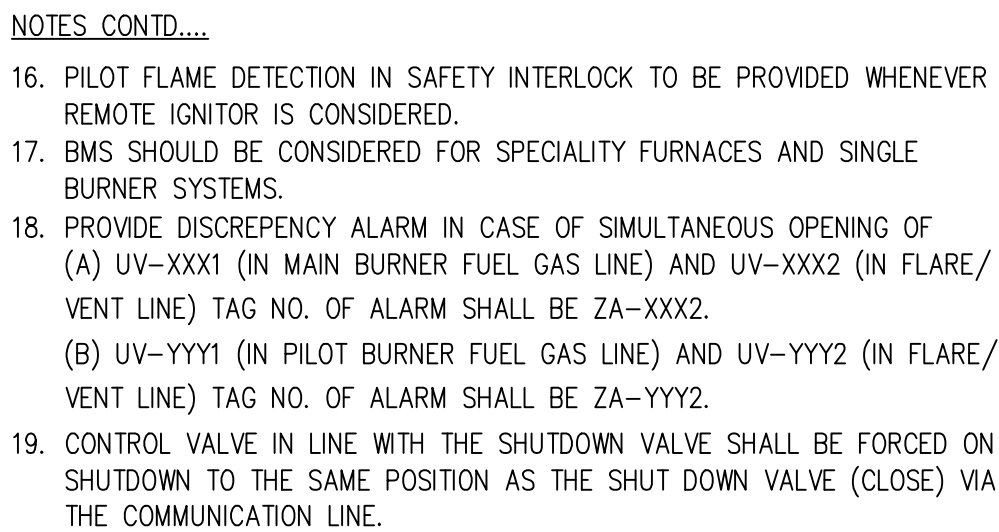




1. FOR P&ID LEGEND ABBREVIATION AND DETAILS,REFER DRAWINGS
B857-79-41-00-1191/1192.

2. INTERLOCK LOGIC:

INTERLOCK NO.	ACTUATED BY	ACTION UPON
I-8111	PT-PALL- A/B/C (AT LOW LOW PILOT GAS PRESSURE) (2oo3)	CLOSE MAIN GAS UVs, PILOT GAS UVs AND FUEL OIL SUPPLY AND RETURN UVs, OPEN MAIN GAS AND PILOT GAS BLEED UVs.
	HIGH-HIGH LEVEL IN FUEL GAS KOD	
I-8112	PT/PALL- A/B/C (AT LOW LOW MAIN GAS PRESSURE) (2oo3)	CLOSE MAIN GAS UV AND OPEN MAIN GAS BLEED UV.
I-8113	PT/PALL- A/B/C (AT LOW LOW FUEL OIL PRESSURE) (2oo3)	CLOSE FUEL OIL SUPPLY AND RETURN UV.
I-8114	PDT/PDALL/PDAHH (LOW LOW DIFFERENTIAL PRESSURE/HIGH DIFFERENTIAL PRESSURE BETWEEN FO SUPPLY AND ATOMISING STEAM) (2oo3)	CLOSE FUEL OIL SUPPLY AND RETURN UV.
I-8115	EMERGENCY SHUTDOWN PUSH BUTTON IN FIELD AND CENTRAL ROOM HARDWARE SWITCH	CLOSE MAIN GAS, PILOT GAS UV AND FUEL OIL SUPPLY AND RETURN UV. OPEN MAIN GAS BLEED AND PILOT GAS BLEED UV.

3. BASED ON BURNER VENDOR FEED BACK, DESUPERHEATER TO BE PROVIDED FOR ATOMISING STEAM, (IF FOUND NECESSARY FOR GOOD BURNER OPERATION).
4. PRESSURE GAUGES ARE REQUIRED FOR BURNER PERFORMANCE TESTING. GAUGES TO REMAIN INSTALLED ON FO, FG & STEAM LINES FOR 10% BURNERS INCLUDING ONE END BURNER. REST OF BURNERS TO HAVE DIAPHRAGM SEAL /COCK TO ENABLE INSTALLING LOOSE GAUGES. DEC. TO PROVIDE TAG NO'S OF PI BASED ON FINAL NO. OF PRESS. GAUGE.
5. FUEL OIL PT/PI/C/PV SET POINTS TO BE DETERMINED BASED ON BURNER VENDOR TEST DATA, COVERING MINIMUM/NORMAL/DESIGN LIBERATION. BURNER TURN DOWN SHALL BE MADE POSSIBLE AT PRESSURE NOT LOWER THAN NORMAL FUEL OIL RETURN PRESSURE.
6. FUEL GAS/PILOT GAS/FUEL OIL TAPPINGS SHALL BE TAKEN FROM TOP OF FUEL GAS/FUEL OIL HEADER.
7. SS MOC TO BE CONSIDERED FOR PILOT GAS LINE AT TAP OFF POINT FROM MAIN FG HEADER OR/OTHERWISE FROM DOWNSTREAM OF PILOT GAS FILTERS (IF ANY).
8. THESE VALVES SHALL BE LOCATED AT A SAFE DISTANCE FROM HEATER (MIN. 15 METERS), PIPING TO REVIEW.
9. INLINE STRAINERS IN BURNER PIPING ARE TO BE PROVIDED. THESE SHALL BE LOCATED PREFERABLY NOT MORE THAN 20M UPSTREAM OF THE BURNER MANIFOLD AND SHALL BE ONE ON-LINE + ONE SPARE WITH MESH SIZE OF 100 FOR FUEL OIL, 200 FOR FUEL GAS AND 200 FOR ATOMISING STEAM PILOT GAS TAP-OFF SHOULD BE DOWNSTREAM OF FILTER UNLESS INDEPENDENT STRAINERS ARE CONSIDERED.
10. PILOT BURNER SHALL BE PROVIDED WITH FLAME IGNITION ROD.
11. DURING CHANGEOVER OF FUEL OIL FOR DUAL FIRING HEATER, OPERATOR TO ENSURE THE SMOOTH CHANGEOVER WITHOUT INTERRUPTION BY SUITABLE PROCEDURE.
12. EMERGENCY PUSH BUTTON IN FIELD SHALL BE MINIMUM 15M AWAY OR CONFORMING TO OISD NORMS WHICHEVER IS GREATER, FROM THE FURNACE AND SHALL BE PROVIDED WITH COVERED ENCLOSURE/ BOX WITH COLOR CODING.
13. PROVIDE PRIORITY ALARM IN DCS.
14. A COMMON RESET PUSH BUTTON TO BE PROVIDED IN AUX. CONSOLE FOR RESETTING FUEL OIL SUPPLY AND RETURN UV.
15. A COMMON RESET PUSH BUTTON TO BE PROVIDED IN AUX. CONSOLE FOR RESETTING MAIN FUEL GAS UV& PILOT GAS UV.

O	19.04.24	ISSUED FOR ENGINEERING	S.K.L	SD	DK	MS	
B	18.04.24	REISSUED FOR CLIENT COMMENTS	S.K.L	SD	DK	MS	
संख्या No.	तिथि DATE	संशोधन REVISONS	ड्रॉन DRN	द्वारा BY	जॉच CHKD	अनुमोदिता APPD.	



**ENGINEERS
INDIA LIMITED**
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भारत पेट्रोलिएम कॉर्पोरेशन लिमिटेड
BHARAT PETROLEUM CORPORATION LTD.
BINA PETROCHEMICAL AND REFINERY
EXPANSION PROJECT (BPREP)

HEATER - FIRING SECTION

(SHT 2 OF 2)

अनुमाप SCALE	कार्य संख्या JOB NO.	विभाग DEPT.	अनुभाग SECTN.	इकाई UNIT	आरेख संख्या DWG. No.	संशोधन
1/4" = 1'-0"	B857	79	41	999	1181	0

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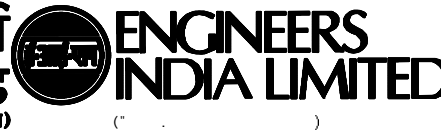
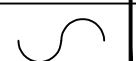
	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
L	CAUSE & EFFECT TABLE															
K																
J																
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B																
A																
	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

(I-8201)	EMERGENCY SHUTDOWN SWITCH HS-XXXXB OR HS-XXXXC	T	T	T	O	C	O	O	C	C	-
(I-8202)	SAL-XXXX OR MOTOR NOT RUNNING (YL-XXXXA) OF FD FAN XXX-FD-XXXX	FULL LOAD	T								HS-XXXX
(I-8203)	SAL-XXXX OR MOTOR NOT RUNNING (YL-XXXXA) OF FD FAN XXX-FD-XXXB	T	FULL LOAD								HS-XXXX
(I-8204)	SAL-XXXX OF FD FAN XXX-FD-XXXX & SAL-XXXX OF FD FAN-XXX-FD-XXXB TOGETHER OR MOTOR NOT RUNNING (YL-XXXXA) OF FD FAN XXX-FD-XXXX & MOTOR NOT RUNNING (YL-XXXXA) OF FD FAN XXX-FD-XXXB TOGETHER	T	T				O		C	C	HS-XXXX
(I-8205)	COMB. AIR FLOW LOW LOW (FALL-XXXX) AND COMB. AIR PRESSURE LOW LOW (PALL-XXX)	T	T				O		C	C	HS-XXXX
(I-8206)	SAL-XXXX OF ID FAN OR MOTOR NOT RUNNING (YL-XXXXA) OF ID FAN			T	O						HS-XXXX
(I-8207)	DRAFT AT ARCH, PAH-XXXXA/B/C (2 OUT OF 3)				O						HS-XXXX
(I-8208)	DRAFT AT ARCH, PAHH-XXXXA/B/C (2 OUT OF 3)	T	T		O		O		C	C	-
(I-8209)	FLUE GAS AT GAPH INLET, DTAHH-XXXXA/B/C (2 OUT OF 3)			T	O						-
(I-8210)	CLOSING OF UV's OF ALL FUELS TOGETHER ie ZSL-XXXXA, ZSL-XXXXB FOR FUEL GAS & ZSL-XXXXA, ZSL-XXXXB FOR FUEL OIL AND ZSL-XXXX FOR PILOT GAS DUE TO (OTHER PROCESS REASONS)	T	T	T(0-5 MINS.) DELAY	O						HS-XXXX
(I-8211)	HIGH HIGH HC CONC. AT FD FAN COMB. AIR SUCTION	T	T	T(0-5 MINS.) DELAY	O	C	O	O	C	C	-
(I-8212)	SAL-XXXX OF ID FAN OR MOTOR NOT RUNNING YL-XXXX OF ID FAN & ZLL-XXXX FOR CLOSING OF FG BYPASS DAMPER (0-20 SECS)	T	T	T	O	C	O	O	C	C	HS-XXXX

C = CLOSE O = OPEN T = TRIP (STOPPING MOTOR)

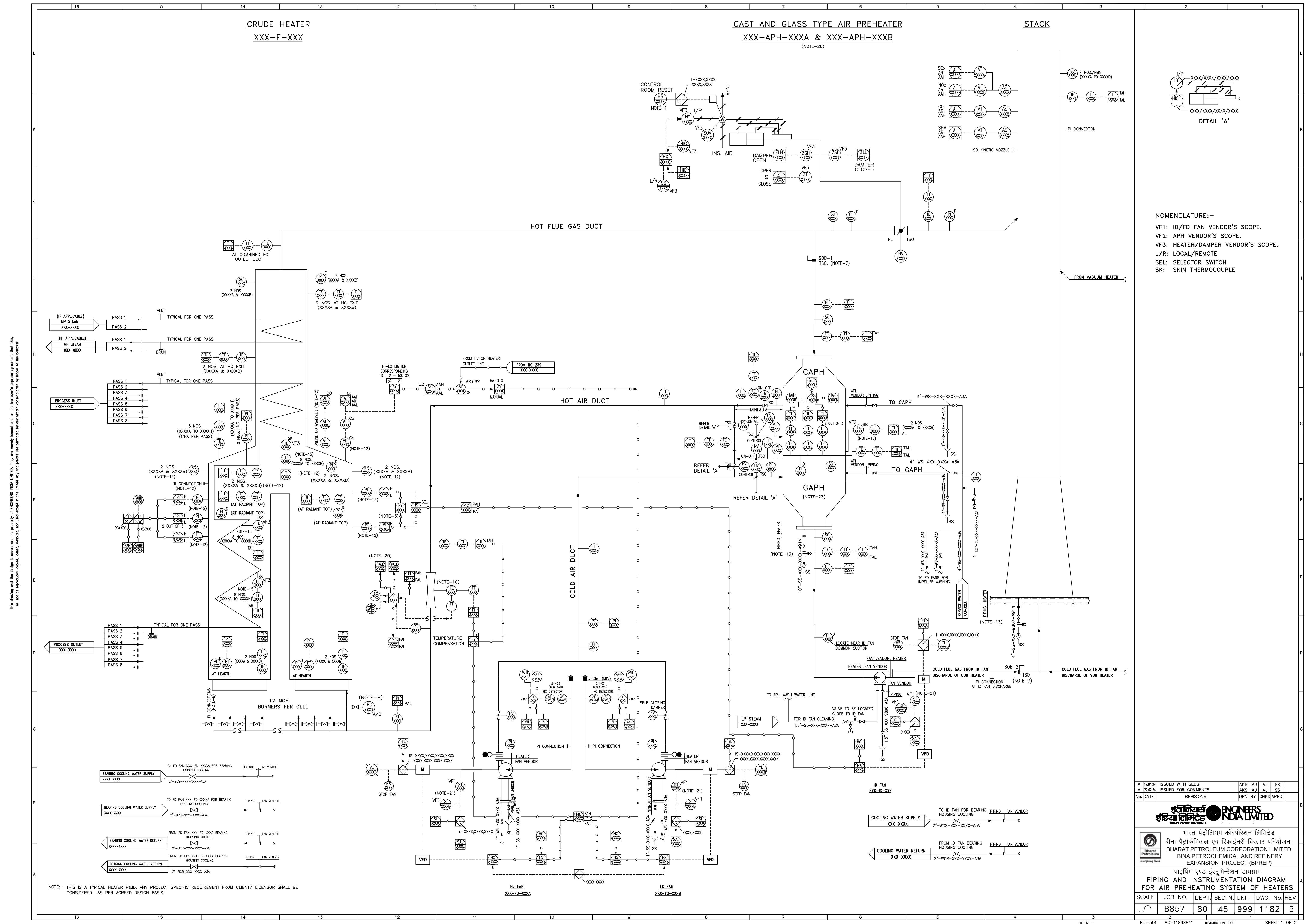
NOTES:-
1. STACK DAMPER SHALL NOT BE CLOSED UNLESS ID FAN IS RUNNING.
2. BOTH THE FD FANS WILL BE IN OPERATION (EACH AT HALF PROCESS LOAD).
3. THE SELECTOR SWITCH PY-XXXX SELECTS HIGHEST OF THE TWO VALUES PI-XXXXA & PI-XXXXB AND GIVES SIGNAL TO PIC-XXXX. OPTION IS ALSO AVAILABLE TO BYPASS PY-XXXX AND GIVE SIGNAL FROM EITHER PI-XXXXA OR PI-XXXXB BY HS-XXXX.
4. A LOCAL EMERGENCY PUSH BUTTON HS-XXXXB SHALL BE PROVIDED 15.0M AWAY FROM FURNACE AND SHALL BE PROVIDED WITH COVERED ENCLOSURE/BOX WITH COLOR CODING.
5. ALL PNEUMATICALLY OPERATED DAMPERS SHALL HAVE PROVISION FOR DELINKING PNEUMATIC ACTUATOR/POWER CYLINDER AND ALL DAMPERS SHALL BE PROVIDED WITH WINCH AND CABLE ARRANGEMENT OPERABLE FROM OPERATING PLATFORM/GRADE WITH DAMPER POSITION INDICATOR.
6. STACK DAMPER HV-XXXX SHALL BE PROVIDED WITH POSITION INDICATOR VISIBLE WHILE OPERATING WINCH AND CABLE ARRANGEMENT FROM GRADE.
7. SOB-1 & SOB-2 SHALL BE MANUALLY / ELECTRICALLY OPERATED AS PER FIRED HEATER EDB. PROVISION SHALL BE MADE TO DECLUTCH THE ELECTRIC MOTOR AND OPERATE MANUALLY WITH HAND WHEEL/GEARBOX ARRANGEMENT. BOTH SOB'S SHALL BE PROVIDED IN HORIZONTAL PORTION OF DUCT & WITH EXTERNAL OPEN/ CLOSE INDICATION.
8. ONE PG TO BE PROVIDED AT ONE OF THE BURNER DUCT OF EACH CELL. FOR ALL OTHER BURNERS ONLY A PROVISION TO BE MADE FOR INSTALLATION OF A PG SUITABLE PROVISION/ACCESSORIES ARE TO BE PROVIDED FOR MOUNTING PORTABLE PRESSURE INSTRUMENT ON BURNER WINDBOX DOWNSTREAM OF AIR REGISTER.
9. ALL DRAFT GAUGES ARE GAUGE BOARD MOUNTED. LOCAL DRAFT GAUGES ON FURNACE & FG DUCT SHALL BE VISIBLE WHILE OPERATING STACK DAMPER HV-XXXX WITH WINCH AND CABLE ARRANGEMENT FROM GRADE.

10.THE REQUIRED MINIMUM STRAIGHT LENGTHS ARE PREFERABLY 7D UPSTREAM & 3D DOWNSTREAM (HOLD) OF THE FLOW ELEMENT. LENGTH SHALL BE FINALIZED AFTER SELECTION OF FLOW ELEMENT. TEMPERATURE COMPENSATION SHALL BE PROVIDED TO OBTAIN MASS FLOW.
11.ALL CONNECTIONS / INSTRUMENT TAPPING / INSTRUMENTS SHALL BE AT ACCESSIBLE LOCATION.
12.INSTRUMENTS / CONNECTIONS LOCATED AT ARCH LEVEL/ BELOW SHOCK ZONE.
13.APH DRAINS ARE PROVIDED AT LOWEST POINT. DRAIN PIPE SIZE SHALL BE 10”NB WITH 2” INSIDE ACID RESISTANT INSULATION.
14. ALL BENDS IN COMBUSTION AIR & FLUE GAS DUCTS SHALL BE PROVIDED WITH MIN. TWO NOS. OF GUIDE VANES. MATERIAL OF CONSTRUCTION FOR GUIDE VANES IN AIR & FLUE GAS DUCTS SHALL BE CS AND SS-316L, RESPECTIVELY. CIRCULAR DUCTS ARE PREFERRED. NOZZLES REQUIRED FOR VENTURI SHALL ALSO BE CONSIDERED AS PER STANDARD PHILOSOPHY.
15. 3 NOS. PER PASS OF SKIN THERMOCOUPLES SHALL BE PROVIDED. SKIN THERMOCOUPLE SHALL BE LOCATED AT LAST RADIANT TUBE, 2ND TUBE FROM RADIANT OUTLET AND CONVECTION BOTTOM MOST SHOCK TUBE IN EACH PASS. SKIN THERMOCOUPLES SHALL BE PROVIDED BY THE HEATER CONTRACTOR.
16. 2 NOS. COLD END SKIN THERMOCOUPLES SHALL BE PROVIDED IN CAST APH (LOCATION WHERE MINIMUM TUBE METAL TEMPERATURE IS EXPECTED) AND SUPPLIED BY APH VENDOR.
17. ALL INSTRUMENT TAG NOS. HAVE AREA PREFIX 'XXXX'.
18. TAG AY-XXXB GENERATES SIGNAL (AS PER COIL TIC AND O2) BASED ON INCREASE/DECREASE OF DEMAND. INITIAL SIGNAL RATIO OF 80:20 TO BE CONSIDERED FOR COIL TIC/O2 RESPECTIVELY. THE RATIO 'X' IS INITIALLY SET AT '1' AND MAY BE VARIED BASED ON OPERATION/SITE FEED BACK.
19. HEATER SHALL TRIP IN THE EVENT OF COMBUSTION AIR FLOW LOW-LOW AS WELL AS COMBUSTION AIR PRESSURE LOW-LOW WITH 'AND' GATE.
20. THIS IS A TYPICAL HEATER P&ID. ANY PROJECT SPECIFIC REQUIREMENT FROM CLIENT/ LICENSOR SHALL BE CONSIDERED AS PER AGREED DESIGN BASIS.
21. SPEED TRANSMITTER MEASURES FAN SIDE RPM.
22. DURING EMERGENCY SHUTDOWN FD FANS SHALL BE DELAYED TRIPPED TIME ADJUSTABLE (0-5 MINS).
23. INDICATIONS OF ONLINE ANALYZERS TO BE LINKED TO CEMS AS PER CPCB REQUIERMENTS.
24. HOT WATER WASHING FOR APH. LP STEAM SHALL BE ROUTED TO CAPH/GAPH WASH WATER LINE. NO OF WASH WATER CONNECTIONS ON CAPH/GAPH SHALL BE FINALIZED BY APH VENDOR.
25. TDLS TYPE O2 ANALYZER SHALL BE PROVIDED IN EACH RADIANT CELL.
26. TYPE AND DETAIL OF APH SYSTEM SHALL BE FINALIZED DURING DETAIL ENGINEERING.
27. AS PER CLIENT’S PREFERENCE, FOR HEATER USING FUEL GAS ONLY, PLATE TYPE AIR PRE-HEATER SHALL BE CONSIDERED AFTER CHECKING FEASIBILITY DURING INDIVIDUAL UNIT DESIGN OR DURING DETAIL ENGINEERING.

B	12.04.24	ISSUED WITH BEDB	AKS	AJ	AJ	SS	
A	27.02.24	ISSUED FOR COMMENTS	AKS	AJ	AJ	SS	
No.	DATE	REVISIONS	DRN	BY	CHKD	APPD.	
 इंजीनियर्स इंडिया लिमिटेड  ENGINEERS INDIA LIMITED							
 Bharat Petroleum भारत पेट्रोलियम कॉरपोरेशन लिमिटेड बीना पेट्रोकेमिकल एवं रिफाईनरी विस्तार परियोजना BHARAT PETROLEUM CORPORATION LIMITED BINA PETROCHEMICAL AND REFINERY EXPANSION PROJECT (BPREP)							
पाइपिंग एण्ड इंस्ट्रुमेन्टेशन डायग्राम PIPING AND INSTRUMENTATION DIAGRAM FOR AIR PREHEATING SYSTEM OF HEATERS							
SCALE	JOB NO.	DEPT.	SECTN.	UNIT	DWG. No.	REV	
	B857	80	45	999	1182	B	

- 10.THE REQUIRED MINIMUM STRAIGHT LENGTHS ARE PREFERABLY 7D UPSTREAM & 3D DOWNSTREAM (HOLD) OF THE FLOW ELEMENT. LENGTH SHALL BE FINALIZED AFTER SELECTION OF FLOW ELEMENT. TEMPERATURE COMPENSATION SHALL BE PROVIDED TO OBTAIN MASS FLOW.
- 11.ALL CONNECTIONS / INSTRUMENT TAPPING / INSTRUMENTS SHALL BE AT ACCESSIBLE LOCATION.
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- 13.APH DRAINS ARE PROVIDED AT LOWEST POINT. DRAIN PIPE SIZE SHALL BE 10”NB WITH 2” INSIDE ACID RESISTANT INSULATION.
14. ALL BENDS IN COMBUSTION AIR & FLUE GAS DUCTS SHALL BE PROVIDED WITH MIN. TWO NOS. OF GUIDE VANES. MATERIAL OF CONSTRUCTION FOR GUIDE VANES IN AIR & FLUE GAS DUCTS SHALL BE CS AND SS-316L, RESPECTIVELY. CIRCULAR DUCTS ARE PREFERRED. NOZZLES REQUIRED FOR VENTURI SHALL ALSO BE CONSIDERED AS PER STANDARD PHILOSOPHY.
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20. THIS IS A TYPICAL HEATER P&ID. ANY PROJECT SPECIFIC REQUIREMENT FROM CLIENT/ LICENSOR SHALL BE CONSIDERED AS PER AGREED DESIGN BASIS.
21. SPEED TRANSMITTER MEASURES FAN SIDE RPM.
22. DURING EMERGENCY SHUTDOWN FD FANS SHALL BE DELAYED TRIPPED TIME ADJUSTABLE (0-5 MINS).
23. INDICATIONS OF ONLINE ANALYZERS TO BE LINKED TO CEMS AS PER CPCB REQUIERMENTS.
24. HOT WATER WASHING FOR APH. LP STEAM SHALL BE ROUTED TO CAPH/GAPH WASH WATER LINE. NO OF WASH WATER CONNECTIONS ON CAPH/GAPH SHALL BE FINALIZED BY APH VENDOR.
25. TDLS TYPE O2 ANALYZER SHALL BE PROVIDED IN EACH RADIANT CELL.
26. TYPE AND DETAIL OF APH SYSTEM SHALL BE FINALIZED DURING DETAIL ENGINEERING.
27. AS PER CLIENT’S PREFERENCE, FOR HEATER USING FUEL GAS ONLY, PLATE TYPE AIR PRE-HEATER SHALL BE CONSIDERED AFTER CHECKING FEASIBILITY DURING INDIVIDUAL UNIT DESIGN OR DURING DETAIL ENGINEERING.

B	12.04.24	ISSUED WITH BEDB	AKS	AJ	AJ	SS	
A	27.02.24	ISSUED FOR COMMENTS	AKS	AJ	AJ	SS	
No.	DATE	REVISIONS	DRN	BY	CHKD	APPD.	
इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED (भारत पेट्रोकेम का उपक्रम)							
Bharat Petroleum energising lives भारत पेट्रोलीयम कॉरपोरेशन लिमिटेड बीना पेट्रोकेमिकल एवं रिफाईनरी विस्तार परियोजना BHARAT PETROLEUM CORPORATION LIMITED BINA PETROCHEMICAL AND REFINERY EXPANSION PROJECT (BPREP)							
पाइपिंग एण्ड इंस्ट्रुमेन्टेशन डायग्राम PIPING AND INSTRUMENTATION DIAGRAM FOR AIR PREHEATING SYSTEM OF HEATERS							
SCALE	JOB NO.	DEPT.	SECTN.	UNIT	DWG. No.	REV	
	B857	80	45	999	1182	B	



NOMENCLATURE:-
VF1: ID/FD FAN VENDOR'S SCOPE.
VF2: APH VENDOR'S SCOPE.
VF3: HEATER/DAMPER VENDOR'S SCOPE.
L/R: LOCAL/REMOTE
SEL: SELECTOR SWITCH
SK: SKIN THERMOCOUPLE

A 12/24/24	ISSUED WITH BEDB	AKS	AJ	AJ	SS
A 27/02/24	ISSUED FOR COMMENTS	AKS	AJ	AJ	SS
No. DATE	REVISIONS		DRN BY CHKD APPD.		
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 भारत पेट्रोलेियम कॉर्पोरेशन लिमिटेड भारत पेट्रोकेमिकल एवं रिफाईनरी विस्तार परियोजना BHARAT PETROLEUM CORPORATION LIMITED BINA PETROCHEMICAL AND REFINERY EXPANSION PROJECT (BPREP)					
पाइपिंग एण्ड इन्स्ट्रुमेंटेशन डायग्राम					
PIPING AND INSTRUMENTATION DIAGRAM					
FOR AIR PREHEATING SYSTEM OF HEATERS					
SCALE	JOB NO.	DEPT.	SECTN.	UNIT	DWG. NO. REV
	B857	80	45	999	1182 B
FIL-501 AQ-1189XB41				POSTERIZATION CODE	
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				SHEET 1 OF 2	

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APPROACH PAPER FOR PROVIDING MAINTENANCE SPACER/BLIND IN P&ID

*This is applicable for Petchem and new units only.

0	20.09.24	Issued For Engineering	KM	AM	MS
A	28.08.24	Issued for Client Approval	KM	AM	MS
Rev No.	Date	Purpose	Prepared By	Reviewed By	Approved By

1.0 Approach

1.1 Normal Blinding Facilities : In order to formulate the philosophy of isolating equipment during turnaround and maintenance, the general approach for providing spacer blind / spectacle blind for each type of nozzles has to be decided. It is to be noted that equipment are required to be positively isolated and blinded for allowing

- Safe man entry into columns/drums/vessels as applicable
- Maintenance & testing of exchangers
- Isolation and maintenance of pumps and compressors

It is to be noted before allowing man entry, all the nozzles need to be blinded.

Based on operational/maintenance prevailing practices/experiences, approaches have to be finalized and for some of lower size nozzles in column/vessels, it is recommended not to show/keep provision of spacer blind/spectacle blind in the P&ID & isometrics. For these nozzles temporary arrangement i.e. by pulling connected lines and inserting temporary blinds at the nozzles would be followed

2.0 Philosophy for spacer blind/ spectacle blind facilities for safe isolation for incorporation in P&ID.

Equipment wise blinding philosophy to be followed across the complex is indicated below.

2.1 Column/ Vessel/ Drum and Tower/Reactor:

The requirement for spacer blind/spectacle blind for process nozzles are indicated below.

Table 2.1

Size	Rating	Remarks
8" and below	150#	No spacer blind / spectacle blind will be required to be shown in P&ID.
6" and below	300#	No spacer blind / spectacle blind will be required to be shown in P&ID.
10" and above	150#	Spacer blind / spectacle blind needs to be provided at the nozzle of the equipment for safe entry and will be shown in P&ID. In case it is a butt welded joint, the blinding to be shown at the nearest flange. It is to be ensured that no other connection is provided in between the flange and equipment, in case there is any such connection, blinding at that connection also to be provided.
8" and above	300#	Spacer blind / spectacle blind needs to be provided at the nozzle of the equipment for safe entry and will be shown in P&ID. In case it is a butt welded joint, the blinding to be shown at the nearest flange. It is to be ensured that no other connection is provided in between the flange and equipment, in case there is any such connection, blinding at that connection also to be provided.
4" and below	600# and above	No spacer blind / spectacle blind will be required to be shown in P&ID.
6" and above	600# and above	Spacer blind /spectacle blind needs to be provided at the nozzle of the equipment for safe entry and will be shown in P&ID. In case it is a butt welded joint, the blinding to be shown at the nearest flange. It is to be ensured that no other connection is provided in between the flange and equipment, in case there is any such connection, blinding at that connection also to be provided.

NOTE:

1. Special requirement which needs to be ensured for specific services

- a) **Column with Side Stripper:** Blind shall be provided at main column and stripper nozzles individually.
- b) **Column/Vessel line connected to Pump:** Blind shall be provided at column nozzle as well as pump suction line for safe man entry and pump maintenance respectively.
- c) For internal reflux lines (without pump) no blind at nozzles are required. In case the associated piping leaves the column to adjoining area and comes back to column, blinds are required for positive isolation and shall be as per table 2.1.
- d) For reboiler inlet/outlet lines, blind will be included only at the column nozzles. Blind requirement at Reboiler nozzle will be analyzed on case to case basis based on hydrotest requirement. .

2.2 Pump:

For Pumps following philosophy to be adopted (applicable for all services).

Table 2.2

S.No	Type	Remarks
1	Suction line	Individual suction lines of all pumps to have spacer blind/ spectacle blind provision after the isolation valve (blinding at pump side) in P&ID.
2	Discharge line	Will have a blind in upstream of NRV (blinding at pump side) Additionally a bleeder valves and end flange will be provided in between the NRV and Isolation valve in P&ID.
3	Warm up connection	One additional gate valve will be provided in the warm up line with a break flange for blinding in between two valves in P&ID.

Note:

1. Any line connecting to pump casing like vacuum breaking/chilling shall have provision of spectacle blind.

The requirement of spacer blind/spectacle blind in pump for maintenance will be followed irrespective of size and rating of line.

2.3 Exchanger/ Air Cooler:

For process/utility nozzles for heat exchanger/ air cooler following philosophy to be adopted.

Table 2.3

S.No.	Type	Remarks
1	Stacked Exchanger	Spacer blind /spectacle blind will be provided for inlet/outlet nozzles of each stack of exchanger (in case stacked) in P&ID.
2	Unstacked Exchanger	Spacer blind/ spectacle blind for Inlet / outlet of each shell and tube side will be provided in P&ID.
3	HP Exchangers	To be finalized on case to case basis and marked in P&ID specifically.
4	Reboiler	Spacer blind/ spectacle blind for Inlet / outlet of each shell and tube side will be provided in P&ID on case to case basis. Refer note 1 (d) of table 2.1. Also Refer point no.1 for stacked Reboiler as applicable.
5	Steam Generator	Spacer blind/ spectacle blind for Inlet / outlet of each shell and tube side will be provided in P&ID.
6	Condenser	Spacer blind/ spectacle blind for Inlet / outlet of each shell and tube side will be provided in P&ID. Also refer point no.1 for stacked condenser as applicable.
7	Air Cooler	Spacer blind / spectacle blind is not required at Air cooler

The requirement of spacer blind/spectacle blind for exchanger/ air cooler as agreed will be followed irrespective of size and rating of line.

2.4 Compressor:

Table 2.4

S.No	Type	Remarks
1	Suction and Discharge Line	Provide spacer blind /spectacle blind in compressor suction and discharge main process line for positive isolation. Recycle lines if connected before inlet/outlet isolation valves then blinds shall be provided in the recycle lines also. All lines like packing vent, jacket cooling water, nitrogen line etc connected to the suction and discharge line of compressor shall be provided with spacer blind/spectacle blind provision in P&ID. For any PSV connected to the compressor suction discharge line, a note "PSV to be dropped for compressor maintenance" to be added in P&ID.

The requirement of spacer/blind for compressor as agreed will be followed irrespective of size and rating of line.

2.5 Reactor:

For reactors case by case review has to be done to implement the blinding philosophy.

2.6 Blinding facilities for Utility/CBD Connection:

- Intermittent N2 lines to consumers will have blinding provision (with spacer blind/ spectacle blind as applicable).
- Turbine steam inlet / outlet lines to have blinding provision (with spacer blind/ spectacle blind as applicable).

In addition, following to be ensured

- For the utility/CBD/OWS connections provided in the vessels columns etc. spectacle blinds be provided irrespective of line sizes, so that there is no chance of any mistake in actual usage/operation.
- All steam out / utility connection will be provided with spacer blind / spectacle blind for column, vessels etc.

2.7 Specific requirement for Flare KOD's:

Inlet nozzle will be provided with flange and blinding facility.

If outlet nozzle will be butt welded (if >48") then the blinding will be done at the B/L location. Vessel will be provided with vent and valve.

If the outlet nozzle will not be butt welded then blind will be required at outlet nozzle of KOD also.

2.8 Other Requirement :

- The decision of provision of spectacle blind or spacer blind in the isometrics/GADs will be dictated by piping material specification of the Project.

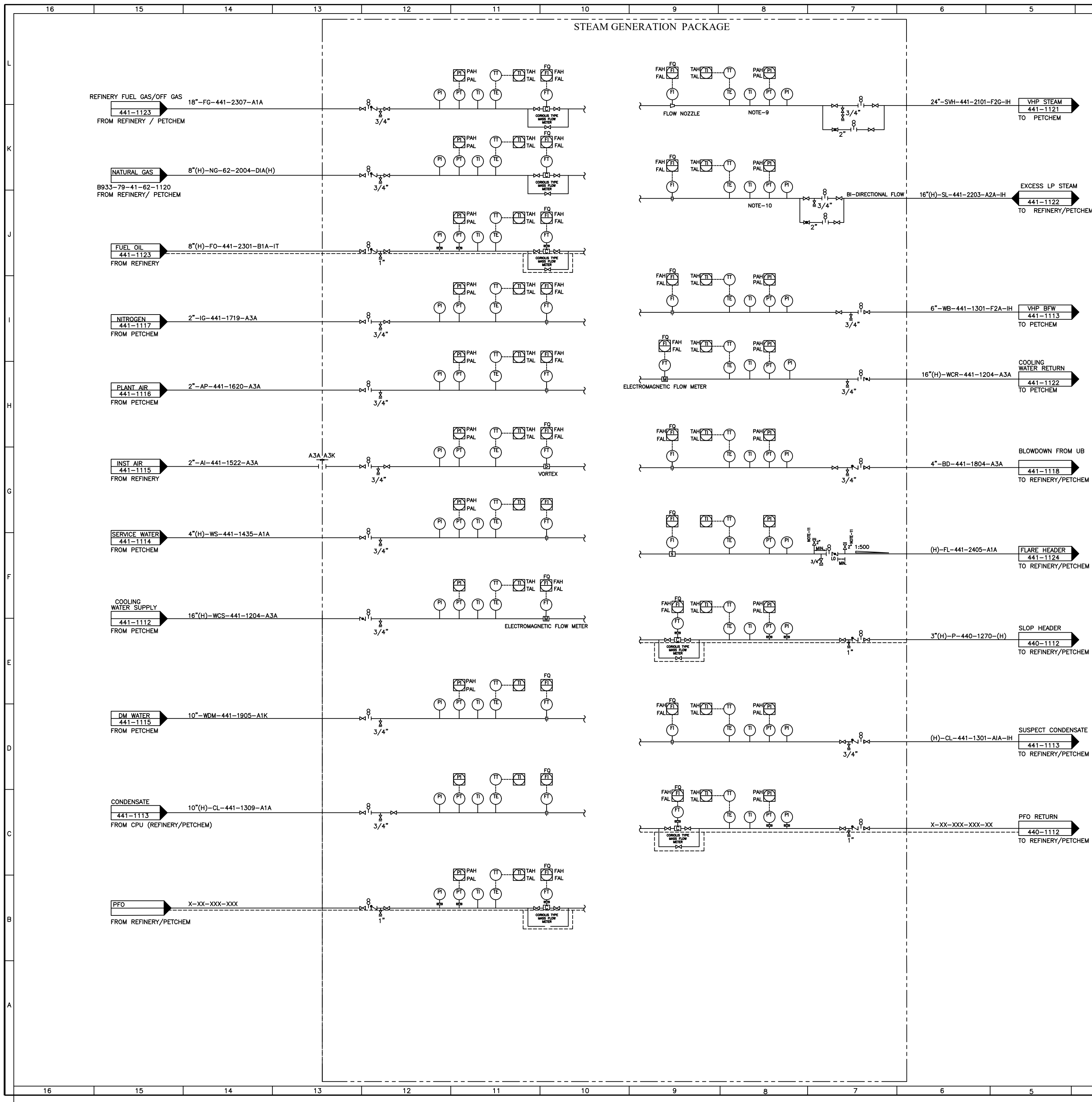
	150#, 300# , 600#	900#, 1500#, 2500#
Spectacle Blind	≤ 8"	≤ 4"

Blind/ Spacers	$\geq 10''$	$\geq 6''$

ii. PSV Depressurizing Lines

Double Block and Blind arrangement for depressurization needs to be considered for all PSV's bypass lines irrespective of operating pressure in the inlet lines.

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GENERAL NOTES:-

1. FOR STANDARD SYMBOLS AND NOMENCLATURE, REFER BEDB PART-B.
2. ALL INSTRUMENT TAG Nos. TO BE PREFIXED BY 420.

NOTES:-

1. ALL INSTRUMENTATION REQUIRED FOR THE SAFE OPERATION AND PERFORMANCE GUARANTEE TEST OF STEAM GENERATION PACKAGE IS IN THE SCOPE OF PACKAGE VENDOR. INSTRUMENTS SHOWN IN THIS P&ID ARE MINIMUM REQUIREMENT. ALL THESE INSTRUMENTS SHALL BE CONNECTED TO THE CENTRAL SYSTEM LOCATED IN SRR.
2. ALL LINE SIZE ARE UNDER HOLD AND SHALL BE CONFIRMED DURING DETAILED ENGINEERING.
3. CONNECTING COMPANION FLANGE, GASKET AND NUT BOLTS ARE IN THE SCOPE OF PACKAGE VENDOR.
4. UPSTREAM AND DOWNSTREAM STRAIGHT LENGTH FOR ALL FLOW METER TO BE DECIDED BY PACKAGE VENDOR.
5. INSTRUMENTS AND LINE NUMBERING SHALL BE DEVELOPED BY VENDOR BASED ON EIL NUMBERING PHILOSOPHY AS IN BEDB PART-B.
6. ALL REQUIRED EXPANDER/REDUCER REQUIRED TO MATCH BATTERY LIMIT LINE SHALL BE IN VENDOR'S SCOPE.
7. TYPE OF FLOW METER SHOWN IS INDICATIVE ONLY. FINAL SELECTION SHALL BE AS PER TENDER.
8. SEPARATE CORROSION PROBE TO BE CONSIDERED IN CW RETURN LINE. THIS WILL INCLUDE A SPOOL PIECE, ATTACHED TO THE 3/4 INCH VENT / DRAIN CONNECTION IN THE UNIT SIDE.
9. SPECIAL INSULATION I.E. 250MM CALCIUM SILICATE (INNER LAYER) 75 MM IN SITES PUF (OUTER LAYER) WITH 50 MICRON MYLAR FOIL BETWEEN INNER AND OUTER LAYER OF INSULATION TO BE PROVIDED FOR VHP STEAM LINE FROM MSSV TO BIL.
10. SPECIAL INSULATION TO BE PROVIDED FOR LP STEAM LINE. DETAILS OF INSULATION SHALL BE FINALIZED LATER.
11. 2" STUB WITH ISOLATION VALVE TO BE PROVIDED FOR INERTIZATION OF FLARE LINE AT BATTERY LIMIT.
12. SEPARATE CORROSION PROBE SHALL BE PROVIDED AT BATTERY LIMIT OF COOLING WATER RETURN LINE.
13. TRIPLE OFFSET BUTTERFLY VALVE SHALL BE PROVIDED IN FLARE LINE FOR ISOLATION.
14. RECIRCULATING COOLING WATER FLUSHING ARRANGEMENT SHALL BE PROVIDED.

0	14.02.25	ISSUED WITH TENDER	AS	PK	SBC	AD
A	04.02.25	ISSUED FOR COMMENTS	AS	PK	SBC	AD
संख्या	तिथि	संशोधन	इन	द्वारा	जोच	संशोधन
No.	DATE	REVISIONS	DRN	BY	CHKD	APPD.

इंजिनियर्स
इंडिया लिमिटेड
(भारत सरकार का उपक्रम)

ENGINEERS
INDIA LIMITED
(A Govt. of India Undertaking)



BHARAT_PETROLEUM_CORP._LTD.

पाइपिंग स्पड इंस्ट्रुमेंटेशन डायग्राम
PIPING AND INSTRUMENTATION DIAGRAM
BATTERY LIMIT P&ID FOR STEAM GENERATION PACKAGE

अनुमाप	कार्य संख्या	विभाग	अनुभाग	इकाई	आरेख संख्या	संशोधन
SCALE	JOB NO.	DEPT.	SECTN.	UNIT	DWG. No.	REV.
~	B957	80	44	420	1101	0

EIL-0241-502-REV-0-A

DISTRIBUTION CODE

PROJECT	BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)	CLIENT:	BHARAT PETROLEUM CORPORATION LIMITED (BPCL)
UNIT:	STEAM GENERATION PACKAGE	JOB NO.:	B957
ITEM NO	420-LM-00-301	UNIT NO.:	420
		SERVICE:	UTILITY BOILER (UB)

GENERAL DESCRIPTION :

STEAM GENERATION PACKAGE CONSISTS OF FOLLOWING:

- * 1 NO. UTILITY BOILER
- * ALL ASSOCIATED FACILITIES REQUIRED TO RUN THE SYSTEM SAFELY AT THEIR DESIGN CONDITION.
- * ALL PIPING OF FUEL AND UTILITIES

BOP SYSTEM SHALL CONSIST OF FOLLOWING:

- * DM WATER TANK WITH PUMPS
- * DEAERATOR
- * BOILER FEED WATER PUMPS
- * GAS PRESSURE REDUCTION & CONDITIONING SKID
- * LIQUID FUEL STORAGE AND FORWARDING SYSTEM
- * LP & HP DOSING SKIDS
- * PRESSURE REDUCTION DESUPERHEATING STATION (PRDS)/ PRESSURE REDUCTION SYSTEM (AS REQUIRED)
- * CBD & IBD FACILITIES
- * CLOSED BLOWDOWN TANK WITH PUMPS
- * CEMS & STACK

THE DETAIL SPECIFICATION OF THE VARIOUS COMPONENTS ARE AS GIVEN BELOW.

A) UTILITY BOILER (UB)

1	QUANTITY	:	ONE NUMBER
2	TYPE	:	WATER TUBE, NATURAL CIRCULATION AND FORCED DRAFT
3	LEVEL OF STEAM GENERATION	:	VHP STEAM
4	OPERATING CONDITION AT B/L OF CPP	:	REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)
5	FUEL TYPE	:	MAIN FUEL - 100% NATURAL GAS (NG) ALTERNATE FUEL - 100% FUEL OIL / 100% REFINERY FUEL GAS (RFG) 100% CRACKER OFF GAS / 100% PFO
			REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201) FOR FURTHER DETAILS.
6	CAPACITY OF EACH BOILER		
	MCR	:	265 TPH (MINIMUM)
	TURNDOWN	:	REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)
7	STEAM QUALITY	:	REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)
8	BOILER FEED WATER		
	PRESSURE, Kg/cm ² G	:	CONTRACTOR TO PROVIDE
	TEMPERATURE, ° C	:	CONTRACTOR TO PROVIDE
		:	BFW DESIGN CONDITION AT UTILITY BOILER B/L SHALL BE AS PER DB OF SGP(B957-420-80-44-DB-3201)
	FEED CONTROL VALVES	:	2 X 100% + 1 X 30% FOR UB 1x30% CONTROL VALVE SHALL BE DESIGNED FOR HIGH DIFFERENTIAL PRESSURE DURING START-UP
9	BOILER FEED QUALITY	:	REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)
10	OTHER UTILITY B/L CONDITIONS	:	REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)

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Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

PROJECT	BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)	CLIENT:	BHARAT PETROLEUM CORPORATION LIMITED (BPCL)
UNIT:	STEAM GENERATION PACKAGE	JOB NO.:	B957
ITEM NO	420-LM-00-301	UNIT NO.:	420
		SERVICE:	UTILITY BOILER

- 11 FD FAN FOR UB : REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)
- 12 SCANNER AIR FAN FOR UB : REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)
- 13 SEAL AIR FAN FOR UB : REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)
- 14 CEMS, STACK TYPE & HEIGHT : REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)

B) DEAERATOR

ONE NUMBER DEAERATOR CUM FEED WATER STORAGE SHALL BE PROVIDED.

REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201) FOR FURTHER DETAILS.

C) BOILER FEED WATER PUMPS

REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)

D) GAS CONDITIONING SKID:

FUEL GAS, OFF GAS AND NATURAL GAS SHALL BE SUPPLIED AT SGP B/L. FURTHER DISTRIBUTION ALONGWITH CONTROL SYSTEM/ INSTRUMENTATION ARE IN PACKAGE CONTRACTOR'S SCOPE.

REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201) FOR FURTHER DETAILS.

E) FUEL STORAGE AND FORWARDING SYSTEM

REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)

F) BLOW DOWN

- CONTINUOUS BLOWDOWN TANKs (CBD) : 1 NO.
- INTERMITTENT BLOWDOWN TANKs (IBD) : 1 NO.
- BLOWDOWN PIT : 1 NO.
- BLOWDOWN PUMPS : 2 NOS.

REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201) FOR FURTHER DETAILS.

G) HP & LP DOSING SYSTEM

REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)

H) PRESSURE REDUCTION DESUPERHEATING STATION (PRDS)/ PRESSURE REDUCTION SYSTEM (PRS) - AS REQUIRED.

REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)

I) SWAS ANALYSIS

REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)

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Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

PROJECT	BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)	CLIENT:	BHARAT PETROLEUM CORPORATION LIMITED (BPCL)		
UNIT:	STEAM GENERATION PACKAGE	JOB NO.:	B957	UNIT NO.:	420
ITEM NO	420-LM-00-301	SERVICE:	UTILITY BOILER		

J) CEMS (CONTINUOUS EMISSION MONITORING SYSTEM)-REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)

K) EMISSION NORMS

REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201)

NOTES:

- UB SHALL BE DESIGNED AS PER IBR (INDIAN BOILER REGULATION) LATEST EDITION.
- BATTERY LIMIT ISOLATION VALVES AND INSTRUMENTATION SHALL BE AS PER BATTERY LIMIT P&ID B957-420-88-44-1101 & BEDB PART-B(B857-999-79-41-ODB-1001)
- CONTRACTOR TO MATCH THE DESIGN PARAMETERS OF INCOMING AND OUTGOING LINES AT THE BATTERY LIMIT.
- CONTRACTOR TO PROVIDE ALL THE FACILITIES REQUIRED TO RUN UB CONTINUOUSLY AT TURNDOWN CAPACITY. UTILITY BOILER SHALL BE PROVIDED WITH ALL ITS AUXILIARIES, INSTRUMENTATION / INTERLOCKS/LOGICS/TRIP SYSTEM FOR START-UP AS WELL AS FOR SMOOTH AND TROUBLE-FREE OPERATION.
- THERE SHALL BE PROVISION FOR TAKING RELIEF VALVES (IF THE SAME IS NOT IN IBR) FOR TESTING AND MAINTENANCE AT SHOP. SO LOCK-OPEN ISOLATION VALVES AND FLANGED JOINT RELIEF VALES SHALL BE CONSIDERED.
- CONTRACTOR TO PROVIDE PRESSURE RELIEF VALVES ON SUPERHEATER OUTLET / STEAM DRUM AS PER IBR REGULATIONS.
- LOCATION OF MSSV (MAIN STEAM STOP VALVE) SHALL BE AS CLOSE AS POSSIBLE (WRT MINIMUM PIPING LENGTHS) TO SGP B/L AND IT SHALL BE NEARER TO OSBL VHP STEAM HEADER.
- REFER SGP DESIGN BASIS (B957-420-80-44-DB-3201) AND BEDB PART-B (B857-999-79-41-ODB-1001) ATTACHED ELSEWHERE IN TENDER FOR FURTHER DETAILS.

0	13.02.2025	ISSUED FOR TENDER	PM	SBC	AD
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By



DATA SHEET FORMAT FOR UTILITY BOILER

PROJECT : ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES, BINA
PETCHEM & REFINERY EXPANSION PROJECT (BPREP)

UNIT : STEAM GENERATION PACKAGE (Unit No. 420)

OWNER : BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

PMC : ENGINEERS INDIA LIMITED.

JOB NO. : B957

0	06/02/2025	ISSUED WITH TENDER	PK	SBC/AD	DD
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

PROJECT:		PLANT:		JOB NO.	
CLIENT:		SERVICE:		QUANTITY:	
ITEM NO:		MR NO:		MAKE:	
1	SITE DATA				
1.1	Wind Velocity (m/s)		Seismic zone		MDMT (°C)
1.2	Elv. from mean sea level (m)		Plant location		
		Max.	Normal	Min.	Design
1.3	Amb. temperature (°C)				
1.4	Relative Humidity (%)				
2	Boiler design details				
2.1	Installation (Indoor/ Outdoor)		Circulation (Natural/ Forced)		
2.2	Type of Boiler		Boiler duty (Mkcal/hr)		
2.3	Overall size(m) -(L X W X H)		Circulation ratio		
2.4	MCR of Boiler (TPH)		Peak Capacity of Boiler (TPH)		
2.5	Code	Design	Material	Mfg.	
		Constn.	Perform. Test	Hyd. test	
2.6	Supp. Type (Bottom/Top/Suspended)		H. test pr. [kg/cm2(g)]		
		Max.	Normal	Min.	Design
2.7	Pressure at B/L [kg/cm2(g)]				
2.8	Temperature at B/L (°C)				
2.9	Pressure at MSSV [kg/cm2(g)]				
2.10	Temperature at MSSV (°C)				
2.11	Min. Boiler turndown in auto contrl. @ rated parameters		Min. possible duration for Peak Cap. (min. / shift)		
2.12	Min. stable opertg. load of boiler (%)		Weight (Ton) with water/ without water		
3	FUEL FIRING SYSTEM (Oil & Gas)				
3.1	Main Fuels		Startup fuel		
3.2	Alternate fuels		Pilot burner fuel		
3.3	N+1 burner philosophy		Combination firing details		
3.4	Location of Burners (Front/LHS/RHS)		No. of Burners		
3.5	Burner elevations		Duty per burner (kcal/hr)		
3.6	Fuel flow per burner (TPH) @ MCR / Turndown / Design		Type of Burner & Make		
3.7	Flame length (mm)		Flame Diameter (mm)		
3.8	Turndown of burner		Medium of atomization (Air / Steam)		
3.9	Max. air flow /Burner (kg/hr)		Type of air register damper		
3.10	Capacity of atomizer at MCR (Kg/Hr)		Type of Igniter & Make		
3.11	Type /make /No. scanner per Burner		Emergency Instru. air for Scanner		
3.12	Air pr. at burner wind box (mmwc)		Qty. of air for scanner cooling(kg/hr)		
3.13	Type of refractory in Burner Block		Main Flame	Pilot Flame	
3.14	Refractory thk. for Burner block (mm)				
3.15	Type of refract./ thk at mounting		Anchor type & MOC for refractory		
4.0	UTILITY REQUIREMENT	Max.	Normal	Min.	Design
4.1	Cooling water (m3/hr)				
4.2	Instrument Air (Nm3/hr)				
4.3	Plant Air(Nm3/hr)				
4.4	Plant Air (Nm3/hr)/steam for atomization (kg/hr)				
4.5	Aux. Steam qty./pr. (Turbine drives, Deaerator, Heaters, S. Blowers etc.)				
5	DESIGN PERFORMANCE PARAMETERS (Furnish for each fuel separately & Combination firing)				
5.1	Load (MCR %)	100%	50%	30%	
5.2	Steam generation kg/hr				
5.3	Fuel fired, MMKcal/hr				
5.4	Steam Outlet Temp (°C)				
5.5	No. Of burners in opern.				
5.6	Fur. Heat input, Kcal/m ² /hr				

5.7	Fur. Heat absorp. Kcal/m ³						
5.8	Radiation heat transfer						
5.9	Air flow kg/hr or NM ³ /hr						
5.10	Excess air, %						
5.11	O ₂ at stack, %						
5.12	CO ₂ at stack, %						
5.13	N ₂ at stack %						
5.14	CO at stack %						
5.15	H ₂ O at stack %						
5.16	SO ₂ at stack %						
6	Flue gas profile	Temp.(°C)	Press.(mmwc)	Temp.(°C)	Press.(mmwc)	Temp.(°C)	Press.(mmwc)
6.1	At Furnace						
6.2	At Furnace exit						
6.3	At SSH inlet						
6.4	At SSH outlet						
6.5	At PSH inlet						
6.6	At PSH outlet						
6.7	At Boiler Bank inlet						
6.8	At Boiler Bank outlet						
6.9	At Economiser inlet						
6.10	At Economiser outlet						
6.11	At APH inlet						
6.12	At APH outlet						
6.13	At Stack inlet						
6.14	At Stack outlet						
7	Air profile						
7.1	At FD Fan discharge						
7.2	At SCAPH inlet (if applicable)						
7.3	At SCAPH outlet (if applicable)						
7.4	At APH inlet						
7.5	At APH outlet						
7.6	At Burner inlet						
8	Steam / Water profile	Temp.(°C)	Pressure (Kg/cm ² g)	Temp.(°C)	Pressure (Kg/cm ² g)	Temp. (°C)	Pressure (Kg/cm ² g)
8.1	At deaerator exit						
8.2	At BFP inlet						
8.3	At BFP outlet						
8.4	At HP heater –I inlet						
8.5	At HP heater –I Outlet						
8.6	At HP heater –II inlet						
8.7	At HP heater –II Outlet						
8.8	At Economiser inlet						
8.9	At Economiser outlet						
8.10	At PSH inlet						
8.11	At PSH outlet						
8.12	At SSH inlet						
8.13	At SSH outlet						
8.14	At MSSV						
8.15	AT Battery Limit						
9	Schedule of losses, %						
9.1	Dry gas						
9.2	Fuel moisture						
9.3	Air moisture						
9.4	Moisture due to H ₂ Combustion						
9.5	Radiation (ABMA)						
9.6	Unaccountable						

ix.	IBD										
x.	Chemical dosing										
xi.	Level Gauge										
xii.	Level transmitter										
xiii.	Temp. indicator										
xiv.	Temp. transmitter										
xv.	Riser										
xvi.	Downcomer										
xvii.	N2 connection										
xviii.	Stand pipe										
xix.	Spare										
xx.	Test Point										
xxi.											
xxii.											
15.3	WATER DRUM (If applicable)										
a.	Design Pressure-kg/cm2(g) /F.V.							Design Temperature (°C)			
b.	Optg. pressure at MCR -kg/cm2(g)							Maximum metal temperature (°C)			
c.	I.D. x Length (TL-TL), mm							Shell & Dished End Material			
d.	Shell Plate Thickness (mm)							Dish End Type(Ellipsoidal / Tori sph.)			
e.	Dished End thickness (mm)							Manhole No./type/size (mm)			
f.	Corrosion Allowance (mm)							Type of Drum Support & MOC			
g.	Insulation Thk.(mm) /MOC/Density							Insulation cladding MOC & thk (mm)			
h.	NDT requirement							PWHT requirement			
i.	Ultrasonic test requirement										
15.4	CONVECTION BANK										
a.	Type of Bank(Bi-drum/Hor coil arrgmt)							Design Pressure-kg/cm2(g)			
b.	Design temperature (°C)							Maximum metal temperature (°C)			
c.	Arrangement (Inline / Staggered)							Type (Bare / finned)			
d.	Bank tubes material							Boiler Bank Duty (Mkcal/hr)			
e.	Type of Flow							LMTD (°C)			
f.	Type of fin & MOC							Maximum fin tip temperature (°C)			
g.	Overall Heat Transfer Co-efficient							Fouling factor Flue gas side			
h.	Fouling factor tube side							Total heating surface of bank tubes			
i.	Details of gas side baffles (if provided)							Pinch point (°C)			
j.	Projected heating surface (m2)							Bank tubes width x Depth			
k.	No. of rows							Number of tubes /row			
l.	Size of bank tubes (OD x THK.)							LongL. Pitch (mm)			
m.	CircumL. pitch(mm)							Height between drum centers (mm)			
n.	PWHT requirement							NDT requirement			
o.	Ultrasonic test requirement										
15.5	SUPERHEATERS										
(i)	PSH (Primary Super Heater)										
a.	Design pressure [kg/cm2 (g)]							Design Temperature (°C)			
b.	PSH arrangement (Vert./ Horiz.)							Maximum metal temperature (°C)			
c.	PSH Duty (MKcal /Hr)							LMTD (°C)			
d.	Steam side Heat Transfer Co-efficient (Kcal/M2/Hr/°C)							Corrosion allowance (mm)			
e.	Flue gas side Heat Transfer Co-efficient (Kcal/M2/Hr/°C)							Overall Heat Transfer Co-efficient (Kcal/M2/Hr/°C)			
f.	Fouling factor Flue gas side (°C.Hr.m2/kcal)							Fouling factor tube side (°C.Hr.m2/kcal)			
g.	Type of Flow							Whether PSH is drainable? (Yes / No)			
h.	Location of Superheater							CircumL. pitch(mm)			
i.	No. of tube rows							LongL. Pitch (mm)			
j.	No. tubes/ row							PSH tube size (OD x THK.)			
k.	PSH tube MOC							PSH provided heating surface (m2)			
l.	Pressure drop (kg/cm2) in PSH							PSH method of support & MOC			

m.	PSH Inlet header size (OD X thk)		MOC of PSH inlet header	
n.	PSH outlet header size (OD X thk)		MOC of PSH O/L header	
o.	Steam Velocity (m/s) in PSH		PWHT requirement	
p.	Ultrasonic test requirement		NDT requirement	
(ii)	SSH (Secondary Superheater)			
a.	Design pressure [kg/cm2 (g)]		Design Temperature (°C)	
b.	Maximum metal temperature (°C)		Whether SSH is drainable? (Yes/ No)	
c.	SSH arrangement (Vert./Horz.)		Type of Flow	
d.	Steam side Heat Transfer Co-efficient (Kcal/M2/Hr/°C)		LMTD (°C)	
e.	Overall Heat Transfer Co-efficient (Kcal/M2/Hr/°C)		Flue gas side Heat Transfer Co-efficient (Kcal/M2/Hr/°C)	
f.	Fouling factor tube side (°C.Hr.m2/kcal)		Fouling factor Flue gas side (°C.Hr.m2/kcal)	
g.	Pressure drop (kg/cm2) in SSH		Steam Velocity (m/s) in SSH	
h.	SSH tube size (OD x THK.)		SSH Duty (Mkcal/hr)	
i.	Location of Superheater		CircumL. pitch(mm) / LongL. Pitch (mm)	
j.	No. of tube rows		No. of tubes/ rows	
k.	SSH tube material		SSH provided heating surface (m2)	
l.	SSH method of support & MOC		Details of superheater spacing arrangement	
m.	Corrosion allowance (mm)		PWHT requirement	
n.	Ultrasonic test requirement		NDT requirement	
o.	Space provided for additional coils(Y / N)		SSH Inlet header size (OD X thk)	
p.	MOC of SSH inlet header		SSH outlet header size (OD X thk)	
q.	MOC of SSH outlet header			
15.6	DESUPERHEATER FOR STEAM TEMPERATURE CONTROL			
a.	Design pressure [kg/cm2 (g)]		Design Temperature (°C)	
b.	Corrosion allowance (mm)		Steam side pressure drop in DSH (kg/cm2)	
c.	Number of Desuperheater		Type of Desuperheater	
d.	Location of desuperheater in steam path		Size of desuperheater piping	
e.	Spray water detail (kg/hr)		100% MCR	80% MCR
f.	Spray water quantity for desuperheater		60% MCR	30%MCR
g.	Material of desuperheater pipe		Operating & design temp. for spray water	
h.	Operating & design press. for spray water		PWHT requirement	
i.	NDT requirement		Ultrasonic test requirement	
15.7	Steam side pressure drop in integral piping from drum to MSSV (kg/cm2)		Steam side pressure drop in piping from MSSV to B/L (kg/cm2)	
a.	No. of safety valve in main steam line		Set pressure safety vale [kg/cm2(g)]	
b.	Capacity of safety valve (kg/hr)		Size of safety valve	
15.8	Down comers			
a.	Number of down comers		Down comers size (OD x THK.)	
b.	MOC of down comers		Type of down comer nozzle	
c.	Corrosion allowance(mm)		Insulation type	
d.	Insulation thickness (mm)		Insulation cladding MOC & thickness(mm)	
e.	Location of Downcomer on header		PWHT requirement	
f.	Ultrasonic test requirement		NDT requirement	
15.9	Risers			
a.	Number of risers		Risers size (OD x THK.)	
b.	Material of construction of risers		Insulation type	
c.	Insulation thickness (mm)		Insulation cladding MOC & thickness	
d.	Corrosion allowance(mm)		Type of riser nozzle	
e.	Location of riser on header		PWHT (Y/N)	
f.	Ultrasonic test(Y/N)		NDT (Y/N)	
15.10	Size of saturated steam pipe (OD X Thk.) - drum to PSH			
15.11	ECONOMISERS			
a.	Design pressure [kg/cm2 (g)]		Design Temperature (°C)	
b.	Maximum tube metal temp (°C)		Eco arrangement (Vert./ Horiz.)	
c.	Type of Economizers (Bare/ Finned)		Location of Economizers	

d.	Type of Flow		LMTD (°C)					
e.	Overall Heat Transfer Co-efficient (Kcal/M2/Hr/°C)		Fouling factor Flue gas side(°C.Hr.m2/kcal)					
f.	Fouling factor tube side(°C.Hr.m2/kcal)		Total provided heating surface (m2)					
g.	Type of fin & MOC		Maximum fin tip temperature (°C)					
h.	Number of blocks for Economiser		Economiser Duty (Mkcal/hr)					
i.	Tube arrangement (Inline /Staggered)		Size of Economiser tubes (OD x THK.)					
j.	Material of Economiser tubes		Size of Economiser headers (OD X THK.)					
k.	No. to tube row		No. of tubes / row					
l.	CircumL. pitch(mm)		LongL. Pitch (mm)					
m.	Projected heating surface (m2)		Pressure drop (kg/cm2)					
n.	Material of economiser header		Space provided for addition of coils(Y/N)					
o.	Type of economizer support & MOC		Water Velocity inside the tubes(m/s)					
p.	Economiser casing material		Economiser casing plate thk.(mm)					
q.	Approach point (°C)		Insulation type					
r.	Insulation thickness		Insulation cladding MOC & thickness					
s.	Excess O2 (%) analyzer at eco outlet		PWHT requirement					
t.	Ultrasonic test requirement		NDT requirement					
16	AIRHEATERS (* Contractor to furnish SCAPH , RAPH details if applicable separately in their format)							
16.1	Type of Airheater envisaged		Orientation of Airheater					
	Detail of Tubular APH							
16.2	Number of blocks of air pre-heater		Type (Gas / Air through tube)					
16.3	Number of tubes per block		Type of arrangement (Inline/ Staggered)					
16.4	Material of tubes		Size of tubes (OD x Thk x L.)					
16.5	Tube side fluid envisaged		Pitch of tube (mm)					
16.6	Type of cleaning provisions		Airheater duty (kcal/hr)					
16.7	LMTD (°C)		Air side heat transfer coefficient (Kcal/M2/Hr/°C)					
16.8	Gas side heat transfer coefficient (Kcal/M2/Hr/°C)		Overall heat transfer coefficient (Kcal/M2/Hr/°C)					
16.9	Fouling factor Flue gas side (°C.Hr.m2/kcal)		Fouling factor air side (°C.Hr.m2/kcal)					
16.10	Total provided heat transfer area (m2)		Type of flow					
16.11	Tube sheet material		Thk. of tube sheets (mm)					
		Air Side	Flue Gas Side					
16.12	Velocity (m/s)							
16.13	Pressure drop (kg/cm2)							
16.14	Provision of cold end anti corrosion of tube							
16.15	Tube to tube sheet joint type		Length of tubes per block					
a.	Plain tubes		APH tube metal temp. at cold end (°C)					
b.	Stay tubes		Dew point temperature of flue gas (°C)					
16.16	Material of construction of casing		Thickness of casing (mm)					
16.17	Total Flue Gas Quantity (kg/hr)		Insulation type					
16.18	Insulation thickness		Total combustion air quantity(kg/hr)					
16.19	Excess O2 (%) analyzer at APH O/L		Insulation cladding material & thickness					
17	BOILER DUCTING							
17.1	Velocity (at MCR) for cold air duct		Velocity (at MCR) for hot air duct					
17.2	Velocity (at MCR) for flue gas duct		MOC /thk.of hot air duct					
17.3	MOC and thk of duct - boiler to eco.		MOC and thk of other flue gas duct					
17.4	Type / MOC of exp. joint for air duct		Type /MOC of exp. joint for the flue gas ducts					
17.5	Location of Duct	Design temp.(°C)	Design pressure (mmwc)	MOC	X- section (m2)	Thk(mm)	Max Vel. (m/s)	Insulation (Y/N)
a.	FD fan to APH							
b.	APH to windbox							
c.	Windbox							

d.	Boiler to stack								
18	BOILER SOOT BLOWING SYSTEM								
18.1	Location of steam tapping for SB system				Pressure of steam at tapping (kg/cm2g)				
18.2	Temp. of steam at tapping point (°C)				Steam Press. of after press. PRV-kg/cm2(g)				
18.3	Steam Temp. after press. reduction (°C)				No & location of LRSB				
18.4	Blowing radius of LRSB (mm)				Lance length of LRSB				
18.5	Duration of cycle of LRSB operation				Steam consum. rate per LRSB				
18.6	Manual retractable in case of motor fail				Number & location of RSB				
18.7	Blowing radius of RSB (mm)				Duration of one cycle of a RSB				
18.8	Duration of cycle of operation of all RSB				Steam consumption rate per RSB				
18.9	Capacity of drive motors for LRSB				Capacity of drive motors for RSB				
19	FD fan								
19.1	No of FD fans (W+S)				Type of drive (Motor/Turbine/Dual) & control				
19.2	Flow at MCR				Design flow				
19.3	Head at MCR (mmwc)				Design Head (mmwc)				
19.4	Bearing temp. (°C)				Winding temp.(°C)				
20	Boiler Feed Pump								
20.1	No of BFP (W+S)				Type of drive (Motor/Turbine/Dual) & control				
20.2	Flow at MCR				Design flow				
20.3	Head at MCR (kg/cm2 g)				Design Head (kg/cm2g)				
20.4	Bearing temp. (°C)				Winding temp.(°C)				
21	SWAS parameter & analyzer details								
	Parameter	Feed water	Drum water	Sat. steam	SH steam	DM water	Deaerator O/L	Condensate	DM water @ BD heat exchanger
i.	Silica (ppm)						-		-
ii.	pH						-		-
iii.	Conductivity (micro-mho/cm)						-		
iv.	Sodium (ppm)	-	-			-	-	-	-
v.	O2 (ppm)	-	-	-	-	-		-	-
22	Stack								
22.1	Stack type (ground mounted / guided)				Design code				
22.2	Stack design temperature (°C)				Stack operating temperature (°C)				
22.3	Stack design pressure (maximum & minimum) -mmwc				Stack operating pressure (maximum & minimum)- mmwc				
22.4	Stack inlet flue gas pressure (mmwc)				Stack inlet flue gas temperature (°C)				
22.5	Stack top temperature considering heat loss (°C)				At normal load			At turn down load	
22.6	Acid dew point of flue gases at MCR				For Main fuel			For Alternate fuel	
22.7	Max.skin temperature of Stack (°C)				Stack draft (mmwc)				
22.8	Dia. at top (mm)				Dia./size at flue gas entry (mm)				
22.9	Dia. at base (mm)				Stack height (m)				
22.10	Flue gas entry angle				Access door size & qty (above bottom plate & below conical bottom plate)				
22.11	Painter trolley				Strake thickness (mm)				
22.12	Lightning arrester				Earthing lug				
22.13	Thickness of stack plate (mm)				Corrosion allowance (mm)				
22.14	Velocity of flue gas at exit (m/s) ??				Material of construction				
22.15	Type of internal lining				Refractory material & thickness				
22.16	Type of insulation, density & thickness				Anchor type & MOC				
22.17	PMN nozzle elevation (as per CPCB)								
22.18	Online stack analyses & emission at MCR (mg/NM3)								
i.	NOx			SOx		HC			
ii.	SPM			CO		H2O			
22.19	Nozzle schedule								

	Description	Qty	MOC	Size			Flange			Noz. no./ Tag	Remark						
				NB	SCH	Thk	Type	Rating	Face/ Finish								
i.	CEMS (SOx, NOx, HC,CO analyzer)																
ii.	SPM analyzer																
iii.	Press. monitoring																
iv.	Temp. monitoring																
v.	Sampling port (poll. moni.)																
vi.	Spare tapping																
vii.	Flue gas inlet																
viii.	Access door																
ix.																	
x.																	
xi.																	
xii.																	
23	HP Dosing system																
23.1	No. of tank			Type of tank & Make													
23.2	Location of dosing			Tank MOC													
23.3	Fluid to be handled & its concentration (as available in market and as made in the tank)			Usable Capacity (between tank outlet & overflow)													
23.4	Level measuring instrument provided			Tank size (dia./thk/height)													
23.5	Motor rating for agitator			Type of HP dosing Pump													
23.6	No. of HP dosing pump (W+S)			Medium to be handled													
23.7	Flow control method			Pump capacity													
23.8	Material of pump internal and piping			Type of mixture													
23.9	Inlet pressure -kg/cm2 (g)			Rated Discharge pressure-kg/cm2(g)													
23.10	Motor rating & RPM of Pump			Normal discharge pressure-kg/cm2(g)													
23.11	Weight of unit (kg)																
23.12	Suction strainer	Type	Size	MOC	Pressure drop in strainer (kg/cm2)			Clean condition	50% Clogged condition								
24	LP Dosing system # 1 (pH correction)																
24.1	No. of tank			Type of tank & Make													
24.2	Fluid to be handled & its concentration (as available in market and as made in the tank)			Tank MOC													
24.3	Level measuring instrument provided			Tank size (dia./thk/height)													
24.4	Motor rating for agitator			Type LP Dosing of Pump													
24.5	No. of pump (W+S)			Medium to be handled													
24.6	Flow control method			Inlet pressure - kg/cm2(g)													
24.7	Pump capacity			Rated Discharge pressure-kg/cm2(g)													
24.8	Material of pump internal and piping			Type of mixture													
24.9	Motor rating of Pump			Normal discharge pressure-kg/cm2(g)													
24.10	Weight of unit (kg)																
24.11	Suction strainer	Type	Size	MOC	Pressure drop in strainer (kg/cm2)			Clean condition	50% Clogged condition								
25	LP Dosing system # 2 (O2 Scavenger)																
25.1	No. of tank			Type of tank & Make													
25.2	Fluid to be handled & its concentration (as available in market and as made in the tank)			Tank MOC													
25.3	Level measuring instrument provided			Tank size (dia./thk/height)													
25.4	Motor rating for agitator			Type LP Dosing of Pump													
25.5	No. of pump (W+S)			Medium to be handled													
25.6	Flow control method			Inlet pressure - kg/cm2(g)													
25.7	Pump capacity			Rated Discharge pressure-kg/cm2(g)													

25.8	Material of pump internal and piping				Type of mixture	
25.9	Motor rating of Pump				Normal discharge pressure-kg/cm2(g)	
25.10	Weight of unit (kg)					
25.11	Suction strainer	Type	Size	MOC	Pressure drop in strainer (kg/cm2)	Clean condition 50% Clogged condition
26	CBD Tank					
26.1	Size of tank, OD x Height				Operating Pressure (kg/cm2 g)	
26.2	Operating temperature (°C)				Design Pressure (kg/cm2 g)	
26.3	Design Temperature (°C)				MOC of tank & thk (mm)	
26.4	Blow down at MCR (%)				Design blow down capacity (%)	
26.5	Manhole size				Corrosion allowance (mm)	
26.6	Safety valve set press.(kg/cm2-g)				Safety valve size & rating	
26.7	Type of insulation & thickness(mm)				Type of cladding & thickness (mm)	
27	IBD Tank					
27.1	Size of tank, OD x Height				Operating Pressure(kg/cm2 g)	
27.2	Operating temperature (°C)				Design Pressure(kg/cm2 g)	
27.3	Design temperature (°C)				MOC of tank & thk.	
27.4	Blow down at MCR (%)				Design blow down capacity (%)	
27.5	Manhole size				Corrosion Allowance (mm)	
27.6	Type of insulation & thickness(mm)				Type of cladding & thickness (mm)	
27.7	Blow down cooling arrangement					
28	Power Consumption at 100% MCR					
28.1	FD Fan (KW)				Boiler Feed Pump (KW)	
28.2	Fuel pump (KW)				HP dosing pump (KW)	
28.3	LP dosing pump (KW)				Scanner air Fan (KW)	
28.4	Seal air fan (KW)				Lube oil Pumps for BFW (kw)	
28.5	API Seal Plan Pumps (kw)					
28.6	Any other Continuous Running Equipment (KW)					
	i)				iii)	
	ii)				vi)	
	Total Auxiliaries Power Consumption at 100% MCR (KW)					
Note-						
1) This data is only for information. It is Contractor's responsibility to fulfil all contractual requirements.						
2) Contractor to mention separately if any other value of corrosion allowance considered for any component other than details mentioned above.						
3) Contractor to furnish details in separate sheet if any item / component not covered in this data sheet.						

