Estimated Quantity for PT/DPT Rate contract

A. TOTAL QUANTITY OF PRESSURE/ DIFFERENTIAL PRESSURE TRANSMITTERS (Break up of Quantity as follows):				2000 Nos
S.No	**Item**	**Spec No/ Rev no**	**Variant Table/ Material code**	**Estimated Quantity for FY-2022-23 & 2023-24**
1	WP Pressure/ Diff. Pressure Transmitters	TC65633-R00	Table 1A	**500**
2	WP Pressure/ Diff. Pressure Transmitters	TC65633-R00	Table 1B	**50**
3	WP Pressure/ Diff. Pressure Transmitters	TC65633-R00	Table 2A	**520**
4	WP Pressure/ Diff. Pressure Transmitters	TC65633-R00	Table 2B	**50**
5	WP Pressure/ Diff. Pressure Transmitters	TC65633-R00	Table 3A	**200**
6	WP Pressure/ Diff. Pressure Transmitters	TC65633-R00	Table 3B	**20**
7	WP Pressure/ Diff. Pressure Transmitters	TC65633-R00	Table 4A	**200**
8	WP Pressure/ Diff. Pressure Transmitters	TC65633-R00	Table 4B	**20**
9	WP Pressure/ Diff. Pressure Transmitters	TC65633-R00	Table 5A	**400**
10	WP Pressure/ Diff. Pressure Transmitters	TC65633-R00	Table 5B	**40**

B.TOTAL QUANTITY OF MANIFOLDS (Break up of quantity as follows):				1000 Nos
S.No	**Item**	**Spec No/ Rev no**	**Variant Table/ Material code**	**Estimated Quantity for FY-2022-23 & 2023-24**
1	2 / 3/ 5Valve Manifolds	TC65070-R03	Table 1	**200**
2	2 / 3/ 5Valve Manifolds	TC65070-R03	Table 2	**600**
3	2 / 3/ 5Valve Manifolds	TC65070-R03	Table 3	**50**
4	2 / 3/ 5Valve Manifolds	TC65070-R03	Table 4	**150**

Instructions to Bidders:

1 Vendor to quote unit prices for all the material codes mentioned in above BHEL specifications.

2 Vendor to incorporate any minor requirements insisted by end customer during data sheet approval without any price implication.

Pre-Qualification Requirements (PQR) of Bidders

Item / System Name: PRESSURE TRANSMITTER

Pre-Qualification Requirements (PQR) of Bidders for above mentioned item/system shall be as follows:

1.0 Bidder shall be Original Equipment Manufacturer or OEM's authorized distributor/channel partner of mentioned item/system having offices in India. All the technical requirements of the mentioned item/system shall be as per the BHEL specification furnished along with the purchase enquiry.

2.0 In case the OEM authorizes their distributor/channel partner for representing them in totality:

a. Authorized distributor/channel partner shall submit **authorization certificate from their OEM** to quote for complete job, for authorized distributor/channel partner the expiry date of validity of distributorship should be clearly indicated along with documentary evidences.

b. OEM shall declare that in the event of discontinuation of their partnership, at any point of time during the warranty period, **OEM will take the total responsibility** for meeting all the commitments made earlier by the authorized distributor/channel partner.

c. The responsibility of complete item to be supplied as per BHEL specification requirements including engineering and selection of its components shall be with OEM only. For this **OEM shall submit a letter in original complying BHEL specification.**

d. Authorized distributor/channel partner shall have **association with the OEM for the past five years** and should have supplied and commissioned with the OEM make of mentioned item/system in India.

3.0 Bidder to confirm that they will provide **spares and services support for the mentioned item/system for at least ten years** from the date of supply. In case of authorized distributor/channel partner, "After Sales Service" and availability of spares to be guaranteed by OEM for at least ten years.

4.0 Bidder shall have an established facility in India for engineering documentation, after sale service for the offered make and model of mentioned item/system.

5.0 OEM shall offer a proven model of mentioned item/system supplied for any power plant / refinery/ other industries.
Bidder shall submit a **certificate of satisfactory performance of the offered model** from their clients in India (client details to be provided), working satisfactorily for a period of not less than one year, which has been supplied during the last five years.
Note: If BHEL is unable to verify the PTR furnished, with end user contact details provided above, the offer will be rejected.

6.0 The Bidder shall be **registered vendor for any one** of the following major Engineering consultants in India:
a. NTPC EOC Noida
b. Engineers India Limited (IOCL/HPCL/ONGC/BPCL)

Bidder must submit the documentary evidence/proof in support of vendor registration by submitting the valid vendor registration letter from the respective agency.
Note: Submitting PO copy of supply against particular project is not acceptable.

7.0 All correspondence, Documentation, catalogs and Manuals shall be in English language.

8.0 Bidder shall furnish the **necessary documentary evidence/proof** in support of claim for meeting the above Pre-qualification requirements**, failing which their offer will be liable for rejection**.

TECHNICAL SPECIFICATION FOR SMART PRESSURE & DIFFERENTIAL PRESSURE TRANSMITTERS

1. **SCOPE:**

These pressure and differential pressure transmitters accurately measure Pressure and differential pressure respectively and transmit a proportional 4 to 20mA or FF signal.

2. **DESIGN:**

The transmitter shall have electronic state of the art sensor meeting all functional requirements. The transmitter shall be microprocessor based 2 -wire type and be HART Protocol compatible.

3. **i 4-20mA SMART HART TRANSMITTER SPECIFICATION (Table 1A/B,2A/B,3A/B & 5A/B):**

In-built lightning and surge protection.	Required for each transmitter.
SIL-2 certification	Required for each transmitter.
Output signal	4-20 mA DC analog along with superimposed Digital signal (based on latest HART protocol/HART7)
Power supply	24VDC±10%

ii FOUNDATION FIELDBUS-SMART TRANMITTER SPECIFICATION (Table 4A&4B):

a. Field transmitters shall be Fieldbus compatible. All such devices shall comply with Foundation Fieldbus standards as a whole and certified.

b. All field devices on the main field bus segment shall be able to communicate at a speed of 31.25 Kbps, as a minimum.

c. All devices shall support peer-to-peer communication. The transmitter shall have LAS Capability.

d. All devices complying any of these standards must be interoperable. Manufacturer must ensure that all such devices have valid interoperability test clearance certificate like ITK 4.1 for Foundation Fieldbus.

e. Fieldbus field devices which require power for their operation shall be capable of operating voltage levels available at bus level which shall typically be minimum 9.0V and maximum 32V DC. Devices, which don't require power supply, shall be capable of operating on the Fieldbus without affecting the existing Fieldbus voltage.

f. No field bus instrument in hazardous area, in general, shall draw current more than the specified limits as per FISCO/FNICO/entity from the bus power supply.

g. None of the Fieldbus devices shall be polarity sensitive.

h. All Fieldbus devices shall have capability to perform continuously their own self diagnostics to check their own health state.

i. All Fieldbus devices shall be EDDL (Electronic Device Description Language) enabled as per IEC-61804, latest version.

j. The transmitter shall be able to update output at the rate of 250 msec.

k. The transmitter shall have selectable damping feature over and above sensor response time. This shall be user selectable from 0 to 36 seconds, as a minimum.

l. Each transmitter shall have registered function block such as PID block, Signal characterizer block, Arithmetic block, Input selector block, Output splitter block.

m. Function block execution time shall be within 40 msec for Analog inputs, 50 msec for PID and 75 msec for Arithmetic block, 85 msec for CHAR block.

n. Function block execution time shall be within 100 msec for Analog inputs, 160 msec for PID and 130 msec for analog output.

o. Transmitter shall be able to provide diagnostics as real time instrument status.

p. Transmitter shall have capability to become device link master.

q. Transmitter shall be provided with in-built lightning and surge protection.

r. Transmitter shall have impulse line plugging detection.

s. Transmitters which require power for their operation shall be capable of operating

t. Each transmitter shall be provided with an integral output meter, which shall be able to display, measured variable with its engineering units, which shall be user configurable.

4. **TRANSMITTER PERFORMANCE:**

5.

