Board. Contractor shall provide hardware and software including accessories like FO cables, convertor etc at both end for connecting Stack analysers to common CDSU (CDSU – supply &amp; installation by others and</p>

		located in RMCR) for further connectivity to CPCB.  Other Contractor shall use Cloud server for interfacing Stack analyser data & Analyser Remote calibration, through CDSU with CPCB/ State pollution control board and shall also ensure provision for Dynamic Limit setting facility as per the CPCB guidelines. Any support / coordination as required in term of providing serial data or otherwise to meet above functionality shall be provided by contractor.
8.22.	Gas Detectors	Contractor shall design and provide hazardous gas detection system (sensors/ transmitters) for alarm and shutdown to protect personnel and equipment from hazardous gas infiltration. The gas detectors shall be 3 wire, SMART type with 4-20 mA HART output wired to Purchaser's F&G PLC.  20% / 60% LEL for HC and 10 ppm / 15 ppm for H2S alarms are to be generated in F&G PLC. However audible/visual alarms (hooters and beacons) in field shall be provided by contractor.  4 nos. portable HC gas detectors, 2 nos. portable H2S gas detectors, 2 nos. portable H2 gas detectors shall be supplied by contractor.  Two nos. of portable calibration kit for HC gas detectors and one number of portable calibration kit for each other type of gas detectors shall be provided.
8.23.	Canopy	Canopy shall be of pre-fabricated Fibre-glass reinforced plastic (FRP). Bolts and nuts for canopies shall be of 316SS material.  Canopy shall be provided by Contractor for all Analysers panels/ racks also.
9.0	<b>MISCELLANEOUS</b>	
9.1	Proven track record	The instruments and accessories as being offered / supplied should have been operating under similar process conditions for at least 6 months
9.2	Vendor list	Refer vendor list for instrumentation items attached elsewhere in the tender. All instrumentation items as per approved vendor list shall be supplied according to vendor enlistment condition with EIL (PMC) for type,

		<p>sizes, ratings, material etc.</p> <p>Only for items not appearing in vendor list, contractor shall furnish proposed sub-vendor list along with PTR for owner's approval.</p>
9.3	Specialty services	<p>For speciality items like Heater Flame Detection / Ionization Rod System (if applicable), Analysers, Anti-Surge Controller (if applicable), Package PLCs, Machine Monitoring system, installation, testing &amp; commissioning shall be done under supervision of manufacturer's specialists. Contractor to make specialist's services available.</p>
9.4	Logistic support	<p>Logistic support certificate (as per format given below) shall be furnished from supplier of all types of PLC, Analysers, Machine Monitoring system and other special instruments.</p>
9.5	Painting requirements	<p>Painting of installation material, instrument supports and structural supports shall be as per painting specification attached elsewhere in tender.</p>
9.6	Space for installation/ removal/ maintenance	<p>Contractor shall ensure sufficient space is provided for installation/ removal/ maintenance of instruments like analyser probes, long insertion length temperature elements, insertion type flow meters, pre-fabricated hook-ups etc.</p>
9.7	Thermowell installation	<p>Non-intrusive Clamp on type surface temperature measurement based on heat dissipation/thermal conductivity shall be used for open loop temperature transmitter where line size is less than 4" or where special MOC thermowell is required due to special MOC or corrosive/dirty fluid for temp range of 300 deg C.</p> <p>For other cases where pipe line is less than 4" nominal bore, blowing up is required for installing of Thermowell.</p> <p>All Thermowell along with flange connection on pipe shall be with minimum 300# rating.</p>
9.8	Control valves	<p>Control valves in dirty or congealing service, up to 8 inches shall be eccentric rotary plug type, however above 8-inch high performance butterfly or V-notch type valve shall be used.</p> <p>All control valves &amp; On-Off valves body along with flange end connection shall be with minimum 300# rating.</p>
9.9	Partial stroke testing (PST)	

9.9.1	PST is not required for Fail open valves. Accordingly no PST Positioners required for Fail open On-off valves.	
9.9.2	The Partial Stroke Testing positioners (PST) with diagnostics features shall be on HART protocol & shall be connected through 4-20 mA HART AO card of Purchaser's DCS for communicating with the Purchaser's Instrument Asset Management System (IAMS). The PST shall carry out the partial stroking of the valve on receiving the command from Purchaser's IAMS either manually or automatically on pre-set regular intervals & send the Valve partial stroking feedback signal to the Purchaser's IAMS. The positioner shall be SIL-2 certified as minimum. No hardware shall be envisaged at Control Room/ Rackroom end, the AO signal from Purchaser's DCS shall be directly wired to PST Positioner without any additional hardware in between.	
9.9.3	Valve PST positioners shall be able to communicate with Universal Hand Held communicator.	
9.9.4	Positioner casing /cover shall be metallic. Bidder to ensure that the PST positioner failure (including electrical, shall not affect the valve on /off functionality and ESD action requirements). All components used in PST shall not affect the on-off valve performance under any circumstances. Also the positioner output shall be limited beyond the allowable value in case of valve struck condition.	
9.9.5	Positioner shall be provided with reverse acting relay (integral to positioner) - so that on loss of power to positioner / at min current to positioner, maximum pneumatic output is generated by the positioner.	
9.9.6	The compatible software with license required for PST positioner's communication with purchaser's shall be in bidder's scope. Software shall be plug-in type and shall be valid for the maximum possible Tags (License shall be perpetual type).	
9.9.7	Positioners shall have pressure sensor based diagnostics on input & output ports.	
9.9.8	PST Positioners tubing in Valve/Actuator end shall not require any additional SOV/ AOV/ pneumatic component (apart from the ones indicated in relevant datasheets) to be introduced in the pneumatic circuit. Any additional component (if found introduced) at a later date shall be replaced by the bidder & entire assembly shall be replaced with positioner arrangement meeting requirements specified.	
9.9.9	PST Positioner shall be located upstream of Shutdown SOV (i.e., SHALL NOT BE LOCATED BETWEEN SOV & ACTUATOR). Shutdown SOV shall be totally separate from the PST positioner (i.e. shall not be integrated with PST positioner).	
9.9.10	Positioner shall be side-mounted on the ON-OFF valve and shall have corrosion resistant linkages and rugged brackets.	
10.0	<b>SPARES</b>	
10.1	Mandatory Spares	<p>Contractor shall quote Mandatory spares as per Mandatory spares list attached with the tender. Prices for mandatory spares shall be included in the base price.</p> <p>All the mandatory spares shall be addressed for each item separately after all procurement is over. CONTRACTOR shall prepare separate transmittals for mandatory spares, which shall identify list and tag number (where applicable) with the basis. CONTRACTOR shall prepare format for such submission for PMC's approval for each item. The</p>

		mandatory spares already reached site shall have receipt note from Owner/PMC or its representative and same shall be attached with the transmittal.
10.2	Commissioning spares	To be supplied as required for commissioning of the instruments. The same shall be included by contractor. Contractor shall procure these spares as per recommendation of vendors/ suppliers.
10.3	Consumables	<p>Contractor shall provide Consumables for 6 months of continuous consumption and the price shall be included in the base price.</p> <p>Contractor to furnish the quantity of calibration gas required for calibration of each type of analyser, gas detector. Volume of calibration gas and no. of calibration gas cylinders shall be calculated based on the following: The calibration gas volume shall be supplied for calibration of each analyser, gas detector for minimum six months operation after Commissioning considering recommended calibration frequency by vendor for offered analysers, gas detectors, and calibration time required for each analyser, gas detector. Calculations for required quantity of calibration gases shall be furnished by Contractor as per above guideline. The delivery of calibration gas cylinders can be staggered in such way that the composition and stability of calibration gas do not deteriorate. Calibration gas cylinders shall be provided in two sets of cylinders so that one set can be sent for refilling with other set connected.</p>
10.4	Two years recommended Spares	Contractor shall quote spares for two years operation & maintenance separately. Prices for these spares shall not be included in the base price of the package.
11.0	<b>INSPECTION &amp; TESTING</b>	
11.1	Inspection and factory testing	All instruments and accessories, system oriented items like package PLC (as applicable), Analyzers, Machine monitoring system, Local Control Panels, special instrument items shall undergo factory testing and inspection by Contractor's authorized representatives, Third Party Inspection (TPI) Agency, as per Instrumentation Design Basis & Design Guideline, Inspection Test Plans and other standard specifications, job specifications attached in the tender and respective instrumentation Purchase Requisitions. Factory Acceptance Testing of critical

		items shall be witnessed by OWNER/ PMC at their discretion.
11.2	Contractor's participation in Owner's DCS/ PLC Factory Acceptance Test	Contractor's full participation required (for proper implementation of VGO-HDT Unit instrumentation and control in DCS / PLC) in DCS/PLC vendor workshop. Complete expenses for Contractor persons visit to DCS/ PLC vendor workshop is in contractor scope.
11.3	Process Logic Simulation check	Contractor's full participation is required in process Logic simulation check in DCS/PLC at site as well as vendor's workshop. Expenses for Contractor person visit to DCS/PLC vendor workshop/ site is in contractor scope.
<b>12.0</b>	<b>TRAINING</b>	
12.1	<b>Programmable Logic Controller (PLC) for Package System (as applicable).</b>	
	At manufacturer's works:	
	Maintenance training:	Two persons for five days
	Operation training	Two persons for five days
	At site	
	Operation and Maintenance training:	10 man days in two to three batches
12.2	<b>Analyzers, Machine Monitoring System</b>	
	Maintenance training at manufacturer's/ supplier's works	Two persons for ten working days ( <b>Note-7</b> )
	<b>Note-7:</b> In case locations are different for different items, the same courses shall be repeated w.r.t. person and days in each work.	
	Operation and maintenance training at site	10 man days in two to three batches
13.0	<b>Warranty</b>	The Bidder shall guarantee trouble free performance of the supplied systems and work during this warranty period (extended warranty period for some items, as

		per scope of work). In case of any defect or non-performance of the system or a component during this guarantee period, the same shall be replaced/rectified free of cost. Any such replacement/repair need to be carried out within 72 hours of reporting the issue to the Bidder. In this regard, Bidder is advised to consider periodic maintenance checks by the respective OEM/ Representative, as required in order to ensure 100% availability/trouble free performance. During warranty period, CONTRACTOR shall supply all spares for Instrumentation and Control items. CONTRACTOR shall provide warranty maintenance services and supply of spares for maintaining an uptime of 98% for each system. Any fault shall be attended within 72 hrs.
15.0	<b>LOGISTIC SUPPORT</b>	Logistic support certificate as per format below from the supplier of package PLCs, Analysers (process, Stack etc.), Machine monitoring system, Anti-surge Control System, Speed Governor System and any System oriented items shall be provided as part of each purchase specification. The logistic support certificate shall be signed by a corporate level person of the vendor.
16.	<b>CPWMC (COMPREHENSIVE POST WARRANTY MAINTENANCE CONTRACT) FOR PACKAGE PLC, ANALYSERS, MACHINE MONITORING.</b>	<p>Comprehensive post warranty annual maintenance contract for 3 years duration shall be provided for Package PLC, MMS/CMS, Analysers any system oriented items to be executed after expiry of warranty.</p> <p>Also refer details furnished elsewhere in the tender document w.r.t Post Warranty Maintenance Contract of above-mentioned items. PWMC will be separately ordered by Owner.</p> <p>CONTRACTOR shall propose 3 year's post warranty maintenance contract &amp; contract shall exclusively mention the service to be provided, methodology, scope of work, and Vendor's responsibility with year wise break up.</p> <p>In the event of any malfunction of the system hardware / system software, experienced service engineer shall be made available at site within 24 hours on the receipt of such Information from OWNER.</p> <p>The contract shall include supply of maintenance spares, tools &amp; tackles as required:</p> <p>Travel, boarding &amp; lodging of service engineer. The quote shall be made year wise upto 3 Years. Contract shall include on site stock &amp; shall give cost of each item after expiry of 3 Years AMC with escalation formula.</p> <p>The service under Post Warranty Maintenance Contract including supply of spare parts and services</p>

		<p>shall broadly encompass:</p> <ul style="list-style-type: none"> <li>- Preventive maintenance</li> <li>- Periodic maintenance</li> <li>- Emergency service</li> <li>- Software support</li> </ul> <p>Preventive maintenance: Once in a year, involving complete overhaul of the system, inspection of hardware and software, fault prediction, inspection of power supply quality, environmental and operating condition checks, calibration checks, major repairs/replacements and detailed reporting.</p> <p>Periodic maintenance: Site visits, minimum four to six times in a year, inspection of general healthiness of the system, study and advice on daily maintenance, inspection of H/W &amp; S/W. if any problem is reported, running of test programs, on-line servicing and solving reported problems.</p> <p>Checks shall be conducted on running system i.e. (a) On-line sub-systems (b) Power supply checks (c) Others vendor to mention.</p> <p>Software maintenance: Maintain existing software to improve and utilise existing application and improve performance of the system. Minor modification of the software shall also be covered under this scope.</p> <p>Emergency service: Any failure shall be on system suppliers' account. The Engineer must report at site within 24 hrs of report of failure, with necessary spares. The system must be brought back within 24 hours after reporting at site.</p> <p>NOTE: 1. Contractor to note that while carrying out the Post Warranty Maintenance Contract activities OWNER'S engineers may associate with system engineers. On job training of these associated engineers shall be covered under this scope. 2. All financial aspects of the Post Warranty Maintenance Contract must be listed clearly by the CONTRACTOR.</p>
17.0	<b>Licensor Special Requirement in VGO-HDT Unit</b>	<ul style="list-style-type: none"> <li>a. Current indication is required for the motors. Contractor to refer Licensor document for details.</li> <li>b. Contractor to note that even though interlock instruments has been indicated as XSHH OR XSLL (X may be flow, pressure or temperature), the same shall be done through transmitter (and not switches). Contractor shall update P&amp;IDs to modify all such discrepancy</li> </ul>

		<p>during detailed engineering.</p> <ul style="list-style-type: none"> <li>c. For interlock numbering, Contractor to note that following philosophy has been followed             <ul style="list-style-type: none"> <li>i) Interlock - I (safety) will be numbered from 1 to 199.</li> <li>ii) Interlock - I (sequence in DCS) to be numbered from 201 to 299.</li> </ul>             Contractor to use the same philosophy while providing interlock numbering to their sub-packages.           </li> <li>d. Wherever TSO has been indicated in control valve, leakage class V shall be considered as a minimum.</li> <li>e. Analyser sample return line, as required, has not been shown in the P&amp;IDs; the same shall be developed by Contractor.</li> <li>f. For on/off valves , TSO requirement shall be as per API STD 598</li> <li>g. Wherever Licensor has indicated requirement of redundant limit switch for Valves, the same shall be followed.</li> </ul>
--	--	---

**Formats for Logistic Support Certificate**

**Certificate For Logistic Support (by Principal)**

(To be signed by Principal's corporate level signatory on company's letterhead)

I, on behalf of M/s \_\_\_\_\_ confirm that the \_\_\_\_\_ \*

quoted by M/s \_\_\_\_\_ for VGO-HDT unit of Rajasthan Refinery Project shall continue to be supported by us. The quoted item shall not be withdrawn from Indian market in next five (5) years from the date of placement of order as a matter of our corporate policy.