BURNER DATASHEET

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PURCHASER/OWNER :		ITEM NO. :		
PROJECT NAME:		JOB NO.		
SERVICE :		LOCATION :		
1	GENERAL DATA :			REV
2	BURNER DESIGN & CONSTRUCTION CODE /STD			
3	ALTITUDE ABOVE SEA LEVEL, m (MIN/ NOR / MAX)			
4	AIR SUPPLY :			
5	AMBIENT / PREHEATED AIR / GAS TURBINE EXHAUST			
6	TEMPERATURE, °C (MIN. /NOR./MAX.)			
7	RELATIVE HUMIDITY, %			
8	DRAFT TYPE : FORCED / NATURAL / INDUCED			
9	DRAFT AVAILABLE : AT BURNER mmWC			
10	COMB. AIR Δ P : ACROSS BURNER mmWC			
11	TURNDOWN FOR ALL FUELS			
12	BURNER DATA			
13	MANUFACTURER			
14	TYPE OF BURNER	LOW NOx, COMBINATION (OIL & GAS), STAGED AIR, FORCED DRAFT		
15	MODEL / SIZE			
16	DIRECTION OF FIRING			
17	LOCATION (FRONT/ TANGENTIAL)			
18	NUMBER REQUIRED			
19	PILOTS :			
20	NUMBER REQUIRED			
21	TYPE			
22	IGNITION METHOD			
23	FUEL			
24	FUEL PRESSURE, Kg/cm ² G			
25	CAPACITY, MMkCal/hr (MAX./MIN.)			
26	OPERATING DATA :	Fuel wise data		
27	FUEL			
28	HEAT RELEASE PER BURNER, MMkCal/hr (LHV)			
29	DESIGN CASE			
30	NORMAL CASE			
31	MINIMUM CASE			
32	EXCESS AIR (%)			
33	AIR TEMPERATURE, °C (MIN. /NOR./MAX.)			
34	FUEL PRESSURE REQUIRED, Kg/cm ² G @ BURNER			
35	FLAME HEIGHT/DIA. @ DESIGN HEAT RELEASE, m (MAX)			
36	ATOMIZING MEDIUM / OIL RATIO, kg/kg			
NOTES :				

0	6/2/2025	ISSUED WITH TENDER	PK	SBC/AD	DD
REV	DATE	DESCRIPTION	BY	CHK	APPD

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GASEOUS FUEL CHARACTERISTICS								REV
1	FUEL TYPE							
2	HEATING VALUE (LHV), (KCal / kg)							
3	SPECIFIC GRAVITY (AIR = 1.0)							
4	MOLECULAR WEIGHT							
5	FUEL TEMPERATURE @ BURNER, °C (NOR / MAX)							
6	FUEL PRESSURE AVAILABLE @BURNER,Kg/cm ² G							
7	FUEL GAS COMPOSITION (MOLE %),	H2						
8		H2S (PPM)						
9		H2O						
10		N2						
11		O2						
12		CO						
13		CO2						
14		C1						
15		C2 / C2=						
16		C3 / C3=						
17		iC4 / nC4						
18		C4= / C5+						
19	TOTAL							
LIQUID FUEL CHARACTERISTICS								
21	FUEL TYPE							
22	HEATING VALUE (LHV) , kCal / kg							
23	SPECIFIC GRAVITY (AT 15°C)							
24	H / C RATIO (BY WEIGHT)							
25	VISCOSITY, (CST) @50°C							
26	@-°C							
27	@-°C							
28	NICKEL, ppmw							
29	VANADIUM, ppmw							
30	SODIUM, ppmw							
31	COPPER, ppmw							
32	IRON, ppmw							
33	WATER, ppmw							
34	CALCIUM, ppmw							
35	CARBON RESIDUE (CCR), % WT							
36	POUR POINT, °C							
37	FIXED NITROGEN, ppmw							
38	SULFUR, % WT							
39	ASH, %WT							
40	CETANE NUMBER							
41	DISTILLATION : ASTM INITIAL BOIL. PT, °C							
42	ASTM MID. POINT, °C							
43	ASTM END POINT, °C							
44	ACIDITY, mg KOH/g							
45	FLASH POINT, °C							
46	FUEL TEMPERATURE @ BURNER, °C							
47	FUEL PRESSURE AVAILABLE @ BURNER,kg/cm ² G							
48	ATOMIZING MEDIUM : AIR / STEAM / MECHANICAL							
49	: TEMPERATURE, °C							
50	: PRESSURE, Kg/cm ² G							
51	FUEL OIL RETURN HEADER PR.@BURNER, kg/cm ² G							
52	VISCOSITY AT OPERATING TEMP. (CST)							
53	VENDOR TO FURNISH RECOMMENDED ALARM VALUES FOR LIQUID FUEL, FUEL GAS & PILOT GAS AS PER BELOW TABLE:							
	RECOMMENDED ALARM VALUE(KG/CM2G)	LIQUID FUEL	FUEL GAS	PILOT GAS				
	LOW-LOW PRESSURE TRIP							
	LOW PRESSURE ALARM							
	HIGH PRESSURE ALARM							
	HIGH HIGH PRESSURE TRIP							
	RECOMMENDED PRESSURE DIFFERENTIAL(IN KG/CM2G) BETWEEN LIQUID FUEL AND ATOMIZING STEAM/ AIR(PDLL) =							

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MISCELLANEOUS			
1	BURNER PLENUM : COMMON / INTERNAL		REV
2	MATERIAL		
3	PLATE THICKNESS, mm		
4	INTERNAL INSULATION		
5	INLET AIR CONTROL : DAMPER OR REGISTERS		
6	MODE OF OPERATION		
7	LEAKAGE, %		
8	BURNER TILE / LINING : COMPOSITION		
9	MINIMUM SERVICE TEMPERATURE, °C		
10	NOISE SPECIFICATION, dBA (SPL at 1m)		
11	ATTENUATION METHOD		
12	PAINTING REQUIREMENTS /SPECIFICATION		
13	IGNITION PORT : SIZE / NO.		
14	SIGHT PORT SIZE / NO.		
15	FLAME DETECTION : TYPE		
16	NUMBER		
17	SCANNER CONNECTION : SIZE/NO.		
18	SAFETY INTERLOCK SYSTEM FOR ATOMIZING MEDIUM & OIL		
19	EMISSION CORRECTED TO 3 VOL% O₂ (DRY BASIS)		
20	NOx • mg/Nm ³		
21	CO • mg/Nm ³		
22	UHC • mg/Nm ³		
23	PARTICULATES • mg/Nm ³		
24	SOx • mg/Nm ³		
25			
26	ELECTRICAL AREA CLASSIFICATION		
27	BURNER MATERIALS		
28	CASING		
29	BURNER TILE / LINING :		
30	OIL TIP		
31	GAS TIP		
32	PILOT TIP / SHIELD		
33	OIL PIPE		
34	GAS PIPE/ GAS MANIFOLD/ GAS FLANGE/ PILOT PIPE/ PILOT FLANGE		
35	CONNECTIONS		
36	GAS SUPPLY		
37	OIL SUPPLY		
38	ATOMISING MEDIUM		
39	PILOT GAS		
40	PRESSURE CONNECTION ON WIND BOX		
41	NOTES :		

SCOPE OF SUPPLY / WORK & SERVICES FOR STEAM GENERATION PACKAGE (FED)

PROJECT : ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES, BINA
PETCHEM & REFINERY EXPANSION PROJECT (BPREP)

UNIT : STEAM GENERATION PACKAGE (Unit No. 420)

OWNER : BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

PMC : ENGINEERS INDIA LIMITED.

JOB NO. : B957

0	10.02.2025	ISSUED WITH TENDER	PK	KS/AD	DD
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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4.0	SCOPE OF SERVICES / WORK	8
5.0	EXCLUSION	13

1.0 INTRODUCTION

Bharat Petroleum Corporation Limited (BPCL) is operating a 7.5 MMTPA (on 8000 hrs per year basis) Bina Refinery (BR) at Sagar, Madhya Pradesh. The existing refinery is producing MS and HSD conforming to BS VI specifications by processing of high sulfur crudes besides other petroleum products like LPG, Naphtha, Kerosene, ATF, Petcoke and Sulphur. In order to remain competitive and improve refinery profitability further, Bina Refinery (BR) has embarked on Petrochemical Diversification Plan and as a part of further expansion of Petrochemical portfolio, it is intended to set up world scale Ethylene Cracker & Associated Units and Ethylene and Propylene based Petrochemical units for its diversification to Petrochemicals along with expansion of its refinery capacity to about 11 MMTPA.. To cater the steam requirement, a new steam generating unit is planned to be execute as a single package.

2.0 PREAMBLE

This entire package shall be handled as a single point responsibility vendor (SPRV) basis i.e. Project management, design, engineering, detailing, procurement engineering, procurement of raw materials and bought outs, manufacturing, fabrication, assembly, testing, inspection, painting, insulation, packing & forwarding, supply, transportation, receiving at site, unloading, site handling, site storage & preservations, site local transportation, site piling, civil foundation construction & underground facilities as necessary, site construction, & assembly, erection & alignment, grouting of complete system, installation, hook up with all interfaces, box up, site testing, painting, final painting, insulation & lining, pre-commissioning, refractory dry out, alkali boil out, chemical wash, steam flashing, start up, commissioning, HAZOP & SIL study, 3D modeling, documentation as required, enabling facilities, clearance of waste generated at site during site construction/installation, Performance guarantee test run, Performance & workmanship guarantees and hand-over to client are package contractor responsibility.

Contractor shall design the equipment, sub systems & systems / facilities as necessary to suit the available plot area earned mark for Steam Generation system including boilers, its associated auxiliaries & accessories, fuels facility, utility systems etc. as indicated in the Indicative "Equipment Layout", design basis, P&ID of plant attached elsewhere in the tender.

Contractor scope of supplies shall cover for all necessary items / components / equipment / systems / facilities including instrumentation & controls, electrical auxiliaries & accessories, cables as necessary for instruments & electrical, piping, pipe fittings valves, pipe supports, structures, pipe rack, finger pipe racks, ducting, supports, platforms, staircases, ladders, underground system & facilities, material associated to civil foundation, construction, grouting & alignment, underground piping & systems, trench for cables, duct & trays for cables, firefighting system & its network along with controls/instrumentation, materials associated to fire proofing as necessary, temporary facilities & arrangement for all kind of tests at works & site, safety system & spares as necessary, consumables, erection materials & machineries, lifting cranes, tools & tackles, jigs & fixtures etc. for complete execution of the Steam Generation package.

The scope of work listed herein is not limiting but all necessary works, required to make the steam generation package in all respect including design, engineering, analysis, study, statutory approvals & permits, documentations, procurements, manufacturing, assembly, erection, hook up, testing, inspection, packing & forwarding, transportation, material loading & unloading at works & site, assembly & erection/installation, pre commissioning, commissioning, performance guarantee test run, operation & maintenance (before handover) are in package contractor's scope and deemed specified.

The Contractor shall read this scope of supply/work document in conjunction with job specification (Document No: B957-420-80-44-SP-3001), process datasheet (Doc. No: B957-420-80-44-DS-3201), design basis (Doc. No: B957-420-80-44-DB-3201), along with other interface departments (i.e. piping, electrical, instrumentation, structure/ civil/ underground system, SME, Inspection, ETDD etc.) design basis, scope of supply /work, job specifications, standard specifications, standards, instructions, and guidelines attached elsewhere in the tender.

Contractor has to ensure utmost care particularly to the technical requirements and scope of work under this tender and all documents forming part of this tender are harmonized. It shall be entirely contractor's responsibility to study and understand the technical requirements and scope of work defined in the tender during pre-bid, bidding & execution. Any ambiguity/ discrepancy noticed & clarification sought by the bidder shall be brought to the notice of PMC / Owner and sorted out / getting clarified at pre-bid stage only before submission of his offer. In absence of same, interpretation of scope of work and technical requirements by PMC / Owner shall be the final and be binding on the bidder / contractor.

3.0 SCOPE OF SUPPLY

- 3.1 The Steam Generation package comprises the following major systems / sub systems / components / equipment's mentioned are as minimum. However, bidder shall include in his offer, if any other additional items / components / equipment /system required for smooth operation & maintenance and highlight the same.
- 3.1.1 Boiler system shall consists of firing & fuel feeding systems, burners, water wall membrane furnace along with super heaters, Steam drum, attemperator/desuperheater, evaporators, risers & downcomers, economizer, feed water control system, CBD & IBD blow down systems, SCAP & APH system (as necessary) steel stack, flue gas/air ducting, expansion bellows, Soot Blowers, instrumentations & controls, electrical, integral & non integral piping, utility piping, valves, pipe fittings, support, & structures along with insulation, refractory, structures, supports, platforms, staircases, ladders etc.
- 3.1.2 Boiler system shall consist of associated necessary auxiliaries / accessories & facilities i.e. FD fan with drives, seal & scanners fans with drives, dosing systems, SWAS & CEMS systems, deaerator & storage system, Boiler Feed water pumping system with drives along with necessary electrical, instrumentation & controls, piping, valves, tubing, supports, insulation, structures & platform with staircases & ladders,
- 3.1.3 FD fans system shall include drives, suction stack, filters, necessary IGV /dampers, isolation, duct system along with supports etc.
- 3.1.4 Deaerator & storage system along with Vent Condenser and necessary accessories & auxiliaries. For details refer to process datasheet & design basis.
- 3.1.5 Boiler Feed water pumping systems along with necessary, shed, accessories & auxiliaries. For details refer to process datasheet & design basis.
- 3.1.6 Boiler feed water LP chemical dosing systems for oxygen scavenging & pH control along with necessary accessories & auxiliaries. For details refer to process datasheet & design basis.
- 3.1.7 HP chemical dosing systems for PH control of Boiler steam drum water along with necessary accessories & auxiliaries. For details refer to process datasheet & design basis.
- 3.1.8 Pressure Reducing & De-super systems (PRDS) along with necessary accessories, instrumentation & controls, valves, piping, fittings, structures, insulation, painting etc. For details refer to process datasheet & design basis.
- 3.1.9 Main fuel, alternative & start-up fuels systems i.e. fuel gas, natural gas/ refinery fuel gas / cracker

off gas, PFO, Fuel oil, fuel storage system, fuel pumping & forwarding system, Close blowdown tank (underground) with pumps, gas conditioning facilities and arrangement along with all auxiliaries / accessories, instrumentation & controls, electrical, valves, filter, KOD, piping, fittings, insulation, painting etc. for smooth operation. For details refer to process datasheet & design basis.

- 3.1.10 All electrical equipment inside battery limit of steam generation system including substation as defined in electrical design basis, scope & supply documents, job specifications, standards attached elsewhere in the tender and Package contractor to refer the same for details scope of supply, work & services.
- 3.1.11 Online continuous stack monitoring system along with all necessary accessories / tubing / isolation / fittings/interface connectivity, supports etc.
- 3.1.12 All necessary materials & accessories for firefighting system (A/G & UG), fire water network / tapping / distribution / stations / sprinkler / spray system/ foam system within battery limit along with necessary connectivity/ hook ups, interface within the system and Boilers, auxiliaries, facilities, instrumentation, electrical, piping, valves, fittings, structures, supports etc.
- 3.1.13 Supply of necessary material & accessories for Fire proofing of steel structures, supports & skirts etc.
- 3.1.14 All raw & bought outs material for civil foundation, grouting, templates, underground system along with necessary piping, junctions, RCC trenches, drains, manholes, pits, connections, funnels, fittings, joints, connectivity etc.
- 3.1.15 Safety system including eye wash & safety shower near the chemical dosing systems.
- 3.1.16 Supply, erection. Installation, commissioning of BMS & soot blower PLC in package vendor's scope. For further details, refer to Instrumentation design basis, scope & supply documents, job specifications & standards attached elsewhere in the tender.
- 3.1.17 Supply of all outgoing power cables and associated control cables, lightening cables within the Steam Generation Package battery limit are in package vendor scope, supply & work. For further details, refer to electrical design basis, scope & supply documents, job specifications, guidelines & instructions attached elsewhere in the tender.
- 3.1.18 Supply of cable trays, cable ducts, supports, RCC cable trenches, conduits, ERCs (Electrical Road Crossings) within the package battery limit for all cables by package contractor.
- 3.1.19 All Instrumentation & controls inside battery limit of steam generation system including SRR as defined in instrumentation design basis, scope & supply documents, job specifications, standards, guidelines and instructions attached elsewhere in tender and Package contractor to refer the same for details scope of supply & work.
- 3.1.20 All building, rooms & shed inside the package B/L like SRR, Substation, SWAS, CEMS, BFW pumps, dosing skids, burner area and steam drum platforms etc. along with structures, interfaces, access & approach bay and necessary facilities by package contractor.
- 3.1.21 Provision of maintenance & operational ease with EOT cranes, chain Pulley & block system (as necessary) for boiler area, FD fans area, burners, PRDSs system, Deaerator area, BFW pumps area and other items as necessary are to be ensured by package contractor as per SME design basis / Specification & standards attached elsewhere attached in Tender.
- 3.1.22 Supply of Mandatory spares, spares for assembly, erection, pre commissioning & commissioning for each equipment/system/component are to be supplied by package vendor.
- 3.1.23 Supply of consumables, chemicals & lubricants required for construction, assembly, erection, alkali boil out, chemical cleaning, steam flushing, pre-commissioning, startup, commissioning, and performance guarantee testing of Boiler, its associated auxiliaries & accessories systems / facility for first fill and use of before handover to client is under the scope of steam generation package contractor.

- 3.1.24 Supply of chemicals & consumables for six-month operations of steam generation package shall be supplied by package contractor for using after final handover.
- 3.1.25 Pipe racks & finger pipe racks inside the steam generation package within B/L wherever required.
- 3.1.26 Supply of plant illumination / lighting systems along with necessary accessories / fittings, earthing, lightning protection are in package vendor scope.
- 3.1.27 Permanent & temporary all necessary piping system, fittings, flexible / hose pipes, gauges, valves, isolations, fittings, blinds, flanges, gaskets, fasteners, test nozzles wherever required for smooth testing, execution & operation of Boiler unit.
- 3.1.28 Supply of necessary insulation, refractory, painting, final painting materials for the steam generation package in contractor scope.
- 3.1.29 Structures, supports, platforms, staircases, ladders etc. wherever required for smooth operation, maintenance and ease of approach in contractor scope.
- 3.1.30 Documentations preparation related to design, engineering, analysis, performing calculations, detailing, calculations & documents / drawing for statutory approval & permit as applicable and defined in this specifications, datasheet, LPC & VDR attached elsewhere in the tender including all interface departments specifications / VDR are in contractor scope.
- 3.1.31 Package Contractor to use the Smart plant P&ID for preparations of all P&IDs, Inputs for smart plant P&ID version is given elsewhere in the tender.

3.2 The Steam Generation system

There shall be one number (01) of natural circulation, membrane panel type water tube boiler for generating steam. Boiler system shall consist of the following but not limited to the list given below:

- 3.2.1 Steam drum with manholes & suitable proven internals.
- 3.2.2 Super-heaters system with attemperators / De-superheaters.
- 3.2.3 Evaporator system, boiler banks and furnace with membrane water wall construction including necessary connecting headers & piping.
- 3.2.4 Economizers (non-steaming type) system with manifolds / headers, piping and ducts/expansion joints / casing.
- 3.2.5 Riser & down comer systems
- 3.2.6 Integral & non integral piping, FW water piping system, Main Steam piping, start-up vents piping, fittings and mountings etc.
- 3.2.7 Pressure parts supports/ boiler bottom supports/sling supports/hangers as applicable.
- 3.2.8 Natural gas, Fuel Oil / Refinery fuel gas / cracker off gas, PFO, Fuel oil storage & pumping, forwarding & filtering system with all necessary accessories system
- 3.2.9 Low NOx Burners, accessories, piping, controls and instrumentation.
- 3.2.10 Air Pre-heater system (as applicable) & associated ducts/ structure & supports
- 3.2.11 Dedicated PLC based Burner Management System (BMS) required for Boiler Burner operation from DCS including all interfaces provision as well as manual operation from local panel for Boiler, whenever required by Operators.
- 3.2.12 Soot Blowers system along with PLC & interface with DCS for boiler system and economizers.
- 3.2.13 Oxygen analyzer shall be provided in flue gas at Boiler Economizer outlet for firing control.

- 3.2.14 Dual drives FD Fan for boiler. Fan shall comprise with inlet screen & suction filter, venturi, inlet guide vanes, control system, coupling & coupling guards, safety devices, instrumentation & controls etc. Provision shall be made to enable to start FD fan from DCS as well as local control system.
- 3.2.15 Scanner Air & Seal Air fans for boiler shall be provided separately along with ducting / structure / supports system. Combined scanner air & Seal air fans is not permitted.
- 3.2.16 Feed control station includes (1 x 30 %) control valve for start-up shall be designed for high differential pressure and 2 x 100 % control valve for normal operation for boiler. For details, refer design basis.
- 3.2.17 Grade mounted self-supporting steel stack for boiler system shall be provided by package Contractor. Complete stack materials, construction, assembly, testing, supply including instruments, electrical, accessories, refractory & insulation, statutory & environmental accessories, aviation lights, painter trolley, bosun chair, platforms, ladders in all respect shall be in package contractor scope.
- 3.2.18 Continuous on-line stack monitoring system consisting sample line probes, tubing, analyzers etc. for analysis of SO_x, NO_x, HC, CO & SPM shall be provided separately on the main stack of boiler as minimum.
- 3.2.19 Stack Monitoring system readings shall be made available in DCS & further necessary provision to transmit CEMS analyzer reading directly to the MOEFCC & CPCB/SPCB server shall be in contractor scope.
- 3.2.20 Sample coolers with manual sampling point shall be provided at operating floor or grade level or SWAS room for superheated steam, saturated steam, steam drum water and feed water and blow down water line separately for UB system.
- 3.2.21 Drum operating & burner area platforms shall be covered from the top with shed and side sheeting (at least 1.5 m) shall be provided to prevent entering rain water considering proper ventilation of Boiler system.
- 3.2.22 The contractor shall provide separate local control panel at each burner floors along with ESD alarm monitor, push button and indications light etc.
- 3.2.23 The Continuous blow down (CBD) tank and Intermittent Blow down (IBD) tank system for Steam Generation system boiler shall be provided including control valve, solenoid operated valve to ensure to avoid drying of boiler, isolation valve, necessary piping, mountings, instrumentations, fittings & structural platforms / supporting etc.
- 3.2.24 Blow down from IBD tank shall be cooled in heat exchangers and shall be routed (by gravity) to a underground blowdown pit and then pumped (2 x 100% pumps) to B/L.
- 3.2.25 All Motor operated valves for UB as per the design basis & process datasheet.
- 3.2.26 Refractory, linings, insulation and cladding as applicable in the package.
- 3.2.27 Mountings & appurtenances etc.
- 3.2.28 All interface connecting flanges, gaskets, bolts
- 3.2.29 All safety valves with independent & separate silencers for drum, super-heaters & start-up vent. There shall be dedicated silencer for each steam safety valve. Common silencer with partition plates for multiple safety valves is not permitted.
- 3.2.30 Auxiliary equipment i.e. SWAS system & shelter/ room (air conditioned), Stack analyzers & CEMS Shelter (air conditioned), Sample Coolers etc. For details, refer Design basis.
- 3.2.31 Necessary spares for erection, pre-commissioning, startup, commissioning and mandatory (as defined in tender).

- 3.2.32 Field Instrumentation & cabling for BMS/ Boiler associated auxiliaries & accessories PLCs and interface connectivity for DCS system up to control room.
- 3.2.33 All piping up to Piping Battery Limit & hook-up as given elsewhere in the tender.
- 3.2.34 All structural items/members and activities within the B/L is in contractor scope.
- 3.2.35 Expansion joints in ducts and inlet of stack
- 3.2.36 Any other items required as per OEM design philosophy for normal, safe & smooth operation are in contractor scope.

Bidder/ Contractor shall follow all interface EIL departments (i.e. Piping, structure, Instrumentation, Electrical, SME, ETDD, Inspection etc.) requirements/scope in their specifications, design basis, standard specifications, standards, guidelines and instructions for detailed technical requirements attached elsewhere intender.

4.0 SCOPE OF SERVICES /WORK

It is bidder / package contractor responsibility & scope work / services to submit all necessary documentations / drawings / calculations, criteria & analysis including bought outs for review of EIL/Owner and get incorporated all comments/ suggestions & resolution provided by EIL / Owner without any cost and time implication.

The Bidder's scope of services/work shall be read in conjunction with interface departments scope of work & services, design basis & specification documents as attached elsewhere in tender. Scope of work / services shall be executed by package contractor in a single point responsibility basis and shall include, but not limited to the following:

- 4.1. Detailed process, Thermal, hydraulic design, process simulations and configurations, finalization of criteria for design, engineering, sizing, detailed engineering, selection of material based on service conditions including preparation of P&IDs, PFDs, Heat & mass balance diagrams (for all operating scenarios), HMBDs, components selection criteria & basis, firing philosophy, controls and logic diagrams, interlock schemes & diagrams, cause & effect diagrams, philosophy write ups for all systems / equipment's / items/ components / auxiliaries / accessories / facilities of complete Steam Generation system within battery limit.
- 4.2. Preparation of datasheets for each system / sub system i.e. Boiler & associated auxiliaries/accessories, Air Pre-heater system, burners, blowers, FD fans, Soot blowers, blowers for scanners & seal air, Stack, Deaerator system, Feed Water heating & pumping system, condensate / DM water system, PRDSs system, dosing systems, SWAS & CEMS system, blow down system, fuel forwarding & firing system, EOT cranes, chain-pulley & blocks including all bought outs, instrumentation & controls, electrical, PSV's, MOV expansion joints, dampers, silencers etc.
- 4.3. Preparation of datasheets for boiler system separately indicating details of furnace wall configuration / coils/tubes, evaporators configuration / tubes / coils, super heaters configuration / tubes / coils, screen tubes, economizers configuration / coils / tubes, drums, headers & manifolds, riser & down comers, furnace & convection section configurations, design & operating pressure & temperature in steam / water side and flue gas side in each section / outlet of each components, approach & pinch temperature at various sections, pressure drops in flue gas & steam side at various sections, sizes, thickness, dimensions, material of construction of each & every components, corrosion allowances of each components, refractory & lining requirements, insulation requirements including thickness & material, painting requirements.
- 4.4. Purchase Specifications for all bought-out items/components shall be prepared by contractor

for approval of Owner/PMC before placement of order.

- 4.5. Datasheets for all bought outs/valves/instruments/electrical etc.
- 4.6. Detailed design engineering / drawings & documents & design calculations / analysis of complete systems including mechanical, structural, supporting system, piping, instrumentation, electrical, bought outs, pipe racks, refractory, insulations etc.
- 4.7. Procurement engineering for raw materials, bought outs for equipment/items/components, piping & fittings, valves, refractory, lining, insulation, painting, instrumentation, control systems, electrical, safety system & arrangement etc.
- 4.8. Preparation of detailed equipment, foundation loading plan layout (includes information i.e. foundation load data along with base plate/anchor bolts details, hard stand requirements and detailed basis of calculation for each equipment of steam generation and these information shall be appropriately covered in document "Overall foundation layout" as per VDR Doc. No.: B957-420-81-41-VDR-7410), equipment/components GADs, section plan layout, component assembly, pressure parts assembly & drawings, code design calculations, support system drawing / details and stress analysis, piping layout, isometrics, fabrication & manufacturing drawings, construction drawings / documents, battery limit hook ups drawing / documents and all other necessary documentations as required in all respect to complete the job are in package contractor scope.
- 4.9. IBR approval for complete pressure parts / equipment / components drawings/documents along with detailed design & stress calculations for manufacturing state and installation states. Contractor shall get incorporated EIL/Owner comments in drawings and design calculations before seeking IBR approval.
- 4.10. Detailed design, analysis, calculations, drawing/documents preparation, approvals of all structural work & piping activities / work including ducting & supporting systems.
- 4.11. Flexibility analysis for riser / down comer, all piping including steam, BFW, DM, Condensate, cooling water, service water, Air, fuel lines etc. up to 1st Isolation valve for Steam Generation plant up to B/L.
- 4.12. Complete design engineering of necessary underground facilities, detail out the facilities required for collection and disposal of liquids effluents. Civil engineering, drawing/documents preparation, approvals, materials procurement, supply, arrangement including machineries / tools / tackles / jigs & fixtures for implementation at site, site works, testing, inspection such as drains, paving, provisions / connections of blow down, oily waste, storm sewers, sump, cooling water supply / return, process, condensate drain system, drinking water system and OWS within B/L & around the plant area as per structural specifications, standards, instruction, guidelines attached in tender.
- 4.13. Design Engineering, supply, work and implementation of Storm water drainage arrangement for CRWS, contaminated rain water, fire water and approach roads reach to unit from main roads existing all around unit providing culverts at crossing, ERCs, IRCs pipe way bridges are in package vendor scope.
- 4.14. Complete civil and foundation design – engineering including piling, layout, drawing / documents preparation, finalization of foundation loadings for implementations, Super-structure of Pipe Racks, all equipment, technological Structure, Operator cabin), Operating & Maintenance Platforms, Architectural sheeting & Ventilation works whatsoever required within Battery Limit area along with statutory & local approvals, materials procurements, supply, arrangement for implementation at site, site civil work & foundations works, inspections, testing

in all respects for erection of equipment /items /systems /facilities, approach roads, drains, trenches, pavements, maintenance/operational area along with all necessary machineries, templates required at site, tools, tackles, jigs & fixtures for complete Boiler system & its associated auxiliaries, accessories & facilities.

- 4.15. Design, engineering and installation of Fire alarm & plant communication systems, equipment and accessories are package contractor scope with the battery limit of package.
- 4.16. Design, engineering, installation, testing and commissioning of CCTV is in package contractor scope. Package contractor shall perform these activities through Owner's existing CPP CCTV OEM.
- 4.17. All work related to laying, hook up & Installations of all cable trays, cable ducts, supports, RCC cable trenches, conduits, ERCs (Electrical Road Crossings) within the package battery limit for all cables by package contractor.
- 4.18. Earth work in excavation and filling for Micro grading & disposal of surplus Earth is in package vendor scope.
- 4.19. All Architectural works, Plumbing and drainage works, etc. in package vendor scope, supply, work & responsibility
- 4.20. Overall dimensional drawings / documents for all the modules, skids, pre-fabricated & loose items along with weight, lifting points & arrangements, anchoring points, packing and forwarding arrangement for each items/equipment's/system of Steam Generation system and associate auxiliaries.
- 4.21. Requirement of hardstand for erection/installation of various equipment / components / modules / skids / sub systems in site shall be in contractor scope including materials supply, civil construction and arrangements in all respect.
- 4.22. Preparation of procedures and guidelines for modularization, transportation, site preservations & storage, site construction, site tests, erection, pre-commission & test of individual system / equipment, commissioning, reliability test, Performance Guarantee Test Run, operation & maintenance etc. and getting approval of the same from EIL / Owner is contractor responsibility.
- 4.23. Study for site constructability, approach, erection feasibility, transportation scheme / rigging scheme shall be in bidder's scope.
- 4.24. Route survey and clearance of encumbrances to ship/transport the modules, skids, manufactured / fabricated items, loose items, bought outs and other consignment are in bidder/contractor scope.
- 4.25.
- 4.26. Hook up with interfaces shall be done at site along with drawings & documents and supplying necessary materials, accessories, fittings, flanges, blinds, gaskets, fasteners during execution.
- 4.27. Preparation of documentations / drawings, calculations, clarifications, technical back-up etc. & presence of expert at statutory authority office for the approval of statutory authority from manufacturing & installation state / country and other statutory authorities shall be done by contractor. In case of requirement of owner support letters to authorities, shall be provided where applicable.
- 4.28. Overall SLD & area classification in package contractor scope and responsibility.

- 4.29. Laying & termination of all cables within battery limit, is in Package contractor scope. For all the cable laying & termination from package B/L to substation & utility control room and substation to control room are in package contractor scope. However, for more details with respect to scope, supply & work, Package contractor to refer Electrical & Instrumentation design basis, scope, job specifications, standards specification, instruction, guidelines attached elsewhere in tender.
- 4.30. Package contractor shall participate in HAZOP studies and provide all inputs for HAZOP for the complete Steam Generation System. HAZOP Review shall be done by EIL at EIL office in presence of contractor, OWNER and PMC representatives. HAZOP chairman shall be from EIL. Package contractor to Implement recommendations arising out during HAZOP studies for the Steam Generation System without any cost & time implication.
- 4.31. 3-D Modeling of the complete package/systems/facilities. For details refer piping design basis, scope of supply / work & specifications.
- 4.32. Fabrication, manufacturing, sub assembly, assembly and test at shop & site.
- 4.33. All bought outs and manufactured items/ equipment's/ components/ systems/sub systems in works and all the site inspection shall be done by EIL / owner in addition to the inspection services of package contractor. Inspection requirement for all equipment under the purview of IBR shall be subject to inspection by IBR authorities. Cost & efforts involved in IBR inspection shall be borne by package contractor.
- 4.34. Refractory application and dry out including pre-dry out are in contractor scope.
- 4.35. Insulation, Primer, Painting & final painting of components, piping, ducting, structures, platforms, staircases/ladders, equipment within the modules & skids of equipment's/items/components/systems of Steam Generation Package.
- 4.36. Packing, forwarding & handling at source & delivery to actual jobsite.
- 4.37. Transportations & shipment of complete shop fabricated/ assembled / modules /skids machined / finished & unfinished items, bought-outs, raw materials, pre-fabricated loose items, structures, all machineries & materials for erection from workshop / source to actual site premise, unloading, storage, preservations including site local transportations, site local handling and transportation, up to foundation bolting, foundation filling materials etc. are in contractor scope in all respect.
- 4.38. Surface cleaning, sand blasting, primer & final painting application wherever applicable as specification attached intender.
- 4.39. Necessary machineries/ cranes / lifting arrangement / tools / tackles / jigs & fixtures / flanges/ valves / piping / tubing/ fittings/ gaskets / blind / plates etc. for implementation during assembly, construction, erection, testing, alkali boil out, alignment, boxing up, interface connectivity at site within B/L & around the plant area as per specifications, standards, instructions & guidelines attached in tender.
- 4.40. Site construction, welding, bolting, fixing, assembly, erection & installation, alignment, testing / Hydro testing, hook ups, insulation & refractory, fire proofing application w.r.to mechanical, piping, structures, electrical, instrumentation etc. of complete package.
- 4.41. Modification, corrections and make the things in order as per site punch list from EIL/Owner.

- 4.42. Hook-up engineering & supply of materials, flanges, fittings, valves, instruments, fasteners, gaskets etc. of all piping as per piping specifications. For piping design, engineering and other details, refer Piping design basis.
- 4.43. Hook-up engineering & supply of materials along with drawings / documents and bill of materials for all structures as per structural specifications. For Structural design, engineering and other details requirement, refer structural design basis.
- 4.44. Hook-up engineering & supply of materials along with drawings / documents and bill of materials for all electrical items / components as per electrical specifications. For Electrical design, engineering and other detail, refer Electrical design basis.
- 4.45. Hook-up engineering & supply of materials along with drawing / documents and materials for all instrumentation items / components as per instrumentation specifications. For Instrumentation design, engineering and other detail, refer Instrumentation design basis.
- 4.46. Site check, correction, modifications and Mechanical Completion.
- 4.47. Pre-commissioning, alkali boiling out & chemical cleaning, steam flushing of boilers & associated system, associate auxiliaries and alignments of equipment/rotating items etc. including all bought outs, auxiliaries & accessories.
- 4.48. Calibration and testing of the instruments / equipment are in contractor scope and responsibility. Contractor shall provide list of instruments and equipment's which shall requires calibration & testing along with complete engineering data / values / calculations / logic and procedures at the time of execution. Calibration shall be done from EIL /Owner approved test laboratory.
- 4.49. Start-up & commissioning the complete Steam generation system along with all bought outs, auxiliary & accessories /facilities.
- 4.50. All kinds of effluent during erection, pre-commissioning, commissioning shall be neutralized by package contractor prior to disposal.
- 4.51. Reliability test run and Performance Guarantee Test Run of the Steam Generation system including all associated auxiliary & accessories/facilities and final handing over.
- 4.52. Arranging all necessary instruments, flanges, blinds, nozzles, gaskets, valves and tools/tackles required for pre-commissioning, commissioning and performance guarantee tests are in contractor scope.
- 4.53. Training of Owner operation / maintenance personals in boilers system including all associated auxiliaries / accessories for at least 30 days with necessary printed and soft training materials.
- 4.54. Disposal and clearing the waste, hazards material generated during site construction / erection / pre-commissioning / commissioning including all construction aids & debris and make plant area / work place neat & tidy are in package contractor scope.
- 4.55. Dismantling of temporary structures / piping at site and disposal / clearing the site etc.
- 4.56. All the applicable statutory approvals as required shall be obtained by package Contractor including IBR, PESO, OISD, DGCA, local labor law, safety, approval related to electrical activities, system & items, transports related wherever applicable to execute the complete steam generation package installation & smooth operation. In case of requirement of owner support letters to authorities, shall be provided where applicable.

- 4.57. Submission of documentation for approval / review / information shall be as per Doc. No. B957-420-80-44-VDR-3001. Other disciplines documents submission shall be as per individual disciplines vendor data requirement attached in tender.
- 4.58. Providing input and assistance / supports to Owner for SAP Entry of all mandatory spares / Excess supplied items in owner SAP system.
- 4.59. Handing over of all mandatory spares, excess supplied items at Owner warehouse with records.
- 4.60. Package Contractor to follow the EIL Pre Commissioning & Commissioning Activities Management System (PCAMS) during pre-commissioning and commissioning of Steam Generation System.

5.0 EXCLUSIONS:

- i) Supply of Fuel for pre-commissioning, commissioning, refractory dry out, alkali boil out, steam blowing.
- ii) DM water for pre-commissioning, commissioning. However, supply of DM water for hydrotesting is in package contractor's scope
- iii) Initial Site grading and leveling.
- iv) Fire Alarm & plant communication system supply and commissioning is not in package contractor scope. However, design, engineering, detailing, technical inputs, documentations, data sheet, drawings & specifications for procurement, erection & hook up with the interface are in package contractor scope.

JOB SPECIFICATION FOR STEAM GENERATION PACKAGE (FED)

PROJECT : ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES, BINA
PETCHEM & REFINERY EXPANSION PROJECT (BPREP)

UNIT : STEAM GENERATION PACKAGE (Unit No. 420)

OWNER : BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

PMC : ENGINEERS INDIA LIMITED.

JOB NO. : B957

0	10.02.2025	ISSUED WITH TENDER	PK	KS/AD	DD
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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1.0 GENERAL

This specification defines the minimum requirement under which the supplier shall carryout project management, design (Process, Thermal, Hydraulic, mechanical etc.) engineering, procurement engineering, procurement of raw materials and bought, consumables and bought out components, manufacturing, fabrication, assembly at shop, inspection, testing at manufacturer's works, supply, painting, packing & forwarding, delivery, transportation & shipment up to actual site premises, receiving at site, unloading at site, site handling & local transportations, storage & preservations at site, site construction, site assembly, site testing, site inspections, erection / installation along with erection machineries, hook ups with associate system / components, HAZOP & SIL study, 3D modeling, alkali boil out, steam flushing & dry out, pre-commissioning & commissioning, reliability test run, performance guarantee test run and handing over of the complete steam generation system to owner including Boilers system comprises Super Heaters, Economizer, water wall panels with manifolds, Drums with Internals, Riser & down comer & Air-preheater (as applicable), Blow down system, Dosing system, Main Steam piping & isolation system, Attemperator & De-super heater system, safety valves with silencers, Startup vent system, Deaerator system, feed water heater, BFW pumps, feed water system, Chemical dosing system, PRDS, Flue gas and air duct system along with accessories & auxiliaries along with FD/ Seal / Scanner fans, fuel forwarding & firing system, stack, instrumentation, controls & electrical, valves / fittings, piping, pipe racks, structures, first fill of consumables, consumables, lubricants & chemicals, foundation filling materials as necessary, grouting, jigs & fixtures, tools & tackles, mandatory spares, erection & commissioning spares, consumables & documentations as per the enclosed Process datasheet, Design basis, Job specifications, standard specifications, instructions, other codes and standards attached or referred elsewhere in tender.

- 1.1 Steam generation system with its auxiliaries & accessories covered under this specification shall be applicable in conjunction with datasheet, design basis, P&IDs, other specifications & standards attached elsewhere in the tender.

2.0 ORDER OF PRECEDENCE:

In the event of conflict among the various documents attached with the tender document, following order of precedence shall apply. However, as a general rule, more stringent requirement shall govern:

- (i) Statutory Requirements
- (ii) Design Basis (Doc. No. B957-420-80-44-DB-3201)
- (iii) Datasheets
- (iv) Other design Basis.
- (v) This specification and other attached job specifications.
- (vi) Standard specifications.
- (vii) Codes and Standards.

However, all such conflicts shall be referred to EIL / Owner for clarification and the decision of EIL / Owner shall be final and binding on the contractor without any cost and delivery implications. Once decision given by EIL/PMC, No other logic and correspondences shall be entertained in this regards.

3.0 DESIGN SPECIFICATION

No. of Boiler	: Refer Process Datasheet
Capacity (TPH)	: Refer Process Datasheet
Turndown	: Refer Process Datasheet
Steam Parameters	: Refer Process Datasheet
Pressure (Kg/cm ² .g) at package B/L	: Refer Process Datasheet
Temperature (Deg. C) at package B/L	: Refer Process Datasheet
Type of Boiler	: Refer Process Datasheet
Type of Fuel	: Refer Process Datasheet / Design basis
Start-up Fuels	: Refer Process Datasheet / Design basis
Alternate Fuels	: Refer Process Datasheet / Design basis
Design Code	: Refer Design basis / Process Datasheet / Specifications.
Corrosion allowance	: As specified in Design Basis

4.0 GENERAL REQUIREMENTS

- 4.1 Bidder / Package contractor, after studying the contents of this tender may decide to obtain clarification before making their offer. Any ambiguity /discrepancy/ clarification shall be discussed at the pre bid stage only and once having done so, the offer shall be in strict compliance to the requirements and technical specifications attached with tender.

Various technical specifications / drawings / documents as referred to in this specification and the List of contents form part of this tender, any deviation to these documents of tender and referred specifications should have prior approval of PMC/Owner. All such deviations shall be raised in the deviation format no. B957-420-80-44-DV-3001 attached in tender and sorts it out at pre bidding stage before submission of bid.

It is in Bidder's responsibility to ensure that all technical deviations if any with respect to the tender requirements are sorted out in the pre-bid meeting stage only since same shall not be entertained after the post bid stages.

- 4.2 In general deviation is not acceptable. However, any deviation at the execution stages which becomes unavoidable or technically not feasible shall be submitted for EIL / Owner approval and shall not be proceed with such deviation till its acceptance by EIL / Owner. Time taken/delay, if any, in processing of deviation permit or its rejection shall be solely to contractor's account.
- 4.3 Bidder shall follow the document no. B957-420-80-44-TR-3001 (Instructions to Bidder) attached in tender to comply the requirements of the tender.

- 4.4 Attending of pre-bid is compulsory for bidder along with their technically competent representatives along with list of technical issues / clarifications.
- 4.5 It shall be the overall responsibility of the contractor to design, manufacture, fabricate and supply the entire steam generation package consists of Boilers system, Burners, fuel handling, forwarding & suitable feeding systems, dosing systems, SWAS & CEMS system, Feed water control station, blow down system, Deaerator system, Boiler feed water pumps & other associate items / components, auxiliaries / accessories & facilities along with instrumentations, electrical, structure, piping, Civil & UG system in conformity with codes / specifications, standards attached in tender in all respect.
- 4.6 Contractor shall furnish a separate detailed data sheet considering design & operating conditions, parameters, service conditions, detailed configuration, capacity, size, dimensions, material of constructions, test requirements, insulation, lining, painting for each component / equipment / item / sub system of boiler (i.e. Drums, furnace wall, evaporator, super heaters, economizers, attemperator, riser & down comers, steam purifiers, blow down system along with details parameters i.e. temperature I/L & O/L, pressure, pressure drop, approach and pinch temperatures of flue gas side as well as water & steam side etc.), feed water system, dosing system, Fuels forwarding & firing systems, SWAS & CEMS systems, stack, hot & cold duct system for flue gas & air, bought outs components, all other necessary auxiliaries & accessories etc. **A clear sketch of boiler configuration along with major components & other items showing over all details & dimensions shall be part of datasheet.**
- 4.7 Systems / Equipment / Components of Steam generation unit and its associated auxiliaries & accessories shall be prefabricated, manufactured, assembled in an extensive modular form and module shall consists of all structures, piping, complete instrumentations & electrical work, attachments, painting & final painting, insulation, refractory, platforms, staircases, ladders etc. Contractor shall take care the same during conceptualization, design, manufacturing, assembly, modularization, shipment and transportation. Modules shall be transported from shop completely ready to fix up basis for erection at site. Therefore, contractor shall carefully consider the site conditions, transport & shipment limitations from his proposed workshop to job site premises, special tools & tackles and hard stand requirement for usages of crane for lifting at high elevations and all issues enabling the erection of the items. Site feasibility for erection / installation and constructability consideration is in contractor scope.

Contractor shall make efforts to minimize the number of skids and modules considering ODC limit. Bidder to refer ODC limits (Doc. No.: B957-ODC Limit) attached elsewhere in tender document for reference purpose.

Any item / system of Steam generation system which can be fabricated / assembled at works considering ODC limit, such activity shall not be permitted at site. Contractor shall take EIL / Owner concurrence in advance for any such activity during execution due to any specific reason.

- 4.8.1 Modularization philosophy for Utility Boilers, Fuels firing system, Deaerator & Feed water control, Dosing systems, Fans, Boiler feed pumps, associated piping, ducting, structure, auxiliaries, accessories etc. in the Steam generation system shall be adopted by bidder & submitted the philosophy during kick off meeting. All issues related to modularization of complete package shall be settled during kick off meeting. **Any item / component / equipment / system is feasible to form module / skid including its associates/attachments at works considering ODC limit, shall not be done at site without permission of EIL/Owner.**
- 4.8.2 All piping in and around modules shall be supported from module structures and

independent footing from grade shall be avoided.

- 4.8.3 All bought outs items i.e. burners, dosing system, BFW & Export Pumps, other pumps, fans, silencers along with auxiliaries, finger pipe rack and structures shall be in modules or skid mounted. Piping, valves, instrument items & accessories, electrical items & accessories, fittings those are outside the modules and not able to be accommodated in modules are to be sent loose with proper identification numbering & marking but pre-fabricated with the preparation of edge i.e. ready to weld, fix & join etc.
- 4.8.4 All modules, boiler casing & ducting shall be supported with suitably designed base frames, structural supports, guides, stiffeners, tie members, spider beams, attachments, lifting arrangements, protection, considering expected loads, jerk factors, various forces during lifting, handling & shipping, transportation features, shipment, environment conditions etc.
- 4.8.5 Platforms, staircases, supporting, attachments, associated accessories & auxiliaries shall be assembled in this module after completion of welding, alignment, bolting, fixing & tests etc. in all respect and same shall be ready to fix basis at site.
- 4.8 It is the responsibility of the contractor to design (to the extent applicable), fabricate, assembly, supply and construct the equipment in conformity with codes / specifications / datasheets and to meet all requirements of tender and statutory requirements as applicable including place of installation.
- 4.9 EQUIPMENT UNDER THE PURVIEW OF INDIAN BOILER REGULATIONS (IBR):
- 4.10.1 Package Contractor / supplier shall carryout design calculations as per IBR & only in case of any doubt / conflict can refer it to EIL / Owner for clarification. Time required for such type of clarifications shall not be considered as any time implication and same shall be considered in Contractor / package vendor account.
- 4.10.2 The design calculations and fabrication drawings after preliminary review of EIL/Owner shall be submitted to Chief Inspector of Boilers (CIB) of the state where vendor's shop is located and CIB of the state of installation.
- 4.10.3 In case the equipment is manufactured outside India, the design calculations and fabrication drawings after preliminary review by EIL/Owner shall be got approved by the agency authorised by IBR and CIB of the state where the equipment is to be installed.
- 4.10.4 It shall be the responsibility of the contractor / supplier to incorporate modifications/ additions if required by CIB and obtain the final approval from CIB of the user state and CIB of manufacturing state/agency authorised by IBR.
- 4.10.5 EIL/Owner shall be kept inform immediately through documentations of all such changes/modifications desired by CIB. All costs involved except CIB's fees for registration before commissioning shall be borne by package contractor.
- 4.10.6 Final approval of all component / equipment assembly, GAD & documents shall be given only after submission of IBR approved copy.
- 4.10 The bidder shall study the actual site to familiarize themselves with the following before submission of offer:
- Plot area available and Site facilities
 - Approach roads / routes
 - Availability of Space for site work

- Movement constraints and restrictions
 - Area for crane placement / hard stand requirements
 - Understand and plan the type of pre-fabrication, modularization scheme, sequence of fabrication and erection
 - Plan all other activities those are not highlighted but are essential in order to execute the total work in all respect as per tender requirements.
- 4.11 After award of contract, contractor shall arrange a kick-off meeting with the following agenda before submission of documents:
- i) Contractor to give a presentation along with execution philosophy and schedule of each activities considering concept, scheme, configuration, design, engineering, procurement, manufacturing, modularization, transportation, site construction, erection and commissioning etc.
 - ii) Review & finalization of master document index and schedule.
 - iii) Details of plan to go with own house facilities and out sourcing components
 - iv) Review and selection of sub supplier / sub-vendors along with documents of PTR details.
 - v) Any clarification on the Process datasheet / specifications.
 - vi) Identification of critical documents, which need to be reviewed on priority and preferably across the table.
 - vii) Identification of multidisciplinary review of documents (critical documents which need to be reviewed on priority).
 - viii) Modularization philosophy in details based on the requirements mentioned in the job specifications considering limitation of ODC limit.
 - ix) Bidder shall incorporate EIL/Owner comments without any cost or time implications.
 - x) Bidder those are going with their Principal/ Licensor/ Collaborator experience & reference. All basic design, drawing, documents including datasheet, P&ID, PFD, HMBD, control mechanism, configuration of system, type of configuration, arrangement, pressure part assembly, commissioning procedure & all other necessary activities related to design & operation of the system shall be vetted & approved by his Principal/ Licensor/ Collaborator before implementation. Vetted & approved documents shall be submitted to EIL/Owner.
- 4.12 The Steam generation system comprises the following major systems / components / equipment / facilities as minimum. However, contractor shall include in his offer, if any other additional item / component / equipment / system required for smooth execution & operation of Steam generation system.
- i) Boilers system and associate auxiliaries / accessories along with water wall furnace & manifolds, Drums with internals, evaporators, Super Heaters, Economizer, Air pre-heater system (as applicable), pressure parts supports, Risers & Down Comers, integral & non integral piping etc. in steam & water sides, necessary fans, firing & fuel feeding systems, burners, seal & scanners fans with drives, blow down systems along with pumping arrangement, stack, SWAS & CEMS system, flue gas/air duct system, expansion bellows, instrumentations & controls, electrical, piping, valves, fittings,

- insulation, refractory, painting, structures, supports, platforms, staircases, ladders etc.
- ii) FD fans system shall include drives, suction stack, filters, necessary IGV /dampers, isolation, duct along with necessary instrumentation, controls, electrical, platforms, ladders, support etc.
 - iii) Deaerator & storage system along with necessary instrumentations & controls, electrical, valves, piping, fittings, supports, structures, platforms, staircases, ladders, insulation, painting etc. for details refer to process datasheet & design basis.
 - iv) Boiler feed water chemical dosing system for oxygen scavenging & pH control along with necessary instrumentations & controls, safety system, electrical, valves, piping, fittings, supports, structures, platforms, staircases, ladders, insulation, painting etc. for details refer to process datasheet & design basis.
 - v) HP chemical (Tri sodium phosphate) dosing system with necessary instrumentations & controls, safety system, electrical, valves, piping, fittings, supports, structures, platforms, staircases, ladders, insulation, painting etc. for details refer to process datasheet & design basis.
 - vi) Boiler Feed water (BFW) pumping systems & export BFW pumps along with necessary instrumentations & controls, electrical, supports, shed, piping, valves, fittings, structures, platforms, staircases, ladders, insulation, painting etc. for details refer to process datasheet & design basis.
 - vii) Fuels forwarding, conditioning & firing system along with suitable feeding arrangement, necessary auxiliaries, accessories, safety arrangement as per statutory norms / applicable code, instrumentations & controls, electrical, valves, filters, piping / ducting, fittings, supports, structures, platforms, staircase, insulation, painting etc. for details refer to process datasheet & design basis.
 - viii) Main fuel / Normal fuels systems i.e. natural gas, conditioning, forwarding systems and arrangement along with all auxiliaries / accessories, instrumentation & controls, electrical, valves, filter, KOD, piping, fittings, insulation, painting etc. for smooth operation. For details refer to process datasheet & design basis.
 - ix) Stack with online continuous stack monitoring system (CEMS) & Boiler steam water analyzing system (SWAS) along with all necessary accessories / tubing / isolation / fittings/interface connectivity, supports etc. and associate systems.
 - x) Firefighting system, fire water network / tapping / distribution / stations / sprinkler / spray system along with necessary connectivity / hook ups, interface for Utility Boilers, auxiliaries, facilities, instrumentation, electrical, piping, valves, fittings, structures, supports etc.
 - xi) Safety system including eye wash & safety shower near the chemical dosing systems.
 - xii) Pipe racks & finger pipe racks necessary in boiler area including structures/supports wherever required.
 - xiii) All field instrumentations, control room instrumentations, cabling, all associated accessories, auxiliaries & interface connectivity / terminations / isolation for the entire boilers system as defined in the tender. For more details refer Instrumentation scope of work, job specifications, data sheet & system configuration attached elsewhere in tender.
 - xiv) All instrumentation necessary systems, cables, cable trenches, overhead cable racks, ducts, laying and terminating materials & fittings, supports/structures, ladder & platforms etc. For details refer instrumentation, specifications, scope of supply & work / services documents attached elsewhere in tender.
 - xv) Electrical scope of supply & work / services, design basis, specifications documents etc. attached elsewhere in tender shall be referred for detailed electrical scope/work and technical requirements.

- xvi) Complete civil work including foundation, foundation bolts, templates, grouting material, sub structure and superstructure etc. Structural design basis, Scope of supply / work & job specifications attached elsewhere in tender shall be referred for detailed civil & structural scope/work and technical requirements.
- xvii) Piping, valves, isolation, fittings, blinds, flanges, test nozzles wherever required within battery limit for safety, smooth & safe operation. Refer details elsewhere in tender.
- xviii) Boiler area illumination / lighting systems along with necessary accessories / fittings, hook up & connectivity.
- xix) Permanent & temporary piping system, fittings, flexible / hose pipes, gauges, valves, isolations, fittings, blinds, flanges, gaskets, fasteners, test nozzles wherever required for smooth testing, execution & operation of Boiler unit.
- xx) Structures, supports, platforms, staircases, ladders etc for smooth operation, maintenance and ease of approach/access, expansion joints, Control panels, junction boxes, instruments / nozzles / access doors / peep holes / manholes / electrical/ valves/ mountings / accessories etc.
- xxi) Suitable safety arrangement & system / measures with necessary controls for fuels forwarding & firing system.
- xxii) Documentations as applicable and defined in this specification, VDR attached elsewhere in the tender including all interface departments specifications / VDR.
- xxiii) Contractor shall necessarily refer all EIL interface departments (i.e. Heat Transfer Department, Process, Piping, Structure, Instrumentation, Electrical, SME, ETDD, Inspection, construction, General civil, Architecture, SMMS etc.) job specifications, design basis, standard specifications, standards, guidelines and instructions for detailed technical requirements attached elsewhere in the tender for bidding, design, engineering, procurement, supply, execution & implementation, construction, erection, pre commissioning, tests & commissioning as applicable.

4.13 PAST TRACK RECORD (PTR) CRITERIA

- 4.13.1 A list of approved sub vendor for various components / items attached in the tender and all bought outs shall be procured from the approved list. Contractor shall adhere to this approved vendor list attached elsewhere in the tender during execution. In case, the approved sub vendor / sub-contractor list do not include any item / component which are necessary for steam generation package, same shall be brought to the notice of Owner/EIL.

In case contractor does not meet the experience, criteria and needs to outsource w.r.to any particular activity or item/component for which subcontracting / outsourcing is allowed, contractor shall mandatorily employ the services of a suitable sub-contractor or sub vendor by meeting the experience criteria /PTR. Before undertaking any such activity, contractor shall ensure that subcontracting agencies / sub vendor is meeting the experience criteria / PTR and EIL/Owner approval is taken. Contractor shall propose to Owner/ EIL for the sub-contractor/ sub vendor along with all relevant PTR documents / information as per PTR criteria given in Clause 4.14.3.

- 4.13.2 Contractor shall proceed on sub-contracting only after concurrence from Owner/ EIL. Decision of Owner/ EIL shall be binding on contractor.
- 4.13.3 Sub-contractor or sub vendor (if any item not listed in approved vendor list attached in tender including burner etc.) shall be accepted based on their past track record (PTR) only i.e. at least 2 similar separate jobs with similar capacity and parameters executed in last 07 years and out of that at least one shall be in successful operation for 1 year.

- 4.13.4 Contractor shall submit list of reference jobs identifying 2 nos. qualifying job references w.r.to the item / sub component / subcontractor for meeting criteria given in Clause no. 4.14.3 along with P.O. / LOI copy where scope shall be indicated clearly, design & engineering documents (Datasheets, PFD, P&ID, GAD etc.), IRN as manufacturing & supply evidences, commissioning evidence and end user feedback etc.
- 4.13.5 At the time of order placement, it is contractor responsibility to ensure that the selected vendor is not on Holiday List of Owner/ EIL, not having any limitation / constraints mentioned in the vendor list for the items.
- 4.14 Based on Process specifications, Design basis, datasheet, P&IDs, specifications, instructions, guidelines & other documents listed & attached with the tender, contractor shall carryout detailed and complete process sizing / thermal sizing & hydraulic design, mechanical / structural & piping design, stress analysis, detailed engineering, preparation of Layout & General Arrangement Drawings, detailed engineering drawings / documents, code calculations & analysis, foundation loading plan, fabrication drawings, purchase specification & datasheets for bought outs and obtain EIL/Owner's approval as per Vendor data requirements before taking up any procurement / fabrication work.
- 4.15 General arrangement of any item / component / equipment / system shall cover the following details & requirements as minimum:
- i) Plan, Elevation & Side views along with dimensions & references, nozzles size, location & tag mark, slope (if any), platforms, stairs, ladders, elevations, grid references, flow marking, direction marking etc.
 - ii) X-sectional enlarge views along with nozzles orientations & instruments levels / locations, attachments, interface between nozzles & shell, shell & internals, joints etc.
 - iii) Overall dimensions, size, diameter, length, thickness, projections etc.
 - iv) Nozzle schedule in tabulated form indicating size (dia. x thk.), Qty., MOC, end connections, rating, STD., finish of end connection, projections, reinforcement requirements, gasket, insulation/lining requirements etc.
 - v) Material of construction for all components with size/dimensions
 - vi) Enlarge view of critical & important component / area, joints, interface area, support details with x-section.
 - vii) Internal details (if any) with x-section, references, size, thickness and dimensions.
 - viii) Basic lining details (if applicable) i.e. thickness, brand name, composition, anchorage MOC & type etc.
 - ix) Insulation thickness, MOC, cladding and painting requirements
 - x) Allowable nozzle loadings & moments
 - xi) Details of major components like shell / dished ends / panels / coils / tube layout / tube sheet / supports & baffles / channel side details/transition joints / tube bundle details & arrangements / flanges / covers / major weld joints & interfaces / shroud details (as applicable).
 - xii) Design & operating parameters, Corrosion allowances, design & construction code /

STD, test requirements, NDT & PWHT requirements etc.

- xiii) Applicable notes, design considerations, references of drawings / STD.
 - xiv) Empty weight, Erection weight, Hydro test weight & operation weight.
 - xv) Equipment name, tag mark, capacity, unit no., EIL Job No., PMC & Owner name with logo, projects name & location.
- 4.16 All special tools, tackles, equipment, machinery, cranes, consumables, chemicals, first fills etc. to carryout complete job at site are the contractor's responsibility.

5.0 REFERENCES

5.1. The following codes in their latest edition shall form the basis of design, materials selection, manufacture, testing and acceptance of equipment and all their requirements shall be complied with.

- a. IBR
- b. ASME Sec. I
- c. ASME Sec. VIII Div. I
- d. ASME B31.3 / ASME B31.1
- e. ASME Sec. II
- f. ASME Sec. IX
- g. ASME Sec V
- h. TEMA
- i. ANSI
- j. API
- k. NFPA 85
- l. IS: 6533, IS: 875, IS: 800, IS: 1893 and API for Steel stack (as applicable)
- m. PNGRB
- n. Structural steel: Follow the requirement mentioned in structural design basis.

Any other applicable code / STD / specifications as listed elsewhere in the tender.

5.2. CRITERIA FOR CARRYING OUT THE SEISMIC ANALYSIS:

Refer Design Basis (Doc No. B957-420-80-44-DB-3201) & Site-Specific Seismic details mentioned elsewhere in the tender.

5.3. SITE-CONDITIONS & UTILITIES

5.3.1 METEOROLOGICAL DESIGN DATA

Refer Process datasheet/ Design basis.

5.3.2 BATTERY LIMIT CONDITIONS:

Refer Process datasheet/ Design basis.

5.3.3 BATTERY LIMIT SPECIFICATION OF STEAM, FUEL AND UTILITIES:

Refer Design Basis.

6.0 TECHNICAL REQUIREMENTS

6.1 General Requirements

6.1.1 Boiler shall be forced draught, natural circulation and membrane wall furnace type design.

6.1.2 The Boilers shall be designed as per IBR & relevant ASME code (as applicable) latest Edition, amendment & addenda.

6.1.3 The Boiler shall be designed for quick start from both cold and warm conditions.

6.1.4 Seamless steel tubes shall be employed in boiler construction. No circumferential joints shall be present in heat transfer tubes/coil up to 11.5 m length. It is necessary to highlight in drawing, even any joint present beyond 11.5 m length of tubes/coil.

6.1.5 Tube to header weld connection shall be set-in type.

6.1.6 Material of construction for complete boiler components shall be selected considering extreme service conditions, maximum temperature and most stringent fuel properties / composition with suitable margin.

6.1.7 Minimum Metal Design Temperature (MDMT) shall be lower of minimum atmospheric temperature and minimum temperature envisaged during operation in case not mentioned in tender.

6.1.8 Skin thermocouples shall be provided on super heater tubes, screen tube & furnace wall (high temperature prone area), steam drum for monitoring (in the control room DCS) of metal temperature during operation.

6.1.9 Fuel efficiency for boiler shall be maximized. However, the heat recovery from flue gas should be limited such that the flue gases temperature at the stack exit is above acid dew point with suitable margin as specified in Process Data sheet.

6.1.10 The flow of steam in super-heater shall be designed over the entire operating range to ensure adequate distribution of steam through all tubes and thereby prevent overheating of any element.

6.1.11 The boiler system and their auxiliaries shall be sized and designed to meet requirements specified in the tender, as a minimum. However necessary margin shall be built in for trouble free operation & maintenance at all operating scenarios.

6.1.12 Coils / Tubes supports in flue gas path shall be designed and considered based on

maximum tip temperature of support. Supports of Coil & tube shall be adopted with higher grade metallurgy than coil & tubes in line with extreme design temperature.

- 6.1.13 All the headers and low points shall have adequate draining facilities. Air vents shall be provided on drum, headers and all high points of piping along with necessary isolation valves / blinds / spacers.
- 6.1.14 No header / manifold shall be located in flue gas path.
- 6.1.15 The boiler will be completely insulated for minimum heat loss and personal protection.
- 6.1.16 Furnace and membrane wall shall be suitably stiffened with buckstay arrangement in regular interval considering maximum expected pressure in flue gas side along with thermal expansion provision at each corner with suitable arrangement. Design shall be done for buckstays with proper parameters supported by calculations & shall be furnished.
- 6.1.17 Boiler walls and casing shall be made gas tight, to reduce leakage of gases to the atmosphere. Openings for peep holes, steam lance openings etc. shall be provided with pressurized air from seal air fans to prevent flame leaking out of the casing.
- 6.1.18 Necessary provision shall be made to keep the boiler system preserved for long duration. Nitrogen gas shall be used for water side preservation for long shutdown of Boiler & purging of Fuel gas line. Double isolation valves, NRV with blinding provision shall be provided to avoid any possible backup of steam / gas to nitrogen system during normal operation.
- 6.1.19 Boilers system and associated auxiliaries / accessories shall be located in the area earmarked as Boiler system. All piping shall be available at the package battery limit on the pipe-rack, for details refer B/L P&ID and Piping specifications / scope of work.
- 6.1.20 Provision shall be made in boilers for cold water filling for start-up using DM water.
- 6.1.21 Boiler system shall be provided with all necessary auxiliaries, instrumentation / control / trip system for start-up, shutdown as well as for smooth and trouble free operation.
- 6.1.22 Contractor shall provide all the facilities required to run boiler system along with auxiliaries & accessories for smooth operation on continuous basis considering load cases mentioned in datasheet / design basis.
- 6.1.23 Double entry / exit shall be provided in all boiler platforms at drum level, fuel firing system, operating levels & burner level as minimum along with alternate escape route (ladders) in case of emergency up to grade level.
- 6.1.24 In case, the height of ladder is more than 6 meters, stepladder shall be considered. Monkey ladder should be provided with grip rods & lock chain at the top for easy entry to top platform. Contractor shall consider staggering of ladders after every 6 meters.
- 6.1.25 Use of Cat ladders shall be strictly avoided. Where inevitable, it shall be 450mm wide and shall have safety cages if height exceeds 3 meters. Wherever step ladder cannot be provided due to space limitation in that case Cat ladder should be provided with grip rods at the top for easy entry to top platform. After 6 meters there should be staggering for both type of ladders.
- 6.1.26 Minimum of 1.0 m of staircase width shall be provided. Maintenance platform shall not be less than 1.5 m wherever required.
- 6.1.27 All access doors on boiler casing / panel, economizer shall be minimum 600 x 600 mm.
- 3.2.1 All Steam safety valves exhaust shall be provided with separate independent silencer. All the

internals of Silencer shall be SS construction. Condensate from the silencer shall be freely drainable and Silencer connection shall be of flanged type. Silencer shall be suitably structural supported.

- 6.1.28 Suitable & sufficient space shall be maintained in between each tubes / coils harp for ease of approach, maintenance and inspections.
- 6.1.29 There shall be enough space between pressure parts coil harps / bundle. Access door / opening shall be provided in all pressure parts chambers / compartments, between coil harps / bundles, transition ducts for ease of inspection / maintenance / replacement. Minimum access door size shall be 600 x 600 mm in between coil harp.
- 6.1.30 Drains shall be provided with suitable size & design with sealing arrangement / metallurgy in flue gas side of each section / compartment/ boiler floor to use during shutdown for cleaning.
- 6.1.31 All Platforms / walkways / stairways / critical equipment / valves shall be provided with rain covering / sunshade. The steam drum and fuel firing system/ burner floors at boiler shall be provided with roof canopy / shade.
- 6.1.32 For personnel safety, landing / cages / safety chain at platform landing and hot exposures prevention provision / toe guard on platform, staircase steps & cut-out area on equipment platforms shall be provided.
- 6.1.33 SWAS & Steam Water sampling:

SWAS system with online analyzers shall be provided separately as per Process data sheet & design basis. In addition to SWAS, provision of local sampling by sample cooler shall be included.
- 6.1.34 The SWAS analyzers shall be located in an analyser shelter / building with suitable redundant HVAC. For detail refer design basis of Steam Generation system (Doc. No. B957-420-80-44-DB-3201).
- 6.1.35 Metallurgy of sampling lines and sample coolers shall be stainless steel.
- 6.1.36 Boiler shall have positive isolation provision for annual maintenance.
- 6.1.37 Soot Blowing system shall be provided in super-heater, economiser and air pre-heaters area of boiler (For details refer Design basis Doc. No.: B957-420-80-44-DB-3201).
- 6.1.38 Contractor shall be referred PDS & Design basis of Steam Generation System for the requirements of Motor operated valves in boiler.
- 6.1.39 The design, manufacture, safety aspects and inspection of the all pressure parts / equipment / components / assembly shall be in exact conformity with IBR (manufacturing & installation states), ASME (as applicable) & statutory (local as well as central) requirements as applicable. **Contractor shall get incorporated EIL/Owner comments in drawings and design calculations before seeking IBR approval.** All final IBR approved drawings / documents shall be submitted to EIL/Owner for reference and record.
- 6.1.40 Hardness of gaskets shall be less than hardness of flanges.
- 6.1.41 The equipment should have free movement at sliding end on the support to avoid any restriction during thermal expansion. The saddle of the equipment should be at centre of the foundation bolt slot during erection. Sliding end of equipment shall be painted as 'CAUTION-SLIDING END' in black on the primer coating in the shop. Only SS shims shall be used for equipment alignment.

- 6.1.42 Contractor shall ensure proper safety & suitable system / measures while designing the boiler for all fuels forwarding, feeding & firing system / arrangement considering fuels nature, fire risk & environment requirements. It is solely contractor responsibility to fire fuel and provide arrangement / system as per requirement along with instrumentation and control.
- 6.1.43 The plant shall be installed outdoor and should be suitable for weather conditions existing at site.
- 6.1.44 Use of SA 515 material is not permitted at all.
- 6.1.45 Radiography shall be done only after PWHT, if required.
- 6.1.46 All lifting lugs shall be designed for a minimum jerk factor of 2.0.
- 6.1.47 All flange bolts to straddle vertical and horizontal centerlines.
- 6.1.48 While preparing fabrication drawing, it shall be endeavored to cover all fabrication details in minimum number of sheets.
- 6.1.49 Contractor shall note that review of drawings, details & statutory authority related documents by EIL/owner shall in no way absolve his responsibility and any changes / modifications etc. required by local or statutory authority at any stage of execution shall be complied by contractor without any schedule / price implication.
- 6.1.50 All the safety related precautions, material, supply, barricading, tools & tackles shall be contractor responsibility. All the Owner's safety recommendations, HSE requirements and all applicable rules & regulations shall be complied by the contractor.
- 6.1.51 All bought out materials in the contractor's scope shall have identification marking supported by manufacturers test certificate.
- 6.1.52 Contractor shall have a single point responsibility for supplying of spares (mentioning Item no., Tag No. etc.) to the owner in consolidated manner after sourcing it from various approved vendors, sub vendors or sub suppliers along with identification number, size, quantity, indicating reference component / equipment with suitable packing considering environmental conditions for storing.
- 6.1.53 Contractor to ensure that all interfaces taken care between components, modules, sub-assembly and assembly at work shop itself by trial / correction / modification to avoid mismatch at site and to minimize the site work.
- 6.1.54 During welding of nozzles, if back gouging is required, gouging electrodes shall be used instead of grinding to avoid / minimize the reduction in the thicknesses of nozzle pipe.
- 6.1.55 All the reinforcement pads shall have tell-tale holes tapped properly and plugged with hard grease. No grabs screw to be provided.
- 6.1.56 Contractor shall use torque wrench for tightening bolts of size M20 to M56.
- 6.1.57 All cost towards statutory approval (if any) in manufacturing & installation state for complete execution shall be borne by Contractor.
- 6.1.58 All Statutory clearances & approvals for the steam generation package for design, manufacturing, construction, erection & commissioning shall be in contractor's scope. Preparation of documentations / drawings, calculations, clarifications, technical back-up etc. & presence of expert at statutory authority office for the approval from manufacturing & installation state / country and any other applicable statutory authorities shall be done by

contractor without any additional cost and time implication unless until specified anywhere in the tender. However, in case of requirement of owner support letters to authorities, shall be provided wherever applicable.

- 6.1.59 Battery limit isolation valves and instrumentation shall be as per B/L P&ID, piping and instrumentation specifications.
- 6.1.60 Counter flange, blinds, fasteners, gaskets etc. at battery limit for all the utility lines shall be provided by contractor.
- 6.1.61 Cranes & lifting arrangement, handling & movement machineries, tools & tackles, jigs & fixtures requirements at site during storage, site handling, construction & erection are responsibility of contractor & shall be arranged by Contractor. Hard stand necessary for construction & its requirement for usage of crane in erection areas / assembly areas shall be in contractor's scope & responsibility.
- 6.1.62 Platforms width specified in this specification shall be considered as minimum and in no case, width of the platform shall be less than the minimum specified in the specification.
- 6.1.63 Mandatory spares and spares for fabrication / assembly / erection / pre-commissioning / commissioning shall be in contractor scope. List of Mandatory spares, shall be furnished item / equipment / system wise along with size, quantity, specification, tag no., reference of components / equipment etc.
- 6.1.64 The list of recommended operational spares for 2 years normal operation & maintenance item / equipment / system wise over and above the mandatory spares are to be submitted separately and shall not be part of base price.
- 6.1.65 All materials (raw & bought outs) & consumable for manufacturing, fabrication, assembly, erection, including insulation material for loose items, pre-commissioning / commissioning and spares shall be supplied by the contractor. Owner will not take any Leftover items and the site shall be cleared of all such items upon completion of the job.
- 6.1.66 Bidder to note that BPCL at its sole discretion may line up separate reputed agency for O&M services for the subject package post successful commissioning. BPCL's decision shall be final & binding on the contractor. This decision shall not absolve any obligation of the contractor in whatsoever manner to meet contractual requirements.
- 6.1.67 Contractor to refer data sheets, design basis, specifications, standards, guidelines, instructions etc. of Heat Transfer Department, Process, Electrical, Instrumentation, SME, Structural, Piping and Inspection for other detailed requirements.

7.0 TECHNICAL REQUIREMENT APPLICABLE FOR SPECIFIC COMPONENT / EQUIPMENT:

7.1 STEAM DRUM

- 7.1.1 Steam drum shall be outside the flue gas passage. In case steam drum partially exposed to flue gas can be accepted with proper lining & proven design feature of OEM. PTR & feedback of end user needs to be furnished during execution in case partially exposed.
- 7.1.2 The steam drum shall be designed and fabricated in accordance with IBR latest edition.
- 7.1.3 Steam drum shall be designed for full vacuum condition in addition to other conditions specified or applicable.

- 7.1.4 All nozzles of drum shall be self-reinforced (SRN) type. Reinforced pad shall not be permitted.
- 7.1.5 Steam drum shall be designed with minimum capacity of storage as specified in Process datasheet / design basis as minimum. Sufficient residence time shall be provided between Low-Low trip and drum bottom so that steam generating coils never run dry even in upset scenarios like trip in boiler as well as associate system.
- 7.1.6 Adequate steam separating devices shall be provided to achieve steam leaving the steam drum. Steam water separators of high efficiency cyclone type backed up adequately by scrubbers or as per OEM recommendation with proven record shall be provided inside the steam drum. All separators / purifiers / internals shall be detachable, removable and replaceable type.
- 7.1.7 Suitable internals shall be provided for the distribution of the incoming feed water to ensure proper distribution of the incoming water along the length of the drum, suitably placed to feed the down comer tubes, but not interfere with the correct function of the water level gauges and with due consideration for chemical dosing and collection point for continuous blow down.
- 7.1.8 Supply of feed water and separation of steam & water shall occur evenly over length of the drum.
- 7.1.9 Chemical dosing and continuous blow down connections shall be located on opposite ends of the drum to prevent short circuiting.
- 7.1.10 Steam drums internals shall be accessible, cleanable, removable and replaceable without damaging the drum inside.
- 7.1.11 The steam drums shall contain the following minimum connections:
- Safety Valves
 - Pressure Gauge
 - Steam Outlet
 - Chemical Feed
 - Riser Connections
 - Down comer Connections
 - Feed water Inlet
 - Drums Vent
 - Drum drains
 - Continuous Blow-down
 - Drum level indicators
 - Test Gauge Connections
 - Nitrogen blanketing connection

- Manholes on either side of drum
- Chemical cleaning connection.
- Instrument connections

- 7.1.12 Drum shall have two number manholes at dish ends. Man holes shall be internal opening type and size of manholes shall be minimum 24" or equivalent size (610 x 510) in case of elliptical shape. Instruments connection on dished end of steam drum shall be avoided.
- 7.1.13 Nozzles, stub ends for valves, fittings, mountings, tubes and any other connections are to be secured and shall be shop welded.
- 7.1.14 Drums shall be fusion welded, stress relieved, and 100% radio graphed. All nozzles shall be welded to the drums.
- 7.1.15 Thermal sleeves shall also be provided for applicable nozzles in steam drum such as feed water nozzle, chemical dosing nozzles etc. to avoid thermal shock.
- 7.1.16 Tube to drum attachment shall be done by expansion groove along with rolling and flaring, or by proper strength welding. Procedure needs to be informed EIL / Owner before application.