Accuracy: Combined effect of repeatability, linearity and hysteresis.	Range >= 750 mmWC: the overall rangeability shall be 1:100 with accuracy of ± 0.04% of the span within a turn down of 1:10. Range < 750 mmWC: the overall rangeability shall be 1:30 with accuracy of ± 0.15% of the span within a turn down of 1:10.
Stability:	Equal to or better than ±0.1 % of span for a period of minimum 10 years, as a minimum for range more than 760 mmWC
Response time: The response time of the transmitter shall be considered as the sum of dead time and 63.2% step response time of the transmitter.	Transmitter shall update the output at least 8 times a second. Transmitter response time shall be as follows: a) For transmitter range of 760 mmWC and above, the response time shall be equal to or less than 500 milliseconds. b) For transmitter range below 760mmWC, the response shall be equal to or less than 1 second.
In-built lightning and surge protection	Required for each transmitter as per IEC 61000 Sections 4.1 thru 4.5.
Load Resistance	570 ohms at 24 V DC.
Span and zero adjustability	Easily / continuously adjustable and tamper proof. Zero and span can be adjusted directly from transmitter body without any external gadget. It can be calibrated even in case of failure of local indicator. However zero and span can be adjusted Remotely by using HHC from anywhere in the transmitter loop.
Insulation Resistance	More than 100 M ohms at 500 V DC

RFI Effect	Less than 0.2 % of URL for the frequencies of 20 to 1000 MHZ and field strength 10 v/m.
Linearization	Programmable
Turn down ratio	10: 1 for Vacuum / Very low pressure (<100mmWC) / Very high (>150 kg/cm2) applications. 100: 1 for other applications.
Over pressure / Static pressure	105kg/cm2 or 150% of URL for Pressure & Differential pressure
Diagnostics	Self-indicating feature.
Proven Performance	Vendor shall have a well proven performance record of operating satisfactorily in a power plant or in a hydro carbon processing industry for a minimum of 8000 running hours.
Zero and Span Drift	+/- 0.015% per Deg C at Max span +/- 0.011% per Deg C at Min Span

6. **PHYSICAL SPECIFICATIONS:**

Process Connection	1/2" NPTF, Horizontal entry. Suitable mating ½" NPT-F oval flange per connection with 'O' rings and suitable high tensile bolts & nuts.
Electrical Connection	½" NPT-F or M20x1.5 TWO entries: One shall be plugged with plug (SS316) Ex-d certified and other with plastic plug. (Cable Gland for Variant table 1A/B, 2A/B, 3A/B & 4A/B Plug-in type socket connector for Table 5A/B.)
Process Cover Material	SS316/316L
Diaphragm Material	SS316L or Hastelloy-C or Gold plated as per the variant table Hastelloy as base metal for gold plated transmitters is not acceptable.
Wetted Cell Body	SS316L
Sensor O - Ring	Viton / Glass filled TFE
Electronic Housing	Dual compartment, made of low copper die - cast Aluminum Alloy with durable corrosion resistant coating
Tag Plate Material	Stainless Steel
Fill fluid	Silicon-oil
Mounting	Stainless steel Bracket (with bolts & nuts)
Environmental protection	IEC IP67 and NEMA .4x
Accessories	Mounting bracket, U clamp (for 2" NB pipe) and fasteners etc shall be suitable for mounting in LIE/LIR in close coupled hookup with horizontal impulse entry for easy interchangeability without impulse modification in future.
Drain and vent plug	The transmitters shall be provided with integral SS Drain and vent plugs of SS316/316L.

7. **HAZARDOUS LOCATION:**

The transmitters shall be dual certified (Intrinsic safe & flameproof) for IEC zone-1 gas group IIA, IIB, IIC; T3 as per the requirement of variant tables.

8. **OTHER FEATURES:**

Zero elevation/suppression	Selectable (pressure transmitters) -100% to x-100 % of URL (differential pressure transmitters)
Indication	Digital 5 digit LCD meter with engineering units
Loop - check output	Transmitter can be configured to provide constant Signal 3.8mA through 21.6mA by HHC
Temperature limit (ambient)	40 to + 80°C
Temperature limit (process)	40 to + 120°C
Humidity	0 to 100% RH
EMI (Emissions)	As per EN 50081-2: 1994
EMI (Immunity)	As per EN 50082-2: 1996

9. **IDENTIFICATION & MARKING:**

1. The following minimum identification markings shall be stamped on to an identification tag / label fixed to the Transmitter.
   a. Manufacturers Type/ Model Number.
   b. Span limit and Range limit.
   c. Material of construction of process wetted part.
   d. The serial number of device.
   e. Year of construction.
   f. Marking for explosion protection
2. A ‘stainless steel tag plate bearing relevant 12 digit material code of BHEL shall be attached to each item.

10. **STATUTORY, INSPECTION AND TEST REQUIREMENTS.**

1. PMI (Positive Material Identification) Test is required for AS/SS Parts.
2. NACE MR0103 requirement shall be followed for the applicable variants as per the variant table.
3. For all Austenitic Stainless steels, Intergranular Corrosion (IGC) Test shall be conducted as per following:
   a. ASTM A262 Practice 'B' with acceptance criteria of 60 mils/year (max.) for casting.
   b. ASTM A262 Practice 'E' with acceptance criteria of 'No cracks as observed from 20X magnification' & microscopic structure to be observed from 250 X magnification for other than casting.
4. Calibration test certificates shall be furnished. Refer attached ITP.
5. Materials certificate shall be furnished.
6. All certificate shall be as per EN 10204.

7. Statutory certificates shall be furnished as follows:
    a. For all intrinsically safe / explosion proof / flameproof equipment / instruments / systems or equipment with any other type of protection allowable as per this package which are manufactured abroad and certified by any statutory authority like BASEEFA, FM, UL, PTB, LCIE etc. should also have the approval of Petroleum And Explosives Safety Organization (PESO) Nagpur.
    b. For all intrinsically safe and flame proof equipment manufactured locally (indigenously), the testing shall be carried out by any of the approved test house like CMRI / ERTL etc. The equipment shall in addition bear the valid approval from Petroleum and Explosives Safety Organization (PESO) Nagpur and a valid BIS license.
8. The statutory approval shall be applicable for:
    1. Transmitter assembly with inbuilt display unit.
    2. Cable glands.
    3. Dummy plugs for electrical entries.

11. **PAINT COATINGS:**

Manufacturer's well proven anticorrosive plant shall be used (If painting is done on any part). It shall be suitable for tropical and marine (on shore) environment.

12. **WARRANTY:**

Vendor shall offer warranty of 24 months from date of supply or 18 months from date of commissioning whichever is earlier. Warranty shall include site visit of service engineer, repair, replacement of modules/ parts, re-installation, site tuning, transportation to works for repair and back to site, re-installation works, transportation etc. including to and fro travel from vendors work to site, lodging, boarding & local travel.

13. **DOCUMENTS:**

The following Technical Information / documents shall be furnished.

a. Along with offer (soft)
    i. Technical catalogues/ literature.
    ii. Drawing showing ,the mounting details
b. After placement of order.
    i. Operation and Maintenance manual (1 set).
    ii. Inspection and Test certificates (3 copies).
    iii. Guarantee certificates (3 copies).
    iv. Calibration details (3 copies).
    v. CD / DVD containing the DD, CFF, configuration files or any other device specific software file required for the DCS / Control System.
c. 1 soft copy of a) and b) above shall be supplied by the vendor after order placement.
d. Vendor to furnish filled up instrument data sheet as per ISA formats within one month of PO placement (1 soft copy and 3 hard copies).

e. The vendor shall provide the, instructions on specific safety procedures for the preservation, installation, startup/commissioning and maintenance of the items being supplied.