I further confirm that in case of placement of order by HRRL on M/s \_\_\_\_\_ we shall continue to support M/s \_\_\_\_\_ in providing back-up engineering, maintenance support and spare part to HRRL for a period of 10 years from the date of expiry of warranty.

Signature with Seal

Authorized, Senior Management Level Signatory

\* Analysers/ Machine monitoring system/ Package PLC/ any other system oriented item provided by contractor.

**Certificate For Logistics Support (by vendor)**

(To be signed by Vendor's corporate level signatory on company's letterhead)

I, on behalf of M/s \_\_\_\_\_ confirm that the \_\_\_\_\_ \*

quoted by M/s \_\_\_\_\_ for VGO-HDT unit of Rajasthan Refinery Project shall continue to be supported by us and our principal(s). The quoted item shall not be withdrawn from Indian market in next five (5) years from the date of placement of order as a matter of our corporate policy as supported by attached certificate from our principal(s) M/s \_\_\_\_\_.

I further confirm that in case of placement of order by HRRL on us, we shall continue to support HRRL in providing back-up engineering, maintenance support and spare part to HRRL for a period of 10 years from the date of expiry of warranty.

Signature with Seal

Authorized, Senior Management Level Signatory

\* Analysers/ Machine monitoring system/ any other system oriented item provided by contractor.

<b>18.0 LIST OF ATTACHMENTS</b>			
<b>S. No.</b>	<b>Description</b>	<b>Document No.</b>	<b>Tender document section no.</b>
1	Guideline for Instrumentation (#)	B224-000-16-51-SP-0001	C4.6
2	Job specifications of Field bus cable	B224-000-16-51-SP-0002	C4.6
3	Job Specification for FRP Cable trays	B224-000-16-51-SP-0003	C4.6
4	Job specification for Wireless Instrumentation	B224-000-16-51-SP-0004	C4.6
5	IO Summary Format	B224-000-16-51-IOF-7210	C4.6
6	Mandatory information required for FF devices	Annexure-I	C4.6
7	EI Interface philosophy	B224-000-16-51-EI-01	C4.6
# Guideline for Instrumentation is to be read in conjunction with EDB.			

# ENGINEERING DESIGN BASIS INSTRUMENTATION

JOB NO: **B224**  
PROJECT: **PMC Services for Execution of Rajasthan Refinery Project (RRP)**  
CLIENT: **HRRL - REGD. OFFICE**

EIL SIGNATURE:

CLIENT SIGNATURE:



2	17/May/2019	Revised and reissued	GARG SACHIN KUMAR	KHANNA REETU (MS)	BHOWAL SAIKAT
1	13/Dec/2018	Revised and reissued based on client comments	GARG SACHIN	KHANNA REETU (MS)	BHOWAL SAIKAT
<b>Rev. No.</b>	<b>Date</b>	<b>Purpose</b>	<b>Prepared by</b>	<b>Reviewed by</b>	<b>Approved by</b>

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

## Table of Contents

1.0 SCOPE . . . . .	5
2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS . . . . .	5
2.1 ABBREVIATIONS . . . . .	5
2.2 CODES & STANDARDS / PUBLICATIONS . . . . .	6
3.0 GENERAL / DESIGN CONSIDERATIONS . . . . .	8
3.1 CONTROL PHILOSOPHY . . . . .	9
3.1.1 TYPE OF PLANT . . . . .	9
3.1.2 MODE OF PLANT OPERATION . . . . .	9
3.1.3 CONTROL ROOM/SATELLITE RACK ROOM REQUIREMENT . . . . .	10
3.1.4 FLOORING REQUIREMENT IN INSTRUMENT ROOMS . . . . .	12
3.1.5 TYPE OF CONTROL AND MONITORING . . . . .	12
3.1.6 INTERLOCK AND SHUT-DOWN SYSTEM . . . . .	12
3.1.7 LOCAL PANEL REQUIREMENT . . . . .	13
3.2 PACKAGE UNITS PHILOSOPHY . . . . .	15
3.2.1 OPERATING PHILOSOPHY . . . . .	15
3.2.2 PLC CONFIGURATION (FOR PACKAGE VENDOR SUPPLIED PLC) . . . . .	17
3.2.3 ANTI SURGE CONTROLLER . . . . .	17
3.2.4 MACHINE MONITORING SYSTEM . . . . .	17
3.2.5 LOCATION OF SPEED GOVERNOR . . . . .	18
3.2.6 TYPE OF LOCAL PANEL . . . . .	18
3.3 DCS REQUIREMENTS . . . . .	18
3.3.1 OPERATOR CONSOLES . . . . .	18
3.3.2 CONSOLE CONFIGURATION . . . . .	19
3.3.3 ENGINEERING CONSOLES . . . . .	19
3.3.4 ENGINEERING & OPERATIONAL DATABASE . . . . .	19
3.3.5 ALARM INFORMATION MANAGEMENT SYSTEM . . . . .	20
3.3.6 GIANT SCREEN REQUIREMENT . . . . .	20
3.3.7 SEQUENCE OF EVENT RECORDING . . . . .	20
3.3.8 ADVANCED CONTROL FUNCTION REQUIREMENT . . . . .	20
3.3.9 ASSET MANAGEMENT SYSTEM . . . . .	20
3.3.10 DOCUMENTATION NODE . . . . .	21
3.3.11 TRAINING KIT . . . . .	21
3.3.12 TRAINING SIMULATOR . . . . .	21
3.3.13 LOADING PHILOSOPHY . . . . .	21
3.4 INSTRUMENTATION ON CONTROL ROOM PANEL / HARD-WIRED CONSOLE . . . . .	21



4.5.1 GENERAL . . . . .	36
4.5.2 CONTROL VALVE RATING . . . . .	36
4.5.3 TRIM DESIGNS . . . . .	37
4.5.4 ON-OFF VALVE . . . . .	37
4.5.5 SOLENOID VALVES . . . . .	37
4.5.6 LIMIT SWITCHES . . . . .	37
4.6 PRESSURE RELIEF DEVICES . . . . .	37
4.7 ELECTRICAL FIELD WIRING . . . . .	37
4.8 CABLE TRAYS AND CABLE DUCTS . . . . .	38
4.9 AIR FILTER REGULATOR . . . . .	39
4.10 CANOPY . . . . .	39
4.11 DESUPERHEATER . . . . .	39
4.12 TEST /LAB EQUIPMENT . . . . .	39
4.13 CCTV SYSTEM . . . . .	39
4.14 FIRE AND GAS DETECTION (F & G) SYSTEM . . . . .	40
4.15 BOILER DRUM INSTRUMENTATION . . . . .	41
4.16 AMBIENT AIR QUALITY MONITORING SYSTEM . . . . .	41
4.17 SAFETY VALVE TESTING AT SITE . . . . .	41
5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS . . . . .	41
6.0 POST WARRANTY ANNUAL MAINTENANCE CONTRACT . . . . .	41
7.0 SPARE PHILOSOPHY . . . . .	42
8.0 ADDITIONAL NOTES . . . . .	43

## 1.0 SCOPE

Hindustan Petroleum Corporation Limited (HPCL) is setting up a grass root refinery & petrochemical complex in Barmer district of Rajasthan.

The complex consists of a 9.0 MMTPA refinery along with an integrated 0.82 MMTPA ethylene capacity Dual Feed Cracker Unit. Downstream basic polymer units to produce Polypropylene, Linear Low Density Polyethylene (LLDPE) and High Density Polyethylene (HDPE) will also be installed. The proposed Dual Feed Cracker shall receive Refinery Fuel Gas, LPG and Naphtha as feedstock from the refinery units.

The proposed Refinery cum Petrochemical Complex shall produce fuel and Petrochemical products by processing Rajasthan crude in admixture with Arab mix crude as well as 100% Arab Mix Crude.

The Complex shall consist of Open Art as well as Licensed process units along with utilities and off-sites and other infrastructure facilities.

## 2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

### 2.1 ABBREVIATIONS

Code	Description
AWG	American Wire Gauge
BEDB	Basic Engineering Design Basis
BIS	Bureau of Indian Standards
CCE	Chief Controller of Explosives
CCTV	Closed Circuit Television
DCS	Distributed Control System
DGMS	Director General of Mines Safety
DPDT	Double Pole Double Throw
FF	Foundation Fieldbus
FRP	Fibre Reinforced Polymer
GRP	Glass Reinforced Polymer
HART	Hi-way Addressable Remote Transducers
HC	Hydrocarbon
HVAC	Heating Ventilation and Air Conditioning
IBR	Indian Boiler Regulations
IP	Ingress Protection
IR	Infrared
IS	Intrinsically Safe
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCC	Motor Control Center
NACE	National Association of Corrosion Engineers
NB	Nominal Bore
NEC	National Electric code
NEMA	National Electrical Manufacturer's Association
NPT	National Pipe Threads
OSHA	Occupational Safety and Health Authority
PESO	Petroleum and Explosives Safety Organisation
PLC	Programmable Logic Controller

Code	Description
PWAMC	Post Warranty Annual Maintenance Contract
RTD	Resistance Temperature Detector
SAMA	Scientific Apparatus Maker's Association
SPD	Surge Protection Device
SPDT	Single Pole Double Throw
TFMS	Tank Farm Management System
<b>POMS</b>	<b>Pipeline Cum Oil Movement Storage</b>
<b>RMCR</b>	<b>Refinery Main Control Room</b>
<b>PMCR</b>	<b>Petrochemical Main Control Room</b>

## 2.2 CODES & STANDARDS / PUBLICATIONS

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

S.No.	Description	Standards / Codes
1	AGA-American Gas Association	
1.1	Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids- Part 1: General Equations and Uncertainty Guidelines	AGA Report No-3 Part-1
1.2	AGA Report No. 7, Measurement of Natural Gas by Turbine Meter	AGA Report No-7
1.3	AGA Report No-9, Measurement of Gas by Multipath Ultrasonic Meters	AGA Report No-9
2	ASME- American Society of Mechanical Engineers	
2.1	Pipe Threads General Purpose (Inch)	B 1.20.1
2.2	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/ Inch Standard	B 16.5
2.3	Metallic Gaskets for pipe Flanges- Ring Joint, Spiral- wound and Jacketed	B 16.20
2.4	Valves-Flanged, Threaded and Welding End	ASME B 16.34
2.5	ASME Boiler and Pressure Vessel Code (BPVC), Section VIII, Division 1: Rules for Construction of Pressure Vessels	ASME BPVC-VIII-1
2.6	Boiler and Pressure Vessel Code (BPVC), Section I: Rules for Construction of Power Boilers	ASME BPVC-I
2.7	Thermowells Performance Test Codes	<b>PTC 19.3 TW :2016</b>
2.8	Orifice Flanges	ASME B.16.36
3	ANSI/FCI-American National Standards Institute/Fluid Control Institute	
3.1	Control Valve Seat Leakage	FCI 70-2
4	API-American Petroleum Institute	
4.1	Part-I Sizing and Selection	API STD 520
	Part-II Installation	API RP 520
4.2	Guide for Pressure Relieving and Depressurising Systems- Petroleum Petrochemical and natural gas industries-Pressure relieving and Depressurising Systems	API STD 521
4.3	Flanged Steel Pressure Relief Valves	API STD 526
4.4	Seat Tightness of Pressure Relief Valves	API STD 527
4.5	Manual of Petroleum Measurement Standards	API MPMS
	Vocabulary	API MPMS 1-Vocabulary
	Proving Systems	API MPMS 4 Chapter-4