7.2 SUPERHEATER

- 7.2.1 Super heater preferably shall not be exposed to the flame or in direct radiation of furnace.
- 7.2.2 Final super heater tubes shall preferably be plain tubes to prevent fin tip temperature exceeding the limit of metallurgy.
- 7.2.3 Primary super heater and final super heater (secondary) shall be employed with attemperator in boiler as minimum for effective control of superheated steam outlet temperature over the range of boiler turndown.
- 7.2.4 Super heaters shall be designed to have a substantially flat load versus temperature characteristics.
- 7.2.5 Super heater hangers and supports shall be preferably of high grade stainless steel / suitable higher grade metallurgy.
- 7.2.6 Necessary supporting provision shall be kept in the design to prevent vibration of the super heater assembly.
- 7.2.7 Package vendor shall perform a tube vibration analysis for flow induced vibration and install anti vibration tube supports as required. The supports shall be designed for 110°C above the maximum operating flue gas temperature. Unsupported span length for tubes shall not exceed 2400 mm. Flow induced vibration analysis report along with anti-vibration tube supports & design shall be furnished by boiler supplier.
- 7.2.8 Acoustic resonance study/analysis shall be done by boiler supplier and report/recommendation shall be submitted to EIL/Owner.
- 7.2.9 Super heaters tubes shall be widely spaced arrangement with clear accessibility for effective cleaning / inspection / maintenance / approach during replacement.

- 7.2.10 Super heaters shall be of drainable type (preferable). However, if there is any design limitation of OEM's design, non-drainable super-heater may be accepted with reasons.

7.3 BOILER BANK

- 7.3.1 Boiler Bank may be provided for boiler based on OEM design.
- 7.3.2 Types of fins adopted shall be of proven design. Water circulation shall be adequate at any part of the boiler bank.
- 7.3.3 Finned tube boiler bank section (if provided) shall be designed to prevent hot spots and fouling.
- 7.3.4 Tubes arrangement shall permit easy access for cleaning and maintenance. Sufficiently large clear spaces shall be left between the individual tube banks of all the heating surfaces to provide easy personnel access to the heating surfaces.
- 7.3.5 The down comer tubes shall be clearly separated from evaporating tubes so that suitable water circulation is maintained.
- 7.3.6 Down comer zone of the boiler bank shall be kept at the cold side of flue gas stream to increase the effectiveness of boiler circulation.

7.4 ECONOMISER

- 7.4.1 Economizer shall be integral part of boiler.
- 7.4.2 Economizer section shall be in-line/ staggered non steaming type of plain / finned tube type. Uniform flow and heat distribution shall be ensured throughout the coil length.
- 7.4.3 Economizer casing may be provided with sufficient nos. of nozzles and effluent outlet flanges, required for water wash during annual overhaul water wash effluent neutralization and disposal facility shall be considered.
- 7.4.4 Suitable access doors shall be provided in economizer section in between each tubes / coils bunch / harp for approach and maintenance / inspection.
- 7.4.5 Proper platforms / stair & ladders shall be provided for access and approach of instruments, nozzles, access doors etc.
- 7.4.6 There shall be proper isolation arrangement by providing flanges between connecting flue gas duct and Economizer.
- 7.4.7 Suitable draining & venting system shall be provided.
- 7.4.8 Suitable expansion joints shall be provided in flue gas duct in between boiler and Economizer system.

7.5 SCAPH & AIR PREHEATER (As applicable to meet the guarantees & other requirements)

- 7.5.1 Boiler shall be installed with suitable Steam Coiled Air Pre-Heater (SCAPH), if necessary shall be considered before tubular Air Pre-Heater. For more detail refer design basis B957-420-80-44-DB-3201.
- 7.5.2 Boiler shall be installed with suitable Air pre-heaters (tubular) system, if necessary, for heating of combustion air for better flame condition and to maximize the combustion efficiency including all accessories, ducting, dampers, expansion bellows, flanges, access doors, instruments, structures,

platforms / staircases / ladders etc.

- 7.5.3 The Air pre-heater shall be the last heat recovery section downstream of the economizer.
- 7.5.4 The low temperature block of the Air pre-heater shall be designed to prevent corrosion and the cold end side tube module section shall be provided with Corten Steel construction
- 7.5.5 Minimum thickness of the tubes shall be 2.34 mm.
- 7.5.6 Air side bypass arrangement shall be provided for the Air heater. One pneumatic operated controlled damper shall be provided in the bypass duct.
- 7.5.7 Refer design basis B957-420-80-44-DB-3201 for further details.

7.6 STACK

- 7.6.1 Separate Grade mounted steel stack for boiler system shall be provided by contractor.
- 7.6.2 The stack shall have personnel protection wherever required to approach various area of stack.
- 7.6.3 The stack design shall be such as to prevent flue gas inversion.
- 7.6.4 Final height to be furnished by Contractor based on pollution norms considering all technical requirements, local law and statutory requirements. Stack heights shall be calculated from the formula given in Design basis and shall be considered whichever is higher or max. However, stack height in no case acceptable less than the minimum height marked in design basis.
- 7.6.5 The boiler shall be considered operating at peak load and MCR respectively with maximum Sulphur in Fuel while calculating stack height.
- 7.6.6 Top of stack shall be at least 5.0 m higher than highest working platform within a radius of 30 m and at least 3.0 m higher than highest working platform for 30-50 m radius.
- 7.6.7 The layout of the flue gas ducts connected to the chimney shall ensure adequate head room for passage of erection and maintenance on the Boiler as required.
- 7.6.8 Flue gas entry to the stack at 45° angle.
- 7.6.9 Opening in stack shall be suitably reinforced. However, in no case the width of opening shall exceed 1.4 times the radius of stack shell for single opening and 1.0 times the radius for two openings.
- 7.6.10 Two no. of access doors shall be provided one above conical base plate & one below conical base plate with size of 600 mm X 600 mm. Provision of air vent holes to make air flow in the section below the conical base plate shall be included.
- 7.6.11 Expansion bellow suitable to the service and temperature conditions shall be provided in the flue gas duct at the entry of stack, i.e. at stack flue gas inlet nozzle.
- 7.6.12 Analyzers requirements in stack shall be as per design basis. However, any additional analyzers which are deemed necessary as per CPCB/SPCB guidelines shall also be in contractor scope. Arrangement / provision of online continuous pollution monitoring parameters and online transmission to statutory board shall be as per stipulation specified in Design Basis / instrumentation specifications / guidelines. Refer instrumentation

specifications / standards / guidelines / instructions for detailed technical requirements of analyzers and mounting details.

- 7.6.13 The CEMS analyzers shall be located in an analyser shelter / building with suitable redundant HVAC near the stack. This CEMS analyzers of utility boilers shelter / building can be common with SWAS analyzers shelter / building (For details refer Design basis Doc. No.: B957-420-80-44-DB-3201).
- 7.6.14 Contractor to keep provision of manual sampling point for flue gas analysis (ORSAT) at approachable height of stack. Pollution monitoring nozzles (PMN), 6" NB size (with 1" inside lining) sampling nozzle in case of stack is lined and Stainless Steel nozzles with 4" NB size in case of stack unlined shall be provided on the stack and necessary ladders and platform for access to the same shall be provided.
- 7.6.15 4 no. such nozzles shall be provided for stack diameter > 2 m and 2 nozzles for stack diameter < 2m.
- 7.6.16 The location of sampling point shall be at 8 times (min.) chimney diameter downstream and 2 times (min.) upstream to prevent any flow disturbance.
- 7.6.17 Stack shall be provided with refractory lined sloped & conical bottom base plate, so that rain water does not collect at the bottom of the stack. Gate valves shall be provided at outlet of drain from stack bottom plate lowest point with collection funnel connected to UG piping.
- 7.6.18 The stack shall be equipped with approved lightening protection system along with suitable arrangement, aviation warning lights along with fixing arrangement, stainless steel rain hood, painter trolley & suitable rail system, accessories, fittings, suitable access platforms and ladders for the measurement points and others.
- 7.6.19 Ladders in stack shall be staggered and height between two platforms shall be maximum 6 meters.
- 7.6.20 Minimum width of working platform at the level of PMN nozzles connections shall be 1400 mm and shall be 360 deg.
- 7.6.21 All round platforms (360 deg) shall be provided for access and maintenance of aviation lights.
- 7.6.22 Suitable protective paint shall be provided in metallic part of stack as per tender requirements.
- 7.6.23 Stack shall be supplied with stainless steel construction rain hood and arrangement of suitable rail system for painter trolley (as applicable).
- 7.6.24 All aviation lights shall have 360 deg. Platform for approach and maintenance.
- 7.6.25 To avoid wind excited sway oscillations and consequent possibility of fatigue in chimney shell or damage to linings, all steel stacks should be fitted with helical strakes (6thk. Min.) or suitable wind spoilers (as applicable).
- 7.6.26 Proper venting holes shall be provided in the stack portion below bottom plate for ventilation.
- 7.6.27 Suitable and sufficient stiffening arrangement shall be provided throughout the height of stack shell at regular interval for structural stability & strengthening.

- 7.6.28 Analysis & Design of the Stack shall be done by standard structural design software packages STAAD PRO (applicable for steel stack).
- 7.6.29 Flanges for nozzles shall be WNRF type.
- 7.6.30 Anchor bolts shall be designed for least resisting moment and shall not be less than the sum of 1.5 times the maximum over turning moment due to dead load & wind load / earthquake load (applicable for steel stack).

7.7 DUCTING

- 7.7.1 The ducting shall be completely insulated for minimum heat loss and personnel protection.
- 7.7.2 The skin temperature of the cladding shall not be more than 60 deg. C at an ambient temperature of 40 deg C @ wind velocity of 1 m/sec.
- 7.7.3 The cold and hot air / flue gas casing / duct minimum casing / plate thickness shall be 6 mm minimum.
- 7.7.4 Suitable and sufficient stiffening arrangement shall be provided to prevent bulging due to overstress and strengthening the system.
- 7.7.5 The external cladding shall not have any pockets where rain water can collect or have crevices where seepage can take place.
- 7.7.6 Hot surfaces shall be external insulation.
- 7.7.7 Flue gas duct of boiler and boiler to stack shall be duly insulated and cladded.
- 7.7.8 Ducting shall be made gas tight, to reduce leakage of gases to the atmosphere.
- 7.7.9 The flue gas casing / duct shall have a design pressure based on the most severe combination of the wind pressure / suction and the maximum operating pressure.
- 7.7.10 Access doors shall be provided in various zones of the boiler duct to enable maintenance and thorough cleaning to be carried out. Similarly, strategically located drains shall be provided at Boiler floor.
- 7.7.11 Access doors shall be provided in sections of the ducting to perform inspection and cleaning. There shall be drain nozzles located in suitable locations for draining.
- 7.7.12 Access doors in the duct of 600 X 600 mm opening shall be provided at regular intervals to facilitate duct inside inspection and also the place where duct takes turn.
- 7.7.13 Retainer plates, guide vanes of suitable metallurgy (min. SS) shall be provided in the ducting as required.
- 7.7.14 Ducts shall be fabricated in suitable length and necessary splice flanges etc. shall be provided for ease of erection and for future maintenance by Owner.
- 7.7.15 Aluminum sheet (min. 1.0 mm thick) shall be used for external insulation as cladding.
- 7.7.16 Flue gas duct shall be provided with internal / external insulation / refractory lining to maintain outside temperature not more than 60 deg C. However, Corton steel flue gas ducts with external insulation (without internal refractory lining) outside boiler main is also acceptable where flue gas temperature exceeds 400 deg C. Contractor's design of flue gas

ducting, MOC, insulation/ refractory lining etc. shall ensure the technical, functional & service requirement.

7.7.17 At the Damper Locations & Expansion joint location there will be the flanged connections to the ducting.

7.7.18 All ducts shall have access doors for cleaning / maintenance in a suitable length of intervals and after each turning.

7.8 Dampers:

The materials of Damper which are exposed (including seals) to the hot gas, material shall be selected suitably to take care of the prolonged exposure to high temperature. Self cleaning and self-lubricated sleeve type bearings and graphite impregnated asbestos packing for shaft sealing shall be provided.

7.9 Expansion Bellow:

7.9.1 Expansion joints of suitable design shall be provided where the contractor considers it necessary to take care of differential thermal movements and to isolate vibration and load transfer.

7.9.2 Suitable expansion joints shall be provided to protect the components/ equipment/ duct to take care of the thermal expansions. Expansion joints shall not be allowed to transfer weights and loads to equipment.

7.9.3 The materials of expansion bellow which are exposed to the hot gas shall be selected suitably to take care of the prolonged exposure to high temperature. Expansion joints in the duct shall be of non-metallic (upto 1800 mm WC) and shall adequately withstand the thermal shocks at the worst operating condition. Materials and thickness of expansion joints shall be selected taking care of the sulphur in fuel, temperature and operation cycle life. These expansion joints shall possess satisfactory track record for similar applications.

7.10 BURNER SYSTEM

7.10.1 Furnace shall be supplied with burners with insulated forced draft registers. The registers shall be equipped with necessary seals.

7.10.2 Each burner shall be provided with an igniter, complete flame protection system, flame scanners, flame protection relays, interlocks, operating switch indicating lights, safety shutoff valves, gas hose, air hose & gas strainer etc.

7.10.3 The burner shall be LO-NOx Type.

7.10.4 Gas retractable/ non retractable pilot (as applicable), shall have proper air and gas mixing arrangement. It must be suitable to ensure safe ignition of specified fuels. The pilot flame shall be visible through the burner peep-hole, at least prior to the ignition of the main flame.

7.10.5 The contractor shall provide local control panel at each burner floor along with ESD monitors, push button and indications light etc.

7.10.6 Spud ring burner shall be provided for gas firing. Provision shall be made for preventing gas leakage by use of air purge etc., when burner gun is removed for tip cleaning.

7.10.7 Contractor to refer datasheet / Design basis /specifications of Thermal Process for details of burner requirements.

7.11 Fuel forwarding System

- 7.11.1 Contractor has to design Fuel forwarding system, as applicable, to meet the demand for boiler system in all cases. Contractor shall design the fuel forwarding system, pressure reduction / increase as applicable along with control valves, isolation, drain, control system, instruments, filters, auxiliaries, accessories, fittings, piping, supports, flanges, blinds etc. complete in all respect for smooth operation of Boiler system.
- 7.11.2 For detailed parameters and other technical data refer Process datasheet/ design basis.

7.12 Boiler Blow down System:

- 7.12.1 Boiler system shall have individual and dedicated Continuous Blow down system and Intermittent blow down system, unless otherwise specified in Design Basis/ Data sheet of Steam Generation System.
- 7.12.2 The vapour from the IBD tank shall be vented to atmosphere at safe height & location.
- 7.12.3 The vessel shall be thermally insulated and have aluminum cladding. The vessel shall be vertical, cylindrical and equipped with all appurtenances like:
- a) Level gauge
 - b) Level transmitter and controller
 - c) Pressure gauge
 - d) Pressure transmitter
 - e) Drain control valves as applicable
 - f) Manhole with cover with hinge connection
 - g) Pressure safety valve as applicable
 - h) Temperature gauge as applicable
- 7.12.4 All necessary valve, piping, instrumentation etc. shall be provided for blow down system.
- 7.12.5 For detailed parameters and other technical data, refer Process datasheet/ design basis.

7.13 FEED WATER REGULATING STATION

- 7.13.1 Feed Water Regulating station shall be provided for boiler.
- 7.13.2 A reliable Drum water level indication should also be provided at respective feed control station for the ease of manual operation.
- 7.13.3 Sufficient care shall be taken care to ensure no passing to feed water line through control valve.
- 7.13.4 Contractor to refer design basis and data sheet of steam generation system for detailed technical requirements.
- 7.13.5 Feed Water Control station shall be at grade level along with necessary rain cover/shed for drives.

7.14 CHEMICAL DOSING SYSTEM

- 7.14.1 Contractor shall refer design basis attached in the tender for Dosing systems applicable in various area of Boiler / BOP items.

- 7.14.2 HP Dosing system shall be provided for boiler comprising of solution preparation tank, metering tank, dosing pumps, calibration bottle, along with associated auxiliaries & accessories including piping, electrical and instrumentation, valves, fittings, structures etc. For details refer design basis / datasheet of boiler system.
- 7.14.3 Each Dosing system shall be of skid mounted self-contained unit with base frame, tanks mixer with driver, feed pumps, motor drivers and interconnecting piping work and supports.
- 7.14.4 Tanks shall be made from stainless steel. Basket type of strainers shall be fitted to the tanks. Tank shall be covered with tight shut off flanged cover. The tanks shall be provided with level gauges and drain valves.
- 7.14.5 All associate interconnecting piping work shall be from stainless steel material.
- 7.14.6 Necessary pressure gauges, relief valves, non-return valves and isolating valves shall also be provided.
- 7.14.7 Necessary structural arrangement, Platform, ladders etc. for proper accessibility, arrangement for filling the chemicals in the tanks shall be provided. Suitable stirrers shall be provided in the mixing tank.
- 7.14.8 Intermittent Drains from dosing tanks shall be routed as per Process Data sheet stipulation.
- 7.14.9 Rain water shed shall be provided on each dosing skid.
- 7.14.10 A local panel shall be provided for start stop of all electrical equipment near the dosing skid.

7.15 INSTRUMENTATION AND CONTROLS

- 7.15.1 The instrumentation and control system of Boiler shall be designed as an integral part of total system. For details, refer instrumentation & electrical design basis, specifications & scope of supply/work & services.
- 7.15.2 PLCs shall be provided for boiler operation, burners as per design basis & instrumentation specification attached elsewhere in tender.
- 7.15.3 Start up and shutdown facilities of all main equipment and auxiliary equipment in the system shall be provided from both local as well as remote (from DCS/PLC) as per design basis & instrumentation specification attached elsewhere in tender.
- 7.15.4 Local instruments, gauges, panels etc. shall be provided for efficient operation and monitoring of various parameters such as pressure, temperature, draft, level etc. as applicable for the following:
- (i) Flue gas path
 - (ii) Feed water
 - (iii) Saturated and superheated steam
 - (iv) Auxiliary steam
 - (v) Fuel
 - (vi) Instrument air

(vii) Cooling water

(viii) Nitrogen

(ix) DM water

(x) Service water

The completeness of the same shall be subject to review by EIL / Owner during detailed engineering.

7.15.5 Contractor to provide instrumentation to monitor temperature and pressure at each section of Boiler (e.g. furnace, screen tubes, super heaters, Boiler Bank /evaporators, economizers, APH, stack etc.) in flue gas path.

7.15.6 Feed water control shall be through 3 element drum level control.

7.15.7 2 out of 3 voting logic for Boiler systems tripping to be provided.

8.0 INSPECTION AND TESTING

8.1 Hydrostatic test of all shop assembled tube assemblies, coil harps, panel, drums, headers, super heaters, evaporator, economizer, pressure parts components, risers & down comers, piping spool and vessels/tanks shall be carried out in accordance with IBR or as applicable code before dispatch from works. Hydro testing of piping spool pieces also can be done at site.

8.2 Hydro testing shall be conducted for complete pressure parts system of boiler after installation in the field at the required pressure as per design & construction code. All necessary blanking, valves, flanges, blinds, gaskets, fasteners arrangement, temporary piping, flexible connections, instruments etc. for the test shall be arranged and supplied by the Contractor.

8.3 Test pressure gauges shall be of direct reading type and shall be periodically calibrated. The certificate of calibration will be presented to the Owner/EIL prior to the commencement of the tests.

8.4 No preservative or paint will be allowed to cover any joint, mechanical or welded, before the pressure test is completed.

8.5 No welding shall be done on pressure parts of boiler after the hydro-test conducted.

8.6 The hydraulic test fluid for ferrite steels shall be clean wetted water and for austenitic steels wetted water with chloride content less than 25 ppm. For the later case, the contractor must provide the Owner with a certificate of water analysis or certificate of guarantee from local water board. If water of such quality is not available, then the contractor must submit the alternative proposals in writing to the owner for discussion and agreement on alternative testing medium.

8.7 The leak test shall be followed by hydrostatic test and maintained for sufficient time to permit thorough examination to be made of all seams and joints.

8.8 Contractor shall conduct smoke bomb test for the leak test checking of flue gas side including ducting area of boiler and associate arrangement.

8.9 After completion of hydrostatic test, water must be drained immediately and the equipment

tested completely dried by dry compressed air or by other means which must be approved by Owner.

- 8.10 All inspection at site and shop shall be carried out by EIL. Package contractor to follow Inspection methodology document attached in the tender.
- 8.11 All inspections at shop / works for fabricated / manufacturing items / components / equipment / attachments / systems, bought outs at sub vendor/ subcontractor works and at site including site fabrications & construction & testing, assembly and alignment at site, site tests, hydro test shall be done as per inspection philosophy given in tender.
- 8.12 Contractor shall have their own qualified inspection team as per approved quality assurance plan & requirements considering mechanical, pressure vessels, instrumentation, electrical, refractory, structure, piping, rotating etc. and before offering to TPI, contractor own inspection has to be satisfied along with documents & records.

Contractor is solely responsible for Quality of materials, fabrications, welding, manufacturing, testing, consumables during fabrications/manufacturing, bought outs, alignment, dimensions, size, painting etc.

- 8.13 Contractor to inform in advance to EIL / Owner before conducting of any test for boiler system or any component/sub system. However, in case EIL / Owner witness the test, such inspection shall be regarded as regular check-up and in no way absolve the Contractor of his responsibility. EIL / Owner shall have access to contractor's / sub contractor's /sub vendor's works at all reasonable times for the purpose of expediting and/ or witnessing the stage inspection.

- 8.14 Testing At Works:

Contractor shall perform all necessary tests and inspections to ensure the quality of material received and workmanship of various activities performed during manufacturing/fabrications/assembly/testing etc. to comply the requirement of this various specifications of tender and quality requirements/QAP. Fittings, valves, instruments, filters and other bought out components shall be duly tested and manufacturer's test certificates for the same shall be furnished by the contractor to EIL/Owner.

- 8.15 For detailed inspection & testing related requirement, contractor to refer Inspection Methodology attached with tender.

9.0 SPARES

Mandatory spares for fabrication / assembly / erection / pre-commissioning / commissioning spares shall be in contractor scope. List of Mandatory spares, shall be furnished item and equipment / system wise along with size, quantity, specification, tag no., reference of components / equipment etc.

Contractor shall include the cost of all kind spares in their base price except 2 years O&M spares recommended by bidder.

Contractor shall furnish a separate itemized priced list of recommended spare for two (2) year's normal operation and maintenance valid for 2 years. Recommended spares shall take in to account related factors of equipment reliability, effect of equipment downtime upon production or safety, costs of parts and availability of equipment service facilities. List shall include the requisite quantity of chemical required for the package during 2 years of normal operation.

10.0 PROTECTION AND PAINTING

For all the equipment / components of boiler system and associated items / components/systems including all auxiliaries, accessories, piping, valves, bought outs and structural items external surface preparation, primer and finish painting shall be carried out suitable to applicable environment conditions and as per the specification else were given in the tender.

Suitable packing materials/guards/rapping materials/caps etc. shall be used for each and every component/item/equipment/system considering environmental conditions for period of dispatch to commissioning.

11.0 GUARANTEE

11.1 GENERAL

11.1.1 This section describes the guarantee parameters which Boiler package must fulfill and the rejection of the plant by the Company.

Apart from the guarantee mentioned below, various other requirements are spelt out in the attached specifications which shall have to be demonstrated by contractor for acceptance of the plant by owner. Prior to conduct of guarantee test, contractor shall demonstrate the operability of the individual equipment w.r.to capacity, pressure, temperature, design conditions, turndown conditions etc. including all auxiliary and accessories to prove the selected sizes vis-a-vis the bid requirement.

The guarantee parameters shall be adjusted from the design ambient conditions to the prevailing site conditions. Necessary calculations shall have to be furnished by contractor for this purpose. Contractor should submit the applicable correction curves.

These shall form the basis of correction during performance testing. Necessary instruments etc. shall be provided by contractor during performance testing to establish the guarantee parameters. Utilities shall be provided by owner as specified.

11.1.2 The contractor shall guarantee the equipment / complete system for the design, materials, workmanship, size, capacity, performance efficiency and compliance to various technical requirements listed in the bid package to the extent of his scope of work and supply. This guarantee shall include sub ordered/bought out items forming part of the total supplies.

11.1.3 The contractor shall repair / replace within 3 months from the date of notification or from the start of PGTR, whichever is applicable for any part of equipment/component/sub system/complete system free of cost and with no loss of time if: -

- i) There is fault in design.
- ii) There is defect in material or workmanship and/or it does not comply with fabrication requirements or there is wrong selection of material for the process requirements.
- iii) It fails to achieve the capacity, parameters, steam purity, emission rate and performance requirements.
- iv) It does not comply with various requirements of the bid package agreed and guaranteed figures provided by Contractor during bid.
- v) The reliability test is not successful.

11.1.4 EIL/Owner shall have the option to replace such defective parts / components / sub system

/ Complete system after intimating the contractor and shall be entitled to recover the costs of such replacements from the contractor.

11.1.5 EIL/Owner's inspection or review of contractor's designs / drawings / documents or deviations shall in no way absolve the contractor or reduce his responsibility towards this guarantee.

11.1.6 The financial liability of the contractor shall be unlimited unless indicated otherwise in EIL/Owner's terms and conditions of the commercial part of the tender.

11.1.7 The guaranteed performance parameters furnished by the Contractor in his offer, shall be without any negative tolerance values whatsoever. All margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.

11.2 RELIABILITY TEST:

The contractor shall operate the plant running the boiler system separately for 14 continuous days to demonstrate the reliability of the Boiler. During the reliability run a total outage of 36 hours with any one continuous outage not exceeding 6 hours is permitted for boiler test run.

11.3 PERFORMANCE TEST:

11.3.1 Contractor shall be responsible for performance guarantee (process / thermal/hydraulic/mechanical) of each individual sub system, system & complete package including all auxiliary and accessories.

11.3.2 Every individual auxiliary and accessories of boiler system and auxiliaries / accessories shall be tested by contractor separately & demonstrate in terms of capacity, turndown, pressure, temperature, design / operating condition, output of the system, performance parameters etc.

11.3.3 Performance tests shall be carried out to determine & demonstrate the parameters as specified in design basis / datasheet/LPC document attached elsewhere in tender:

11.3.4 All instruments used for the performance testing shall be calibrated against standard instruments at a reputed laboratory (to be approved by Owner/ EIL). Necessary calibration certificates shall be obtained by the contractor and submitted to Owner/ EIL prior to the usage of these instruments.

11.3.5 Performance testing as required, after successful completion of reliability test run shall be conducted as per requirement specified in data sheet / design basis / performance test code specified in the tender.

11.3.6 All tools, tackle, valves, gauges, flow meters, orifices, nozzles, blinds, supports, pumps, gaskets, other instruments, all necessary accessories for Performance Guarantee Test Run (PGTR) shall be in contractor scope.

11.4 GUARANTEED PARAMETERS

11.4.1 As per Process datasheet (Document no. B957-420-80-44-DS-3201), design basis (Doc No. B957-420-80-44-DB-3201) & Loading and Penalty criteria document (No. B957-420-80-44-LPC-3201) attached elsewhere in the tender.

11.4.2 **Steam Purity:** As per process datasheet / design basis

11.4.3 **Emission Rates:** As per process datasheet / design basis

- 11.4.4 All other guaranteed parameters and equipment / sub system specific capacity/parameters shall also be demonstrated during PGTR for various operating scenarios as per process datasheet, design basis of steam and power generation package and specifications. In case of not meeting the same, the component/ equipment/ system shall be liable for rejection.

12.0 DRAWINGS / DOCUMENTS FOR REVIEW:

As per VDR including interface department VDR requirement attached elsewhere in the tender.

JOB SPECIFICATION OF BURNER & ASSOCIATED AUXILIARIES/ ACCESSORIES

PROJECT : ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES
RELATED TO BINA PETCHEM & REFINERY EXPANSION
PROJECT (BPREP)

UNIT : STEAM GENERATION PACKAGE

OWNER : BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

PMC : ENGINEERS INDIA LTD.

JOB NO. : B957

0	06.02.2025	ISSUED WITH TENDER	PK	SBC/AD	DD
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

1.0 GENERAL

- 1.1 This specification defines the minimum requirement for selection, design, engineering of burner. This is only for providing basic guidelines for burner however all the responsibility lies with contractor & burner vendor to supply most suitable & reliable burner for smooth operation & long life without fail.

2.0 BURNER VENDOR EXPERIENCE

- 2.1 Bidder shall ensure that burner vendor if the same is not as per EIL master vendor list should have proper PTR (Past proven track record) for offered model designed for similar fuel and similar size (if not same size, then one bigger and one smaller size each) to at least two users in the last ten years and at least one should be in successful operation for at least one year.
- 2.2 Reference list for the offered burner model as per clause 2.1, including client, location, service (forced or natural draft), type of fuel (as per tender design basis), year of supply and end user contact person name, address, telephone and fax no. shall be submitted. Bidder shall submit PTR and certificate of satisfactory operation for the offered model.

3.0 APPLICABLE CODES

The burners shall be designed, constructed, inspected and tested in accordance with this specification, and the requirements of the latest editions of codes and standards including:

ASTM* - For Material designation

ASME B1.20.1 - Pipe Threads General Purpose

ASME Sec. IX - Welding of pressurized fuel containing parts

ANSI B16.5 - Flanges

API RP 531 M - Measurement of Noise from Fired Process Heaters

NFPA 85

* Equivalent British / Indian standards are acceptable.

4.0 DESIGN CRITERIA FOR BOILER BURNERS:

- 4.1. Burners shall be suitable for outdoor operation in a specified complex environment under the specified ambient conditions.
- 4.2. Burner shall be Low NOx type
- 4.3. Burner shall be suitable to fire all fuel & combination firing as per design basis/Tender.

- 4.4. Numbers of burner in operating conditions for boiler MCR shall be as per design basis.
- 4.5. Each burner shall be provided with an ignitor, complete flame protection system, flame scanners, flame protection relays, interlocks, purge cycle timer, operating switch indicating lights, safety shutoff valves, stainless steel gas/liquid hose & stainless steel strainer for fuel, air hose.
- 4.6. Burners shall be suitable for all fuels as per specifications. Each burner shall be suitable for firing main/Normal and alternate fuel.
- 4.7. Burner design shall take into account the burner spacing and clearances from furnace tubes /refractory walls and needs to prevent flame impingement on tubes and walls. The maximum flame length and diameter shall be selected suitably to avoid any impingement & hot spot. Adequate distance between flame & furnace tubes / refractory wall shall be kept.
- 4.8. Provided Maximum flame length & diameter shall not exceed at any operation scenario.
- 4.9. Burner flame shall be stable at all operating condition & during turndown condition.
- 4.10. In case of a multiple burner system, burners shall be so designed that their performance does not get affected due to the operation of the adjacent burner. There shall be no flame overlapping between adjacent burners.
- 4.11. Acceptable NOx emission levels are indicated in the design basis / data sheet. In order to meet these NOx emission levels, burners must have either of the following low NOx features:
 - a) Staged Fuel
 - b) Staged Air
 - c) Staged fuel in combination with staged air.
 - d) Staged air and fuel in combination with flue gas recirculation
 - e) Any other proven burner design

Bidder is required to state the low NOx feature adopted and explain.

- 4.12. Burner shall fulfil all emission requirements at all loads and with all fuels as per Tender.
- 4.13. Sight glasses in burner shall be provided suitably to check pilot & main flame.
- 4.14. CFD analysis shall be done for air & combustion in burner to ensure proper flame with in specified boiler furnace and there is uniform air distribution at all loads, there is no flame impingement / hot spot & flame is stable during turndown & all operating condition. Boiler OEM/Burner vendor shall furnish CFD analysis report along with

recommendations to EIL/Owner and accordingly all recommendations shall be implemented by Burner/Boiler vendor.

- 4.15. The flame shall be clearly visible through scanner tube unobstructed by any burner parts.
- 4.16. The flame monitoring system, when specified, should not only be able to differentiate between the flame viewed and adjacent flame for all fuels that are to be burnt, but also ignore the re-radiations from the refractory walls.
- 4.17. Burner noise at any location 1.0 M from the furnace with one burner firing at design heat release shall not exceed 85 dBA.
- 4.18. Materials for thermal and acoustic insulation shall be of high quality. When block Insulation, fibre glass or mineral wool is used as internal lining for burner plenum or wind box it shall be suitably anchored by studs and have exposed face protected from shredding by expanded metal sheets.

5.0 General :

- 5.1. Burner vendor to provide logic and write-up for safe and smooth start-up, shutdown and operation of burner.
- 5.2. Burner vendor to provide Installation, operation and maintenance manual for burner which includes pre-commissioning, commissioning, start up and shut down procedure along with preventive maintenance as minimum.
- 5.3. Burner vendor shall provide supervision/ site check listing of complete package, instrument installation, field testing, calibration, loop checking, pre-commissioning and commissioning as well as integration of local panel with burner (if required).
- 5.4. Burner vendor is required to participation in HAZOP study / SIL study (if required).
- 5.5. Burner vendor to provide services required (if any) other than covered in requisition which calls for presence of vendor's technical person at site.
- 5.6. Contractor to refer datasheet / Design basis /specifications attached elsewhere in tender in addition to this specification.

6.0 INSTRUMENTATION AND CONTROLS

The instrumentation and control system of Burner system shall be designed as an integral part of total system and shall be installed in the control room/fields. For details, refer instrumentation specifications / design basis& details mentioned elsewhere in tender.

7.0 DEMONSTRATION:

Supplier shall demonstrate the following design parameters during Performance test based on the operating Conditions specified in the datasheet.

- a) Heat release, maximum / normal / minimum
- b) Turndown ratio
- c) Atomizing steam/Air consumption rate as applicable
- d) Excess air at maximum and normal operating condition
- e) Flame dimensions at maximum / Normal / minimum heat liberation
- f) Flame stability
- g) NO_x, CO and Particulate Matter emission rate
- h) Noise level at 1.0 M distance from burner

8.0 INSPECTION AND TESTING

One number burner each of offered model / size shall be tested at vendor's works. In case burner supplier do not have test facility, bidder can opt for site testing & acceptance during pre-commissioning / commissioning subject to the following conditions:

- i) Submission of letter from burner suppliers about non-availability of test facilities.
- ii) Test shall be conducted at site with presence of Owner / EIL along with burner OEM.
- iii) In case any requirement of tender or parameter of approved datasheet does not meet during site test, contractor / burner supplier will rectify or replace the component or whole burner without any additional cost within 45 days from the start date of test or before commissioning start date whichever falls earlier.
- iv) In case burner rectification or replacement (for the sl. No.8-iii above) not done within specified period or burner does not perform even after rectification / replacement, supply shall be considered as incomplete.

Details of test check points other than listed in Sr no. 7 of above, shall be finalized during review of test procedures. Burner shall be tested for guaranteed parameters as applicable and as offered to steam generation package contractor. Burner testing has to be carried out along with air preheat (if applicable) / air at ambient temperature as specified in burner datasheet.

Burner light up shall be carried out with the proposed igniter being supplied with the burner.

Tested burner shall be stamped "TESTED EQUIPMENT" after shop / site test for easy identification.

Shop / site performance testing shall be witnessed by Owner / EIL. Hence, prior notice (minimum 6 weeks) has to be given by the bidder, for the date and venue of test.

It is bidder responsibility to arrange all tools and tackles, jigs & fixtures, instruments, nozzle, blind, gaskets & other necessary arrangement during shop / site performance testing and facilitate check by Inspection agency, Owner & EIL so that acceptance can be given.

9.0 SPARES

Refer burner spare list attached in tender. However, spares required for assembly / erection / pre-commissioning / commissioning shall be in contractor scope. List of recommended spares, shall be furnished item and equipment / system wise along with size, quantity, specification, tag no., reference of components / equipment etc. as per requirement of tender.

10.0 PROTECTION AND PAINTING

The safe handling procedure and precautionary requirements shall be clearly spelt out in the Installation / Operation and Maintenance manual, to ensure that the equipment and its components are safe during transportation, installation and handling.

External surface preparation, primer and finish painting shall be carried out suitable to applicable environment conditions and as per the specification else were given in the tender.

Suitable packing materials / guards / rapping materials / caps etc. shall be used for each and every component / item / equipment / system considering environmental conditions for period of despatch to commissioning & packing specification mentioned elsewhere in tender.

11.0 DRAWINGS / DOCUMENTS FOR REVIEW: As per VDR attached with tender.

VENDOR DATA REQUIREMENTS FOR STEAM GENERATION PACKAGE

A	18-FEB-2025	Issued for Tender	-PK-	KS/AD	-DD-
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

VENDOR DATA REQUIREMENTS

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

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Technical Confirmation / Checklist (Doc. No. B957-420-80-44-TM-3001)	✓				
2.	Agreed Deviations / exceptions / conflicts at Pre-bid stage are duly filled in the Deviation format B957-420-80-44-DV-3001.	✓				
3.	Duly filled & signed/ stamped ANNEXURE-1 (PROFORMA FOR GUARANTEED FIGURES FROM BIDDERS) of Performance Guarantee and Loading & Penalty Criteria (B957-420-80-44-LPC-3201).	✓	✓			
4.	List of all drawings/documents for submission (DCI)		✓			
5.	Heat & mass balance diagram for Guaranteed case as per performance guarantee and Loading & penalty criteria document (B957-420-80-44-LPC-3201)	✓	✓			
6.	P&IDs in smart plant P&ID for Steam Generation Package with write-up of operation and control.		✓		✓	
7.	PFDs for Steam Generation Package with Heat & Mass Balance Diagram for all operating cases and MCR capacity case as defined in Design basis(B957-420-80-44-DB-3201).		✓		✓	
8.	Package Datasheet duly filled up in format (Doc. No. B957-420-80-44-DS-3202) with signature & seal.	✓	✓		✓	
9.	Burner Datasheet with catalogue.		✓		✓	
10.	Burner General Arrangement Drawing		✓		✓	
11.	Stack Datasheet		✓		✓	
12.	Dosing System Datasheet (Sketch of dosing system along with configuration & dimensions shall be attached to D/S)		✓		✓	
13.	Cause & affect diagram		✓		✓	
14.	Process datasheet for Deaerator (along with Outline diagram of deaerator indicating overall dimensions of equipment, nozzle sizes etc).		✓		✓	
15.	Deaerator Vessel sizing and Process/ Hydraulic design calculation for storage and deaeration section. Heat and Mass balance calculation for the Deaerator at stratup, Normal and maximum load.		✓		✓	
16.	Write-up for sustainability of boiler during black-out			✓	✓	

**VENDOR DATA REQUIREMENTS
FOR
STEAM GENERATION PACKAGE**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
17.	Burner testing procedure			✓		
18.	Performance guarantee test procedures & methodology.		✓		✓	
19.	CFD analysis report and recommendation as per Design specification of burner B957-420-80-44-SP-3201.			✓	✓	
20.	Following procedures are to be submitted: 1) Pre-commissioning & commissioning procedure 2) Chemical cleaning & alkali boil out procedure			✓	✓	
21.	Battery limit conditions (showing terminal points, operating/design conditions etc as per required format)		✓			
22.	Control philosophy & logic write-up for Boiler along with BMS.		✓		✓	
23.	Utility consumption figures (maximum) i.e. DM water/Cooling Water/ Instrument air/ Plant air / Service water/ N2/ any other utility.	✓	✓		✓	
24.	Effluent summary			✓		
25.	Write-up covering Salient technical Features of the complete system	✓		✓		
26.	Operation and maintenance manual and Start-up/shutdown philosophy			✓		
27.	Basic design calculations for system design, equipment selection with complete reference data / references used in calculations.			✓	✓	
28.	Process / Thermal data sheet of bought out items and components (fuel forwarding system, fans, pumps, tanks, safety valves, silencers etc.)			✓	✓	
29.	Normal electric power, Emergency electrical power and DC power requirement of Complete system	✓		✓	✓	
30.	Furnace absorption heat flux to its limiting value as used by bidder for designing boiler.			✓		
31.	Start-up and loading curves for utility boilers including start-up curves under hot, warm and cold conditions.			✓		
32.	Equipment list for complete system			✓		
33.	List of instruments and equipment required for calibration, listing & measuring along with data, calculation, drawings/documents and information.			✓		
34.	Performance curves/ selection charts/ Nomographs / Equipment sizing calculation			✓	✓	
35.	Flow sheets/ P&IDs of the bought out equipments/system/ package			✓	✓	
36.	Correction curves as per performance guarantee and Loading & penalty criteria document (B957-420-80-44-LPC-3201)	✓	✓			
37.	List of steam consuming equipment during guaranteed operation.	✓	✓			

**VENDOR DATA REQUIREMENTS
FOR
STEAM GENERATION PACKAGE**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
38.	Purchase specifications for bought-out equipment (like Bellows etc.) along with datasheets.		✓			
39.	List of major sub vendors along with Proven Track Record (wherever applicable) and scope matrix		✓			
40.	List of mandatory spares for complete steam Generation system / equipment / components including all bought outs.		✓			
41.	Steam generation plant Layout showing whole system, equipment / components / auxiliaries & accessories including boiler auxiliaries & accessories, Deaerator, BFW & fuel Gas & Natural Gas Conditioning skid, FD fans, dosing systems, SWAS & CEMS, tank, stack, bought outs, structures, pipe racks, major piping, stack, ducting, platforms, staircases, indicating tag numbers, grid references, dimensions, approach road, maintenance space, list of components, underground facilities, battery limit marking, location of catch basin, hose station, storm water drain, interface details notes etc.	✓	✓			
42.	Equipment General Arrangement Drawings (GAD) of boiler system with plan, elevation, side view & cross-sections along with complete design & operations data and associated equipment, dimensions, size, interfaces, inspection and access door locations, FD fan & Air Pre-heater location, instrumentation connections, structure, location of platforms, walkways, stairs, ladders, ducts, piping and valves etc. with size, thickness, MOC, rating, STD, quantity, end connections, type of each pressure parts components (e.g. tube, drum and header etc.) shown in a tabular form, design considerations, references, notes etc.	✓	✓			Vendor to submit Preliminary GA of boiler with Bid.
43.	General arrangement of stack & details along with bottom chair & foundation details, nozzle orientation & platform details elevation wise, splice joint details, aviation light, lightning arrestor, painting trolley details etc.		✓		✓	
44.	Datasheets for Expansion joints covering design consideration, parameters, design code, hardware, MOC, size, thickness, corrosion allowances, nozzle details, relevant notes, reference codes and specification, test requirements etc.		✓		✓	
45.	Modularisation philosophy along with dimensional sketches, weight & lifting arrangement etc. for complete Steam Generation Package.			✓		
46.	Preservation procedure in details and storage instructions for the boiler components / auxiliaries / accessories.			✓	✓	
47.	Site Installation procedure, instruction, guidelines & check list for complete Steam Generation Package.			✓	✓	

**VENDOR DATA REQUIREMENTS
FOR
STEAM GENERATION PACKAGE**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
48.	Transportation scheme for the modules/ stack / skids / loose items of the package from vendor works to actual job site premises of installation country.			✓		
49.	Erection / installation and constructability study & procedure along with rigging scheme of the package modules/ stack / skids / loose items.			✓	✓	
50.	Drawings / documents for modules, skids & loose items / components along with dimensions, weight, base frame, supports, stiffeners, spider beams, guides, lifting arrangements with basis of calculations for various loads while designing base frame, guides, stiffeners, lifting arrangements etc.			✓	✓	
51.	Detailed fabrication drawing & As Built drawing of all equipment's/components of complete Steam Generation System Package.			✓	✓	
52.	Vendor recommended list of spares for normal 2 years operation & maintenance			✓	✓	
53.	Drawings (GA/details) : -Drums with internals & externals -Super heater assembly -Evaporator assembly -Furnace membrane walls with header -Economizer assembly -Attemperator with headers -Riser and downcomers -Burner system -Blow down system -APH			✓	✓	
54.	Complete Pressure Parts Assembly indicating configuration, design & operating parameters, MOC, dimensions, heat transfer area, support locations etc.			✓	✓	
55.	Boiler supporting system & Major equipment / component supporting arrangement details			✓	✓	
56.	Stack design calc. (STAAD Pro Input/output file) with basis & consideration.			✓		
57.	IBR Design & stress calculations and analysis for complete pressure parts including pressure parts supports.			✓	✓	Vendor needs to submit this along with the GAD & pressure part drawing.
58.	IBR approved Pressure part drawings which shall include all details like GA drawing of super heater, evaporator, economiser, wall tubes panel, steam drum and headers along with internals, attemperator etc.			✓	✓	
59.	Design calculation for supports, structure, non pressure parts etc.			✓		
60.	Flexibility analysis of risers/Down comers.			✓		
61.	Equipment attributes (Doc. No.: B957-420-80-44-DS-3001) attached with tender shall be duly filled by contractor and submitted during post order stage.			✓	✓	

**VENDOR DATA REQUIREMENTS
FOR
STEAM GENERATION PACKAGE**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
62.	General Arrangement drawing for Expansion joints covering design consideration, parameters, design code, hardware, MOC, size, thickness, corrosion allowances, Nozzle details, relevant notes, reference codes and specification, erection weight, test requirements etc.			✓	✓	
63.	Installations / Erection procedure for the boiler / auxiliaries / accessories.			✓	✓	
64.	Packing procedure, equipment / component identification tag no., details and proper packing list covering each and every modules, skids, component and loose pre- fabricated items of the package			✓	✓	
65.	Filled in MTO format (B957-420-80-44-MTO-3001) to be submitted	✓		✓	✓	
66.	Utility consumption figures (for start-up, intermittent & continuous operation & shut-down) i.e. DM water/Fuel oil/ Fuel gas/Off gas/ Natural gas/ PFO/Cooling Water/ Instrument air/ Plant air / Service water/ N2/ any other utility.		✓		✓	
67.	Welding procedure & qualification records		✓		✓	@Review by Authorized Inspection Agency.
68.	Inspection Reports including: - Radiography - D.P. tests - Hydro test - Non-destructive test, - Mechanical run test - Mill / material test - Other tests as per spec. / design & construction codes		✓		✓	@Review by Authorized Inspection Agency.
69.	Material test certificates along with inspection report.		✓		✓	@Review by Authorized Inspection Agency.
70.	Quality Assurance Plan(*)			✓		@Review by Authorized Inspection Agency.

Notes :

1. "TICK" denotes applicability.
2. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
3. Final documentation shall be submitted in hard copy (Six prints) and soft (two CDs/DVDs) in addition to submission through EIL edocx.
4. Refer - 6-78-0001: Specification for quality management system from Bidders.
5. Refer - 6-78-0002: Specification for documentation requirements from Contractors.
6. Refer - 6-78-0003: Specification for documentation requirement from Suppliers.
7. All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
8. Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder /

contractor / supplier during finalization of Document Control Index (DCI).

9. "@" indicates submission of documents to Inspection Agency.

10. Bill of Material shall form part of the respective drawing.

11. Also refer other department's VDR :-

12. Electrical

13. Instrumentation

14. Static & machinery equipment's (SME)

15. Piping

16. Structures

17. Within one week on receipt of the Fax of Acceptance from the EIL, Vendor shall furnish a detailed list of drawings and the schedule of submission of drawings along with their review category (EIL / Owner review & Record).

18. Drawings requested for submission "For Dossier" shall be "as built" drawings. These drawings shall be certified by the site in-charge and for records.

19. Complete list of drawings / documents with anticipated submission date must be submitted Within 15 days after award of contract. This should be finalized with EIL. Documents Submitted before finalization of this index shall be returned without review. Supplier must adhere to the following order of submission of documents:

i) Master document index with schedule of submissions.

ii) P&IDs, datasheets and Thermal / hydraulic calculations.

iii) Purchase specification of critical bought-out equipment / components.

iv) GADs and Engineering drawings.

v) Mechanical / Structural design calculations with soft copy.

vi) Detailed fabrication drawings / documents.

20. The Vendor shall plan the complete detailing / drawing work such that drawing / documents for submission to EIL are limited to the ones defined in this document.

21. Drawings / documents after review shall be returned to Vendor within 4 weeks after receipt in EIL.

22. After review, one set of documents / drawings shall be given to the inspection agency (inspector) by the vendor.

23. Documents as sought in Loading & Penalty criteria shall also be complied.

24. Package Contractor to follow the document numbering philosophy for the documents submitted to EIL/CLIENT as per EIL numbering system, guidelines to numbering shall be provided to the Package Contractor at post order stage.

25. All post order documents shall be submitted / approved through EIL edocx portal

26. All the documents submitted to EIL (whether Contractor own documents or from Subcontractor/ sub vendor) must have at proper space the document approval block in prescribed format (on Top sheet of document or near Title Blocks of drawing).

27. All data / drawings shall be in English language and in the Metric system.

28. All drawings / documents shall be thoroughly checked and duly signed and stamped by Contractor including drawing / documents of sub-vendor, before submission to EIL. Documents, which are unchecked, unsigned, and without revisions clearly marked, shall be returned without review. Any delay on account of this shall be to the Contractor's account. Also successive reviews of the same documents shall apply only with respect to

comments on the previous revision.

29. Document distribution schedule

The documents listed under column 6 shall be submitted as hard bound indexed books and in soft copies (CDs) containing all drawings/documents as per Bidder data requirement. The distribution of these documents and CD shall be as described herein:

i).six hard copies + one set of CDs to client site

ii).one hard copy + one set of CDs to client head office

iii). one hard copy + one set of CDs to consultant / PMC

30. Two hard copies of bound indexed books to the site with consignment and shall be submitted within four weeks of release note/despatch of material/equipment from Bidder's works.

31. All documents/drawings shall be legible and of good quality. Illegible documents shall be returned without review and any delay in approval of such documents shall be to vendor's account.

32. GAD shall be submitted along with design calculation.

33. Vendor shall furnish drawings / documents / data as detailed herein at various stages of the Contract, e.g. proposal, execution and record purposes. All drawings and data shall bear the purchaser's job number, PR no., EIL job no., client's name, location, Name of Project, item number and service.

34. IMPORTANT:- Vendor to note that all Vendor prints shall be submitted to EIL in PDF format (to be converted from native file only) through Vendor Portal (Refer instructions below). In addition to above, hard copies as indicated above shall also be furnished for EIL approval. Procedure for Using Vendor Portal URL of the Portal: <http://edocx.eil.co.in/vportal/login>

User Name: Supplier Code as provided by EIL during enlistment

Password: Password used for downloading RFQs from IPP website.

35. A response sheet indicating the response of Vendor to EIL comment on the earlier revision shall accompany resubmission of document. Submission not accompanied by updated Index / response sheet will not be entertained for review.

36. Final documentation shall be submitted in hard copy (Six prints) and soft (two CDs/DVDs) in addition to submission through EIL edocx portal.

37. GAD shall be submitted only after approval of thermal data sheet.

38. DRAWINGS / DOCUMENTS FOR SUBMISSION: i)All the deliverables (drawings/sketches) by Contractor shall be in AutoCAD version 14.0 or higher . ii)Text part of all the write-ups, etc shall be typed in MS-Word (latest) and tables in MS-Excel. iii)All drawings/documents for review shall be provided in Electronic form also besides hard copies in requisite number as specified. iv)All As-built drawings documents shall be provided through edocx portal, in electronic form (CDs) also besides hard copies in requisite number as specified.

39. For all documents under Review category, manufacturing to be taken up only after EIL's approval is obtained. These approvals should preferably be obtained across the table in case of criticality w.r.to activity scheduling. Any of the EIL comments are to be mandatorily incorporated without schedule and cost implication.

40. For all documents under records category, Vendor to submit documents for information and proceed with the work. Employer / EIL's comment, if any can be incorporated during execution whenever some non-conformance to Job specs. /standards are detected by EIL/ Employer. It is CONTRACTOR'S responsibility to correct the deviation, if any, to the stipulation in the bid document, without any cost or time implication to owner.

41. The drawing commented with Code-2 (proceed with manufacturing, fabrication as per commented drawing, Revised drawing required) shall be resubmitted to EIL within 4 weeks from the date of comments. Vendor is expected to comply with EIL's comments in the next revision after code-2.

42. Vendor must submit the drawings in a planned manner and total drawings to be bunched together in not more than four groups based on job sequencing requirements and the co-related drawings must be submitted

together in one bunch. Drawing Submission Schedule to reflect groupings accordingly.

43. Documents once reviewed in Code-1 shall not be submitted (incorporating some changes) again for review, however if some change is really necessary, the same shall be brought to the notice of EIL separately through design change note for review / information. Finally As built drawings, duly updated, shall be submitted.

44. Overall foundation layout document mentioned in VDR Doc. No.: B957-420-81-41-VDR-7410 shall consists of information i.e. foundation load data along with base plate/anchor bolts details, hard stand requirements and detailed basis of calculation for each equipment of steam generation



MANDATORY SPARE PARTS FOR STEAM GENERATION PACKAGE (FED)

PROJECT : ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES, BINA
PETCHEM & REFINERY EXPANSION PROJECT (BPREP)

UNIT : STEAM GENERATION PACKAGE (Unit No. 420)

OWNER : BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

PMC : ENGINEERS INDIA LIMITED.

JOB NO. : B957

A	10.02.2025	ISSUED WITH TENDER	PK	KS/AD	DD
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

- 1.1 This section defines the Philosophy for mandatory spares to be supplied by the bidder as part of the contract.
- 1.2 Contractor shall supply mandatory spares for Steam Generation System pertaining to FED spares scope as follows for boiler.

S. No.	ITEMS	PARTS	DESCRIPTIONS
1.	Steam Drum, Mud drum, Attemperators, Vessels, Tanks	Gasket	400%
		Fastener	20% (for each size)
		Steam purifier / Demister / Replaceable internals	200% of each type
2.	Pressure parts, APH tubes (if applicable)	All types of tubes	5% of each size / type
3.	Stack / Access Doors / Expansion Bellow/ Soot Blower, silencer	Gasket	200%
		Fastener	20%
4.	Other equipment / components/ valves at flue gas side in boiler	Gasket	400%
		Fastener	20% (for each item)
5.	Burner	Liquid fuel Tip Assembly	1 set of each type
		Liquid fuel Gun Assembly	1 no. of each type

- 1.3 The spare quantities where specified in terms of percentage, shall be rounded off to the next higher integer.
- 1.4 All spares supplied by package vendor shall be properly wrapped and packed so that spares will be preserved in as new condition under the normal condition of storage envisaged and shall be properly tagged & coded so that at a later stage same can be identified. Packing list shall be furnished so that parts can be identified.
- 1.5 Mandatory spares handover to client with proper packing list and identity tags in a single lot in an exclusive container/box.
- 1.6 These spares shall not be used during construction, erection or commissioning.
- 1.7 The above list excludes spares for Refractory, Instrumentation, Electrical, Piping, SME & other discipline etc. Bidder to refer the specification of other departments / discipline attached elsewhere in the Tender for the supply of spares.



TECHNICAL CONFIRMATION/ CHECKLIST

FOR

STEAM GENERATION PACKAGE (FED)

PROJECT : ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES, BINA
PETCHEM & REFINERY EXPANSION PROJECT (BPREP)

UNIT : STEAM GENERATION PACKAGE (Unit No. 420)

OWNER : BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

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0	10.02.2025	ISSUED WITH TENDER	PK	SB/KS/AD	DD
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S.No.	QUERIES	BIDDER'S CONFIRMATION / REPLY
Bidder must furnish answers/ clarifications/ confirmations of all the following queries and submit along with offer.		
GENERAL		
1.	This Technical Confirmation/ checklist shall be submitted with categorical confirmation against each of the clauses. Confirm compliance.	
2.	Bidder to confirm that submitted offer is in line with the requirement specified in the tender.	
3.	Bidder to confirm that the scope of work shall be in compliance with the tender document. There is no intention to mention all equipment, materials and work / services explicitly but nevertheless required to fulfill the functional requirements shall be deemed to have been included in the scope of contractor with no additional cost or time implication to the owner. Confirm compliance.	
4.	Bidder to confirm that special instructions to bidders for Pre-Bid requirements has been read thoroughly, understood & met the requirements. Confirm complete documents enclosed with tender have been received and requirements have been fully understood with clarifications where necessary have been discussed and obtained before submission of offer.	
5.	Bidder to confirm that all clarifications, doubt, discrepancies & deviations are discussed clarified & settled during pre-bid stage before submission of offer. Such issue shall not be entertained in post order.	
6.	Bidder to confirm that only agreed deviations during pre-bid are furnished in bidder's offer in "Deviation format" attached with requisition. Any deviation, assumption, clarification attached elsewhere in the offer shall not be entertained. Confirm compliance.	
7.	Bidder to note that the details of components/ Equipment / sub system /system are not required to be furnished in their offer at bidding stage, unless otherwise asked in the tender. If the bidder furnishes any such details, these shall not be reviewed or taken cognizance of at this stage. These details shall be treated as preliminary and for reference and record purpose only and shall not be contractually binding. Review of these details will be done in submission after award of contract. Bidder to confirm the same.	

8.	Bidder to confirm their agreement and compliance to requirements mentioned in Performance Guarantee and Loading & Penalty Criteria document (B957-420-80-44-LPC-3201) attached in the tender.	
9.	Bidder to confirm that sequence of submission as defined in Vendor Data Requirement (B957-420-80-44-VDR-3001) shall be complied with.	
10.	Bidder to confirm that all document shall be submitted as per Vendor Data Requirement (B957-420-80-44-VDR-3001).	
11.	Bidder to confirm that Equipment attributes (Doc. No.: B957-420-80-44-DS-3001) attached with tender shall be duly filled, by contractor & submitted during post order stage.	
12.	Bidder to confirm that Material take off format (Doc. No: B957-420-80-44-MTO-3001) attached with tender shall be duly filled by contractor and submitted during pre-bid & post order stage.	
13.	Bidder to confirm that the scope of work shall be in compliance with the following documents attached with the tender: • Design Basis of Steam Generation system (B957-420-80-44-DB-3201) • Scope of supply / work & services for steam generation package (B957-420-80-44-SW-3001) • Battery Limit P&ID (B957-80-44-420-1101) • PDS of Boiler & BOP (B957-420-80-44-DS-3201) • All other attached PDS, and all other equipment, materials and work not explicitly mentioned but nevertheless required to fulfil the functional requirements shall be deemed to have been included in the scope of bidder with no additional cost or time implication to the owner.	
14.	Bidder to confirm that back up calculations along with necessary documents (i.e., PGTR report with supporting calculations, efficiency design calculations etc.) for fuel consumption as well as system efficiency offered for the present job shall be furnished (whenever required or asked by Owner / PMC) and establish that same has been achieved by him in one of the previous Boiler job executed by the bidder supported by PGTR report & documentation.	
15.	Bidder to confirm that Heat & mass balance diagram (HMBD) for Guaranteed case as per Performance Guarantee and Loading & Penalty Criteria document (B957-420-80-44-LPC-3201) is furnished along with offer.	

16.	Bidder to confirm duly filled, signed & stamped, Annexure 1- Table A of Performance guarantee and Loading & Penalty criteria document (B957-420-80-44-LPC-3201) is submitted along with Technical Bid.	
17.	Bidder to confirm duly filled Annexure 3 of Performance guarantee and Loading & Penalty criteria document (B957-420-80-44-LPC-3201) is submitted along with Technical Bid.	
18.	Bidder to confirm that Boiler Datasheet duly filled up in PMC format attached in requisition (Doc. No. B957-420-80-44-DS-3202) with signature & seal is furnished along with offer.	
19.	Bidder to confirm that Utility consumption figures Maximum) i.e. DM water/ Cooling Water/ Air for instruments/ Fuel oil/ /PFO/Plant air/ Service water/ N2/ any other utility are furnished along with offer.	
20.	Bidder to confirm that Write-up covering Salient technical Features of the complete system is furnished along with offer.	
21.	Bidder to confirm that Normal electrical Power, Emergency electrical power and DC power requirement of Complete system is furnished along with offer.	
22.	Bidder to confirm that Correction curves as per Performance Guarantee and Loading & Penalty Criteria document (B957-420-80-44-LPC-3201) is furnished along with offer.	
23.	Bidder to confirm that list of steam consuming equipment during guaranteed operation as per performance guarantee and Loading & Penalty criteria document (B957-420-80-44-LPC-3201) is furnished along with offer.	
24.	Bidder to confirm that quoted guarantee fuel consumption figure in their price bid is based on some previously achieved figures in similar Utility Boiler job executed by the bidder.	
25.	Bidder to confirm the submission of guaranteed figures as required along with commercial offer (as a part of commercial section) as per tender document Bidder to confirm that the guaranteed parameters as submitted along with bid shall not be revised once bid is received.	
26.	a. Confirm that Bidder has reviewed conceptual plot plan attached in the tender. b. Bidder shall confirm adequacy of the area given in the conceptual plot plan attached in the tender.	
27.	Bidder to submit the following along with bid:	

	a. Preliminary GAD of boiler b. Overall layout of Steam generation system including all associated auxiliaries & accessories.	
28.	Confirm that all bought outs / equipment / components shall be sourced from one of the EIL / Client approved vendor list attached elsewhere in the tender document.	
29.	Confirm that erection, pre-commissioning, startup & commissioning spares, as required and mandatory spares as per list enclosed with tender are included in the base price.	
30.	Confirm that bidder recommended spares for two years normal operation & maintenance shall be furnished separately along with item wise list & unit rates for consideration. This spare shall not be included in base price. Bidder to confirm.	
31.	Confirm that wherever the Material of construction of equipment / components / parts has been specified in the tender specification, the same or superior MOC shall be offered.	
32.	Bidder to confirm that main pipe racks, finger pipe racks and associate structures of Steam Generation System are considered in their offer.	
33.	Confirm adequate and necessary facilities, machineries, cranes, tools, tackle, jigs & fixtures shall be mobilized to site for the execution of scope of work & supply mentioned in the tender.	
34.	Bidder to confirm that HAZOP Study participation is considered in their offer along with implementation of recommendation from the study without any time & cost implication.	
35.	Bidder to confirm that safe disposal of waste / hazardous material generated during site construction & erection/ pre-commissioning/ commissioning are considered by bidder in his offer.	
36.	Bidder to confirm that all tools, tackles, valves, gauges, flow meters, orifices, pipe & fittings, nozzles, flange & blinds, supports, pumps, gaskets, fasteners, other measuring instruments, all necessary jig & fixtures, accessories for Performance Guarantee Test Run (PGTR) considered in his scope & offer.	
37.	Bidder to confirm that ITP requirements mentioned in tender for various items/ equipment / components of Steam Generation System shall be complied with.	

38.	Confirm that all consumables, chemicals, lubricants for initial charge and for pre-commissioning, alkali boil out, testing, commissioning and site performance guarantee run have been included in the bidder's scope & offer.	
39.	Bidder to confirm that necessary consumables/ chemicals & lubricants for first fill of complete Steam Generation System is considered in his scope & offer.	
40.	Bidder to confirm that chemicals & consumables for 06 months operations of complete Steam Generation System is considered in their scope & offer.	
41.	Confirm that all Drawings / Data requirements as per specifications and codes attached and referred to has been included in the bidder's proposal.	
42.	Confirm all aspects of site preservations & storage, unloading, material handling, lifting, local transportations & machineries/necessary materials are considered.	
43.	Bidder to confirm that training of Owner operation & maintenance personnel for complete steam generation system along with associated auxiliaries & accessories at least for 30 days (on office as well as site) along with hard copy and soft necessary materials is included in their offer.	



DEVIATION SCHEDULE FORMAT (TECHNICAL) (FED)

PROJECT : ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES, BINA
PETCHEM & REFINERY EXPANSION PROJECT (BPREP)

UNIT : STEAM GENERATION PACKAGE (Unit No. 420)

OWNER : BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

PMC : ENGINEERS INDIA LIMITED.

JOB NO. : B957

0	10.02.2025	ISSUED WITH TENDER	PK	KS/AD	DD
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DEVIATION SCHEDULE - TECHNICAL (STEAM GENERATION PACKAGE)

(Tender No.: B957-420-80-44-PG-T-7410)

Bidders are requested to mark “√” as applicable

☐ NO DEVIATION REQUIRED

☐ DEVIATION REQUIRED

List of deviations (exceptions and/ or additions requested by bidder) from specification, standards and / or drawings etc.

Sl. No.	DOCUMENT(S)/ DRAWING(S)		DEVIATION PROPOSED
	NO. AND TITLE	PARAGRAPH/ CLAUSE/ DETAIL	

NOTE: BIDDER TO FURNISH THIS DULY FILLED FORMAT ALONG WITH SEAL & SIGN AT PRE-BID STAGE & BID STAGE AND ANY DEVIATIONS APPEARING ELSEWHERE SHALL NOT BE CONSIDERED.

BIDDER'S NAME:

BIDDER'S SIGNATURE
AND SEAL/STAMP
DATE:

PRE-COMMISSIONING & COMMISSIONING SPECIFICATION FOR STEAM GENERATION SYSTEM

PROJECT : ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)

UNIT : STEAM GENERATION PACKAGE

OWNER : BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

PMC : ENGINEERS INDIA LTD.

JOB NO. : B957

0	07.02.2025	ISSUED FOR TENDER	PK	SBC/AD	DD
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Attachments:-

ANNEXURE-I	FORMATS TO BE USED DURING PRECOMMISSIONING AND COMMISSIONING
ANNEXURE-II	PRE-COMMISSIONING ACTIVITIES NEED TO BE COMPLETED FOR DECLARING MECHANICAL COMPLETION WITHIN CONTRACTOR STIPULATED TIME FOR PROCESS SYSTEMS IN UNITS
ANNEXURE-III	PRE-COMMISSIONING ACTIVITIES NEED TO BE COMPLETED FOR DECLARING MECHANICAL COMPLETION WITHIN CONTRACTOR STIPULATED TIME FOR UTILITY SYSTEMS IN UNITS

1.0 INTRODUCTION

Bharat Petroleum Corporation Limited (BPCL) is operating a 7.5 MMTPA (on 8000 hrs per year basis) Bina Refinery (BR) at Sagar, Madhya Pradesh. The existing refinery is producing MS and HSD conforming to BS VI specifications by processing of high sulfur crudes besides other petroleum products like LPG, Naphtha, Kerosene, ATF, Petcoke and Sulphur. In order to remain competitive and improve refinery profitability further, Bina Refinery (BR) has embarked on Petrochemical Diversification Plan and as a part of further expansion of Petrochemical portfolio, it is intended to set up world scale Ethylene Cracker & Associated Units and Ethylene and Propylene based Petrochemical units for its diversification to Petrochemicals along with expansion of its refinery capacity to about 11 MMTPA. To cater the steam requirement, a new steam generating unit is planned.

2.0 SCOPE

The following facilities are envisaged under Steam generation system.

- Utility Boiler - 1 No.
- BOP (Balance of plant)

Note: - For capacities and specification of each equipment and BOP refer tender document

Associated utilities and offsite facilities including DM/ Polished Condensate & Feed water system, fuel handling & forwarding facilities, Instrument & plant air system, Fire Protection System and other balance of plant systems as applicable and equipment's as mentioned in the tender shall be provided so as to make the unit complete for safe and efficient operation.

Under this bid document contractor shall implement the following:

- a. Utility Boiler & associated facilities (hereafter referred as 'Unit') as per tender document shall be provided. Bidder shall bid for complete scope of supply/work (as per the scope matrix) and agree to take single point responsibility for the entire scope of the package. Scope of work of the contractor with respect to these facilities is described elsewhere in the bid document (refer scope matrix). The Bidder's scope under Steam generation package shall confirm to scope of work as per bid document indicating scope but not limited to materials and supplies as per the specifications and drawings/ documents/standards enclosed and forming a part of the Tender.
- b. The CONTRACTOR shall be responsible to carry out pre-commissioning and commissioning of the Unit as indicated under scope of work.
- c. A procedure for detailed mechanical completion, pre-commissioning, commissioning and start up shall be developed by CONTRACTOR based on the inputs from the OEM (Original Equipment Manufacturer)/licensor and guidelines provided in this document. Also, CONTRACTOR shall prepare the start - up and shut down procedure along with operating manual of the Unit on the guidelines provided in the document.

- d. PCAMS Software is used by EIL in start – up and commissioning. Status of all the formats shall be through PCAMS only, hence Contractor to align his system with the PCAMS software and working at site by the Contractor shall be through PCAMS only.

3.0 DEFINITIONS

3.1. MECHANICAL COMPLETION

Mechanical Completion of systems mean that all installation works of the unit is completed and hydro tested in accordance with approved construction drawings, approved specification, applicable code(s) as defined in the bid package, accepted international good engineering practice and all the pre-commissioning activities are completed in a comprehensive manner by the Contractor as detailed in section 3.2 except mutually agreed minor leftover such as insulation, painting etc. which may be completed during pre-commissioning phase.

Contractor shall submit certificate as per FORMAT-I (attached as Annexure-I) stating system/sub-system, which is mechanically completed along with test certificates connected with the system/sub systems viz. hydrotest reports, NDT reports, inspection certificates, certificates of various statutory bodies etc.

OWNER/ PMC representatives will check the system and shall issue FORMAT- II (as per format given in Annexure-I) which includes deficiencies / modifications, intimation of deviations from P&IDs, requirement of safety, start-up, Operation and Maintenance required for the portion of the work that is declared by the Contractor as mechanically complete.

Contractor shall liquidate all the checklist points agreed between Contractor/OWNER/PMC and issue certificate in form of FORMAT – III (as per format given in Annexure-I). All the coordination for resolution of P&ID issues, alarm/trip values, interlocks and complex loop issues shall be closed by CONTRACTOR.

Contractor shall get the approval or acceptance of FORMAT-III to carry out pre- commissioning activities as mentioned in section 3.2 under the guidance / supervision of Owner / PMC.

3.2. PRE-COMMISSIONING ACTIVITIES

Pre-commissioning activities will include but will not be limited to the following:

- a. Opening & box-up of piping, valves, instruments, spool pieces etc. as per pre- commissioning procedure.
- b. Air blowing, cardboard blasting, water flushing, Air drying and steam blowing of pipes, vessels, columns, equipment's for clearance of box-up & maintain records for commissioning

- activities. In case sufficient pressure during water flushing is not available, contractor to make necessary temporary arrangement for getting the required pressure. (Inspection of all vessels and columns shall be jointly by OWNER/ PMC).
- c. Manual cleaning in big size compressor's suction lines as per requirement.
 - d. Fabrication and supply of temporary facilities, for example, temporary bypasses, spools, blinds, jump overs, vents, strainers, screens etc. Fabrication / Purchase of valve keys/blinds and other pre-commissioning /commissioning related consumables as required.
 - e. Chemical cleaning / Passivation / Degreasing/Refractory dry out/Alkali boil out as applicable.
 - f. Adsorbent/support balls/ Molecular sieves/Filters loading (as required) typically including shifting of these materials from stored location to site, preparation of equipment for loading including internal cleaning, drying, dismantling of internals, opening of manholes, flanges etc., arrangement for loading (hopper, chute, crane/hydra, scaffolding, temporary platform, ventilation system etc), carrying out loading as per procedure under the supervision of Owner / PMC, box-up of reactor internals, manholes, flanges etc, any other activity required to perform safe loading.
 - g. Unloading of Adsorbent/ Molecular sieves/ Filters from equipment including opening of manholes/ flanges, making arrangements for unloading (crane/hydra, scaffolding, temporary platform etc.), collection and shifting of Adsorbent/Molecular sieves/Filters to the required location, internal cleaning & drying, box-up of internals, manholes, flanges etc, any other activity required to perform safe unloading.
 - h. Carry out leak test/tightness test. Carry-out integrated leak test & maintain records. Attending leaks by tightening to the required torque/replacement of faulty gaskets where necessary.
 - i. Receiving material required as per requisite format approved by EIC from owner's store / warehouse / designated area or any other location within plant premises including loading, unloading and maintain the records.
 - j. Contractor to ensure that Gaskets, stud, bolts etc. used are strictly as per piping material specification for the pipe class specified for that line.
 - k. Carrying out RIGGING JOBS including dismantling/ erection of structure/ equipment, piping, etc. as per the instructions of the Engineer-in-charge.
 - l. Opening & Box Up of Static Equipment / column/Vessel / Man ways and Pipe Line Flanges/Heat Exchangers, Isolation, removal & re-fixing of instruments mounted on Static Equipment / columns /Vessels, Heat Exchangers bundle pulling and re-fixing.
 - m. Opening and Re-Fixing of all Type of Valves including PSVs & control valves, line mounted Instruments Including both Ways Transportation between Plant and Work Shop.
 - n. Scaffolding, erection and dismantling jobs including supply and erection of temporary scaffolding & staging, making temporary platforms using pipes, pipe clamps, beam clamps etc. in conformance with established safety codes, BIS codes etc. inside/ outside of equipment like Columns, Vessels, structures etc.

- o. Carrying out filters, strainers, steam traps, demister pads related jobs including removal of auxiliary connections, dropping assemblies, cleaning, finally boxing up the complete assembly with proper alignment, flushing, draining, cleaning and filling up of hydraulic oil consoles / tanks of rotary equipment, removing and cleaning all types of filters and strainers, Cleaning of area / oil spillage, after the job, Cleaning of all types of steam traps, Dropping, cleaning and re-fixing the de-mister pads after inspection, Cleaning and lubrication of fasteners, etc.
- p. Rechecking of alignments for the rotating equipment.
- q. Assistance during inertization of equipment/piping.
- r. Assistance to carry out checks on rotary equipment as per OEM requirement.
- s. Topping up of bearing oil/ lube oil in rotary equipment.
- t. Hose connections/ removal.
- u. Opening & box-up of piping for connection & disconnection of chemical drums / iso containers & their unloading into the system.
- v. Make cold/ hot alignments, necessary checks, adjustments, repairs required during pre-commissioning & commissioning of the system / equipment.
- w. Install, adjust and replace mechanical seals, packing and accessories, as necessary during pre-commissioning / commissioning period.
- x. Providing assistance to Vendor's representative for equipment preparation/ repair and any other similar activity as per the commissioning requirement as per the instruction of Engineer-in-charge including supply of necessary hand tools, equipment, consumables (scaffolding, electrodes, gas) and with single point responsibility of contractor's supervision.
- y. Carry out site modifications as found necessary during system check / inspection from view point of operability, maintenance and safety of the units.
- z. Check pipe hangers, supports, guides and pipe specialties for hot settings and make minor adjustments as necessary.
- aa. Carry out cleaning of vessel internal surface, distributors, supports, packing material etc as and when required.
- bb. Instrument pre-commissioning includes all checks that will ensure instrument operability i.e. remove all shipping stops, check pointer travels, and verify instrument capability to measure, operate and stroke in the direction and manner required by the process application, conduct checking of complex loops and interlocks, instrument loop checking, instrument calibration, check for proper tagging of instruments etc.
- cc. Electrical pre-commissioning including proper earthing, pre-commissioning checks done on cable continuity checks, electrical panels, MCCs, switch gears, motors, transformers etc.
- dd. Supplying and installation of locks and chains for locking of valves wherever required.
- ee. To remove insulation from insulated piping, Valves, flanges etc. in such a way so that these can be reused and re-fix the same after the job is completed.
- ff. Carry out dewatering of pits / basins as directed, using electrical pump.