14. **PACKING**

1. The material shall be properly packed to ensure that it is capable of withstanding transit risks without damage.
2. The item shall be stored in a covered shed for long periods before installation.
3. The packing shall be suitable for such storage.
4. The following details shall be properly packed on marking case.
   a. Manufacturers name.
   b. BHEL purchase order number.
   c. BHEL product standard number

15. **VARIANT TABLEs:**

Table-1A: Weather Proof Pressure Transmitter:

Var. No	Range (Kg/cm2-G)	Over/ Static pressure	Material Code	Remarks
01	0 to 1 (ABS)	105	TC9765633017	
02	-1 to +10	105	TC9765633025	
03	0 to 4	105	TC9765633033	
04	0 to 16	105	TC9765633041	
05	0 to 40	105	TC9765633050	
06	0 to 60	105	TC9765633068	
07	0 to 160	250	TC9765633076	
08	0 to 250	400	TC9765633084	

Table-1B: Weather Proof Differential Pressure Transmitter:

Var. No	Range (Kg/cm2-G) (0-min-max)	Static pressure (kg/cm2)	Material Code	Remarks
11	-300 to 800 mmWC	105	TC9765633114	
12	0-60-600 mmWC	105	TC9765633122	
13	0-320-3200 mmWC	105	TC9765633130	
14	0-640-6400 mmWC	105	TC9765633149	
15	0-0.25-2.5 kg/cm2	105	TC9765633157	
16	0-0.5-10 kg/cm2	105	TC9765633165	
17	0-0.6-60 kg/cm2	105	TC9765633173	

Table-2A: SIL Certified Intrinsic safe Pressure Transmitters with flame/explosion proof enclosure (Ex-ia & Ex-d certified):

Var. No	Range (Kg/cm2-G)	Over/ Static pressure	Material Code	Remarks
21	0 to 1 (ABS)	105	TC9765633211	
22	-1 to +10	105	TC9765633220	
23	0 to 4	105	TC9765633238	
24	0 to 16	105	TC9765633246	
25	0 to 40	105	TC9765633254	
26	0 to 60	105	TC9765633262	
27	0 to 160	250	TC9765633270	
28	0 to 250	400	TC9765633289	

Table-2B: SIL Certified Intrinsic safe Differential Pressure Transmitters with flame/explosion proof enclosure (Ex-ia & Ex-d certified):

Var. No	Range (Kg/cm2-G) (0-min-max)	Static pressure (kg/cm2)	Material Code	Remarks
31	-300 to 800 mmWC	105	TC9765633319	
32	0-60-600 mmWC	105	TC9765633327	
33	0-320-3200 mmWC	105	TC9765633335	
34	0-640-6400 mmWC	105	TC9765633343	
35	0-0.25-2.5 kg/cm2	105	TC9765633351	
36	0-0.5-10 kg/cm2	105	TC9765633360	
37	0-0.6-60 kg/cm2	105	TC9765633378	

Table-3A: NACE & SIL Certified Intrinsic safe Pressure Transmitters with flame/explosion proof enclosure-Gold plated Diaphragm (Ex-ia & Ex-d certified):

Var. No	Range (Kg/cm2-G)	Over/ Static pressure	Material Code	Remarks
41	0 to 1 (ABS)	105	TC9765633416	H2/H2S Service, NACE Certified
42	-1 to +10	105	TC9765633424	
43	0 to 4	105	TC9765633432	
44	0 to 16	105	TC9765633440	Gold Plated Diaphragm
45	0 to 40	105	TC9765633459	
46	0 to 60	105	TC9765633467	
47	0 to 160	250	TC9765633475	
48	0 to 250	400	TC9765633483	

Table-3B: NACE & SIL SIL Certified Intrinsic safe Differential Pressure Transmitters with flame/explosion proof enclosure- Gold plated Diaphragm (Ex-ia & Ex-d certified):

Var. No	Range (Kg/cm2-G) (0-min-max)	Static pressure (kg/cm2)	Material Code	Remarks
51	-300 to 800 mmWC	105	TC9765633513	H2/H2S Service, NACE Certified Gold Plated Diaphragm
52	0-60-600 mmWC	105	TC9765633521	
53	0-320-3200 mmWC	105	TC9765633530	
54	0-640-6400 mmWC	105	TC9765633548	
55	0-0.25-2.5 kg/cm2	105	TC9765633556	
56	0-0.5-10 kg/cm2	105	TC9765633564	
57	0-0.6-60 kg/cm2	105	TC9765633572	

Table-4A: NACE & SIL Certified Intrinsic safe Pressure Transmitters with flame/explosion proof enclosure-Gold plated Diaphragm (Ex-ia & Ex-d)-FOUNDATION FIELDBUS:

Var. No	Range (Kg/cm2-G)	Over/ Static pressure	Material Code	Remarks
61	0 to 1 (ABS)	105	TC9765633610	H2/H2S Service, NACE Certified Gold Plated Diaphragm
62	-1 to +10	105	TC9765633629	
63	0 to 4	105	TC9765633637	
64	0 to 16	105	TC9765633645	
65	0 to 40	105	TC9765633653	
66	0 to 60	105	TC9765633661	
67	0 to 160	250	TC9765633670	
68	0 to 250	400	TC9765633688	

Table-4B: NACE & SIL SIL Certified Intrinsic safe Differential Pressure Transmitters with flame/explosion proof enclosure- Gold plated Diaphragm (Ex-ia & Ex-d)- FOUNDATION FIELDBUS:

Var. No	Range (Kg/cm2-G) (0-min-max)	Static pressure (kg/cm2)	Material Code	Remarks
71	-300 to 800 mmWC	105	TC9765633718	H2/H2S Service, NACE Certified Gold Plated Diaphragm
72	0-60-600 mmWC	105	TC9765633726	
73	0-320-3200 mmWC	105	TC9765633734	
74	0-640-6400 mmWC	105	TC9765633742	
75	0-0.25-2.5 kg/cm2	105	TC9765633750	
76	0-0.5-10 kg/cm2	105	TC9765633769	
77	0-0.6-60 kg/cm2	105	TC9765633777	

Table-5A: Weather Proof Pressure Transmitter-Plug in connector:

Var. No	Range (Kg/cm2-G)	Over/ Static pressure	Material Code	Remarks
81	0 to 1 (ABS)	105	TC9765633815	
82	-1 to +10	105	TC9765633823	
83	0 to 4	105	TC9765633831	
84	0 to 16	105	TC9765633840	
85	0 to 40	105	TC9765633858	
86	0 to 60	105	TC9765633866	
87	0 to 160	250	TC9765633874	
88	0 to 250	400	TC9765633882	

Table-5B: Weather Proof Differential Pressure Transmitter-Plug in connector:

Var. No	Range (Kg/cm2-G) (0-min-max)	Static pressure (kg/cm2)	Material Code	Remarks
91	-300 to 800 mmWC	105	TC9765633912	
92	0-60-600 mmWC	105	TC9765633920	
93	0-320-3200 mmWC	105	TC9765633939	
94	0-640-6400 mmWC	105	TC9765633947	
95	0-0.25-2.5 kg/cm2	105	TC9765633955	
96	0-0.5-10 kg/cm2	105	TC9765633963	
97	0-0.6-60 kg/cm2	105	TC9765633971	

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised By	Approved By
00	09.02.2022	First issue	--------	P.D.M

Ref. Doc.

INSPECTION AND TEST PLAN
ELECTRONIC TRANSMITTER (L, F, P, DP & T)

CLIENT DOC. NO.: EPCC06-TIL-C00-ISP-ITP-000-0016
CONTRACTOR DOC. No.: 201744C-C00-ITP-1553-0001

--: OWNER :--
INDIAN OIL CORPORATION LIMITED

--: PMC :--
TOYO ENGINEERING INDIA PRIVATE LIMITED

--: CONTRACTOR :--
TECHNIP INDIA LIMITED

Document Category (Submission Purpose)	
Gy	Approval
KK	Review
Gy	Information
Gy	Implementation

For Toyo Engineering India Pvt. Ltd. (PMC) use only

TOYO ENGINEERING INDIA PVT. LTD.
MUMBAI - 400 078

A	Approved/ Reviewed	No Comments
B	Reviewed with comment	Document needs to be resubmitted
C	Not Approved	Document needs to be resubmitted
D	Not for Approval	Retained for Information/ Records

DATE		TOYO Job No. 6373	
SIGN	AE	LAE	TM/DH

NOTE: Review by PMC/TOYO whether or not resulting in comments shall not relieve Contractor of any obligations or requirements under the contract and it shall not be construed as an authorization of or consent to any deviation from contract.