S.No.	Description	Standards / Codes
	Metering	API MPMS 5 Chapter-5
4.6	Process Measurement Instrumentation- Part I - Process Control and Instrumentation	API RP 551
4.7	Transmission Systems	API RP 552
4.8	Venting Atmosphere and Low Pressure Storage Tanks	API 2000
<b>4.9</b>	<b>Valve inspection &amp; tests</b>	<b>API 598</b>
5	BS-British Standards	
5.1	Multi-Element Metallic Cables Used in Analogue and Digital Communication and Control- Part 7: Sectional Specification for Instrumentation and Control Cables	BS EN 50288-7
6	EN-European Standards	
6.1	Metallic materials- Types of inspection documents	BS EN 10204:2004
7	IEC-International Electrotechnical Commission	
7.1	Explosive Atmosphere-Part 0: Equipment- General Requirements	IEC 60079-0 ED.6.0 2011
7.2	Electrical Insulation - Thermal Evaluation and Designation	IEC 60085
7.3	Tests on Electric and Optical Fiber Cables under Fire Conditions - Part 1-1: Test for Vertical Flame Propagation for a Single Insulated Wire or Cable-Apparatus	IEC 60332-1-1
7.4	Degree of protection provided by enclosures.(IP code)	IEC 60529 ED.2.1 B
7.5	Industrial Process Control Valves - Part 2-1: Flow Capacity - Sizing Equations for Fluid Flow Under Installed Conditions	IEC 60534-2-1
	Industrial Process Control Valves- Part 2: Flow Capacity - Section Three - Test Procedures	IEC 60534-2-3
	Industrial Process Control Valves - Part 2-4: Flow Capacity - Inherent Flow Characteristics and Rangeability	IEC 60534-2-4
	Industrial Process Control Valves - Part 2-5: Flow Capacity - Sizing Equations for Fluid Flow Through Multistage Control Valve with Interstage Recovery	IEC 60534-2-5
7.6	Thermocouple Tolerances	IEC 60584-2
7.7	Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors	IEC 60751
7.8	Electromagnetic Compatibility (EMC) - Part 4: Testing and Measurement Techniques Set (Contains 30 sections)	IEC 61000-4 SET
7.9	Industrial Communication Networks - Fieldbus Specifications - Part 1: Overview and Guidance for the IEC 61158 and IEC 61784 series	IEC/TR 61158-1 Ed 3.0
	Industrial Communication Networks - Fieldbus Specifications - Part 2: Physical Layer Specification and Service Definition	IEC 61158-2 Ed 5.0
8	IS-Indian Standard	
8.1	Specification of Thermal Evaluation and Classification of Electrical Insulation	IS-1271
8.2	PVC insulated (heavy duty) electric cables working Part I -voltage up to and including 1100V	IS-1554
8.3	Specification for pressure and vacuum gauges	IS-3624

S.No.	Description	Standards / Codes
8.4	PVC insulation and sheath of electric cables.	IS-5831
8.5	Specifications for Thermocouples	IS-7358
8.6	Thermocouple compensating cables.	IS-8784
9	ISA-International Society of Automation.	
9.1	Binary logic diagrams for process operations	ISA 5.2 (1976) (R1992)
9.2	ISA 7.0.01 Quality Standard for Instrument Air	ISA 7.0.01
9.3	Standards related to control valves	S-75.xx
10	ISO - International Organisation for Standardization	
10.1	Measurement of Fluid Flow by Means of Pressure Differential Devices - Part 1: Orifice Plates, Nozzles and Venturi Tubes Inserted in Circular Cross-Section Conduits Running Full	ISO 5167-1
10.2	Measurement of Fluid Flow in Circular Cross-Section Conduits Running Full Using Pressure Differential Devices - Part 2: Orifice Plates	ISO 5167-2
10.3	Measurement of Fluid Flow in Circular Cross-Section Conduits Running Full Using Pressure Differential Devices - Part 3: Nozzles and Venturi Nozzles	ISO 5167-3
10.4	Measurement of Fluid Flow in Circular Cross-Section Conduits Running Full Using Pressure Differential Devices - Part 4: Venturitube	ISO 5167-4
<b>10.5</b>	<b>Industrial valves – Measurement, test and qualification procedures for fugitive emissions</b>	<b>ISO 15848</b>
11	Enclosures for Industrial control and systems.	ICS-6
12	NFPA-National Fire Protection Association	
12.1	Purged and pressurized enclosures for electrical equipment.	NFPA-496

### 3.0 GENERAL / DESIGN CONSIDERATIONS

S.No.	Description
1	All instruments and equipments shall be suitable for use for specified site climatic conditions and industrial environment in which corrosive gases and/or chemicals may be present. As a minimum, all instruments and enclosures in field shall be dust proof and weatherproof to IP-65 as per IEC-60529 or equivalent NEMA enclosure rating or better and secure against the ingress of fumes, dampness, insects and vermin. All external surfaces shall be suitably treated to provide protection against corrosive plant atmosphere.
2	In case of contradiction between licensor specification and this Design basis, this design basis shall prevail unless licensor requirements are stringent. In case, job specification categorically identifies requirement, which is in contradiction to this document, job specification will prevail.
3	The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4 "Electromagnetic compatibility for Industrial Process measurement and Control equipment".
4	All electrical/electronic instruments used in hazardous area shall have statutory certification from the country of origin. Additionally these instruments shall be certified by CCE/PESO/DGMS as applicable, whenever installed in India. Instruments shall be certified by CCE/PESO. Also indigenous flameproof equipment shall comply with BIS requirement. CCE number shall be marked either by raised lettering cast integrally on the body of the instrument or on the nameplate attached to the instrument.

S.No.	Description
5	Material of construction and end connection rating shall be as per piping material specification as a minimum except for thermowells for temperature elements / temperature gauges wherein min. Class 300 rating and SS 316 material of construction shall be used. For control valves and On-Off valves minimum Class 300 rating flange shall be used.
6	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 authorised representative.
7	Prefabricated FRP canopy shall be used for field instruments.
8	For Instrumentation Electrical interface, input and output contacts as well as different voltage level signals (i.e 110V DC, 110 VAC/220 VAC, 24 V DC, 4-20 mA) shall be in separate multicables.
9	All instruments in sour service shall meet NACE MR 0103 requirement wherever required as per licensor specification/ piping material.
10	Threaded end connections shall be to NPT as per ASME B 1.20.1. Flanged end connections shall be as per ASME B 16.5. Orifice flanges shall be as per ASME B 16.36.
11	Redundancy Philosophy for DCS: a) Controller : Redundant ( 1:1 redundancy) b) Data Acquisition(I/O cards): Redundant if Control/Interlock application ( 1:1 redundancy). Non-redundant if no control/ interlock application. AI card Limited to 16 channels & DI card Limited to 32 channels, and universal I/O cards limited to maximum 32 channels. c) Communication subsystem: Redundant ( 1:1 redundancy), including FO Cables. d) Power supply subsystem: Redundant (1:1 redundancy). e) System Server(For server based DCS): Redundant ( 1:1 redundancy). f) FF H1 cards: Redundant ( 1:1 redundancy). h) FF power supply: Redundant ( 1:1 redundancy). i) Wireless Gateway: Redundant.
12	Motor trip contact shall be NO Type for all motors irrespective of motor rating.

### 3.1 CONTROL PHILOSOPHY

#### 3.1.1 TYPE OF PLANT

S.No.	Description	EIL Choice	Remarks
1	Grassroot	YES	
2	Expansion		
3	Other		

#### 3.1.2 MODE OF PLANT OPERATION

S.No.	Description	EIL Choice	Remarks
1	Centralised		
1.1	For all process units a) Refinery Units b) Petro chemical Units	YES	a) RMCR & b) PMCR

S.No.	Description	EIL Choice	Remarks
1.2	<b>For Offsites</b> <b>a) Refinery Tankages ( TF-1 TO 5 ,8-19)&amp; Blending</b> <b>b)TF-20, 23, 24, 25, 26</b> <b>c) TF-21, 22,27, 28,29,30 Spheres &amp; BOG Compressor, Bullets, VRU-1,2,3</b> <b>d)Flare</b>	YES	a) POMS control room, b) POMS control room, c) POMS Control room d) RMCR
1.3	<b>For utilities</b> <b>a) CT-1, CT-5,CT-6,Air &amp; Nitrogen, Fire Water</b> <b>b)CT-2, CT-3</b> <b>c) CT-4</b>	YES	a) RMCR, b) PMCR, c) CPPControl room
1.4	For Power Plant	NO	
2	Dedicated		
2.1	For each process unit	NO	
2.2	For Power Plant	YES	CPP Control Room
2.3	<b>For utilities</b> <b>a) RWTP</b> <b>b) RODM CPU, ETP</b>	<b>YES</b>	<b>a) SRR#14, b) SRR#6</b>
2.4	For Offsites a) For Loading unloading b) Pipeline Receipt Terminal , Blending c) Gas Receipt Terminal d) Tank Farms	YES	<b>a) Loading unloading control room. b,c &amp; d) POMS,</b>
2.5	Polymer Bagging & Pelletizing	YES	Product warehouse

### 3.1.3 CONTROL ROOM/SATELLITE RACK ROOM REQUIREMENT

S.No.	Control Room/ SRR	Process/ Utility Units	Floor Location	Remarks
1A	RMCR	Main Control Room (Refinery)	Ground	Below stated Process units.Offsites & Utilities
1B	RMCR(Rack)	<b>TF-21,22, BOG Compressor/ vaporiser, Mounded bullets, (C3/C4 feed, offspec propylene/Butene-1, H2)</b>	Ground	<b>POMS control room(Pipeline cum Oil Movement storage)</b>
2D	PMCR	CT-2(Cracker)	Ground	PMCR
2A	PMCR	Main Control Room (Petrochem)	Ground	Below Listed Unit
2C	PMCR	Air & N2	Ground	<b>Racks in PMCR, Operations from RMCR</b>
2B	RMCR(Rack)	CT-1 (Ref.)	Ground	RMCR
3	SRR#1	CDU/VDU, SAT LPG TU, Saturated FGTU.	Ground	RMCR
4	SRR#2	VGO-HDT, Refinery Off Gas PSA	Ground	RMCR

S.No.	Control Room/ SRR	Process/ Utility Units	Floor Location	Remarks
5	<b>SRR#3, LCR(for coke yard)</b>	DCU, Unsaturated LPG Treating Unit, Coke yard	Ground	<b>RMCR, LCR for Coke yard for control.</b>
6	SRR#4	PPU Train-1 & Train-2.	Ground	PMCR
7	<b>SRR#5, LCR(for Sulphur pelletization, conveying and SILO Unloading)</b>	<b>-SRU, ARU, SWS TGTU, CT-5, Sulphur pelletization, conveying and SILO Unloading</b>	Ground	<b>RMCR, LCR</b>
8	SRR#6	RODM, CPU, ETP	Ground	RMCR
9A	<b>PMCR</b>	CT-3 (Polymer)	Ground	PMCR for CT-3
9B	SRR#7	-CT-4 (CPP)	Ground	CPP Control Room
9C	SRR#7	<b>TF-14, 23 to 26, MS Blending,TF-27-29, Spheres , VRU Near Unloading control room</b>	Ground	POMS control room
10	SRR#8	<b>TF-4,5,8 to 13, 15 -20, 30, Crude Blending, VRU</b>	Ground	POMS Control room
11	<b>SRR#9A  SRR#9B</b>	<b>DFCU, Ethylene recovery unit (SRR#9A), Pygas HDT, BTX, Butadine CH4, Spent Catalyst (SRR#9B)</b>	Ground	PMCR
12	SRR#10	<b>MS Block (NHT/ISOM/SRR/PFCC Gasoline HDT)</b>	Ground	RMCR
13	SRR#11	DHDT, HGU	Ground	RMCR
14	SRR#12	PFCC +PRU	Ground	RMCR
15	SRR#13	LLDPE/HDPE swing train 1 & 2, Butene-1	Ground	PMCR
16	SRR#14	RWTP, flare, Firewater	Ground	<b>RMCR (for Flare and Fire water)</b>
17	CPP CR	CPP	Ground	CPP Control room
18	POMS Control Room	<b>-Pipeline receipt terminal -Gas receipt terminal TF- 1,2,3</b>	Ground	POMS
19	Loading Unloading control room	Loading & unloading control room		
20	<b>PMCR</b>	<b>CT-6</b>	<b>Ground</b>	<b>Racks in PMCR, Operations from RMCR</b>
21	<b>PP Bagging Room</b>	<b>PP Bagging</b>	<b>Ground</b>	<b>PP Bagging Room</b>
22	<b>LLDPE/HDPE Bagging Room</b>	<b>LLDPE/Bagging</b>	<b>Ground</b>	<b>LLDPE Bagging Control Room</b>
23	<b>LLDPE/HDPE Extruder Room</b>	<b>Extruder</b>	<b>Ground</b>	<b>Extruder Control room</b>
24	<b>PP Extruder Room</b>	<b>Extruder</b>	<b>Ground</b>	<b>PP Extruder Room</b>

### 3.1.4 FLOORING REQUIREMENT IN INSTRUMENT ROOMS

S.No.	Rooms of SRR/ Control Room	Flooring Type (shall be as per Architecture)	Cable Routing inside C/R	Remarks
1	<b>Rack Room in SRR (Process units)</b>	Cable Cellar	All cables within cable cellar shall be routed through Cable Ducts / Trays. Parallel running of Low Voltage Communication cable and Power cable to be avoided.	Cable entry shall be through MCT.
2	<b>Rack Room in RMCR, PMCR, POMS, SRR#6, SRR#14</b>	False Flooring	Through Tray	Cable entry shall be through MCT.
3	Engineering Room	Solid Floor	Trench	All the cables shall be laid inside the trenches.
4	Console Room	Solid floor	Trench	All the cables shall be laid inside the trenches.