- gg. Maintenance & repairing of valves by a skilled valve repair mechanic.
- hh. Dropping & reinstatement of valves by a skilled valve repair mechanic.
- ii. Supply & Installation of barricading tape.
- jj. Supplying safety appliances & suitable PPEs to all workers.
- kk. Removal of scrap to identified area, maintain housekeeping, & return material after the job completion.
- ll. CONTRACTOR to ensure during Pre-Commissioning, all the accessories /equipments required for availability of utilities for carrying out commissioning works shall be ready at least three months before start of Commissioning activities.
- mm. CONTRACTOR to coordinate and confirm compliance regarding completion of all, mechanical, Instruments and Electrical installation work.
- nn. CONTRACTOR to take trial run of Fire Water system, Gas detector system and other safety system and obtain approval of the same from OWNER/PMC/EIL.
- oo. To obtain necessary safety / work permits and comply with all safety norms & regulations.
- pp. Supplying consumables required to complete the assigned works including but not limited to the following.
 - Welding consumables electrodes, filler wire, Argon gas, Al. lugs etc.
 - Flame cutting consumables like DA, O₂, etc.
 - Cutting wheel, grinding wheel, buffing wheel Fuel, oil, Lubricants etc. for running contractor deployed machinery,
 - Emery papers
 - Cardboard for cardboard blasting
 - Soap solution with squeeze bottles as required for leak test.
 - Plastic sheets
 - Gaskets
 - Aluminum /brass target plates
 - Temporary Strainer SS mesh.

3.3. DECLARING READY FOR COMMISSIONING

- a. The unit shall be considered 'Ready for Commissioning' (FORMAT-IV) when all the facilities have been completed along with their auxiliaries and support facilities in every respect including charging of lubes, chemicals, preparation of solution, last minute modifications, if any, as recommended by OWNER / PMC. All temporary structures, scaffolding etc. used for carrying out pre-commissioning activities shall be removed, all the blinds shall be placed into position as per P&IDs /OWNER/PMC.
- b. Contractor shall ensure that all safety devices like pressure safety valves (PSV), emergency shutdown valves are tested, witnessed and certified by representative of Contractor

/OWNER/PMC. These certificates are to be handed over to OWNER/PMC prior to start-up of the UNIT.

- c. Once the Unit has been declared "Ready for Commissioning", the Contractor shall not carry out any erection related work including hot work without prior permission of the OWNER.

3.4. COMMISSIONING

- a. Commissioning of the Unit will be carried out by Contractor once mechanical completion is over successfully, all pre-commissioning activities are carried out and system is ready for commissioning under necessary guidance and overseeing of PMC/OWNER. Representative from process designer will provide necessary co-ordination during start up and related technical clarifications shall be furnished by them.
- b. Commissioning of the Unit means taking the feed in, passing it through the normal route; establishing the process control parameters first at turndown & then at design throughput stipulated in the process package (guarantee parameters as per bid document) with supplementary instructions if any from OWNER.
- c. Contractor will provide necessary assistance during commissioning of the unit.
- d. The Unit shall be considered to be commissioned successfully once all the system with instrumentation / control systems and support systems have been on uninterrupted stable operation for not less than 72 hours. Any interruption of duration up to 30 minutes during the commissioning run of 72 hrs shall be ignored. However for interruptions greater than 30 minutes, the commissioning run period shall be extended by the time equal to the interruption plus the time taken to stabilize the Unit back to the normal operating conditions. Whether the 72 hours operation has been successful or not, shall be decided by the OWNER / PMC based on the observations recorded during 72 hours. The countdown for 72 hours operation shall start only after Unit has been on stable operation with all controls and safety system in normal operation for a period of not less than 48 hours. OWNER will issue acceptance certificate (Format-V) accordingly. Three months in advance of starting the commissioning, the CONTRACTOR shall submit proposal to the OWNER's Representative giving details of the programme to be followed during commissioning. This shall be checked by OWNER/PMC. The CONTRACTOR shall depute operating team comprising of commissioning co-coordinator, process/operational co-coordinator, mechanical, electrical & instrumentation engineers, technicians/ semi-skilled personnel to carryout UNIT startup & commissioning and maintenance under the overall guidance of PMC/OWNER. OWNER shall depute operating team consisting of operators (field and control room) and supervisors during the commissioning.
- e. The bidder CONTRACTOR in his offer shall submit the organization manpower chart of commissioning team and the bio-data of key persons who shall be present at the time of

- commissioning. The bidder CONTRACTOR shall also specify the planned duration of stay of these personnel.
- f. The CONTRACTOR shall also be required to provide on the job training to OWNER's operation personnel by associating them in all the day to day pre- commissioning, commissioning, maintenance activities and UNIT operations. After successful commissioning of the process Unit same shall be handed over to the OWNER for operation. In case of any constraint in achieving the above process parameters in the Unit by the CONTRACTOR, the same shall be communicated by the CONTRACTOR to the OWNER in writing. This will be reviewed jointly by OWNER/PMC to arrive at a decision on whether the constraint is on account of reasons attributable to the CONTRACTOR or not. The action in either case will be according to the relevant provisions / provided elsewhere in the contract.
- g. CONTRACTOR in some cases may be required to do part commissioning of the mechanically completed sections of the UNIT as per directives from the OWNER.
- h. Upon successful commissioning of the Units the same shall be taken over by the OWNER for day to day operation and maintenance only, the final take-over shall be subject to compliance to all the contractual obligations by the CONTRACTOR. Once the Unit is successfully commissioned CONTRACTOR will issue the format-V to OWNER for take-over of the Unit from CONTRACTOR.

4.0 OTHER REQUIREMENTS

- 4.1 The Contractor shall also provide 'No Smoking' boards & Do's and Dont's, boards for other designated instructions in unit areas.
- 4.2 Contractor shall also ensure implementation of all recommendations arising out of audits viz. internal pre-commissioning audit and audit by statutory bodies like PESO, OISD etc., as and when required.
- 4.3 Before startup of unit, safety audit shall be conducted by Owner/PMC. All such check lists/ deficiency report generated by safety audit team shall be liquidated by the Contractor. The safety audit shall cover aspects such as floor opening, trip hazards, bump hazards, electrical safety concerns, mechanical safety concerns etc.
- 4.4 Correct support, vibration and thermal expansion problems detected during commissioning.

5.0 HOUSE KEEPING

- 5.1 Provide continuous clean-up of the construction and operational area.
- 5.2 Remove excess materials, temporary facilities and scaffolding and pick-up trash.
- 5.3 Perform washing for further clean-up as required.

6.0 FINAL INSPECTION BEFORE START OF COMMISSIONING

- 6.1 OWNER/Contractor /PMC or any other Third party (Like OISD) shall carry out a final inspection of the UNIT before starting the commissioning activity.
- 6.2 Record of liquidation of checklist point, test record etc. shall be submitted by the Contractor to OWNER/PMC. Any deficiency/ changes required in the offered system shall to be liquidated by the Contractor.
- 6.3 It shall be the Contractor's responsibility to repair any damage to the system occurred during storage, installation, pre-commissioning and commissioning stage.

7.0 UTILITIES REQUIREMENT

All the utilities like Instrument air, Plant air, Cooling water, Service water, DM water, steam, power, etc. shall be as mentioned elsewhere in Tender for pre-commissioning and commissioning. However, temporary piping/ fittings required to be done for drawing these utilities shall be in the scope of Contractor.

8.0 SAFETY

- 8.1 The Contractor shall follow OWNER's safety practices during execution of pre- commissioning / commissioning works. Contractor is required to maintain and follow all safety practices equivalent or better than those being practiced by OWNER for the complex during pre-commissioning and commissioning.
- 8.2 Necessary Hot/ cold work permit shall be obtained to carryout jobs once declared mechanically completed. (Refer OISD-STD-105, work Permit System).

9.0 CHEMICAL CLEANING AND PASSIVATION

9.1. Scope of Work

As a part of pre-commissioning/ commissioning activities, some systems require chemical cleaning. Contractor shall procure, supply materials and carry out at site all work related to chemical cleaning for all equipment & piping.

The scope of chemical cleaning & Passivation of Steam generation system shall include but not be limited to the following:

- Pre-treatment cum On-stream cleaning of Re-circulating Cooling Water
- Chemical cleaning of SS piping & fittings.
- Procurement & supply of all chemicals required for Chemical Cleaning and Passivation job
- Preparation of temporary circuits, arrangement of pumps, piping, valves and tanks etc. for the same.

- Arrangement of DM water from the Battery limit.
- Arrangement of indirectly heated Boiler/Electrical heating/ MP/LP steam for the heating purpose shall be done by the bidder for the total job, if applicable.
- Carrying out chemical cleaning operations as per the enclosed specifications.
- Setting up of a Laboratory/ Facility near the job area for monitoring the Chemical Cleaning operation before and during the execution.
- Chemical cleaning of Main steam piping.
- Chemical cleaning of boilers by alkali boil out.
- System to be kept drained, dried and boxed up under positive pressure of nitrogen after positively insulating from other systems.
- External chemical cleaning and Passivation of SS welds and fittings of tanks and pipes are in the Contractor scope.
- Safe disposal of Chemical Cleaning effluent is in the contractor scope.

9.2. List of Specifications

Contractor shall carry out the job strictly as per the following specifications enclosed with the Bid document:

- i. Spec. No B957-000-06-42-CCS-001 (Attached elsewhere in tender)
Job Specification for Pre-treatment cum On-stream Cleaning of Re-circulating Cooling Water
- ii. Spec. No. B957-000-06-42-CCS-004 (Attached elsewhere in tender)
Job specification for chemical cleaning of VHP / HP steam piping
- iii. Spec. No. . B957-000-06-42-CCS-008 (Attached elsewhere in tender)
Job Specification for chemical cleaning of boilers by alkali boil-out method
- iv. Spec. No. B957-000-06-42-CCS-011 (Attached elsewhere in tender)
Job Specification for External Chemical Cleaning and Passivation of SS Welds & Fittings of Tanks and Pipes

10.0 SCOPE MATRIX

The dark box in the first column pertains to the activities to be performed by the Contractor to achieve mechanical completion as per Contract. The activities indicated in the Second column are also to be performed by the Contractor. However, the same shall not be reckoned for Mechanical Completion with regard to Contracts. For activities where dark box is placed in both first and second column, the activity needs to be completed by contractor to the extent

possible for mechanical completion i.e. The reason for non-completion should not be attributable to the contractor.

S.No	Work	Work Responsibility		
		CONTRACTOR		OWNER
		1	2	3
1.1	Manufacturer OR Vendor Service Assistance where responsibility is not indicated in Section 2.			
1.1.1	Obtain the assistance of the manufacturer or vendor, when necessary, to make a satisfactory installation as agreed on by the Contractor and the Owner	■	□	□
1.1.2	Obtain the assistance of the manufacturer or vendor, as required, for technical assistance during run-in by the Owner's operating and maintenance personnel, for training or for informational and operating purposes	□	■	□
1.1.3	Furnish names and telephone numbers including emergency contact of manufacturers, and vendors, technical service representatives for use by the Owner.	□	■	□
1.2	Permits			
1.2.1	Procuring all necessary permits and certifications required to be secured by the Owner for initial use of the plant.	■	□	□
1.2.2	Make applications for all necessary permits issued in the Owner's name that are required for plant use, occupancy and operation.	■	□	□
1.3	Instructions			
1.3.1	Maintain an adequate vendor instruction file so that information may be readily retrieved through plant commissioning.	■	□	□
1.3.2	Transmit to the Owner all applicable vendor's or manufacturer's instructions and drawings.	■	□	□
1.3.3	Provide the Owner with any special instructions such as the required procedures for drying liners	■	□	□
1.4	Removal of Rust Preventives			
1.4.1	Remove all rust preventives and oils used to protect the equipment during the construction period whenever these protective materials will be detrimental to operation	■	□	□
1.4.2	Provide the Owner with a record of work completed.	■	□	□
1.5	Lubricants			
1.5.1	Provide a list of the manufacturer's recommended lubricants for use in the plant	■	□	□
1.5.2	Approve the lubricant list	□	□	■
1.5.3	Provide all lubricants	■	□	□
1.5.4	Flush systems and install initial charge of the lubricants. Dispose of all flushing oil in accordance with the Owner's instructions	■	□	□
1.5.5	Maintain Lubrication after initial charge	■	■	□
1.6	Packing and Seals			
1.6.1	Install mechanical seals and accessories, as required.	■	□	□
1.6.2	Install permanent packing and accessories as required.	■	□	□
1.6.3	Adjust and replace mechanical seals, packing and accessories as necessary during commissioning period.	□	■	□
1.7	Removal of Temporary Bracing			
1.7.1	Remove all temporary supports, bracing or other foreign objects that were installed in vessels, ducts piping, transformers, machinery or other equipment to prevent damage during shipping, storage and erection and repair any damage sustained	■	□	□
1.8	Rotation and Alignment			
1.8.1	Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting the driver.	■	□	□

S.No	Work	Work Responsibility		
		CONTRACTOR	OWNER	
		1	2	3
1.8.2	Perform cold alignment to the manufacturer's tolerances and record data.	■	□	□
1.8.3	Perform any doweling required.	■	□	□
1.8.4	Perform Hot alignment	□	■	□
1.8.5	Obtain the services of a factory representative to witness installation of equipment as required.	■	□	□
1.9	Tie-Ins at Unit Limits			
1.9.1	Prepare all systems for safe tie-ins	■	□	□
1.9.2	Obtain approval and make the necessary tie-ins at the unit limits, as required by the specifications and as directed by the Owner.	■	□	□
1.9.3	Remove blinds, car seals and so forth as required.	□	■	□
1.10	Leak and Pressure Tests			
1.10.1	Notify the Owner of the schedule for non-operating field leak tests or field pressure tests on piping and field fabricated equipment, unless otherwise directed by the Owner.	■	□	□
1.10.2	Provide any special media for test purposes.	■	□	□
1.10.3	Conduct all tests in accordance with applicable codes, specifications, regulations and the Owner's instructions.	■	□	□
1.10.4	Witness Tests.	■	■	■
1.10.5	Maintain records as required.	■	□	□
1.10.6	Dispose of all test media in accordance with the Owner's instructions.	■	□	□
1.10.7	Conduct all operational tightness tests.	□	■	□
1.10.8	Trial run of Fire Fighting system	□	■	□
1.10.9	Trial run of Gas Detection system	□	■	□
1.11	Inspection			
1.11.1	Provide inspection of the plant to verify that erected facilities conform to flow diagrams, construction drawings, vendor prints and specifications.	■	□	□
1.11.2	Verify that specified materials have been installed in the plant and document verification to the extent required by the Owner.	■	□	■
1.11.3	Verify and approve the plant inspection. Note any exceptions on a separate work order list (punch list).	□	□	■
1.11.4	Provide for special inspections such as those required by insurance or governmental agencies.	■	□	□
1.11.5	Perform and report routine shop inspection.	■	□	□
1.11.6	Perform shop inspection and witness tests as desired.	■	□	□
1.11.7	Witness final shop inspections, as specified.	■	□	■
1.12	Pressure / Vacuum Safety Relief devices			
1.12.1	Provide the Owner with a list of proper pressure settings.	■	□	□
1.12.2	Transfer relief devices to and from the specified unit	■	□	□
1.12.3	Test and adjust all devices to and from the specified unit	■	□	□
1.12.4	Install all devices after testing, adjusting and tagging.	■	□	□
1.12.5	Maintain records as required.	■	□	□
1.13	Flushing and Chemical/Mechanical Cleaning.			
1.13.1	Conduct all flushing, blowing and chemical/mechanical cleaning operations where such operation can be accomplished without using permanently installed equipment., with details of flushing plans (by CONTRACTOR)	■	□	□
1.13.2	Conduct all flushing and blowing operations where permanently installed equipment must be used to obtain proper line velocities.	■	□	□

S.No	Work	Work Responsibility		
		CONTRACTOR	OWNER	
		1	2	3
1.13.3	Provide any special media for flushing and blowing operations where permanently installed equipment must be used to obtain proper line velocities.	■	□	□
1.13.4	Dispose of all media in accordance with the Owner's instructions.	■	■	□
1.13.5	Turn systems over to the Owner free of trash and construction debris (not necessarily free of welding slag)	■	■	□
1.13.6	Maintain records, as required.	■	■	□
1.14	Temporary Screens, Strainers spools and Blinds.			
1.14.1	Provide and install all required temporary strainers.	■	■	□
1.14.2	Clean strainers, as required during circulation.	■	■	□
1.14.3	Remove strainers when system is adequately cleaned.	■	■	□
1.14.4	Provide install and remove all blinds, spools required for flushing and isolation.	■	■	□
1.14.5	Maintain records as required.	■	■	□
1.15	Purging/Inerting			
1.15.1	Install purge/inerting connections.	■	□	□
1.15.2	Provide purge materials and conduct necessary purge operations.	■	■	□
1.15.3	Provide inerting materials and introduce where specified.	■	■	□
1.16	Vessel Packing and Fixed Beds			
1.16.1	Install all inert materials such as sand, gravel balls rings and saddles.	■	□	□
1.16.2	Install all materials other than the materials specifically noted in Section 2, such as chemicals, resins, desiccants and other similar items.	■	■	□
1.16.3	Install all mixed beds involving combinations of material, covered by 1 and 2 above.	■	■	□
1.16.4	Inspect the vessel interior before and during loading to ensure proper installation.	■	■	□
1.16.5	Maintain records, as required.	■	■	□
1.17	House-Keeping			
1.17.1	After completion of construction, remove excess material, temporary facilities and scaffolding, rough sweep or rake the area and pick up trash, perform washing or further cleanup, as required.	■	□	□
1.17.2	After completion of construction, maintain adequate housekeeping practices, as required for safe operation.	■	□	□
1.18	Maintenance, Spare Parts and Special tools			
1.18.1	After pre-commissioning is complete, protect equipment from normal weather conditions, corrosion or damage	□	■	□
1.18.2	After pre-commissioning is complete provide adequate maintenance for equipment including the cleaning of strainers and the repairing of steam traps.	■	□	□
1.18.3	Provide the Owner with spare parts list as recommended by the manufacturers.	■	□	□
1.18.4	After pre-commissioning is complete, maintain adequate spare parts and supplies required during commissioning & performance test run.	□	■	□
1.19	Noise Survey			
1.19.1	Conduct individual equipment noise surveys, as required by the Occupational Safety & Health administration on the Owner's specifications.	■	■	□
1.19.2	Document all survey data	■	■	□
2.1	Vessels			

S.No	Work	Work Responsibility		
		CONTRACTOR	OWNER	
		1	2	3
2.1.1	Open the vessel after erection and put in place any internals requiring field installation. These internals will be inspected before and after installation.	■	□	□
2.1.2	Open both internal and external manways for inspection of the vessel by the Owner, unless otherwise specified.	■	□	■
2.1.3	Witness inspections to the extent desired.	□	□	
2.1.4	Dry out if required, upon vessel and install materials that are designated in 1.16	■	□	□
2.1.5	Close after proper execution of closure permits.	■	□	□
2.2	Shell and Tube Exchangers			
2.2.1	Perform field inspection, if required of exchangers that have previously been shop inspected.	■	□	□
2.2.2	Carry out hydro test at Site.	■	□	□
2.3	Air-Cooled Exchangers			
2.3.1	Inspect exchangers to ensure that temporary shipping supports and erection materials have been removed.	■	□	□
2.3.2	Adjust fan assemblies to obtain specified tip clearance and test.	■	□	□
2.3.3	Check operation of louvers and operating linkage	■	□	□
2.4	Fired Heaters			
2.4.1	Perform the pressure test in accordance with the applicable codes, specifications and the Owner's instructions if required.	■	□	□
2.4.2	Provide all non-operating preferring checks in accordance with the manufacturer's instructions.	■	□	□
2.4.3	Blow fuel lines, check them for cleanliness and connect burner piping.	■	□	□
2.4.4	Check operation of registers and dampers and verify position of indicators.	■	■	□
2.4.5	Check operation of air preheaters, blowers and soot blowers	■	□	□
2.4.6	Dry refractory during initial firing by following manufactures temperature cycle.	■	□	□
2.4.7	Conduct Boil-out, chemical cleaning, and flushing operations, Conduct light off, drying, and purging operations. as required. Dispose of wasted, cleaning media, in accordance with Owners instruction	■	□	□
2.4.8	Obtain and charge liquid heat transfer heat media, if required.	□	■	□
2.4.9	Conduct light off, drying, and purging operations.	□	■	□
2.4.10	Obtain the assistance of a service engineer for technical advice during installation for start-up if desired.	■	■	□
2.5	Pumps, Compressors and Drivers			
2.5.1	Level base plates and sole plates and grout all bearing surfaces.	■	□	□
2.5.2	Alleviate any excess piping stresses that may be imposed on pumps, compressors and drivers.	■	□	□
2.5.3	Chemically clean any completed lube and seal oil system when specified. Dispose of wastes and cleaning media in accordance with the Owner's instructions.	■	□	□
2.5.4	Charge the lube oil, seal oil and oil cooling systems with flushing oil and circulate for cleaning purpose. Dispose of any flushing oil in accordance with Owner's instructions.	■	□	□
2.5.5	Charge the lube oil, seal oil and oil cooling systems with the operating oil recommended by the manufacturer.	■	□	□
2.5.6	Operate equipment and make vibration trip governor and safety device checks and any operating tests and adjustments as required.	■	■	□
2.5.7	Obtain the assistance of service engineer for technical advice during installation or start up if desired.	■	■	□

S.No	Work	Work Responsibility		
		CONTRACTOR	OWNER	
		1	2	3
2.5.8	Maintain records as required.	■	□	□
2.6	Tanks			
2.6.1	After erection and installation, install any internals, which require field installation.	■	□	□
2.6.2	Test tank and internals as required. Dispose of test water in accordance with the Owner's instructions.	■	□	□
2.6.3	Conduct chemical cleaning or flushing operations as required. Dispose of wastes and cleaning media in accordance with the Owner's instructions.	■	■	□
2.6.4	Witness test and inspections to the extent desired.	□	□	■
2.6.5	Close after proper execution of closure permits.	■	□	□
2.7	Piping System			
2.7.1	Notify the Owner of test schedule.	■	□	□
2.7.2	Hydrotest or pneumatically test all piping as required by codes, specifications and the Owner's instructions.	■	□	□
2.7.3	Witness field pressure tests, when notified.	□	□	■
2.7.4	Flush and drain system and install orifice plates. Orifice plates shall not be installed before hydrostatic testing. (see 2.9 for the removal or isolation of other inline components).	■	□	□
2.7.5	Drain system, remove blinds and perform tightness tests as required.	□	■	□
2.7.6	Insulate or, piping system, paint flanges, threaded joints or field welds after the specified testing of each system a has been completed. Unless instructed otherwise by Owner.	■	■	□
2.7.7	All welded joints (longitudinal, girth and nozzle) in underground piping that have not been shop tested shall be left exposed (free of paint, dope and wrap) until the specified testing has been completed. After final testing of these joints cover the system.	■	□	□
2.7.8	Check pipe-hangers, supports, guides, expansion joints and other pipe specialties for the removal of all shipping and erection stops and for the correctness of cold settings for the design service. Also provide the Owner with instructions for hot settings.	■	□	□
2.7.9	Check pipe-hangers, supports guides and pipe specialties for hot settings and make minor adjustments as necessary.		■	□
2.7.10	Install permanent filter elements as required.		■	□
2.7.11	Verify, to the extent required by the Owner that specified valve packing has been provided in valves installed in the plant.	■	□	□
2.7.12	Install car seals on valves whether necessary.	□	■	□
2.7.13	Check and record the positions of all car sealed valves paint of identify valves as required.	□	■	□
2.7.14	Correct support, vibration and thermal expansion problems detected during commissioning.		■	□
2.7.15	Re-torque all hot and cold service bolting during commissioning and startup as required.		■	□
2.8	Electrical Power and Lighting Systems			
2.8.1	Notify the Owner of the test schedule.	■	■	□
2.8.2	Witness tests when notified and record test data as required.	□	□	■

S.No	Work	Work Responsibility		
		CONTRACTOR		OWNER
		1	2	3
2.8.3	Using a megohmmeter, make insulation tests on all wing except lighting wiring.	■	□	□
2.8.4	Using a megohmmeter, make insulation tests on motor and transformer winding from phase to phase and phase to ground.	■	□	□
2.8.5	Make grounding system tests to determine the continuity of connections and the value of resistance to ground.	■	□	□
2.8.6	Arrange for breakdown tests on oil sample from oil insulated transformers larger than 100 kilovolts absolute.	■	□	□
2.8.7	Charge electrical gear with oil and / or other media as required.	■	□	□
2.8.8	Perform trials and adjustments on all switchgear, motor control equipments and generators.	■	■	□
2.8.9	Test and set switchgear and circuit breaker relays for proper coordination.	□	■	□
2.8.10	Obtain local inspector's approval, where required.	■	■	□
2.8.11	Energize all substations with approval of the Owner after completion of all tests.	■	■	□
2.8.12	Check phase sequence polarity and motor rotation.	■	■	□
2.8.13	Check installation of emergency power and lighting systems.	■	■	□
2.8.14	Provide the Owner with a record of work complete.	■	■	□
2.9	Instrument System			
2.9.1	Conduct any non-operating checks to ensure instrument operability, that is remove all shipping stops, check pointer travels and verify instrument capability to measure operate and stroke in the direction and manner required by the process application.	■	■	□
2.9.2	As dictated by the Owner's practice, bench or field calibrate instruments with standard test equipments and make all required adjustments and control point settings.	■	□	□
2.9.3	Clean all transmission and control tuning by blowing with cooled and filtered clean air before connecting to instrument components.	□	■	□
2.9.4	Clean all air-supply headers by blowing with clean air and check them for tightness.	□	■	□
2.9.5	Leak test pneumatic control circuits in accordance with clean the latest edition of ISA Recommended Practice 7.1. Pneumatic control circuit pressure test.	■	■	□
2.9.6	Install and connect all system components and verify their conformance to specification and design criteria for function and range using dummy transmission signals as need.	□	■	□
2.9.7	Check all electrical signals and alarm wiring for continuity, correct source of power and polarity.	□	■	□
2.9.8	Check thermocouples for proper joining of wires, position of elements in wells proper polarity and continuity of receiving instruments.	□	■	□
2.9.9	Identify orifice plates by tagging.	■	■	□

S.No	Work	Work Responsibility		
		CONTRACTOR	OWNER	
		1	2	3
2.9.10	Check and record bores or orifice plates and install after completion of flushing operations.	☐	☒	☐
2.9.11	Isolate or remove, if necessary, in line components such as control valves, positive displacement meters and turbine meters for pressure testing. Reinstall these items after testing the system with the components removed or isolated.	☒	☒	☐
2.9.12	Isolate or remove components for flushing operations and reinstall them on the completion of these operations.	☒	☒	☐
2.9.13	Install any sealing fluids as required.	☐	☒	☐
2.9.14	Fully pressurize and energize the transmitting and control signal system(s) by opening process connections at primary sensors and final regulations and by making control mode settings for automatic operation of equipment as the process unit is charged and brought on stream.	☐	☒	☐
2.9.15	Provide a schedule of recorder charts.	☒	☒	☐
2.9.16	Checking piping from instruments to process piping for tightness.	☒	☒	☐
2.10	Boilers/Heaters			
2.10.1	Make a non-operating boiler pressure test in accordance with applicable codes, specifications and the Owner's instructions, if required.	☒	☐	☐
2.10.2	Inspect the boiler for completeness and correctness of installation and make other non-operating preferring checks.	☒	☐	☐
2.10.3	Check operation of air pre-heaters, dampers soot blowers and other equipment for proper positioning and travel.	☒	☒	☐
2.10.4	Dry refractories during initial firing by following the manufacturer's temperature cycles.	☒	☒	☐
2.10.5	Purge, flush and drain steam mains as necessary.	☒	☒	☐
2.10.6	Obtain and charge treated water of bailout and initial operation as required.	☐	☒	☐
2.10.7	Commission auxiliaries as detailed elsewhere under the appropriate equipment type.	☐	☒	☐
2.10.8	Conduct boilout, chemical cleaning, and flushing operations, as required .Dispose of wastes, cleaning media, in accordance with Owners, instruction.	☒	☐	☐
2.10.9	Conduct initial light-off, making associated checks and adjustments	☐	☒	☐
2.10.10	Obtain the assistance of service engineer for technical advice during installation of start-up if desired.	☒	☒	☐
2.10.11	Conduct all operating tests and obtain the required certifications.	☐	☒	☒
2.10.12	Check and set pressure relief valves.	☐	☒	☐
2.11	Miscellaneous Equipment (Agitators, Mixers, Rotary Filters, Weigh Scales and Materials Handling Equipments).			
2.11.1	Fully assemble rotary filters except for final filter media (cloth, pre-coat or screen).	☒	☐	☐

S.No	Work	Work Responsibility		
		CONTRACTOR	OWNER	
		1	2	3
2.11.2	Install all final filter media.	☐	☒	☐
2.11.3	Level and calibrate weigh scales with the assistance of the manufacturer's representation and set tare weights wherever possible.	☒	☐	☐
2.11.4	Manually check materials handling equipment for freedom and direction of movement.	☒	☐	☐
2.11.5	Check clearance on materials handling equipment as directed by the Owner.	☐	☒	☐
2.11.6	Make all final adjustments during run in and conduct any required performance test.	☐	☒	☐
2.11.7	Obtain a service engineer for technical assistance during installation of startup, if required.	☒	☒	☐
2.11.8	As required obtain certification that all lifting and materials handling installations and other items of equipment comply with government regulations.	☒	☒	☐

ANNEXURE - I

FORMATS TO BE USED DURING PRE - COMMISSIONING AND COMMISSIONING

(TOTAL 5 FORMATS)

FORMAT - I

INTIMATION REGARDING SYSTEM COMPLETION

PROJECT: _____
UNIT: _____

CUSTOMER: _____

Following system/sub-system has been mechanically completed in all respects with exceptions noted below. The system/sub-system can be taken up for checking and preparation of checklist.

SYSTEM/SUBSYSTEM NO.

SYSTEM/SUBSYSTEM DESCRIPTION:

EXCEPTIONS:

SIGNATURE

DATE

CONTRACTOR'S
CONSTRUCTION :
CO-ORDINATOR

The system is ready/ not ready for Check listing

OWNER:

PMC:

FORMAT - II

CHECKLIST

PROJECT: _____ CUSTOMER: _____ UNIT: _____

SYSTEM/SUB-SYSTEM _____

CHECKLIST TYPE

PRELIMINARY/FINAL

SL.NO.

CHECKLIST ITEMS

REMARKS

SIGNATURE

DATE

PMC:

OWNER:

FORMAT - III

READY FOR PRE-COMMISSIONING CERTIFICATE

PROJECT: _____ CUSTOMER: _____
UNIT: _____

This is to certify that the following Plant/system/sub- system as detailed below is completely installed and all the Checklist points are carried out except for minor details as given in the attached list.

SYSTEM/SUB-SYSTEM No. _____

DESCRIPTION OF SYSTEM/SUBSYSTEM: _____

SIGNATURE DATE

CONTRACTOR 'S CONSTRUCTION
CO-ORDINATOR:

CONTRACTOR 'S COMMISSIONING
CO-ORDINATOR

The system is ready/ not ready for pre-commissioning

PMC / OWNER :

FORMAT - IV

READY FOR COMMISSIONING CERTIFICATE

PROJECT: _____ CUSTOMER: _____
UNIT: _____

This is to certify that all the necessary pre-commissioning activities for the system/sub-system as detailed below have been completed and the system/sub-system is ready for commissioning except for the minor details as given below which will not affect the commissioning trial runs.

SYSTEM/SUB-SYSTEM No. : _____

DESCRIPTION OF SYSTEM/SUB-SYSTEM: _____

SIGNATURE DATE

CONTRACTOR 'S COMMISSIONING:
CO-ORDINATOR

SIGNATURE DATE

PMC / OWNER:

FORMAT - V

COMPLETION OF COMMISSIONING CERTIFICATE

PROJECT: _____ CUSTOMER: _____
UNIT: _____

This is to certify that the system/sub-system as detailed below has been successfully commissioned and is under operational control of Client's Production department.

SYSTEM/SUB-
SYSTEM _____

DESCRIPTION OF SYSTEM/SUB-SYSTEM: _____

SIGNATURE

DATE

CONTRACTOR'S
COMMISSIONING :
CO-ORDINATOR

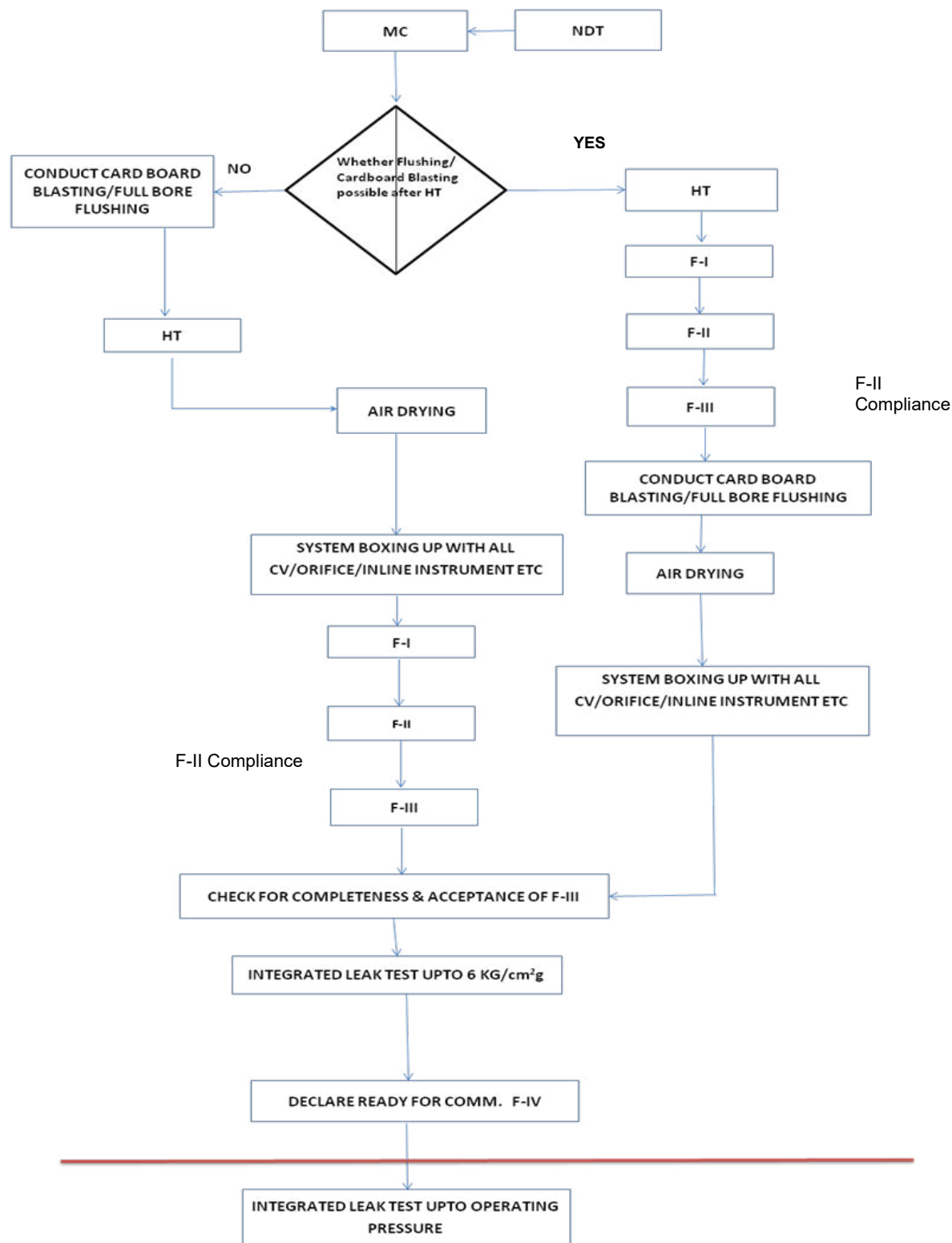
SIGNATURE

DATE

PMC / OWNER :

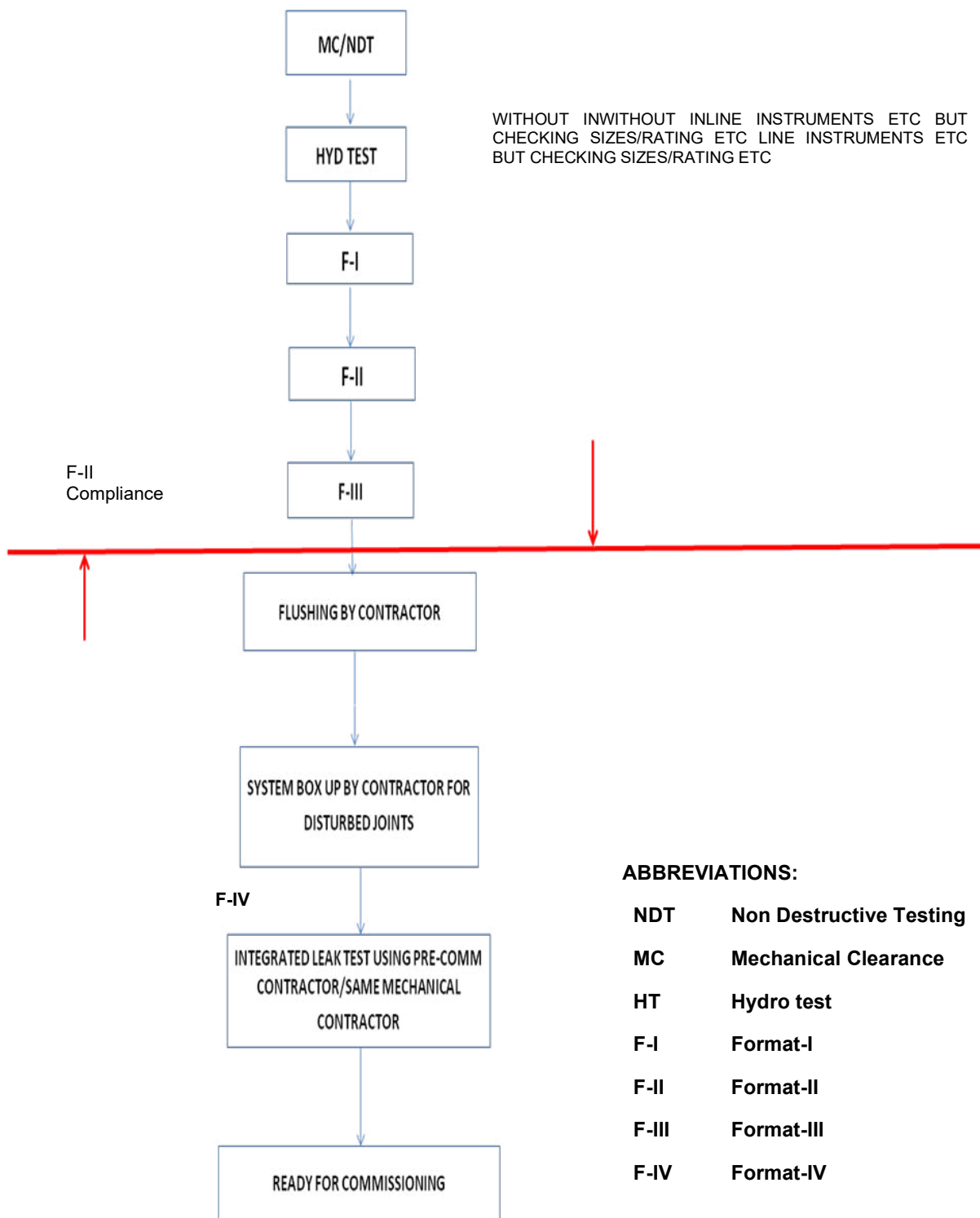
ANNEXURE-II

PRE-COMM ACTIVITIES NEED TO BE COMPLETED FOR DECLARING MECHANICAL COMPLETION WITHIN CONTRACTOR STIPULATED TIME FOR PROCESS SYSTEMS IN UNITS



ANNEXURE-III

PRE-COMM ACTIVITIES NEED TO BE COMPLETED FOR DECLARING MECHANICAL COMPLETION WITHIN CONTRACTUAL STIPULATED TIME FOR UTILITY SYSTEM IN UNITS



SNO.	ITEM TAG NO.	Process Unit	Qty	Type of Boiler draft	Type of Boiler support	Design Code	Boiler MCR (Max Continuou s Rating) in TPH	Steam Pressure at boiler outlet (at MSSV in kg/cm2g) at MCR
			Nos.					
1								
2								
3								
4								
5								
					Notes : 1. The editable excel file shall be shared with :			

Steam temperature at boiler outlet (at MSSV in degC) at MCR	Main Steam Design Pressure (in kg/cm2g)	Main Steam Design temperature (in degC)	Boiler Feed water temperature (at Economiser inlet in degC).	Stack inlet Temperature at MCR. (Deg.C)	Stack Outlet Temperature at MCR. (Deg.C)

successful bidder (OEM) which need to be duly filled in and furnished along with vendor documents

ATTRIBUTES (Doc.No.: B957-420-80-44-EA-3001)

Stack Design Temperature at (Deg.C)	Steam drum PSV set pressure (in kg/cm2g)	Superheater outlet PSV set pressure (in kg/cm2g)	Main Fuel	Alternate Fuel	Boiler efficiency	Utility boiler Make / Vendor

ents.

Tube size (OD)				Furnace tube thickness (mm)			
SSH tube size (OD)	PSH tube size (OD)	Evaporator tube size (OD)	Economiser tube size (OD)	SSH tube Thickness (mm)	PSH tube thickness (mm)	Evaporator tube thickness (mm)	Economiser tube thickness (mm)

Material Of Construction								
SSH tube size MOC	PSH tube MOC	Evaporat er tube MOC	Economi ser tube MOC	Steam Drum MOC	Stack MOC	Type of Burners	Stack height (Min.) (M)	Stack ID at exit (M)

Others								
No. of Deaerator	No. of BFW Pumps	No. of FD Fan	No. of scanner air fan	No. of Blowdown Cooler	No. of Blowdown pump	No. of Sealing air fan	No. of Blowdown transfer pump	No. of dosing Skid

Utility Boiler	Steam / Water Drums	Superheater			Evaporator		Economiser	
Furnace Dimensio n	Weight	No. / Type	Weight		No. of Banks / Type	Weight	No. of Banks / Type	Weight
m x m	MT		MT			MT		MT

Others		Remarks
No. of Burners	Refractory Details	
	MT	

COLUMNS AS COSTING INPUT, TO BE PROVIDED AFTER RELEASE OF MR / TENDER WITH PROVISION TO REVISE WHILE RELEASING AS AADHAR INPUT																											
K1	K2	K3	K5	T7	T8	T9	T10	T11	T12	T13			T14	T16			T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27
Sl. No.	Tag No.	Process Unit	Qty	Water tube Boiler		Performance Parameters			Steam Drums	Evaporator tube, membrane	Economiser	Super heater	APH tube	Others													
				Fuel	Design Code	Max. Cont. Rating (MCR)	Steam O/P Pressure	Steam O/P Temp.	MOC	MOC	MOC	MOC	MOC	Type & Make of Burners	Duty of Each burner	No. of Burners	Stack Top dia. & height (Min.)	Stack MOC	Deaerator size & Capacity	Deaerator wt.	HP dosing system (if applicable)	No. of PRDS & size					
			Nos.			TPH	kg/cm2 (g)	Degree								MMCAL			meter								
1		420	1	Natural Gas, Fuel oil, Refinery Fuel gas, Cracker off gas, PFO	IBR																						



**SPECIAL INSTRUCTION TO BIDDERS
FOR
STEAM GENERATION PACKAGE
(FED)**

**DOCUMENT No.
B957-420-80-44-TR-3001
Rev. 0**

Page 1 of 3

INSTRUCTION TO BIDDERS FOR STEAM GENERATION PACKAGE (FED)

**PROJECT : ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES, BINA
PETCHEM & REFINERY EXPANSION PROJECT (BPREP)**

UNIT : STEAM GENERATION PACKAGE (Unit No. 420)

OWNER : BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

PMC : ENGINEERS INDIA LIMITED.

JOB NO. : B957

0	10.02.25	ISSUED WITH TENDER	PK	KS/AD	DD
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

1.0 Scope

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

2.0 Special Requirements

2.1 Bidder to note that bid evaluation may be carried out without any post-bid correspondence. In view of the same, Bidder in his own interest is advised not to submit any deviation. Owner reserves right to carry out bid evaluation with available information in the bid without any post-bid correspondence.

2.2 No technical details of any nature shall be included in the offer until unless ask for the same. If the offer contains any such technical deviations or clarifications or stipulates any unsolicited technical specifications (even if in line with the technical requirements), **the offer is liable for rejection.**

2.3 Pre-Bid stage:

- i) The bidders shall be invited for a pre-bid meeting after floating of enquiry. Participation in pre-bid meeting is **MANDATORY** for all the serious bidders. The Pre-bid meeting shall be attended by competent technical representative(s) of bidder who is competent enough to discuss and conclude all the technical and commercial issues.
- ii) In case, any bidder is not attending the **PRE- BID meeting**, it shall be understood that the bidder does not have any comments/ deviations/ assumptions/ clarifications to tender requirements. In case, bidder furnishes any deviations or clarifications or stipulates any unsolicited technical specifications in his Bid, **the complete bid is liable to be rejected.**
- iii) Bidder / contractor, after studying the contents of this tender may decide to obtain clarifications before making their offer. Bidder to note that any ambiguity /discrepancies / clarification shall be discussed at the pre bid stage only and once having done so, the offer shall be in strict compliance to the requirements and technical specifications attached with tender. Various technical specifications / drawings / documents as referred to in this specification and the List of contents form part of this tender, any deviation to these documents of tender and referred specifications should have prior approval of PMC/Owner. All such deviations shall be raised and sort it out at pre bidding stage before submission of bid.

Bidders shall submit their clarifications/deviations etc. within the cut-off date as specified in the enquiry document, after which Owner/PMC reserves the right not to entertain any clarifications/deviations.

- iv) Bidder to note that only technically infeasible deviations shall be discussed during **PRE- BID meeting** provided a suitable justification for the same is furnished. Owner'/PMC's decision on such deviations shall be treated as **FINAL**. Deviations with extra cost and time implication shall not be permitted.

It is in Bidder's interest to ensure that all technical deviations are sorted out in the pre-bid meeting stage.

- v) Conflicts, if any, between various documents attached in the tender shall be highlighted by the bidder during pre-bid meeting and Owner / PMC's decision shall be final.

Any conflict brought to Owner / PMC's notice during pre-bid & post bid stage shall be subject to Owner / PMC's clarification/ decision during that stage and the same shall be complied to by the bidder without any cost/ time implications.

- vi) In case the parameters and/or scope of certain item(s) included in the Tender get revised due to revision in process requirements or discussion during pre-bid meeting and/or any other reasons, an amendment (clearly identifying the changes) shall be issued.
- vii) Deviations / exceptions / clarifications / conflicts b/w various documents duly filled in the enclosed deviation format "B957-420-44-DV-3001" only shall be discussed during the pre-bid meeting:

2.4 Bid requirement:

- i) Deviation format "B957-420-80-44-DV-3001" duly filled, signed & stamped.
- ii) Duly filled, signed & stamped Technical confirmation / check list (documents no. B957-420-80-44-TM-3001 and other department's Technical confirmation/ check list documents)
- iii) Duly sealed and signed filled in un-priced price schedule.
- iv) Seal & signed index of tender and all the amendments.
- v) Filled in MTO format (B957-420-80-44-MTO-3001) to be submitted
- vi) Bidder shall mandatorily & necessarily provide **Preliminary GAD / Layout and it's suitability** to fit into the space provided in the bid.
- vii) Technical parameters (for which commercial loading is specified) as submitted along with bid will not be allowed to be revised once submitted bid is received.
- viii) Any change in the technical scope required to achieve the offered parameters in the bid based on technical evaluation will have to be complied by the bidder without any change in quoted prices.

2.5 **In case of any ambiguity in the requirements specified in Tender, the stringent of the same shall be applicable and the decision of Owner / PMC shall be final.**

VENDOR LIST FOR STEAM GENERATION PACKAGE (FED)

PROJECT : ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES, BINA
PETCHEM & REFINERY EXPANSION PROJECT (BPREP)

UNIT : STEAM GENERATION PACKAGE (Unit No. 420)

OWNER : BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

PMC : ENGINEERS INDIA LIMITED.

JOB NO. : B957

0	10.02.25	ISSUED WITH TENDER	PK	KS/AD	DD
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Vendor / Supplier list for Fabric Expansion Joint

- KELD ELLENTOFT INDIA PVT. LTD., CHENNAI, TAMIL NAIDU, INDIA.
- EAGLEBURGMANN KE PVT. LTD., CHENNAI, TAMIL NAIDU, INDIA
- RM APPLIED ENGINEERS, MUMBAI, MAHARASTRA, INDIA.
- URJA PRODUCTS PVT. LTD., AHMEDABAD, GUJRAT, INDIA.

B957-ODC Limit

SI No	Annexure - 1						
A	Transportation of Single Piece by Road from Port to Project Site at BPREP,Bina Refinery						
1.0	Ports	CARGO DIMENSIONS L x W x H in Meters			Weight in MT	Distance in Kms	
1.1	Mumbai Port	25	4	4.5	150	2290	
1.2	Nhava Sheva(JNPT)	25	5.5	5	250	2340	
1.3	Kandla	25	5.5	5	250	1410	
1.4	Mundra	25	5.5	5	250	1470	
2.0	Name of location- Suggested Jetty						
2.1	_____KHASHALI_____Jetty (MUMBAI Port)	40	6	6	300	2200	
2.2	Kandla Jetty (Kandla Port)	15	5	5.5	200	1410	
2.3	Adani - Mundra Jetty (Mundra	20	6	6	250	1470	
2.4	Jetty (_____Port)						
B	Transportation of Single Piece by Road from following locations .to Project Site at BPREP,Bina						
1.0	Fabricator/Fabrication Site Location	L x W x H in Meters			Weight in MT	Distance in Kms	
1.1	Hazira- LNT	25	5	4.5	250	1434	
1.2	Dahej - GODREJ/ ISGEC	25	5	4.5	250	1584	
1.3	Vadodara -VTV	25	5	4.5	250	1234	
1.4	Chennai	25	5	5.1	250	1882	
1.5	Tarapur- GR Engineering	25	5	5	250	2170	
1.6	Padgha/ - , Phills	20	4.5	5	250	2220	
	Vikhroli - Godrej	20	4.5	5	250	2265	
1.7	MIDC,Navi Mumbai - Rabale	20	4.5	5	250	2250	
1.8	Murbad- Loyd	20	4.5	5	250	2300	
1.9	Ambernath- Technoproses	20	4.5	5	250	2280	
1.10	Acchad, Talasari- TEMA	25	5	4.5	250	2120	
1.11	Pune	25	4.5	5	250	1916	
1.12	Umbergaon GIDC-Anup Engineering Plant 1&2, GMMP Plant 1&2	25	5	5	250	891	
1.13	Yamuna Nagar	25	5	5	250	690	
1.14	Mangalore	20	4.5	3.5	200	2210	
1.15	Vizag	15	3	4.9	250	1643	
1.16	Coimbatore	20	5	4.7	250	2210	
1.17	Hadkal khati	40	6	6	650	5	
NOTE	Succesful Bidder to carry out Physical survey and provide feasibility details						

Note:

1. Bidder to note that above tentative ODC list is for rweference purpose only.
2. Bidder shall be solely responsible for consignment movement and limitationassociated with the same, BPCL/EIL shall not be held responsible for anyn delay occurred on account of above list provided in the tender and no extra cost and time implication shall be given to bidder.

EXPERIENCE RECORD - STEAM TURBINE (SPECIAL 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 (SPECIAL PURPOSE)**
ITEM NO.: _____

Document No.
B957-420-80-42-ERP-9981
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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	GENERAL					
1.1	Cross reference to manufacturer's Standard Reference list	----				
1.2	Make					
1.3	Model Number					
1.4	No. of units supplied					
1.5	Type of drive arrangement (Direct/through Gear Box)					
1.6	Type of driven equipment					
1.7	Type of lubrication system					
1.8	Shop where turbine is designed, manufactured & tested with complete address					
1.9	Single valve/Multi valve					
1.10	Type : Condensing/Extraction Condensing/Back Pressure					
1.11	No. of controlled extractions					
1.12	No. of uncontrolled extractions					
1.13	No. of Inductions					
2.0	OPERATING CONDITIONS					
2.1	Rated Power (kw)					
2.2	Power at zero extraction (kw)					
2.3	Rated speed (rpm)					
2.4	Speed Range (rpm)					
2.5	Inlet Steam Flow, Nor / Rated (kg/hr)					
2.6	Inlet Steam Pressure (kg/cm ² A)					
2.7	Inlet Steam Temperature (°C)					

**EXPERIENCE RECORD PROFORMA
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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.
2.8	Exhaust Steam Pressure (kg/cm ² A)					
2.9	Exhaust Steam Temperature (°C)					
2.10	Condenser C.W. inlet temperature (°C)					
2.11	Condenser C.W. outlet temperature (°C)					
2.12	1st Extraction/Induction					
2.13	Type (controlled/uncontrolled)					
2.14	No. of Steam Inlet Valves					
2.15	Steam Pressure (Kg/cm ² ,a)					
2.16	Steam Temperature (°C)					
2.17	Steam Quantity (Kg/hr.) (Min./Nor./Max.)					
2.18	2nd Extraction/Induction					
2.19	Type (controlled/uncontrolled)					
2.20	No. of Steam Inlet Valves					
2.21	Steam Pressure (Kg/cm ² ,a)					
2.22	Steam Temperature (°C)					
2.23	Steam Quantity (Kg/hr.) (Min./Nor./Max.)					
2.24	3rd Extraction/Induction					
2.25	Type (controlled/uncontrolled)					
2.26	No. of Steam Inlet Valves					
2.27	Steam Pressure (Kg/cm ² ,a)					
2.28	Steam Temperature (°C)					
2.29	Steam Quantity (Kg/hr.) (Min./Nor./Max.)					

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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	CONSTRUCTIONAL FEATURES					
3.1	First Section (From Main Inlet to 1st Extraction / Induction or Main Inlet to Exhaust (where no extraction or induction is involved))					
3.2	Curtis Stage					
3.3	No of stages					
3.4	1st Stage Curtis Wheel (Yes / No)					
3.5	Material of Curtis Wheel					
3.6	Material of Curtis Blades					
3.7	Material of Nozzles					
3.8	Impulse Stages					
3.9	No of subsequent Impulse Stages					
3.10	Material of Impulse Wheels					
3.11	Material of Impulse Blades					
3.12	Material of Nozzles					
3.13	Reaction Stages					
3.14	No of subsequent Reaction Stages					
3.15	Material of Reaction Wheel					
3.16	Material of Reaction Moving Blades					
3.17	Material of Reaction Stationary Blades					
3.18	Second Section (1st extraction / induction to 2nd extraction/ induction or 1st extraction / induction to exhaust for turbines with one extraction / induction)					
3.19	Curtis Stage					
3.20	No of stages					

EXPERIENCE RECORD PROFORMA
STEAM TURBINE (SPECIAL PURPOSE)
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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.
3.21	1st Stage Curtis Wheel (Yes / No)					
3.22	Material of Curtis Wheel					
3.23	Material of Curtis Blades					
3.24	Material of Nozzles					
3.25	Impulse Stages					
3.26	No of subsequent Impulse Stages					
3.27	Material of Impulse Wheels					
3.28	Material of Impulse Blades					
3.29	Material of Nozzles					
3.30	Reaction Stages					
3.31	No of subsequent Reaction Stages					
3.32	Material of Reaction Wheel					
3.33	Material of Reaction Moving Blades					
3.34	Material of Reaction Stationary Blades					
3.35	Third Section (2nd extraction / induction to 3rd extraction/ induction or 2nd extraction / induction to exhaust for turbines with two extraction / induction)					
3.36	Curtis Stage					
3.37	No of stages					
3.38	1st Stage Curtis Wheel (Yes / No)					
3.39	Material of Curtis Wheel					
3.40	Material of Curtis Blades					
3.41	Material of Nozzles					
3.42	Impulse Stages					

**EXPERIENCE RECORD PROFORMA
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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.
3.43	No of subsequent Impulse Stages					
3.44	Material of Impulse Wheels					
3.45	Material of Impulse Blades					
3.46	Material of Nozzles					
3.47	Reaction Stages					
3.48	No of subsequent Reaction Stages					
3.49	Material of Reaction Wheel					
3.50	Material of Reaction Moving Blades					
3.51	Material of Reaction Stationary Blades					
3.52	Fourth Section (3rd extraction / induction to exhaust)					
3.53	Curtis Stage					
3.54	No of stages					
3.55	1st Stage Curtis Wheel (Yes / No)					
3.56	Material of Curtis Wheel					
3.57	Material of Curtis Blades					
3.58	Material of Nozzles					
3.59	Impulse Stages					
3.60	No of subsequent Impulse Stages					
3.61	Material of Impulse Wheels					
3.62	Material of Impulse Blades					
3.63	Material of Nozzles					
3.64	Reaction Stages					
3.65	No of subsequent Reaction Stages					
3.66	Material of Reaction Wheel					

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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.
3.67	Material of Reaction Moving Blades					
3.68	Material of Reaction Stationary Blades					
3.69	Inlet Casing					
3.70	Material of Casing					
3.71	Design temperature (°C)					
3.72	MAWP @ design temperature (kg/cm ² G)					
3.73	MAWP @ 15°C					
3.74	Intermediate Casing					
3.75	Material of Casing					
3.76	Design temperature (°C)					
3.77	MAWP @ design temperature (kg/cm ² G)					
3.78	MAWP @ 15°C					
3.79						
3.80	Exhaust Casing					
3.81	Material of Casing					
3.82	Design temperature (°C)					
3.83	MAWP @ design temperature (kg/cm ² G)					
3.84	MAWP @ 15°C					
3.85	Miscellaneous					
3.86	Type of Steam Seal (Gland / Carbon Ring / Dry)					
3.87	Material of Shaft					
3.88	Diameter of Shaft under Bearings (mm)					
3.89	Diameter of Shaft under Coupling (mm)					
3.90	Radial Bearings					

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STEAM TURBINE (SPECIAL PURPOSE)
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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.
3.91	-Type					
3.92	-Make					
3.93	Thrust Bearings					
3.94	-Type					
3.95	-Make					
3.96	Span Between Bearings					
3.97	Governor					
3.98	Type					
3.99	Make					
3.100	Model					
3.101	Class of governing (as per NEMA)					
3.102	Governor Actuation (Electric, Hydraulic)					
4	OTHER INFORMATION ON INSTALLATIONS					
4.1	Date of supply of entire unit					
4.2	Date of commissioning of entire unit					
4.3	No. of operating hours completed as on the date of issue of material requisition					
4.4	Major Problems encountered					
4.5	Name of plant					
4.6	Purchaser's Name and Address					
	Name (Company / Organization)					
	Name of Contact Person					

**EXPERIENCE RECORD PROFORMA
STEAM TURBINE (SPECIAL PURPOSE)**
ITEM NO.: _____

**Document No.
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Rev. No. A
Page 9 of 9**

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.
	Address					
	Telephone No.					
	Fax No.					
	email-id					

NOTES TO BIDDERS:

1. Prototype pump model/ model series shall not be considered.
2. It is mandatory that all references furnished for engine model/ model series should meet the qualification criteria laid out in the MR.

DESCRIPTION OF MODEL DESIGNATION SYSTEM: _____

SL. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS		REMARKS
			Ref.- 1	Ref.-2	
1.	2.	3.	4.	5.	6.
1.0	GENERAL				
1.1	Cross reference to manufacturer's Standard Reference list				
1.2	Make				
1.3	Model				
1.4	No. of units supplied				
1.5	Driven Equipment / Type of Driven Equipment				
1.6	Type of Drive Arrangement (Direct/Gear Box/Other)				
1.7	Shop where engine is designed, manufactured & tested with location and complete address				
2	OPERATING CONDITIONS				
2.1	Fuel used				
2.2	Rated Engine Power at Std oper. conditions as per ISO 3046/BS 5514 (ISO Std. Power), KW				
2.3	Rated Engine Power at Site conditions (Service Std. Power), KW				
2.4	Engine rpm				
2.5	BMEP at standard conditions (ISO/BS)/at rated conditions, kg/cm ² g				

Place:

[Signature of Authorized Signatory]*

Date:

Name:

Designation:

Seal:

SL. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS		REMARKS
			Ref.- 1	Ref.-2	
1.	2.	3.	4.	5.	6.
3	CONSTRUCTION				
3.1	No. of Cylinders/Cylinder Arrangement				
3.2	Bore x Stroke, mm.				
3.3	Charging type				
3.4	Engine Cooling (Air, Cooled/Water Cooled)				
3.5	Engine frame provided with explosion relief device : Yes/No/Not recommended by vendor				
4	OTHER INFORMATION ON INSTALLATIONS				
4.1	Date of supply				
4.2	Has the complete engine completed ONE Year of operation at site, as on bid due date? – Yes / No				
4.3	Purchaser's Name, Address, Contact No. & email ID				

Place:
Date:

[Signature of Authorized Signatory]*

Name:
Designation:
Seal:

NOTES TO BIDDERS:

1. Prototype dosing skid size series shall not be considered.

SL. NO.	PARAMETER	INFORMATION ON PROPOSED SKID	INFORMATION ON REFERRED EXISTING INSTALLATIONS			REMARKS
			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
1	Order / Reference number in the General Reference list					
2	Skid Size & Weight (L x W x H, m & Tons)					
3	Fluid / Chemical handled					
4	Capacity of Dosing Vessels / Tanks (m3)					
5	Material of Construction of Dosing Vessels / Tanks					
6	Capacity of Metering Pump in the dosing system (LPH)					
7	Type of Metering Pump in the dosing system					
8	Type of capacity control for metering pump					
9	Package engineered by					
10	Package supplied by:					
11	Package supplied from (Shop address):					
12	Date of supply of entire unit					
13	Date of commissioning of entire unit					
14	No. of operating hours completed as on the date of issue of material requisition					
15	Major Problems encountered					
16	Purchaser's Name and Address along with details of contact person, telephone / fax number & e-mail ID					

Date:

Place:

[Signature of Authorized Signatory]*

Name:

Designation:

Seal:

*: To be authenticated in-line with provisions indicated in the Commercial section.

[To be submitted in original, along with bid]

NOTES TO BIDDERS:

1. Prototype steam turbine model/ model series shall not be considered.
2. It is mandatory that reference steam turbine model / model series shall have similar steam parameters and similar service.

TRAIN CONFIGURATION: _____

DESCRIPTION OF MODEL DESIGNATION OF EACH CASING: _____

S. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS		REMARKS
			Ref.-1	Ref.-2	
1.0	GENERAL				
1.1	Make / Model Number / Frame Size				
1.2	Type : Condensing / Extraction Condensing / Induction Condensing / Back Pressure / Back Pressure Extraction				
1.3	Type of drive arrangement				
1.4	Type of drive shaft (Single Ended / Double Ended)				
1.5	Shop where Turbine / Package is designed, manufactured, packaged, tested & supplied				
2.0	OPERATING CONDITIONS EACH SECTION EACH CASING (\$\$)				
2.1	Rated Power (kW) / Power at zero extraction (kW)				
2.2	Maximum Torque (N-m)				
2.3	Rated Speed (RPM) / Speed Range (rpm)				
2.4	Inlet Steam Flow, Nor / Rated (kg/hr)				
2.5	Inlet Steam Pressure (kg/cm ² A) / Temperature (°C)				
2.6	Exhaust Steam Flow, Nor / Rated (kg/hr)				
2.7	Exhaust Steam Pressure (kg/cm ² A) / Temperature (°C)				
2.8	Extraction/Induction Steam Flow, Nor / Rated (kg/hr)				

S. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS		REMARKS
			Ref.-1	Ref.-2	
2.9	Extraction/Induction Steam Pressure (kg/cm ² A) / Temperature (°C)				
3.0	CONSTRUCTION INFORMATION ON EACH CASING & EACH IMPELLER (§§)				
3.1	Casing Split / Method of fabrication (Cast/ Welded)				
3.2	Material of Casing / MAWP (Kg/cm ² A)				
3.3	Type of Impellers / No. of Impellers / Material of Impellers				
3.4	No. of controlled/uncontrolled, extractions & inductions				
3.5	Governor type / NEMA Class / actuation type				
3.6	Bearing type / Shaft Dia. Under bearing (mm)				
3.7	Bearing Span (mm)				
3.8	Type of shaft end seals				
3.9	Casing Nozzles Size / Rating / Type / Orientation				
4	OTHER INFORMATION ON INSTALLATIONS				
4.1	Date of supply & commissioning				
4.2	Whether one year of field operation completed after commissioning as on bid due date				
4.3	Purchaser's Name, Address, Contact No. & email ID				

(§§): Bidder to provide information for each casing/impeller.

NOTES TO BIDDERS:

1. Prototype Gear Box model/ model series shall not be considered.
2. It is mandatory that all references furnished for GearBox model/ model series should have similar parameters.

DESCRIPTION OF MODEL DESIGNATION: _____

S. 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	GENERAL					
1.1	Cross reference to manufacturer's Standard Reference list	----				
1.2	Make / Model					
1.3	No. of Units supplied					
1.4	Type of Driver / Driver Rating (kW x rpm)					
1.5	Driven Machine					
1.6	Shop where Gear Box is designed, manufactured and tested with location and address					
2	GEAR BOX DETAILS					
2.1	Codes / Standards followed (API-613/API-677/ Others)					
2.2	Gear Box Rating (kW)					
2.3	Speed (input/output) (rpm)					
2.4	Maximum continuous speed (input/output) (rpm)					
2.5	AGMA / API S.F.					
2.6	Pitch Circle Diameter (Pinion / Gear) (mm) / Pitch line velocity (m/sec.)					
2.7	Gear Ratio / No. of stages					
2.8	Center to Center distance between high speed & low speed shafts (mm)					
2.9	Tooth profile					
2.10	Type of Gears : Single helical / Double helical / Herringbone					

Place:

Date:

[Signature of Authorized Signatory]*

Name:

Designation:

Seal:

*: To be authenticated in-line with provisions indicated in the Commercial section.
original, along with bidFormat No 1645-ERP-911 Rev.1

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S. 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.
2.11	Type & No. of Bearings (Radial)					
2.12	Gear Shaft					
2.13	Pinion Shaft					
2.14	Type & No. of Bearings (Thrust)					
2.15	Gear Shaft					
2.16	Pinion Shaft					
2.17	MATERIAL OF CONSTRUCTION :					
2.18	Casing					
2.19	Pinion					
2.20	Gear					
2.21	Shaft (high speed / low speed)					
2.22	Bearings					
3	OTHER INFORMATION ON INSTALLATIONS					
3.1	Date of supply and commissioning					
3.2	Whether one year of successful field operation completed after commissioning as on bid due date					
3.3	Purchaser's Name, Address, Contact No. & email ID					

Place:
Date:

[Signature of Authorized Signatory]*

Name:
Designation:
Seal:

*: To be authenticated in-line with provisions indicated in the Commercial section.
original, along with bidFormat No 1645-ERP-911 Rev.1

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NOTES TO BIDDERS:

1. Prototype blower model/ model series shall not be considered.
2. It is mandatory that all references furnished for rotary blower model/ model series should have similar parameters.

DESCRIPTION OF MODEL DESIGNATION: _____

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	GENERAL					
1.1	Cross reference to manufacturer's Standard Reference list	----				
1.2	Make					
1.3	Model Number					
1.4	Number of units supplied					
1.5	Type of Drive Arrangement (Direct Driven / through Gear Box / V-Belt)					
1.6	Shop where pump is designed, manufactured, packaged, tested & supplied with address					
2	OPERATING CONDITIONS					
2.1	Gas handled					
2.2	Capacity rated (kg/hr Nm ³ /hr)					
2.3	Inlet Capacity rated (Am ³ /hr)					
2.4	Inlet pressure (kg/cm ² G)					
2.5	Inlet temperature (EC)					
2.6	Discharge Pressure(kg/cm ² A)					
2.7	Discharge Temperature (EC)					
2.8	RV Set Pressure (kg/cm ²)					
2.9	Compressor BkW (kW)					
2.10	Compressor speed (rpm)					
2.11	Motor Rating & Speed (kWxRPM)					

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.
2.12						
3	CONSTRUCTION					
3.1	MAWP (kg/cm ² G)					
3.2	No. of lobes (Male / Female)					
3.3	Type of Bearings -Radial -Thrust					
3.4	Type of Lubrication					
3.5	Type of Shaft Seals -Drive End Shaft Side -No. of Shaft Seals -Conveying Chamber Side					
4	MATERIAL OF CONSTRUCTION					
4.1	Casing					
4.2	Rotors					
4.3	Shaft					
4.4	Timing Gears					
5	OTHER INFORMATION ON INSTALLATIONS					
5.1	Date of supply and commissioning					
5.2	Whether one year of successful field operation completed after commissioning as on bid due date					
5.3	Purchaser's Name, Address, Contact No. & email ID					

NOTES TO BIDDERS:

1. Prototype model/ model series shall not be considered.
2. It is mandatory that all references furnished for ID/FD Fan model/ model series should have similar parameters and in similar fluid (gas) service.