			Written By: Vinay Datrange 2021.05.17 20:31:01 +05'30'	Checked by: Suresh Gupta 2021.05.20 10:08:22 +05'30'	Approved By: V K Yadav 2021.05.25 09:35:39 +05'30'
0	17.05.2021	Issued for Review	VBD	SEG	VKY
REV	DATE	DESCRIPTION	PREPARED BY	CHECKED BY	APPROVED BY

REVISION HISTORY	
REV.	REVISION DESCRIPTION
0	Issued for Review

CONFIDENTIAL PROPERTY OF
TECHNIP INDIA LIMITED

INSPECTION AND TEST PLAN
FOR
ELECTRONIC TRANSMITTER (F, L, P, DP and T)

CLIENT : IOCL, BARAUNI REFINERY
PROJECT : EPCC-06, BR-09 EXPANSION PROJECT
DOC NO : 201744C-C00-ITP-1553-0001 Rev. 0

INSPECTION CATEGORY -C

SL. NO.	STAGE DESCRIPTION	TYPE OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE CRITERIA	VERIFYING DOCUMENT	INSPECTION BY				RECORD	REMARKS
						MANUFACTURER	TPIA	Technip Energies	PMC/Client		
1	Material Identification	Review of Manufacturer's Test certificates / NACE -as applicable	Purchase Requisition/ Approved drawings / Data sheet	Purchase Requisition/ Approved drawings / Data sheet	Material Test Certificate EN10204-3.1	H	R	-		OR	
2	Enclosure class protection certificates	Review of enclosure protection certificate certificates	Purchase Requisition/ Approved data sheet/ Approved Drawings	Purchase Requisition / Approved drawing / data sheet	Inspection Report	H	W	-		OR	
3	Review of Area Classification certificates,	Review of Area Classification certificates,	Purchase Requisition/ Approved data sheet/ Approved Drawings	Approved Drawings / Applicable Code / Purchase Requisition	Inspection Report	H	W	-		OR	
4	Visual & Dimensional and Mounting Check	Visual & Dimensional Check, Verification of TAG No, Model No, Serial Number etc.	Purchase Requisition/ Approved data sheet/ Approved Drawings	Purchase Requisition/ Approved Procedures / Applicable code	Inspection Report	H	W	-		OR	
5	Hydrostatic Test	Hydrostatic Test	Purchase Requisition/ Approved data sheet/ Approved Drawings	Purchase Requisition/ Approved Procedures / Applicable code	Inspection Report	H	W	-		OR	
6	Calibration, Accuracy, Linearity, Reputability test.	Calibration and Accuracy check, Zero, Span adjustment, Communication check	Purchase Requisition/ Approved data sheet/ Approved Drawings	Purchase Requisition/ Approved data sheet/ Approved Drawings	Inspection Report	H	W	-		OR	
7	Dielectric Test	IR/ HV Test	Purchase Requisition/ Approved data sheet/ Approved Drawings	Purchase Requisition/ Approved data sheet/ Approved Drawings	Inspection Report	H	W	-		OR	
8	Power ON check	Power ON check, display check	Purchase Requisition/ Approved data sheet/ Approved Drawings	Purchase Requisition/ Approved data sheet/ Approved Drawings	Inspection Report	H	W	-		OR	
9	Power supply variation check	To check the output for varying voltage	Purchase Requisition/ Approved data sheet/ Approved Drawings	Purchase Requisition/ Approved Procedures / Applicable code	PMI Report	H	R/W	-		OR	

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INSPECTION AND TEST PLAN
FOR
ELECTRONIC TRANSMITTER (F, L, P, DP and T)

CLIENT : IOCL, BARAUNI REFINERY
PROJECT : EPCC-06, BR-09 EXPANSION PROJECT
DOC NO : 201744C-C00-ITP-1553-0001 Rev. 0

INSPECTION CATEGORY -C

SL. NO.	STAGE DESCRIPTION	TYPE OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE CRITERIA	VERIFYING DOCUMENT	INSPECTION BY				RECORD	REMARKS
						MANUFACTURER	TPIA	Technip Energies	PMC/Client		
10	Load Test at 24 Volts DC and reverse Polarity Test	Load Test and effect of Reversing the Polarity	Purchase Requisition / Approved drgs	Purchase Requisition / Approved drgs / Applicable Code	Inspection Report / Packing List	H	W	-		OR	
11	Configuration and Self Diagnostic facility check	Configuration parameters, Local/ Remote (with Hand held configurator) configuration, check for failure of sensor, electronics, power supply	Purchase Requisition / Approved drgs	Purchase Requisition / Approved drgs / Applicable Code	Inspection Report / Packing List	H	W	-		OR	
12	Positive Material Identification (for SS and AS)	PMI for AS/SS items	Purchase Requisition/ Applicable code	Purchase Requisition/ Applicable code	PMI Test Report	H	R			OR	
13	Loose Supplies & Spares	Verification of Loose Supplies & Spares	Purchase Requisition/ Purchase Order	Purchase Requisition/ Purchase Order	Packing List/ Test Certificates	H	W			OR	Separate IRN shall be issued for spares
14	Preservation & Packing	Preservation & Packing	Purchase Requisition/ Approved Procedure	Full compliance to Purchase Requisition	Preservation Report and Packing list	H	R	-		OR	
15	Inspection Record Book and issue of IRN	Review of Inspection Record Book & Issue of Release Note	Purchase Requisition/ Approved Procedure	Confirmation of completion of all required inspection	Inspection Record Book	H	H	H	R	OR	TPI IRN shall be reviewed by Technip

Notes

1) Requirements of Purchase Requisition shall govern, wherever more stringent than this ITP. All the Raw material shall technically complied with PR and project specification IBCE-6373-C00-INC-SPC-000-0001 Rev-3
2) Client comments, if any, shall be provided later to the vendor for implementation
3) All raw material shall be procured from IOCL/TOYO approved vendor.
4) Witness Quantity - 10% of offered lot. This shall include min 1 no/type/ model.

LEGEND: H - HOLD POINT; W - WITNESS; IW - INITIAL WITNESS;
R - REVIEW OF DOCUMENTS; S - SURVEILLANCE;
OR - OFFICIAL RECORD; IR - INTERNAL RECORD;

REF.DOC.: QCS Requirement for Supplier (Doc No. 201744C-C00-PP-0603 Rev.1)

TECHNICAL SPECIFICATION FOR INTEGRAL MANIFOLDS FOR PRESSURE & DIFFERENTIAL PRESSURE TRANSMITTERS

1.0 GENERAL

This specification defines the requirements for 2-valve, 3-valve & 5-valve integral manifolds for transmitters procured vide BHEL spec TC55816/**TC55812/**TC55820/TC55821/TC55822/ **TC65633**.

Vendor shall explicitly bring out any conflict between this addendum and its attachments if any.

2.0 DESIGN

a) The manifold shall be suitable for pressure & differential pressure transmitters with horizontal entry vide BHEL spec TC55816/**TC55812/**TC55820/ TC55821/TC55822/**TC65633**.

b) The pressure transmitters shall be provided with 2-valve integral manifolds.

c) The differential pressure transmitters shall be provided with 3, 5-valve integral manifolds.

d) The material of construction shall be SS316 as a minimum. The manifolds **in Variant Table-1 & Variant Table-2 (Clause 5.0 & 6.0)** shall be suitable for NACE & H_2 service applications.

e) The pressure rating for the manifolds shall be as follows:

   i. For **3000** psig minimum, refer Variant Table-1 **and Variant Table-3**.

   ii. For **6000** psig minimum, refer Variant Table-2 **and Variant Table-4**.

f) The manifolds shall be integrated with the transmitter at vendor works and vendor shall include all the accessories like O-rings, gaskets, nuts, bolts etc.

g) Vendor shall clearly indicate whether the manifolds can be mounted integrally with the transmitters or if any change required in model numbers of transmitters as per BHEL specifications TC55816/**TC55812/**TC55820/TC55821/TC55822/**TC65633** for including the integral manifolds and shall submit for BHEL approval indicating the model number with & without integral manifold.

h) PMI (Positive Material Identification) Test is required for AS/SS Parts. PMI specification is attached.

i) NACE requirement shall be followed for the applicable variants as per the attached NACE specification.

3.0 EXAMPLE

a) Pressure transmitter matl code : TC9755816062

b) 2-valve manifold matl code : TC9765070012

c) If both the above codes are specified in purchase enquiry, the transmitter against the matl code TC9755816062 shall be supplied along with 2-valve integral manifold.