### 3.1.5 TYPE OF CONTROL AND MONITORING

S.No.	Description	Units	Remarks
1	Centralised	YES	
1.1	Distributed Control System	<b>All Process Units, Air &amp; N2, cooling Tower, flare, fire water and offsite</b>	
1.2	Control panel with Micro-processor based Instruments		
2	Dedicated		
2.1	Distributed Control System	<b>CPP</b>	
2.2	Programmable Logic Controller	<b>a) RWTP b) RODM CPU, c) ETP</b>	
3	Local Panel Control System		
3.1	Microprocessor based/PLC		For Packages, like PSA, Bagging etc. (To be finalized during detailed engineering.)
3.2	Pneumatic		
3.3	Hydraulic		

### 3.1.6 INTERLOCK AND SHUT-DOWN SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Logic Representation		

S.No.	Description	EIL Choice	Remarks
1.1	As per ISA	YES	
1.2	As per actual electronics		
1.3	Other		
2	Interlock Execution		
2.1	Independent of Shutdown System		
2.1.1	With DCS	YES	Only for dryer sequence & as per licensors requirement
2.1.2	Dedicated		
2.2	With Shutdown system	YES	
3	Shutdown System		
3.1	Dedicated unit wise	YES	
3.2	Common for all units		
3.3	Type of hardware		
3.3.1	PLC	YES	
3.3.2	Relay		
4	PLC Configuration for shutdown		
4.1	Dual Modular Redundant	NO	
4.2	Triple Modular Redundant	YES	Note 2(iv)
4.3	Quad	YES	Note 2(iv)
5	SIL3 Classification	YES	Note-1
6	Process Bypass Switch (As per P&ID)	YES	Note 2(i)
7	ESD Switch location (As per P&ID)	YES	Note 2(ii),(iii)
8	PLC scan time		250 msec

Note-1:- PLC configuration shall be TMR or Quad, SIL-3 certified for process units and its associated package units and offsites as per IEC 61508. SIL validation/ evaluation for critical loops shall be considered as per licensor / process requirement.

Note-2:-

- (i) Soft type with common hard wired key in aux. console .
- (ii) ESD switch shall be located in field or control room. As per P&ID.
- (iii) ESD switch shall be pull type or with mushroom head. As per P&ID.
- (iv) redundancy shall be achieved using separate cards/modules.

### 3.1.7 LOCAL PANEL REQUIREMENT

S.No.	Description	EIL Choice	Remarks
1	Location		
1.1	Hazardous Area	YES	As per Area classification
1.2	Non Hazardous Area	YES	as per Area classification
2	Type		
2.1	Weatherproof	YES	Note-3
2.2	Flame-proof	NO	
2.3	Purged	YES	Note-3
3	Instruments Type		
3.1	Pneumatic		
3.2	Electronic	YES	

Note-3:-

- (i) In general, the local control panel shall be weatherproof with explosion-proof / flame-proof (EExd) JB, push-buttons, selector switches, lamps etc. and Intrinsically safe HMI & Alarm annunciator in hazardous area.
  
- (ii) All local panels shall be SS-316 with FRP canopy.

### 3.2 PACKAGE UNITS PHILOSOPHY

#### 3.2.1 OPERATING PHILOSOPHY

S.No.	Package Description	Control & Monitoring-Centralized DCS	Control & Monitoring-Dedicated PLC in CR	Control & Monitoring-Dedicated PLC in Local Panel	Interlock & Shutdown-Centralised PLC	Interlock & Shutdown-Dedicated PLC in CR	Interlock & Shutdown-Dedicated PLC in Local Panel	Remarks
<b>19</b>	<b>TUD/BUD</b>							
1	Compressor Packages	YES			YES			
2	Extruder packages			YES			YES	PLC in Extruder Control room
3	Pneumatic Conveying		YES			YES		PLC in SRR
4	Bagging and Palletizing			YES			YES	PLC in Product Warehouse
5	Membrane unit		YES			YES		PLC in SRR
6	PSA		YES			YES		
7	Other Packages	YES			YES			
8	Feed Filter with autoback wash		YES			<b>YES</b>		
9	CDSP		YES			<b>YES</b>		
10	Refrigeration Package		YES			<b>YES</b>		
11	Decoke air compressor			YES			YES	
12	Thermal Oxidation Package		YES			<b>YES</b>		
13	<b>a) Air Dryer b) LP Air compressor</b>			YES			YES	
14	Sulphur Palletisation		YES			<b>YES</b>		
15	Oil Mist Lubricator			YES			YES	
<b>16</b>	<b>Soot Blower</b>		<b>Yes</b>			<b>Yes</b>		<b>PLC in SRR</b>

S.No.	Package Description	Control & Monitoring-Centralized DCS	Control & Monitoring-Dedicated PLC in CR	Control & Monitoring-Dedicated PLC in Local Panel	Interlock & Shutdown-Centralised PLC	Interlock & Shutdown-Dedicated PLC in CR	Interlock & Shutdown-Dedicated PLC in Local Panel	Remarks
17	RWTP		Yes			Yes		SRR#14
18	RODM CPU and ETP		Yes			Yes		SRR#6
19	Top heading/ unheading (TUD) and Bottom Heading/Undeading(BUD)		Yes			Yes		
20	Coke Cutting		Yes			Yes		

**Dedicated PLC for any Package if specified by Licensor to be considered.**

**For proprietary items like , Soot Blower, ClO2 dosing, VAR etc. or licensor specific requirements, Package vendor"s proven and standard PLC / Control System shall be used.**

**b. Wherever dedicated PLC is considered for packages, all signals shall be interfaced with DCS serially for monitoring purposes and mapped to DCS with dedicated graphics.**

### 3.2.2 PLC CONFIGURATION (FOR PACKAGE VENDOR SUPPLIED PLC)

S.No.	Description	EIL Choice	Remarks
1	Dual Processor, single I/O		
2	Redundant Processor, redundant I/O & Redundant Power Supply , Redundant Communication	YES	
3	Vendor"s standard	YES	For proprietary items like catalyst loading system & slide valves, Refrigeration
4	Others	YES	(DMR, TMR, QUAD SIL-3 PLC) Where SIL-3 Loops are applicable for corresponding Packages.

Note-4:- Package logic shall be implemented in unit DCS/PLC. However if package PLC is required, it shall be located in SRR/MCR/LCR.

### 3.2.3 ANTI SURGE CONTROLLER

S.No.	Description	EIL Choice	Remarks
1	Type		
1.1	Conventional Single loop Controller		
1.2	DCS		
1.3	Dedicated Special Controller	YES	With serial interface to DCS
1.4	PLC		
2	Location		
2.1	HWC in Control Room	YES	HMI in control room
2.2	Rack Room	YES	Note-5

Note-5:- Anti Surge Control Systems for Compressors shall be in SRR and control & operation shall be provided in operator consoles in control room. If any vendor provide integrated control for antisurge, speed governing, over speed, performance control the same is accepted.

### 3.2.4 MACHINE MONITORING SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Type		
1.1	Machine Monitoring System	YES	with hardwired connection to PLC for interlocks and serial link to DCS
2	Machine Monitoring System Monitors Location		
2.1	SRR/ Control Room	YES	Note-6
2.2	Field Local Panel	YES	Note-6
3	MMS Display Unit Location		
3.1	Local Panel	YES	

Note-6:- Location of MMS cabinet shall be based on distance of the equipment from SRR / control room. In case of distance limitation MMS Rack can be located in Field Local Control Panel.

### 3.2.5 LOCATION OF SPEED GOVERNOR

S.No.	Description	EIL Choice	Remarks
1	Control room (on hardwired console)	YES	
2	SRR	YES	
3	Local Panel(Only for general purpose turbine)		

Note-7:- HMI shall be in Control Room. Electronics shall be in SRR.

### 3.2.6 TYPE OF LOCAL PANEL

S.No.	Description	EIL Choice	Remarks
1	Weather proof to IP65	YES	
2	Purged, type-Z As per NFPA 496	NO	
3	Purged, type-X As per NFPA 496	YES	If it becomes unavoidable to install the local panel in Zone-1.
4	Components and terminals in flameproof box	YES	Push Buttons, Lamps, Selector Switches
5	Intrinsically Safe Alarm Annunciator	YES	If applicable
6	IS PC for display of loop powered indicators.	YES	

Note-8:- All components in Local panel shall be Exi or Exd. Panel shall be with SS316 body.

## 3.3 DCS REQUIREMENTS

### 3.3.1 OPERATOR CONSOLES

S.No.	Control Room	Units	Number of Operator Consoles	Number of display screens/ console
	RMCR	CT-6(PFCC+PRU)	in U&O Console	
	RMCR	DHDT, HGU	4 nos., 2 nos.	
17	POMS	Tank farm	4no	
1	RMCR	CDU/VDU, SAT LPG MEROX, LPG DEPROPANIZER, Saturated FGTU	5nos	
2	RMCR	MS Block (NHT/ISOM/CCR/PFCC Gasoline HDT)	5nos	
3	RMCR	PFCC + PRU	6nos	
4	RMCR	DCU, Unsaturated LPG Treating Unit, Coke yard	6nos	
5	RMCR	VGO-HDT, Refinery Off Gas PSA	4nos	
6	RMCR	SRU, ARU, SWS,	3nos.	

S.No.	Control Room	Units	Number of Operator Consoles	Number of display screens/ console
7	PMCR	Steam recovery unit, Ethylene recovery unit, Benzene recovery unit, Pygas HDT, BTX, Benzene recovery unit, pygas HDT, BTX	6nos(For Cracker+ PGH+C4H) 2 for ERU, 2 for BDEU and 2 for BTX	
8	PMCR	PPU Train 1 & 2	<b>4nos + 1 in Extruder Control room</b>	
9	PMCR	LLDPE/HDPE swing train 1 & 2, Butene-1	<b>6nos + 1 in Extruder Control room</b>	
10	RMCR	CT-1 (Refinery)	in U&O Console	
11	RMCR	CT-2 (Cracker)	U&O Console	
12	PMCR	CT-3 (Polymer)	in U&O Console	
13	CPP Control Room	CPP		
14	RMCR	CT-5 (SRU)	in U&O console	
15	RMCR	RWTP	1 no	
16	RMCR	RO DM CPU	1no	

Note-9:- The number of Operator Consoles specified is tentative and shall be firmed up based on Licensor / Client's requirements and shall be defined accordingly in the job specifications

### 3.3.2 CONSOLE CONFIGURATION

S.No.	Description	EIL Choice	Remarks
1	Console configuration		
1.1	Single		
1.2	Stacked (Dual)	YES	
2	Type of monitor		
2.1	LED (TFT LCD with backlit LED)	YES	
2.2	LCD		
3	Engineering functions from operator console	NO	

### 3.3.3 ENGINEERING CONSOLES

Number of consoles for each SRR/Control Room:

Note-10:- Number of consoles for each SRR/Control Room shall be decided during Detailed engineering.

### 3.3.4 ENGINEERING & OPERATIONAL DATABASE

S.No.	Description	EIL Choice	Remarks
1	Unitwise	YES	

S.No.	Description	EIL Choice	Remarks
2	Combined	YES	

### 3.3.5 ALARM INFORMATION MANAGEMENT SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Required	YES	

### 3.3.6 GIANT SCREEN REQUIREMENT

S.No.	Description	EIL Choice	Remarks
1	Giant Screen Required	Yes	
1.1	No. of Screens		Shall be finalised during detail engg.
1.2	Size		Shall be finalised during detail engg.
1.3	Location	RMCR / PMCR, CPP & POMS	Giant screen in RMCR and PMCR, Large video screen in others

### 3.3.7 SEQUENCE OF EVENT RECORDING

S.No.	Description	EIL Choice	Remarks
1	SER Functionality	YES	
2	Resolution		
2.1	PLC Scan Time	250 msec for SIL3 PLC	
2.2	1 millisecond		
2.3	Others		
3	Dedicated SER PC		

### 3.3.8 ADVANCED CONTROL FUNCTION REQUIREMENT

S.No.	Description	EIL Choice	Remarks
1	Advanced Process Control Functions.		
1.1	Through DCS		
1.2	Through Dedicated System	YES	As per licensor package

### 3.3.9 ASSET MANAGEMENT SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Required	YES	
1.1	Integrated with DCS and PLC	YES	
1.2	Dedicated through multiplexer	NO	

S.No.	Description	EIL Choice	Remarks
2	Dedicated Asset Management system PC	YES	

DCS and PLC shall be supplied with HART pass through cards, HART master/slave multiplexer shall not be used.(even for Package PLC).

### 3.3.10 DOCUMENTATION NODE

S.No.	Description	EIL Choice	Remarks
1	Required	YES	

DON shall be automatically updated after some period.