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	GENERAL					
1.1	Cross reference to manufacturer's Standard Reference list	----				
1.2	Make					
1.3	Model Number					
1.4	Type					
1.5	Number of Units supplied					
1.6	Driver					
1.7	Type of Drive Arrangement					
1.8	Shop from where Blower + Driver +controls etc. is designed, manufactured, tested and supplied					
2	OPERATING CONDITIONS					
2.1	Gas handled					
2.2	Rated Capacity @ inlet (Am ³ /hr)					
2.3	Suction/Discharge Pressure/Temperature (kg/cm ² G/°C)	_____/____	_____/____	_____/____	_____/____	_____/____
2.4	Static Differential Pressure (mm of WC)					
2.5	Static Efficiency (%)					
2.6	Fan BkW					
2.7	Fan Speed/Fan Speed Range (RPM)	_____/____	_____/____	_____/____	_____/____	_____/____

Place:

[Signature of Authorized Signatory]*

Date:

Name:

Designation:

Seal:

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.
2.8	Driver Rating (kWxRPM)					
2.9						
3	CONSTRUCTION					
3.1	Type of Suction (SISW (overhung) /SISW (between bearings/ DIDW)					
3.2	Whether suitable for Hazardous Area (Yes / No)					
3.3	Type of Impeller/Impeller diameter (mm)	_____/____	_____/____	_____/____	_____/____	_____/____
3.4	MAWP (kg/cm ² G)					
4	MATERIAL OF CONSTRUCTION					
4.1	Fan Casing/ Impellers/ Shaft Base-plate					
5	OTHER INFORMATION ON INSTALLATIONS					
5.1	Date of Supply					
5.2	Purchaser's Name, Address, Contact No. & email ID					

Place:

Date:

[Signature of Authorized Signatory]*

Name:

Designation:

Seal:

1	GENERAL							
2	Project:	BINA PETROCHEMICAL & REFINERY EXPANSION			Job No.:	B957		
3	Owner:	M/s BPCL			Site:	BINA, MP	Unit No.: 420	
4	Purchaser:				Unit:	SGU		
5	Item No.:				Service:			
6	No. Reqd.:	Working:	Standby:	Driver:		Type:		
7	Applicable to:	☒ Proposal		☐ Purchase	☐ As Built			
8	Note: ☒ Scope option/information specified by Purchaser ☐ information required from / options left to vendor. Vendor to cross ☒ the selected option.							
9	☐ Manufacturer:		☐ Model		☐ Fan Type / AMCA Argmt.# :			
10	Place of Mfrg. of Fan:							
11	Drive Arrgt. :	☒ Direct	☒ Thru Gear Box	☐ Thru Fluid	☐ Thru V-Belt Drive	☐ Other:		
12	Driver By: FAN VENDOR		Driver Mounted By: FAN VENDOR					
13	OPERATING CONDITIONS (REFER PROCESS DATASHEET)							
14	(ALL DATA ON PER UNIT BASIS)			Test Block	Design	Normal	Turndown	Startup
15								
16	☐ Optg. Case							
17	☐ Gas Handled: Air							
18	☐ Density (kg/Nm ³)							
19	☐ Delivered (DRY) (Nm ³ /sec)							
20	☐ Weight Flow (kg/hr: Dry/Wet)							
21	INLET CONDITIONS:							
22	☐ Temperature (Max. / Min.) (°C)							
23	☐ Relative Humidity (%)							
24	☐ Molecular Weight (Min.)							
25	☐ Inlet Volume (Nm ³ /hr : dry)							
26	☐ C _p / C _v (K ₁) or (K _{Avq})							
27	☐ Compressibility (Z ₁) or (Z _{Avq})							
28	☐ Static Pressure @ Sound Trunk (mmWC) (Note 2)							
29	☐ Press. Loss Across Sound Trunk (mmWC)							
30	☐ Static Pressure @ Inlet Dampers (mmWC)							
31	☐ Static Pressure @ Fan Inlet (mmWC)							
32	DISCHARGE CONDITIONS:							
33	☐ Static Pressure @ Fan Outlet (mmWC)							
34	☐ Static Pressure @ Disch. Damper (mmWC)							
35	☐ Diff. Pressure Disch. Damper (mmWC)							
36	☐ Diff. Pressure Across Evase (mmWC) (Note 3)							
37	☐ Static Pressure @ Evase Outlet (mmWC)							
38	PERFORMANCE:							
39	☐ BkW Required @ Temp. (All losses Incl.) (kW)							
40	☒ Fan Speed (1500 rpm max.) (RPM)							
41	☐ Guarantee Point							
42	☐ Performance Curve No.							
43	☐ Static Diff Pressure Across Fan (mmWC)							
44	☐ Inlet Damper / Vane Position (% of Open)							
45	☐ Discharge Damper Position (% of Open)							
46	☐ Fan Static / Total or Overall Efficiency (%)							
47	FAN CONTROL							
48	☒ Fan Control furnished by: Fan Vendor							
49	Control Signal Type:		Source:	Sensitivity:	Range:	☐ Auto Lock on failure		
50	Method:	☐ Inlet Damper: ☐ for isolation of Fan; ☐ for capacity regulation;				☐ Control	☐ Auto	☐ Manual
51		☐ Outlet Damper: ☐ for positive isolation of Fan; ☐ Other:				☐ Control	☐ Auto	☐ Manual
52		☒ Inlet Guide Vanes				☒ Control	☒ Auto	☒ Manual
53		☐ Variable Speed through variable frequency drive (VFD)/Pole Switchable Motor				☐ Control	☐ Auto	☐ Manual
54		☐ Variable Speed through Fluid Coupling				☐ Control	☐ Auto	☐ Manual
55		☐ Starting Method: 20% Testblock vol. @ 20°C						
56		☒ Actuators: Type: ☐ Pneumatic Actuated ☐ Electric Actuated ☐ Other:						
57	NOTES: 1. -deleted-							
58	2. Sound trunk means Inlet Box / Inlet Silencer.							
59	3. Evase is a diffuser or a diverging discharge transition piece.							
60								

61	OPERATING CONDITIONS (REFER PROCESS DATASHEET)											
62	GAS ANALYSIS						OTHER CONDITIONS					
63	☐ Mole%	☐	Design		Maximum		Normal		Minimum			REMARKS
64		M.W.	Wt%	Mol%	Wt%	Mol%	Wt%	Mol%	Wt%	Mol%		
65	Air	28.9										
66	Oxygen	32.00										
67	Nitrogen	28.02										
68	Water Vapor	18.02										
69	CO	28.01										
70	CO ₂	44.01										
71	H ₂ S	34.08										
72	HCl	36.47										
73	Cl ₂	70.91										
74	SO ₂	64.06										
75												
76												
77												
78	Total											
79	Avg. Mol. Wt. (DRY)											
80	Corrosives:											
81	☐ Corrosion / Erosion Caused By:											
82	☐ Corrosion / Erosion Protection:											
83	SITE / INSTALLATION DATA								SPECIFICATIONS			
84	Location:								Noise specifications:			
85	☐ Indoor	☐ Heated	☐ Under Roof						☒ Applicable to Machine: 85 dBA @ 1 m			
86	☒ Outdoor	☒ Unheated	☐ Partial Sides									
87	☒ Grade	☐	☐ At Elevation						☒ Applicable to Neighborhood: 85 dBA @ 1 m			
88	☐ Winterization Req'd.		☒ Tropicalization Req'd.					See Specification				
89	Site data: (Refer Site & Utility Data)								☐ Acoustic Housing (if req'd.) ☐ Yes; ☐ No			
90	☐ Elevation (m):		☐ Barometer (kg/cm ² A):					Applicable specifications:				
91	☐ Temperature		°C (Summer)		°C (Winter)				☒ Job Specification(s) for RED, Electrical, Instr.			
92	☐ Wind load		kg/m ²		☐	Velocity		m/hr		☒ EIL Process Package		
93	Unusual conditions:								☒ EIL Std: 6-42-0002			
94	☐ Dust	☐ Fumes										
95	☒ Other		Refinery Atmosphere									
96												
97	Electrical Area Classification (Refer Electrical Specs)								Painting:			
98	☐ Class:		Group:		Div.:		Temp. Class:		☐ Manufacturer's Standard			
99									☒ Other: Refer requirement specified in PDS.			
100									Shipment:			
101	☐ Domestic		☒ Export		☒ Export Boxing Req'd							
102									☒ Outdoor Storage Period: TWELVE(12) Months			
103									Erection:			
104	Shipped		☒ Assembled									
105			☐ Partially Assembled									
106			☒ Other (Note 5)									
107												
108												
109	NOTES:											
110	4. -deleted-											
111	5. Voluminous parts shall be dispatched in loose condition with necessary support to avoid damage during transit. Small parts											
112	shall be crate packed and hardware shall be box packed.											
113												
114												
115												
116												
117												
118												
119												
120												

121	CONSTRUCTION FEATURES									
122	Speeds (rpm):					Shaft				
123	☐ Max. Cont. Speed:		☐ Trip Speed:			Shaft Length (mm):		Dia @ Wheel (mm):		
124	Max. Tip Speed		m/sec @ Rated			☐ Material:				
125			m/sec @ MCS							
126	Housing					Impeller / Blades				
127	Suction: ☐ SISW (overhung) ☐ SISW (between bearing)					☐ Material (Remark-5) ☐ Coating Type				
128	☐ DIDW (between bearing)					☐ Diameter (mm) ☐ No. of blades				
129	☐ Inlet Bell / Diffuser / Inlet Transition Piece					☐ Type: ☐ Backward Curved, Non-Overloading ☐ Hollow Airfoil				
130	☐ Evase / Diffuser / Outlet Transition Piece					☐ Solid Airfoil / Single Thickness				
131	☐ Insulation Type Thickness: (mm):					☐ Fabrication method:				
132	☐ Insulation Stud By:					Hub				
133	☐ Drains. No. / Size / Type / Loc.:					☐ Shrink Fit		☐ Keyed		☐ Other:
134	☐ Fan Inlet Access Split for Rotor Removal: YES					☐ Positively Locked				
135	☐ Manways: Size (mm): Type/Loc.:					☐ Material:				
136	☐ Bearing housing:					Shaft Sleeves:				
137	Split: Horizontal / Vertical Material:					Provided: ☐ Yes ☐ No				
138	Type:					☐ Material: (Remark-5)				
139	☐ Cooling required: ☐ None ☐ Air Cooled									
140	☐ Water Cooled: m3/hr @ °C					Shaft Seals				
141	☐ Radial Bearings (DE + NDE):					Type ☐ Labyrinth		☐ Packing		☐ Mechanical Seal
142	Type: ☐ Hydrodynamic ☐ Antifriction ☐ Sleeve					Mech. Seals: Make:		Model / Seal Code:		
143	Thrust Bearing:					No. of rings in Packing:				
144	Type: ☐ Flat Land ☐ Tapered Land ☐ Tilted Pad					MOC of Laby./Packing:				
145	☐ Other:					Rotation viewed from coupling end: ☐ CW ☐ CCW				
146						GD ² value of Fan rotor:				
147	☐ Temp. Detectors (Metal / Oil) ☐ Thrust ☐ Journal									
148	☐ Type:					Main Connections: (By vendor)				
149						☐ Inlet: No.x Size: x mmx mm; Area (m ²) :				
150	☐ Lubrication for Fan Bearings					☐ Flange Size:				
151	Type: ☐ Ring Oil (constant level) ☐ Grease: NO					☐ Location / Orientation:				
152	☐ Forced Feed					☐ Exp. Joint: ☐ Yes ☐ No; Furnished By: ☐ Fan Mfr. ☐ Other:				
153	☐ Mtg. Pedestal		☐ Yes ☐ No		☐ Outlet: No.x Size: x mmx mm; Area (m ²) :					
154	☐ Sole Plates		☐ Yes ☐ No		☐ Flange Size:					
155	Vibration Probe along with Vibration Transmitter					Location / Orientation: At Fan Discharge				
156	☐ Allowable Vibration Limits:					☐ Exp. Joint: ☐ Yes ☐ No; Furnished By: ☐ Fan Mfr. ☐ Other:				
157	☐ :m, Peak to Peak: @ Location:									
158	☐ mm/sec: @ Location:					Other Connections:				
159	☐ Seismic Sensor-Spot space(s) (provision for mtg.)					Service		No.		Size
160	☐ Seismic Sensor duly mounted					Lube Oil Inlet				
161	☐ Speed Detectors					Lube Oil Outlet				
162	☐ Non-Contact Probe					Cooling Water Inlet				
163	☐ Speed Switch					Cooling Water Outlet				
164	☐ Other:					Condensate Drain				
165	☐ Type: ☐ Model:					Other				
166	☐ Manufacturer:					Pressure Gauge				
167	☐ Location:					Temperature Gauge				
168	☐ Scale Range:									
169	☐ Weights (kg):					☐ Space Requirements (m):				
170	Fan Assy.		Gear				L		W	
171	Rotors		Fluid Cplg.				Fan Assembly			
172	Sound Trunk		Other:				Fluid Coupling			
173	Evase		Other:				Gear			
174	Driver #1		Max. Maintenance				Clutch			
175	Driver #2		Erection / Shipping				Driver #1			
176	Baseplate						Driver #2			
177							Complete Assembly			
178	NOTES:									
179	6. Refer remark no. 5.									
180	7. -deleted-									

181	CONSTRUCTION FEATURES (CONTINUED)					
182	Fan Cleaning System:			Base-plates & Soleplates:		
183	■ Required Cleaning Medium: WATER			□ Tri- Directional Adjusting Screws For Eqpt.		
184	■ Furnished by: ■ Fan Mfr. □ Other:			□ Pilot Holes For Dowels		
185	MATERIALS: (REFER REMARK NO. 5)			■ Type Grout: RCC □ Type Pre-coat:		
186	Part	Material	Material Specification	Soleplates For: ■ Bearing Pedestals □ Gear		
187	Fan Housing / Casing			■ Driver ■ Fan Housing Support		
188	Shaft			Base-Plates		
189	Impeller / Blades			■ Common (under Driver & Inboard bearing pedestal)		
190	Hub / Center Plate / Shrouds			□ Fan Alone □ Other		
191	Shaft Sleeves			■ Decking ■ Non Skid □ Open Const		
192	Inlet Damper (Blade / Shaft)			■ Drip Rim □ Open Drain		
193	Outlet Damper			Suitable For: □ Column Or ■ Perimeter Support		
194	Inlet Guide Vanes			□ Leveling Pads W / Removable Cover		
195	Inlet Bell			□ Sub-sole Plates Required		
196	Evasé			■ Anti-vibration Pads		
197	Inlet / Outlet Expansion Joint			□ Suitable for support over elevated steel structure		
198	Inlet Trash Screen / Housing			■ Suitable for support over concrete foundation		
199	Rain Hood(s)					
200	Inlet / Outlet Transition Piece					
201	Base plate					
202	Couplings		Driver - Fan			
203	■ Coupling & Guard		Yes			
204	Furnished By		Fan Vendor			
205	■ Type		Flexible Metallic with Spacer & Non-sparking guard			
206	□ Mfg.					
207	□ Model/Number					
208	■ Lubrication		Dry			
209	■ Mount Cplg. Halves		Yes			
210	- Fan		By Fan Vendor			
211	- Driver		By Fan Vendor			
212	- Gear		NA			
213	□ Spacer Length					
214	□ Ltd. End Float Reqd.					
215	■ Coupling Guard Reqd.		Yes			
216	■ Service Factor		1.5			
217	□ Cplg. Rating kW/100 RPM					
218	□ Keyed Or Hydr. Fit					
219	□ Adapter (Solo) Plate(If Reqd.)					
220	■ Materials (Coupling / Disc Pack)		CS/SS			
221	SHOP INSPECTION & TESTS (EACH FAN)					
222	Description	Observed	Witnessed	Description	Observed	Witnessed
223	■ Shop Inspection	□	□	□ Pressure Test	□	□
224	■ Cleanliness Inspection	□	□	- Housing	□	□
225	□ Hardness Verification	□	□	- Ducting	□	□
226	□ Charpy Impact Testing	□	□	- Lube Oil System	□	□
227	■ Shaft Run-out Check	■	□	■ Performance Test	□	■
228	■ Dyn. Bal. of both Rotor Assys. (Gr.2.5:ISO)	■	□	(as per BS:848/AMCA 210)		
229	■ Calibration Check Of Balancing Eqpt.	■	□	■ NLMRT for 4 hours	□	■
230	■ DP/MP test for Impeller / Casing Welds	■	□			
231	■ US/LP test for shaft	■	□	□ Damper functional test	□	□
232	□ Assembly+Fit Up Check (Main/Spare rot)	□	□	□ LO Console functional test	□	□
233	□ Initial &/Or Final Alignment Check	□	□	■ Functional / Simulation test LCP	□	■
234	□ Gear Tooth Contact Check	□	□			
235	■ Vibration Level Test (during MRT)(for ref.)	□	■	■ QC Review	□	□
236	■ Sound Level Test (during MRT)(for ref.)	□	■	■ Dimens. & Visual Insp.	□	■
237	■ Material Certf. : Casing/Impeller/Shaft/Slv.	□	□	■ Pre-shipment Insp.	□	■
238	□ Surface & Subsurface Insp.	□		□ Radiography of Butt welds	□	□
239	Type:	□	□			
240	□ Casing tightness test with Helium	□	□			

241	ACCESSORIES	
242	■ Inlet Stack along with Bird/Insect Screen, Rain Hood	■ Canopy for Motor(s)
243	■ Inlet Silencer (if required)	■ Foundation / Anchor Bolts
244	□ Complete Inlet Ducting, Prefabricated	■ Jacking Bolts for Motor & Fan (2 Directions)
245	□ Insulation cleats on Fan scroll & inlet box	■ Vibration Eliminators / Anti Vibration Mountings(as reqd.)
246	■ Expansion Joints / Flexible Connections: Fan Inlet	□ Prefabricated CW Piping & Fittings for Brg. Cooling
247	■ Expansion Joints / Flexible Connections: Fan Outlet	■ Impeller cleaning system complete with
248	□ By Contractor □ By Fan Vendor	prefabricated piping & fittings
249	■ Companion flanges with gaskets, bolts & nuts: Fan Inlet (@ vendor's B/L)	■ All utility connections terminated with isolation
250	■ Companion flanges with gaskets, bolts & nuts: Fan Outlet (@ vendor's B/L)	valves at vendor's battery limits (Single point
251	□ By Contractor □ By Fan Vendor	connections, with companion flanges, nuts, bolts & gaskets).
252	■ Casing Drain including inlet box drain, terminated at vendor's B/L	■ Inlet / Outlet Transition Pieces
253	with isolation valve (50 mm NB, minimum).	■ Local Instruments including junc. box, as specified
254	■ Other accessories & instrumentation as per P&ID attached elsewhere.	■ Local Control Panel(s) / LGB (s) [As required]
255	□ Fluid Coupling complete with all associated auxiliary systems & instr. & controls	■ Mandatory Spares, as specified
256	Make: Model:	■ Quotation for Spares for 2 year normal operation
257	□ Variable speed drive system complete with all assoc. auxiliary sys. & controls	■ Commissioning Spares (as recommended)
258	Make: Model:	■ Special tools / tackles (as recommended)
259	■ Inlet Box Control (IGV): Make:	■ Cabling / Tubing between Fan & Control Panel
260	□ Damper (Inlet): Slide gate type, with optg. gears & linkages, for fan isolation.	
261	□ Damper (Outlet): Slide gate type, with optg. gears & linkages, for fan isolation.	
262	NOTES:	
263	8. -deleted-	
264	9. Local Instruments indicated on P&ID are included in fan vendor's scope.	
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REMARKS

2. FAN DESIGN

- 2.1 All fans shall be provided with individual suction stacks. Permanent pressure loss across the inlet stack and in the outlet system between the fan outlet flange & the evase outlet flange are to be assessed by fan vendor and add the total losses to the pressure increase for sizing the fan.
- 2.2 Vendor shall furnish separate performance curves for all the operating cases, together with the surge line indicated, to justify the continued operation from minimum to maximum capacity at the operating speed(s).
- 2.3 "START/STOP" fan push buttons shall be considered in the local control station.
- 2.4 The fan sizing shall be done for the maximum capacity considering the maximum suction temperature.
- 2.5 The motor rating shall also be adequate for operation of fans at the specified minimum specified ambient conditions at the rated speed in unthrottled conditions.
- 2.6 Fan shall be suitable for continuous operation (mechanically) at 15°C above the maximum specified operating temperature.
- 2.7 Centrifugal fan manufacturer shall have single point responsibility for the complete package including Fan, drivers, coupling & silencer etc.
- 2.8 Centrifugal fans first critical speed of the rotor shall be higher than 120% of rated speed.(i.e. the rotor shall be "classically stiff" type)
- 2.9 Centrifugal fans casing shall be suitably split such that impeller assembly can be removed for maintenance without disturbing inlet and outlet ducting.
- 2.10 The inlet guide vane at fan inlet shall be provided with the following
 - An external guide vane position indicator
 - Spindles supported at both ends
 - Manual operation of guide vane from grade level shall
 - The guide vane ring protected by a dust cover (which shall allow full access to all parts for inspection)
- 2.11 **Unitisation:** The Fan, driver & all auxiliaries shall be supplied duly mounted on a common base-plate (except for specified loose items). Unitisation of each fan package along with driver and associated job auxiliaries shall be done in manufacturer's shop.
- 2.12 All rotating equipment base plates shall have jacking provision for levelling and jacking/levelling screws for alignment in horizontal and vertical planes.
- 2.13 Only Stainless Steel shims shall be provided for equipment alignment.

3. CAPACITY CONTROL

- 3.1 The capacity of the fan shall be regulated from field as well from DCS through actuated Inlet Guide vane.

4. MISCELLANEOUS

- 4.1 Bidder shall refer to process data sheet for specification, requirements and vendor's scope of supply / works. It may be noted that P&ID is indicative only & the actual scope of supply/work shall also take care of the requirements specified in the process data sheets, standard specifications etc.
5. MOC shall be suitable for the operating and design conditions. References for MOC for similar operating conditions shall also be furnished.

DATE	REV.	JOB ENGINEER	REVIEWED & APPROVED BY

**EXPERIENCE RECORD PROFORMA
ROTARY PUMP (SCREW TYPE)**

ITEM NO.: _____

Document No.
B957-420-80-42-ERP-9994
Rev. No. A
Page 1 of 2

NOTES TO BIDDERS:

1. Prototype pump model/ model series shall not be considered.
2. It is mandatory that all references furnished for pump model/ model series should have similar parameters.

DESCRIPTION OF MODEL DESIGNATION: _____

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	GENERAL					
1.1	Make / Model Number					
1.2	Number of units supplied					
1.3	Type of driver / Driver rated kW / Speed (rpm)					
1.4	Shop where pump is designed, manufactured, packaged, tested & supplied with address					
2	OPERATING CONDITIONS					
2.1	Fluid handled / Fluid temperature (Min / Max) Deg C					
2.2	Viscosity, Min / Max (cP)					
2.3	Capacity (m ³ /hr) / Differential Head Rated (m)					
2.4	Maximum Suction pressure (kg/cm ² ,A)					
2.5	Differential Pressure, Rated (kg/cm ²)					
2.6	NPSHR (m)					
2.7	BKW (kW) / Rated Speed (rpm)					
2.8	MAWP outer casing (kg/cm ² G) @ 15°C & @ pumping temperature					
3	CONSTRUCTION					
3.1	Type of Pump (Single / Twin / Triple Screw)					
3.2	Sealing Element (packing / mechanical seal)					

Place:

Date:

[Signature of Authorized Signatory]*

Name:

Designation:

Seal:

[To be submitted in original, along with bid]

*: To be authenticated in-line with provisions indicated in the Commercial section.

EXPERIENCE RECORD PROFORMA
ROTARY PUMP (SCREW TYPE)

ITEM NO.: _____

Document No.
B957-420-80-42-ERP-9994
Rev. No. A
Page 2 of 2

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.
3.3	No. of shaft ends to be sealed per pump					
3.4	No. of seals per pump					
3.5	API Sealing Plan No.					
3.6	Lubricating Fluid (same as pumping fluid / other)					
4	MATERIAL OF CONSTRUCTION					
4.1	Casing					
4.2	Insert					
4.3	Screws					
4.4	Shaft					
5	OTHER INFORMATION ON INSTALLATIONS					
5.1	Date of supply and commissioning					
5.2	Whether one year of successful field operation completed after commissioning as on bid due date					
5.3	Purchaser's Name, Address, Contact No. & email ID					

Place:

Date:

[Signature of Authorized Signatory]*

Name:

Designation:

Seal:

[To be submitted in original, along with bid]

*: To be authenticated in-line with provisions indicated in the Commercial section.

NOTES TO BIDDERS:

1. Prototype pump model/ model series shall not be considered.
2. It is mandatory that all references furnished for pump model/ model series should have similar parameters and in similar fluid (liquid) service.

NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS		REMARKS
			Ref.-1	Ref.-2	
1	GENERAL				
1.1	Model Number				
1.2	Type of Driver / Driver Rating (kW)				
1.3	Shop where pump is designed, manufactured, packaged, tested & supplied				
2	OPERATING CONDITIONS				
2.1	Service / Fluid handled / Fluid temperature (deg C)				
2.2	Rated Capacity (LPH) & Differential Pressure, Rated (kg/cm ²)				
2.3	NPSHR (m) / excluding acceleration head / Overall Efficiency (%)				
2.4	BKW, Rated and Rated Speed				
2.5	Maximum Suction pressure (kg/cm ² A)				
2.6	Type of lubrication system				
2.7	Type of pump (Simplex / Duplex / Triplex etc.)				
2.8	Type of compression element (Plunger / Diaphragm)				
2.9	Type of valves (Single Ball / Double Ball / Others)				

Place:
Date:

[Signature of Authorized Signatory]*
Name:
Designation:
Seal:
[To be submitted in original, along with bid]

*: To be authenticated in-line with provisions indicated in the Commercial section.

NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS		REMARKS
			Ref.-1	Ref.-2	
2.10	Stroke Variation (local manual / remote auto / remote manual)				
2.11	Type of diaphragm (single / double / sandwich)				
2.12	Cylinder bore (mm) and Stroke (mm)				
2.13	Speed (Strokes per minute)				
2.14	Casing MAWP (15°C / PT / Design Temperature)				
3	MATERIAL OF CONSTRUCTION				
3.1	Plunger / Diaphragm / Cylinder				
4	OTHER INFORMATION ON INSTALLATIONS				
4.1	Date of supply				
4.2	Purchaser's Name, Address, Contact No. & email ID				

Place:
Date:

[Signature of Authorized Signatory]*
Name:
Designation:
Seal:
[To be submitted in original, along with bid]

*: To be authenticated in-line with provisions indicated in the Commercial section.

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

ITEM NO. : _____

Document No.
B957-420-80-42-ERP-9997
Rev. No. A
Page 1 of 2

NOTES TO BIDDERS:

1. Prototype pump model/ model series shall not be considered.
2. It is mandatory that all references furnished for pump model/ model series should have similar parameters.

DESCRIPTION OF MODEL DESIGNATION: _____

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	GENERAL					
1.1	Make / Model Number					
1.2	Number of units supplied					
1.3	Type of driver / Driver rated kW / Speed(rpm)					
1.4	Shop where pump is designed, manufactured, packaged, tested & supplied with address					
2	OPERATING CONDITIONS					
2.1	Service / Fluid handled / Fluid temperature (deg C)					
2.2	Rated Capacity (m ³ /hr) & Rated Diff. Head (m)					
2.3	Maximum Suction pressure (kg/cm ² ,a)					
2.4	Differential Pressure, Rated (kg/cm ²)					
2.5	Minimum Submergence Required (mm)					
2.6	Setting depth / Column Length (mm)					
2.7	Efficiency / BkW, Rated (kW)					
2.8	Minimum Continuous Stable Flow, (m ³ /hr)					
2.9	Rated Speed (rpm)					
2.10	MAWP casing (kg/cm ² G) @ 15 Deg C @ pumping temperature					

Place:
Date:

[Signature of Authorized Signatory]*

Name:
Designation:
Seal:

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Template No. 5-0000-0001-T3 Rev. 1

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EXPERIENCE RECORD PROFORMA
CENTRIFUGAL PUMP (VERTICAL)

ITEM NO. : _____

Document No.
B957-420-80-42-ERP-9997
Rev. No. A
Page 2 of 2

3	CONSTRUCTION					
3.1	Type of Pump Discharge (discharge through column / separate discharge)					
3.2	Type of line shaft (open / close)					
3.3	Line shaft lubrication (pumping medium / separate lubricant)					
3.4	Start-up pre-lubrication required (yes / no)					
3.5	No. of stages (single / two)					
3.6	Impeller diameter - Rated/ Maximum / Minimum (mm)					
3.7	Whether the proposed model and reference models have identical hydraulic design (for impeller / diffuser / volute)					
3.8	Sealing Element (packing / mechanical seal)					
3.9	Type of mechanical seal (Single / Double)					
4	MATERIAL OF CONSTRUCTION					
4.1	API - 610 Material Code					
4.2	Casing / Impellers					
4.3	Line Shaft / Column					
4.4	Line Shaft bearing					
5	OTHER INFORMATION ON INSTALLATIONS					
5.1	Date of supply & commissioning					
5.2	Purchaser's Name, Address, Contact No. & email ID					

Place:
Date:

[Signature of Authorized Signatory]*

Name:
Designation:
Seal:

*: To be authenticated in-line with provisions indicated in the Commercial section.
Template No. 5-0000-0001-T3 Rev. 1

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NOTES TO BIDDERS:

1. Prototype pump model/ model series shall not be considered.
2. It is mandatory that all references furnished for pump model/ model series should have similar parameters and in similar fluid (liquid) service.

DESCRIPTION OF MODEL DESIGNATION SYSTEM: _____

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

Place:

Date:

[Signature of Authorized Signatory]*

Name:

Designation:

Seal:

[To be submitted in original, along with bid]

*: To be authenticated in-line with provisions indicated in the Commercial section.

S. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS		REMARKS
			Ref.-1	Ref.-2	
2.7	Type of Bearings / Bearing span (mm)				
2.8	Shaft Diameter under Bearing (mm)				
2.9	Casing MAWP (15°C / PT / Design Temperature)				
3	MATERIAL OF CONSTRUCTION				
3.1	Casing / Impeller / Shaft				
4	OTHER INFORMATION ON INSTALLATIONS				
4.1	Date of supply and commissioning				
4.2	Whether one year of successful field operation completed after commissioning as on bid due date				
4.3	Purchaser's Name, Address, Contact No. & email ID				

Place:
Date:

[Signature of Authorized Signatory]*

Name:

Designation:

Seal:

[To be submitted in original, along with bid]

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**EXPERIENCE RECORD PROFORMA
CENTRIFUGAL PUMP (HORIZONTAL MULTISTAGE)**

ITEM NO.: _____

Document No.
B957-420-80-42-ERP-9999
Rev. No. A
Page 1 of 2

NOTES TO BIDDERS:

1. Prototype pump model/ model series shall not be considered.
2. It is mandatory that all references furnished for pump model/ model series should have similar parameters.

DESCRIPTION OF MODEL DESIGNATION: _____

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	GENERAL					
1.1	Make / Model Number					
1.2	Number of units supplied					
1.3	Type of driver / Driver rated kW / Speed (rpm)					
1.4	Drive (Fixed Speed / Variable Speed / Variable Frequency)					
1.5	Shop where pump is designed, manufactured, packaged, tested & supplied with address					
2	OPERATING CONDITIONS					
2.1	Fluid handled / Fluid temperature (Min / Max) Deg C					
2.2	Capacity (m ³ /hr) / Differential Head Rated (m)					
2.3	Maximum Suction pressure (kg/cm ² ,A)					
2.4	Differential Pressure, Rated (kg/cm ²)					
2.5	NPSHR (m)					
2.6	Efficiency (%) / BkW (kW) / Rated Speed (rpm)					
2.7	Minimum Continuous Stable Flow, (m ³ /hr)					
2.8	MAWP outer casing (kg/cm ² G) @ 15°C & @ pumping temperature					
3	CONSTRUCTION					
3.1	No. of stages / API Pump Type					

Place:

Date:

[Signature of Authorized Signatory]*

Name:

Designation:

Seal:

[To be submitted in original, along with bid]

*: To be authenticated in-line with provisions indicated in the Commercial section.

EXPERIENCE RECORD PROFORMA
CENTRIFUGAL PUMP (HORIZONTAL MULTISTAGE)

ITEM NO.: _____

Document No.
B957-420-80-42-ERP-9999
Rev. No. A
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3.2	Casing split - Outer casing (Axial / Radial)					
3.3	Casing split - Inner casing (Axial / Radial)					
3.4	First Impeller Type (Single flow / Double flow)					
3.5	Impeller diameter - Rated/ Maximum / Minimum (mm)					
3.6	Impeller mounting (Inline / Back to back)					
3.7	Balancing Device used (Balance drum / Balance disc / Others)					
3.8	Type of Radial Bearings (Antifriction / Sleeve / Tilting Pad / Others)					
3.9	Type of Thrust Bearings (Taper land / Tilting Pad / Others)					
3.10	Span between bearings (mm) / Shaft diameter under: Seals / Bearings (mm)					
3.11	Shaft Sleeve provided between impeller (interstage bushings) - Yes / No					
3.12	Whether the proposed model and reference models have identical hydraulic design (for impeller / diffuser / volute)					
3.13	Type of lubrication (Pressurised / Splash / Ring / Oil mist / Grease)					
3.14	Lubrication system (API-610 / API-614 / Manufacturer Standard)					
3.15	Type of mechanical seal (Single / Double) / API Sealing Plan No.					
4	MATERIAL OF CONSTRUCTION					
4.1	Outer Casing / Inner Casing / Impellers / Shaft					
5	OTHER INFORMATION ON INSTALLATIONS					
5.1	Date of supply and commissioning					
5.2	Whether one year of successful field operation completed after commissioning as on bid due date					
5.3	Purchaser's Name, Address, Contact No. & email ID					

Place:

Date:

[Signature of Authorized Signatory]*

Name:

Designation:

Seal:

[To be submitted in original, along with bid]

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Template No. 5-0000-0001-T3 Rev. 1

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ENGINEERING DESIGN BASIS STATIC & MACHINERY EQUIPMENT (EQUIPMENT DIVISION)

JOB NO: B857
PROJECT: EPCM Services for Site Enabling for Bina Petrochemical and Refinery Expansion Project
CLIENT: BPCL - BINA REFINERY

EIL SIGNATURE:

CLIENT SIGNATURE:

Manish Kumar
Pandey

Digitally signed by
Manish Kumar Pandey
Date: 2024.07.26
16:15:56 +05'30'



0	23/Jul/2024	Issued For Implementation	VENKATESAN D	PESALA VENKATA SUBBA SATYANARAYANA	NALIN KUMAR
A	14/Feb/2024	Issued For Owner's Comments & Consent	VENKATESAN D	SHISHUPAL CHOUDHARY	NALIN KUMAR
Rev. No.	Date	Purpose	Prepared by	Reviewed by	Approved by

Legend: ***Bold italic*** text denotes change with respect to previous revision.

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1.0 STATIC EQUIPMENT

1.1.0 SCOPE

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

Electrical items, Instrumentation & Controls, Piping, Rotating Equipment etc. associated with Static Equipment shall comply with the design requirements as given in the respective discipline specifications.

1.2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

1.2.1 ABBREVIATIONS

Code	Description
SMPV	Static and Mobile Pressure Vessel
MDMT	Minimum Metal Design Temperature
CA	Corrosion Allowance
ASME	American Society of Mechanical Engineers
API	American Petroleum Institute
OISD	Oil Industry Safety Directorate
TEMA	Tubular Exchanger Manufacturers Association
EJMA	Expansion Joint Manufacturers Association
EEMUA	Engineering Equipment and Materials Users Association
NACE	National Association of Corrosion Engineers
WRC	Welding Research Council
TL	Tangent Line
IBR	Indian Boiler Regulations
PESO	Petroleum and Explosives Safety Organization

1.2.2 CODES & STANDARDS / PUBLICATIONS

The following codes and standards in their latest edition including latest addenda as on the date of first issue of this design basis shall be followed unless otherwise specified in the requisition for the design, fabrication, inspection and testing of Vessels, Columns, Reactors, Spheres, Storage Tanks, Steel Silos, Bins, Hoppers, Steel Flare/Vents Stacks, Silencers, Tube bundle extractor, Air coolers & Heat exchangers:

S.No.	Description	Standards / Codes	Edition
1	For Pressure Vessels, Heat Exchangers	ASME SEC. VIII DIV.1	Latest
2	For Nondestructive Examination	ASME SEC. V	Latest
3	For Pressure vessels and heat exchangers (Selectively for high pressure/high thickness)	ASME SEC. VIII DIV.2	Latest
4	For Storage Spheres	ASME SEC. VIII DIV.2	Latest
5	For Atmospheric Storage Tanks	API 650	Latest
6	For Low Pressure Storage Tanks	API 620	Latest
7	For Tank Inspection, Repair, Alteration & Reconstruction	API 653	Latest

S.No.	Description	Standards / Codes	Edition
8	For Cryogenic Storage Tanks (Double Wall)	API 620/BS-EN 14620/ API 625	Latest
9	For Silos, hoppers and bins	IS: 9178/EN-1991-4/EN- 1993-4-1	Latest
10	For steel vent stacks etc.	IS: 6533/ ASME Sec. VIII Div.1	Latest
11	For workmanship of Vessels not categorized under any other code	ASME SEC. VIII DIV.1	Latest
12	For FRP vessels and Tanks	BS : EN-13121/ASME Sec.X	Latest
13	For Mounded Vessel	ASME SEC. VIII DIV.2/PD 5500/EEUMA 190	Latest
14	For Welded Aluminium Alloy Storage Tanks	ASME B 96.1	Latest
15	For material specification	ASME SEC. II	Latest
16	For material specification	ASTM/IS	Latest
17	For wind load consideration	IS:875/SITE DATA	Latest
18	For seismic design consideration	IS:1893/SITE DATA	Latest
19	For welding	ASME SEC. IX	Latest
20	For flanges	ASME B 16.5	Latest
21	For large diameter flanges	ASME B 16.47	Latest
22	For gaskets	ASME B 16.20/ B 16.21	Latest
23	For shell and tube Exchanger	TEMA Class R, API 660,ASME Section VIII Div.1 & 2	Latest
24	For Air Cooled Exchanger	API 661	Latest
25	For Air Cooled Exchanger Structural Design	IS 800	Latest
26	For brazed aluminium plate fin exchanger	ALPEMA / API 662 Part-2	Latest
27	For fabrication considerations for vanadium modified Cr-Mo steel heavy wall pressure vessels	API RP 934B	Latest
28	Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments.	NACE MR 0103	Latest
29	Petroleum and natural gas industries - Materials for use in H ₂ S containing environments in oil and gas production	NACE MR 0175/ ISO 15156	Latest
30	Local Stresses in Spherical & Cylindrical Shells due to External Loadings	WRC Bulletin #107 / 537	Latest
31	Local Stresses in Cylindrical Shells due to External Loadings on Nozzles	WRC Bulletin #297	Latest
32	Methods and Controls to Prevent in-Service Environmental Cracking of Carbon Steel Weldments in Corrosive Petroleum Refining Environments	NACE-RP-0472	Latest

S.No.	Description	Standards / Codes	Edition
33	For cathodic protection of underground vessels/storage tanks	API RP 1632	Latest
34	Avoiding Caustic Stress Corrosion Cracking of Carbon Steel Refinery Equipment & Piping	NACE SP 0403	Latest
35	Code of Practice for Lining Vessels & Equipment for Chemical Process	IS 4682	Latest
36	Plate-And-Frame Heat Exchangers	API 662 Part-1	Latest
37	Hair-Pin type Heat Exchangers	API 663	Latest
38	Spiral Plate Heat Exchangers	API 664	Latest
39	Standards of the expansion joint manufactures association, Inc.	EJMA + ASME SEC. VIII DIV.1	Latest

STATUTORY PROVISIONS

National laws and statutory provisions such as Indian Boiler Regulation and Petroleum and Explosives Safety Organization, Nagpur, India together with any local by-laws for the state shall be complied with. Static and Mobile Pressure Vessel (SMPV) rules and OISD norms as applicable shall also be complied with.

1.3.0 GENERAL / DESIGN CONSIDERATIONS

S.No.	Project Philosophy
1	Equipment shall be designed in compliance with the latest design code requirements and applicable standards/ specifications. All design calculations shall be performed considering all applicable loads for erection, operating and hydro test conditions.

1.3.1 EQUIPMENT SIZING

S.No.	Equipment Type	Project Philosophy
1	Columns	Based on inside diameter
2	Tanks & Spheres	Based on inside diameter
3	Reactors	Based on inside diameter
4	Vessels/Shell & Tube Heat Exchangers	Based on inside diameter (Based on OD for exchangers/vessels fabricated from pipe).
5	Air Cooled Heat Exchangers	Based on nozzle size and no. of tube rows

1.3.2 MINIMUM SHELL / HEAD THICKNESS

S.No.	Project Philosophy
1	Minimum thickness of equipment wall/components shall be as given below:

S.No.	Project Philosophy
1.1	For carbon and low alloy steel vessels - 6mm (For corrosion allowance upto 3.0 mm. In case of higher corrosion allowance, thickness to be increased accordingly), but not less than that calculated as per following For diameters less than 2400 mm Wall thickness = (Dia./1000) + 1.5 + CA (if any) For diameters 2400 mm and above Wall thickness = (Dia./1000) + 2.5 + CA (if any) All dimensions are in mm.
1.2	For stainless steel vessels and high alloy vessels - 3 mm, but not less than that calculated as per following for diameter more than 1500mm. Wall thickness = (Dia./1000) + 2.5 + CA (if any) All dimensions are in mm.
1.3	Vertical vessel with Height (TL to TL) / Diameter ratio greater than 5 shall be considered as tall column and shall be designed accordingly.
1.4	For carbon steel, stainless steel, low alloy steel columns/towers & high alloy steel columns/tower - 8mm (For corrosion allowance up to 3.0 mm. In case of higher corrosion allowance, thickness to be increased accordingly).
1.5	For shell & tube heat exchangers, minimum thickness shall be as per TEMA.
1.6	For Air Cooled heat exchangers, minimum thickness shall be as per API 661, however minimum tube sheet thickness shall be 22mm (excluding corrosion allowance).
1.7	For Double Wall Storage Tanks, Minimum thickness shall not be neither less than those indicated in applicable design code nor less than the mentioned below: i) Inner Shell-10mm ii) Inner Bottom Plate-8mm iii) Outer shell/Bottom/Roof-5mm

1.3.3 EQUIPMENT END CLOSURES

S.No.	Project Philosophy
1	Unless specified otherwise, Deep Torispherical Dished End with 80 % crown radius and 15% knuckle radius or alternatively 2:1 semi Ellipsoidal Dished End shall be used for pressure vessels & heat exchangers.
2	Hemispherical Ends shall be considered when the thickness of shell exceeds 70 mm.
3	Flat Covers may be used for atmospheric vessels.
4	Pipe Caps may be used for vessels diameter <= 600mm having no internals.
5	Flanged Covers (consisting of standard forged WN flanges and blind flange as per ASME B16.5/16.47) shall be used for Vessels/Columns of Diameter <= 900mm having internals.
6	All columns having diameter 900 mm and below shall be provided with intermediate body flanges. Numbers of intermediate flanges shall be decided based on column height and type of internals.

1.3.4 DESIGN PRESSURE

S.No.	Project Philosophy

S.No.	Project Philosophy
1	Design pressure shall be as per Process datasheet. If design pressure is not specified in Process datasheet, the same shall be as per BEDP.
2	Design pressure specified shall be at the highest point of equipment. The design pressure at any lower point is to be determined by adding the maximum operating liquid head and any existing pressure gradient within the equipment (like differential pressure as mentioned in Process Data Sheet , pressure exerted by catalyst/packing).
3	Equipment shall be designed for steam out conditions as specified by process data sheet.
4	Unless otherwise specified elsewhere, pressure chambers of combination units including heat exchanger shall be designed for testing independently without pressure in the adjacent chamber in corroded condition.

1.3.5 TEST PRESSURE

S.No.	Project Philosophy
1	Unless specified otherwise, equipment shall be hydrostatically tested in the fabricator's shop as per design code.
2	Equipment open to atmosphere shall be tested by filling with water to the top.
3	
3.1	Pressure Chambers of combination units and heat exchangers that have been designed to operate independently shall be hydrostatically tested to code test pressure as separate equipment i.e. each chamber shall be tested without pressure in the adjacent chamber unless otherwise specified in equipment data sheet.
3.2	When pressure chambers of combination units and heat exchangers have their common elements designed for maximum differential pressure, the common elements shall be subjected to test pressure equivalent to the differential pressure multiplied by a factor as per applicable design code.
3.3	Coils shall be tested separately to code test pressure.
4	Unless otherwise specified in applicable design code allowable stress during hydro test in tension shall not exceed 90% of yield point.
5	Storage tanks shall be tested as per applicable code.

1.3.6 DESIGN TEMPERATURE

S.No.	Project Philosophy
1	Design Temperature shall be as per Process datasheet. If design temperature is not specified in Process datasheet the same shall be as per BEDP.
2	Unless otherwise specified in process datasheet, Minimum Metal Design Temperature (MDMT) shall be lower of minimum atmospheric temperature and minimum temperature envisaged during operation.

1.3.7 CORROSION ALLOWANCE

S.No.	Project Philosophy
1	Corrosion allowance shall be as per Process datasheet. If Corrosion allowance is not specified in Process datasheet the same shall be as per BEDP.
2	Unless otherwise specified in datasheet, corrosion allowance shall not be considered for tubes of Heat Exchangers & Air coolers.
3	For weld overlayed equipment, weld overlay thickness (after final machining) shall be provided such that undiluted chemistry (as required) from top is equal to the weld overlay thickness/corrosion allowance required by Process data sheet.

S.No.	Project Philosophy
4	For alloy clad equipment, no corrosion allowance is required on the base metal. The cladding shall be in no case less than 3.0 mm and the same shall be considered as corrosion allowance for the purpose of stress analysis i.e. no contribution of clad thickness to be considered for stress calculations.
5	Corrosion allowance for nozzles and manhole neck shall be at least equal to that specified for the equipment. No Corrosion allowance is required for flange faces.
6	Removable CS/LAS internal parts, bolted or clamped-in-place, shall have extra thickness equal to half of specified corrosion allowance over each exposed surface, unless otherwise specified.
7	Fixed CS/LAS internal parts shall have extra thickness equal to specified corrosion allowance over each exposed surface, unless otherwise specified.
8	For SS Vessels and its components, there shall be no corrosion allowance, unless otherwise specifically indicated.

1.3.8 WIND CONSIDERATION

S.No.	Project Philosophy
1	Wind load shall be calculated on the basis of IS 875. a) Drag coefficient for cylindrical vessels shall be 0.7 minimum. b) Drag coefficient for spherical vessel shall be 0.6 minimum. c) Basic wind speed of 39 m/s shall be considered d) Other factors shall be as below K1 = 1.0 K2 shall be based on Category 3 for units and 2 for offsite K3 = 1.0 A contingency factor of 1.1 shall be applied to wind pressure.

1.3.9 EARTHQUAKE CONSIDERATION

S.No.	Project Philosophy
1	Earthquake loads for equipment shall be calculated in accordance with IS 1893 /site-specific seismic spectra as specified in the project specification.

1.3.10 CAPACITY

S.No.	Equipment Type	Project Philosophy
1	Tank	
1.1		Capacity shall be specified as Nominal capacity and Stored Capacity
1.2		Nominal capacity for fixed roof tanks shall be volume of cylindrical shell.
1.3		Stored capacity for fixed roof tanks shall be equal to nominal capacity minus free board volume (equivalent to 1000 mm of shell height) or if overflow nozzle is provided then up to the bottom of overflow nozzle.
1.4		Nominal capacity (also the stored capacity) for floating roof tanks shall be volume of cylindrical shell minus free board volume (equivalent to 1800 mm of shell height).

S.No.	Equipment Type	Project Philosophy
1.5		Nominal capacity (also the stored capacity) for fixed cum floating roof tanks shall be volume of cylindrical shell minus free board volume (equivalent to 2500mm to 3500mm of shell height for tanks with vent / overflow slot in shell).
1.6	Double Wall Storage Tank	Capacity of Double Wall Storage Tank shall be as per Process Datasheet.
2	Bullets (above ground or underground)	
2.1		Nominal capacity is the geometric capacity of Bullet.
2.2		Stored capacity shall be 85% of nominal capacity.
3	Sphere	
3.1		Nominal capacity is the geometric capacity of Sphere.
3.2		Stored capacity shall be 85% of nominal capacity.

1.3.11 SUPPORTS

S.No.	Project Philosophy
1	Skirt support shall be provided for all tall columns {Refer Section 1.3.2 (1.3)}, vertical vessels and reactors. However, small vertical equipment may be supported on legs (pipe or structural section) or brackets.
2	All Cr-Mo steel reactors shall be supported on skirts. Welding of external clips on Cr-Mo steel Reactors shall be avoided wherever possible.
3	Skirt Thickness- The thickness for the skirts inclusive of corrosion allowance shall be the maximum of following: a) 6 mm. b) Thickness required by analysis. c) 30 mm or 1/3 of the vessel wall thickness whichever is lower. Corrosion allowance of total 1mm minimum shall be considered for skirt unless otherwise specified in the project specifications to achieve final thickness of skirt shell.
4	All columns with diameter more than 1200 mm shall be self-supporting.
5	a) All columns with diameter up to 1200 mm shall be supported by superimposed structure around the column covering the entire height. Guy wires are not permitted to be used for supporting any equipment. b) All columns having diameter up to 1200 mm, piping & structural cleats shall not be provided on equipment.
6	In specific cases, columns having diameter 1200 mm & less and total L/D ratio not exceeding 10 may be self-supported.
7	Flare and Vent stacks shall be supported structurally by super imposed structure all around for the entire height.
8	Storage spheres shall be supported on pipe legs with tie rod bracing and turnbuckles.
9	Buried vessels shall be suitably anchored to prevent the uplift due to underground water. Anchor bolts shall have corrosion allowance of 6 mm on diameter. Buried vessels shall be rested on concrete saddles with anchoring bracket at the centerline of the vessel.

S.No.	Project Philosophy
10	For tailing lug requirements refer Annexure-1 to SMED - Static part(SI.no-1.0) of Design basis.
11	For skirt template requirements refer Annexure-1 to SMED - Static part(SI.no-1.0) of Design basis.
12	All reactors/vertical vessels/ columns shall be provided with rain shield to cover the fire proofing.Rain shield shall be full welded just above fire proofing of skirts.

1.3.12 MANHOLES

- Vessels and columns with diameter from 900 mm up to 1200 mm shall be provided with min. 500 NB manholes. For vessels and columns with diameter greater than 1200 mm manhole size shall be 600 NB min. Manhole size shall be increased (if required) to facilitate easy passage of removable internals.
- High pressure reactor manholes shall be on I.D. basis. Size shall be as per Licensor drawing.
- Clean out doors shall be provided as per client's / process requirements and Size of clean out doors fittings for tanks shall be 36" (900 mm) x 48" (1200mm).
- For storage tanks minimum number of manholes (Size 600mm) shall be as follows:

S.No.	Tank Diameter	Shell Manhole	Flush Type Clean Out Doors	Roof * Manhole
1	Diameter <= 12 m	1	#	1
2	12 m < Diameter <= 45 m	2	1	2
3	45 m < Diameter <= 61 m	3	2	2
4	Diameter > 61 m	4	2	2

* In the deck of floating roof tank one number additional 30" NB manhole with internal ladder shall be provided on floating roof as per fabricator's standard.

One Flush type Clean Out doors shall be provided for Storage Tanks having Diameter equal or less than 12.0 m based on service requirement wherever required.

1.3.13 FLOATING ROOF

Unless otherwise specified floating roof shall be of following construction.

S.No.	Tank Diameter	Type Of Floating Roof - External	Type Of Floating Roof - Internal
1	Diameter <= 12 m	Double Deck Type	Double Deck
2	12 m < Diameter <= 60 m	Pontoon Type	Pontoon type@
3	Diameter > 60 m	Double Deck Type	Double Deck

@ It is suggested to use Aluminium Floating Roof for conversion of existing cone roof tank to covered floating roof tank.

1.3.14 FLANGES

S.No.	Project Philosophy

S.No.	Project Philosophy
1	Nozzle flanges up to 600 NB shall be as per ASME B16.5 and above 600 NB shall be as per ASME B 16.47 (SERIES 'B') except that for high pressure heat exchanger. Non-standard flanges shall be designed as per ASME Sec. VIII Div. 1.
2	Unless otherwise specified, W.N. Flanges shall be used for all classes.
3	Unless otherwise specified, all girth flanges and intermediate body flanges shall be of weld neck type only.

1.3.15 INTERNALS

S.No.	Project Philosophy
1	Unless otherwise specified removable internals shall be bolted type and material of bolting shall be stainless steel TP 304. For shell & tube heat exchangers, floating head bolting shall be compatible to shell material and SA 193 Gr. B7M/2HM shall be used as a minimum.

1.3.16 PIPE DAVIT

S.No.	Project Philosophy
1	Vertical Vessel/Column having safety valve size 80 NB and above and or having internals, shall be provided with pipe davit.
2	Exchangers shall be provided with davits for removal of flat channel cover and shell covers only.

1.3.17 VENT/DRAIN NOZZLE CONNECTIONS

S.No.	Project Philosophy
1	Exchangers shall be provided with vent and drain connection of 40 NB nozzle with blind flange etc. Separate vent and drain will not be provided if vented / drained by process/other nozzles. For clad exchangers, minimum size of vent and drain nozzle connection shall be 80 NB.

1.3.18 MP CONNECTIONS FOR PG/TI

S.No.	Equipment Type	Project Philosophy
1	Shell & Tube heat exchangers	
1.1		For Clad Exchangers: One no. 50NB LWN nozzle on each inlet/outlet with BF etc. If not feasible, then on main shell/channel or piping close to main nozzles.
1.2		Others : One no. 40 NB nozzle with blind on each inlet / outlet. Rating shall be same as process nozzle.
2	Air Cooler	
2.1		One on one of the inlets & one on one of the outlets of each header, size 40 NB nozzle with BF etc. If it is not possible to provide on process nozzle then it shall be provided on header.
2.2		Rating shall be same as process nozzle.

1.3.19 IMPORTANT CONSIDERATIONS

S.No.	Project Philosophy
1	All columns and vessels shall be capable of withstanding water full condition during system testing in corroded condition.
2	In addition, all vertical vessels, columns and horizontal vessels shall be designed so as to permit site testing of the equipment with water at the test pressure on the top of the equipment considering 33% of design wind load. The design shall be based on fully corroded condition.
3	Design of components not covered in IBR (Indian Boiler Regulations) shall be in accordance with ASME SEC VIII DIV I.
4	All nozzle necks, all nozzle flanges and blind flanges shall be of weld deposit construction for clad equipment. Loose liners are not permitted.
5	No flanged connection shall be provided inside support skirt or other confined areas.
6	All vertical equipment shall be provided with two lifting lugs. Lifting lugs shall be designed with minimum impact factor of 1.5.
7	a) For Skirt Diameter above 1200 mm permanent sloping ladder should be provided inside the skirt of the column and vertical vessels to approach the bottom head for inspection purposes. b) For Skirt Diameter up to 1200 mm ladder rungs shall be provided as feasible to approach the bottom head for inspection purposes.

1.3.20 HEAT EXCHANGERS

S.No.	Type	Project Philosophy
1	Tube Sheet type for floating head and U tube heat exchanger	
1.1		Non-extended for floating head and U tube exchangers. Extended for Stab in bundles only of 'B' type stationary head of U tube exchangers
2	Testing accessories for shell and tube Heat Exchanger	
2.1		Testing rings shall be provided on all floating 'S' & 'T' head type exchangers.
2.2		Dummy shell shall be provided for fixing test ring for exchangers such as kettle type or floating head without shell covers (TEMA 'AHT' or 'AKT') or stab in bundle where shell design pressure is higher than tube side pressure.
2.3		Test flanges shall be provided :-
2.3.1		For exchangers with removable bundle.
2.4		For number of test ring/test flange/ dummy shells Refer Annexure-1 to SMED - Static part(SI.no-1.0) of Design basis.
2.5		For shell side interconnected and stacked exchangers the minimum number of test rings shall be equal to the number of exchangers in one stack.
2.6		For 'U' tube & removable bundle exchanger, number of test flanges shall be equal to number of exchangers in one stack.

S.No.	Type	Project Philosophy
2.7		Tag No. of the exchanger shall be engraved at suitable location on the test rings / test flanges / dummy shells.

1.3.21 AIR COOLERS

S.No.	Type	Project Philosophy
1	Noise level	The noise level shall be limited to 85 dB (A) max. measured at a distance of one meter from the bundle at the header access platform walkways and one meter from the bay limit on motor maintenance platform. The noise level within the air cooler bay shall be 90 dB (A) maximum, at locations defined as per API.
2	Access Platform	Shall be provided wherever possible on all the four sides, (width - 900 mm) with stairs on one side and ladder on other side.
3	Maintenance Platform	Localized steel platform duly inter-connected along full length and width of air coolers for fan/motors etc.
4	Protective Covering (for finned tubes) on bundle top	By heavy-duty wire mesh.
5	Hot dip galvanizing of air cooler structural	Air coolers structural shall be hot dip galvanized for the following:
5.1		Plenum chambers, Bundle Frames
5.2		Motor suspension structure, Fan guards, Gratings for stairs and platforms
5.3		Wire mesh for fin tube protection
6	Final Painting	Final painting of header boxes shall be carried out at vendor's shop.
7	Lifting Arrangement	Lifting Arrangement to be provided for removal of motor and gearbox.

1.3.22 BOUGHT OUT SUPPLIERS

As per approved Project Vendor List.

1.4.0 SPECIFIC DESIGN REQUIREMENTS

1.4.1 LPG STORAGE SPHERES/BULLETS

S.No.	Project Philosophy
1	Selection of material of construction for various LPG Storage applications shall be as per OISD-STD-150.
2	All LPG spheres/Bullets shall be post weld heat treated irrespective of storage application and adopted shell thickness.

1.4.2 TALL COLUMNS

S.No.	Type	Project Philosophy
1	Deflection of Column	Maximum allowable deflection at top of column shall be equal to height of the column divided by 200 up to a maximum of 300 mm.

S.No.	Type	Project Philosophy
2	Skirt Support Base	Base supporting including base plate, anchor chairs, compression ring, foundation bolting etc. shall be designed based on over-turning moment (greater of seismic or wind). A minimum number of 8 foundation bolts shall be provided. Nos. of foundation bolts shall be in multiple of four.
3	Minimum Hydro test Pressure	Minimum Hydro test Pressure shall be equal to 1.3 x design pressure x temperature correction factor, as specified in ASME Code Section VIII Div. I.
4	Analysis of Column/Tower for Wind Induced Vibrations	Analysis of each column shall be carried out for stability under transverse wind induced vibrations as per standard design practice.

1.4.3 STORAGE TANKS

S.No.	Project Philosophy
1	All storage tanks shall be designed as per code considering liquid height up to top curb-angle of shell.
2	Tanks shell thickness calculation shall be carried out by the one (1) - foot method as per API 650 for tank diameters less than and equal to 60m (200 feet).
3	Maximum height of unstiffened shell shall be calculated based on the corroded thicknesses of shell courses. Section modulus of wind girders shall also based on corroded thickness of shell courses.
4	Seismic design as per API 650/API 620 is mandatory for storage tanks.
5	Annular bottom plates shall be provided for all storage tanks 12 meter diameter and above.
6	Anchor bolts shall be provided based on design considering wind/seismic loads, uplift due to internal pressure etc. However, tanks having diameter ≤ 10 meters shall be provided with anchor bolts and shall be spaced at maximum 3M of circumference.
7	Tanks having design temperature more than 93°C shall have thermal isolation barrier (suitable fire bricks) between tank bottom and foundation.
8	Roof slope shall be 1:6 for all cone roof storage tanks of diameter less than 12 M and shall be 1:12 for diameter 12M and above.
9	Double Wall Storage Tank
9.1	The Double Wall Storage Tanks shall be above ground, flat bottom, vertical, full containment double wall cylindrical type in which the inner tank is designed to contain the refrigerated liquid during normal operation and the outer tank is designed to contain/hold the entire refrigerated liquid in the event of the failure of inner tank.
9.2	Double wall storage Tanks Shell shall be designed for Joint Efficiencies of 100 % for all Horizontal & Vertical joints.
9.3	Anchor bolts / anchor straps for inner/ outer tank shall be provided based on design considering wind/seismic loads, uplift due to internal pressure etc.
9.4	Size (Diameter and height) of the double wall storage tank shall be decided based on the Nominal and Stored capacities. All capacity calculation for sizing shall be done on the basis of cold dimensions of tank taking due consideration of the shrinkage during operating conditions.
9.5	The Double Wall Storage Tanks shall be constructed and erected on a raised foundation for natural ventilation.
9.6	No shell course shall have a thickness less than the course above it except the Top shell course of Outer tank.
9.7	Inner & Outer Tank shall be designed for the Design conditions specified on the Process Data sheet & also for Hydro - Pneumatic Test conditions specified.

S.No.	Project Philosophy
9.8	Tanks shall be provided with the appurtenances & accessories listed on Process Data sheets.
9.9	Tanks shall be furnished with minimum one Roof Manhole for access to the Inner Tank.
9.10	The tank (inner and outer) shall be designed for the most critical combination of loadings as specified in the project specification during the operation and testing/applicable code.
9.11	Roof and roof structure design for all applicable loading for e.g. super structure if any coming over roof shall be carried out.

1.4.4 MOUNDED BULLET

S.No.	Type	Project Philosophy
1	Cathodic Protection	Impressed current cathodic protection system shall be designed and installed as per the EIL Specification.
2	External Coating	Applied protection shall be fully tested for absence of holidays using high voltage spark tester.
3	Internal Coating	Bottom 90 Deg. of internal surface of vessel shall be coated with anti-corrosion coating suitable for stored product.
4	Location / Spacing of Vessels	Minimum spacing of vessels and other safety regulation shall be as per OISD - STD- 150.
5	Mound Load	
5.1		Weight of mound shall be calculated for saturated mound and specific gravity of mound shall be taken not less than 2.0 for this purpose. Load of mound on a vessel shall be calculated with arching effect.
5.2		Mound depth above top of the vessel shall be as per OISD-STD-150 and load shall be as per EEMUA-190.

1.4.5 REACTORS

S.No.	Project Philosophy
1	The design shall be done based on Process Licensor's Specifications.
2	Material selection shall strictly be as per Licensor's Specification.
3	Minimum thickness as per Licensor's Specification shall be adhered to.
4	MDR & UDS as per ASME Code shall be obtained by the Fabricator for Reactors designed and stamped as per ASME SEC. VIII Div. II.
5	FEM Analysis shall be done for all Process nozzles, shell to head junction Y shaped skirt, welded/weld overlayed support rings and any other stressed point as defined in Licensor's specification.
6	All internals shall have minimum thickness as given in Process Licensor's Specification and shall be designed for loads defined in Licensor's drawings.
7	Thermal analysis for HOT box shall be conducted.
8	Reactors as well internals shall be fabricated by Process Licensor's approved Vendors.
9	Lifting arrangement shall be as defined by Process Licensor's drawings.
10	Floating type insulation supports shall generally be provided wherever feasible.

1.4.6 SILENCERS/VENT SILENCERS

S.No.	Project Philosophy
1	The design shall be such as to limit the noise level to 85 dBA at 1-meter (perpendicular) distance from silencer discharge.
2	Mineral wool or glass fibre of suitable density shall be used for acoustic insulation.
3	Silencer shall be located outside the building, unless specified otherwise.
4	Silencers venting to atmosphere shall be provided with detachable rain hood and bird screen.
5	ASME Sec. VIII Div.1 shall be governing code for mechanical design of silencers.

1.5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

S.No.	Description	Selected Option	Remarks
1	Storage Tanks		
1.1	Type of External Floating Roof/ Internal Floating Roof	Pontoon Type Single Deck(without buoy) for dia. > 12 m & <= 60m Or Double Deck for sizes <=12 m dia.& > 60 m dia Or Any Other(Specify)	Final selected option. Pontoon Type Single Deck(without buoy) for dia. > 12 m & <= 60m
1.2	Primary Drain	Flexible Drain Pipe System (Stainless steel armored clad flexible hose or the flexible hose with stainless steel carcass). Or Articulated Steel Pipe with Flexible Joint (Swivel type joint is not acceptable) Or Any other (Please Specify)	Final selected option : Articulated steel pipe with Pivot joints(Refer BPCL applicable Specification)
1.3	Primary Seal	Foam Seal (PU coated - (liquid mounted for external floating roof & vapour mounted for internal floating roof)) Or Liquid Filled Endless Seal Or Mechanical Seal	Final Selected option: Foam Seal (PU coated - (liquid mounted for external floating roof & vapour mounted for internal floating roof))
1.4	Type of Floating Roof (for conversion of existing cone roof to covered floating roof)	Aluminium Or SS Or CS	Final Selected option : Aluminium
1.5	Requirement of primary drain for internal floating roof tanks	Yes / No	Final Selected option : Yes
1.6	Steps/Platforms	Painted Or Hot dip Galvanized,Bolting to be electrogalvanised	Final Selected option : Hot dip Galvanized,Bolting to be electrogalvanised

S.No.	Description	Selected Option	Remarks
1.7	Hand Railing on Tanks	GI pipe bolted to stairway, Bolting to be electrogalvanised Or CS with Painting	Final Selected option : GI pipe bolted to stairway, Bolting to be electrogalvanised
1.8	Clean out Doors for tanks	For all tanks Or For tanks as per process data sheet	Final Selected option : For tanks as per process data sheet
1.9	Minimum size of Shell manholes	20" NB / 24" NB / 30" NB	Final Selected option : 24" NB
1.10	Minimum size of Roof manholes	20" NB / 24" NB / 30" NB	Final Selected option : 24" NB
1.11	Camouflage painting requirement meeting Defence/Strategic Location	Required / Not Required	Final Selected option : Not Required
1.12	Under tank leak detection and subgrade protection for caustic & alkaline tanks	Required / Not Required	Final Selected option : Required
1.13	Emergency overflow slots for internal floating roof tanks (non-pressure type)	Required (Owner to specify) / Not Required	Final Selected option : Detail engineering contractor to decide.
1.14	Emergency drain for single deck External Floating Roof tanks	Required / Not Required	Final Selected option : Not Required
1.15	Pipe davit	Required / Not Required	Final Selected option : Required
2	Air Cooler		
2.1	Roof on air cooler tube bundle	Required / Not Required	Final Selected option : Not Required
3	Heat Exchangers		
3.1	Tube bundle extractor	Required (If required, Please specify quantity and specify whether it shall be procured by Owner or EIL) / Not Required	Final Selected option : Required and Number to be finalised during detail engineering.

For specific requirements of Owner, refer Annexure-1 to SMED - Static part(Sl.no-1.0) of Design basis.

1.6.0 MATERIAL HANDLING FACILITIES FOR NORMAL MAINTENANCE OF EQUIPMENT

1.6.1 TUBE BUNDLE EXTRACTOR

S.No.	Project Philosophy
1	For safe and quick removal of tube bundle of exchangers installed at various elevation and location in Refinery, Mechanised Tube Bundle Extractor units to pull out the tube bundles from exchangers horizontally for cleaning and maintenance safely shall be provided.
2	The unit shall be operable hydraulically or pneumatically to perform the required function. Ordinarily available plant air of Refinery shall be available for the Tube Bundle Extracted, for extraction or insertion of tube bundles into the exchanger
3	The unit should have the capability of pulling out the most obstinate tube bundle from the exchanger or fixing / inserting it again after cleaning repair etc. into the exchanger, balancing it after the bundle has been pulled out of the exchanger and bringing it to the grade, safely from any elevation.
4	The unit should be designed such that the tube bundle can be extracted or inserted into the exchanger shell, with minimum of hydraulic or pneumatic power.
5	Unit shall have built-in safety features to prevent the bundle from rolling off the extractor, should the frame go down by any reason. The unit shall have the capability to balance itself against any external load acting simultaneously, once the tube bundle has been removed from the shell.
6	The unit should be simple, self contained device, operable with minimum skill, without any hazardous exposure to the operator and the maintenance personnel.
7	Unit should be such that the levelling fixing, and clamping of Extractor with the exchanger flange is achievable with an ordinarily skill of the operator, minimum of time and ease. Coupling for supply of air, to air motor(s), shall be quick connect / disconnect type.
8	The unit shall have self contained hydraulic fluid reservoir of suitable capacity and necessary appurtenances for the operation of the Extractor. Hydraulic fluid used should be suitable for the site conditions in which it is going to function.
9	Contractor shall provide mobile plant air supply unit or necessary plant air supply points on supply headers, fixed near to all exchanger, in Refinery, for operation of Tube Bundle Extraction Unit.
10	The control of the Tube Bundle Extractor unit shall be fail safe.
11	The unit is crane lifted into position, for removal or insertion of tube bundle, by any of the normal duty crane available in the Refinery for the purpose of regular material handling. No additional working platform, aids are necessary to perform the required function.

1.7.0 SPARE PARTS

1.7.1 MANDATORY SPARES

S.No.	Equipment Type	Project Philosophy
1	Reactor, Columns, Vessels, Tanks, Bullets, Silencer.	Gaskets : Two sets for each installed gasket. Fasteners : 10% (Min. 2 in each size) of installed fasteners Sight/Light Glass : 4 sets for each installed glass.
2	Shell & Tube Exchangers, Spiral, Plate Type Heat exchangers(PHE)	400% Gaskets (incase of PHE, gaskets referred are only Nozzle gaskets) 20% Bolting (Min. 4 studs & 8 nuts per joint)

S.No.	Equipment Type	Project Philosophy
3	Air Coolers	400% gasket for header cover & nozzles with blind flange 200% gaskets for plugs 20% plugs 100% belts 20% Bolts & Nuts for all nozzle with BF & Cover plate One set of Diaphragm Actuator with positioner for each type of auto variable pitch fan, in case Diaphragm actuator with positioned type of control is used. In case of any other type of control system, vendor recommended spares for their selected type of auto variable pitch fan shall be provided.
4	Agitators/Mixers	Gasket for Agitator Mounting nozzle -400 % for each flanged / bolted connections for Agitator/ motor assembly. Bolting for Agitator Mounting nozzle - 10 % (minimum 2 sets) for each flanged / bolted connections for Agitator/ motor assembly. Agitator- Oil Seal for Gear Box - 2 Set. Wear parts for mechanical seal -One set for each Tag No. Mechanical seal -100% of installed quantity. Bearing for Gear reducer - One set for each Tag No. Agitator Bearing - 100% of installed quantity. Internal Bolting for Agitator - 10 %(minimum 2 nos.) for each installed fasteners. Filter for Oil Lubrication System - 25% (Min. 1 no.) for each installed filter for Oil Lubrication system.

1.7.2 COMMISSIONING SPARES

One set of gasket for each installed gasket and 10% (min. 4 sets) of stud with 2-nuts for each installed gasketed joints as a minimum for columns, vessels, exchangers and air coolers.

For Screw Plug / Breech lock heat exchanger, One diaphragm/ Gasket retainer, 200 % gaskets, 20% of push bolts and other fasteners shall be considered as a minimum.

For other Equipment/Unengineered Equipment:

Commissioning Spare Parts shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended spares shall be obtained along with the offer. Any commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor. Any leftover (unused) spares after commissioning, out of those included by vendor in his offer, shall be handed over to the owner.

1.7.3 RECOMMENDED SPARES FOR NORMAL OPERATION & MAINTENANCE

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

1.7.4 SPECIAL TOOLS AND TACKLES

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

Special tool required for removal of Thread lock ring and trolley (in case of shell removable type only) Breech Lock / Screw Plug heat exchanger shall be supplied by equipment fabricator.

2.0 PACKAGE EQUIPMENT

2.1.0 SCOPE

This Design basis defines the minimum criteria to be followed for the design of various mechanical equipment/systems/packages covered under this part of design basis.

2.2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

2.2.1 ABBREVIATIONS

Code	Description
AC	Air Conditioning
AHU	Air Handling Unit
CCOE	Chief Controller Of Explosives
CFC	Chlorofluorocarbon
CFM	Cubic Feet Per Minute
DBT	Dry Bulb Temperature
ERW	Electric Resistance welding
GIS	Gas-Insulated Substation
HC	Hydrocarbon
HOC	Heat of Compression
HOT	Hand Operated Travelling
IBR	Indian Boiler Regulations
ODP	Ozone Depletion Potential
PCW	Pellet Cooling Water
PESO	Petroleum and Explosives Safety Organisation
PSA	Pressure Swing Adsorption
QOC	Quick Opening Closure
RH	Relative Humidity
SRR	Satellite Rack Room
TSS	Tertiary Separator System
UPS	Uninterrupted Power Supply
VAM	Vapour Absorption Machine
VAR	Vapour Absorption Refrigeration
VCR	Vapour Compression Refrigeration
VFD	Variable Frequency Drive
VVVF	Variable Voltage Variable Frequency
WBT	Wet Bulb Temperature
WG	Water Gauge

2.2.2 CODES & STANDARDS / PUBLICATIONS

In general, Codes & Standards published by the following bodies, including their latest addenda as on bid due date shall be followed, unless specified otherwise:

S.No.	Description	Standards / Codes	Edition
1	Material: American National Standards Institute	ANSI	Latest
2	American Petroleum Institute	API	Latest
3	Air-conditioning, Heating & Refrigeration Institute	AHRI	Latest

S.No.	Description	Standards / Codes	Edition
4	American Society of Heating, Refrigerating and Air Conditioning Engineers	ASHRAE	Latest
5	American Society of Mechanical Engineers	ASME	Latest
6	American Society for Testing and Materials	ASTM	Latest
7	American Welding Society	AWS	Latest
8	British Standards	BS	Latest
9	Indian Standards	IS	Latest
10	International Organisation for Standardisation	ISO	Latest
11	National Fire Protection Association	NFPA	Latest
12	Occupational Safety and Health Act	OSHA	Latest
13	Tubular Exchanger Manufacturer's Association	TEMA	Latest
14	Heat Exchangers Institute	HEI	Latest
15	Process Control Room Safety	OISD-STD-163	Latest

STATUTORY PROVISIONS

National laws, regulations and statutory provisions, such as PESO (formerly Department of Explosives, Nagpur, India), PNGRB Regulations together with any local by-laws for the State shall also be complied with.

2.3.0 GENERAL / DESIGN CONSIDERATIONS

While specific guidelines pertaining to individual equipment/system/package are listed in subsequent sections, the following shall be considered for all items while formulating their specifications and also in their procurement engineering activities:

S.No.	Project Philosophy
1	Reliability in service (assessed from vendor's proven track record and ensured by incorporating certain minimum design features or requirements in the specifications).
2	Compliance with applicable national or international codes and standards as well as applicable statutory regulations in existence for a specific item.
3	Ease of operation and maintenance including any necessary measures for ensuring safety of personnel and equipment.
4	Standardization of components, wherever feasible.
5	Adherence to any limitation of available space for the equipment and for its operation/maintenance.
6	Provision for any known future expansion of plant capacity with a minimum modifications or shutdown.
7	Corrosion allowance for carbon steel vessels shall be minimum 3mm, unless otherwise specified.
8	All components/equipment shall meet the requirements of respective hazardous area classification.
9	Noise level of the running equipment shall not exceed 85dBA at 1m distance from source, if not specified otherwise in this document.
10	All couplings, gears, and exposed rotating parts shall be provided with adequate protection guards.

S.No.	Project Philosophy
11	Minimum headroom clearance of 2.2 m for entry purpose in multi-tier package equipment shall be considered.
12	Heat exchanger inside the Packages like Air-conditioning system, Compressed air and Nitrogen Plant, Instrument air dryer package, Extruder and Pelletiser Package, Pneumatic Conveying Package and other utility packages not handling hydrocarbons shall be as per TEMA C unless otherwise specified in Licensor specification/Process datasheet.
13	Package item shall be skid mounted as far as possible.

2.4.0 SPECIFIC DESIGN REQUIREMENTS

2.4.1 AIR CONDITIONING SYSTEM

2.4.1.1 GENERAL

S.No.	Project Philosophy
1	All the areas as defined in Architectural drawings or as defined in Process specification are to be air conditioned.
2	Air-conditioning system shall be selected based on following guidelines:
2.1	In general, Package units may be provided for smaller capacity requirements upto 45 TR. For requirements upto 3 units (working), one standby unit shall be provided and above 3 units (working), 2 standby units shall be provided.
2.2	Air-conditioning requirement more than 45 TR, shall comprise either of the following: a) Centralized AC system with Air/water cooled condensing units and DX coil AHUs. b) Centralized AC system with Air/water cooled chillers with chilled water coil AHUs and chilled water re-circulating pumps. The chiller shall be a skid mounted assembly of Air/water cooled condenser, reciprocating/scroll/screw/centrifugal compressor, DX/flooded evaporator. c) Vapour Absorption Refrigeration (VAR) system for 70 TR and above shall be considered, in case steam is available. Option b) shall be envisaged for higher air-conditioning requirements for which Option a) is not available.
2.3	Reciprocating/scroll compressor shall be used up to 80 TR and screw compressor for 81-160 TR. Centrifugal Compressor (oil free) shall be used for 161 TR and above.
2.4	For option a) and b) in S.No 2.2 above, air conditioning system shall have one unit of identical capacity as standby for condensing units/ chiller package and Chilled water pumps, as applicable. If reciprocating compressors are provided, not more than 3 working compressors shall be provided for a system. For option c) in S.No 2.2 above, i) Two(2) nos. VAM machines (both working), each VAM machine with 65% capacity of the design capacity. ii) Pressure reducing & de-superheating station (PRDS) shall be common for both VAM units. iii) Condensate pumps, Dosing pumps and Chilled water pumps shall be one(1) working and One(1) standby.

S.No.	Project Philosophy
2.5	Air-conditioning requirements for Individual area/room up to 5 TR and where no specific RH requirement is envisaged, may be provided with single/multiple window (with 5-star rating) or split air-conditioners (inverter controlled). One unit shall be provided as a standby in all applications where round the clock air conditioning is required. Air-conditioning requirement of the areas where there is variation in load (viz. office area) and no specific RH control is envisaged, shall be catered by Variable Refrigerant Flow (VRF)/ Variable Refrigerant Volume (VRV) type HVAC System with air cooled Outdoor Units. No standby shall be considered in this case.
3	Combined Fire & Smoke Dampers shall be pneumatically operated for Control Room and Satellite rack room building. For other buildings, Combined Fire & Smoke Dampers shall be electrically operated motorized spring return type. All combined fire & smoke dampers shall be fail safe type (Closed position under power failure) and shall be UL-555 and UL-555S certified. Blast damper in fresh air intake shall be provided for blast proof buildings.
4	Air Conditioning equipment shall be interlocked with gas/smoke detection and fire fighting systems. For Control room and Satellite rack room, required hydrocarbon and toxic gas detection system shall be provided in the fresh air duct as per OISD Standard.
5	Minimum one (1) air change / hr or 17 CFM per person whichever is higher shall be considered for calculating fresh air quantity for all air-conditioned buildings except Switchgear hall of Substation. For Switch gear hall of Substation, minimum Two(2) air changes/hr or 17 CFM per person, whichever is higher shall be considered. Licensor's specification shall also be followed for calculating fresh air/ventilation requirement, wherever applicable.
6	Refrigerant for vapour compression system shall be R-134A/R-407A/R-407C/R-410A for central and package AC. Refrigerant for Windows/Split AC shall be non-CFC and non-ODP environmental friendly as per manufacturer's standard.
7	Chemical laboratory Air Conditioning shall be once through system (i.e. no return air duct). Common header for compatible fumes can be provided with common fans (1 working + 1 standby). Chemical storage room/warehouse air conditioning and ventilation shall be as per Licensor's requirement.
8	Chemical filter unit shall be provided to achieve G1 environment inside the air conditioned space from outside GX environment as per ISA-71.04 (Latest edition). Chemical filters shall be selected to capture Group-A gases as per ISA-71 - 04 standard as specified in S. No.2.4.1.5 given below. Chemical filter shall be provided for all air conditioned area except admin building, chemical warehouse building and operational staff rooms.
9	For Control Rooms & Satellite Rack Room (SRR), OISD-STD-163 shall be followed.
10	PLC/ Microprocessor based control system shall be provided for central HVAC.