4.0 REFERENCE PRODUCT STANDARDS

a) Smart & FF Press. & Diff. Press. Transmitters: TC55816/ **TC55812**/ TC55820/ TC55821/ TC55822/**TC65633.**

5.0 **VARIANT TABLE-1(NACE & H2 Service): Pressure Rating 3000 psig.**

Var. No	Description	Matl code
01	Integral 2-valve manifold for pressure transmitter	TC9765070012
02	Integral 5-valve manifold for differential pressure transmitter	TC9765070020
05	Integral 3-valve manifold for differential pressure transmitter	TC9765070055

6.0 **VARIANT TABLE-2(NACE & H2 Service): Pressure Rating 6000 psig.**

Var. No	Description	Matl code
03	Integral 2-valve manifold for pressure transmitter	TC9765070039
04	Integral 5-valve manifold for differential pressure transmitter	TC9765070047
06	Integral 3-valve manifold for differential pressure transmitter	TC9765070063

7.0 **VARIANT TABLE-3: Pressure Rating 3000 psig.**

Var. No	Description	Matl code
07	Integral 2-valve manifold for pressure transmitter	TC9765070071
08	Integral 5-valve manifold for differential pressure transmitter	TC9765070080
09	Integral 3-valve manifold for differential pressure transmitter	TC9765070098

8.0 **VARIANT TABLE-4: Pressure Rating 6000 psig.**

Var. No	Description	Matl code
10	Integral 2-valve manifold for pressure transmitter	TC9765070101
11	Integral 5-valve manifold for differential pressure transmitter	TC9765070110
12	Integral 3-valve manifold for differential pressure transmitter	TC9765070128

9.0 **RECORD OF REVISIONS:**

Rev. No.	Date	Revision Details	Revised By	Approved By
00	21/05/2010	First issue	--------	V.V.S
01	21/11/2011	Variants 05 & 06 added. Changes highlighted.	RAM	V.V.S
02	14/03/2014	Variants 07 to 12 added. Changes highlighted	MNA	RAM
03	02.02.2022	New spec TC65633 added.	V.N	P.D.M

<Security Level 2>

IBCE

POSITIVE MATERIAL IDENTIFICATION (PMI)

DOC. NO.: IBCE-6373-C00-ISP-QMS-000-0002

PROJECT NAME: BR-9 EXPANSION PROJECT

TOYO JOB NO.: 6373

OWNER: INDIAN OIL CORPORATION LIMITED.

PMC: TOYO ENGINEERING INDIA PRIVATE LIMITED.

2	01.03.2019	Addition comments	LPL	LPL	MP
1	21.03.2018	Issued after incorporating comments	LPL	LPL	MP
0	27.02.2018	Issued for Information	LPL	LPL	MP
REV	**DATE**	**DESCRIPTION**	**MADE BY**	**REVIEWED BY**	**APPROVED BY**

REVISION HISTORY	
REV.	**REVISION DESCRIPTION**
0	First Issue
1	Second Issue
2	Third issue

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1 Scope

1.1 This specification applies to the requirements for Positive Material Identification (PMI) to be performed at the vendor's works on all Metallic Alloy Materials (Ferrous and Non Ferrous) and welds procured either directly by the EPCC Contractor / Vendor or indirectly through the sub vendor.

1.2 This specification covers the procedures and methodology to be adopted to assure that the chemical composition of metallic alloy material and weld is consistent with the material specification as specified in the purchase document using a '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 PMI to be performed on Metallic Alloy Material as listed below.

- Bulk Piping Material as Pipes, Fittings, Flanges, Valves, Fasteners etc.
- Gaskets (for ring type joints)
- Instrumentation items as Control valves, Safety valves etc.
- Materials for fabricated equipment & rotating equipment
- welds in equipment, piping etc.

Following items shall be excluded from the scope of PMI examination

- Gaskets other than for ring type joints
- Internal components of Valves

1.4 All grades of Metallic alloy materials & welds shall be subject to a PMI test at site. In case of any defective materials being found at site, the EPCC Contractor shall be responsible to effect replacement of such defective materials at project site without any delays to the satisfaction PMC / Owner.

2 Definitions

2.1 Vendor – Any supplier or Manufacturer on whom an order is placed by EPCC Contractor for the supply of referred items. This definition shall also include any sub vendor or manufacturer on whom a sub order is placed by vendor.

2.2 Alloy Material – Any metallic material of Ferrous or Non Ferrous grade (including welding filler material) that contains alloying elements such as chromium, nickel, molybdenum, vanadium etc., which are intentionally added to enhance mechanical or physical properties and / or corrosion resistance.

2.3 Inspection lot – A group of items offered for inspection covered under the same size, heat and heat treatment lot.

3 Codes and Standards 

The following standards are referenced herein and form part of the Order. Current editions of the industry standards including all mandatory addenda in effect at the time of the order shall apply unless otherwise indicated.

AMERICAN PETROLEUM INSTITUTE (API)

API 578,(Latest Edition) "Material Verification Program for New and Existing Alloy Piping Systems"

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
ASME Boiler and Pressure Vessel Code, including all mandatory addenda in effect on the date of the Order
Section II "Material Specifications"
Part A - "Ferrous Material Specifications"
ASME SA-751, "Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products"
Part B - "Nonferrous Material Specifications"
Part C - "Specifications for Welding Rods, Electrodes and Filler Metals"

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
ASTM A193/A193M, "Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications"
ASTM A751, "Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products"
ASTM E62, "Chemical Analysis of Copper and Copper Alloys (Photometric Methods)"
ASTM E322, "X-Ray Emission Spectrometric Analysis of Low-Alloy Steels and Cast Irons"
ASTM E350, "Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron"
ASTM E352, "Chemical Analysis of Tool Steels and Other Similar Medium and High-Alloy Steels"
ASTM E353, "Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys"
ASTM E354, "Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys"
ASTM E478, "Chemical Analysis of Copper Alloys"
ASTM E527, "Numbering Metals, and Alloys (UNS)"
ASTM E572, "Analysis for Stainless and Alloy Steels by X-ray Fluorescent Spectrometry"
ASTM E1086, “Test Method for Optical Emission Vacuum Spectrometric Analysis of Stainless Steel by the Point-to-Plane Excitation Technique”

4 PMI Examination

4.1 The EPCC Contractor shall submit a procedure of PMI to comply with the requirements of this specification for approval by PMC / Owner.

4.2 PMI examination of alloy materials is independent of any certification, markings or color coding that may exist and is aimed at verifying that the alloy used are as per specified grades.

4.3 The EPCC Contractor & Vendor 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 EPCC Contractor and vendor shall ensure that all alloy materials are segregated & stored in separately identified locations to prevent mix up of materials of different alloy specifications or alloy materials with carbon steel. Non ferro magnetic materials shall be segregated at all times from ferro magnetic materials.

4.5 PMI Examination is subject to witness inspection by TPIA / PMC / Owner.

5 Acceptable Methods for PMI

5.1 The method used for PMI examination shall provide a quantitative determination of the alloying elements like chromium, molybdenum, nickel, vanadium etc. in metallic alloy materials.

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. The following methods / instruments are acceptable.

(a) Portable X-Ray Fluorescence Analyzers

TN Technologies Alloy Analyzer 9266, 9277 (The Metallurgist XR) or Metallurgist Pro, Metorex – X – MET 880, X-MET 960 or X-MET 2000

(b) Portable optical emission Analyzer

Spectro Port Model TP-07 or TFO-02, Spectro Test F, Metorex ARC-MET 900, or ARC-MET 930.

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. The data of the last service shall be stated on the PMI report form.

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 material 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 Ring type joint Gasket of alloy material shall be inspected by using portable X-Ray Fluorescence instrument.

5.11 Testing shall be done as per procedures outlined by the manufacturer of alloy analyzer being used. Modification of these procedures if any must be approved by the manufacturer of the alloy analyzer.

5.12 The persons performing PMI shall demonstrate their capabilities to the satisfaction of the visiting TPIA representative. If the vendor 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 PMC / Owner.

6 Extent of PMI Examination

2

Positive Material identification (PMI) check shall be done at all three stages for fabrication jobs (1) At Sub vendors Shop (2) After Receipt at Shop (3) Final Stage before Hydro.

Following sampling plans shall be applicable for PMI examination of various alloy material items.