### 3.3.11 TRAINING KIT

S.No.	Description	EIL Choice	Remarks
1	Required	NO	
1.1	For DCS		
1.2	For PLC		

### 3.3.12 TRAINING SIMULATOR

S.No.	Description	EIL Choice	Remarks
1	Required	YES	

### 3.3.13 LOADING PHILOSOPHY

S.No.	Description	%	Remarks
1	Control Processor	50%	
2	Communication Processor / Bus	50%	
3	Maximum number of Nodes in the network	70% of the maximum capacity	

### 3.4 INSTRUMENTATION ON CONTROL ROOM PANEL / HARD-WIRED CONSOLE

S.No.	Type	Description	Remarks
1	Alarm Annunciator		
1.1	On panel/ Hanging Type/ On console	On Console	Soft configuration through DCS graphics. On Hardwired console as per P&ID.
1.2	First out sequence Required	YES	

S.No.	Type	Description	Remarks
2	Multi-point Temperature Indicator Required	NO	
3	Auto Manual Station On panel/on console	YES On Console	Soft configuration through DCS graphics. On Hardwired control as per P&ID.
4	Manual Loading Station On panel/on console	YES On Console	Soft configuration through DCS graphics. Hardwired as per P&ID.
5	Selector Switch On panel/on console	YES On Console	Soft configuration through DCS graphics. Hardwired as per P&ID.
6	Start/Stop, Push Button On panel/on console	Open/close On Console	Soft configuration through DCS graphics. Hardwired as per P&ID
7	Emergency Push (Pull) Button location On panel/on console	YES On hardwired Console	
7.1	Type Push Type With protective cover		
	Pull Type With mushroom head	YES	Note-11, 12
8	Process Bypass Switch/ Indication On panel/on console		Note-12. Process Bypass switch shall be on hardwired console as per Licensor /P&ID.

Start-up shut down operation and status lamps shall be on HWC as per the requirements of P&ID.

Note-11:- All ESD trip switches shall be pull to trip with protection cover.

Note-12:- If hardwired ESD switch is required as per P&ID then same shall be pull type with dual independent NC contact which will be ORed in PLC to prevent spurious trips due to loose contact. Start-up bypass and START/STOP operation shall be soft configured through DCS graphics. Emergency interlock bypass switches shall be soft configured with common MOS.

### 3.5 GENERAL

#### 3.5.1 TYPE OF POWER SUPPLY

S.No.	Type	Tolerance for Instruments	Back up time for UPS	Emergency Power Supply Requirement
1	110V AC UPS	110 VAC $\pm$ 10%, 50Hz $\pm$ 3Hz	As per Electrical Design Basis	As per Electrical Design Basis

### 3.5.2 POWER SUPPLY REQUIREMENT

For each of the items below, user shall select the power supply type from the choices available.

S.No.	Description	110 V AC 50Hz UPS	110 V DC	24V DC	110 V AC Non UPS	240V AC 50Hz (UPS)	240 V AC 50Hz (Non UPS)	415 V AC-3 phase	Remarks
1	Distributed Control system	YES							Dual feeder from UPS
2	Package Units	YES					YES		Non-UPS for lighting
3	Alarm Annunciator	YES							
4	PLC	YES							
5	Solenoid Valves			YES					110VAC UPS for distance >700 meter
6	Smart/ FF Positioners, I/P, Transmitters			YES					
7	I/P Interrogation Voltage			YES					
8	Gas Detectors			YES					
9	Analyzers and Analyzer System	YES		YES					
10	Chromatographs	YES							
11	Training Kit for DCS/PLC	YES							
12	Training Simulator for DCS	YES							
13	Level Gauge Illumination						YES		
14	Cabinets Fan						YES		Note-13
15	Cabinets Lighting						YES		Note-13
15.1	Control Room						YES		
15.2	Local Panel	YES					YES		Non-UPS power for light

S.No	Description	110 V AC 50Hz UPS	110 V DC	24V DC	110 V AC Non UPS	240V AC 50Hz (UPS)	240 V AC 50Hz (Non UPS)	415 V AC-3 phase	Remarks
16	CCTV	YES							
17	Analyzer Cabinet Air Conditioning						YES		IF APPLICABLE
19	UCP	YES					YES		Non-UPS for Lighting
18	Analyzer Shelter HVAC							YES	
20	server/CPU RACKS Air conditioning							yes	

Note-13:- 110V AC UPS shall be considered for DCS / ESD system cabinets and operating consoles lighting & fan. For DCS/ESD marshalling cabinets, 240 V AC Non-UPS supply shall be considered for cabinet lighting & fan.

24 V DC power supply will be derived from UPS using redundant bulk power supply.

All Non-DCS Loads shall be through Isolation Transformer only.

### 3.5.3 POWER SUPPLY DISTRIBUTION

S.No.	Description	EIL Choice	Remarks
1	Less than 1.5 kVA for field and 3KVA within control room/SRR	PDB in Rack room	
2	Greater than 1.5kVA for field and 3KVA for control room/SRR	UPS ACDB in UPS room	

PDB shall be separate for DCS and non-DCS loads.

### 3.5.4 CABLE ENTRY

S.No.	Description	EIL Choice	Remarks
1	Control Rooms	MCT Block	
2	Satellite Rack Rooms	MCT Block	
3	<b>Local control Rooms / Bagging / Extruder control room</b>	<b>MCT Block</b>	
4	Analyser Rooms / Shelter	MCT Block	

### 3.5.5 AIR SUPPLY AT BATTERY LIMIT

As per Process BDEP.

### 3.5.6 SIZE OF INSTRUMENT NOZZLES

As per Process BDEP Section 9

### 3.5.7 INSTALLATION / TUBING HOOK-UPS

S.No.	Description	EIL Choice	Remarks
1	Instrument Installation		
1.1	Close coupled	YES	For pressure Gauges and for other instruments where mandatorily recommended by Licensor
1.2	Remote	YES	(i) For DP Type Level and PDT (ii) For PT & DP Type FT - Services above ASME 600 class. - Services with maximum operating temp. above 325 Deg.C - Steam - Hydrogen (iii) For DP type FT pertaining to venturi, Flow Nozzle, D- D/2 Tapping, Meter Run. (iv) For Congealing services and corrosive services where diaphragm seal is used as per P&ID. (v) For Pressure Gauges: - Services with maximum operating temp. above 100 Deg C. - Reciprocating Pump discharge line where vibration is expected.
1.3	Pre-fabricated Hook Ups	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 and 2 valve manifold for PT) & 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 and pre-engineered ready for installation
2	Instrument impulse lines		
2.1	Piping Impulse Lines	YES	For Hydrogen service, Diaphragm seal, line rating above 600 class and mandatorily recommended by Licensor.
2.1.1	Instrument manifolds		

S.No.	Description	EIL Choice	Remarks
2.1.1.1	For PT/pressure gauges - Fabricated /integral	Fabricated	Note-14 (ii)
2.1.1.2	For flow DP transmitter - Fabricated /integral	Fabricated	Note-14 (ii)
2.1.2	Impulse Line Valves		
2.1.2.1	Isolation valves	Globe. For prefabricated hook-up It shall be Ball Valve.	Equalization valve shall also be Globe Type.
2.1.2.2	Vent/drain valves	Gate. For prefabricated hook-up it shall be Ball Valve.	
2.2	Signal and air supply tubing		
2.2.1	SS tubing(for inst air)	YES	Note-14
2.2.2	PVC Covered copper tubing(for inst air)		
2.2.3	Seal pot for steam and condensing vapour services	NO	
2.2.4	Main instrument air distribution		<b>Note- 14 (iii)</b>
2.2.4.1	CS		
2.2.4.2	SS	YES	
2.2.5	Instrument Air isolation valve for each instrument	BALL VALVE	
2.2.6	Instrument Air isolation valve for each instrument material	SS 316	
3	Air Supply Tubing		
3.1	Material		
3.1.1	SS 304		
3.1.2	SS 316		
3.1.3	SS 316L	YES	
3.1.4	Others		
3.2	Tube size		
3.2.1	1/4" OD with 1mm wall thickness		
3.2.2	<b>1/4" OD with 0.049" wall thickness</b>	YES	<b>1/2"OD with 0.049" wall thickness where valve requires higher size.</b>
3.2.3	Others		
4	Steam/Electrical Tracing		As per P&ID.
4.1	Tubing Material for Steam Tracing		
4.1.1	Bare Copper		
4.1.2	SS 316	YES	
4.1.3	Others		
4.2	Tube size	YES	

S.No.	Description	EIL Choice	Remarks
4.2.1	1/4" OD with 1mm wall thickness		
4.2.2	<b>3/8" OD with 0.049" wall thickness</b>	YES	
4.2.3	3/8" Tubing		
5	Impulse tubing		
5.1	Material		
5.1.1	SS 316		
5.1.2	SS 316L	YES (if applicable)	
5.2	Tube size		
5.2.1	<b>1/2" OD with 0.049" Wall Thickness</b>	YES (if applicable)	
5.2.2	Other		

**Note-14:-**

- (i) 1/4" tubing for instrument air. Depending upon valve air requirement, 1/2" tube may also be considered for large sized valves.
- (ii) Integral manifold shall not be used for high pressure application. Site fabricated manifold shall be used for high pressure and steam application. Integral manifold shall be minimum SS316 material.
- (iii) Instrument air header shall be minimum SS-316 and with SS-316 X-mas tree like distribution pots.
- (iv) Electrical tracing shall be used for instrument impulse line wherever indicated by Licensor or if the main process line is electrically traced. For other tracing requirement steam tracing shall be used.

**3.5.8 FIELD TRANSMITTER TYPE**

S.No.	Description	Conventional	Smart	Fieldbus	Wireless	Remarks
1	Open loops			YES	YES	
2	Close loops			YES		
3	For anti-surge loops		YES			As per Vendor's standard requirement.
4	For interlock/shut-down loops/ Safety system loops		YES			
5	Pump seal Instruments				YES	Wireless is preferred

**Note-15:-**

- a) FF for open loops and simple closed loops. HART for interlock/shutdown and complex loops
- b) For Offsites & Utilities wherever distances do not permit use of Fieldbus transmitters, SMART/Wireless type transmitters shall be used.
- d) Wireless HART/ ISA 100 will be considered for the following:  
- All open loop non critical TT, TT across exchanger/air cooler, battery limit open loop pressure and temperature transmitters, pump seal instruments, acoustic sensor to measure leak through PSV connected to flare and TSO valves connected to flare ,



S.No.	Description	Intrinsically Safe	Flame proof	Remarks
4	Solenoid valves	YES FOR 24VDC	Yes for 110VAC	<b>110V AC UPS for distance &gt;700m</b>
5	Positioners	YES		
6	Special instruments/ Analyzers etc.	YES	YES	As per manufacturer standard
7	Fieldbus Instrument			High Power Trunk Field barrier concept to be followed for Fieldbus loops.
7.1	IS(Entity Concept) with High Power Trunk	YES		
7.2	FISCO			As required as per Area Classification
7.3	FISCOIC/FNIICO			
8	Gas Detector		YES	

Note-16:- If Intrinsically safe item is not available for any instruments, then it must be Flame proof. MCC I/Os shall be non-intrinsically safe. FF Instruments/Transmitters shall be IS Ex ia only.

### 3.5.12 JUNCTION BOXES AND ACCESSORIES

S.No.	Description	Weather proof	Flame proof + Weather proof	Remarks
1	For IS Instruments	Yes		Note-17, 18
2	For flame proof instruments		YES	

Note-17:- All junction boxes shall have bottom cable entry. JB shall be of SS316/FRP for IS instruments. All junction boxes shall be with self locking type allen screws (SS 316 make) type fasteners and hinges. Junction boxes shall have tag numbers engraved on front cover with CCOE certificate nos.

Note-18:- Fieldbus Barriers Instruments in Zone 1, FF Junction boxes shall be IP 65, Ex e type of SS-316.

### 3.5.13 BARRIERS

S.No.	Description	EIL Choice	Remarks
1	Intrinsic Safety Barriers, with 3-port Isolating type	YES	

### 3.5.14 STACK ANALYZERS

S.No.	Description	EIL Choice	Remarks
1	Stack Monitoring System Required	YES	
1.1	Separate for each stack	YES	As per P&IDs
1.2	Common for all stacks	NO	

S.No.	Description	EIL Choice	Remarks
2	Sample Extraction		
2.1	Hot Extraction	YES	
2.2	Dilution Type	YES	
2.3	Types of Analyzer		
2.3.1	CO - NDIR	YES	Common analyser for CO, SO <sub>x</sub> , and NO <sub>x</sub>
2.3.2	SO <sub>x</sub> - NDIR	YES	
2.3.3	NO <sub>x</sub> - NDIR	YES	
2.3.4	SPM - Opacity	YES	
3	Analyser Shelter		
3.1	Required		Requirement of shelter or Panel will be decided during detail engineering
4	Shelter/Analyser Panel Location		As per area classification
4.1	Hazardous area		
4.2	Safe area		

Note-19:- Stack analyzers shall be in compliance with CPCB guidelines. Integrated cloud based CEMS connected to CPCB as per CPCB guidelines shall be considered for refinery & petrochem.

Stack analyser shall be flameproof type and mounted in SS cabinet without AC. Vortex Cooling System may be used for the panel. All electrical components and sample handling components shall be certified for hazardous area classification.

### 3.5.15 EARTHING SYSTEM

S.No.	Description	Earth Pit	Remarks
1	Panel Earth for Panels, racks, cabinets, consoles, shelters etc. with power $\geq$ 110 V	Dedicated connected to electrical earth pit through SPD/ Other	
2	Signal Earth	Separate signal earth pit	
3	SPD Earth	Separate safety earth pit	

DCS/ PLC console/ panel earthing as per DCS vendor/Package vendor recommendation.