2.4.1.2 INDOOR DESIGN CONDITIONS

S.No.	Area	DBT, DEG C	% RH
1	Control Room Building with all associated rooms including UPS and Battery Charger Room	23 ± 1 (For Cooling)/ 19 ± 1 (For Heating)	50 ± 5
2	Laboratory Room	23 ± 1 (For Cooling)/ 19 ± 1 (For Heating)	50 ± 5
3	Switchgear hall	26 ± 1 (For Cooling)/ 19 ± 1 (For Heating)	50 ± 5

S.No.	Area	DBT, DEG C	% RH
4	VFD Panel Room	26 ± 1 (For Cooling)/ 19 ± 1 (For Heating)	50 ± 5
5	Data Concentrator /MMI Room of Substation Building	26 ± 1 (For Cooling)/ 19 ± 1 (For Heating)	50 ± 5
6	Administrative Building	24 ± 1(For Cooling)/ 20 ± 1 (For Heating)	30 to 70
7	Operational Staff Room	24 ± 1 (For Cooling)/ 20 ± 1 (For Heating)	30 to 70

2.4.1.3 OUTDOOR DESIGN CONDITIONS

S.No.	SEASON	DBT (DEG C)	WBT (DEG C)
1	Summer	42	23.7
2	Monsoon	33.3	28.3
3	Winter	7.2	3.3

Notes:

- 1) Outdoor design conditions specified shall be followed for Air conditioning system heat load calculation.
- 2) Design temperature for sizing of air cooled heat exchanger/condenser shall be 42 deg C (Peak ambient temperature)

2.4.1.4 OUTDOOR AIR QUALITY

S.No.	Air Quality (As per Class GX(severe) of doc.ISA-S71.04)
1	H2S <= 50 ppb
2	SO2/SO3 <= 300 ppb
3	Cl2 <= 10 ppb
4	NOX <= 1250 ppb

2.4.1.5 ADDITIONAL DESIGN REQUIREMENT

S.No.	Project Philosophy
1	For all building specified under Clause No 2.4.1.2 shall have an indoor air quality as per Class G1 of ISA Standard 71.04. H2S < 3ppb SO2/SO3<10ppb Cl2<1ppb NOx<50ppb
2	Outdoor units of Air conditioning system shall be mounted such that its drain is connected to nearest drain system. Service water line of 1 or 2 inches shall be provided near the outdoor units for washing/cleaning of the outdoor units in weekly preventive maintenance.
3	Tapping shall be provided on the Inlet and Outlet lines of the Condenser which will be required for the descaling of the condenser.
4	Chemical filter health will be checked by measuring the air quality of filtered air using a Portable Environmental control monitors (ECM). Two (1 working + 1 spare) ECM's shall be provided for the entire HVAC system of the project.

2.4.2 BASKET FILTER

S.No.	Project Philosophy
1	Basket filters shall be used when particles of 150 microns or larger size are to be filtered from a fluid stream, unless otherwise specified in Process Data Sheet.
2	In order to avoid the possibility of frequent basket cleaning, the gross basket area shall be at least 20 times of the filter inlet nozzle area and the free basket area shall be at least 8 times the filter inlet nozzle area.
3	Unless otherwise specified, filter shall be vertical type with facility for removal of the basket from the top after opening the top housing cover.
4	Filter housing design shall be as per ASME Section VIII, Division 1. For steam jacketed housings, applicable IBR requirements shall also be complied with.
5	For filter top cover, lifting/handling davit shall be provided irrespective of weight of top cover. For other blind flanges weighing more than 15 kg, lifting/handling davit shall be provided. Wherever davit arm cannot be provided due to size or weight constraint, suitable handling arrangement (i.e. lifting eye and monorail) shall be considered.
6	Filter top cover shall be of Weld neck blind flange type.
7	Filter basket shall be of straight cylindrical shape. Neither concentric nor pleated type basket are acceptable.
8	Unless otherwise specified, fluid flow direction shall be from inside to outside of the filter element.
9	For Filter with nozzle size higher than 16", multiple baskets may be provided considering the difficulty in strengthening and maintenance.

2.4.3 BELT CONVEYORS (CONVENTIONAL TYPE)

NOT APPLICABLE

2.4.4 BELT FEEDER

NOT APPLICABLE

2.4.5 CARTRIDGE FILTER

S.No.	Project Philosophy
1	Cartridge Filter shall normally be used when particles of less than 150 microns size are to be filtered from a fluid stream, unless otherwise specified in Process Data Sheet.
2	Cartridge selection such as material and type shall be consistent with the service conditions.
3	Unless otherwise specified, filter shall be vertical type with facility for removal of the cartridge element from the top after opening the top housing cover.
4	Number of Cartridge elements shall be selected based on manufacturer's recommendations.
5	Filter housing design shall be as per ASME Section VIII, Div.1. For steam jacketed housings, applicable IBR requirements shall be complied with.
6	For filter top cover, lifting/handling davit shall be provided irrespective of weight of top cover. For other blind flanges weighing more than 15 kg, lifting/handling davit shall be provided. Wherever davit arm cannot be provided due to size or weight constraint, suitable handling arrangement (i.e. lifting eye and monorail) shall be considered.
7	Filter top cover shall be of Weld neck blind flange type.

2.4.6 CHAIN PULLEY BLOCK

S.No.	Project Philosophy
1	All Chain Pulley Blocks shall be spark resistant construction irrespective of hazardous area classifications.
2	Chain Pulley Block with geared trolley or hook mounted, depending on service requirement, shall be generally provided for areas with equipment / component to be lifted weighing 0.5 MT to 10 MT and lift is less than 10 m or where frequency of maintenance/operation is very less. However in cases with lifting weighing is more than 10 MT and/or lift is more than 10 m but frequency of operation is very less Chain Pulley Blocks may also be considered.
3	The minimum capacity of chain pulley blocks with monorail shall be weight of the largest components to be handled plus design margin of ten percent (10%) as a minimum, rounded off to nearest standard capacity. Wherever two chain pulley blocks are required, each of 75% capacity of the total weight shall be provided.
4	Chain pulley block of standard capacity shall be provided. CP Block shall be of detachable type suitable for mounting on trolleys of same rating/capacities.
5	The duty class of Chain pulley block shall be minimum M2 class as per IS 3832.

2.4.7 COKE DRUM UNHEADING SYSTEMS

NOT APPLICABLE

2.4.8 CRYOGENIC AIR SEPARATION PLANT

S.No.	Project Philosophy
1	The plant shall be designed on the basis of distillation of liquid air in a single column for only nitrogen production or in double column for both nitrogen and oxygen production.
2	The plant shall be capable of fully automatic operation once started. The control and monitoring of the plant shall be from the control room.
3	Ambient air quality shall be as per BEDB Part B. If ambient air quality is not available in BEDB Part-B, the plant shall be designed taking into consideration ambient air quality prevalent at site.
4	CO2 level shall be considered as 400 ppmv in design unless otherwise specified in the Process specifications.
5	Plant shall be designed for a 50% turndown operation without venting of air or product into atmosphere.
6	The main air compressor of the air separation plant shall be integrally geared centrifugal type.
7	Refrigeration unit shall be R-134A/R-407A/R-407C/R-410A based Vapour Compression type, with one working and one standby compressor. However vendor's standard proven design with direct/evaporative type cooling is also acceptable.
8	The Air Purification Unit shall have twin tower and dual bed desiccant system of heat reactivated type. The desiccant shall be activated alumina for moisture removal and Molecular Sieve for CO2 and HC removal. The reactivation heater shall be electrical type with thyristorised control panel. Purification cycle time shall be four hours.
9	No standby turbo expander along with its gearbox shall be provided. However, a spare rotor assembly shall be provided for each turbo expander.
10	The material for vessels & piping inside the cold box shall be austenitic Stainless Steel. For trays and plate fin exchangers, aluminium alloy material shall be used.
11	Compressors and refrigeration unit shall be housed in a building with roof and side sheeting.

S.No.	Project Philosophy
12	Vertical liquid nitrogen storage tanks/cold convertors with stainless steel inner shell contained within a carbon steel outer shell shall be designed as per ASME Sec.VIII Div. I and shall also meet CCOE/PESO/ Static and Mobile Pressure Vessels (SMPV), Govt. of India regulations. The space between the shells shall be filled with perlite insulation and vacuum sealed.
13	Liquid nitrogen vaporizers shall be of either atmospheric type, rated for a continuous duty of 8 hours without any requirement of defrosting or steam bath type for the specified flow requirement. Steam bath vaporizer shall be Package skid mounted type.
14	Electrical type Deriming Heater, shall be provided.
15	The layout of the nitrogen storage system shall be in accordance with statutory regulations and approved by CCOE/PESO/ Static and Mobile Pressure Vessels (SMPV), Govt. of India.
16	On line dew point analyzer, Oxygen and CO2 analyzers shall be provided for measuring the quality of N2. Analyzers shall be housed in an air-conditioned analyzer room.
17	Silencers shall be provided wherever air or gas venting is involved to minimize noise level.
18	The various liquid drains from the cold box shall be connected to a stack where the liquids are vaporized by means of dry air. Stack shall be of stainless steel material.
19	The cold box shall be perlite insulated and maintained under positive pressure with dry nitrogen.

2.4.9 DUST COLLECTION SYSTEM: BAG FILTER TYPE

S.No.	Project Philosophy
1	Dust collection system shall be designed for maximum inlet dust loading, dust characteristics and to meet the permissible dust emission level at stack outlet.
2	Dust filter shall be reverse pulse jet type bag filter controlled by Electronic Timer and/or Pressure Differential Transmitter.
3	Pressure drop across the bag filter shall not exceed 150 mm WG, unless otherwise specified in the Process Data Sheet.
4	For bag filter system, air to cloth ratio shall be decided based on the application but shall not exceed $1.2 \text{ m}^3/\text{min}/\text{m}^2$, unless otherwise specified. The sizing of the duct shall be generally based on 20-25 m/s conveying velocity.
5	Large bag filters shall be of modular construction and it shall be possible to isolate any module for maintenance, while other modules are operational.
6	Operating temperature of bag filter shall be maintained so as to avoid condensation of any gas or vapour, and if required the bag filter casing shall be insulated.
7	For explosive dust, bag filter shall be suitably designed and provided with explosion vent.
8	The exhaust duct/piping shall be routed to a safe location and shall conform to local statutory requirements.
9	If discharging to atmosphere, filters shall be designed for an outlet dust emission of maximum 5 mg/Nm ³ or process data sheet or as required by pollution control board requirement, whichever is stringent
10	Isolation valves shall be provided upstream and downstream of each solenoid valve in the blowback line.

2.4.10 ELECTRIC TRACTION LIFT

S.No.	Project Philosophy

S.No.	Project Philosophy
1	Capacity of goods lift shall be at least weight of the largest component to be handled with a design margin of minimum 20% subject to min. 1000kg.
2	The capacity of passenger Lift in the building shall be as per the peak traffic requirements or as decided by Client.
3	Doors shall be Automatic power operated central opening (single or multiple panels) sliding type (either central opening or side opening) for both passenger and goods lift. However for goods lift, manual override push button to be provided inside the car, to bypass the door closing interlock and keep the door in open position while on a landing level.
4	For lift having both side doors, doors shall be interlocked so as to open only one door at a time based on requirement.
5	Travel Speed of Lift and Recommended Speed shall be as below:
5.1	Passenger Lift: Up to 5 floors- 1.0 m/s From 6 to 12 floors-2.0 m/s More than 12 floors-2.5 m/s
5.2	Goods Lift: For Travel length ≤ 30 m - 0.5 m/s $30 \text{ m} < \text{Travel Length} < 40$ m - 0.75 m/s Travel Length ≥ 40 m - 1.0 m/s
6	Infrared full curtain electronic door detection system shall be provided. Other type of door detection such as photocell type is also acceptable based on the Vendor's proven track record. However, for hazardous area, photocell based sensor are not to be considered.
7	The design, installation and testing of Lift shall comply with local laws and regulations, as per IS: 14665: Part 1& 2 or other International standards subject to prior approval of Owner/EIL.
8	No. of starts/stops per hour for motor shall be selected based on peak traffic requirement, lift speed and length of travel and no. of landings. However, in no case number of starts/stop per hour shall be less than 120.
9	Controllers shall be micro processor based VVVF drive type.
10	Machine room shall be located above the highest landing level and shall be non-pressurized.

2.4.11 ELECTRIC WIRE ROPE HOIST

S.No.	Project Philosophy
1	Electrically operated Hoist with trolley will be generally provided for handling equipment / component weighing 10 MT or above and / or lift more than 10m or where frequency of maintenance/operation is relatively high. However, in cases where lifting weight is less than 10 MT and/ or lift is less than 10 m but frequency of operation is high or required for continuous operation, Electric Hoist may also be considered
2	The capacity of the Electric Hoist shall be decided based on heaviest equipment to be handled during maintenance with 10% margin.
3	Up to 16 MT capacity Electric Wire Rope Hoist shall be as per IS 3938. For capacity above 16 MT, Electric hoist shall be manufacturer's standard based on satisfactory Proven Track Record.
4	Class designation for Electric hoist intended for maintenance shall be considered as 2 as per IS 3938. Class designation of electric hoist for process and continuous operation shall be considered as 4 as per IS 3938.

S.No.	Project Philosophy
5	For electric hoists which are to operate in areas classified as hazardous, besides ensuring that all electrical components are certified for use in the specified hazardous areas, materials of construction for rubbing, non-lubricated metallic parts shall be in such a way that the possibility of sparking during operation is eliminated. This is done by having one part in every such pair made from a suitable non-ferrous material such as HTB/ Aluminium bronze.

2.4.12 EOT & HOT CRANE

2.4.12.1 GENERAL

S.No.	Project Philosophy
1	These cranes are normally installed in process and utility buildings for the primary purpose of handling equipment and components for maintenance or replacement. Other applications involving use of cranes during plant operation may also exist.
2	Hand Operated Travelling (HOT) cranes shall be used when the loads to be handled are within 10 MT and span not exceeding 10 m, the lift requirement is moderate, and frequent or fast crane operation is not foreseen. Electrically Operated Travelling (EOT) cranes are used where the requirements are more demanding.
3	The bridge structure of Overhead Travelling Cranes shall be made from box (double web) type, plate type, or fabricated from rolled sections. The structure can be single girder or double girder type. The use of single girder bridge is limited to lifting capacities up to 5 MT and span lengths up to 10 m. In case either of these values is exceeded, the double girder bridge shall be used.
4	For cranes which are to operate in areas classified as hazardous, besides ensuring that all electrical components are certified for use in the specified hazardous areas, materials of construction for rubbing, non-lubricated metallic parts shall be in such a way that the possibility of sparking during operation is eliminated. This is done by having one part in every such pair made from a suitable non-ferrous material such as HTB/ Aluminium bronze.
5	Minimum capacity of the crane shall be maximum weight of the equipment to be lifted plus 10% margin.
6	Cranes shall be designed for minimum head room above the highest hook position and for closest approach of the hooks to each end stop.

2.4.12.2 EOT CRANES

S.No.	Project Philosophy
1	Unless otherwise stated, the following hoisting and travel speeds with corresponding acceleration shall be used:- *Hoisting Speed: 2.0 m/min * Hoisting Acceleration: 7 cm/s² *Cross travel Speed: 7.0 m/min *Cross travel Acceleration: 7 cm/s² *Long travel Speed: 10.0/15.0 m/min (for bay length ≤ 100 m) *Long travel Acceleration: 8 cm/s² (for bay length ≤ 100 m) *Long travel Speed: 15.0 m/min (for bay length > 100 m) *Long travel Acceleration: 8 cm/s² (for bay length > 100 m) #Higher operating speeds may be considered for higher lifts and longer bay lengths. Lower operating speed may be considered based on operation requirements.

S.No.	Project Philosophy
2	Suitable inching (creep) speed mechanisms shall be provided for main hook and auxiliary hook (if applicable) to facilitate accurate spotting of the load. Creep speed for main hoist and Auxiliary hoist shall be 10% of the main hoisting speed and Auxiliary speed respectively.
3	EOT Crane shall be normally operated by remote control panel suitable for applicable electrical area classification. Minimum 3 numbers of radio remote control (1 operating + 2 spares) shall be provided for each crane. In such cases, pendant type control is not required.
4	EOT Crane shall be designed for duty class of M-5 as per IS: 3177 & IS: 807 unless otherwise specified.
5	DC electromagnetic or Electro hydraulic thruster brake shall be used for the hoisting motion. Electro hydraulic thruster-operated brakes shall be used for the cross and long travel motions.
6	Auxiliary hoist shall be provided in case of cranes having capacity 15 MT and above. Capacity of Auxiliary hook shall be 20% of the main hook capacity, unless otherwise specified.
7	Full length maintenance walkways shall be provided on both sides along the long travel.
8	EOT Crane shall be provided with annunciator to provide audio/visual alarm/warning at the time of starting of longitudinal and transverse movement of the crane.
9	One connecting walk way shall also be provided at least on one gable end.

2.4.12.3 HOT CRANES

S.No.	Project Philosophy
1	HOT Cranes shall be designed for minimum head-room above the highest hook position and for closest approach of the hooks to each end stop.

2.4.13 FEED FILTER

S.No.	Project Philosophy
1	Feed filter shall meet the specified flux rate as per Data sheet.
2	One bank shall be kept for maintenance in addition to bank under back wash while selecting the flux rate, unless otherwise specified in Licensor specification/Process Data sheet.
3	Backwash quantity shall be minimum and shall not exceed the figure indicated in Licensor specification/Process Data sheet.
4	Filter element shall be of wedge wire type, unless otherwise specified in Licensor specification/Process Data sheet.

2.4.14 FILTER SEPERATOR/COALESCER

S.No.	Project Philosophy
1	Material and type of coalescing/separating elements shall be consistent with the service conditions as specified in data sheets. Coalescer pack/element supplier's recommendations shall be followed for meeting the performance requirements.
2	Type of Coalescer packs/elements shall be as per Process Data Sheet. Coalescing element shall be designed and fitted in such a way that it can be removed for maintenance and refixed.
3	Coalescer vessel shall be designed, as per ASME Section VIII, Div.1. For steam jacketed housings, applicable IBR requirements shall be complied with.
4	All Filter Separator/ Coalescer shall be provided with Weld neck blind flange type cover.

S.No.	Project Philosophy
5	For any blind flange, weighing more than 15 kg, lifting/handling davit shall be provided.

2.4.15 FLARE STACK COMPONENTS

S.No.	Project Philosophy
1	The flare stack components shall include the flare tip with pilot burners, gas seal, flame front generator, and related hardware.
2	Noise level at design flare load and at maximum smokeless load shall not exceed 90 dBA at the base, unless otherwise specified in the Process data sheet.
3	Ignition of pilot burners shall be through Flame front Generator, unless otherwise specified in the Process data sheet.
4	Location of flame front generator panel shall be such that the pilot flame is visible from it.
5	The flame front generator panel shall be gas-electric automatic type suitable for outdoor location. Suitable weather hood shall be provided. The flame front generator shall be suitable for manual ignition also.
6	Molecular/ Gas seal shall be provided to ensure safe flare operation by preventing ingress of air into the stack. Unless otherwise specified in Process Data Sheet, flare tip upto and including 900mm dia shall have tip integral with gas seal/ velocity seal and flare tip more than 900mm dia. shall have Molecular Seal/ diffusion seal/ density seal fitted upstream of the tip. The seal shall be designed to minimise purge gas requirement.
7	The tip shall be designed to ensure smokeless combustion rate as specified in the Process Data Sheet, with the aid of a smoke suppression medium such as steam. Where such a medium is not available, the tip shall be inherently designed to flare with minimum smoke generation.
8	Tip shall be provided with windshield for prevention of flame lift-off.
9	Continuous pilot burners with flame sensors (thermocouples) shall be provided. Pilot burners shall be low gas consumption (low energy) type.
10	Material of Construction (MOC) of flare tip and seal shall be as per Process Data Sheet.
11	Suitable provision of retractable davit for trouble free tip replacement shall be provided. A ground winch (electric type) with wire rope shall be used for replacement of the tip.

2.4.16 HYDRAULIC DECOKING SYSTEM

NOT APPLICABLE

2.4.17 INSTRUMENT AIR DRYER

S.No.	Project Philosophy
1	The air dryer used shall be one of the following types: - -Heatless purge type (PSA type) -Split flow no purge loss type -Split flow no purge loss type with Heat of compression (HOC) provision.
2	The desiccant shall be activated alumina or molecular sieve depending on the application.
3	For the purpose of desiccant quantity calculation, dynamic adsorption capacity shall be considered as 7.5% (max.) for heat regenerated type air dryer and 0.2% (max.) for heatless type Air dryer.

S.No.	Project Philosophy
4	Adsorber vessels, heater vessels, and other pressure vessels shall designed as per ASME Section VIII, Division-1. Adsober vessel for heatless type dryers shall be designed for cyclic loading as per ASME Sec. VIII Div. 2
5	The dryer shall normally be designed for outdoor location, unless otherwise specified.
6	The dryer shall normally be pre- assembled and skid mounted. Higher capacity units may, however, be fabricated as suitable subsystems for assembly at site.
7	The dryer shall be designed based on the following:
7.1	Over design on heater rating and condenser surface area - 20%
7.2	Changeover valve - Non-lubricated Control valve system (either plug or ball type)
7.3	Type of operation - Automatic
7.4	Accessories - On-line Dew point analyzer
8	Control system for Instrument Air Dryer shall be PLC based.

2.4.18 LOADING ARM

S.No.	Project Philosophy
1	Loading arm shall be suitable for filling road tanker and rail wagon.
2	Loading arm shall be metallic type and shall be provided with swivel joints and load balancer.
3	The length of inboard arm, outboard arms and connecting pipe or drop pipes shall be such as to give adequate flexibility in loading or unloading operations. The following range of flexibility shall be provided, as a minimum:
3.1	Loading arms for road tankers: When road tanker is parked at the centre of clear space in the loading bay and with loading arm base riser centre line and tanker nozzle(s) centre lines(s) are on same axis, in plan view (Refer:2.4.18.1 for Road Tanker Top Loading and 2.4.18.2 for Road Tanker Bottom Loading)
3.2	Loading arms for rail wagon: When rail wagon is parked with centre line of folding platform and wagon nozzle on the same axis, in plan view (Refer:4.18.3)
4	The loading arm shall be designed for manoeuvring of the arm with single man effort.
5	Client to inform end connection detail (size/type) between loading arm and tankers.
6	Dry break coupling (both male & female) shall be provided for the bottom loading arms. The companion part of the coupling (male/female) will be provided to BPCL to ensure compatibility with the trucks available for loading. BPCL shall consider suitable transition piece as per site requirement in case truck end connection is flanged type.

2.4.18.1 LOADING ARMS FOR ROAD TANKER-TOP LOADING

S.No.	Parameter	Atmospheric Loading	Pressure Loading
1	Longitudinal direction (i.e., Along the length of tankers)	-3m to +3m	-1m to +1m
2	Transverse direction (Perpendicular to road tanker).	-0.3m to + 0.3m	-0.3m to + 0.3m
3	Vertical direction (From tanker flange centre line/top elevation)	-0.3m to + 0.3m	-0.3m to + 0.3m

2.4.18.2 LOADING ARMS FOR ROAD TANKER-BOTTOM LOADING

S.No.	Parameter	Atmospheric Loading	Pressure Loading

S.No.	Parameter	Atmospheric Loading	Pressure Loading
1	Longitudinal direction (i.e., Along the length of tankers)	-1m to +1m	-1m to +1m
2	Transverse direction (Perpendicular to road tanker).	-0.4m to + 0.3m	-0.4m to + 0.3m
3	Vertical direction (From tanker flange centre line/top elevation)	-0.3m to + 0.3m	-0.3m to + 0.3m

2.4.18.3 LOADING ARMS FOR RAIL WAGON

NOT APPLICABLE

2.4.19 PASTILLATOR

NOT APPLICABLE

2.4.20 PIPE CONVEYER

NOT APPLICABLE

2.4.21 PRESSURISATION AND VENTILATION SYSTEM

S.No.	Project Philosophy
1	Ventilation air requirement shall be calculated based on Minimum 15 air changes per hour.
2	Air intake shall be located in non-hazardous and chemical fume-free areas at adequate elevation and shall be protected against rains and dust.
3	Pressurized areas shall have over pressure of 3-5mm WG.
4	Combined Fire & Smoke dampers shall be electric motorized and fail safe type.
5	Pressurization fan shall be 2 nos of 50% capacity without any standby, unless otherwise specified.

2.4.22 PSA HYDROGEN PLANT

S.No.	Project Philosophy
1	The system shall employ Pressure Swing Adsorption (PSA) process to produce high purity hydrogen product stream from a crude hydrogen feed stream. The hydrogen purity shall be 99.99% mol. minimum over the entire operating range of the plant, unless otherwise specified in Licensor/Process specification.
2	Turn down rate of the PSA Hydrogen plant shall be as specified in the Licensor/Process specification.
3	The system shall be capable of operating on a continuous or intermittent basis and shall be completely automatic, requiring no operator attention, with all cycle control valves actuated by a control system.
4	Independent of the requirement of codes and standards, all the vessels in H2 service shall be 100% radiographed.
5	Killed carbon steel, SA 516 Gr.60/ Gr. 70, or superior shall be used as material of construction of vessels.
6	Unless otherwise specified, number of beds shall be decided by PSA Hydrogen vendor based on operation and design considerations as specified in the PDS. However in no case, the number of beds shall not be less than 5.

S.No.	Project Philosophy
7	Adsorber vessel shall be designed as per ASME SEC.VIII Div.1 & Div. 2. Fatigue analysis shall be carried out as per ASME Section VIII Div 2. However fatigue analysis as per vendor's standard is also acceptable, subject to being equivalent or superior to those required by ASME Section VIII Div 2.
8	Tail gas surge vessel shall be provided.
9	Product Filter (1 working+1 standby) shall be considered in the Hydrogen Product line.

2.4.23 PSA NITROGEN PLANT

S.No.	Project Philosophy
1	The PSA process shall use carbon molecular sieves as adsorbent which preferentially adsorbs oxygen.
2	The PSA towers may be filled with desiccant for removal of moisture as dictated by the process requirements. Alternatively, an air dryer unit may be provided upstream of the PSA unit.
3	Where very high purity nitrogen is desired in the product, nitrogen from PSA unit shall be passed through Deoxo unit, for removal of oxygen and then through a nitrogen dryer unit to remove moisture.
4	The system shall be capable of operating on a continuous as well as intermittent basis and shall be completely automatic requiring no operator attention, with all cycle control valves actuated by a control system.
5	PSA unit shall be designed for outdoor installation.
6	The filters shall be suitably valved to carry out maintenance when the PSA unit is in operation.
7	All the pressure vessels shall be designed, fabricated, inspected and tested as per ASME Sec.VIII Div.1 & Div. 2. In addition, for vessels subjected to cyclic loading, fatigue analysis shall be carried out as per ASME Section VIII Div 2. However fatigue analysis as per vendor's standard is also acceptable, subject to being equivalent or superior to those required by ASME Section VIII Div 2.
8	On line dew point analyser, oxygen analyser shall be provided for measuring the quality of gas. Additionally, Hydrogen analyser shall be provided in case Deoxo unit is used.

2.4.24 REFRIGERATION SYSTEM (FOR PROCESS APPLICATIONS)

S.No.	Project Philosophy
1	The refrigeration system design parameters including selection of refrigerant shall be as per process duty conditions.
2	Depending upon capacity of refrigeration system, refrigerant compressor shall be either reciprocating type, screw (oil flooded) type or centrifugal type.
3	Automatic capacity control shall be provided with refrigerant compressor to accommodate process load variation. This shall be through valve unloaders in case of reciprocating compressor, through automatic slide valve arrangement in case of screw compressor and variable inlet guide vanes at suction in case of centrifugal compressor.
4	Refrigerant compressor shall comply with applicable API code depending on type of compressor, unless otherwise specified.
5	Materials of construction shall be selected based upon the type of Refrigerant selected.
6	Area classification shall be dependent on the type of Refrigerant and on the location of the system in the plant complex.

S.No.	Project Philosophy
7	Equipment noise level (Driver + Driven equipment train + auxiliaries) shall not exceed 85 dBA when measured at One-meter distance from the equipment skid in any direction.
8	All PSVs in the refrigerant line shall be coupled with Rupture discs at the upstream of PSVs to avoid any continuous leakage of refrigerant from PSVs.

2.4.25 ROLL CRUSHER

NOT APPLICABLE

2.4.26 STACKER CUM RECLAIMER

NOT APPLICABLE

2.4.27 TERTIARY SEPARATOR SYSTEM

NOT APPLICABLE

2.4.28 WEIGH BRIDGE-RAIL (IN-MOTION TYPE)

NOT APPLICABLE

2.4.29 WEIGH BRIDGE (ROAD)

S.No.	Project Philosophy
1	The weigh bridge shall be electronic type using load cells for weight measurement.
2	The weigh-bridge shall have overload capacity of at least 25% over the rated capacity.
3	Weighing accuracy shall be - 0.025% to + 0.025% of weight over complete capacity range.
4	The weigh-bridge shall be pitless type unless otherwise specified due to space/operational constraint.

2.4.30 BAGGING AND PALLETISATION UNIT

S.No.	Project Philosophy
1.0	GENERAL
1.1	Net weight of Product in each small bag : 25Kg. Net weight of Product in each jumbo bag : 1000 Kg.
1.2	Effective bagging hours : 12 hrs/day (2 shifts of 8 hours/day. 6.0 hrs effective time / shift).
1.3	Bagging Operation : 7 days/week.
1.4	Guaranteed Bagging Accuracy: The bagging scale accuracy shall be ± 15 g as an average for the consecutive weighing and a max. deviation of ± 20 g for each weighing of 25 kg.
1.5	a) Type of 25 kg bags : Woven PP bags (open mouth premade gusseted type) or FFS. [Type to be confirmed by BPCL during Feed preparation] b) Type of Jumbo bags : Details to be provided by BPCL.

S.No.	Project Philosophy
1.6	Size of 25 kg bags : a) Length : 870mm b) Layflat Width : 420mm c) Gusset : 2 x 60 mm Material of Bag: PP/PE
1.7	Size of Jumbo bags a) Length : 1100 mm b) Width : 1100 mm c) Height : 1500 mm Material of Bag: PP/PE
2.0	BAGGING MACHINE
2.1	The bagging machine shall be automatic type with auto bag placer.
2.2	Suitable venting and de-dusting system shall be provided, if necessary.
2.3	Material of construction (MOC) of items of bagging machine coming in contact with pellets shall be of stainless steel.
3.0	STITCHING MACHINE (FOR 25 KG BAGS)
3.1	Stitching machine shall be automatic and shall start with the feel of the bag.
3.2	Stitching shall be double lock chain stitch with top folding.
3.3	Stitching machine shall be revolving type double headed.
3.4	Stitch length shall be approx. 8 mm as per industry practice.
4.0	PALLETISATION SYSTEM (FOR 25 KG BAGS)
4.1	Palletisation system shall include feeding belt conveyors, palletisation units and pallet roller accumulators.
4.2	Palletisation system shall be completely automatic floor type, PLC controlled.
4.3	a) Wooden/ plastic pallets shall be used. b) The empty pallet of size 1300mmX1100mmX150mm shall be used. However, the machine shall be suitable for handling pallet of size upto 1500mmX1200mmX150mm.
4.4	Each pallet shall have 40 bags, each of 25 kg capacity, in 8 layers.
4.5	The palletiser shall effectively form the layers such that it shall be possible to stack the pallets 3 high in warehouse, ensuring stability
4.6	Pallet magazine shall be suitable for minimum 13 number pallets
4.7	Specified number of bags shall be stacked in individual pallets by automatic Palletiser. The Pallets will be stacked in warehouse using Forklift Trucks
4.8	The system shall be provided with following machines/equipment also: i) Check weigher ii) Metal Detector iii) Bag Rejection Device iv) Ink Jet Printer for printing alpha-numeric digits including "Inaccurate Weight" & "Metal" contaminated bags, as applicable.
4.9	Pallets of 25kg bags will be Stretched hood wrapped.

2.4.31 EXTRUSION AND PELLETIZATION SYSTEM

S.No.	Project Philosophy
1	Extrusion and Pelletization system shall be as per Licensor Process Data sheet.
2	All lube oil pumps, hot oil pumps and water pumps shall have 100% installed standby.
3	Service factor for gear boxes shall be minimum 1.5.
4	Life of bearings (L-10) shall be considered minimum 40000hrs.
5	The pellet dryer shall be centrifugal type capable of operating continuously and shall be provided with pre-dewatering screen.
6	Wet air fan shall be of centrifugal type, preferably with straight radial blades.
7	The pellet vibrating screen shall be double deck type and shall have flexible connections at inlet, outlet, oversize and undersize nozzles.

S.No.	Project Philosophy
8	All equipment piping/chutes etc. shall be earthed properly.
9	Extruder start-up material shall go through a trench to water basin where separation of polymer and water will take place. All necessary recirculating pump/ piping etc. to feed the water back to diverter valve (to cool the polymer and to ensure flow of cut polymer to water basin) shall be in vendor's scope.
10	Machine monitoring system for following shall be considered (to be confirmed by Client): a) Extruder main motor & gear box b) Gear Pump motor & gear box c) Under Water Pelletizer motor & gear box. Machine monitoring/conditioning system shall monitor the following minimum parameters: I. Motor Bearing temperature and vibration II. Motor winding temperature III. Motor Shaft displacement/imbalance IV. Gear box shaft bearing vibration/imbalance V. Gear box temperature
11	PCW tank shall be sized for higher of following criteria: a) To cater requirement of minimum three start-ups without needing any make-up water b) Three minutes of PCW pump capacity c) As per Licensor's specifications.
12	For sizing of PCW circuit, minimum flow rate of PCW shall be considered as 12 m ³ /hr/ ton of pellet produced or as specified in Licensor specification/Process data sheet, whichever is higher.

2.4.32 PNEUMATIC CONVEYING SYSTEM

S.No.	Project Philosophy
1	General
1.1	The system shall be designed taking into consideration the following factors: a) Material and its characteristics b) Capacity and turndown requirements, and c) System Configuration and Piping layout The designed system shall have least consumption of energy per tonne of material transported. A conservative material to air ratio shall be selected to avoid salutation in horizontal lines and to keep the pressure drop minimum. While deciding conveying velocity, product degradation and pressure drop shall be taken into account. If necessary, the conveying lines may have different cross sections in various zones of transportation. The conveying system shall have programmable logic controllers for automatic operation and shall be provided with control panel and graphic display unless stated otherwise
2	Conveying Blowers/Compressor
2.1	Adequacy of blowers (positive displacement blowers may be used for system pressure limited to 0.9 kg/cm ² g) shall be checked for the required conveying capacity and distance. Either blower (if adequate) or compressor shall be used optimizing the overall cost
2.2	The conveying blowers/compressor shall be supplied with suction and discharge silencers, coolers, filters etc. The blower/compressor shall be statically and dynamically balanced. Atleast 20% margin over BkW at maximum operating pressure or 5% margin over BkW at relief valve set pressure, whichever is higher, shall be considered for selection of Motor for all compressors/ blowers. Design operating point of blower/compressor shall be at a point not exceeding 80% of maximum permissible flow and 90% of maximum permissible pressure for the selected blower/ compressor, unless otherwise specified in the job specification.

S.No.	Project Philosophy
2.3	There shall be 100% installed standby for all the conveying blowers/compressors except for blending & bagging blowers for which common standby shall be considered so as to optimize the system configuration unless otherwise specified in the Licensor specification.
3	Rotary Feeders
3.1	Only proven models already satisfactorily used in similar services shall be used. Rotor radial and lateral clearances shall be carefully decided considering the operating temperature and consequential thermal expansion. Insulation shall be considered to prevent local cooling, if required
3.2	The rotary feeder shall be tested for gas or air leakage. The feeder shall be provided with vent line for conveying application. Rotary feeder shall be so designed as to prevent product smearing or pinching
3.3	Seal purging with air or nitrogen shall be provided for rotary feeder handling powder materials. In case of rotary valves with closed end rotors, purging of end plates shall also be provided
4	Piping
4.1	The conveying line routing shall take into account (a) minimum conveying line length (b) least number of bends (c) no abrupt change in direction and (d) installation of long radius bends
4.2	Piping material shall be compatible with the material being handled
4.3	For polymer products, all gaskets must be white neoprene only. Piping shall have continuity with static jump over at every flange and shall be earthed, wherever there is a possibility of static charge generation
4.4	Piping for polymer pellet conveying shall have special type proven treatment to avoid snake skins
4.5	Straight length between any two flanged joints shall not exceed 6m
4.6	Clean out pocket at strategic locations shall be provided
4.7	Bend radius of conveying line shall be generally 8 to 10 D, and bend shall be smooth wrinkle free

2.4.33 ADDITIONAL PACKAGE/EQUIPMENT

S.No.	Project Philosophy
1	

2.5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

Notes:

- All equipment/components shall be designed to suit prevailing climate/environmental conditions.
- Energy efficiency shall be accorded prime importance in the design/selection of the equipment/package.
- Vendors/sub-vendors shall be as per EIL/Client approved list.
- 3-D Modeling shall be done for all the major packages to avert fouling and to ensure accessibility and ease of operation & maintenance.
- Vendors will be invited to participate in the HAZOP study wherever applicable. HAZOP recommendations to be implemented by the Vendor without any additional cost to the Owner. The same shall be justified by Vendor, in case not required as per Vendor's proven experience. However, with adequate PTR/ technical justification which will be reviewed by both PMC and Client.
- Cycle time shall be manually adjustable for varying feed rates to improve recovery for PSA Hydrogen Package.
- For PSA Hydrogen package, If upstream Inst air line is Carbon Steel then duplex magnetic filter shall be provided.

8. No. of Man-days for commercial comparison purpose for Extruder package shall be 300 man-days .
9. Usage of material prone to accumulating static charge as filter media in air dryers shall be avoided. Filter material suitable for the same will be selected as per Vendor's recommendation.
10. Suitable mothballing of equipment during transportation and storage at site to be considered for atleast 12 months period post dispatch from vendor works.

2.6.0 MATERIAL HANDLING FACILITIES FOR NORMAL MAINTENANCE OF EQUIPMENT

2.6.1 MATERIAL HANDLING FACILITIES

S.No.	Type of Equipment	Type of Maintenance Facility
1	Any equipment requiring maintenance	Chain Pulley Block / Electric Wire Rope Hoist / EOT Crane / HOT Crane

2.7.0 SPARE PARTS

Commissioning spares, Mandatory Spares and Special tools and tackles shall be separately packed with separate packing list. Packing case shall be clearly marked as Commissioning spares / Mandatory Spares / Special tools and tackles.

2.7.1 MANDATORY SPARES

Mechanical Mandatory Spares shall be procured for packaged equipment items along with the main equipment. Mandatory spares shall be as per below table. Mandatory spares required for Electrical, Instrumentation and Piping items as applicable for the packages shall be provided as per respective department mandatory spare philosophy.

S.No.	Type	Description
1.0	AIR CONDITIONING SYSTEM	
1.1	For all VCR based Air-conditioning system except Window/Split AC [For each building]	
1.1.1	Refrigerant	One (1)full charge along with storage cylinders for one unit of each AC System.
1.2	For VAR System [For each building]	
1.2.1	Refrigerant pump	One(1) No.
1.2.2	Solution pump	One(1) No.
1.2.3	Vacuum Pump	One(1) No.
1.2.4	Gaskets/O-Rings for machine	Two(2)sets of each size and type
1.3	Chilled Water Pumps	As per Sl.No 1.4 of cl. no. 3.7.1 of Engineering Design Basis (SME)
1.4	Environmental Control Monitor (ECM)	One(1)no for the complete HVAC system of this Project.
2.0	BASKET FILTER [For each Basket Filter tag]	
2.1	Gaskets/O-rings	Two(2) sets of each size and type.
2.2	Filter element along with mounting nut, bolt, and washer	Two(2) Complete Sets
2.3	Fasteners	10% (Min 2 nos.) of each type and size
3.0	CARTRIDGE FILTER [For each cartridge filter tag]	

S.No.	Type	Description
3.1	Gaskets/O-rings	Two(2) sets of each size and type.
3.2	Filter element along with mounting nut, bolt, and washer	Two(2) Complete Sets
3.3	Fasteners	10% (Min 2 nos.) of each type and size
4.0	Chain Pulley Block	NIL
5.0	CRYOGENIC AIR SEPARATION PLANT (For each train)	
5.1	Expansion Turbine	
5.1.1	Dynamically Balanced Rotor-Cartridge type (plug & play)	One(1) set
5.1.2	Bearings	One(1) no. for each type & size
5.1.3	Seals	Tw(2) sets for each type & size
5.1.4	Gaskets	Four(4) sets for each type & size
5.1.5	O-rings	Four(4) sets for each type & size
5.1.6	Retainer rings	One(1) set for each type & size
5.1.7	Oil Filter elements	Two(2) sets for each type & size
5.2	For Refrigeration Unit	
5.2.1	Refrigeration Compressor (Positive displacement-Rotary type)	As per SI.No. 2.10 of Cl.No of 3.7.1 of Engineering Design Basis (SME)
5.2.2	Refrigeration compressor(Reciprocating compressor)	As per SI.No. 2.8 Cl.No of 3.7.1 of Engineering Design Basis (SME)
5.2.3	Refrigerant Charging Pump, if applicable	One(1) no.
5.2.4	Lubricant charging Pump, if applicable	One(1) no.
5.3	For vessels and tanks/heat exchangers	
5.3.1	Gaskets for Vessels	Two(2) sets of gaskets of each type and size.
5.3.2	Gaskets for Heat Exchangers	400% of installed gaskets
5.3.3	Fasteners for Vessels	10% (min 2 nos) of each type and size
5.3.4	Fasteners for Heat Exchangers	20% bolting (Min 4 studs and 8 nuts per joint)
6.0	Dust Collection System: Bag Filter Type	
6.1	Gaskets	Two(2) sets of each size and type
6.2	Filter element (bag) along with mounting nut, bolt, and washer	20% of total installed bags
6.3	Fasteners	10% (Min 2 nos.) of each type and size
7.0	ELECTRIC TRACTION LIFT	NIL
8.0	ELECTRIC WIRE ROPE HOIST	NIL
9.0	EOT & HOT CRANE	Two(2) nos Radio Remote Type Control along with battery(for each EOT Crane)
10.0	FEED FILTER PACKAGE	
10.1	Gaskets	Two(2) sets of each size and type
10.2	Filter element along with mounting nut, bolt, and washer	20% (Min 2 nos.) of installed filter elements
10.3	Gaskets/O-rings	Two(2) sets of each size and type
11.0	FILTER SEPARATOR/COALESCER (For each tag)	
11.1	Filter/coalescer/separator element along with mounting nut, bolt, and washer	Two(2) Complete Sets
11.2	Gasket/O-rings	Two(2) sets of each size and type

S.No.	Type	Description
11.3	Fasteners	10% (Min 2 nos.) of each type and size
12.0	FLARE STACK COMPONENTS	NIL
13.0	INSTRUMENT AIR DRYER (For each unit)	
13.1	For Vessels	
13.1.1	Gaskets	Two(2) sets of each size and type
13.1.2	Fasteners	10% (min 2 nos) of each type and size
13.2	For shell and Tube Exchangers (if applicable)	
13.2.1	Gaskets	400% of each installed gaskets
13.2.2	Fasteners	20% (min 4 studs and 8 nuts per joint).
13.3.3	Cartridge Filter	Two(2) complete sets of installed Filter elements along with mounting nut, bolt, and washer for each filter
14.0	LOADING ARM	NIL
15.0	PRESSURISATION AND VENTILATION SYSTEM	NIL
16.0	PSA HYDROGEN PLANT	
16.1	Gaskets	Two(2) sets gaskets of each type and size
16.2	Fasteners	10% (min 2 nos) of each type and size
16.3	Product Filter/Tailgas filter	Two(2) complete sets of installed filter elements along with mounting nut, bolt and washer for each filter.
17.0	PSA NITROGEN PLANT	
17.1	Gaskets	Two(2) sets gaskets of each type and size
17.2	Fasteners	10% (min 2 nos) of each type and size
18.0	REFRIGERATION SYSTEM(For Process Applications)	
18.1	Refrigeration Compressor	As per SI.No. 2.10 Cl.No of 3.7.1 of Engineering Design Basis (SME)
18.2	Refrigerant Charging Pump, if applicable	One(1) no.
18.3	Lubricant charging Pump, if applicable	One(1) no.
18.4	Gaskets for Vessels	Two(2) sets gaskets of each type and size
18.5	Fasteners for Vessels	10% (Minimum 2 in each size) of installed fasteners
18.6	Gaskets for Heat Exchangers	400 % of each installed gaskets
18.7	Fasteners for Heat Exchangers	20% Bolting (Min. 4 studs and 8 nuts per joint)
19.0	WEIGH BRIDGE(ROAD)	NIL
20.0	BAGGING AND PALLETISATION UNIT	NIL
21.0	EXTRUSION AND PELLETIZATION SYSTEM	
21.1	Extruder Die Plate	One(1)no
21.2	Extruder Knife Holder	One(1)no
21.3	Extruder knives	Ten(10) sets
21.4	Seal for Extruder shaft (wearing parts)	One(1)set
21.5	Wearing Parts for coupling for Extruder	One(1)set
21.6	Plates and Gaskets of Plate heat Exchanger	One(1)set

S.No.	Type	Description
21.7	Rotor for auxiliary driven equipment	1 (One) set except for the following items: a) Extruder main screw b) Melt pump rotor c) Pelletizer rotor d) PCW pump rotor e) Pellet dryer
21.8	All bearings, oil seals, O rings, gaskets, filters, rupture discs installed in entire Extruder package	One(1) set
21.9	Fasteners for Heat Exchangers	20% bolting (Min 4 studs and 8 nuts) per joint.
21.11	Screen packs	Ten(10) sets of each mesh size
21.10	Gaskets for Heat Exchangers	400% of installed gaskets.
21.12	Flexible connections for Inlet, Outlet, Oversize and Undersize nozzles of Pellet Classifier.	One(1) set for each nozzle connection.
21.13	Extruder gear pump seals and bearing	One(1) set
21.14	Pump seals and bearing	One(1) set for each pump tag [common for both working and standby] in the package.
21.15	Gaskets for all interface and package intermediate flange connections, vessel blinds and body flange	Four(4) sets of each installed gaskets.
22.0	PNEUMATIC CONVEYING SYSTEM	
22.1	Screw Compressor	As per SI.No. 2.10 of Cl.No 3.7.1 of Engineering Design basis(SME).
22.2	Roots Blower	As per SI.No. 2.12 of Cl.No 3.7.1 of Engineering Design basis(SME).
22.3	Cartridge filter	Two(2) complete sets of installed Filter elements along with mounting nut, bolt, and washer for each filter
22.4	Bag Filter	20% of total installed Filter element (bag) along with mounting nut, bolt, and washer for each filter
22.5	Fasteners for vessels	10% (min 2 nos) of each type and size
22.6	Gaskets for Vessels	Two(2) sets of each size and type
22.7	Fasteners for Heat Exchangers	20% bolting (Min 4 studs and 8 nuts) per joint.
22.8	Gaskets for Heat Exchangers	400% of installed gaskets

2.7.2 COMMISSIONING SPARES

Vendor shall supply commissioning spares sufficient for trouble free commissioning of the system at site. Any commissioning spares required during commissioning, over and above, the commissioning spares supplied, shall be made available by the vendor without any cost and time implication to Owner. If for any reason, during commissioning, vendor needs to utilize spares from 2 years operational spares or mandatory spares, the same shall be replenished by vendor within a reasonable time without any cost implication to Owner. Any unused commissioning spares shall be handed over to owner.

2.7.3 RECOMMENDED SPARES FOR NORMAL OPERATION & MAINTENANCE

Vendor shall quote for spare parts with recommended quantities and itemised prices for first two years of operation of the equipment. Proper coding and referencing of spare parts shall be done so that later identification with appropriate equipment is facilitated.

Recommended spares and their quantities should take into account related factors of equipment reliability, effect of equipment downtime upon production or safety, cost of parts and availability of vendor's service facilities around the proposed location of equipment.

2.7.4 SPECIAL TOOLS AND TACKLES

Special tools and Tackles shall be supplied by vendor along with the main equipment as per vendor's recommendation.

3.0 ROTATING EQUIPMENT

3.1 SCOPE

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

Electrical items, Instrumentation & Controls, Piping, Pressure Vessels, Heat exchangers etc. associated with rotating equipment shall comply with the design requirements as given in the respective discipline specifications.

3.2 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

3.2.1 ABBREVIATIONS

Code	Description
API	American Petroleum Institute
ARC	Automatic Re-circulation Valve
CP	Chain Pulley
DG	Diesel Engine-Generator
EDB	Engineering Design Basis
EOT	Electric Overhead Traveling
EC	Experience Criteria
FD	Forced Draft
GEG	Gas Engine-Generator
GTG	Gas Turbine-Generator
HEI	Heat Exchange Institute, Inc.
HOT	Hand Overhead Traveling
ID	Induced Draft
LSTK	Lump-sum Turn Key
MOC	Material of Construction
MVL	Master Vendor List
PMC	Project Management Consultant / Consultancy
PTR	Proven Track Record
QAP	Quality Assurance Plan
SPRV	Single Point Responsibility Vendor
SQT	Seal Qualification Test
STG	Steam Turbine Generator
GTC	Gas Turbine driven compressor

3.2.2 CODES & STANDARDS / PUBLICATIONS

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

For design aspects not specifically covered by Data Sheets, Specifications, Codes and Standards or Regulations, the design shall be based on good engineering practice.

S.No.	Description	Standards / Codes	Edition	Note
1	PUMPS			

S.No.	Description	Standards / Codes	Edition	Note
1.1	Centrifugal Pumps (Special Purpose Process Service)	API Std. 610 12th edn. & EIL Std. Spec. 6-41-0008		Note-1
1.2	Centrifugal Pumps (General Purpose Process Service)	EIL Std. Spec. 6-41-0002		Note-2
1.3	Centrifugal Pumps (General Water Service)	EIL std. Spec. 6-41-0003		Note-3
1.4	Centrifugal Pumps (Slurry & Liquor Service)	Mfr. Std.		
1.5	Positive Displacement Pumps (Reciprocating)	API Std. 674, 3rd Ed. & EIL Std. Spec. 6-41-0020		
1.6	Positive Displacement Pump (Controlled Vol.)	API Std. 675, 3rd Ed. & EIL Std. Spec. 6-41-0021		
1.7	Positive Displacement Pumps (Rotary)	API Std. 676 3rd Ed. & EIL std. spec 6-41-0022		
1.8	Positive Displacement Pumps (Rotary)	API Std. 681 2nd Ed.		
1.9	Seal-less Pumps	API Std 685 3rd Ed.		
2	COMPRESSORS / FANS & BLOWERS			
2.1	Centrifugal Compressors	Part 1 & 2 API Std. 617 8th Ed. & EIL Std. Spec. 6-42-0005		
2.2	Axial Compressors	Part 1 & 2 API Std. 617 8th Ed. & EIL Std. Spec. 6-42-0005		
2.3	Expander-Compressors	Part 1 & 4 API Std. 617 8th Ed. & EIL Std. Spec. 6-42-0005		
2.4	Integrally Geared Process Centrifugal Compressors	Part 1 & 3 API Std. 617 8th Ed. & EIL Std. Spec. 6-42-0005		
2.5	Packaged Integrally Geared Centrifugal Air Compressors	API Std. 672 4th ED. & EIL Std. Spec. 6-42-0004		
2.6	Reciprocating Compressors (Utility & Instrument Air Service)	EIL Std. Spec. 6-42-0010		
2.7	Reciprocating Compressors (Process Service)	API Std. 618 5th Ed. & EIL Std. Spec. 6-42-0011		
2.8	Positive Displacement Compressors (Rotary)	API Std. 619 5th ED. & EIL Std. Spec. 6-42-0015		

S.No.	Description	Standards / Codes	Edition	Note
2.9	Centrifugal Fans	EIL Std. Spec. 6-42-0002		Note-4
2.10	Centrifugal Fans (including Induced Draft/Forced Draft fans) for Petroleum, Chemical and Gas Industry Services	API Std. 673 3rd Ed. & EIL Std. Spec. 6-42-0016		
2.11	Roots Blowers	Mfr. Std.		
2.12	Diaphragm Compressors	EIL Std. Spec. 6-42-0012		Note-9
2.13	Air Operated double Diaphragm pump (AODD)	Mfr. Std.		
3	MECHANICAL DRIVERS / GEAR BOXES			
3.1	Diesel Engines	ISO 3046 & EIL Std. Spec. 6-43-0040		
3.2	Gas Turbines	API Std. 616 5th Ed. & EIL Std. Spec. 6-43-0041		
3.3	Steam Turbines (General Purpose)	API Std. 611 5th Ed. & EIL Std. Spec. 6-43-0042		Note-5
3.4	Steam Turbines (Special Purpose)	API Std. 612 7th Ed. & EIL Std. Spec. 6-43-0043		
3.5	Special Purpose Gear Units	API Std. 613 6th Ed.		
3.6	General Purpose Gear Units	API Std. 677 4th Ed.		
3.7	Special Purpose Coupling	API Std. 671 5th Ed.		Note-6
3.8	Gas Engine and GEG set	ISO 3046 & EIL Std. Spec 6-43-0044		
4	AUXILIARIES			
4.1	Lubrication, shaft sealing and control-oil systems and auxiliaries	API Std. 614 6th Ed.		Note-7
4.2	Shaft sealing for centrifugal & rotary pumps	API Std. 682 4th Ed.		
4.3	Vibration, Axial Position & Bearing Temp. Monitoring Systems	API Std. 670 5th Ed.		
4.4	Steam Condensers	HEI + TEMA		
4.5	Dry Gas Sealing Systems for Axial, Centrifugal, Rotary Screw Compressors and Expanders	API Std 692 1st Ed		
4.6	All Other rotating equipment not listed above	Mfr. Std.		

Notes:

1 Centrifugal pumps for special purpose process service are classified as pumps which are meant for process service (both for on-site & offsite) but excluding the pumps covered either under general- purpose process service or general water service.

2 Centrifugal pumps for general purpose process service are classified as pumps for applications where maximum pressure by all considerations does not exceed 16.0 kg/cm² g, pumping temperature remains within -29 DEG C to 205 DEG C, Specific gravity is not less than 0.7 at the specified operating conditions or when dual pressurised / un-pressurised mechanical seals are not required/ specified. Typical areas of application are non-process services & utility services such as De-mineralised Water (DMW) plants, Raw Water Treatment Plants (RWTP), Effluent Treatment Plants (ETP), Blow-down services etc.

3 Centrifugal pumps for general water service are classified as pumps for applications such as Large Capacity Cooling Water Pumps, Auxiliary Cooling Water Pumps, fire water pumps & other centrifugal pumps handling clean & cold water and sump pumps handling predominantly water/liquid similar to water as pumping fluid. Pumps handling cooling water in Process units are not covered.

4 Centrifugal fans are to be considered as meant for non-critical service.

5 General-purpose steam turbines (conforming to API Std. 611) in addition to criteria specified in API 611, General-purpose steam turbines may also be used, subject to market availability & with proven track record, for cases where all the following conditions exist:

- Inlet pressure < 60 bar g;
- Inlet temperature < 475 DEG C;
- Speed < 6000 rpm;
- Turbine rating < 1500 kW; and

Driven equipment is usually spared or is in non-critical service.

The above criteria supersedes the criteria specified in API-611

6 Special-purpose couplings (conforming to API Std. 671) shall be used in equipment trains, as specified in the EDB.

7 Lube oil system (conforming to API Std. 614; general purpose or special purpose) shall be as specified on main equipment data sheet.

8 EIL standard specification will not be applied to pumps in auxiliary systems such as lube oil system/cooling water system etc of Rotating Equipment Packages. These items can be sourced by Package Vendor as per their past experience & shall be of field proven design. The equipments sourced by the package vendors shall however comply the relevant API / IS standards.

9. EIL standard Specifications which are under revision, final released specifications along with respective API editions shall govern

3.3.0 GENERAL / DESIGN CONSIDERATIONS

3.3.1 UNIT RESPONSIBILITY

S.No.	Equipment Type	Unit Responsibility

S.No.	Equipment Type	Unit Responsibility
1	All equipments (except for Steam /Gas Turbine Generating Sets, GAS/ Crude/ Diesel Engine power Generating sets, Gas Turbine Driven Compressor, Screw compressor(oil Flooded) and Dosing skids	With the driven equipment manufacturer, who shall also be the SPRV (Single Point Responsibility Vendor) for the complete equipment unit including driver, driven equipment & all other associated auxiliary systems, instrumentation & controls etc. All Rotating Equipment drivers shall be procured from the respective driven equipment manufacturers, complete with all associated auxiliary systems
2	Steam/Gas Turbine Generating Sets	With the Steam/Gas Turbine manufacturer, who shall also be the SPRV of the package. Steam/Gas Turbine Generating Sets shall be procured along with alternators, complete with all associated auxiliary systems, from the steam/ Gas Turbine Manufacturers.
3	Gas/Diesel/Crude Oil Engine Power Generating Sets	With the GEG/DG/CEG Set Packager, who shall also be the SPRV of the package. Gas/Diesel/Crude Oil Power Generating Sets shall be procured along with alternators from an established GEG/DG/CEG Set Packager. The packager shall be authorized packager of engine manufacturer.
4	Gas Turbine Compressors	With either GT or Compressor manufacturer, who shall be the SPRV of the package. GTCs shall be procured either from compressor manufacturer or from Gas Turbine manufacturer, complete with all associated auxiliary systems.
5	Screw Compressors (Oil Flooded)	With either the manufacturer of screw compressor (oil flooded) or their authorized packager, who shall be the SPRV of the package. Above package shall be procured from the manufacturer of the screw compressor (oil flooded) or their authorized packager.
6	Dosing Skids	With the packager of the proposed Dosing skids, who shall also be the SPRV of the package. Dosing skids shall be procured from an established dosing skid packager.

3.3.2 UNITISATION

Unless otherwise specified, rotating equipment units shall be unitised along with their respective drivers as under:

S.No.	Equipment Unit	Unitisation Location
1	Electric Electric Motor driven centrifugal gas compressors (motor base-plate/skid mounted)	At Compressors manufacturers works.
2	Steam turbine driven centrifugal gas compressors	At compressor manufacturers works.

S.No.	Equipment Unit	Unitisation Location
3	Electric Motor driven Centrifugal gas Compressor (motor mounted directly on foundation)	At Site
4	Gas Turbine Compressors	At GT manufacturer's shop or at compressor manufacturer's shop
5	Steam turbine electric power generating sets	At Steam turbine manufacturer works or at site.
6	Screw compressors (Oil Flooded)	At compressor manufacturer works or their authorized Packagers works.
7	Gas Turbine electric power generating sets	At gas turbine manufacturer works or GTG packager works
8	Gas/Diesel/Crude Oil Engine electric power generating sets	At GEG/DG/CEG packager works or Engine Manufacturer works
9	Electric Motor driven Reciprocating Compressors (non skid mounted i.e.directly mounted on foundation)	At Site
10	Dosing Skids	At Dosing Skid packager works
11	Centrifugal Fans (not provided on baseplate/ skid)	At Site
12	All other rotating equipments	At respective rotating equipment manufacturer's works

3.3.3 EQUIPMENT SELECTION AND SIZING CRITERIA

S.No.	Project Philosophy
1	Selection of Rotating Equipment shall be based upon the following considerations: - Suitability for the specified duty conditions - Standard Models under vendor's regular range of manufacture - Proven Track record
2	Unless otherwise specified in the process package, sizing of centrifugal fans, internal combustion engines, air compressors & gas turbines shall be based on maximum site coincident ambient temperature and relative humidity.
3	Allowable working pressure & temperature of the rotating equipment shall be most stringent of design pressure & temperature out of: - Design Pressure & temp as specified in Mechanical/Process data sheets (if any) - The licensor's specifications and other codes & standards attached or referred to.
4	All rotating equipment & drivers including gear units and couplings (if any) shall be designed to perform satisfactorily under specified start up conditions, part load operation, maximum differential pressure operation & relief valve set pressure and up to full speed.

3.3.4 ECONOMIC COMPARISION OF VENDORS OFFER

S.No.	Project Philosophy

S.No.	Project Philosophy
1	Loading & Penalty (on account of equipment energy consumption/ Specific fuel consumption) shall be done only for the following equipment: - Centrifugal Pumps - Hydraulic Power Recovery Turbine - Centrifugal Compressors - Screw Compressors - Reciprocating Air Compressors with atmospheric suction pressure - Centrifugal Fans/Forced Draft Fans/Induced Draft Fans - Gas Turbines - Gas Engine Generators - Diesel Engines (except for emergency & fire water service)
2	In case of driven equipment, their shaft power consumption shall be considered for economic comparison of vendors offer. However for gas turbine, gas engine and diesel engine drivers, specific fuel consumption shall be considered for economic comparison of vendors offer. For HPRT, power generated shall be considered for economic comparison of vendors offer.
3	Vendor's offers shall be loaded by Net Present Value of the cost of excess energy consumption (over the vendor having least energy consumption) over a period of Five years starting from one year after delivery.
4	Loading shall be applied on operating units only and not on standby units.
5	Loading shall not be done on equipment, which are for intermittent operation.
6	Commercial comparison on account of supervision charges: The rotating equipment vendor shall provide his services for supervision during erection, commissioning and field trial testing of the rotating equipment packages. Electrical & Instrumentation engineers shall also be present along with vendor's erection and commissioning engineers, as required. The supervisory cost of mandays as specified for each rotating equipment package (as specified in cl 3.3.4.1) shall be considered for the purpose of commercial comparison (which he may decide between days for Indian/Foreign supervisors and also discipline wise but total of man days per equipment package). The vendor shall indicate in his proposal the cost of providing the above services on per diem basis. The presence of OEM vendor for the purpose of erection and commissioning shall be on need basis and criticality of the equipment as decided at site, based on the site conditions. Per diem rates, as quoted by the vendor shall be the basis of payment, based on actual requirements.
7	For economic comparison of equipment vendor's offer, Equipment Cost including Cost of mandatory spares (if specified), commissioning spares and special tools and tackles + Loading (as defined above) + Supervision charges (as defined above)" shall be considered. Note: Any other cost which is specified to be part of commercial comparison can also be made part of economic comparison criteria.
8	The following values for estimating loading & penalty shall be considered: i) Cost of Electrical Power : Rs ____ * _____ per kWh ii) Rate of Interest : <u>*12%</u> per year iii) No of years : 5 Years (starting from one year after delivery of equipment) Cost of Electricity - Rs 8.46 per unit for Bina Rs 4.3 per unit for COT Vadinar *Client to provide details.
9	The maximum loading & penalty to be applied on account of equipment power consumption/specific fuel consumption however shall not exceed 10% of the total package cost.
10	Guarantee parameters shall be submitted as part of bids. In case of suo-moto change in guaranteed parameters (used for techno-commercial evaluation of offers) by the bidder after submission of their offer, the changed guaranteed parameters shall be considered for techno-commercial evaluation for Loading & Penalty purposes as per the methodology given below:

S.No.	Project Philosophy
10.1	For Power consuming equipment (e.g. pumps / compressors etc.): In-case of suo-moto change in guaranteed parameters (used for techno-commercial evaluation of the offer) by the bidder after submission of their offer, the changed guaranteed parameters are to be considered for techno-commercial evaluation for Loading & Penalty purposes as per the methodology mentioned below: (1) In-case the changed guaranteed values are higher than the originally quoted guaranteed values, bidder's bid/offer shall be rejected. (2) In-case the changed guaranteed values are lower than the originally quoted guaranteed values, the guaranteed parameters contained in original proposal are to be considered for the purpose of loading for commercial evaluation. (3) In-case, after commercial loading as per above, the bidder (who had lowered the guaranteed values as compared to the originally quoted guaranteed values) turns out to be L1, the changed guaranteed values (which are lower than the originally quoted guaranteed values) are to be considered for ordering and applicable performance penalties during Performance Test. (4) The guaranteed changed values by bidder during TQ/CQ shall be freeze before opening price bids. Any change in guaranteed values post opening price bids, offer of the bidder shall not be considered or shall be evaluated as per original offered values.
10.2	For Power generating equipment (e.g. GTG / STG / Expander-Generator / Expander-Compressor / HPRT, etc.): In-case of suo-moto change in guaranteed parameters (used for techno-commercial evaluation of the offer) by the bidder after submission of their offer, the changed guaranteed parameters are to be considered for techno-commercial evaluation for Loading & Penalty purposes as per the methodology mentioned below: a) In-case the changed guaranteed values are lower than the originally quoted guaranteed values, bidder's bid/offer shall be rejected. b) In-case the changed guaranteed values are higher than the originally quoted guaranteed values, the guaranteed parameters contained in original proposal are to be considered for the purpose of loading for commercial evaluation. c) In-case, after commercial loading as per above, the bidder (who had increased the guaranteed values as compared to the originally quoted guaranteed values) turns out to be L1, the changed guaranteed values (which are higher than the originally quoted guaranteed values) are to be considered for ordering and applicable performance penalties during Performance Test. (d) The guaranteed changed values by bidder during TQ/CQ shall be freeze before opening price bids. Any change in guaranteed values post opening price bids, offer of the bidder shall not be considered or shall be evaluated as per original offered values.
11	Loading and penalty criteria proposed for economic comparison shall be considered for cases wherein procurement is being done by OWNER/EIL.

3.3.4.1 NO OF MANDAYS

No. of Mandays are defined for commercial comparison purpose for each equipment package.

S.No.	Rotating Equipment Package	No. of Mandays
1	Centrifugal Pumps (Single/Two Stages) - Electric Motor Driven Package	20
2	Centrifugal Pumps (Single/Two Stages) - Steam Turbine Driven Package	20
3	Centrifugal Pumps (Multistage) - Electric Motor Driven Package	30
4	Centrifugal Pumps (Multistage) - Steam Turbine Driven Package	30
5	Large Capacity Centrifugal Pump - Electric Motor Driven Package	20
6	Fire Water Pumps - Diesel Engine Driven Package	20
7	Rotary Pump - Electric Motor Driven Package	20
8	Metering Pump - Electric Motor Driven Package	20
9	Reciprocating Pump - Electric Motor Driven Package	20
10	Reciprocating Pump - Diesel Engine Driven Package	20
11	Centrifugal Compressor (Single Casing) - Electric Motor Driven Package (without inter-stage process piping)	150
12	Centrifugal Compressor (Single Casing) - Steam Turbine Driven Package (without inter-stage process piping)	150
13	Centrifugal Compressor (Single Casing) - Gas Turbine Driven package (without inter-stage process piping)	150
14	Centrifugal Compressor (Multi Casing) - Steam Turbine Driven Package (without inter-stage process piping)	150
15	Centrifugal Compressor (Multi Casing) - Gas Turbine Driven package (without inter-stage process piping)	150
16	Axial Compressor - Steam Turbine Driven Package (without inter-stage process piping)	150
17	Package integrally geared centrifugal compressor-electric motor driven package	50
18	Screw Compressor - Electric Motor Driven Package	50
19	Skid mounted Reciprocating Compressor - Electric Motor Driven Package	30
20	Reciprocating Compressor - Electric Motor Driven Package (without inter-stage process piping)	150
21	Reciprocating Compressor - Electric Motor Driven (with inter-stage process piping)	150
22	Reciprocating compressor + Electric Motor + Soft Starter (with inter-stage process piping)	150
23	Reciprocating compressor + Electric Motor + Soft Starter (without inter-stage process piping)	150
24	Diaphragm Compressor - Electric Motor Driven Package	50

S.No.	Rotating Equipment Package	No. of Mandays
25	Induced Draft (ID) Fan - Electric Motor Driven Package	30
26	Induced Draft (ID) Fan - Electric Motor Driven Package with variable speed fluid coupling	30
27	Forced Draft (FD) Fan - Electric Motor Driven Package	30
28	Forced Draft (FD) Fan - Electric Motor Driven Package with variable speed fluid coupling	30
29	Steam Turbine driven Induced Draft (ID)/ Forced Draft (FD) fans	40
30	Diesel/Gas Engine - Generator Sets	150
31	Steam Turbine - Generator Sets	150
32	Gas Turbine Generator sets	150
33	Chemical Dosing/Injection Package	20
34	Hot Gas Expander Generator Package	150
35	Sealless Centrifugal Pumps	20
36	Dual Drive (Turbine+ Motor) Driven Centrifugal Compressor	150
37	Liquid Ring Vacuum Pumps/Compressors	30

3.3.5 EQUIPMENT QUALIFICATION CRITERIA (EQC)

All Rotating Equipment shall meet the qualification criteria/experience criteria requirement as specified in the specification of the relevant rotating equipment, as applicable. Rotating Equipment Vendor shall complete the Experience Record Proforma enclosed with the inquiry document to amply prove that the offered Rotating Equipment meet the qualification criteria/experience criteria requirement for technical acceptance.

*Alternatively Indian Subsidiary of Foreign Principal can be qualified based on prevalent 'Make in India' Policy of EIL.

3.3.6 EQUIPMENT SUPPLIERS

Unless otherwise specified by the Owner, the equipment shall be sourced from one of the approved suppliers from Master Vendor List as applicable for the Project.

3.3.7 SEALING SYSTEM SELECTION CRITERIA

3.3.7.1 CENTRIFUGAL PUMPS

S.No.	Project Philosophy
15	Barrier or Buffer oil used in mechanical seal pots of pumps handling pumping liquid >250 Deg C shall be synthetic oil to prevent coking & fouling of seals.
1	All Pumps shall be provided with mechanical seals (except general water service pumps handling clean cold water), unless specified otherwise. The type of mechanical seal (i.e. single or dual un-pressurised / pressurised) shall be as defined in the process package.
2	Unless otherwise specified, mechanical seals shall conform to API Standard 682, 4th edition for centrifugal pumps. However, Large capacity water service horizontal pumps (i.e pumps with rated flow above 500 m3/h) shall be provided with Non-API horizontally split mechanical seals.
3	Seal Qualification tests (SQT) shall have been conducted on the proposed mechanical seal model(s) for standard API 682 seals.

S.No.	Project Philosophy
4	In case the offered mechanical seal is intended to be supplied by the Indian counterparts of the seal manufacturers, following requirements shall be met: - For standard mechanical seals, for which SQT has been conducted by the principals, critical components such as Bellows, Springs and Seal Faces shall be sourced from their principals. - For Engineered seals, the complete mechanical seal along with sleeve and gland plate shall be sourced from their principals. Seal drawings shall be from the principals or duly vetted by principals.
5	Any seal offered under "Engineered Seal" category or when seal area/stuffing box is subjected to operating pressure $\geq 20\text{Kg/cm}^2\text{g}$ (i.e. seals having MDSP $\geq 20\text{Kg/cm}^2\text{G}$) shall undergo the following Seal Acceptance Test (SAT): All seals installed in one pump per item / tag shall undergo SAT as per the following: "Four hour static test, four hour dynamic test and one hour cyclic test with test fluid selection as per API 682 and test conditions commensurate with either API 682 test conditions or the conditions expected during operation in normal as well as start-up / shut-down conditions, whichever is more stringent. However for temperature, API limit of 260 degree C may be followed for testing in case of high temperature applications." Propane testing, as per API 682 4th Edn. Conditions, shall be carried out only for liquids with S.G < 0.6 & pumping temperature of -5degC to 176degC or for all flashing hydrocarbons with pumping temperature < -5degC. Additionally, for propane testing, in case operating pressures are higher than API 682 4th Edn. test conditions, additional seal acceptance testing with Diesel/Mineral oil (as applicable) shall be carried out at actual operating pressures(as per above). SAT certificates shall also be furnished as part of final documentation.
6	Mechanical seals to be suitable for maximum shut-off pressure under static conditions for pusher type seals. For Bellows seal, mechanical seal shall be suitable upto bellows design pressure, as a minimum.
7	Unless otherwise specified, Tank/Pit mounted vertical pumps, type VS4 (process service) shall be provided with dry running vapour seals as per vendor's standard. However, VS1 type pump (if specified) shall be provided with seals as per API 682.
8	In LPG service or HC containing LPG, double seals with dry running out board seals (with Plan 75, 76) shall not be used.
9	All the mechanical seal coolers (process side) shall have flange connection.
10	All the flushing oil line shall be without any short radius elbow.
11	All the piping on pump skids i.e. bearing cooling water, seal cooler shall be SS metallurgy and minimum size shall be $\frac{3}{4}$ inch dia.
12	Barrier or Buffer oil used in mechanical seal pots of pumps handling pumping liquid >250 Deg C shall be synthetic oil to prevent coking & fouling of seals.

3.3.7.2 CENTRIFUGAL/SCREW COMPRESSORS

S.No.	Project Philosophy
1	Centrifugal Compressors/Oil free screw compressors (for gas service) shall be provided with Dry Gas Seals except for services (like Air, N2 etc.) where normally labyrinths shall be used for sealing. Even for N2 service (with some contaminant) dry gas seal may be considered. Oil flooded screw compressors shall be provided with mechanical contact seals with seal oil system.

S.No.	Project Philosophy
2	The offered model of Dry Gas Seal shall be field proven and similar in terms of specified process gas service, shaft diameters, speeds, sealing pressures and configuration as compared to at least TWO Units designed, manufactured, tested and supplied and at least ONE of these units shall have completed at least one year of operation as on the bid due date of main (driven) equipment. Compressor vendor shall be asked to furnish past supply experience list of the seal manufacturer for the offered model of seal and justify meeting acceptance criteria.
3	The offered dry gas seal skid and panel shall be field proven and similar to the specified operating parameters as compared to at least TWO UNITS designed, manufactured, tested and supplied by the proposed manufacturer and at least ONE of these units shall have completed at least one year of operation as on the bid due date of main (driven) equipment. Compressor vendor shall be asked to furnish past supply experience list of the seal manufacturer for the offered model of dry gas seal skid and panel and justify meeting acceptance criteria. In case PTR of the foreign principal is provided for qualification, Dry Gas Seal Skid & Panel drawings shall be from Principal/Duly vetted by Principal.
4	Dry gas seals shall be bi-directional and of cartridge design. Configuration for Dry Gas Seal shall be Tandem with intermediate labyrinth unless specified otherwise. Lift off speed of seal faces shall be below the compressor train minimum operating speed including the shop speed for performance test.
5	Dry gas seals & sealing system (Primary seal gas supply and vent) shall be designed for Compressor Casing MAWP.
6	Seal gas skid shall be compact and design shall ensure that there is no condensate ingress in dry gas seals.
7	Unless otherwise specified, Dry Gas seal skid & panel (including all related instrumentation) shall be procured from Dry Gas Seal supplier.
8	Seal Gas Skid shall be compact and the design shall ensure that there is no condensate ingress in the dry gas seals.

3.3.7.3 ADDITIONAL EQUIPMENT

S.No.	Project Philosophy
1	NIL

3.3.8 DRIVE ARRANGEMENT

S.No.	Project Philosophy
1	All equipment shall be either directly driven or driven through gear box. However, belt driven arrangement (only Toothed belt) may be used for Reciprocating/Diaphragm Compressors upto driver rating of 160 kW.
2	Belt drive arrangement may also be provided for other rotating equipment e.g. roots blowers etc.
3	Belts used for equipment located in hazardous area shall be static non-conducting type and shall be certified suitable for the area classification. Approach to be provided for belt replacement. Belts shall confirm anti-static ISO 9563 along with water resistant
4	All pulleys shall be provided with taper lock bushes.
5	All general purpose steam turbines shall be equipped with brush seals.

3.3.9 COUPLINGS

S.No.	Project Philosophy

S.No.	Project Philosophy
1	Unless otherwise specified, Couplings shall be of metallic, non-lubricated, flexible element type (i.e. either diaphragm or discs) with spacer, for all equipment. All coupling models shall be selected for a minimum service factor of 1.5 over driver rating. DBSE shall be more than the seal cartridge length.
2	Couplings for the following equipment shall conform to API Standard 671: - Centrifugal compressors (API Std. 617) - Special purpose Steam Turbines (API Std. 612) - Gas Turbines (API Std. 616) - Rotary Screw Compressors (API Std. 619) - Packaged Integrally Geared Air Compressor (API Std 672) - Multi-stage (greater than two stages) centrifugal pumps with Forced lubrication system & speed greater than 3000 rpm. However, in case of gearbox driven multistage pumps, both low speed and high speed couplings shall conform to API 671
3	Couplings as per manufacturer's standard may be supplied for the following equipment: - Reciprocating Compressors - Packaged Rotary Compressors (Screw type for Plant & Instrument Air Service) - Diesel/Gas/Crude Oil Engine driven equipment - High speed integrally geared pumps The couplings for the above equipment shall however comply to the requirements of the individual codes as applicable for the equipment above (e.g. API-618 for Recip Compressors etc.).
4	Universal type coupling (hook joint) can be used for engine and driven equipments.
5	Removable coupling guard shall be provided which shall be fabricated from non-sparking material, and shall be open at the bottom to permit manual shaft rotation. The guard shall be sufficiently rigid to withstand deflections as a result of bodily contact of nominally 100 kgs. Coupling guard shall have a hinge to open and inspection window to see the healthiness of the coupling shims. Centrifugal compressors and Gas Turbines coupling guards may have vendor standard features.