A) Flanges, Fittings, Valves, RTJ Gaskets - 100 %

B) Pipes - 100 %

C) Fabricated / Rotating Equipment - All pressure retaining parts & welds

1

1) Piping and Fired Heater Tubing Bulk Materials	
Random length seamless and ERW pipe, and seamless heater tubing:	Each component part
Random length fusion welded pipe (ERW pipe excluded):	Each component base material part (1). Refer to Section 2 below for tests on welds
Forged fittings (e.g. flanges, branch fittings, weldolets, blinds, plugs, etc.):	Each component part
Seamless and ERW pipe, and seamless heater tube fittings:	Each component part
Fusion welded pipe fittings:	Each component base material part (1). Refer to Section 2 below for tests on welds
Valves, including body, bonnets, plugs, vents, drains etc.:	Each pressure retaining component part. Refer to Section 2 below for tests on welds & Section 3 for tests on bolting.
Permanent strainers, traps, including blind flanges, plugs etc.:	Each pressure retaining component part. Refer to Section 2 for tests on welds and Section 3 for tests on bolting
2) Pressure Retaining Welds	
Circumferential welds, including valve body-to-flange and valve body-to-bonnet welds; Longitudinal welds	Each weld, with 1 test per weld seam for automatic and semi-automatic welding processes, and 1 test per weld seam and 1 test per 450mm weld length thereafter for manual welding processes(2)

Repair welds:	1 test on excavated weld to ensure incorrect material fully removed; thereafter 1 test per 450mm repair weld length
3) Bolting	
External pressure retaining bolting for flange rating Classes<900:	Sample basis per Table 3
External pressure retaining bolting for flange rating Classes >=900:	Each bolt and nut
Valve bonnet bolting for flange rating Classes >=900:	Each bolt and nut
Valve bonnet bolting for flange rating Classes <900	Sample basis per Table 3
4) Gaskets	
Solid metal or jacketed metallic gaskets for flange rating Classes >=900:	100%
Alloy rings associated with ring-type joints (RTJ'):	100%
Gaskets, other than above:	PMI is not required

Notes:

(1) PMI on these components may be undertaken in conjunction with PMI of the deposited weld metal per Note 2.

(2) For all welds, PMI shall be performed on the completed weld capping pass (both internal and external, where access permits) and the base material on either side.

△1

TABLE 3

Number of Units in a Lot	Representative Sample
1 -5	100% of all units
6 - 199	5 units or 5%, whichever is greater
>=200	10 units or 3%, whichever is greater

Notes:

(1) If all units of the representative Sample are acceptable, the inspection Lot shall be acceptable.

(2) If any unit from the representative Sample is found to be unacceptable, the remainder of the Lot shall be examined 100%. If the remainder of the Lot is found acceptable, the sampling technique in Table 3 shall be resumed. The unacceptable unit(s) shall be replaced and the replacements examined 100%.

(3) If a Lot is found unacceptable, the next two Lots, of the same material product and from the same source, shall be examined 100%. If both Lots are acceptable, the sampling technique in Table 3 shall be resumed.

(4) If any of the Lots examined in (3) above is found unacceptable, the remaining material product from the same source shall be examined 100%. Any unacceptable unit(s) shall be replaced and the replacements examined 100%.

(5) When the material markings are incomplete, preventing positive correlation between the material requisition, purchase order and a material test certificate, the materials shall be rejected.

7 Recording and Documentation

The results of PMI examination shall be recorded in a Report Format enclosed with this specification.

8 Acceptance Criteria 

Materials tested by an approved analysis method shall contain the amounts of alloying elements specified in the requisite material grade / Material specification

9 Marking

All alloy materials tested by PMI shall be identified using either of the following methods by indicating “AV”.

a) Bar code / Hologram sticker
b) A low stress stamp marking
c) Color coding as per Appendix -2 of Painting specification: IBCE-6373-C00-FQC-PRC-000-0003

Failed Components 

Materials, items, and welds which are found to be unacceptable during identification testing shall be immediately marked with a red 'R', rejected, removed and segregated from the lot, pending Purchaser's acceptance of the Supplier's corrective action plan.

ELEMENTS TO BE DETERMINED DURING PMI 1

MATERIALS (1)	ELEMENTS TO BE DETERMINED
1 Cr - 0.5 Mo	Cr, Mo, V
1.25 Cr - 0.5 Mo	Cr, Mo, V
2.25 Cr - 1 Mo	Cr, Mo, V
5 Cr - 0.5 Mo	Cr, Mo, V
9 Cr - 1 Mo	Cr, Mo, V
12 Cr (Type 410S/405)	Cr
12 Cr	Cr
17 Cr	Cr
304 (L)	Cr, Ni, Mo, Nb(Cb), Ti
310	Cr, Ni, Mo, Nb(Cb), Ti
309 (L)	Cr, Ni, Mo, Nb(Cb), Ti
309 Nb	Cr, Ni, Mo, Nb(Cb), Ti
316 (L)	Cr, Ni, Mo, Nb(Cb), Ti
321	Cr, Ni, Ti, Nb(Cb)
347	Cr, Ni, Nb(Cb), Ti
Inconel 182/82	Ni, Cr
Inconel 625	Ni, Cr, Mo, Nb(Cb) + Ta, Ti
Inconel 600	Ni, Cr
Incoloy 800	Cr, Ni, Al, Ti, Cu
Incoloy 825	Cr, Ni, Mo, Ti
Admiralty Brass	Cu, Sn, As
Aluminium Brass	Cu, Al, Zn
Cupro-nickel (70-30)	Cu, Ni
Cupro-nickel (90-10)	Cu, Ni
Monel 400	Cu, Ni
Titanium	Ti

Note: (1) List of materials is not exhaustive, and shall not be construed as limiting the alloy materials subject to PMI

POSITIVE MATERIAL IDENTIFICATION REPORT
BULK MATERIALS

Page of

Project	Client							Job No.
PMI Report No.	Vendor / sub-vendor :							
Purchase Order No.	Testing Agency							
Purchase Requisition No.	PMI Location							
Bulk Item Type (as per Requisition)	Method of Examination. 1							
Material Specification / Grade Number of items in Lot.	Instrument Type 1							
Requisition Item No. / Description	Alloy content, Weight Percent							Remarks Accept/Reject
Element	Cr.	Mo	Ni	V	Nb	Ti	Cu	
Specified Range								
Actual Observation 1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
Instrument Type / ID Last Service Date	Inspection Agency							Witnessed By

APPENDIX - A

SPECIAL SERVICE REQUIREMENTS

These requirements are applicable in addition to the requirements specified in the Piping Material Specification.

1.0 HYDROGEN SERVICE

1.1 PIPES, FITTINGS & FLANGES

1.1.1 METHOD OF MANUFACTURE

All carbon steel pipes, fittings & flanges having wall thickness 9.53mm and above shall be normalized. Cold drawn pipes & fittings shall be normalized after the final cold draw pass for all thickness. In addition, fittings made from forgings shall have carbon - 0.35% maximum and silicon - 0.35% maximum. The normalizing heat treatment shall be a separate heating operation & not a part of the hot forming operation.

All alloy steel (Cr-Mo) pipes, forgings & fittings shall be normalized and tempered. The normalizing 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 psi.

1.1.2 POST WELD HEAT TREATMENT (PWHT)

All carbon steel pipes & fittings post weld heat-treatment shall be carried out as per table 331.1.1, 331.1.2 & 331.1.3 of ASME B31.3 2016 edition.

All alloy steel (Cr-Mo) pipes & fittings shall be post weld heat treated irrespective of type or thickness of weld.100% radiography of welded joints shall be done both before and after PWHT.

All austenitic SS grades shall be solution annealed after welding.

1.1.3 FERRITE NO. TEST

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 embitterment during heat treatment. FN shall be determined by Ferrite scope prior to post weld heat treatment.

1.1.4 IMPACT TEST

For carbon steel and alloy steels pipes, fittings & flanges of thickness over 19mm, 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 in accordance with ASTM A370. Impact energies at 0^0C shall average greater than 27J (20 ft-lb) per set of three specimens, with a minimum of 19J (15 ft-lb).

If welding is used in manufacturing, impact test of Heat Affected Zone (HAZ) and weld metal shall also be carried out.

1.1.5 HARDNESS

For carbon steel pipes & fittings, hardness of weld and HAZ shall be limited to 200 BHN (max.).
For alloy steel pipes & fittings, hardness of weld and HAZ shall be limited to 225 BHN (max.).

1.1.6 RADIOGRAPHY

All girth welded joints (longitudinal & circumferential) shall be 100% radiographed in accordance with UW-51 of ASME Section VIII, Div-1 and ASME Section V.

1.1.7 JACKETED PIPING

For Jacketed piping, shop fabricated jacketed spools to be used.

1.2 VALVES

1.2.1 All valve castings shall be of radiographic quality.

1.2.2 All cast valve flanges and bodies of rating class 900 or greater shall be examined in accordance with paragraph 7.2 through 7.5 of Appendix 7of ASME Section VIII, Div-1, regardless of casting quality factor.