### 3.5.16 TYPE OF CABLES

S.No.	Description	EIL Choice	Remarks
1	Flame retardant		
2	Flame retardant and low smoke	YES	
3	Flame retardant and Fire resistant	YES	Branch Cable for Fire Safe Valves with Fire safe Actuators
4	others		

### 3.5.17 UNITS OF MEASUREMENT

As per Process BEDB section 2.5

## 4.0 SPECIFIC DESIGN CONSIDERATIONS

### 4.1 TEMPERATURE INSTRUMENTS

#### 4.1.1 TEMPERATURE MEASUREMENT

S.No.	Description	EIL Choice	Remarks
1	Temperature gauges		
1.1	Bimetallic	YES	Refer Section 4.1.4 of this document.
1.2	Filled system	YES	Refer Section 4.1.4 of this document.
2	Thermowell flange rating		
2.1	Vessel Nozzle rating		
2.2	Minimum 300# rating	YES	
3	Thermocouple		
3.1	Type		
3.1.1	All K Types	YES	
3.1.2	K/E/T/S (as per range)		Other Type as per Process condition and Licensor Specification.
3.2	Element		
3.2.1	Simplex		
3.2.2	Duplex	YES	Note-20
3.3	Grounded		
3.4	Un-grounded	YES	
4	RTD (Pt-100) 3 wire element	YES	RTD are to be utilized as temperature element only for motor winding and bearing temperature.
4.1	Simplex		
4.2	Duplex	YES	
5	Temperature Transmitter		
5.1	Required	YES	For Open And closed loops
5.2	Location		
5.2.1	Head-mounted		
5.2.2	Remote-mounted	YES	
6	Multi input Temperature Transmitter	YES	

Note-20:- Associated transmitter shall be configured for dual redundant operation i.e. if sensor 'A' fails the measurement shall automatically switch to sensor 'B'.

#### 4.1.2 THERMOWELLS

S.No.	Project Philosophy
1	Thermowells and flanges shall be fabricated from bar-stock. Thermowells and flanges shall be minimum of 316 SS or better material to suit the service conditions.

S.No.	Project Philosophy
2	Immersion length of thermowells for different line sizes shall be as follows:- Line Size - Immersion length (U) 4" to 6" - 280 mm 8" to 20" - 320 mm Above 20" and Vessels/columns - 400 mm Unsupported Length may change suitably to meet the vibration analysis. Immersion length is based on 200 mm length in general between flange face and outer wall of pipe. However, the same may change to meet vibration analysis report. In vessels, where fouling with vessel internals is expected, the immersion length shall be suitably modified. However licensors standards / recommendation shall be followed as governing case for licensor units.
3	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 1000 mm).
4	Vendor to carryout vibration analysis of Thermowell as per ASME PTC 19.3 TW latest revision.
5	<b><i>Non- intrusive Clamp on type surface temperature measurement based on heat dissipation/thermal conductivity shall be used for open loop temperature transmitter where line size is less than 4".</i></b>
6	Velocity collar in thermo wells shall not be used, instead special type (for example twisted square type) may be used.
7	All the thermowells shall be offered for hydrotesting at site to PMC/OWNER before installation.

#### 4.1.3 THERMOCOUPLES/RTD

S.No.	Project Philosophy
1	Thermocouples elements shall be 18 AWG for simplex & 20 AWG for duplex.
2	Heater skin thermocouples shall generally be extraction type with sheath material SS446/416 upto 600 °C unless specified otherwise. All skin thermocouples shall be provided with heat shield assembly.
3.1	Temperature transmitters shall be provided for all temperature elements
3.2	Dual compartment type temperature transmitter shall be used.
3.3	RTD shall be with Class A accuracy.
4	RTD are to be utilized as temperature element for motor winding and bearing temperatures.
5	Furnace tube skin thermocouples shall be installed under supervision of OEM.  For Heater thermocouples, mineral insulated Inconel-600/ SS-446 sheath may be considered suitably.

#### 4.1.4 TEMPERATURE GAUGES

S.No.	Project Philosophy
1	All temperature gauges are to be bimetallic type in general upto operating temp. 350 °C. Case material shall be SS304. Filled type temperatures gauges are envisaged only for underground locations sump high temp.(above 350 °C),Vibration services,U length more than 500mm.Filled system if used shall be gas filled type.Mercury filled temperature gauge shall not be used.

#### 4.2 PRESSURE INSTRUMENTS

S.No.	Project Philosophy
1	Case material for pressure gauges shall be SS304. All pressure gauges with ranges more than 0 to 60 kg/cm <sup>2</sup> g shall have safety type, solid front case. Dial size for gauges shall be 150 mm. Pressure gauges shall have over range protection up to 1.3 times maximum pressure scale with out any calibration drift. Instruments which can be exposed to vacuum shall have under range protection.
2	Diaphragm seal element with capillary shall be used for toxic, congealing, corrosive and highly viscous services. Diaphragm / flange material shall be as per process requirement, but SS316 is to be considered as minimum. On pulsating services glycerine filled gauges or pulsation dampers shall be installed.
3	Remote surface mounting pressure gauges shall be considered for services of higher operating temperature $\geq 120^{\circ}\text{C}$
4	All transmitters shall have an integral output meter with LCD/LED display. Remote mounted meters may be provided for specific applications as per P&IDs.
5	All pressure and differential pressure transmitter shall have less than or equal to 0.2% stability for 10 years.
6	Remote sensor type DP instrument shall be used for level and DP measurement greater than 5 meters.
7	Diaphragm seal instruments in high temperature rating shall be direct mounted with filled fluid thermal range expander.
8	Mini syphon shall be considered for pressure gauges in steam service.
9	Diaphragm seal D/P Level transmitters wherever used shall have 3" ANSI RF process connection with minimum 300# rating. Process tapping shall also be 3" flange.

### 4.3 LEVEL INSTRUMENTS

#### 4.3.1 LEVEL MEASUREMENT

S.No.	Description	EIL Choice	Remarks
1	Level Stand-pipe philosophy		
1.1	As per EIL standard		
1.2	Licensor Requirement	YES	For Licensed Unit
2	Tank Level Gauging		As per P&IDs
2.1	Servo		
2.2	Mechanical Float or DP type		
2.3	Hydrostatic		
2.4	Radar	YES	
3	Tank Farm Management System(TFMS)	YES	
3.1	Dedicated Tank Farm Management (with Serial Communication to DCS)	Yes	
3.2	With DCS		
3.3	Redundancy Required for communication to DCS	Yes	

S.No.	Description	EIL Choice	Remarks
3.4	No. of display screens (HMI) for TFMS (dedicated)		As per Detailed engineering
3.5	TFMS HMI Display Location		
3.5.1	Control room		
3.5.2	Satellite room		

#### 4.3.2 LEVEL GAUGES

S.No.	Project Philosophy
1	Preferably all level gauges shall be Magnetic type .However if required or absolutely necessary gauge glasses shall be steel armoured reflex or transparent type.
2	Protective shields shall be used on gauge glasses depending on service e.g. in steam condensate and caustic services. Frost shields shall be used if the operating temperature is below 0 °C. For high pressure & corrosive application automatic shutoff arrangement like ball check valve etc to be used such that the level gauges is automatically isolated in case gauge glass breaks.
3	All level gauges shall be provided with vent/drain valves with plug or connected to closed drain/vent in H2S service or as required by licensor.

#### 4.3.3 LEVEL TRANSMITTER

S.No.	Project Philosophy
1	Generally Guided Wave Radar type instruments shall be used for level measurement up to 2700 mm and in interface level measurement. Differential pressure transmitter shall be used for level measurement above 2700 mm and for services requiring purge or where liquid might boil in external portion. Internal displacer type of level transmitters shall be avoided unless application necessitates its use.
2	Displacer type of level instruments shall be used for interface applications and where guided wave radar type level instruments are not suitable.All displacer type of level transmitters shall be of torque tube material of inconel,as a minimum.
3	Non Contact Radar type level transmitters may be used on corrosive, congealing, slurry services. Remote sensor type differential pressure transmitter based on digital calculation shall be used for congealing, corrosive, high viscosity service, in cases of very long impulse lines and wherever solid/catalyst may come in impulse lines for level measurement beyond 2700 mm.
4	For sump levels, Guided wave radar or non- contact type radar level instrument shall be used depending on the application within accuracy $\pm 5$ mm

#### 4.3.4 LEVEL STANDPIPE PHILOSOPHY

S.No.	Project Philosophy
1	Maximum number of nozzles on the standpipe shall be limited as follows:
1.1	To 8 with no displacer type/ guided wave radar type level instrument on it.
1.2	To 6 with displacer type/ guided wave radar type level instrument on it.
2	Multiple Level Gauges shall be used for centre to centre length for more than 1480mm for transparent and reflux type.
3	Separate standpipe shall be used for boot interface level measurement in addition to standpipe for the horizontal vessel.

S.No.	Project Philosophy
4	ESD instruments shall have independent tapping directly from vessel.

#### 4.3.5 LEVEL SWITCHES

Wherever applicable

S.No.	Project Philosophy
1	Level transmitter shall be used instead of level switches.
2	Vibration Fork Type Level Switches may be used for Catalyst services and Tank high level detection application.

#### 4.4 FLOW INSTRUMENTS

##### 4.4.1 FLOW MEASUREMENT

As per Process BEDB Section 9.4.2

##### 4.4.2 TYPES OF TAPS FOR ORIFICE

S.No.	Description	EIL Choice	Remarks
1	Flange (2" and above)	YES	Below 2" - Meter Run
2	D-D/2 (for > 14", rating upto 300#)	YES	
3	D-D/2 (for > equal to 14" & rating 600# and above)	YES	
4	2 1/2 - 8D		

##### 4.4.3 PRIMARY DEVICES

S.No.	Project Philosophy
1	Orifice, Flow nozzles and Venturi shall be designed in accordance with ISO 5167 latest edition. The ratio of the orifice bore to inside pipe diameter ( $B=d/D$ ) shall be between the limits as laid down by ISO 5167.
2	The primary element shall generally be thin plate, square-edge concentric orifices plate mounted between a pair of weld-neck type orifice flanges with flange taps. The minimum pressure rating of flanges shall be 300 lb ANSI. Wherever D-D/2 taps are required, the ratings of the orifice flanges shall be as per piping specification. Process tapping shall be flange tapping as per ISO5167
3	Eccentric and Segmental type of orifice plates shall be used for specific applications.
4	Quadrant edge or conical entrance orifice plates shall be used for services with low Reynolds number.
5	Vent and Drain holes shall be provided wherever necessary. The orifice assembly shall be provided with jack screw for removal of orifice plate
6	In case sufficient upstream/downstream length is not available; multi-bore orifice element may be considered.
7	Multivariable vortex flowmeter shall be used for steam flow measurement. Thermal mass flow meter to be used for stack flue gas measurement.

S.No.	Project Philosophy
8	0.75" tap shall be considered for high viscous fluid; flange rating shall be considered as 300# or more for the same to maintain the sufficient strength in the flange after tapping. Instrument tapping connections shall be 1/2"NPT (F) up to 600# pressure rating. For corrosive and congealing service or for services above 600#; instrument tapping connections shall be 3/4". Maximum schedule of impulse pipes and associated fittings to be used in general is schedule 160.
9	<b>All flowmeters shall be minimum 300# rating (body and flange)</b>

## 4.5 CONTROL VALVES

### 4.5.1 GENERAL

S.No.	Project Philosophy
1	Control valves 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.
2	Ball valves shall be considered for services where solids in suspension, high rangeability, low pressure drops, and tight shut-off are required.
3	Butterfly valves shall be considered for services where solids in suspension, low pressure drops and high capacities are required.
4	Angle valves shall be considered for services where flashing, coking, solids in suspension or very large pressure drops are encountered.
5	Bellows Seal type valve shall be used for H2S service or H2 service or wherever specified by licensor.
6	For high temperature application control valves suitable precautions shall be taken in datasheet for gland packing and materials.
7	Type of control valve indicated in licensor document/P&ID shall be followed.
8	Control valve sizing shall be as per ISA 75.01.01
9	Control valves shall be provided with extended bonnet cooling for services with temperature above 200° C. In case, manufacture design calls for extended bonnet at lower temperature, the same shall be considered by manufacturer.
10	Gland packing shall be of high performance / low emission type. Fugitive emission packing shall be provided for all valves in carcinogenic, toxic and amine services. The packing material shall comply to ISO 15848 standard or equivalent.
11	<b>Control valve in congealing service shall be eccentric rotary plug type valve for sizes upto 8". For greater than 8" high performance butterfly or V notch type ball valve design both are acceptable.</b>
12	Control valve shall be with Contact Less positioner (linkage less positioner is also acceptable) except in utility, boot drain and battery limit service.
13	Damper and valves in PSA shall be with linkage less positioner.
14	Cage guided valve shall be avoided in dirty and congealing services.
15	For low differential pressure application (<0.5Kg/cm <sup>2</sup> ) flow control valve, valve design shall be "vendor to decide" between globe and butterfly type.

### 4.5.2 CONTROL VALVE RATING

As per Process BEDB Section 9.8.3

#### 4.5.3 TRIM DESIGNS

S.No.	Project Philosophy
1	For pressure drop upto 10 kg/cm <sup>2</sup> material used for Trim shall be minimum 316 SS Stellite, with guide of hardened stainless steel like 440 C, 17-4 PH. For higher pressure drops or erosive and slurry services and in general for all steam services, hard facing of plug, seal rings and sealing area of inner valve with stellite shall be used.
2	Special cases may require 17-4 PH seat ring and 440 C solid plugs or other materials like Hastelloy, Monel etc.

All Control and ON-OFF valve trim shall be stellite minimum except for leakage class VI valve and for cavitation cases. AFR and its mounting plate shall be minimum SS316. All control valves and on-off valves connected to flare line shall be TSO; i.e. leakage class VI. Except for Metal seated valves required in high pressure and temperature application

#### 4.5.4 ON-OFF VALVE

S.No.	Description	EIL Choice	Remarks
1	Type	Butterfly/Ball	Note-21

Note-21:- Up to 6", valve shall be Ball type whereas for 8" and above Triple offset Butterfly design can be considered. Minimum rating shall be 300#. scotch yoke type actuator shall be used. This philosophy is only for Hydrocarbon lines and is not applicable for utility services.