3.3.10 ALLOWABLE NOISE LEVEL

S.No.	Project Philosophy
1	Equipment noise level (Driver + Driven equipment train + auxiliaries) shall not exceed 85 dBA when measured at One-meter distance from the equipment skid in any direction. This requirement is not applicable for equipment for infrequent operation such as diesel engine driven fire water pump package/emergency DG/GEG/CEG Sets.
2	All equipment shall meet the local/central statutory requirements for Noise and emission controls.
3	Acoustic hoods shall not be used for any equipment except for DG sets (upto 1500KVA), gas turbines, rotary compressors and roots blowers.

3.3.11 EQUIPMENT STORAGE

All rotating equipment shall be packed for an outside storage period of twelve (12) months. Equipment vendor to ensure the following before despatch:

- All the openings shall be plugged & sealed condition during dispatch
- Instruments like gauges, speed indicators, probes, oiler etc shall be removed from the main equipment and dispatched separately to avoid the damage of these components during transportation handling and erection.
- In addition to normal packing the pump and motor skids shall be separately covered with

transparent polythene cover with opening for piping.

3.3.12 INITIAL FILL

The initial fill of lubricants, sealing fluid & other consumables shall not be included in the scope of supply of rotating equipment vendor. However vendor shall furnish list of recommended make oils for bearing lubrication & seal pot buffer Liquid (as applicable).

3.3.13 INSTALLATION CRITERIA

3.3.13.1 PUMPS

S.No.	Project Philosophy
1	All pumps shall be suitable for outdoor installation. No equipment shelter is envisaged.

3.3.13.2 COMPRESSORS

S.No.	Project Philosophy
1	Unless otherwise indicated, process gas compressors shall be located under-roof with side walls partially open.
2	Centrifugal compressors driven by gas turbine: All centrifugal compressors driven by gas turbine can be installed on ground floor (i.e. on finished floor level) with air filtration system located outside the compressor house. A provision of suitable rain-hood / shelter adjacent to the proposed compressor house can protect the filters from high humidity & long monsoon period. Further air needs to be drawn from safe area.
3	Centrifugal compressors driven by steam turbine/Axially split Centrifugal Compressor driven by motor: All centrifugal compressors driven by steam turbine/ Axially split Centrifugal Compressor driven by motor shall be installed on Mezzanine floor with adequate working platform all around and drop out facility for maintenance. Other associated auxiliaries such as lube oil system, surface condenser, gland steam condenser, Condensate extraction pumps etc. shall be located on ground floor (i.e. on finished floor level).
4	Radially Split Centrifugal compressors driven by electric motor: All barrel centrifugal compressors driven by electric motor shall be installed on ground floor (i.e. on finished floor level). However, in case in the vicinity of such compressor, other compressors are being installed on the mezzanine floor, then electric motor driven radially split centrifugal compressor shall also be installed on the mezzanine floor with adequate working platform all around and drop out facility for maintenance. Other associated auxiliaries such as lube oil system etc. shall be located on ground floor (i.e. on finished floor level).
5	Integrally Geared Packaged Centrifugal Compressors/Rotary Screw Compressor: All Integrally Geared Packaged Centrifugal Compressors/Rotary Screw Compressor can be installed on ground floor (i.e. on finished floor level). Air filtration system, as applicable shall be located outside the compressor house.
6	Reciprocating multi-stage/multi-cylinder compressors: Reciprocating compressors shall be so located that no trenches are required for volume/pulsation bottles. Large reciprocating multi-stage/multi-cylinder compressors shall be installed on Mezzanine floor with its interstage piping/auxiliary equipment located on the ground floor. Skid mounted reciprocating compressors can be located on finished floor level.
7	Reciprocating air compressors (skid mounted) can be located outdoor without an equipment shelter.

3.3.13.3 STEAM TURBINE GENERATORS

S.No.	Project Philosophy
1	All STGs shall be located under-roof with side walls partially open and shall be suitable for outdoor installation.
2	All STGs shall be installed on Mezzanine floor. Other associated auxiliaries such as lube oil system, surface condenser, gland condenser, condensate extraction pumps etc. shall be located on ground floor (i.e. on finished floor level).

3.3.13.4 DIESEL/GAS/CRUDE OIL ENGINE & GAS TURBINE DRIVEN GENERATING SETS

S.No.	Project Philosophy
1	All GEG/CEG/DG & GTGs shall be installed on ground floor (i.e. on finished floor level) under roof/generator set room. DG sets (rating upto 1500 kVA) may not require a roof/genset room.
2	DG Sets of rating higher than 1500 kVA and GEG/CEG sets shall be installed in an acoustically treated room/building.

3.3.13.5 GENERAL

S.No.	Project Philosophy
1	All other rotating equipment shall be suitable for outdoor installation and shall be installed on ground floor (i.e. on finished floor level). No equipment shelter is envisaged.

3.3.14 MATERIALS

The material of construction of the wetted parts of rotating equipment shall be as specified in the process package. Other material shall be suitable for minimum MDMT specified elsewhere.

3.3.15 HEAT EXCHANGERS

3.3.15.1 LUBE OIL COOLERS

S.No.	Project Philosophy
1	Coolers shall be water-cooled, shell and tube type as per TEMA 'C' with oil in shell and water in tube.
2	The oil side operating pressure shall be higher than water side operating pressure.
3	For shell-and-tube heat exchangers, the low pressure (LP) side shall be preferably specified with a design pressure at least equal to 10/13 of high pressure (HP) side design pressure.
4	The material of construction shall be suitable for the specified service and as per governing API specification.

3.3.16 SAFETY

S.No.	Project Philosophy

S.No.	Project Philosophy
1	Equipment design and engineering shall incorporate adequate safety features [as per applicable specifications of respective equipment as well as environment codes (if any) & standards applicable for the subject project] to provide protection to equipment and environment.
2	Thermal relief valves shall be provided for components that may be blocked in by isolation valves (including any cooling water return circuit piping of a cooler or a jacket). Set pressure for Thermal Relief Valve shall be less than or equal to the design pressure of cooling water return header as indicated in BEDB.
3	All electrical components & installations, instruments shall be suitable for the electrical area classification and grouping in which the equipment is installed.

3.3.17 INSPECTION AND TESTING

S.No.	Project Philosophy
1	Each rotating equipment shall be subjected to mechanical run test at vendor's works.
2	Each rotating equipment shall be subjected to a performance test at vendor's works except the following: - Steam Turbines (Special / General Purpose) - Reciprocating Compressors (Other than for Air Service) - Reciprocating Air Compressors with suction pressure other than atmospheric pressure.
3	Unless otherwise specified, complete unit test at manufacturer's works will be specified for the following equipment as a minimum: - Gas Turbine Driven API 617 Centrifugal Compressor - Electrical Motor Driven Horizontal Multistage API 610 Centrifugal Pumps with force feed lubrication system. - GTG/GEG/DG/CEG Sets.
4	All other requirement with regard to inspection & testing shall be as specified in the inquiry document.
5	Owner and/or his Consultant may participate along with the their inspectors in any inspection and tests. The vendor shall notify to owner of all inspection and tests atleast four weeks before the scheduled date of inspection and test and reconfirm the same at least one week before the date of inspection and testing.

3.3.18 SCOPE OF SUPPLY AND WORK

Scope of supply and work shall be as indicated in the inquiry document.

3.3.19 INTERFACE

Equipment nozzles especially at purchaser's interface shall be as per purchaser's piping specifications.

In case, non-standard sizes are unavoidable, companion flanges along with gaskets and fasteners shall be procured from the equipment vendor.

3.3.20 ERECTION OF EQUIPMENT

Erection of all rotating equipment shall be carried out by the mechanical works contractor, under the supervision of equipment vendor.

3.4.0 SPECIFIC DESIGN REQUIREMENTS

Specific design Requirements shall be as indicated in the standard specifications for the relevant rotating equipment. Refer Table-1 for the applicable standard specifications.

3.4.1 CENTRIFUGAL PUMPS

S.No.	Project Philosophy
1	The maximum impeller diameter for a single stage overhung pump design operating with 2-pole (50Hz motor), shall not exceed 17 inches (430 mm). Further $I(SF)$ [as per equation K.2 of Annexure K of API 610 12th Edn] ≤ 1.2 times the value from equation K.4 of Annexure K (Refer API 610 12th Ed. for Annexure – K & L3/D4 calculations) shall be followed for all pumps operating with 2-pole (50Hz) motor.
2	Double suction single stage, two-stage & multi-stage pumps shall be of in-between bearing types.
3	No cast iron pressure containing parts shall be used for hydrocarbon service except for shaft driven lube oil pumps.
4	Suction flange rating shall be same as that of discharge flange for all pumps.
5	Inducers shall not be used except for integrally geared type of pumps.
6	Hydraulic Power Recovery Turbines shall be optimised for best efficiency at Normal Flow.
7	Pumps shall be provided with constant level oiler & bearing isolators suitable for normal splash lubrication. Bearing isolators shall be of non-contact type and shall meet the requirements of API 610.
8	All high temperature pumps with hot circulation provision shall have provision of hot liquid circulation from pump bottom to suction line. This will ensure uniform heating of complete pump.
9	For non API pumps, unfiltered vibration limit at vendor test bed and site test shall be governed by ISO 10816-7 (Table: A.1 & A.2). Limits mentioned in this standard shall be measured & applicable in radial (X & Y direction) and axial directions.
10	All multistage horizontal centrifugal pumps intended for high temperature service ($PT > 120^{\circ}C$) shall be provided with pump casing - skin temperature monitoring system consisting of the following: - Four thermocouples along with Yoke mounted temperature transmitters with integral indicators for each thermocouple. - One Junction Box (JB) to be mounted on pump base plate. - Cables between the thermocouples and transmitters. - Cables between transmitters and junction box.
11	All rotating equipment base plates shall have jacking provision for aligning the prime movers.
12	All LCWS pumps shall be provided with suitable coating. However during pump evaluation & testing will be carried out without considering coating. Pumps shall be coated before despatch.
13	Baseplate drain shall be provided with 2" flanged connection.
14	Single and two-stage pumps operating at temperatures less than $150^{\circ}C$ and multi-stage pumps operating at temperatures less than $120^{\circ}C$ shall be suitable for instantaneous startup from ambient to full operating temperature. For higher operating temperatures the vendor shall provide suitable hardware (i.e. piping, valves & fittings) & as part of the operating manual a suitable startup procedure shall be provided. Any required monitoring equipment (i.e., skin thermo couples) to ensure that the pump, including seal(s), does not incur damage due to rapid heat up shall be supplied by pump vendor.
15	Pumps shall be selected to have their rated operating point falling in the range of 70% to 110% of best efficiency point (BEP) flow of the rated impeller except for low flow pumps (≤ 20 m ³ /hr) or pump rated BkW upto 15 kW.
16	All small bore lines on pump skids shall be fabricated of SS metallurgy.
17	All the flanged joints of the vertical pumps shall be of standard rating

S.No.	Project Philosophy
18	Vertical Non API Centrifugal water service Pumps shall meet the unfiltered Vibration Velocity limits as per ISO 10816
20	Unless otherwise specified, Between bearing pumps are required in case wherein pump design temperature is above 250 deg C
21	Pumps shall have NPSH margin of 1m over NPSHr at rated point

3.4.2 RECIPROCATING PUMPS

S.No.	Project Philosophy
1	All reciprocating pump (reciprocating pumps as per API 674 & and controlled volume/metering type as per API 675) units shall be procured complete with speed reducer, driver, suction pulsation dampener (if required or specified), discharge pulsation dampener, relief valves, instrumentation, suction & discharge manifolded piping duly pre-fabricated for multi-head pumps etc. all duly mounted on a single common base plate as a skid mounted package.
2	All controlled volume pumps (as per API 675) shall be hydraulically operated double diaphragm type with rupture detection system for each head. This system shall contain PG & PT as per Instrumentation Specifications.
3	All controlled volume pumps (except for pneumatically driven solenoid or by an AC operated solenoid) shall have positive return stroke mechanism. Controlled volume pumps with lost motion design or with spring return stroke mechanism shall not be permitted.
4	Pulsation suppression shall be provided at the discharge of all metering pumps. When necessary Pulsation dampener shall be provided at suction to maintain adequate margin between NPSHA & NPSHR.
5	For pulsation dampeners, the first preference shall be for volume bottle type dampener and if the same is not sufficient a bladder type N2 pre-charged dampener shall be provided. In that case, Vendor shall also supply the N2 pressure regulator along with gas charging kit.

3.4.3 PACKAGED INTEGRALLY GEARED CENTRIFUGAL AIR COMPRESSOR

S.No.	Project Philosophy
1	Air Compressors for Instrument Air service shall be of minimum 3 stages.
2	Unless otherwise specified, Oil cooler, Intercooler and Aftercooler should be as per proven manufacturer standard design, however coolers shall be shell and tube design with removable tube bundle and water in tube type. Material of construction shall be as specified in data sheet.
3	Driver rating shall be at least 110% of Compressor rated BkW at rated condition or BkW at unthrottled min. ambient temp. & maximum Atm. Pressure whichever is higher.
4	Individual components such as compressor, gear box & Intercoolers shall be individually maintainable without interference with each other. Intercoolers integral with compressor casing are not acceptable.

3.4.4 RECIPROCATING COMPRESSORS

S.No.	Project Philosophy
1	Horizontal Reciprocating compressor of BkW greater than 160kW will be balanced opposed type.
2	Unless otherwise specified, rotational speeds of reciprocating compressors in hydrogen rich service (Mol Wt. Less than 12) shall generally be limited to a maximum of 350 rpm.

S.No.	Project Philosophy
3	Unless otherwise specified, reciprocating compressors shall be skid mounted packages upto a motor rating of 300 kW.
4	Mechanical Run Test shall be carried out with shop lube oil system.
5	In case the compressor are designed for dual services like nitrogen and hydrogen, compressor valves shall be suitable for both the services. Compressor vendor shall inform the limitation, if any, for continuous operation period of these valves on dual service. In case, compressor valves are not suitable for both service conditions, separate set of valves shall be provided for each service conditions. Additionally, mandatory spare part list shall also include each set of valves for respective service conditions.
6	All supports for Suction, Discharge and other piping shall be taken from grade. No support shall be taken from compressor house columns or other compressor house structural members.
7	Drain of Suction volume bottle shall be routed to separate drain pot. Drain pot should not be integral part of suction volume bottle. Drain pot shall be equipped with instrumentation for auto draining on level.
8	Unless otherwise specified, stepless capacity control system shall be provided for all reciprocating compressors (except labyrinth type) with driver rating ≥ 1 MW.
9	Closed circuit cooling water system shall be provided for compressors and in case of single unit for multiple compressors, the cooling water supply for cooling water skid shall be isolatable for each compressor.
10	Unless otherwise specified, Labyrinth Compressor shall be a vertical labyrinth piston compressor with metallic labyrinth. Use of non-metallic flexible labyrinths is permitted only for clean & non-polymerising gases.

3.4.5 LIQUID RING VACUUM PUMPS/COMPRESSORS

S.No.	Project Philosophy
1	The vendor for the complete unit shall be an established manufacturer of LRVP and he shall also be the manufacturer of the proposed LRVP having adequate engineering, manufacturing & testing facilities for the same.
2	The LRVP model offered shall be from regular manufacturing range of the manufacturer and shall meet the following minimum experience requirements: LRVP shall be identical in terms of model & similar in terms of power rating, Rotational Speed, Inlet and discharge pressures, Inlet temperatures, Actual Inlet flow, process gas, Mechanical Design, Materials, Type of shaft seals etc. as compared to at least ONE unit designed, manufactured, tested and supplied from the proposed manufacturing plant and as a minimum, this package shall have completed one year of satisfactory operation at site, as on bid due date. (Similar means 80% or higher for power rating, Rotational Speed, Inlet and discharge pressures, Inlet temperatures, Actual Inlet flow)
3	The motor name plate rating (with service factor equal to one) shall be atleast 110% of the maximum power required (including gear and coupling losses) for any of the specified operating conditions or for power required at RV set pressure whichever is higher.

3.4.6 POSITIVE DISPLACEMENT (ROOTS TYPE) BLOWER

S.No.	Project Philosophy
1	The vendor for the complete unit shall be an established manufacturer of roots blowers having adequate engineering, manufacturing and testing facilities for the same.

S.No.	Project Philosophy
2	The compressor model offered shall be from regular manufacturing range of the manufacturer and shall meet the following minimum experience requirements: Blowers shall be identical in terms of model & similar in terms of power rating, Rotational Speed, Inlet and discharge pressures, Inlet temperatures, Actual Inlet Flow, Process Gas, Mechanical Design, Type of Rotor, Rotor Dynamics, Materials etc. as compared to at least ONE units designed, manufactured, tested and supplied from the proposed manufacturing plant and as a minimum, this package shall have completed one year of satisfactory operation at site, as on bid due date. (Similar means 80% or higher for power rating, Rotational Speed, Inlet and discharge pressures, Inlet temperatures & Actual Inlet Flow)
3	The motor nameplate rating (with Service Factor equal to one) shall be at least 110% of the maximum power required for any of the specified operating conditions or for power required at RV set pressure whichever is higher.
4	RV set pressure shall be "Suction Pressure + 1.1 X Differential Pressure" only. RV can be of manufacturer's standard.

3.4.7 SEALLESS PUMPS

S.No.	Project Philosophy
1	The vendor shall be established sealless pump manufacturer having adequate engineering, manufacturing and testing facilities for the same.
2	The pump model offered shall be from the existing regular manufacturing range of the vendor. The mechanical as well as the hydraulic performance (including NPSHR) for the complete range of operation of the offered model shall have been established in the shop test. The offered pump model shall meet the following minimum experience requirements: Pumps shall be identical in terms of model & similar in terms of Mechanical Design and Operating/Service conditions of Capacity, Differential Head, NPSHR, Temperature, Pressure and Power rating, pump speed etc. as compared to at least ONE UNIT of the proposed model designed, manufactured, tested and supplied from the proposed manufacturing plant in the last ten years and as a minimum, this package shall have completed one year of satisfactory operation at site, as on bid due date. (Similar means 80% or higher for Operating/Service conditions of Capacity, Differential Head, NPSHR, Temperature, Pressure and Power rating, pump speed, etc.)

3.4.8 CRYOGENIC PUMPS

S.No.	Project Philosophy
1	The vendor shall be a Cryogenic pump manufacturer having engineering, manufacturing and testing facilities for the same.

S.No.	Project Philosophy
2	The pump model offered shall be from the existing regular manufacturing range of the vendor. The mechanical as well as the hydraulic performance (including NPSHR) for the complete range of operation of the offered model shall have been established in the shop test. The offered pump model shall meet the following minimum experience requirements: Pumps shall be identical in terms of model & similar in terms of Mechanical Design and Operating/Service conditions of Capacity, Differential Head, NPSHR, Temperature, Pressure and Power rating, pump speed etc. as compared to at least ONE UNIT of the proposed model designed, manufactured, tested and supplied from the proposed manufacturing plant in the last ten years and as a minimum, this package shall have completed one year of satisfactory operation at site, as on bid due date. (Similar means 80% or higher for Operating/Service conditions of Capacity, Differential Head, NPSHR, Temperature, Pressure and Power rating, pump speed etc.)

3.4.9 SPECIAL PURPOSE GEAR UNITS

S.No.	Project Philosophy
1	The vendor shall be a Special purpose gear manufacturer having engineering, manufacturing and testing facilities for the same.
2	The offered gearbox models shall be of proven design and shall be from the gearbox manufacturer's existing regular production range. Each of the gearbox model offered shall be identical in terms of model series & similar in terms of size (centre to centre distance, power rating, pinion speed, bearing journal speed, pitch line velocity and tooth profile) as compared to at least ONE UNIT designed, manufactured, tested and supplied by the vendor earlier from the proposed manufacturing plant and as a minimum, this package shall have completed one year of satisfactory operation at site, as on bid due date. (Similar means 80% or higher for size i.e. power rating, pinion speed, bearing journal speed & pitch line velocity)
3	In case of alternators, gears shall be designed for short-circuit condition of the alternator.
4	Gears shall be double helical type.

3.4.10 ADDITIONAL EQUIPMENTS

S.No.	Project Philosophy

S.No.	Project Philosophy
1	ID Fans / FD Fans / Centrifugal fans and blowers: (a) First critical speed of the rotor shall be higher than 120% of rated speed. (b) The fan/ blower casing shall be suitably split such that impeller assembly can be removed for maintenance without disturbing inlet and outlet ducting. (c) SS Bolt and nuts shall be provided for the split casing joints of fans/blowers for corrosive services. (d) Fans operating in hot gas service shall be provided with a deflector plate or other suitable provision between shaft seal and bearing housing to deflect hot gas leakage away from the bearing housing. (e) Inlet guide vanes, if specified, shall be provided with following: • An external guide vane position indicator. • Spindles shall be supported at both ends. • Manual operation of guide vane from grade level shall be possible. • The guide vane ring shall be protected by a dust cover which shall allow full access to all parts for inspection. • Dampers shall be louver type with opposed blade.
2	Axial Flow Propeller Pumps
2.1	The vendor shall be a Axial Flow Propeller pump manufacturer having engineering, manufacturing and testing facilities for the same.
2.2	The pump model offered shall be from the existing regular manufacturing range of the vendor. The mechanical as well as the hydraulic performance (including NPSHR) for the complete range of operation of the offered model shall have been established in the shop test. The offered pump model shall meet the following minimum experience requirements: Pumps shall be identical in terms of model & similar in terms of Mechanical Design and Operating/Service conditions of Capacity, Differential Head, NPSHR, Temperature, Pressure and Power rating, pump speed etc. as compared to at least ONE UNIT of the proposed model designed, manufactured, tested and supplied from the proposed manufacturing plant in the last ten years and as a minimum, this package shall have completed one year of operation at site, as on bid due date. (Similar means 80% or higher Operating/Service conditions of Capacity, Differential Head, NPSHR, Temperature, Pressure and Power rating, pump speed, etc.)
3	Revamp of Rotating Equipment A General i. The requirement laid down in this section are the minimum technical requirements for carrying out revamping works of rotating equipment. ii. Revamped equipment along with its driver and auxiliary system meets the mechanical and hydraulic performance requirements for the revised process parameters. iii. Revamped equipment shall conform to the applicable codes and specifications. iv. Revamping of rotating equipment shall be done by Original Equipment Manufacturers only. v. Revamped equipment shall be integrated with the existing units. vi. Revamp of all equipment's to be done at site only, however if it is required for critical equipment (compressor/multistage pumps), the same can be sent to manufacturer's shop, provided it is done in the shut down duration envisaged in the bid package.

S.No.	Project Philosophy
3.1	For Revamp of Centrifugal Pumps: i. Normally revamp of centrifugal pumps involves modifications of pump internals, supply of new electric motor driver, new coupling and new coupling guard, etc. Any change in the pump casing, base plate and sealing system are not envisaged (except wherever these changes are specified /expected). Supply of all these components/accessories to be included by the pump vendor in his scope of supply. ii. In order to accommodate new motor, any modifications in the existing base plate, if required, shall be carried out by the pump vendor. As a first attempt, only the motor footprints shall be considered for modification, which can be done without changing the base plate/foundation. iii. No modifications in the existing foundation are envisaged for the post revamped operating conditions of the pumps (except wherever these Changes are specified /expected). The existing foundation drawing along with anchor bolt location to be provided to check foundation suitability. iv. The adequacy of the existing coupling for the revised operating conditions shall be checked. In case, the existing coupling is found inadequate then the pump vendor shall include new couplings suitable for the revised condition.
	v. Vendor to indicate the revised impeller diameter (mm). All the new impellers to be installed in the existing pumps shall be supplied with wear rings and casing wear rings, etc. Material of construction of the new impellers shall be same as that of the existing impeller unless otherwise specified. vi. The materials/ components & other spares required for revamp of the equipment shall be procured from the OEM. vii. Pump vendor shall prepare detailed pump modification plan & submit the same along with filled in mechanical data sheet of the pump & motor & performance curve for each equipment viii. All the modifications required e.g. fitment of the new impeller, installation of new coupling & motor, modification of the existing base plate, etc or any additional modification recommended shall be carried out at site. ix. After the completion of all the modifications, the subject pumps shall be run at site for minimum four hours and the general performance (mechanical and hydraulic) of the pump shall be verified.

S.No.	Project Philosophy
3.2	For Revamp of Compressors i. Based on the revised operating conditions, compressor vendor shall carry out adequacy check of existing compressors and confirm suitability of existing compressors for the revised operating conditions with respect to Material, design pressures, design temperatures, flow rates, critical speeds etc. In addition to the adequacy check of the compressors, adequacy check shall be carried out for existing drivers, lube oil system, sealing system, anti surge control system, instrumentation and controls. Modification required, if any, in these equipments, systems, auxiliaries /accessories including replacement if any shall be in vendor's scope of supply/work. ii. Compressor vendor shall undertake a site visit if required, to ensure that the components that are to revamped/modified are suitable for revamp/ modification. The equipment supplier shall bring the components /systems almost to original condition. iii. Vendor to do the adequacy check of the coupling (between the compressor and the driver) and Replacement of the coupling (if required). iv. Vendor to perform Lateral Analysis (wherever required) and Torsional analysis of the complete compressor –driver train. Vendor to provide services for technical supervision for the following: -Modifications required in the compressor package associated auxiliary systems (if any) -Re-commissioning of the revamped unit -Field Testing at site vi. Vendor to supply additional items not specified by the Owner but recommended by the vendor for safe, smooth and efficient operation of the compressor package

3.5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

S.No.	Project Philosophy
1	All equipment shall be packaged from vendor's works considering minimum storage period of 12 months in outdoor condition. Packings should enable following equipment mothballing practices - shaft movement, oil change for bearings, Nitrogen pressure inside wetted parts of equipment to avoid ingress of moisture & rust prevention including periodic checking of N2 pressure with refilling facility.
2	Dry Gas Seals performance test should be witness by BPCL/ Competent third party.
3	Inspection of imported equipment's should be witness by BPCL / Competent third party
4	In case of single operating machine with no standby, duplex oil cooler shall be considered. Wherever duplex oil coolers are installed, they must be with online change over system
5	Multiple servomotors in a single steam control valve of steam turbines shall be avoided.
6	All mechanical seal system shall be provided with transmitters at secondary seal pot level & pressure instead of switch.
7	Hydrocarbon service pump shall have all plugs (casing/Nozzle) in welded condition
8	All pumps shall have pressure gauges at pump suction and discharge piping
9	No pump shall have grease lubrication without the approval of customer (except small vertical pumps)
10	Cooling water pumps shall have internal ceramic coating
11	Non-metallic wear rings in cooling water pump shall be used.
12	All Reciprocating compressor shall have double NRV in lubricator loop and loader/unloader indicator pin

S.No.	Project Philosophy
13	Bearing RTD vibration in 2oo3 logic & axial position in 2oo2 shall be considered for trip
14	All standalone rotating equipment with Forced lubrication shall have Machine Condition Monitoring System
15	For forced feed lubrication, lube oil sampling point to be given in each bearing lube oil drain piping for the purpose of sampling on routine basis to analyze the bearing deterioration.
16	Wherever more than one Turbomachinery's are installed in a single compressor structure/shed, Single EOT is not sufficient then minimum 2 EOTs to be provided with anti-collision mechanism.
17	Rotary equipment OEM to mention the suffix and prefix of the antifriction bearings in part list instead of mentioning only bearing numbers. Antifriction bearings make to be of either SKF or FAG, please refer note enclosed herewith.
18	The rotary equipment OEM should include a Unique Part Number of each item listed in the equipment cross section drg, seal drawings to facilitate the identification of interchangeable spare parts by the user.
19	All Motor antifriction bearings on drive and non-drive end shall have greasing facility to lubricate the bearings at site and get the maximum bearing life.
20	Standalone centrifugal compressors shall be equipped with transmitters to measure: a. Lube oil inlet pressure to all bearings b. Lube oil filter differential pressure c. Secondary oil pressure for turbines, including trip oil pressure and governing oil pressure d. Governing oil differential pressure e. After cooler temperature f. Current for motors g. Lube oil discharge pressure h. Lube oil header pressure i. All DGS parameters.
21	Critical equipment shall have Lube oil systems shall feature online moisture and particle analyzers.
22	Pump operation, even at extreme points of the pump curve, shall maintain NPSHR below NPSHA throughout the curve.
23	Pump strainer mesh size shall be specified in datasheets.
24	Critical equipment shall include lubrication sample points for oil analysis.
25	Base plates shall be sloped for proper liquid drainage.
26	Slurry pumps and equipment encountering catalyst presence shall feature anti-abrasive/anti-erosive casing coatings and detailed flushing specifications.
27	API Seal plan 23 shall have venting to flare header and PT at seal inlet
28	Separate valve provision in API plan 53 loop to check the bladder N2 pressure without draining the pump fluid
29	In case of CBD pump is provided with ECS seal system N2 Blanketing shall be provided.
30	Pump shall be provided with desiccant breather ,watchdog constant level oiler, separate oil sample point(if In case separate sample point is not possible it must be thru bearing housing drain)& magnetic drain plug.
31	Critical equipment shall feature vibration monitoring systems with casing vibration sensors and temperature sensors.

Notes:

3.6.0 MATERIAL HANDLING FACILITIES FOR NORMAL MAINTENANCE OF EQUIPMENT

3.6.1 MATERIAL HANDLING FACILITIES

Equipment layout shall incorporate adequate maintenance platforms, support structures, hand rails, operational access, material handling facilities for inspection and maintenance of equipment & for operation of these facilities. Non-skid decking covering all walk & work

areas shall be provided on top of the base plate, as required.
Material handling facilities for normal maintenance of rotating equipment shall be provided as per the following criteria:

S.No.	Type of Equipment	Type of Maintenance Facility
1	Centrifugal Pumps	Refer Piping EDB
2	Reciprocating Pumps excluding Metering Pumps	Refer Piping EDB
3	Centrifugal Compressor (Gas)	EOT Crane
4	Plant & Inst. Air Compressor (Centrifugal)	EOT Crane
5	Reciprocating Compressor (Gas)	EOT Crane
6	STG/GTG	EOT Crane
7	GEG/DG/CEG Sheds	
8	< =1500 kVA	Trolley mounted CP Block + Monorail
9	> 1500 kVA	EOT Crane / HOT Crane
10	Pump Houses	HOT Crane

Note-1: Electric motor driver/ alternators (if applicable) shall be considered as a single component for maintenance except for single bearing electric motors where motor stator & rotor shall be considered as individual components.

Note-2: Electric power generator shall be considered as a single component for maintenance except for single bearing electric power generator where generator stator & rotor shall be considered as individual components.

Note-3: Where the equipments are installed in open area, no permanently installed material handling facility shall be provided.

3.7.0 SPARE PARTS

3.7.1 MANDATORY SPARES

Mandatory spares shall be procured along with the main equipment, if specified by the client. Such spares for each equipment item shall be as per the below table. These spares include only those spares, which are critical for equipment and require longer delivery periods. Unit price of each of the listed spares shall be indicated separately in the Proposal.

S.No.	Description	Description of Mandatory Spares(Qty per Item Tag No.)(i.e. Total qty for working and standby)
1	PUMPS:	
1.1	Centrifugal Pumps Multistage Horizontal (Special Purpose Process Service) / Hydraulic Power Recovery Turbine	1 set of pump element assembly including dynamically balanced rotor (Only for multi-stage horizontal centrifugal barrel type) -- OR -- 1 set of dynamically balanced rotor (Only for multi-stage horizontal centrifugal axial split type) + 1 set of mechanical seals + 1 set of bearings + 2 set of gaskets + 2 set of O-rings + 400% lube oil filter cartridges (if applicable)

S.No.	Description	Description of Mandatory Spares(Qty per Item Tag No.)(i.e. Total qty for working and standby)
1.2	Centrifugal Pumps Single/Two stage (Special Purpose Process Service) Horizontal/Vertical	1 set of shaft & impellers + 1 set of mechanical seals + 1 set of bearings + 2 set of gaskets + 2 set of O-rings + 400% lube oil filter cartridges (if applicable)
1.3	Centrifugal Pumps (General Purpose Process Service)	1 set of shaft & impellers + 1 set of mechanical seals + 1 set of bearings + 2 set of gaskets + 2 set of O-rings
1.4	Centrifugal Pumps (General Water Service)	1 set of shaft & impellers +1 set of mechanical seals (if applicable) + 1 set of bearings + 1 set of gaskets + 1 set of O-rings
1.5	Centrifugal Pumps (Slurry & Liquor Service)	1 set of shaft & impellers + 1 set of mechanical seals + 1 set of gaskets + 1 set of O-rings
1.6	Positive Displacement Pumps (Reciprocating)	1 set of valve assembly +1 set of bearings +1 Set of worm shaft and worm wheel +1 Set of gaskets/packing/ O-rings
1.7	Positive Displacement Pumps (Controlled Volume)	1 set of valve assembly +1 set of diaphragms +1 set of bearings +1 set of packings/gaskets/O Rings
1.8	Positive Displacement Pumps (Rotary)	1 set of rotor assembly + 1 set of mechanical seals + 1 set of bearings +1 set of packings/gaskets/O Rings
1.9	Liquid Ring Vacuum Pumps/Compressors	1set of dynamically balanced rotor + 1 set of bearings + 1 Set of shaft seals + 1 set of packings/gaskets/O Rings
1.10	Seal-less Pumps	1 Set of dynamically balanced assembled rotor plus removable stationary hydraulic parts [diffuser(s) or volute(s)], the back cover and containment shell (but not the volute/fixed diffuser casing) (in case of Magnetic driven pump) OR 1 set of back pull out assembly (excluding volute casing, baseplate) with dynamically balanced rotor (in case of canned motor pump) + 1 set of bearings + 1 set of gaskets + 1 set of O-rings
2	COMPRESSORS / FANS & BLOWERS	

S.No.	Description	Description of Mandatory Spares(Qty per Item Tag No.)(i.e. Total qty for working and standby)
2.1	Centrifugal Compressors/Blowers	1 set of dynamically balanced rotor + 1 set of compressor seals + 1 Set of O ring for diaphragm type rotor assembly. + 1 set of bearings + 1 set of labyrinths / carbon rings + 400% lube oil filter cartridges + 400% dry gas seal filter cartridges + 1 set of O ring for diaphragm type rotor assembly.
2.2	Axial Compressors	1 set of dynamically balanced rotor + 1 set of compressor seals + 1 set of bearings + 1 set of labyrinths / carbon rings + 400% lube oil filter cartridges + one set of O ring for diaphragm type rotor assembly.
2.3	Expander-Compressors	1 set of dynamically balanced rotor (Rotor implies complete machine centre section including bearing and seals) + 1 set of labyrinths / carbon rings + 400% lube oil filter cartridges + 400% dry gas seal filter cartridges +1 set of gaskets/O Rings
2.4	Integrally Geared Process Centrifugal Compressors	1 Set of Dynamically balanced Rotors (including all pinions, shafts and impeller) + 1 set of bearings + 1 set of compressor seals + 1 set of labyrinths / carbon rings + 400% lube oil filter cartridges + 400% dry gas seal filter cartridges +1 set of gaskets/O Rings
2.5	Centrifugal Fans	1 set of shaft & impeller + 1 set of seals + 1 set of bearings + 400% lube oil filter cartridges (if applicable) +1 set of gaskets/O Rings
2.6	Induced Draft / Forced Draft Fans	1 set of dynamically balanced rotor + 1 set of seals + 1 set of bearings + 400% lube oil filter cartridges (if applicable) +1 set of gaskets/O Rings
2.7	Packaged Integrally Geared Centrifugal Air Compressors	1 Set of Dynamically balanced Rotors (including all pinions, shafts and impeller) + 1 set of shaft seals + 1 set of bearing assemblies + 400% lube oil filter cartridges +1 set of gaskets/O Rings

S.No.	Description	Description of Mandatory Spares(Qty per Item Tag No.)(i.e. Total qty for working and standby)
2.8	Reciprocating Compressors (Utility & Instrument Air Service)	1 set of cylinder valve assemblies + 1 set of piston ring & rider band + 2 sets of packing (stuffing box + intermediate box). + 1 set of big end, small end and crank shaft bearings + 400% lube oil filter cartridges (if applicable) +1 set of gaskets/O Rings +One set of gaskets for complete compressor assembly including distance piece, cross head assembly, cylinder cover, etc. (as applicable). + One set of cross head bushing and pin.
2.9	Reciprocating Compressors (Process Service)	1 set of cylinder valve assemblies + 1 set of piston ring & rider band + 2 sets of packing (stuffing box + intermediate box). + 1 set of big end, small end and crank shaft bearings + 1 no. warehouse spare for auxiliary lube oil pump without electric motor + 400% lube oil filter cartridges +1 set of gaskets/O Rings +One set of gaskets for complete compressor assembly including distance piece, cross head assembly, cylinder cover, etc. (as applicable). + One set of cross head bushing and pin.
2.10	Positive Displacement Compressors (Rotary)	1 set of dynamically balanced rotor + 1 set of compressor seals + 1 set of bearing assemblies + 400% lube oil filter cartridges (if applicable) + 400% dry gas seal filter cartridges +1 set of gaskets/O Rings
2.11	Diaphragm Type Positive Displacement Compressors	4 Sets of Diaphragm + 1 set of bearings + 400% lube oil filter cartridges +1 set of gaskets/O Rings
2.12	Roots Blowers	1 set of dynamically balanced rotor +1 set of bearings +400% lube oil filter cartridges (if applicable) +1 set of gaskets/O Rings
3	MECHANICAL DRIVERS / GEAR BOXES	
3.1	Diesel Engines	1 set of seals + 1 set of gaskets/ O rings
3.2	Gas Turbines	1 set of seals + 1 set of gaskets/ O rings

S.No.	Description	Description of Mandatory Spares(Qty per Item Tag No.)(i.e. Total qty for working and standby)
3.3	Steam Turbines (General Purpose)	1 set of dynamically balanced rotor + 1 set of bearings + 1 set of seals + 1 set of gaskets/ O rings
3.4	Steam Turbines (Special Purpose)	1 set of dynamically balanced rotor + 1 set of bearings + 1 set of seals + 1 set of gaskets/ O rings
3.5	Special Purpose Gear Box	1 set of bearings +1 set of seals + 1 set of gaskets/ O rings
3.6	General Purpose Gear Box	1 set of bearings 1 set of seals + 1 set of gaskets/ O rings
3.7	Special Purpose Coupling	1 set of Coupling Shim Membranes + 1 set of Fasteners

Notes:

- 1 Element consists of assembled rotor plus stationary hydraulic parts [diffuser(s) or volute(s)].
- 2 The word "set" means the quantity required for full replacement of that part in one machine.
- 3 Spare rotors shall be boxed in a metal containers for vertical storage with nitrogen purging. Storage container shall be property of the owner. Storage metal container shall be provided with Pressure Indicator & Nitrogen cylinder for ensuring recommended positive pressure so as to cater transit requirements.

3.7.2 COMMISSIONING SPARES

Commissioning Spare Parts shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended spares shall be obtained along with the offer. Any commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor. Any leftover (unused) spares after commissioning, out of those included by vendor in his offer, shall be handed over to the owner.

3.7.3 RECOMMENDED SPARE PARTS FOR NORMAL OPERATION & MAINTAINENCE

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

3.7.4 SPECIAL TOOLS AND TACKLES

Special Tools and Tackles shall be procured along with the main equipment as per equipment manufacturer's recommendations.

3.8.0 INSTRUMENTATION ASSOCIATED WITH EQUIPMENTS

3.8.1 MACHINE HEALTH MONITORING THROUGH DEDICATED MACHINE CONDITION MONITORING SYSTEM

S.No.	Project Philosophy
1	Centrifugal Compressors, Expander Compressor, Screw Compressor (with hydrodynamic bearings and forced feed lubrication), Special Purpose Steam Turbine, Gas Turbine (with hydrodynamic bearing and forced feed lubrication), Special Purpose Gear Units and Multi stage Centrifugal Pumps/HPRT (with forced feed lubrication) shall be provided with proximity probes/detector and monitors for measuring shaft radial vibration, axial position and bearing temperatures etc. Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.
2	Special Purpose Gearbox, Gas Turbines and Screw Gas Compressor (with anti-friction bearing) shall be provided with accelerometer based probes/detector and monitors, for measuring vibration. Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.
3	Reciprocating Gas Compressors (Driver rating $\geq 1000\text{KW}$) shall be provided with probes/detector and monitors, for measuring frame and cylinder vibration, piston rod position (each cylinder), rod run-out, rod load & rod reversal, internal cylinder pressures, cylinder valve & packing temperatures, bearing temperatures and cross-head acceleration. Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.

3.8.2 MACHINE HEALTH MONITORING THROUGH PLC / DCS

S.No.	Project Philosophy
1	Packaged Integrally Geared Instrument Air Compressor, General Purpose Steam Turbine (with forced feed lubrication) (Driver rating $\geq 160\text{KW}$), Multi stage Centrifugal Pumps (without forced feed lubrication) (Driver rating $\geq 160\text{KW}$), General Purpose Gear Box (Driver rating $\geq 160\text{KW}$) shall be provided with probes/detector for measuring vibration and bearing temperature. Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.
2	Reciprocating Gas Compressors (Driver rating $\geq 300\text{KW}$) shall be provided with probes/detector and transmitters, for measuring frame and cylinder vibrations, piston rod drop (each cylinder) and bearing temperatures suitable for configuration through PLC/DCS. Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.

3.8.3 VIBRATION MONITORING INSTRUMENTATION

Vibration monitoring instrumentation shall be provided as follows:

S.No.	Project Philosophy
1	Hydrodynamic radial bearings with forced feed lubrication shall be fitted with X-Y proximity probes except for Reciprocating Compressors & high speed integrally geared pumps.
2	Hydrodynamic thrust bearings shall be fitted with two numbers proximity type axial probes except for reciprocating compressors & high speed integrally geared pumps.
3	A key-phaser is required for each speed change of the shaft system for hydrodynamic bearings.
4	Casing mounted accelerometers shall be provided for special purpose gearboxes and gas turbines.
5	Reciprocating Gas Compressor Frame & cylinder shall be fitted with accelerometers.

S.No.	Project Philosophy
6	Bearing housings with anti-friction bearings, for equipments covered in 3.8.2 above, shall be fitted with accelerometers.
7	Integrally geared air compressors shall be fitted with minimum one number proximity radial probe for each bearing & one number axial position probe for each shaft.

3.8.4 TEMPERATURE MONITORING INSTRUMENTATION

For temperature monitoring instrumentation shall be fitted as follows:

S.No.	Project Philosophy
1	Hydrodynamic radial bearings shall be fitted with at least two (2) temperature probes.
2	Hydrodynamic thrust bearings shall be fitted with at least two (2) temperature probes each on active and inactive side.

3.8.5 GENERAL INSTRUMENTATION

S.No.	Project Philosophy
1	All other process pumps, not covered under above, shall have provision for mounting accelerometers (X & Y) on each bearing housing. (Tapping size 5 mm UNF in accordance with probe manufacturer). Vendor to provide cap for the same.
2	Also refer Electrical Specifications for Instrumentation requirements w.r.t. motors.

3.9 VENDOR DATA REQUIREMENT

Vendor Data Requirement as indicated in the respective equipment Material Requisitions shall be followed.

4.0 MASS TRANSFER MECHANICAL EQUIPMENT

4.1.0 TRAY AND TOWER INTERNALS

4.1.1 SCOPE

This specification covers the basis to be followed for Design, Engineering, Fabrication, Inspection / Testing, Supply and Installation (inside the columns at site) of Trays, Packed Column Internals and Tower Packings separately and collectively known as "Internals". For licensed units, in case the requirements specified here are in conflict with licensor's specifications, licensor's requirements shall govern. In addition, EIL practices shall be followed unless noted otherwise.

In case of any conflict between various documents, resolution shall be in accordance with the following:

- Licensor Data Sheets/P&ID' s
- EDB
- Job Specifications
- Standard Specifications/Engineering Standards.

4.1.2 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

4.1.2.1 ABBREVIATIONS

Code	Description
EDB	Engineering Design Basis
BEDB	Basic Engineering Design Basis
TSR /BB	Tray Support Ring & Bolting Bar
GAD	General Arrangement Drawing
ID	Inside Diameter
TPIA	Third Party Inspection Agency

4.1.2.2 CODES & STANDARDS / PUBLICATIONS

International Standards/Codes along with applicable EIL Standard Specifications shall be the basis of design, selection, manufacture, inspection/testing of the Internals.

For design aspects not specifically covered by Data Sheets, Specifications, Codes and Standards or Regulations, the design shall be based on good engineering practice.

4.1.3 USAGE OF EXISTING INTERNALS(FOR REVAMP CASE)

NOT APPLICABLE

4.1.4 TECHNICAL/DESIGN CONSIDERATIONS

4.1.4.1 PROCESS PARAMETERS, DESIGN CONDITIONS & SELECTION OF INTERNAL

As per BEDB & Process Datasheets

4.1.4.2 MECHANICAL REQUIREMENTS

4.1.4.2.1 DESIGN LOADING

S.No.	Project Philosophy
1	The design of column internals / tray components shall be based on the loads given below using the corroded thickness and considering under tolerance as per ASME code.
2	Design loads for tray assemblies shall be based on a liquid height of 50 mm liquid above weirs plus self-weight of deck plates and beams or live load of 150 kg/m ² whichever is severe. In case liquid density is less than water, 1000 kg/m ³ shall be considered for purpose of calculating liquid load.
3	Under down flow plates and seal pans shall be designed to withstand a weight of liquid equal to half the normal tray spacing plus self-weight of UDF plates and beams or 300 kg/m ² , whichever is severe. In case liquid density is less than water, 1000 kg/m ³ shall be considered for purpose of calculating liquid load.
4	Five trays above and below 2-phase feed inlets and five trays in bottom zone of column wherever process steam / vapour feed or two-phase feed is admitted, shall be provided with lock nuts. Trays shall be capable of sustaining a net thrust of i) 1464 kg/m ² and with shear clips for Vacuum Columns (Stripping + Wash + HVGO sections) ii) 1000 kg/m ² and with shear clips for Crude Column/ Fractionator Columns. iii) 450 kg/m ² for all other services.
5	One tray above and below the intermediate vapour/liquid feeds shall also be provided with locknuts. Additionally, all lattice girders and major beam boltings shall be provided with lock nuts
6	The packing support plate shall be designed to support the maximum expected load of tower packings, liquid hold-up (min 10 percent). In case of liquid density is less than water, 1000 kg/m ³ shall be considered for purpose of calculating load due to liquid hold up.
7	Bed limiters / retaining grid frame shall be strong enough to take care of surges/uniformly distributed load of 100 kg/m ² and 135 kg concentrated load at any point.
8	Hold down plate shall exert sufficient static load on the bed to restrict movement of the packing. The hold down plate shall be designed for exerting a load of 100 kg/m ² minimum on the packed bed.
9	Liquid Distributors / Redistributor shall be designed for self-weight plus maximum expected liquid load.
10	All Internals assemblies except cartridge tray assemblies, shall be able to withstand the self-weight plus the following number of 135 kg concentrated loads (maintenance loads) at ambient temperature. Vessel Diameter Number of 135 kg loads Up to 1200 mm 1(at center of diameter) Up to 3600 mm 2(at center and ¼ point of diameter) Over 3600 mm 3(at center and ¼ points of diameter)
11	Chimney/Collector Trays shall be designed to withstand a load of self-weight & lower of liquid weight of (Riser height + 50 mm) or (Weir height + 50 mm). OR 300 kg/m ² whichever is higher. In case of liquid density is less than water, 1000 kg/m ³ shall be considered for purpose of calculating load due to liquid hold up.

4.1.4.2.2 ALLOWABLE STRESS AND DEFLECTION

S.No.	Project Philosophy

S.No.	Project Philosophy
1	Allowable stresses for all Internals shall be as per ASME Sec. II. Part D w.r.t. Tables 1A & 1B, latest edition.
2	The maximum deflection of tray/tower internal assembly shall not exceed 1 mm per meter of column diameter or 7.5 mm, whichever is lower for the design loadings given in clause 1.4.2.1, S. No. 2 and 3 above. Deflection for distributor assembly shall be limited so that overall liquid mal-distribution does not exceed the limit as per clause 1.5.4, S. No. 1, Para 1.6. Deflection for support plate and seal pans shall be limited to L/400, where L is the length of individual component
3	Deflection as per S. No. 2 may be ignored for trays designed based on design loadings as per Clause 1.4.2.1 S. No. 4 & 10
4	For large diameter vessels (more than 6000 mm), initial camber not exceeding 6 mm may be made in the principal support members of the assemblies so as to limit the deflection as specified in S. No. 2 above.

4.1.4.2.3 MATERIALS

All materials shall conform to those specified in the respective process drawings or data sheets.

No substitution of material will be permitted without the written consent of Owner/EIL in required formats as per procedure. In case substitution of material is proposed, vendor shall clearly indicate the reasons for requiring such change and give chemical and physical properties of the proposed alternate material with their standard specification number.

All the material supplied by vendor shall be new and of first quality supported with mill test certificates.

Unless specified in data sheets, Material shall be as per S. No. 1 to 7 (As applicable)

S.No.	Type of Material	Description
1	11-13 Cr Stainless Internals	All sheet and plate material shall be in accordance with SA 240 Type 410S or 405 having No.1 finish only for thickness more than 4 mm. For thickness up to and including 4 mm, No. 2B/2D finish is also acceptable. All bolting material shall be 13 Cr SA 193 Gr B6X or B6 for bolts and SA 194 Grade 6 for nuts and lock-nuts. All sheet and plate material shall be in accordance with SA 240 Type 410S or 405 having No.1 finish only for thickness more than 4 mm. For thickness up to and including 4 mm, No.2B/2D finish is also acceptable. All bolting material shall be 13 Cr SA 193 Gr B6X or B6 for bolts and SA 194 Grade 6 for nuts and lock-nuts.
2	16 Cr - 12 Ni Stainless Internals	All sheet and plate material shall be in accordance with SA 240 Type 316/ 316L having No.1 finish. For thickness upto 4.0 mm, No. 2B/2D finish is also acceptable. For sheet material SA 240 Type 316/ 316L, all bolting material shall be SA 193 B8M for bolts and SA 194 Gr.8M for nuts and lock nuts. For sheet material SA 240 Type 316L, Carbon content shall be < 0.03% for bolting material.

S.No.	Type of Material	Description
3	18 Cr - 8 Ni Stainless Internals	All sheet and plate material shall be in accordance with SA 240 Type 304/304L having No.1 finish only for thickness more than 4 mm. For thickness up to and including 4 mm, No. 2B/2D finish is also acceptable. All bolting material shall be SA 193 B8 for bolts and SA 194 Gr.8 for nuts and lock-nuts. For sheet material SA 240 Type 304L, Carbon content shall be < 0.03% for bolting material
4	Monel Internals	All sheet and plate material shall be in accordance with SB127 in hot rolled, annealed and pickled condition. All bolting material shall be Monel, made from rod or bar stock, SB164.
5	Carbon Steel Internals	Unless otherwise specified, sheets and plates shall be procured in hot rolled conditions and shall be free of mill scale. Material shall be suitable for bending. The bend test specimens shall stand being bent cold through 180 degree without cracking on outside of the bent portion, to an inside diameter equal to or less than twice the thickness of the specimen or as per relevant material specification, whichever is severe. All sheet, plate material shall conform to SA285, SA283 or better unless specified otherwise on the data sheets/drawings.
6	Gaskets	Trays gasketing material shall be woven tape, fabricated from Asbestos Free Material such as Woven Fiber-glass Tape (Amatex-G36-P752 or equal), Woven Teflon Tape, Woven Expanded Graphite Tape or Ceramic Fiber Tape etc. and shall be suitable for process fluid and column design temperature, unless specified otherwise in the Data Sheets/Purchase Specifications. The thickness of the woven tape shall be 1.5 mm minimum.
7	Support Rings/Bolting Bars/Support Cleats	Support rings, downcomer or up comer bars and other parts welded to vessel shall be of same metallurgy as of vessel. Minimum thickness excluding corrosion allowance of welded parts shall be 6 mm for vessel ID up to 3000 mm, 10 mm for ID 3001 mm to 12000 mm and 12 mm for ID > 12000 mm. Corrosion allowance as specified in vessel data sheets shall be added on both sides of Support Ring, Bolting Bar and other welded parts.

4.1.4.2.4 MINIMUM THICKNESS OF INTERNALS

Minimum thickness of various internals /components shall be as given below:

Corrosion allowance, wherever specified in the data sheets for Internals in excess of corrosion allowance as indicated in Clause 1.4.2.5 below shall be added to the minimum thickness specified below

S.No.	Item Description	Alloy	CS
1	Deck plates, seal pans, draw-off Pans, weirs/seal plates, other removable Components	2.0	3.5*

S.No.	Item Description	Alloy	CS
2	Welded deck plates, downcomer aprons and other welded components	3.0	3.5*
3	Downcomer/Internal pipes	2.0	3.5*
4	Bubble Caps	1.5	2.0
	Risers (fixed)	2.0	3.5*
	Risers (removable)	1.5	2.0
5	Valves	1.5	(will not be used)
6	Structured Packings	0.15	(will not be used)
7	Support Grid for Structured Packings	5.0	8.0
8	Locating Grid/Retaining Grid/Bed Limiter	5.0	8.0
9	Grid Packings	1.0	(As per vendor's standard)
10	Support Plate for Random Packings	2.0	5.0
11	Feed Pipes (Seamless / ERW)	Sch40S	8.0
12	Random Packing	(As per vendor's standard **)	(As per vendor's standard **)
13	Loose Beams	To suit load	To suit load
14	Lattice Girders		
14.1	Primary Members	5.0	8.0
14.2	Secondary Members	3.0	6.0
14.3	Gusset Plates	10.0	10.0
14.4	Downcomer bolting bars	6.0	10.0
15	Z-Bars	5.0	8.0

(*10 USSG is also acceptable in lieu of 3.5 mm)

(** Random Packing thickness shall be suitable for test load comprising of dead weight of the packed bed + 10% liquid load. Maximum compression shall be limited to 5% of the bed height without damaging the bottom packing.)

All bolting shall be minimum M10 for Internals and M16 for Lattice Girders. All bolt head/nuts shall be hexagonal.

Minimum corroded thickness of the internals for the loading condition as per Clause 1.4.2.1 S. No. 4 Para (i) and (ii) above, shall be 3.0 mm.

4.1.4.2.5 CORROSION ALLOWANCE

S.No.	Project Philosophy
1	The following corrosion allowance shall be added to calculate thickness of Internals unless otherwise specified on data sheets:
1.1	No corrosion allowance is required for Monel or Stainless steel alloy assemblies.
1.2	The corrosion allowance for all surfaces of floor of carbon steel assembly shall be 1.5 mm (total).
2	Unless specified on the data sheets, corrosion allowance shall be higher of 1.5 mm (total) or one quarter of the vessel corrosion allowance on each surface of trays and its components.

S.No.	Project Philosophy
3	Beams, trusses and other support members shall have total corrosion allowance equal to vessel corrosion allowance for removable type construction and twice the vessel corrosion allowance for non-removable type construction through vessel man-hole.

4.1.5 ARRANGEMENT / DETAIL OF INTERNALS

S.No.	Project Philosophy
1	All assemblies except one piece cartridge type trays shall be of removable type unless otherwise indicated. The general design, number, type and spacing shall be established on the individual vessel drawing / data sheets. Cartridge type trays shall be designed to rest on four support cleats.
2	Each removable section shall be so dimensioned / sized to permit passage through vessel manhole and shall be suitable for assembly/ dismantling from upper side in so far as structural contingencies permit. Maximum diagonal dimension of the components shall be restricted to vessel manhole ID – 12 mm clearance.
3	Internals support trusses supporting more than one Internal, as are commonly used in large diameter columns and which cannot be installed through manholes, shall be split into sections for access through manhole and minimizing welding work inside the column.
4	Internals decks shall have a maximum length of 4000 mm. To achieve this, maximum distance between main support beams or girders shall be limited to 4000 mm. However, the main support beams or girders having length more than 4000 mm shall be provided with butt joint with splice plates of the same thickness on both sides. The butt joint shall be off-centre from beam centre and numbers of butt joints shall be as minimum as possible.
5	Manways i) One (1) manway in single cross flow decks, two (2) manway in double flow decks and so on shall be provided. These manway shall be freely removable from top and bottom. Manway shall be in the same vertical line for a set of trays. These shall be at such a location and of a shape and size to permit easy access to every area of the tray. Manway of different set of trays (about 20 trays) shall be staggered to each other. Minimum clear opening on tray shall be 380 mm x 450 mm. In case same cannot be provided due to design conditions, minimum manway size (clear opening) of 360 mm x 500 mm or 330 mm x 550 mm can be accepted as a special case. ii) Where manway cannot be provided, decks shall be split (turn up turndown) to provide suitable access for Inspection and assembly from top as well as bottom.
6	Unless specified otherwise, support rings, bolting bars, support bracket/cleats when required shall be designed for welding to the vessel. All other parts shall be designed for bolting or clamping in place. Clamping shall be used on Tray floor and all downcomer / up comer / loose beams / major beams shall be through bolted. Spacing of bolting or clamping shall be close enough to ensure optimum liquid tight construction but shall not exceed 125 mm on deck portion in downcomer area/liquid holding area/downcomer apron bolting etc. and 150 mm in active area. All joints and seams of trays specified to be liquid tight without gasketed joints shall be seal welded at site. Maximum spacing for clamps/bolting for gasketed construction shall be restricted to 100 mm. For revamp jobs, use of Z- Bars shall be maximized to minimize welding/cutting of TSRBB on the shell, wherever possible.

S.No.	Project Philosophy
7	Drawings and instructions for installation and fabrication of support ring, bolting bar and support bracket/cleats welded to vessel shall be furnished by Internals designer/supplier. They shall show clearly the type, size and extent of welding. All support rings and bolting bars shall be continuous-ly welded on both sides. All support brackets shall be welded all around.
8	When locations of bed support, retainer and distributor are not indicated on data sheets, Tower Internal/Packing supplier shall determine and indicate dimensional requirement.
9	Gasketing need not be used in the design or installation of Internals except for bubble cap trays, all liquid holding portions (e.g. seal pans, draw-offs), collector trays, distributors and redistributors. Fabrication shall provide tight metal-to-metal joints. Metal seal plates shall be used to close constr-ction joints where necessary.
10	All stiffeners and support members shall be located on the underside of the tray floor with the exception of open type trusses supporting two trays. Stiffeners and support members in bubbling areas shall not exceed 75 mm in width and shall be designed so as not to impede or channel the liquid flow on the tray. Depth of stiffeners and support members transverse and parallel to the liquid flow shall not exceed 20 and 30 percent respectively of tray spacing.
11	A minimum of 20 mm overlap shall be provided between tray floor section and support members.
12	Trays and seal pans not specified to be liquid tight, and of a design which would not easily drain shall be provided with one or more 12 mm diameter/square drain holes/slots located in the outlet/inlet weir directly above the tray floor. Size and number of drain hole/slot may be reduced depending upon liquid rate. Draw off sumps shall be located flush with the invert inside of draw off nozzles to allow complete draining of sumps. A 12 mm dia.hole shall be provided in each distributor pipe where the process fluid does not discharge vertically downwards. One 6 mm dia.vent hole with cover shall be provided in the top of the downstream end of each liquid distributor pipe to prevent vapour binding.
13	All the three (3) and four (4) pass trays shall have pressure equalizing pipes (vent tubes) across the downcomers.
14	Burrs shall be removed from all perforated areas and edge of Internal sections.
15	The maximum allowable pressure drop for a packed bed shall include packed bed support, bed limiter and distributor.
16	In the active area of the Tray, no formed section shall weigh more than 25 kg, except in the downcomer area where this can be relaxed to 50 kg. For diameter more than 4000 mm, these values can go upto 40 kg and 100 kg respectively. Tray manway shall have a maximum weight of 15 kg.
17	All internal flanged joints for pipes shall be provided with gasket

4.1.5.1 TRAYS

S.No.	Project Philosophy
1	BUBBLE CAP TRAY
1.1	Fixed risers shall be used unless otherwise specified in the data sheets. For deck plates less than 3 mm in thickness, riser shall be expanded into upward flanged opening in the deck plates and then stitch welded to upturned edges of the opening.
1.2	For deck plate 3 mm thickness and more, the riser shall be continuously welded to the deck plates with the holes in the deck plate being plane, not upturned. Caps shall be attached to the attachments welded to the top of risers.

S.No.	Project Philosophy
1.3	Bubble caps are to be furnished in Full Annealed and scale free bright condition.
2	VALVE TRAY
2.1	Valve assemblies of proprietary trays shall be provided with following features. i)A means of preventing the orifice covers from adhering to tray floor. ii)A means of preventing the orifice covers with integral guide legs and lift stops from popping out of place during operation.
3	SIEVE TRAY
3.1	All perforations shall be punched and made from top side and burr side on tray decks must be downwards when installed, unless specified otherwise. In case of liquid-liquid extractor column trays, punching direction shall depend on the direction of liquid flow of continuous phase.

4.1.5.2 PACKING

S.No.	Project Philosophy
1	TOWER PACKING
1.1	If type of packings is not specified in the process data sheets, following shall be taken as guidelines: i)For wash zone of vacuum column, Grid Packings shall be used. ii)For all other applications preferably Pall Rings shall be used. If pall rings are not expected to perform desired performance, proprietary random packings may be used. Alternatively, Vendor may also adopt/recommend use of Structured Packings.

4.1.5.3 SUPPORT PLATE

S.No.	Project Philosophy
1	PACKING SUPPORT PLATE
1.1	Packed bed support plate shall be vapour injection type, providing separate passage for liquid and vapour flow.The support plate shall have at least 90 percent free area based on cross sectional area of vessel.Slot size shall be so selected to avoid any sneak through of packings from slots.
2	HOLD DOWN PLATES
2.1	Hold down plates shall be provided on the top of ceramic or carbon tower packings.The hold down plate shall directly rest on the bed without any support cleats. Hold down plate shall exert sufficient static pressure on the bed to restrict movement of the bed. Care shall be taken not to use hold down grid with metallic or plastic tower packings.

S.No.	Project Philosophy
3	BED LIMITERS/BED RETAINERS Bed Limiters/Bed Retainers shall be located just above top of packings to avoid fluidizing of bed and shall be fixed in position so as not to be moved by the packings and shall be designed so as not to affect distribution from the liquid distributor to the packings. Bed Limiters/Bed Retainers for use with spray nozzle distributor shall be designed with major structural support on the underside of the retainer so as not to affect the spray distribution on the packings. Expanded metal with equal opening area is also acceptable in lieu of wire mesh.

4.1.5.4 DISTRIBUTOR / REDISTRIBUTOR

S.No.	Project Philosophy
1	Distributors of liquid feed to packed beds, unless otherwise specified in data sheets, shall be gravity flow type (e.g. orifice drip trays, tubed drip trays, trough type, orifice header laterals) in accordance with following requirements. However, Tubed drip trays shall be avoided as cleaning the same will be difficult, if plugged:
1.1	Distributors shall preferably be provided with side elevated orifices. For such elevated orifices, anti fouling covers are not required.
1.2	In case deck type distributors are provided / specified, orifices shall preferably be minimum 6.0 mm diameter and shall be arranged on an approximate equal spacing throughout the distributor. Distributor supports shall be designed and arranged so as not to interfere with flow from orifices. In case orifice diameter calculated is less than 6.0 mm, then antifouling covers shall be provided on each orifice.
1.3	Vapour risers shall have a total cross sectional area as per Vendor's design but not less than 15 percent of vessel cross sectional area. Number, size and arrangement of vapour risers shall be such so as not to affect the orifice spacing and liquid distribution to the packings.
1.4	Distributor joints shall be gasketed to be liquid tight. Gasket material used shall be suitable for service and soft enough for leak tight joint.
1.5	Distributor shall be capable of performing satisfactorily for the range of loadings specified to cover entire range of plant operation.
1.6	Flow variation from orifice to orifice shall not be more than 10 percent at turndown condition.
1.7	Feed pipe shall form part of Distributor supply.

4.1.5.5 FLASH FEED DISTRIBUTOR

S.No.	Project Philosophy
1	Flash feed distributor for flashing or mixed phase, vapour and liquid feeds to packed bed shall be designed to separate the two phases and distribute the liquid phase on distributor/redistributor. If flashing feed gallery is used, riser area shall be 50% of vessel cross sectional area.

4.1.6 FABRICATION

4.1.6.1 TOLERANCE

S.No.	Project Philosophy

S.No.	Project Philosophy
1	All sections shall be truly flat within 2 mm and shall be free from burrs and welds spatter.
2	Tolerances wherever unspecified shall be taken as ± 1 mm and not to be accumulative, except on thickness and assembly diameter.
3	Tolerances on thickness shall be as per applicable specification and tolerances on assembly diameter shall be as below: Cartridge Trays : D(-3, +0) Other Assemblies : D $\leq$ 1500, D(-6, +0) 1500 < D $\leq$ 4500, D(-10, +0) D > 4500, D(-20, +0)

4.1.6.2 WELDING

S.No.	Project Philosophy
1	All welding shall be done by TIG/GTAW Process only. However for Site welding where TIG welding cannot be done due to access/Practical Constraints, Metal Arc welding may be carried out after taking approval from Engineer-In-Charge. Resistance welding is permitted for minor details where weld is a non-strength weld.
2	Gas or Carbon arc welding shall not be used.
3	Welding electrodes of composition similar to Internals material shall be used except austenitic electrodes of higher chromium and nickel content such as AWS A5.4, ASME SFA 5.4 class E309 and E310 may be used for 12 Cr stainless steel. For dissimilar material welding, electrode composition shall be similar to nobler material being welded. Following electrodes shall be used unless specified otherwise: E 7018 for all CS materials E 308 for all SS 304 to SS 304 E 308L for all SS 304L to SS 304L E 309MoL for SS 410S to SS 410S, SS to CS SS410S to SS304,304L,316,316L E 316 for all SS 316 E 316L for all SS 316L E Ni Cu7 for Monel to Monel Pure Nickel for Monel to CS/SS.
4	Welding wherever specified, is to be done by qualified and approved welders using the suitable fillers and fluxes recommended for the materials in the fabrication drawings. For welding the stud on tray decks and support beams, use of stud welding gun with suitable flux is acceptable. In manually welding the studs, care .
5	A proposed Welding Procedure Specification (WPS) shall be submitted to AIA for his approval. On approval, a Procedure Qualification Test (PQT) shall be conducted which shall be witnessed by AIA. On acceptance of all tests as per ASME Section IX, a final WPS along with Procedure Qualification Record (PQR) shall be submitted. Production welding shall start only after approval of final WPS/PQR and qualification of welders as per ASME Section IX. AIA may accept previously qualified WPS/PQR at his sole discretion.

4.1.6.3 MISCELLANEOUS

S.No.	Project Philosophy
1	All parts fabricated shall be smooth,true,clean and free from burrs, grease and dents.Openings for passage of workman must have exposed edges rounded.
2	All support rings, bolting bars,beams support brackets and other components which are integral and therefore welded to the column shell inside,shall be supplied and installed by column fabricator.
3	Total draw-off trays shall be designed for zero leakage construction and may be seal welded (if required) at site to attain zero leakage.
4	Seal welds shall have a throat thickness at least equal to the specified corrosion allowance.
5	All stainless steel tray assemblies/internals and their components (e.g. Bubble caps, valves etc.) shall be pickled and passivated. However, for SS400 series material, Pickling and Passivation of only weld affected zone is also permitted by Pickling paste method. Pickling and Passivation shall be as per ASTM A380. However, vendor shall prepare procedure for Pickling and Passivation and obtain approval from Owner/PMC.
6	All parts shall be fabricated in accordance with good shop practice and in uniformity so that all corresponding parts will be inter-changeable.

4.1.7 SPARE PARTS

4.1.7.1 MANDATORY SPARES

Following operational spares shall be procured along with the internals as mandatory spares:

S.No.	Title	Spare Philosophy	Remarks
1	Valves for trays	10% of each type	
2	Bolts/Nuts	10% of total for each type / size (minimum 10 nos. of each size).	
3	Clamp assemblies	10% of total for each type / size (minimum 10 nos. of each size).	
4	Gasketing or tapes	100% of each type and size	
5	Sealing Ropes/ foils for cartridge	200% of each size	
6	Spray Nozzles	25% subject to minimum 5 Nos. of each type and size.	
7	Tower Packings (Only Random Packings)	5% of each type and size.	

4.1.7.2 ERECTION & COMMISSIONING SPARES (CONSTRUCTIONAL SPARES)

The supply shall include the following as Erection & Commissioning Spares :

S.No.	Quantity	Description	Remarks
1	Bolts/Nuts	10% of total for each size (minimum 10 nos. of each size).	
2	Clamp assemblies	10% of total for each type size (minimum 10 nos. of each size).	

S.No.	Quantity	Description	Remarks
3	Valves for trays	5% of each type	
4	Bubble caps	5% of each type and size	
5	Gasketing or tapes	100% of each type and size	
6	Sealing Ropes/ foils for cartridge trays	200% of each size	
7	U-clamps	10% of each type and size or 10 nos. whichever is minimum	
8	Tower Packings(Only Random Packings)	10% for Metallic and Plastic Packings,15% for Carbon and Ceramic Packings	
9	Spray Nozzles	Up to 25 Nos. (of each type) - 100% More than 25 (of each type) - 25% (subject to minimum of 25 No.)	

4.1.7.3 RECOMMENDED SPARES FOR NORMAL OPERATION & MAINTENANCE

As per Manufacturer's recommendations, a quotation for spare parts for Two-years normal operation (over and above mandatory spares) along with unit price shall be obtained with the proposal for customer to order the same separately.

4.1.8 OWNER / CLIENT SPECIFIC REQUIREMENTS

S.No.	Project Philosophy
1	

4.1.9 EXECUTION PHILOSOPHY

S.No.	Project Philosophy
1	Shall be decided during the execution of Project.

4.1.10 SITE INSTALLATION AND SUPERVISION

S.No.	Project Philosophy
1	For new columns,Installation of Trays,Tower Packing &Internals shall be carried out by Tray/Internals supplier only as per the EIL / Vendor's Installation Procedure and the approved General Arrangement Drawings for each column.
2	For revamp jobs,cutting & removal of existing attachments,welding of new attachments inside the existing columns and installation of new internals shall preferably be done by column internals supplier. Alternatively, all these activities can be included in the scope of Mechanical Contractor (covered in separate mechanical tender) to have single point responsibility for complete Site Work. In such a case all such modifications, installation shall be carried out under the supervision of Internals supplier so as to ensure guarantee of performance of column internals by supplier.
3	Requirement of air conditioning (Humidity and temperature control) system for all columns during installation / welding / Inspection of internals at site shall be finalized by client.

4.1.11 INSPECTION & TESTING

4.1.11.1 GENERAL

S.No.	Project Philosophy
1	The materials, fabrication, testing and trial assemblies are subject to inspection by Owner/EIL, at shop floor before shipment and during installation.
2	Any rejection made by Inspector shall be final. Approval/Inspection by EIL/Owner and/or their designated representative shall in no way relieve the Vendor of his responsibility to meet all the requirements of the Purchase Order
3	Owner/EIL/Authorized Inspector shall have free entry to the Vendor's shop at all times where and while the work is being performed. The Vendor shall offer the inspectors all reasonable facilities to satisfy them that the materials are being furnished with the specifications.
4	Vendor shall notify the Owner/EIL sufficiently in advance of any fabricating operations to permit the Inspector to arrive at the Vendor's shop.

4.1.11.2 STAGewise INSPECTION DURING FABRICATION

S.No.	Project Philosophy
1	Dimensions The inspector will check that the thickness and the dimensions of all parts for the Decks, Weirs, Seal and Draw off pans, Down comers, Draw off pipes, Supports, Beams, Valves, Bubble caps, Clamps, Studs, Bolts, Nuts, Risers, Washers and Gaskets etc. are as per the approved drawings.
2	The inspector shall check each individual part of the equipment fabricated as per approved drawings and specifications. For instance, for the Bubble cap dimensions, height, width and number of slots, heights, O.D. and I.D. or riser and cap, shroud ring height, exit and inlet weirs height etc. shall be measured. The inspector will check that all identical parts shall be interchangeable.
3	Inspector shall check that the sharp edges on the Internal components, manway covers, weirs, downcomers etc. are properly removed. Also that all burrs from punched holes and loose weld slags and materials are removed from all components. Stage-wise inspection during fabrication will be thoroughly carried out. Before starting welding, welders' qualification test will be carried out, if required, as per ASME Sec. IX. Where numbers of similar items are to be made, inspector shall give the clearance for the fabrication of the lot only after checking and approving the first sample piece.

4.1.11.3 TRIAL ASSEMBLY

S.No.	Project Philosophy
1	One tray of each type and size with its accessories shall be assembled as floor mock-up, inside the fabricators' shop. The components for such an assembly will be taken at random from each lot of identical items.

S.No.	Project Philosophy
2	The assembled tray will be carefully checked for its dimensions, tolerances, number and arrangement of perforation, the working of the valves in case of valve trays, V-notch or Blocked Weir, adjustability of weir, vent tube details, downcomer clearance, weir heights, downcomer length and width, number of clamps, gaps and potential leakage points etc.
3	The assembly shall also be checked for each type and size of packed tower internals. Inspector will also check the flatness and deflection of the trays, internals, beams, tray edges and beam ends clearance.

4.1.11.4 LEAK TESTING

S.No.	Project Philosophy
1	Bubble cap, Collector trays, Liquid holding portion of other trays such as Seal pans, Recessed seal pans, Draw off pans, Distributors/Redistributors shall be subjected to leakage test at shop floor as well as in the field by filling water up to weir level or up to normal liquid level as the case may be. Appropriate ring fixture or a portion of column shell with supports for seal pan/recessed seal pans/draw off box etc. shall be made by Internals Vendor to facilitate leak testing in the shop.
2	Leak testing shall be carried out with service gaskets and drain holes temporarily plugged. Leakage rate shall not exceed 0.5 percent of design liquid flow rate unless otherwise specified.
3	All distributors/redistributors shall be leak tested with all holes temporarily plugged. It shall be ensured that leakage is uniform and not from few concentrated places/corners. All plugs shall be removed after leak testing is over.
4	For collector trays/other internals, if seal welding is carried out at site inside the column, leak testing at shop floor is not required.

4.1.11.5 DISTRIBUTOR PERFORMANCE TESTING

S.No.	Project Philosophy
1	All Liquid distributors/redistributors shall be water tested in the vendor's shop by the following procedure at 50%, 100% and 110% of the design liquid volumetric flowrate. The vendor shall certify to the purchaser at the time of bidding that they believe their equipment can meet the testing requirements listed below:
2	If the distributor contains a predistributor, it shall be tested first to ensure that it has a CV of 5 or less at the design flow rate. Each orifice in the predistributor shall be tested. The CV is defined as the ratio of the standard deviation to the sample mean, expressed as a percent.
3	The distributor/redistributor itself shall be tested and the CV determined. To determine the CV, at least 30 pour points or at least 10% of the pour points (whichever is higher) shall be randomly selected and tested. If the CV specified below cannot be met, the vendor will correct the problem at its expense.
3.1	For orifice pans, tubed drip pans and other similar devices, a CV of 10 or less must be achieved at the design liquid volumetric flow rate.