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

Casting	:	A217Gr.WC1, A217Gr.WC4, A217Gr.WC5, A217Gr.WC6, A217Gr.WC9, A217Gr.C5, A217Gr.C12.
Forging	:	A182 Gr.F11 CL.2, A182 Gr.F22 CL.3, A182 Gr.F5, A182 Gr.F9

1.2.4 Body/ bonnet/ cover joints & stuffing box of valves shall have low emission. One valve per metallurgy, per rating, per size shall be helium leak tested as per ASME Section 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**				
	Up to 300	600	800 & 900	1500	2500
Up to 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 total leakage rate of less than 0.0001 ml/s of helium.

1.3 C.S. & A.S. VALVES

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.

The Brinell hardness of heat-treated casting shall not exceed 200 BHN for carbon steel & 225 for alloy steel.

Repair of defective casting shall be outlined in writing to the purchaser before repair starts. Repair method to be approved prior to welding.

Casting shall be preheated to a minimum of 400ºF prior to welding and all chromium molybdenum alloys shall be post weld heat treated after welding is complete. Stress relieving is essential for welds.

Carbon steel shall be normalized and alloy steel shall be normalized and tempered. Dye penetrant test of welds shall be in accordance with ASTM E165 Procedure B-2.

Interpretation as per Appendix-8 of ASME-VIII Div.1.

The tensile stress for AS shall be less than 100,000 psi.

Charpy V-notch impact testing is to be done for valve material (average 20 ft-lb for set of 3 (min. value 15 ft-lb) at 30^0F).

For radiography and acceptance criteria for valve casting refer Clause 7.6.

1.4 S. S. VALVES

Casting and test bar shall be heat treated together. Valve casting shall be in the solution heat treated and pickled condition.

Critical body and bonnet casing section typically defined by ASME B16.34 shall be radiographed and shall meet the requirement of ASTM E446 (up to 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 & ASTM E142 shall be used for recommended practice & controlling quality of radiography as a guide. The entire surface of all casting shall be dye-penetrant inspected after pickling.

Repair 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 E-165 Procedure B-2, Interpretation as per Appendix 8 of ASME VIII Div 1.

2.0 IBR (INDIAN BOILER REGULATIONS)

2.1 IBR stands for Indian Boiler Regulation. For steam services, it is statutory obligation to meet IBR requirements. For items under IBR, composition restrictions, test reports, painting, etc. shall be as per IBR's stipulations.

2.2 All items under purview of 'IBR' (Indian Boiler Regulations) shall be accompanied with IBR certificate original in Form III A for pipes and IIIC for other piping items, duly approved by IBR Authority/Local Authority empowered by Central Board of India. Alternatively, photocopy of original certificate duly countersigned and attested by Local Boiler Inspection, is the minimum requirement.

2.3 In carbon steel piping, carbon content shall not exceed 0.25% for all Pipes, fittings, flanges & valve bodies, etc. that may require welding. Moreover, for flanges the sulphur and phosphorus also shall be limited to 0.05% each.

3.0 IMPACT TESTS

Welded pipes and fittings used below ASME temp.-29 Deg.C. shall be impact tested as per requirement of ASME B31.3.

4.0 MATERIAL REQUIREMENT FOR CARBON STEEL COMPONANTS USED IN SOUR SERVICE

4.1 SCOPE

In general, for refinery services, NACE Standard MR0103 shall be applicable. For services where HIC (Hydrogen Induced Cracking) resistant carbon steel is specifically mentioned in the Process Documents, this specification shall be followed.

4.1.1 This specification lays down the requirements related to the chemical composition, manufacture, fabrication and testing requirements for carbon steel components intended to be used in sour service in petroleum refinery environments. These requirements are specified in order to make the carbon steel component resistant to the various forms of material damage in a sour environment, such as Sulfide Stress Cracking (SSC), Hydrogen Induced Cracking (HIC), Stress Oriented Hydrogen Induced Cracking (SOHIC), Blistering etc. These requirements can be used for resisting Alkaline Stress Corrosion Cracking (ASCC) also. This specification is applicable for corrosive petroleum refining facilities.

4.1.2 The service medium is defined as “Sour” when the service environment conforms to one of the following conditions, as defined in NACE Standard MR0103.

Service environments containing free water (in liquid phase) and:

(a) >50 ppmw dissolved H2S in the free water.

(b) Free water pH < 4 and some dissolved HTS present.

(c) Free water pH >7.6 and 20 ppmw dissolved hydrogen cyanide (HCN) in the water and some dissolved HTS present.

(d) >0.003 MPa absolute (0.05 psia) partial pressure H2S in the gas in processes with a gas phase.

4.2 REFERENCE CODES AND STANDARDS

NACE MR 0103	ASTM A 694	ASTM A 770
NACE RP 0472	ASTM A 216	ASTM A 370
NACE Publication 8X194 & 8X294	ASTM A 106	ASTM A 578
NACE TM 0284	API 5 L	ASME SEC II PART C
ASTM A 20	API 6 A	ASME SEC VIII-DIV.I
ASTM A 516	ASTM E 18	ASME SEC IX
ASTM A 105	ASTM E 45	ANSI B 16.34
ASTM A 234	ASTM E 92	ANSI B 31.3

All ASTM Standard designations shall be applicable for corresponding ASME designations which would be read as ASME SA XXX instead of ASTM A XXX.

4.3 GENERAL REQUIREMENT

4.3.1 The steel for sour service shall be manufactured by either basic oxygen or electric arc furnace route and shall be fully killed and fine grained.

4.3.2 Carbon steel shall not contain intentional additions of elements such as lead, selenium or sulphur to improve machinability.

4.3.3 Carbon steel shall be used in one of the following heat treatment conditions.
(i) Hot-rolled
(ii) Annealed
(iii) Normalized
(iv) Normalized and tempered
(v) Normalized, austenitised, quenched and tempered
(vi) Austenitised, quenched and tempered

4.3.4 All material after cold forming shall be thermally stress relieved to meet a hardness requirement of 200 BHN maximum.

4.3.5 All products shall be free of low temperature transformation microstructures such as bainite bands or islets of martensite.

4.4 MATERIAL SPECIFICATION

All items are required to conform to the chemical composition of the respective specification as listed below.

Plate: SA-516 Gr.60

Pipe: SA-106 Gr. B or SA-333 Gr.1 or 6

Forgings: SA-105 or SA-350 Gr.LF1 or LF2 or SA-266 Class-I
Fittings: SA-234 Gr. WCB or SA-420 Gr.WPL6

Castings: SA-216 Gr. WCA, WCB or WCC or SA-352 Gr. LCA, LCB or LCC

Tubing: SA-179 or SA-214

4.5 PRODUCT SPECIFIC REQUIREMENTS

4.5.1 Plates and rolled products

All rolled products such as plates and sheets and fittings / pipes made of rolled products shall meet the following specific requirements.

4.5.1.1 The steel shall be made through a clean steel making route and shall have minimum of inclusions.

4.5.1.2 The sulphur level shall be restricted to 0.003 wt%.

4.5.1.3 The steel shall be calcium treated for inclusion morphology control and the Ca/S ratio shall be in the range of 2 to 3. When sulphur content is less than 0.0015%, then Ca/S ratio is not applicable and calcium can be present up to 50 ppm.

4.5.1.4 For plates including and above 25 mm thick, through-thickness tensile testing shall be carried out in accordance with ASTM A770, with minimum reduction in area being 35'f» as determined in accordance with ASTM A370, on one plate per heat.

4.5.1.5 No repair welding shall be permitted on plated.

4.5.1.6 When the fabrication of the components from the previously HIC tested plates involves no heavy wall thickness reduction or material flow, such as bending, spinning or welding, no fresh HIC test would be required on the final product. However, for

fabrication of products where heavy reduction of thickness and heavy flow of material is encountered while forming such as like forging, extrusion or drawing, metallographic examination of the final product shall be required to be carried out to ensure absence of elongated inclusions.

4.5.1.7 The plates shall be procured only from pre-qualified manufacturers.

4.5.2 Pre-qualification criteria for vendors with prior experience track record

Vendors/manufacturers who have proven track record of supplying materials for sour service applications in petroleum refineries to any of the reputed operating companies/Engineering Consultants or Process Licensors such as UOP/ IFP/ EXXON/ BP/ CHEVRON/ IOCL/ HPCL/ BPCL/ EIL will be considered as 'pre-qualified vendors/manufacturers', on production of the relevant Purchase Orders and test certificates, certified by a witnessing third party inspection agency such as DNV/Lloyds/BV/ABSTECH/TUV/SGS/CEIL for the conformance of the materials to the respective materials specification of the mentioned operators / engineering consultants. For pre-qualified vendors, Clause No.4.5.4 is not applicable.