#### 4.5.5 SOLENOID VALVES

S.No.	Project Philosophy
1	Solenoid valves body material shall be SS 316.
2	Solenoid valves insulation class shall be H.
3	Vent port of all solenoid valves are to be provided with SS/ Brass bug screens, to prevent blockage of port because of bugs and to save the port from dust.

#### 4.5.6 LIMIT SWITCHES

S.No.	Project Philosophy
1	Limit switches shall be generally proximity type (intrinsically safe). Instead of Proximity switches, restrictive dry magnetic proximity Switches can be used for high temp, for high vibration & corrosive atmosphere with hermetically sealed

#### 4.6 PRESSURE RELIEF DEVICES

S.No.	Project Philosophy
1	Generally spring operated pressure relief valves may be used. Pilot operated relief valves may be used for special services and where set pressure is closer to the operating pressure by 10% of the set pressure and back pressure is more than 50% of the set pressure or as specified by Licensor.
2	Bellows type shall be used where back pressure is more than 10% of the set pressure and less than 50%

#### 4.7 ELECTRICAL FIELD WIRING

S.No.	Project Philosophy
1	Instrument electronic signal & alarm cables single pair shall be 1.5 mm <sup>2</sup> and multipair shall be 1.5 mm <sup>2</sup> twisted in pair individually and overall shielded with aluminium Mylar tape with drain wire and armoured. Larger conductors may be selected when required to reduce voltage drop.
2	Control wiring for actuating devices and solenoid valves of the interlock and shutdown system shall generally be 1.5 mm <sup>2</sup> armoured cable. Control cable shall be twisted pair, individually shielded.
3	Multicore extension cables for Thermocouples, wherever applicable, shall be 20 AWG single conductor twisted pairs, armoured, individual pair and overall aluminium mylar shielded with over all drain wire. Single pair extension cables shall be armoured cable with 16 AWG single conductor wire.
4	Power supply cables to field instruments shall be minimum 2.5 mm <sup>2</sup> armoured.
5	All cable glands shall be of Stainless Steel and they shall be of double compression type suitable for armoured cables. Instrumentation Cable entry inside cabinet located in Control room/SRR/ Sub Station shall be via MCT.
6	Slipper type PVC sleeves (cable shrouds) shall be used over cable glands for all cable entries in junction boxes.
7	For longer distances, conductor sizes shall be selected based on voltage drop.
8	Cables used for Foundation Fieldbus shall be suitable for specified application.
9	Overall quantity tolerance for each item shall be +0% to -4%. Quantity tolerance for each drum shall be +0% to -8%. Positive quantity tolerance is not acceptable/payable.
10	FO cable shall be double armored type. HDPE conduit are not required. All FO cable shall be single mode type only.
11	Primary insulation material for all instrumentation cables shall be XLPE.

Note-22:- Instrument Signal /Control Cable/Power Cable/FO Cable:

- All types of field cables such as FF, analog signal, Fiber optics, power and control including field exposed Ethernet (Cat 5/cat 6) cables shall be armored cable.
- Cat 5/Cat 6 system cables and patch cords inside panels shall be pre-fabricated (factory fitted RJ45 Jack) F/UTP cables.
- Water swellable tapes shall be provided between outer sheath and metal armor for all field cables.
- Armor for FO, signal cable, power and control cable shall be "Galvanized Steel Round wire".
- All instrument cables shall be FRLS type except for Branch cable for fire safe valves which shall be Fire Resistant
- Both Signal Cables and Control Cables shall be twisted pair (10 to 12 twists per meter) individually and overall shielded.

Foundation Fieldbus Cable:

- FF cable shall be individually and overall Foil Shielded with Armor type as "copolymer coated, corrugated, overlapped steel tape" with more than 90% coverage.
- Fieldbus cabling shall be in accordance with the requirements of IEC 61158-2, paragraph 22.2.2, "Type A".
- FF Cable shall have Polyolefin insulation with twisted pair ( min 15 twists per meter)

#### 4.8 CABLE TRAYS AND CABLE DUCTS

S.No.	Project Philosophy
1	All cables on the main pipe rack shall be laid in cable duct fabricated out of FRP.
2	All branch cables shall be run on cable trays.Cable trays shall be made of FRP material with SS316 nut/bolt etc

S.No.	Project Philosophy
3	<b><i>Cable duct within process units shall be fireproof type. Fire proofing of instrument cable duct shall be considered which will reduce safety hazard due to loosening of aluminum top cover over a period and improve the installation time.</i></b>
4	FRP Ducts/Trays shall be Antistatic with Resistivity < 10 <sup>9</sup> as per ASTM D257, to prevent fire in case of static charge created due to rubbing of 2 insulated materials.

#### 4.9 AIR FILTER REGULATOR

S.No.	Description	EIL Choice	Remarks
1	Filter Size	5 microns Max.	

#### 4.10 CANOPY

S.No.	Description	EIL Choice	Remarks
1	Material		
1.1	FRP	YES	Pre-fabricated FRP.
1.2	GPR		
1.3	MS		
2	Canopy to be provided for :-		
2.1	Transmitter	YES	
2.2	JB's	YES	
2.3	Temperature Elements	YES	
2.4	Local Panels	YES	
2.5	Positioner	YES	
2.6	<b><i>Analysers</i></b>	<b><i>YES</i></b>	

#### 4.11 DESUPERHEATER

As per Process BEDB

#### 4.12 TEST /LAB EQUIPMENT

S.No.	Description	EIL Choice	Remarks
1	Required	NO	

Calibration test bench reqd.Quantity and further detailing to be done during detail engineering.

#### 4.13 CCTV SYSTEM

S.No.	Description	EIL Choice	Remarks
1			
1.1	For Process units	YES	
1.2	Flare	YES	
1.3	Plant surveillance	YES	

S.No.	Description	EIL Choice	Remarks
2	Monitor		
2.1	Location		Location, Number and type shall be finalised during detail engg.
2.2	Number		
2.3	Type		
3	Recording facility Required		
3.1	All cameras	YES	
3.2	Selective Number of points		

integrated CCTV system with plant periphery intrusion detection system with all other gate security system shall also be considered.

Mobile CCTV station is required, which can be mounted on security vehicle and shall be connected to CCTV server for monitoring.

#### 4.14 FIRE AND GAS DETECTION (F & G) SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Gas Detectors Required	YES	Gas detectors shall be Infrared (IR) type & open path for hydrocarbons and catalytic combustion/ metal oxide semiconductor type with IS protection for hydrogen and toxic gas respectively shall be considered.  The sensor shall be easily replaceable. The life span of IR type sensor shall be minimum 5 years and for others 3 years may be considered. All detectors shall be SIL certified
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	H2S Detectors		if applicable
1.2.1	Electrochemical	YES	
1.2.2	Semiconductor		
2	Fire detection system		Refer Electrical design basis
2.1	Automatic fire detection Required		
2.2	Plant Fire detection Required		
2.3	Flame Detectors		
3	Separate F & G LAN Required	No	
4	F&G PLC/Monitor		
4.1	Separate F&G PLC (SIL-3)		Gas detection shall be implemented in main plant PLC.
4.2	Plant PLC		

S.No.	Description	EIL Choice	Remarks
4.3	Plant DCS		
4.4	Separate Controller/Monitor		
5	Integration with DGFAP		

**Note: Process area Fire detectors shall be connected to Main Plant PLC**

#### 4.15 BOILER DRUM INSTRUMENTATION

S.No.	Description	EIL Choice	Remarks
1	Type of level instrument		As per P&IDs.
1.1	Conductivity		
1.2	GWR		
1.3	DP		As per P&IDs.
1.4	Constant Head Chamber		As per P&IDs.
1.5	Bicolour level Gauges		As per P&IDs.

#### 4.16 AMBIENT AIR QUALITY MONITORING SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Required	Yes	
1.1	No. of fixed stations		Nos shall be based on Environment clearance report or on the basis of EIL Safety-Health-Environment group's advice.
1.2	No. of mobile stations		
2	Mobile van Required	Yes	

#### 4.17 SAFETY VALVE TESTING AT SITE

S.No.	Description	EIL Choice	Remarks
1	Required	YES	
1.1	By Contractor	YES	
1.2	By Purchaser	NO	
1.3	Test jig Required	YES	

Testing jig for Safety Valve testing shall be arranged by Mechanical Contractor

#### 5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

S.No.	Project Philosophy
1	

#### 6.0 POST WARRANTY ANNUAL MAINTENANCE CONTRACT

S.No.	Description	EIL Choice	Remarks
1	PWAMC		
1.1	Comprehensive	YES	DCS, Plant PLC
1.2	Non-comprehensive	NO	

a) Warranty : Following special requirements for warranty shall be considered for Analysers, Machine monitoring system, package PLC, transmitters (pressure, differential pressure and temperature)

In addition to the standard warranty (ref: Defect Liability Period), two years (2 years) extended Warranty for above items shall be considered.

b)Comprehensive Post warranty annual maintenance contract

3 years comprehensive post warranty annual maintenance contract for Analysers, package PLC, machine monitoring system shall be considered.

## 7.0 SPARE PHILOSOPHY

S.No.	Type	Description	Remarks
1	Mandatory Spares	10% of quantity or minimum one no. of each type of complete instrument with respect to range, type & material of construction for each instrument. Exclusions are control valves, self actuated pressure control valve, safety valve, flame arrester, breather valve, level gauge, analyzer, desuperheater, reactor skin thermocouple, special flow meter, displacer level transmitter, radar type level instrument, tank level instrument, machine monitoring instruments.	
2	For Startup and Commissioning	Required	
3	Consumable spares for six months operation	Required (for DCS/PLC, analysers / Chromatographs, Machine Monitoring systems, Local / Main Control Panels)	
4	DCS, PLC, Machine Monitoring Spare Philosophy		
4.1	System Spares (Control Room/ SRR wise)	Bus Capacity- 50% Number of nodes- 40%	
4.2	Installed Spares (with wiring, isolators etc)	I/O Level- 20% Marshalling Level- 20%	
4.3	Spare Space	I/O Level- 20% Marshalling Rack- 20%	
4.4	Mandatory Spares	5% or minimum one of each type of module including processor modules	
5	For two years operation as per vendor recommendation	Required	

## 8.0 ADDITIONAL NOTES

S.No.	Notes
1	Time synchronization of DCS and PLC system shall be done by dedicated GPS system. This GPS system shall synchronize all the control system of complete refinery_petrochem & piping complex and Electrical system.
2	Complete Instrument air line shall be of SS 316.
3	All control valve positioner shall be provided with advanced online diagnostic positioner and performance diagnostic software in asset management system of latest and advanced version available with OEM.
4	Power supply from UPS to system/marshalling panel shall be redundant including cable and MCBs.
5	Air filter regulator shall be SS 316 material.
6	<b>E&amp;I Interface philosophy shall be as per E&amp;I Guidelines.</b>
7	Package logics /controls shall be implemented in main DCS/PLC.
8	Multi path Ultrasonic flowmeter of split range type( low and high range) shall be used for flare flow measurement having accuracy better than +-5% of volumetric flow with no effect of molecular weight on accuracy.
9	Multi path Ultrasonic flowmeter shall be used for heater pass flow measurement for trip and control. Ultrasonic flowmeter shall be used for congealing services which will be decided during P&ID review on case to case basis. If the sensor of flowmeter is in contact of fluid then online retractable assembly shall be provided by OEM.
10	Only push in type screw less terminal blocks (TB) shall be used. TBs shall have lever indicating termination of wire.
11	MCC Interface with control room/SRR shall be through Universal Remote I/O in DCS& PLC to controller in SRR/control room(whenever possible).
12	Control valve and on-off valve body rating of the valve shall be minimum 300#.
13	The minimum pressure rating of orifice flanges shall be 300 lb ANSI. Where D, D/2 taps are required, the ratings of the orifice flanges shall be same as that of the pipe class.
14	Stem shearing safety factor shall be 2 for rotary valves.
15	Corrosion monitoring shall be Wireless non intrusive type.
16	All power cables for instrumentation items in field shall be of copper only.
18	Level transmitter in pump seal shall be GWR type.
19	Tunable diode laser type analyzer may be considered instead of NDIR or GC type wherever applicable for example for O2, NH3, CO, CO2, H2O, H2S, HCN, NO, N2O and CH4 etc. Wherever GC is recommended, separate compartment for Oven and electronic section with independent doors shall be considered. Multi oven GC for multi-streams shall be considered to ensure dedicated oven for each stream and failure/maintenance of one oven will not hamper the GC processing of other stream.
20	In rack or in row type precision AC shall be considered for servers and racks for stations for DCS/PLC, TFMS, CCTV etc.
21	Virtual environment shall be used for engineering of DCS/PLC and concept of visualization (virtual machines) shall be utilized for DCS/PLC.
22	All compressor houses having H2 compressor will have H2 detectors installed at heights above the compressor in the compressor house. Other Compressor houses will also have hydrocarbon detectors and CCTV installed as specified.