4.5.3 Pre-qualification criteria for New Vendors without track record

A vendor who has no track record of supplying sour service materials to any of the reputed engineering consultants/operators, as mentioned in Clause 4.5.2 above, shall be considered as a new vendor and shall be required to carry out HIC test as detailed out in Clause 4.5.4 for pre-qualification by any one of the reputed third party inspection agencies like Lloyds, BV, CEIL, DNV or TUV etc..

4.5.4 Hydrogen Induced Cracking (HIC) Test

The requirements for HIC test shall be as follows.

(i) This test is required for vendor pre-qualification only.

(ii) This test shall be performed on a set of three specimens representing each production batch/heat of rolled products in accordance with NACE TM 0284 with the following acceptance criteria:

(a) Crack Length Ratio (CLR) 10.0%
(b) Crack Sensitivity Ratio (CSR) < 1%

(iii) In case of failure of any one of the specimens, three more specimens from the same product shall be retested and all the specimens shall meet the acceptance criteria. In case of failure of any retest sample, the material shall be considered unacceptable.

4.6 POST WELD HEAT TREATMENT (PWHT) AND HARDNESS REQUIREMENT

All the weld joints, irrespective of thickness, shall be given a post weld heat treatment. The temperature range for PWHT shall be 595-650°C. Other aspects such as rate of heating, holding time etc. for PWHT shall be as per ASME Sec.VIII, Div.I /ANSI B31.3 requirements. The hardness of the weldment after PWHT shall be 200 BHN maximum.

5.0 OTHER DEMANDING SERVICES

For items with other demanding services specified otherwise shall be as per Licensor's requirements.

6.0 Contractor to check applicability of piping classes for respective units referring to ''Attachement-2'' (Index for Piping Material Specification).

VENDOR'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN**		QP. NO.:	
	CUSTOMER: BHEL, HYDERABAD – 32. PROJECT: PRODUCT:	BHEL P.O.NO.: P.O.DATE: BHEL SPEC: REV:	REV NO:	DATE:
			PAGE 1 OF	

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**												
2.0	**INPROCESS INSPECTION**												
3.0	**FINAL INSPECTION & TESTING**												
4.0	SURFACE PREPARATION & PAINTING												
5.0	**PRESERVATION & PACKING**												

VENDOR TO NOTE & DELETE THIS INFORMATION :

THIS FORMAT IS IN MICROSOFT WORD. HEADER & FOOTER SHALL BE AVAILABLE IN EACH PAGE OF QP. QP SHALL BE IN LANDSCAPE & A4 SIZE ONLY. FONT SIZE SHALL BE MIN 10. VENDOR SHALL SIGN & STAMP IN EACH PAGE OF QP. P.O.NO. & DATE SHALL BE INDICATED. QP NO. SHOULD BE UNIQUE AND SHALL NOT REPEAT. ALL THE TESTS / CHECKS INDICATED IN THE BHEL SPEC. SHALL BE INDICATED IN THE QP.

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.	PREPARED BY VENDOR'S SIGNATURE & STAMP	APPROVED BY BHEL QA SIGNATURE & STAMP	APPROVED BY CUSTOMER'S SIGNATURE & STAMP

GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN

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1. QAP shall be made in landscape mode on A4 size paper as per the format enclosed. Font size shall be minimum 10.

2. Each page of QAP shall contain the following information.
    a) Vendor's name & address.
    b) Customer: BHEL, Hyderabad.
    c) Project.
    d) BHEL Product Standard Number/revision number as referred in P.O.
    e) BHEL Purchase Order Number & Date.
    f) Product as per P.O. description.
    g) QAP Number (unique and shall not repeat)/revision number/date.
    h) Page number and number of pages
    i) Vendor signature & stamp

3. QAP shall contain four parts / stages as follows.
    a) Raw materials and bought out items.
    b) Inprocess Control / Inspection.
    c) Final assembly, Inspection & Testing.
    d) Painting, preservation & packing.

4. Under '**Component**', indicate name of the component (say casing, rotor, pressure gauge, etc).

5. Under '**Characteristics**', indicate appropriately (say chemical analysis, mechanical properties, NDT (UT,DP etc), Hydrostatic test, calibration check etc.)

6. Under '**Class**', indicate minor, major or critical depending on the importance of characteristic.

7. Under '**Type of check'**, indicate appropriately (say chemical, mechanical, UT, DP etc.)

8. Under '**Quantum of check'**, indicate appropriately (say 100%, 10%, sample, per melt, per heat, all pieces etc.)

9. Under '**Reference document'** and '**Acceptance norms'**, appropriate National & International standards, BHEL standards, approved drg references etc should be indicated. It is not correct to mention as "Vendor's internal standards or Vendor's standard practise etc". If vendors' internal standards are referred, same shall be in line with BHEL Spec. indicated in the P.O. These may require review & approval by our Engineering dept.

10. Under 'Format of record', indicate appropriately supplier's Test certificate, calibration certificate, lab report, inspection report etc.

11. Please refer 'Agency' in QAP format.
    Under columns
        P: Perform,
        W: Witness,
        V: Verify
    Indicate against each characteristic
        1: BHEL CQS/Nominated inspection agency, OR
        2: Vendor / Sub vendor
    Note:
    - Performing agency is normally vendor or his sub vendor (Legend 2).
    - Where witness points are indicated in specification, P.O., Drawing etc., for such operations, under Witness (W) column use 1.

- And for review of test certificatesUnder 'Verify' column, use code1

12. Under 'D' please put √ (Tick) against each characteristic where vendor proposes to submit test certificate/report etc OR as required as per BHEL Spec.

13. Vendor's signature & stamp should be available on each page of QAP.

14. Vendor should read the BHEL Product Standard thoroughly and QAP should be made only inline and relevant to the Specification & Approved Drgs.

15. The following operations/characteristics/check points may be included (**as appropriate)**
    a) Visual check
    b) Dimensional check
    c) Mechanical and Chemical properties.
    d) Surface preparation before painting (by chemical cleaning, sand blasting, shot blasting etc as the case may be.)
    e) Painting check for shade, Dry Film Thickness (DFT), Adhesion/ peel off test etc.
    f) Check for correctness for all components mounted as per General arrangement Drg, Bill Of Materials (BOM), etc for range, rating, make, color, size, location as per GA, quantity, label description including tag nos., annunciator facia, loose components, accessories, spares etc.
    g) Verification of test certificate for protection class for the enclosures.
    h) Mechanical functioning of switches.
    i) Continuity of earthing and provision of earth points.
    j) Colour coding of wiring, size, tightness & dressing of wiring.
    k) Review of test certificates of assembled items, raw materials, internal test reports etc.
    l) Witness of functional checks, which may include mechanical run & electrical run, H.V.test, IR measurement, Electrical and Mechanical tests etc.
    m) PQR, WPS, Welder Qualification Record, welding records (fitup, DP) etc.
    n) Material identification (for punch marks of serial numbers, Heat No, Melt No, Inspector's stamp etc)
    o) Hydraulic Pressure Test, Pneumatic Pressure Test, Liquid Penetration Examination and other Non Destructive Tests.
    p) Tests on Galvanised items (Visual, Hammer Test, Knife Test, Thickness, Preece Test (Copper sulphate test), Hydrogen evaluation test, Stripping test (for Mass of Zinc coating)
    q) All tests as per BHEL Product Standard & approved drawings including Type tests and Routine tests on individual items and on System as a whole.
    r) Marking, Packing and Preservation.

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS

Annexure – I

Sampling Plan for Inspection

Sl NO.	Lot Size (Numbers)	Sample Size	Acceptance Number (Maximum number of permissible defectives)
1.	2 - 8	Sample size = Lot Size	0
2.	9 - 15	Sample size = Lot Size	0
3.	16 - 25	8	0
4.	26 - 50	13	0
5.	51 - 90	20	0
6.	91 - 150	32	0
7.	151 - 280	50	0
8.	281 - 500	80	0
9.	501 - 1200	125	0
10.	1201 - 3200	200	0

Visual Inspection:

Vendor: 100%

BHEL / BHEL TPIA:

A) 1 – 200 numbers lot size, 100% to be visually inspected.

B) > 200 numbers lot size, 200 numbers to be visually inspected.