**PRE-QUALIFICATION CRITERIA**

**SINGLE STAGE STEAM TURBINE**

S.No.	BHEL Requirement	Vendor's Confirmation	Deviation if Any	Remarks
1	All the suppliers need to submit this document i.e. titled pre-qualification criteria and furnish required information along with offer.			
2	<p>a) Name, address, e-mail id, contact no.etc. of manufacturer of Single stage steam turbine</p> <p>b) Name, address, e-mail id, contact no.etc. of authourised agency / trading house quoting on behalf of manufacturer In case offer is received from authourised agency / trading house, the following requirements shall be full filled. i) Valid letter of authorisation and copy of agreement to be enclosed with offer. ii) The offer <b>shall</b> be either from the authorised agency or from the manufacturer directly. In case of BHEL receiving offer from both, then offer from manufaturer will only be considered. Offer from an unauthorised agency / entity on behalf of any vendor shall be summarily rejected. iii) Name, address, e-mail id, contact no.etc. of entity on whom order to be released in case of L1 shall be clearly indicated.</p>			
3	Supplier to confirm/provide the following criteria/documents for evaluation of offer.			
	(a) The supplier should have the proven experience in manufacturing and supply of Single stage turbine.			
	i) Application: Lube oil system			
	ii) Service: Steam turbine as a driver for Lube oil Pump			
	iii) Satisfactory Working of equipment: At least two year in a power plant ending lastday of month previous to the one in which enquiry floated.			
	iv) All the facilities required for manufacturing of single stage turbine shall be available with manufacturer. All the facillites of assembling and testing (at closest to enquiry parameters) of turbine shall be available with manufacturer as per API 611 (General Purpose).			
	v) Vendor shall furnish the details of Sale after Service facilities available in India with referneces of executed project. Spare shall be readily available at propretary suppliers/ distributors in India.			
	All the above criteria 3(a) (i) to 3(a) (v) must be combinedly met by the vendor against a single supply reference of steam turbine.			
	(b) The supplier meeting all the above criteria as 3 (a) (i) to 3 (a) (v) shall furnish details of such supplies only as indicated above ( sl no 3 (a)) including equipment Manufacturer's Name, power plant name, date of supply (in DDMMYY format), No of years the equipment is in service) Manufacturer & power plant. (including mobile no and e-Mail ID) <b>Note : Suppliers shall furnish minimum 02 and maximum 06 number of latest customer reference details as indicated above in the attached annexure-II PTR. Details furnished in any other format shall not be considered.</b> <b>All the documents shall be furnished only in English. Documents furnished in other langauges will not be considered for further evaluation.</b>			
	(c) BHEL reserves the right to cross verify with the above such customers including overseas customers with a copy to the supplier and satisfy itself with reference to the claims of the supplier. If the information furnished by the supplier is not found satisfactory, the offer will be technically rejected.			
4	Offers without the requirement as above 3(a) & 3(b) will not be technically evaluated by BHEL. Further, no correspondence in this matter will be entertained.			
5	The vendors should furnish the detailed process of manufacturing and testing procedures along with the offer.			
6	List of BHEL qualified bidders shall be forwarded to BHEL's End Customer for their review and approval. The list finalized by BHEL's End Customer shall be final and binding.			
7	BHEL team may carry out vendor evaluation/assesment(incase of a new vendor) by a visit to vendor works for qualifying /rejecting the technical bid based on the findings of the visit.			
8	Vendors to submit their bid in 2 - part system i.e. A) <b>Part-I</b> shall consists of PQC: Pre-Qualification Criteria along with the required documents like 1)Annex-I (PQC) sub supplier questionire, 2) Annex-II (PQC) PTR to purchase spec TC64514 R02, 3) Annex-III (PQC) Technical Deviation Sheet to TC64514 R02. B) <b>Part-II</b> shall consists of Techno-Commercial Bid: Vendor shall submit duly filled Annex-I, II, III, IV & V to TC64514 R02, technical offer as per TC64514 R02 along with Price Bid.  Offers failing to meet prequalification criteria Part-I will not be considered for further evaluation.			

## SUPPLIER QUESTIONNAIRE

**Name of the proposed Equipment / Item / Process with Model / Type / Rating / Capacity / Size / Tonnage etc. (As applicable):**

---

---

1. **Name of Proposed Sub-Supplier:** \_\_\_\_\_

**Website:** \_\_\_\_\_

2. **Address of Regd. Office:**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Details of contact person:**

Name \_\_\_\_\_

Mobile no. \_\_\_\_\_

Desig. \_\_\_\_\_

E-mail:

- **Country of Head Office**

\_\_\_\_\_

- **Field of activitie**

\_\_\_\_\_

3. **Address of Works where Item is being manufactured**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Details of contact person:**

Name \_\_\_\_\_

Mobile no. \_\_\_\_\_

Desig. \_\_\_\_\_

E-mail:

4. **Branch / Liaison office Hyderabad** **Details of contact person:**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Name \_\_\_\_\_

Mobile no. \_\_\_\_\_

Desig. \_\_\_\_\_

E-mail:

## SUPPLIER QUESTIONNAIRE

**5. Details of Proposed Works:**

- a. Year of Establishment of present works: \_\_\_\_\_
- b. Year of Commencement of: \_\_\_\_\_  
Manufacturing at the above works
  
- c. Details of change in works address in past, if any : \_\_\_\_\_
- d. Total Covered Area : \_\_\_\_\_
  
- e. Details of covered area like no. of sheds, : \_\_\_\_\_  
Area of each shed etc.
- f. Electric power- Connected load: \_\_\_\_\_  
Electric power- Stand by load & system: \_\_\_\_\_

**6. Annual Turnover & Profit in past three years :** \_\_\_\_\_  
\_\_\_\_\_

**7. Do you have in-house Department for**

- a) Design Yes / No
- b) Research & Development Yes / No
- c) Quality control/Inspection Yes / No
- d) After Sales Service Yes / No

If any of these items answered with “No”, an explanation shall be provided.

**8. Furnish Type Test report for the proposed product (if applicable).**

**9. Approval/Certification by National/International standards/accredited agency applicable for the proposed product (if applicable).**

**10. Furnish statutory/mandatory certification for proposed product (if applicable).**

**11. Furnish supply Experience list of the proposed product.**

List shall include Item description (Type / Size / Rating / Model / Tonnage, as applicable), Customer name, Quantity, Year of Supply, and Year of commissioning.

**12. Enclose End User's operational feedback certificate for the proposed product.**

## SUPPLIER QUESTIONNAIRE

13. **Enclose list of equipment & machinery specific to the proposed product.**

This should include name of equipment, capacity & nos. etc.:

14. **Enclose Process Flow Diagram indicating in-house & outsourced process.**

### SUPPLIER QUESTIONNAIRE

15. **Enclose Testing & Inspection facilities specific to the proposed product:**

a. In-house \_\_\_\_\_

b. Outsourced \_\_\_\_\_

16. **Storage of finished goods (covered / open).** \_\_\_\_\_

17 **Enclose list of the source / make with location of major raw material, bought out items and out sourced process** \_\_\_\_\_

18. **Furnish details regarding local service support and spare parts availability in site** \_\_\_\_\_

## SUPPLIER QUESTIONNAIRE

### 19. Quality management

#### 19.1 General

19.1.1 Work Instruction for different processes available. (Y / N) \_\_\_\_\_  
if yes, furnish list.

19.1.2 Evaluation system for raw material / bought out item's supplier is available.  
(Y / N) \_\_\_\_\_

19.1.3 Records generated during inspection maintained & available for review?  
(Y / N) \_\_\_\_\_

19.1.4 Statistical quality control techniques used? (Y/N) If yes please furnish details.  
(Y / N) \_\_\_\_\_

19.1.5 ISO certificate for the works available? (Y / N) \_\_\_\_\_  
If yes, enclose copy of the certificate.

19.1.6 Quality & HSE Manual for the works available (Y / N) \_\_\_\_\_  
If yes, enclose copy of the manual.

#### 19.2 Corrective action

19.2.1 Specifically confirm whether System for identifying & disposition of Non  
Conformity in the process / product is available (Y / N) \_\_\_\_\_

19.2.2 Specifically confirm whether System for Customer complains & their satisfactory  
disposal is available. (Y / N) \_\_\_\_\_

#### 19.3. Documentation Control

19.3.1 Procedure available for documentation control (Y / N) \_\_\_\_\_

#### 19.4. Control of Inspection, measuring & testing equipments.

19.4.1 Procedure for calibration of testing & measuring instrument available.  
(Y / N) \_\_\_\_\_

## SUPPLIER QUESTIONNAIRE

**20. Certification of sub-supplier**

**I CERTIFY THAT THE INFORMATION SUPPLIED HEREIN (INCLUDING ALL PAGES ATTACHED) IS CORRECT.**

**SEAL**

**SIGNATURE** \_\_\_\_\_

**NAME** \_\_\_\_\_

**DESIGNATION** \_\_\_\_\_

**MOBILE NO** \_\_\_\_\_

**EMAIL** \_\_\_\_\_

**M/S.** \_\_\_\_\_

**PLACE** \_\_\_\_\_

**DATE** \_\_\_\_\_

LIST OF ENCLOSURE:

**ANEXURE II to Purchase Specification TC64541**

**Project: MCA-1059 HRRL VGO RGC**

BHEL Enquiry Ref No \_\_\_\_\_ Date \_\_\_\_\_

Vendor offer Ref No \_\_\_\_\_ Date \_\_\_\_\_

The vendor shall complete the experience record proforma as per below to prove that the equipment offered meets the EQC for technical acceptance. The EQC – EQUIPMENT QUALIFICATION CRITERIA shall be as per clause 5.4 of EIL Standard spec for General-purpose steam turbine 6-43-0042 Rev. 3.

Vendor may furnish additional information to justify that the EQC is being met. In addition, manufacturer's catalogue and general reference list for all the below equipment's shall also be furnished along with the proposal.

**PROVEN TRACK RECORD FOR THE MODEL BEING OFFERED (FOR MORE THAN 8000 HOURS/Complete one year)**

<b>SL.NO</b>	<b>PLANT NAME /LOCATION</b>	<b>CLIENT</b>	<b>MODEL/INLET/OUTLET STEAM PARAMETERS/KW/SPEED/MATERIAL</b>	<b>YEAR OF COMMISSIONING</b>	<b>NO. OF RUNNING HOURS LOGGED</b>

Signature and stamp of vendor

**EXPERIENCE RECORD - STEAM TURBINE (GENERAL PURPOSE)**

SERVICE :

ITEM NUMBER. :

VENDOR. :

**INSTRUCTIONS TO BIDDERS:**

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

**Description of Model designation system :**

SL. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS			REMARKS
			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
1	<b>GENERAL</b>					
1.1	Cross reference to manufacturer's Standard Reference list	----				
1.2	Model Number					
1.3	Type (Condensing / Backpressure)					
1.4	Number of stages					
1.5	Number of units supplied					
1.6	Type of drive arrangement (Direct / Thru gear box etc.)					
1.7	Type of driven equipment					
1.8	Type of lubrication system : API 611 / API 614					
1.9	Shop where turbine is designed, manufactured & tested with location & complete address					
2	<b>OPERATING CONDITIONS</b>					
2.1	Inlet pressure: rated/design (kg/cm <sup>2</sup> A)					
2.2	Inlet temperature: rated/design (EC)					
2.3	Exhaust pressure: rated/design (kg/cm <sup>2</sup> A)					
2.4	Exhaust temperature: rated/design (EC)					
2.5	Turbine rating (kW)					
2.6	Rated speed of turbine (rpm)					
2.7	Turbine efficiency (%)					
2.8	MAWP (kg/cm <sup>2</sup> G)					
2.9	Hydrostatic test pressure (kg/cm <sup>2</sup> g)					
3	<b>CONSTRUCTION</b>					
3.1	Casing Split: Axial/radial split					

SL. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS			REMARKS
			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
3.2	Casing support: Centerline/Foot					
3.3	Wheels: Simply supported / Overhung					
3.4	Wheel diameter (mm)					
3.5	Rotor: Solid / Built up					
3.6	Number of blades per stage					
3.7	Tip speed (m/s)					
3.8	Bearings Type: Journal: Thrust:					
3.9	Type of bearing lubrication: Ring oiled/Pressurised					
3.10	Span between bearing centres (mm)					
3.11	Shaft diameter under Bearings (mm)					
3.12	Whether quoted model and reference model : a. has identical mechanical design b. has identical thermodynamic design					
4	<b>MATERIALS OF CONSTRUCTION</b>					
4.1	Casing : Inlet / Exhaust					
4.2	Stationary Blading					
4.3	Moving Blading					
4.4	Shaft					
4.5						
5	<b>OTHER INFORMATION ON INSTALLATIONS</b>					
5.1	Date of supply of entire unit					
5.2	Date of commissioning of entire unit					

**EXPERIENCE RECORD PROFORMA  
STEAM TURBINE (GENERAL PURPOSE)**  
ITEM NO.: \_\_\_\_\_

SL. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS			REMARKS
			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
5.3	No. of operating hours completed as on the date of issue of material requisition					
5.4	Major Problems encountered					
5.5	Name of plant					
5.6	Purchaser's Name and Address					
	Name (Company / Organization)					
	Name of Contact Person					
	Address					
	Telephone No.					
	Fax No.					
	email-id					

**Annexure-III (TDS) to Purchase Specification TC64514**

**Project: MCA-1059 HRRL VGO RGC**

**Technical Deviation Sheet (TDS Sheet):**

**Deviations to all of the enquiry documents**

<b>Sl. No</b>	<b>Spec No</b>	<b>Description of Spec</b>	<b>Deviation</b>	<b>Reason</b>

**Vendor's Signature**

**Vendor's Company seal**