S.No.	Project Philosophy
3.2	Four orifice parts, tubed drip pans or trough distributors that employ a modular (sectional) design,(wherein many pieces are geometrically identical) all pieces of the same geometry shall be treated as one group or strata. One piece from each strata shall then be tested by the procedure outlined above.
3.3	The average flow rate per pour point for any grouping of 10 of the tested pour points from a single area should differ by no more than 5% from the average for the group or strata being tested.
3.4	Spray nozzle distributors shall not be tested in the vendor's shop but must be tested in the tower prior to start-up to ensure that all nozzles are operable and develop the desired spray pattern. This test shall be carried out as close to design rates as possible.
3.5	The test results shall be furnished to PMC/Owner in a written report. This report shall also contain a drawing of the distributor in plan view. This drawing shall be broken down into 3 radial zones of equal area and the location of pour points sampled in each zone.
4	All distributors/redistributors shall be leak tested at shop floor as well as at site.For distributors/redistributors,if performance testing is carried out at shop floor,leak testing at shop floor is not required.

4.1.11.6 SPRAY NOZZLES

S.No.	Project Philosophy
1	Apart from the usual material quality tests (chemical analysis and mechanical properties) and manufacturing quality control tests, vendor shall include for & carry out the testing of the spray nozzles with respect to the flow rates for specific DELTA P,spray angle,spray coverage and distribution for the tip distance given in the data sheet.The testing medium shall be water.These results shall be submitted to Owner/EIL for review.Tests and acceptance criteria is as below: Flow rates:-10% to +10% for specific DELTAP Spray angle:-5 DEG to +5 DEG Flow variation: As per vendor's Standard(Data to be reported for Information) No.of nozzle to be tested: 10% of each size and type(Min. 2 nos. of each type & size).

4.2.0 CRUDE OIL DESALTER

4.2.1 SCOPE

This section covers the basis to be followed for the purpose of carrying out Design, Engineering, Procurement and supply of Crude Oil Desalter & its auxiliary items including requirements with regard to spare parts and special tools & tackles. Wherever Licensor specifications are available, licensor's specifications / requirements shall govern. ***missing

Electrical items, Instrumentation & Controls etc. associated with Desalter shall comply with the design requirements as given in the respective discipline EDB / Job specifications.

4.2.2 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

4.2.2.1 ABBREVIATIONS

Code	Description
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
EDB	Engineering Design Basis
BEDB	Basic Engineering Design Basis
BS&W	Basic Sediments & Water
IS	Indian Standard
IP	Indices de protection (Protection Indexes)
MOC	Material of Construction
GPC	General Purchase Conditions
PGTR	Performance Guarantee Test Run
SPRV	Single Point Responsibility Vendor
NIT	Notice Inviting Tender
ASTM	American Society For Testing And Materials
RFQ	Request for Quotation

4.2.2.2 CODES & STANDARDS / PUBLICATIONS

International Standards/Codes along with applicable EIL Standard Specifications as per the table given below shall be the basis of design, selection, manufacture, inspection/testing of the crude Desalter.

For design aspects not specifically covered by Data Sheets, Specifications, Codes and Standards or Regulations, the design shall be based on good engineering practice.

S.No.	Description	Standards / Codes	Edition
1	Boiler & Pressure Vessel Code	ASME Section VIII Division-I	
2	For Material specifications	ASME Section II	
3	Non-destructive Examination	Section V	
4	Welding & Brazing Qualifications	Section IX	
5	For Flanges	ASME B 16.5	
6	For large diameter flanges	ASME B 16.47	

4.2.3 GENERAL / DESIGN CONSIDERATIONS

4.2.3.1 METEOROLOGICAL DATA

Refer Section "METEOROLOGICAL DESIGN DATA" of BEDB Part-B.

4.2.3.2 PROCESS DATA

Refer BEDB PART-B. Additional design data is defined below:-

4.2.4 SPECIFIC DESIGN REQUIREMENTS

S.No.	Project Philosophy

S.No.	Project Philosophy
1	No. of Stages: As per Process Datasheet
2	Sizing of Desalter vessel: By EIL / Vendor
3	De-sludging operation: Automatic or Manual
4	Type of Mixing device (Static Mixer or Mix valve or both)
5	Provision shall be provided for Cuff (Emulsion) Header
6	Desalter Vessel Design shall be as per ASME Section VIII-Div.1
7	MOC for internal proprietary components (Electrode grid etc.): As per Vendor's recommendation or as per Licenser Datasheet.
8	MOC for internal Non-proprietary items (Headers/Supports etc.): CS or as per Licenser Datasheet.
9	Corrosion allowance for removable CS internals: Half of specified corrosion allowance over each exposed surface unless specified otherwise.
10	Corrosion allowance for non-removable (Fixed) CS internals: Specified corrosion allowance over each exposed surface unless specified otherwise.
11	Tentative size of Desalter vessel for plot space: By EIL or Vendor
12	Code Stamping Requirement for Desalter Vessels: Yes / No
13	Equipment is located outdoor location and shall be designed accordingly.

4.2.5 TEST METHODS

S.No.	Project Philosophy
1	Salt content of Crude Oil (IP 77/72 or ASTM 3230D or Any other proven method)
2	Sediment in Crude Oil (IP 375 or ASTM D4007)
3	Water in Crude Oil (IP 386 or ASTM D4007)
4	Floatable Oil in Brine / Effluent Water (IS 3025 Part B or ASTM D 3921:96 or IP 137)

4.2.6 OWNER / CLIENT SPECIFIC REQUIREMENTS

S.No.	Project Philosophy
1	PGTR : Lumpsum separate price shall be obtained by EIL for PGTR. If required, client may carry out PGTR.
2	Clients involvement in Document Review : No
3	Client's supplied drawings / documents (for revamp cases): NA
4	3 number of probe for Special Level Instruments (e.g. AGAR Multi Probes) for Level Measurements are required.

4.2.7 VENDOR DATA REQUIREMENTS

Vendor Data Requirement as indicated in the respective Material Requisitions shall be followed.

Only critical vendor data/documents such as Equipment Data Sheets, P&ID's, PFD, GAD 's of equipment shall be taken for Owners/Consultant's review. Other documents shall be taken for information purpose

4.2.8 SITE INSTALLATION AND SUPERVISION

Erection of Desalter Vessels alongwith Installation of Internals and other items for Desalter System (such as Electric Grids, Transformers, associated Piping and Structural, other Electrical components, Instruments, Mix Valves, Safety Valves, Connections etc) shall be carried out by Mechanical contractor.

Desalter Vendor shall provide their supervision during installation of internals and other

items (on per diem basis) to ensure proper installation in order to meet the Performance Guarantees.

4.2.9 SAFETY

S.No.	Project Philosophy
1	Equipment design and engineering shall incorporate adequate safety features [as per applicable specifications of respective equipment as well as environment codes (if any) & standards applicable for the subject project] to provide protection to equipment and environment.
2	All Controls shall operate in a fail- safe mode.
3	All electrical devices shall be certified as per electrical specifications to meet the requirements & shall be certified for the area classification in which they are

4.2.10 SPARE PARTS

4.2.10.1 MANDATORY SPARES

Mandatory (operational) spares shall be procured along with the main equipment, as defined below. These spares include only those spares, which are critical for equipment.

S.No.	Title	Spare Philosophy	Remarks
1	Electrical Insulators (Each type & Size)	2 Sets	
2	Bushing Assembly	3 Sets	
3	Bolting	20% Bolts and Nuts of each type (Min. 4 nos. of bolts and 8 nos.of nuts)	
4	Gaskets	400%	

Mandatory spares for Electrical and Instrumentation shall be as per Respective EDB / Job specification.

4.2.10.2 ERECTION & COMMISSIONING SPARES

Vendor shall recommend & provide list of spares parts required for erection & commissioning over and above mentioned minimum requirement list, given in the table below.

S.No.	Title	Spare Philosophy	Remarks
1	Electrical Insulators (Each type & Size)	2 Sets	
2	Bushing Assembly	2 Sets	
3	Bolting	20% Bolts and Nuts of each type (Min. 4 nos. Of bolts and 8 nos. of nuts)	
4	Gaskets	200%	

4.2.10.3 SPECIAL TOOLS & TACKLES

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

4.2.11 PROCUREMENT PHILOSOPHY

S.No.	Project Philosophy
1	Issue of RFQ : On limited basis or NIT
2	Evaluation of offer based on Loading and Penalty on utilities (Power/Demulsifier) and Vessel Size (if applicable) : No If yes, provide following information: - Cost of Power (per kWh) - Type & Cost of Demulsifier (per Kg) - Rate of interest (per year) - No. of years - Cost of Desalter vessel : To be considered or Not
3	No. of days for supervision during internal installation / commissioning shall be decided by EIL.
4	Maximum time allowed for corrective engineering by vendor to meet performance shall be as per GPC.

4.2.12 EXECUTION PHILOSOPHY

S.No.	Equipment Type	Unit Responsibility
1	GENERAL	(a) Design, Engineering and Supply of complete Desalter system including vessels by Desalter package supplier on SPRV basis. OR (b) Design, Engineering and Supply of proprietary and specialty components including electrical and instruments & controls by Desalter supplier except Desalter vessels and non-proprietary items.
1.1		Installation of Desalter System including its all components shall be carried out by Mechanical Contractor and Desalter Vendor shall provide their supervision during installation of Proprietary & specialty components (such as Electrode Grids, Bushing etc.) on per diem basis.

4.2.13 INSPECTION

S.No.	Project Philosophy
1	The inspection of all the items (Imported) for the Desalter shall be carried out by Third Party Inspection Agency (stage wise and final).TPI shall be engaged by Desalter Vendor as per list given in the requisition.
2	Calibration, testing of instruments shall be done by vendor and shall be inspected by reputed third party finally before dispatch.
3	All other requirement with regard to inspection & testing shall be as specified in the MR document. Standard ITP' s to be followed.
4	The PGTR (Performance Guarantee Test Run) (if applicable) shall be conducted as specified in the Job Specification document.

4.3.0 VACUUM EJECTOR SYSTEM

4.3.1 SCOPE

This Specification covers the basis for carrying out Design, Engineering, Procurement, Inspection/Testing and Supply of Ejector System package including requirements with regard to spare parts and special tools & tackles. Wherever Licensor specifications are available, licensor's requirements shall govern.

4.3.2 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

4.3.2.1 ABBREVIATIONS

Code	Description
ASME	American Society of Mechanical Engineers
API	American Petroleum Institute
TEMA	Tubular Exchanger Manufacturers Association
HEI	Heat Exchange Institute
EDB	Engineering Design Basis
LRVP	Liquid Ring Vacuum Pump
MOC	Material of Construction
TPIA	Third Party Inspection Agency
PTR	Proven Track Record
NIT	Notice Inviting Tender
SPRV	Single Point Responsibility Vendor
LPC	Loading & Penalty Criteria
RFQ	Request for Quotation

4.3.2.2 CODES & STANDARDS / PUBLICATIONS

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

For design aspects not specifically covered by Data Sheets, Specifications, Codes and Standards or Regulations, the design shall be based on good engineering practice.

S.No.	Description	Standards / Codes	Edition
1	Ejectors	HEI / ASME SEC. VIII, DIV.1	
2	Condensers	TEMA / ASME SEC. VIII, DIV.1	
3	Vacuum pumps	API 681	

4.3.3 GENERAL / DESIGN CONSIDERATIONS

4.3.3.1 EJECTOR DESIGN CRITERIA

S.No.	Project Philosophy
1	Type of system: Hybrid System (Comprising of two stage ejectors + Last stage vacuum pump) OR All ejector system (Comprising of all stages as ejectors) OR As specified in PDS.

S.No.	Project Philosophy
2	1st stage & 2nd stage will be all ejectors for both the system (Hybrid or All ejectors)
3	No.of elements/capacity of 1st Stage Ejectors: As per PDS.
4	No.of elements/ capacity of 2nd Stage Ejectors: As per PDS.
5	3rd stage may be all ejectors condensers or LRVP.
6	In case, 3rd stage is LRVP, minimum 2 nos. pumps will be operating and one will be stand by. (Also refer spare philosophy for the project)
7	In case, 3rd stage is all ejectors, then No. of elements shall be as per PDS.
8	Ejectors can be mounted vertically or horizontally in ejector system based on the available plot area.
9	Minimum material of construction to be as below: - Ejector mixing chamber/diffuser : CS - Motive Steam Nozzle : SS 316Ti

4.3.3.2 EJECTOR SYSTEM DESIGN CRITERIA

S.No.	Project Philosophy
2	Ejector condenser bottom flange elevation to be minimum 13 m above Hot-Well Top.
3	As per EIL Practice, Type of Vacuum valve will be as below: - Gate valve (Non Motorized): < 14" - Gate valves (Motorized) : >= 14"
4	PGTR Requirement at site for ejector system before commissioning : No

4.3.4 SPECIFIC DESIGN REQUIREMENTS

4.3.4.1 CONDENSERS

S.No.	Project Philosophy
1	Ejector condensers shall be designed as per BEDB Part-B.
2	Ejector Condensers Type - Fixed tube sheet - Floating head Type (as per BEDB Part-B)
3	Ejector shall be designed for 90% of minimum operating pressure of steam at ejector Battery Limit as per HEI recommendation.

4.3.4.2 VACUUM PUMP SYSTEM

S.No.	Project Philosophy
1	Stand by philosophy for LRVP shall be as follows:-
1.1	Up to 3 operating LRVP' s one spare shall be required.
1.2	For 4 operating LRVP' s two spare shall be required.
2	Each complete LRVP system shall be skid mounted comprising vacuum pumps, separator, condenser, instruments & control, electrical,control valves, valves, piping etc. Common Cooler & Separator is not acceptable.
3	Switching over philosophy for LRVP to LRVP: Automatic

4.3.5 PROCUREMENT PHILOSOPHY

S.No.	Project Philosophy
1	Issue of RFQ on limited basis
2	LPC Criteria applicable or not. If yes, provide cost of power, steam, and rate of interest & No. of years: Not Applicable.

S.No.	Project Philosophy
3	No. of days for supervision during internal installation / commissioning shall be decided by EIL.
4	Maximum time allowed for corrective engineering shall be as defined in GPC.

4.3.6 OWNER / CLIENT SPECIFIC REQUIREMENTS

S.No.	Project Philosophy
1	

4.3.7 VENDOR DATA REQUIREMENT

Vendor Data Requirement as indicated in the respective equipment Material Requisitions shall be followed.

Only critical vendor data/documents such as Equipment Data Sheets, P&ID's, PFD, GAD of equipment and system for complete vacuum ejector system, Line schedule, Instrument datasheet, Control Valve datasheet shall be taken for Owners/Consultant's review. Other documents shall be retained for information.

4.3.8 SPARES PHILOSOPHY

4.3.8.1 ERECTION & COMMISSIONING SPARES (Ejector, Condenser & Separator)

S.No.	Title	Spare Philosophy	Remarks
1	Fasteners	10% studs and nuts but not less than 4 studs with 8 nuts for each joint.	
2	Gaskets	100% gaskets for each flanged joint.	

4.3.8.2 MANDATORY SPARES (Ejector, Condenser & Separator)

S.No.	Title	Spare Philosophy	Remarks
1	Fasteners	20% studs and nuts but not less than 4 studs with 8 nuts for each joint.	
2	Gaskets	400% gaskets for each flanged joint.	
3	Steam nozzle	100% for each ejector.	

Spares for other items shall be as per other departments respective EDB's. Special Tools & Tackles shall be procured as per vendor recommendations.

4.3.9 EXECUTION PHILOSOPHY

S.No.	Project Philosophy
1	Complete LRVP system shall be skid mounted.
2	Vendor shall be responsible on SPRV basis for supply of Vacuum Ejector System.
3	Site installation shall be carried out by mechanical contractor and supervision shall be provided by Ejector System Supplier on per diem basis.

4.3.10 INSPECTION METHODOLOGY

S.No.	Project Philosophy
1	Standard ITP to be followed.
2	Inspection shall be carried out by TPIA / EIL as per Project Philosophy.

Annexure-1
to SMED - Static part(Sl.no-1.0)
of Design basis.

Client specific requirements.

General

1. Standardize the anchor bolt size across the equipment in a range to reduce construction efforts.
2. Projection of vacuum stiffening rings, on insulated pressure vessel shall be less than the thickness of insulation. Alternatively, the stiffening rings shall be covered with insulation & cladding.
3. All columns/vessel stiffener ring shall have sufficient drain holes of 10 mm dia (minimum 6 Nos) to avoid water logging.
4. Tailing lug to be provided for all skirt supported equipment irrespective of weight.
5. All equipment with skirt supported design shall be provided with template.
6. For heat exchangers working at critical high temperature/ high pressure/ operating at auto ignition temperature: possibility of engineered spring washer arrangement to be checked for all gasket joints i.e. Float head gasket, tube sheet gasket, Channel box & shell gaskets etc.
7. All the davit arrangements/ lifting lugs/ any other handling tools must undergo stage-wise inspection and to be tested for its holding capacity for a period of at least 8 hours at suppliers shop to ensure that there is no failure of welded joints/ fillets/ links / eye bolts etc.
8. Mating WNRF flanges of all process nozzles including gasket and fasteners/washers shall be kept in the scope of the Equipment manufacturer.
9. For Shell & tube heat exchangers, In case wherein actual test at supplier's shop and commissioning exceeds more than and/or 12 months, following shall be ensured during pre-commissioning and before final commissioning: I). Minimum 10% sample hydro testing of S&T type exchangers per OEM shall be carried out at site to ascertain the integrity of float head (805) & tubesheet gasket (803) joints. II). In case of any leak observed during testing, BPCL in consultation with respective PMC/EPCM shall take a call for increasing sample size.
10. Unless otherwise specified by the Licensor, all exchangers with cyclic loading, possible dual phase service, high pressure exchangers, Critical exchangers shall be provided with specially designed Gaskets (ex. Kammprofile Gaskets). For definition of Critical Exchanger, High pressure exchangers refer below.
11. Critical exchanger definition: A) Light hydrocarbon service exchangers operating at or above auto ignition temperature. B) Handling Toxic, inflammable, high H₂S concentration (more than 100 ppm), hydrogen pure or mix, LPG service exchangers. C) Exchangers handling any fluid (incl steam) more than 450 Deg C. D) HP exchanger: handling fluids/gases more than 60 kg/cm²g on any side.
For Exchangers & Air Fin coolers, irrespective of tube-to-tube sheet joint design, holes in tube sheets {lesser than 25 mm (1 in) thick} shall be provided with one groove approximately 3 mm (1/8 in) wide and 0.4 mm (1/64 in) deep. A second groove shall be provided for tube sheets 25 mm (1 in) or greater in thickness. This requirement is over & above the seal or strength welding required as per applicable design code / standard.
12. All Exchanger in Steam service shall have metallic SPWD gasket in place of IJA gasket.
13. In shell & tube Heat Exchangers, Minimum number of test rings/ test flanges/ dummy shells shall be at least two per set of three bundles. – Shall be two per set of three.
14. Shell & tube exchangers in chemical process service shall be as per TEMA Class-B.

Air Fin coolers

15. Air fin cooler fan thrust bearing shall have spacer in addition to circlip for locking the thrust bearing.
16. AFC fan shall be provided with hooks for motor erection and dismantling.
17. Bearing Block Diagram: The locking arrangement of the NDE angular ball bearing at fan side to be split ring type of thickness around 8mm with a circlip locking arrangement so that the load will be on the split ring.
18. Single Plug Design (Air Fin cooler Header) : Single plug design shall be used irrespective of design pressure and/or service fluid.
19. Light Weight Aluminium platform (movable) to be provided to facilitate the day-to-day maintenance activities at each AFC floor.
20. For Air fin cooler, with suitable structure in place, heavy duty wire mesh to be designed for a load of 5 persons (Live load: 100 kg/cm²). This is required for erection and fire water sprinkler activities post erection of coolers. Persons may have to go on top of bundle to do minor construction & maintenance activities.
21. Economic comparison of Air cooler fan shall be performed.
22. One Scissor trolley per group of air coolers on one location shall be provided.

Storage tanks

23. Minimum thickness of Bottom & Shell plate of new storage tanks shall be 8 mm.
24. Both fixed roofs and external floating roofs of storage tanks shall have minimum 6 mm thickness irrespective of material of construction.
25. Thickness of the annular plate shall be atleast 2 mm above the design thickness calculated per applicable API Code.
26. All wind girders shall be provided as a walkway with a minimum width of 600mm and with an outward slope of 1 :100. Minimum thickness for wind girder top plates shall be 8mm. Handrails shall be provided all around at the unprotected areas.
27. Compression plates of Secondary seal system shall be of SS metallurgy with minimum 16 SWG thicknesses. Only SS fasteners with rounded head shall be used.
28. Only galvanized seamless A106 Gr. B / SA 53 pipes with minimum Sch. 80 thickness shall be used for floating roof leg supports.
29. Socks shall be provided for gauge well pipe and roof support leg sleeves. Protection sleeves or plate shall be used before welding it directly to tank plate.
30. Split pins (SS 410 or SS316 depending on the design load) for rolling ladder and bolting used for adjustment of height of floating roof leg supports shall be of SS metallurgy.
31. Storage Tank boot sealing shall be provided to avoid water ingress under the bottom plates and subsequent corrosion of annular plate extension and bottom plates.
32. BPCL AES specifications shall be followed for roof drain line.
33. Metallic components of primary and secondary sealing system shall be of SS 316 metallurgy.
34. Pressure Relieving Devices to be installed on Rim Vent in case of Vapour Mounted Seal (primary Seal) in floating roof tanks.
35. In case of Liquid Mounted Seal (Primary Seal) Rim Vent is not required
36. All gauge & guide pole assemblies, pertaining to floating roof should be electrically insulated from floating roof. This is to prevent jumping of lightning current across it. The insulation level should be rated greater than 1 KV.
37. Roof Drain shall be Articulated steel pipe with Pivot joints. Refer BPCL specification for further details.

LIST OF DATASHEET (STATIC & MACHINERY EQUIPMENT)

STEAM GENERATION PACKAGE TENDER No. B957-420-80-44-PG-T-7410

ANNEXURE-A	:	STATIC EQUIPMENT
ANNEXURE-B	:	PACKAGED EQUIPMENT
ANNEXURE-C	:	ROTATING EQUIPMENT



**ANNEXURE-A
TO
DATASHEET LIST
(STATIC & MACHINERY EQUIPMENT)
STEAM GENERATION PACKAGE
TENDER No. B957-420-80-44-PG-T-7410**

**PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE
CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO
BINA PETCHEM & REFINERY EXPANSION PROJECT
(BPREP)**

OWNER : M/s BHARAT PETROLEUM COOPERATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

JOB NO : B957

0	16-01-2025	ISSUED AS TENDER INPUT	SRIKANTH	VIVEK	PB
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

Blank Data Sheet, to be duly filled by vendor for pressure vessel, Agitator / Mixer and tanks shall be taken from B957-999-80-42-DS-1001, Annexure of EIL Standard Specification 6-12-0030 & 6-12-0031 and duly filled-in Datasheet to be submitted during detailed engineering.

Notes:

1. Contractor shall furnish filled in the datasheets / proformas separately for each equipment / package after placement of order during detailed engineering. Datasheet / proforma format shall be filled by respective equipment supplier (vendor) and shall be vetted by Contractor prior submission to Owner / EIL for approval.
2. Equipment for which no such data sheets/ proformas are provided by Owner/ PMC, the Contractor may use his standard data sheets/ proformas or of Equipment Manufacturer's standard data sheets/ proformas & furnish the same.
3. Contractor/ Vendor to furnish all blank data.

		MIXER DATA SHEET		DATA SHEET NO.		REV	
				XXXX-XXX-80-42-DS-XXXX		X	
				SHEET		1 OF 2	

1.0	PROJECT :		SERVICE				
2.0	CUSTOMER		DUTY :				
3.0	JOB NO.		ITEM NO. :		NO. REQD.		
4.0	UNIT NO.		MANUFACTURER :				
5.0	LOCATION		MAKE / TYPE / SIZE :				
5.1	AREA CLASSIFICATION						

6.0	OPERATING CONDITIONS							

6.1	PURPOSE :				FLOW RATE THROUGH VESSEL:		(m3/hr)	
6.2	OPERATION :				RETENTION TIME (HR):			
6.3	BATCH OPERATION TIME :							
6.4	CONTINUOUS FLOW RATE REQUIRED WITHIN THE TANK (min.)		m3/hr		RATED :		MAX. :	
6.5	OPERATING PRESSURE (Kg/cm ² g) :		OPERT. TEMP(°C) :		SOLIDS PRESENT :		TYPE & SIZE:	
6.6	FOAM TENDENCY :				SOLUBILITY :			
6.7	DEGREE OF AGITATION				ABRASION :			
6.8	CORROSIVE PRODUCTS				SETTLING :			
6.9	PROCESS LIMITATION (IF ANY) :		NONE	H.P.	TIP SPEED	SPACE	TORQUE	SEE NOTES

7.0	PRODUCTS TO BE MIXED (IN SEQUENCE)							
7.1	S.NO.	COMPONENT	PERCENTAGE COMPOSITION		VISCOSITY (CST)		DENSITY	
			BY VOLUME	BY WEIGHT	AT OPER TEMP.		AT 15°C	AT OPER. TEMP.
7.2	AVERAGE PROPERTIES OF MIX							

8.0	CONSTRUCTION							

8.1	VESSEL : ITEM NO. :		DRG. NO.		SUPPLY		BY OTHERS	BY VENDOR	LINING	NO	YES
8.2	VOLUME:		DIA/SIDE (mm) :		HEIGHT/LENGTH (mm) :		THICKNESS (mm)				
8.3	TOP :	OPEN :	CLOSED TYPE	FLAT	DISHED	MIXER MOUNTING NOZZLE SIZE (mm DIA.):					
8.4	BOTTOM :	FLAT	DISHED	CONICAL	DEPTH OF BOTTOM FROM WLF/TANGENT LINE (mm) :						
8.5	BAFFLES :	NO	YES	VENDOR TO SUGGEST		TYPE	NO. :	SIZE(L x W x T)/DIA (mm)			
8.6	BAFFLE SPACING FROM WALL (mm) :		HEATING COILS PROVIDED :		NO	YES	SIZE				
8.7	LIQUID LEVEL (INCH FROM WELD/TANGENT LINE) :		NORMAL :		MIN.	MAX.					
8.8	MOUNTING SPACE FOR MIXER		AVAILABLE	AMPLE	RESTRICTED	(mm)	ACTUALLY REQD. (mm)				
8.9	MIXER : LOCATION	SIDE ENTRY	TOP ENTRY	BOTTOM ENTRY	PORTABLE	MOTOR/GEARBOX MOUNTING:		HORIZONTAL	VERTICAL		
8.10	MOUNTING :	CLAMPED	FLANGED	MOUNTING ANGLE :		INSTALLATION HEIGHT REQUIRED:		mm			
8.11	SHAFT SEAL :	MECH SEAL	STUFF. BOX	LABYRINTH SEAL	VAPOR SEAL						
8.12	MAKE	TYPE :		CLASS	SIZE :						
8.13	MTRL.	NO. OF RINGS :		LANTERN RINGS	YES	NO					
8.14	SHUT-OFF DEVICE WITH :		(A) TANK FULL	YES	NO	(B) UNDER PRESSURE	YES	NO			

9.0	MATERIALS (SEE NOTE 5)							

9.1	IMPELLER :		SHAFT :		SHAFT SLEEVE :			
9.2	TANK		AUX. TANK COUPLING :		BAFFLES :			
9.3	MTG. FLANGE		STEADY BEARING :		BOLTS			
9.4	GASKET:		STABILIZER RING :		HIGH SPEED COUPLING :			
9.5					H.S. CPLG GUARD :			

10.0	CHARACTERISTICS							

10.1	IMPELLER	TYPE :			NO.	DIA. (mm)	SPEED (RPM) :		
10.2	BLADES	TYPE :			NO.	PITCH :	WIDTH (mm) :		
10.3	MINIMUM	SUBMERGENCE			CLEARANCE FROM (A)THE BOTTOM OF IMPELLER TO TANK BOTTOM (mm)		B) SIDEWALLS (mm)		
10.4	SHAFT	DIA (mm) :	SOLID	PIPE SCH	(A) INSIDE TANK	(B) AT THE BEARINGS / IN STOOL	CHROME PLATING :	YES	NO
10.5		LENGTH FROM MIXER FLANGE (mm) :			TOTAL LENGTH (mm) :	ROTATION FROM IMP. END :		.CW	.CCW
10.6	STABILIZER :								
10.7	DRIVE UNIT :	TRANSMISSION TYPE	GEAR	BELT	DIRECT COUPLED	AGMA S.F. :	LUBRICATION :	FORCED	SPLASH
10.8		TYPE OF G. BOX/BELT :	MAKE :	RPM : INPUT / OUTPUT PERMISS. LOAD : THRUST (KG)	RADIAL(KG)				
10.9		DISPOSITION OF RED. UNIT :	HORIZONTAL	VERT.	INCLINED	C/C DISTANCE :	SPEED RATIO :		
10.10		HIGH SPEED COUPLING :	TYPE :	MAKE :	H.S. COUPLING GUARD :	NO	YES		
10.11		LOW SPEED COUPLING :	TYPE :	MAKE :	AUX. TANK COUPLING :	NO	YES	TYPE	
10.12		ELECTRIC MOTOR : K.W. :	SYN. RPM :	RPM AT FULL LOAD :					
10.13			MAKE :	VOLTS / PHASE / CYCLES :					
10.14		ENCL :	MTG. (A)	HORIZ.	VERT.	(B)	FOOT	FLANGE	
10.15			FRAME SIZE :		INSULATION CLASS				
10.16		MTG. FLANGE :	(A) TANK	SIZE	RATING :	FACING :			
10.17			(B) MIXER	SIZE	RATING :	FACING :			

X								
NO.	DATE	REVISION				BY	CHK	APP

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		DATA SHEET NO.		REV	

		MIXER DATA SHEET		XXXX-XXX-80-42-DS-XXXX		X	
				SHEET		2 OF 2	
11.0	PERFORMANCE						
11.1	HORSE POWER ABSORBED :		(A) WITH BAFFLE :		(B) WITHOUT BAFFLES :		POWER NO. USED
11.2	BASIS OF POWER CALCULATION :						
11.3	EFFECT OPER. TIME :		RECYCLE TIME		TANK-TURN-OVER RATE :		
11.4	CRITICAL SPEED OF MIXER (RPM)		OPERATING SPEED AS PERCENTAGE OF CRITICAL SPEED :				
11.5	SEAL FLUSHING :		☐ YES ☐ NO		API PLAN		SEAL COOLING (SEE NOTE-6): ☐ REQUIRED ☐ NOT REQUIRED
11.6	EFFECTIVE SPHERICAL RADIUS OF AGITATION : THEO : (mm)						
11.7	GUARANTEE FURNISHED :		☐ MECHANICAL ☐ PERFORMANCE ☐ SMOOTH OPERATION				
12.0	TESTING						
12.1	S.NO.	TEST	REQUIRED	WITNESSED	CERTI. REQD.	REMARKS	
	1	MATERIAL CHECK					
	2	DIMENSIONAL CHECK					
	3	MECH. RUNNING TEST ON AIR AT SHOP					
	4	PERFORMANCE TEST WITH WATER AT SHOP					
	5	PERFORMANCE TEST AT SITE					
	6	STATIC BALANCE					
	7	DYNAMIC BALANCE					
	8	SHUT-OFF					
13.0	MISCELLANEOUS						
13.1	MAX. LOAD ON MTG FLANGE DURING OPERATION :		FORCES		MOMENTS		
13.2	WEIGHTS (Kgs) :	MIXER :	DRIVER :	ACCESSORIES :	TOTAL :		
14.0	SCOPE OF SUPPLY						
14.1	MIXER UNIT WITH ALL NECESSARY ACCESSORIES AND APPURTENANCES						
14.2	ELECTRIC MOTOR				MOTOR CANOPY		
14.3	GEAR REDUCER		☐ BELT DRIVE		MOTOR STARTER		
14.4	MIXER MTG. FLANGE				MTG. FLANGE GASKET AND A SET OF BOLTS		
14.5	AUX. TANK COUPLING				LOW SPEED COUPLING		
14.6	HIGH SPEED COUPLING				H.S. COUPLING GUARD		
14.7	SHAFT SEAL AS SPECIFIED				BELT DRIVE GUARD		
14.8	ANGUL. MOUNTING PIECE				SPARE PARTS		
14.9	SPECIAL TOOLS FOR MAINTENANCE				INSPECTION AND TESTING		
14.10	DRIVER ENGG. COORDINATION AND SHOP ASSEMBLY WITH DRIVER				OPERATING MANUAL/CATALOGUE		
14.11	FIELD ASSEMBLY				TYPICAL SKETCH WITH BID		
14.12	DOCUMENTS AND DATA AS SPECIFIED						
NOTES : 1 BIDDER SHALL FURNISH ALL RELEVANT DATA FOR EACH MIXER ALONG WITH THE BID AS PER VENDOR DATA REQUIREMENTS. 2 BIDDER TO CONFIRM IF DYNAMIC BALANCING TEST IS A REQUIREMENT FOR THIS ITEM 3 BIDDER TO FURNISH THE EXACT MATERIAL INDICATING DESIGNATION ETC. FOR ALL MATERIALS QUOTED 4 BIDDER TO FURNISH LIST OF TWO (2) YEARS OPERATION SPARES AND INDICATE IF COMMISSIONING SPARES WILL BE REQUIRED. 5 CORROSION ALLOWANCE EQUAL TO SPECIFIED FOR VESSEL/TANK SHALL BE CONSIDERED FOR EACH EXPOSED SURFACE. 6 ALL INSTRUMENTS/EQUIPMENTS/ACCESSORIES REQUIRED FOR SEAL COOLING TO MEET BATTERY LIMIT CONDITIONS SHALL BE SUPPLIED BY VENDOR 7 REFERENCE DOCUMENTS:							
X							
NO.	DATE	REVISION			BY	CHK	APP
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Annexure-B

LIST OF DATASHEET

(SME - PACKAGED EQUIPMENT)

STEAM GENERATION PACKAGE

TENDER No. B957-420-80-44-PG-T-7410

PROJECT	:	MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)
OWNER	:	BHARAT PETROLEUM CORPORATION LIMITED (BPCL)
EPCM	:	ENGINEERS INDIA LIMITED
EIL JOB No.	:	B957

0	03.02.2025	ISSUED WITH TENDER	KJS	AK	KCP
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

MANDATORY SPARE LIST
(SME - PACKAGED EQUIPMENT)
FOR
STEAM GENERATION PACKAGE

Annexure-B
DOCUMENT No.
B957-420-80-42-ID-7410
Rev. 0
Page 2 of 2

Sr. No	Datasheet-Title	Document No.
1.	EOT Crane	B957-420-80-42-DS-4001
2.	HOT Crane	B957-420-80-42-DS-4002
3.	Chain Pulley Blocks	B957-420-80-42-DS-4003
4.	Electric Hoist	B957-420-80-42-DS-4004
5.	Water cooled chiller	B957-420-80-42-DS-4005
6.	Water cooled condensing unit	B957-420-80-42-DS-4006
7.	Chilled water pump	B957-420-80-42-DS-4007
8.	Air Handling Unit	B957-420-80-42-DS-4008
9.	Fine Filters	B957-420-80-42-DS-4009
10.	Chemical Filter Unit	B957-420-80-42-DS-4010
11.	Split Air conditioners	B957-420-80-42-DS-4011
12.	Water cooled packaged unit	B957-420-80-42-DS-4012

GENERAL INFORMATION

1	Project		Tag No.	
2	Client		Quantity	
3	Project Location		Service	Maintenance
4	Job No.		Manufacturer	
5	Unit/Building			

Purchaser's Requirement

6	Purchaser's Requirement			
7	Denotes Applicability	☒		
8	Applicable Specifications : EIL STD SPEC. 6-48-0002,IS:3177 & IS:807 (latest revisions)and specifications referred therein.			
9	Applicable to	Proposal	☐	Purchase
			☐	As built
			☐	

OPERATING DATA

11	Location	Indoor	☒	Outdoor	☐		Area Classification	Safe	☐	Hazardous	☐
12	Duty Class	M1	☐	M2	☐	M3	☐	M4	☐	Power Collection	As per Electrical data sheet
13		M5	☒	M6	☐	M7	☐	M8	☐	Power Supply	As per Electrical Specification
14	Span(m)		Bay Length(m)				Control	Radio	☒	Pendant	☐
										Cabin	☐
15	Lift(m)	Main Hook		Auxiliary hook			Control Type	Radio Remote Control			
16	HOIST	Capacity (MT)	Hoisting Speed (m/min)	Hoisting Accel. (cm/sec ²)	Creep Speed (m/min)		Max. vertical Girder Deflection	As per IS:807			
17	Main Hoist		*	*	10% of Normal speed		LT Speed (m/min)	*	CT Speed (m/min.)	*	
18	Aux. Hoist		*	*	10% of Normal speed		LT Accel. (cm/sec ²)	*	CT Accel.(cm/sec ²)	*	
19	Type of Crane	Single Girder					☐	Double Girder			☐
20	Painting Specification	As per attached Painting Specification					☒	As per Vendor's Painting Spec.			☐
21	Environment	Corrosive	☐	Highly corrosive	☐		Anti-Spark Design	Yes	☐	No	☐

MANUFACTURER'S DATA

23	Bridge Girder	Hoisting Mechanism				MH	AH
24	Type of Construction	*				*	*
25	Material	*				*	*
26	Size	*				*	*
27	End Carriage	*				*	*
28	Type	*				MH	AH
29	Wheel base	*				*	*
30	Material	*				*	*
31	Max. wheel load without impact,KN	*				*	*
32	Rail	LT		CT		Diameter/Construction	
33	Specification	*		*		Type of Core	
34	Size (lbs/yd)	*		*		Factor of safety	
35	Length,m	*		*		Tensile strength	
36	Bulb width,mm	*		*		Hook & Hook blocks	
37	Material	*		*		MH	
38	Wheel	Trolley		Bridge		Material of Hook	
						*	

39	Quantity	*	*	Type and size of bearing at hook support	*	*
40	Wheel diameter, mm	*	*	Safety latches provided	Yes	
41	Material of wheel core/hub	*	*	Buffers	Trolley	Bridge
42	Material of wheel tyre	*	*	Type of construction	*	*
43	Surface hardness of Core/ tyre, BHN	*/*	*/*	Location	*	*
44	Thickness of tyre at tread, mm	*	*	Material	*	*
45	Bearing type and make	*	*	Quantity	*	*
46	Bridge Drive Machinery and Trolley Drive Machinery			Stoppers	LT	CT
47	Type of Bridge Drive Unit	*		Quantity	*	*
48	Type of Trolley Drive Unit	*		Type	*	*
49	Materials of :			Size	*	*
50	Gear / Pinions	*		Material	*	*
51	Shafts	*				
52	Housing	*				
53	Gear boxes	MH	AH	LT	CT	
54	Make/Model	*	*	*	*	
55	Ratio	*	*	*	*	
56	Type of gear	*	*	*	*	
57	Service factor	*	*	*	*	
58	Coupling	MH	AH	LT	CT	
59	Type of Coupling	*	*	*	*	
60	Between Motor and Gear Box	*	*	*	*	
61	Between Gear Box and Drum	*	*	*	*	
62	Make	*	*	*	*	
63	Quantity	*	*	*	*	
64	Brakes	MH	AH	LT	CT	
65	Make/Model	*	*	*	*	
66	Type	*	*	*	*	
67	Quantity	*	*	*	*	
68	Braking capacity at full load torque	*	*	*	*	
69	Designed distance for complete stopping from full speed, mm	*	*	*	*	
70	Motor	MH	AH	LT	CT	
71	Make/Model	*	*	*	*	
72	kW rating	*	*	*	*	
73	Quantity	*	*	*	*	
74	Manufacturer	*	*	*	*	
75	RPM	*	*	*	*	
76	Limit Switch	MH	AH	LT	CT	
77	Type	*	*	*	*	
78	Make/Model	*	*	*	*	
79	Quantity	*	*	*	*	

80	Location	*	*	*	*
81	Platforms on Bridge Girders		Illumination fitting on bridge		
82	Type of construction	*	Numbers	* (4 for Double girder)	
83	Material	*	Type/Make	*	
84	Minimum width, mm	750	Portable hand lamp with wiring	Provided	
85	Nos. (Full length platform)	1			
86	No. of Short Platforms	2			
87	Length of each short platform, mm (min.)	900			
88	Handrail height,mm, (min.)	1100			
MH: Main Hoist		AH: Auxiliary Hoist	LT: Long Travel	CT: Cross Travel	

GENERAL INFORMATION				
1	Project		Tag No.	
2	Client		Quantity	
3	Project Location		Service	Maintenance
4	Job No.		Manufacturer	
5	Unit/Building		For technical details, Refer EIL Std. spec. 6-48-0003	

1.0 PURCHASER'S REQUIREMENTS

Sl.No.		
1.1	Shop/Building	
1.2	Tag No.	
1.3	Quantity	
1.4	Location	
1.5	Service	
1.6	Main hoist capacity, kg	
1.7	Auxiliary hoist capacity	
1.8	Span (Centre-centre runway rails), m.	
1.9	Highest position of main hook from FFL, m	
1.10	Type of crane (Single/Double girder)	
1.11	Class of Duty (As per IS 3177)	
1.12	Type of Hoist	
1.13	Maximum lifting pull at full load	
1.14	Maximum LT & CT pull at full load	
1.15	Bay length (m),(approx.)	
1.16	Area classification	
1.17	Gantry (Runway) LT rails size mm, square bar	
1.18	Special Requirements (if any)	

2.0 MANUFACTURER'S SPECIFICATIONS

(Contractor to fill up completely for each Crane separately and submit after order)

2.1 WEIGHT OF EQUIPMENT

2.1.1	Wt.of complete crane kgs.	:
2.1.2	Wt. of trolley kgs.	:
2.1.3	Wt. of bridge girder kgs.	:
2.1.4	Wt. of each end carriage kgs	:
2.1.5	Max.wheel load kgs	:
		:

2.2 CRANE STRUCTURE

- 2.2.1 Girder Particulars
- a) Type of girder construction :
 - b) Size :
 - c) Number :
 - d) Material :
 - e) Weight of girder, kg :
- 2.2.2 Bridge Wheels
- a) Type :
 - b) Number per end carriage :
 - c) Material :
 - d) Surface hardness no. (BHN) :
 - f) Diameter :
 - g) Wheel base centre :
 - h) Type and make of bearing :
 - i) Bearing size, number :
 - j) Bearing lubrication details :
- 2.2.3 Bridge Travel Buffers
- a) Type of construction :
 - b) Location :
 - c) Material :
 - d) Number :
- 2.2.4 End Carriage
- a) Type of construction :
 - b) Size :
 - c) Number :
 - d) Material :
 - e) Weight Kg. :
 - f) Length :
- 2.2.5 L T Runway Rails (in vendor's scope of supply)
- a) Type and size, (mm x mm) :
 - b) Length, :
 - c) Material :
 - d) End stoppers/buffers at four corners : Yes
provided.

1	EIL JOB NO.		B957	
2	Unit No.		Package Tag	
3	Service of Unit	Maintenance	CUSTOMER :	BPCL
			PROJECT	BPREP
			LOCATION	BINA, MP, INDIA
4	Item no.	*	Quantity	
5	Manufacturer:	*	Model no. :	*
6	☒ Denotes Applicability			
7	Applicable Specification : IS 3832 along with ammendments & EIL spec 6-61-0015			
8	Applicable to	Proposal	☐ Purchase	☐ As Built
9	OPERATING DATA			
10	Mounting Type:	Hook	☐ Lug push Trolley	☐ Geared Trolley
11	Capacity (T) :	*		
12	Mechanism Class :	M1	☐ M2	☒ M3
13	Factor of Safety:	Min.4		
14	Location :			
15	Area classification :	HAZARDOUS		
16	Overtravel restraint :	Required	☒ Not required	☐
17	Distance between operating level and suspension level,m:	*		
18	Hoist lifting height (minimum) ,m :	*		
19	Headroom(maximum) ,m :	*		
20	Chain pull for hoisting and traversing ,kgs:	*		
21	Location of Lowest point of hand chain loop	0.4 m above operating level		
22	Bottom hook swivelling with thrust bearing:	Yes	☐ No	☐
23	MANUFACTURER DATA:			
24	Capacity(T) :	*		
25	Velocity ratio :	*		
26	Range of lift ,m :	*		
27	Headroom ,m:	*		
28	Pull for hoisting under full load ,kgs :	*		
29	Pull for traversing under full load ,kgs :	*		
30	No. of falls (load chain) :	*		
31	Type of Gear :	Spur Gear	☒ Worm gear	☐
32	Type of automatic mechanical load brake :	*		
33	Size and no. of trolley wheel	*		
34	Base material of trolley wheel	*		
35	Hardness (BHN) of trolley wheel base and rim	*		
36	Diameter	*		
37	Bottom hook :	As per IS 15560		
38	Top hook :	As per IS 15560		
39	Load chain trough (Type) :	*		
40	Length of hand chain (hoist and traverse separately) ,m :	For hoist :	*	For traverse : *
41	Hardness of Ratchet	*		
42	Hardness of pawl	*		
43	F.O.S on load chain :	*		
44	Load chain :	Pitched	☒ Polished	☒
45	Hand Chain :	Pitched	☒ Polished	☒
46	Safety latches on bottom hook :	Required	☒ Not required	☐
47	Safety latches on top hook :	Required	☒ Not required	☐
48	Total weight,kg :	*		
49	MONORAIL DETAILS:	APPLICABLE	☐ NOT APPLICABLE	☐
50	Mono Rail Size	*		
51	MATERIALS OF CONSTRUCTION:			
52	Load chain (Hoist) ,T(8) as per IS 6216 :	*		
53	Hand chain (Hoist) , L(3) as per IS 2429 (part 1) :	*		
54	Hand chain (Traverse) :	*		
55	Load chain wheel :	*		
56	Gear (hoist) :	*		
57	Gear (Traverse) :	*		
58	Ratchet wheel, chain guides :	*		
59	Pawl :	*		
60	Hand chain wheel (hoist) :	*		
61	Hand chain wheel (traverse) :	*		
62	Bottom hook :	*		
64	Load chain trough:	*		

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1.	GENERAL INFORMATION			
2.	Project	BPREP	Tag No.	
3.	Client	M/s BPCL	Quantity	
4.	Project Location	BINA, MP, INDIA	Service	Maintenance
5.	Job No.	B957	Manufacturer	
6.	Unit/Building			
7.	OPERATING PARAMETERS			
8.	Capacity:		Lift:	
9.	Location:		Lift speed, M/min.:	
10.	Lift creep speed, M/Min.:		Traverse speed, M/Min.:	
11.	Beam size:		Length of travel:	
12.	Operating Floor level:		Elevation of Bottom of monorail where Hoist to be mounted :	
13.	Area Classification:		Duty Class:	
14.	CONSTRUCTION FEATURES			
15.	Make:		Model:	
16.	Overall size:		Overall weight:	
17.	MATERIAL OF CONSTRUCTION			
18.	Drum:		Wheels:	
19.	Trolley:		Hook:	
20.	Sheave:		Rope:	
21.	Rope size:		No of falls:	
22.	Min. breaking load, Kg:		Factor of safety:	
23.	Drum size:		Type of hook:	
24.	Safety latch in hook:		Type of bearing:	
25.	Hoist motor, KW:		Travel motor, KW:	
26.	Hoist brake type:		Travel brake type:	
27.	Hoisting:		Lowering:	
28.	Traverse:		Limit switches:	
29.	Control voltage:		Service factor:	
30.	Flexible power cable details:		Pendant Wt.:	
31.	Pendant push button station details:		Length of pendant cable:	
32.	Gear ratios:		Weight of hoist, kgs:	

NOTE:

1. Contractor/ Vendor to submit filled-in data sheet of each electric hoist separately.

1.	OPERATING CONDITIONS			
2.	Duty	Continuous/Intermittent		
3.	Installation	Indoor/Outdoor		
4.	Quantity			
5.	Working	Nos.		
6.	Stand by	Nos.		
7.	Area classification	Safe/Hazardous		
8.	Driver	Electric motor		
9.	Refrigerant	R134a/R-407a/R407c/R410a		
10.	Capacity of each chiller package – Nominal	TR		
11.	Capacity of each chiller package – Actual	TR		
	MANUFACTURER SPECIFICATION			
12.	Compressor			
13.	Make			
14.	Model			
15.	Type	Scroll/ Screw		
16.	No of stages/ No. of compressor/ Unit			
17.	Capacity			
18.	Saturated suction pressure			
19.	Saturated suction temperature			
20.	Saturated discharge pressure			
21.	Saturated discharge temperature			
22.	Compressibility			
23.	Drive	V-belt / flexible coupling		
24.	Screw Compressor			
25.	Rotor Diameter			
26.	No of lobes – Male/Female			
27.	Rotor length to diameter ratio(L/D)			
28.	Rotor Clearance			
29.	Shaft Diameter	mm		
30.	Shaft seal type			
31.	General Parameters			
32.	Compressor speed	RPM		
33.	Guaranteed shaft power (All losses inclusive)			
34.	Motor power & speed			
35.	Motor suitable for loaded starting	Yes/No		
36.	Description of unloaded starting arrangement			
37.	Min compressor speed for proper lubrication/capacity control	RPM		
38.	LUBRICATION			
39.	Type	Splash/Pressure		
40.	Oil pump driven by	Compressor shaft/ Electric motor		
41.	Grade of lubrication oil			
42.	Lubrication oil charge			
43.	CAPACITY CONTROL			
44.	Type			
45.	Actuators	Automatic cum manual		
46.	Actuators operated by	Microprocessor controlled		
47.	Compressor to unload on power failure/stoppage	Automatic cum manual		
48.	Capacity regulation steps	%	%	%
49.	Capacity (TR)	100	75	50

50.	Shaft power (kw)				
51.					
52.	DIMENSIONS / WEIGHTS				
53.	Compressor weight				
54.	Maximum erection weight				
55.	Maximum maintenance weight with component name				
56.	Overall size				
57.	MATERIAL				
58.	Screw Compressor				
59.	Casing				
60.	Rotors				
61.	Shaft				
62.	Shaft Sleeve				
63.	Shaft Seals				
64.	Scroll Compressor				
65.	Casing				
66.	Rotors/Scroll				
67.	Shaft				
68.	Shaft Sleeve				
69.	Shaft Seals				
70.	Condenser				
71.	Type	Shell & Tube water cooled			
72.	Model				
73.	Heat Rejection				TR
74.	Cooling water temperature at inlet				°C
75.	Cooling water temperature at outlet				°C
76.	Cooling water pressure at inlet				Kg/cm ² (g)
77.	Cooling water pressure at outlet				Kg/cm ² (g)
78.	Fouling resistance, water side				0.0004 m ² hr °C/Kcal
79.	LMTD				°C
80.	Overall heat transfer coefficient				Kcal/hr m ² °C
81.	Cooling water flow rate				m ³ /hr
82.	No. of passes, tube side				Nos.
83.	Water velocity inside tube				m/sec
84.	Pressure drop, water side				Kg/cm ²
85.	Design pressure, shell side				Kg/cm ² a
86.	Design pressure, tube side				Kg/cm ² a
87.	Hydraulic test pressure, shell side				Kg/cm ² a
88.	Hydraulic test pressure, tube side				Kg/cm ² a
89.	Pneumatic test pressure, shell side				Kg/cm ² a
90.	Pneumatic test pressure, tube side				Kg/cm ² a
91.	Design temperature, shell side				°C
92.	Design temperature, tube side				°C
93.	Total no. of tubes				Nos.
94.	Tube OD at plain end				mm
95.	Tube thickness at plain end				mm
96.	Tube length between tube sheets				mm
97.	Tube type	Integrally finned copper tubes			
98.	Fin spacing				FPI

99.	Total tube surface areas, m ²	
100.	Water side	
101.	Refrigerant side	
102.	Shell OD	mm
103.	Shell thickness	mm
104.	Tube to tube sheet joint, expanded/welded	
105.	Water inlet flange	Size mm
106.	Water outlet flange	Size mm
107.	Material	
108.	Shell	
109.	Channel/channel covers	
110.	Tube sheet	
111.	Baffles/Tube supports	
112.	Tubes	Integrally finned copper tubes
113.	Flanges	
114.	Gasket	
115.	Bolts & Nuts	
116.	Chiller (Evaporator)	
117.	Type	Shell & Tube
118.	Make	
119.	Model	
120.	Capacity	TR (actual)
121.	Chilled water temperature at inlet	°C
122.	Chilled water temperature at outlet	°C
123.	Chilled water pressure at inlet	Kg/cm ² (g)
124.	Chilled water pressure at outlet	Kg/cm ² (g)
125.	Fouling resistance, water side	0.0004 m ² hr °C/Kcal
126.	LMTD	°C
127.	Overall heat transfer coefficient	Kcal/hr m ² °C
128.	Chilled water flow rate	m ³ /hr
129.	No. of passes, tube side	Nos.
130.	Pressure drop, water side	Kg/cm ²
131.	Design pressure, shell side	Kg/cm ² a
132.	Design pressure, tube side	Kg/cm ² a
133.	Hydraulic test pressure, shell side	Kg/cm ² a
134.	Hydraulic test pressure, tube side	Kg/cm ² a
135.	Pneumatic test pressure, shell side	Kg/cm ² a
136.	Pneumatic test pressure, tube side	Kg/cm ² a
137.	Design temperature, shell side	°C
138.	Design temperature, tube side	°C
139.	Total no. of tubes	Nos.
140.	Tube OD at plain end	mm
141.	Tube thickness at plain end	mm
142.	Tube length between tube sheets	mm
143.	Tube type	copper tubes
144.	Fin spacing	FPI
145.	Total tube surface areas, m ²	
146.	Water side	
147.	Refrigerant side	
148.	Shell OD	mm
149.	Shell thickness	mm

150.	Tube to tube sheet joint, expanded/welded	
151.	Water inlet flange	Size mm
152.	Water outlet flange	Size mm
153.	Material	
154.	Shell	
155.	Channel/channel covers	
156.	Tube sheet	
157.	Baffles/Tube supports	
158.	Tubes	
159.	Flanges	
160.	Gasket	
161.	Bolts & Nuts	
162.	INSPECTION AND TESTING	
163.	As per Job Specification and EIL Standard Specification No. 6-61-0017	

1.	OPERATING CONDITIONS	
2.	Duty	Continuous/Intermittent
3.	Installation	Indoor/Outdoor
4.	Quantity	
5.	Working	Nos.
6.	Stand by	Nos.
7.	Area classification	Safe/Hazardous
8.	Type	Water Cooled
9.	Driver	Electric motor
10.	Refrigerant	
11.	Capacity of each Condensing Unit – Nominal	TR
12.	Capacity of each Condensing Unit – Actual	TR
13.	MANUFACTURER SPECIFICATION	
14.	Compressor	
15.	Make	
16.	Model	
17.	Type	Reciprocating/Scroll
18.	No of stages	
19.	Capacity	
20.	Saturated suction pressure	
21.	Saturated suction temperature	
22.	Saturated discharge pressure	
23.	Saturated discharge temperature	
24.	Drive	V-belt / flexible coupling
25.	Reciprocating Compressor	
26.	Cooling of cylinder side, top covers (Recip. Compressor)	By air
27.	No of cylinders (Recip. Compressor)	
28.	Bore/stroke (Recip. Compressor)	
29.	Actual discharge temperature	
30.	Maximum allowable cylinder temperature (Recip. Compressor)	
31.	Maximum allowable cylinder pressure (Recip. Compressor)	
32.	Mean piston speed (Recip. Compressor)	m/sec.
33.	General Parameters	
34.	Compressor speed	RPM
35.	Guaranteed shaft power	
36.	Motor power & speed	
37.	Motor suitable for loaded starting	Yes/No
38.	Description of unloaded starting arrangement	
39.	Min compressor speed for proper lubrication/capacity control	RPM
40.	LUBRICATION	
41.	Type	Splash/Pressure
42.	Oil pump driven by	Compressor shaft/ Electric motor
43.	Grade of lubrication oil	
44.	Lubrication oil charge	
45.	CAPACITY CONTROL	

46.	Type	Sliding valve/ Valve unloaders/ Hot gas bypass/Others			
47.	Actuators	Automatic cum manual			
48.	Actuators operated by	Microprocessor controlled			
49.	Compressor to unload on power failure/stoppage	Automatic cum manual			
50.	Capacity regulation steps	%	%	%	%
51.	Capacity (TR)	100	75	50	25
52.	Shaft power (kW)				
53.	DIMENSIONS/WEIGHTS				
54.	Compressor weight				
55.	Maximum erection weight				
56.	Maximum maintenance weight with component name				
57.	Overall size				
58.	MATERIAL				
59.	Reciprocating Compressor				
60.	Cylinder & head				
61.	Piston				
62.	Piston rings				
63.	Cylinder liners				
64.	Valve plates				
65.	Valve seat				
66.	Valve springs				
67.	Connecting rod				
68.	Crankshaft				
69.	Crankcase				
70.	Bearings				
71.	Suction strainer				
72.	Flywheel				
73.	Scroll Compressor				
74.	Casing				
75.	Rotors/Scroll				
76.	Shaft				
77.	Shaft Sleeve				
78.	Shaft Seals				
79.	ACCESSORIES				
80.		Purchaser's Requirement		Vendor's Confirmation	
81.	Local panel & gauge panel	Required			
82.	Pressure gauge for compressor gas inlet	Required			
83.	Pressure gauge for compressor gas outlet	Required			
84.	Pressure gauge for lubrication oil	Required			
85.	Temperature gauge for compressor gas inlet	Required			
86.	Temperature gauge for compressor gas outlet	Required			
87.	HP/LP switch	Required			
88.	Lub. Oil pressure low switch	Required			
89.	Sight Glass	Required			
90.	Capacity control device	Required			
91.	Automatic unloading device for start up	Required			
92.	V-belt/flexible coupling drive package	Required			

93.	Oil separator	If required	
94.	Common base frame for compressor & motor	Required	
95.	Slide rail for motor / belt tensioner	Required	
96.	Foundation nuts & bolts	Required	
97.	Guards for moving parts	Required	
98.	Cooling water piping	Required	
99.	Suction strainer	Required	
100.	Thermostat operated crank case heater	Required	
101.	Suction & discharge manifolds	Required	
102.	Suction & discharge service valves	Required	
103.	Safety valve for each cylinder	Required	
104.	Replaceable cylinder liners	Required	
105.	Magnetic oil plug	Required	
106.	Discharge muffler	Required	
107.	Oil pump	Required/Not required	
108.	Mechanical seal	Required/Not required	
109.			
110.	Oil filter	Required	
111.	Oil temp. gauge	Required	
112.	Sight glass	Required	
113.	Condenser		
114.	Type	Shell & Tube water cooled	
115.	Model		
116.	Heat Rejection	TR	
117.	Cooling water temperature at inlet	°C	
118.	Cooling water temperature at outlet	°C	
119.	Cooling water pressure at inlet	Kg/cm ² (g)	
120.	Cooling water pressure at outlet	Kg/cm ² (g)	
121.	Fouling resistance, water side	m ² hr °C/Kcal	
122.	LMTD	°C	
123.	Overall heat transfer coefficient	Kcal/hr m ² °C	
124.	Cooling water flow rate	m ³ /hr	
125.	No. of passes, tube side	Nos.	
126.	Water velocity inside tube	m/sec	
127.	Pressure drop, water side	Kg/cm ²	
128.	Design pressure, shell side	Kg/cm ² a	
129.	Design pressure, tube side	Kg/cm ² a	
130.	Hydraulic test pressure, shell side	Kg/cm ² a	
131.	Hydraulic test pressure, tube side	Kg/cm ² a	
132.	Pneumatic test pressure, shell side	Kg/cm ² a	
133.	Pneumatic test pressure, tube side	Kg/cm ² a	
134.	Design temperature, shell side	°C	
135.	Design temperature, tube side	°C	
136.	Total no. of tubes	Nos.	
137.	Tube OD at plain end	mm	
138.	Tube thickness at plain end	mm	
139.	Tube length between tube sheets	mm	
140.	Tube type	Integrally finned copper tubes	
141.	Fin spacing	FPI	
142.	Total tube surface areas, m ²		

143.	Water side	
144.	Refrigerant side	
145.	Shell OD	mm
146.	Shell thickness	mm
147.	Tube to tube sheet joint, expanded/welded	
148.	Water inlet flange	Size mm
149.	Water outlet flange	Size mm
150.	Material	
151.	Shell	
152.	Channel/channel covers	
153.	Tube sheet	
154.	Baffles/Tube supports	
155.	Tubes	Integrally finned copper tubes
156.	Flanges	
157.	Gasket	
158.	Bolts & Nuts	
159.	INSPECTION AND TESTING	
160.	As per EIL Standard Specification No. 6-61-0017	

1	GENERAL									
2	Project:		CBR			Job No.:		B416		
3	Owner:					Site:				
4	Purchaser:					Building :		Unit No:		
5	Item No.:					Service:		Chilled Water		
6	No. Reqd.:		Working : 1 (One)		Standby : 1 (One)		Parallel Operation Required:		☐ Yes ☐ No	
7	Applicable to		☐ Proposal ☐ Purchase				☐ As Built			
8	☐ Scope option & Information specified by purchaser ☐ Information Reqd. from & option left to vendor. Vendor to cross ☐ the selected option									
9	Driver: Working				Standby				Driver Supplied & Mounted ☐ Pump Mfr. ☐ Other	
10	OPERATING CONDITIONS									
11	Liquid Handled					Capacity (m ³ /hr): Min/Nor/Rated:				
12	Pumping Temp.		Normal		Max.		Discharge Pressure (kg/cm ² ,A):			
13	Specific Gravity at P.T./15°C:					Suction Pressure: Nor./ Max.				
14	Vapour Pressure at P.T.					Diff. Pressure (kg/cm ²) @ Rated				
15	Viscosity at P.T.				Corr./Eros. By:		Diff. Head (m) @ Rated Capacity:			
16	Solids in		☐ Yes ☐ No		Size:		%		NPSH Available (m):	
17	MANUFACTURERS SPECIFICATIONS									
18	Pump Manufacturer:					Model No.:				
19	CONSTRUCTION					PERFORMANCE				
20	Casing Mounting:		☐ Centerline ☐ Foot ☐ Inline				Proposal Curve No.			
21	Casing Split:		☐ Axial ☐ Radial				Visc. Corr. C ₁₁		C _Q C _H	
22	Type:		☐ Single Volute ☐ Double Volute ☐ Diffuser				NPSH Reqd. (Water)		F/L Speed	
23	Casing Connection:		☐ Vent ☐ Drain ☐ Gauge				No. of stages:		Efficiency (%):	
24	Nozzles		Size		ANSI Rating		Facing		Position	
25	Suction								Rated BKW(0% Tol.): kW	
26	Discharge								Max. head rtd imp.(m): kW	
27	Imp. (mm) Max:		Rated:		Min:		Type:		MCF	
28	Brg.: Type/No. Radial:		Thrust:		Lub:		M.A.W.P @ 15°C/P.T./Design Temp.(kg/cm ² ,G):			
29	Cplg.: Make/Typ		Fleximetl w		Nonspark ☐ ☐ No		Hydrostatic Test pressure (kg/cm ² ,G):			
30	Driver Half cplg. mounted by:		☐ Pump Mfr. ☐ Others				Rotation facing coupling end:		☐ CW ☐ CCW	
31	Packing Type:		Size:		No. of rings:		Seal flush/ Quench plan:		Material :	
32	Mech. Seal:		Model		API Code :		Ext. seal flush fluid:		LPM: @ kg/cm ² G/ °C	
33	Base Plate Drain Rim		☐ ☐ No		Fdn. Bolts: ☐ ☐ No		Seal Barrier fluid:		LPM: @ kg/cm ² G/ °C	
34	Throat Bush: ☐ ☐ No		Matl.:		Bal. Device: ☐ ☐ No		Ext. quench fluid:		LPM: @ kg/cm ² G/ °C	
35	Materials (API-610 Matl. Class):				MOC		ASTM Grades		C.W. Plan : LPM: @ kg/cm ² G/ °C	
36	I - Cast Iron		Casing				Weight(kg):		Driver:	
37	B - Bronze		Impeller							
38	AUXILIARY PIPING INTERFACE CONNECTIONS									
39	S - Carbon Steel		Inner Case parts				(All interface conn. shall be termntd. with a flng. block			
40	C - 11-13% Chr.		Sleeve Packed						Size Rating(ANSI) Facin	
41	h - Hardened		Sleeve Seal				Lantern Ring Inlet/Outlet			
42	f - Faced		Casing ring ☐ H-BHN				Ext. Seal flush fluid			
43	K - SS 304		Impeller ring 50(min)				Seal Quench fluid Inlet			
44	L - SS 316		Shaft				Seal pot vent/ drain			
45	X		Throttle Bush				Casing vent/ drain			
46	Y		Throat Bush				C.W Inlet/ Outlet			
47	Z		Balance Drum				Base plate drain (only)			
48	☐ Driver suitable for Pump starting with open Disc. Valve condition.					Casing steam jacket				
49	INSPECTION & TESTS (EACH PUMP)									
50			Witness		Observe				Witness Observe	
51	☐ Shop Test / Inspection		☐		☐		☐ NPSH As Reqd. ☐ Per Spec. ☐ Mandatory		☐	
52	☐ Material Certificates		☐		☐		☐ Dismantle Insp. & Re-assembly after Test		☐	
53	☐ Hydrostatic		☐		☐		☐ Unitization/Dimensional Check		☐	
54	☐ Performance/Sound Level		☐		☐		☐ Check for direction of rotation of pump &		☐	
55	Applicable Specification: EIL Std. Specification No. 6-41-0003									
56	REMARKS:- 1) Max. allowable casing working pressure shall not be less than ___ kg/cm ² G @ ___ °C.									
57	2) Down Stream Design Pressure is ___ kg/cm ² g.									
58	3) Accessories and Instrumentation shall be as per EIL approved vendors only.									
59	4) Unitization of Pump and Driver shall be done in pump manufacturer's shop.									

1.	OPERATING CONDITIONS			
2.	Duty	Continuous		
3.	Installation	Indoor		
4.	Area Classification	Safe/Hazardous		
5.	Type (Double skin)	Draw through/forced through		
6.	Quantity			
7.	Working			
8.	Stand by			
9.	Arrangement	Horizontal floor mounted		
10.	MANUFACTURER SPECIFICATION			
11.	Make / Model			
12.	FILTER AT AHU INLET			
13.	Make / Model			
14.	Total air flow rate	m³/hr		
15.	Quantity of filter elements	nos.		
16.	Filtration efficiency	Microns		
17.	Size of filter elements	mm x	mm x	mm
18.	Face velocity	m/sec		
19.	Pressure drop in clean condition	mm WC		
20.	Maximum allowable pressure drop	mm WC		
21.	Fixing	Flange/channel		
22.	Type of filter	Dry fabric cleanable		
23.	COOLING COIL SECTION			
24.	Make /Model			
25.	Air entering condition	°C DB/	°C WB	
26.	Air leaving condition	°C DB/	°C WB	
27.	Refrigerant/chiller water temperature at inlet	°C		
28.	Refrigerant/chilled water temperature at outlet	°C		
29.	Refrigerant/chilled water flow rate	m³/hr		
30.	ADP	°C		
31.	LMTD	°C		
32.	Capacity	TR		
33.	Total air flow rate	m³/hr		
34.	Face area	m²		
35.	Coil size	mm x	mm	
36.	Velocity of air across coil (face velocity)	m/sec		
37.	No. of rows			
38.	Tube per row			
39.	Type	Dx/Chilled Water		
40.	By pass factor			
41.	Pressure drop (Air side)	mm WC		
42.	Pressure drop (Water side)	mm WC		
43.	Tube OD	mm		
44.	Tube thickness	mm		
45.	Bend thickness	mm		
46.	Fin spacing	FPI		
47.	Bonding of fins (Hydraulically/with mandrel)			
48.	Fouling Factor	m2 hr. deg C/kcal		
49.	BLOWER SECTION			
50.	Type	Centrifugal		
51.	Blade profile	Forward/Backward/Radial		
52.	No. of impellers	nos.		
53.	Impeller diameter	mm		
54.	Air flow rate	m³/hr		

55.	Static pressure	Minimum 65 mm WC	
56.	Impeller speed	RPM.	
57.	Power consumption at shaft	kW	
58.	Guaranteed power consumption at motor	kW	
59.	Air out velocity	Not more than 9.2 m/sec	
60.	Drive arrangement	V-belt drive	
61.	Motor	kW/ RPM	
62.	No. of belts		
63.	Bearings	Self aligning heavy duty ball	
64.	Noise level		
65.	DIMENSIONS / WEIGHTS		
66.	Overall size & Overall weight	Kg.	
67.	ACCESSORIES		
68.		Purchaser's	Vendor's confirmation
69.	Requirement		
70.	Guard for moving parts	Required	
71.	Slide rail below motor	Required	
72.	Fire resistant flexible connection at AHU outlet	Required	
73.	Insulated drain pan with drain connection	Required	
74.	Grease nipple for bearings	Required	
75.	Painting on MS parts	Required	
76.	Vibration isolator (ribbed neoprene rubber	Required	
77.	Bronze/gun metal bushes at spindle ends of	Required	
78.	Drain piping	Required	
79.	V-belt drive with V-belts, pulleys	Required	
80.	Common base frame	Required	
81.	Volume control damper at AHU outlet	Required	
82.	Insulation of fan section & coil section	Required	
83.	ACCESSORIES/INSTRUMENTS/CONTROLS (REFRIGERANT CIRCUIT ONLY)		
84.	Liquid strainer	Required	
85.	Drier	Required	
86.	Sight glass	Required	
87.	Pressure gauge for Refrigerant in/out	Required	
88.	Solenoid valve	Required	
89.	Expansion valve	Required	
90.	MATERIAL		
91.	Coil tubes	Seamless copper tubes	
92.	Filter Media	HDPE mesh	
93.	Fins	Aluminium	
94.	AHU casing		
95.	Drain pan	18 Gauge SS Sheet	
96.	Impeller	M.S. sheets	
97.	Blower shaft	C-40/EN-8	
98.	V-pulley	C.I. Grooved	
99.	Face & bypass damper blade	16 Gauge G.I. Sheet	
100.	Filter casing	Aluminium	
101.	Face & bypass damper frame	16 Gauge CRCA	
102.	Bearings at face & bypass damper	Nylon / Sintered Brass / Gun Metal	
103.	Filter mounting frame	Zinc sprayed M.S. Sections	
104.	Coil header	MS	
105.	Coil casing	GSS	
106.	INSPECTION AND TESTING		
107.	As per EIL Standard Specification No. 6-61-0017		

1.0	OPERATING CONDITIONS	
1.1	Location (Building)	
1.2	Mounting	Plenum mounted / AHU mounted
1.3	Total quantity of air handled	CFM (m ³ /hr.)
1.4	Type of filter media	
1.5	Expected impurities in air	As generally present in ambient air
2.0	MANUFACTURER SPECIFICATION	
2.1	Make/ Model	
2.2	Capacity per filter element	CFM (m ³ /hr.)
2.3	Quantity of filter element	Nos.
2.4	Size of filter element	610 mm x 610 mm x 305 mm
2.5	Face velocity	~500 FPM
2.6	Filtration efficiency	95% down to 5 micron
2.7	Pressure drop in clean condition	6.5 mm WC
2.8	Maximum allowable pressure drop (When due for cleaning)	mm WC
2.9	Fixing	Flange / Channel
2.10	Weight of each filter element	Kg.
2.11	Method to clean filter	Wash in water / ~~Compressed air jet~~
2.12	Mounting of filter	~~Horizontal~~ / Vertical
2.13	Direction of air flow	Horizontal / ~~Vertical~~
3.0	ACCESSORIES	
3.1	Nuts, bolts, rubber bushes, springs as necessary for mounting	To be provided by Vendor
3.2	The filter modules in ladder type	
4.0	MATERIAL	
4.1	Filter casing	~~Carbon steel~~ / Aluminium / SS
4.2	Filtering media	HDPE/Nylon mesh/ ~~Non woven felt~~ /G.I. wire
4.3	Separators	Aluminium
4.4	Wire mesh to support filter media	G.I. / ~~S.S.~~
4.5	Gasket	~~Felt~~ / Neoprene sponge rubber
4.6	Nuts/bolts/bush/springs	Galvanised
4.7	Filter mounting frame	Ladder type made of MS rolled sections,
5.0	INSTRUMENT	
5.1	Pressure drop measurement device	DPG / Water tube manometer
6.0	INSTRUMENT	
6.1	As per EIL's Standard Specification No. 6-61-0017. Dust test not required. Type test will suffice.	

Note:

1. Bag type filter is not acceptable.

A. DATA SHEET FOR CHEMICAL FILTER

1.	Location/Building	
2.	Installation	Outdoor / Indoor
3.	Make/Model	
4.	Operating air flow	
5.	Velocity through filter max/min	
6.	Overall size.	
7.	Construction of filter chamber	REFER NOTE
8.	Construction mat. of filter packs	
9.	Qty/Type of filter media/modules	
10.	Type of chemical used	
11.	Qty of chemicals required	
12.	Initial overall pressure drop in filter	
13.	Final overall pressure drop in filter	
14.	Qty/Type of pre filter	
15.	Qty/Type of final filter	
16.	Efficiency of pre filter	As per Standard Spec. No. 6-61-0017
17.	Efficiency of final filter	As per Standard Spec. No. 6-61-0017
18.	Total wt. of filter with all internals	
19.	Mounting arrangement of filter unit	Floor Mounted
20.	Operating condition, input	As per Standard Spec. No. 6-61-0017
21.	Operating condition, output	As per Standard Spec. No. 6-61-0017
22.	Size of inlet/outlet flanges	
23.	Nature & properties of chemical used for filter	
24.	NOTE: Min.16 G galvanised steel sheets with sloping roof. Painted inside & outside with 2 coats of epoxy paint over epoxy primer. Stainless steel door latches & hinges for servicing access doors. Compressible gaskets to prevent air leakage around doors & between doors & filters. All joints shall be sealed with silicone rubber.	

B. DATA SHEET FOR FRESH AIR CENTRIFUGAL FAN

A	OPERATING CONDITIONS	
i	Fluid handled	Ambient Air
ii	Suspended Solids	Nil
iii	Nature of fluid	Non corrosive / Non toxic
iv	Suction temperature Maximum / Minimum	°C
v	Fluid flow rate	CFM
vi	Duty	Continuous
vii	Height above m.s.l.	M
viii	Area Classification	Safe/Hazardous
ix	Quantity	

a	Working	1 Nos.	
b	Stand by	1 Nos.	
x	Location	Indoor / Outdoor	
B	MANUFACTURER SPECIFICATION		
i	Make		
ii	Model		
iii	Spark proof construction	Reqd. / Not reqd.	
iv	Class of construction	I/II/III/IV	
v	Type	Centrifugal SISW/DIDW	
vi	Blade	Backward/Forward/Radial	
vii	Static pressure	mm WC	
viii	Outlet velocity	m/sec	
ix	Operating Range	Nm³/hr to	Nm³/hr
x	Outlet area	m²	
xi	Impeller speed at design condition	RPM	
xii	Mounting arrangement	3/1-A	
xiii	Impeller diameter	Mm	
xiv	Impeller speed (Safe Limit)	RPM	
xv	Type of drive	Direct/Gear/V-belt	
xvi	Motor kw/rpm		
xvii	Noise level		
xviii	Corrosion proof construction	Only painting required	
xix	Details of painting	Painting as per specs.	
xx	Total weight (Fan + motor + Base frame)	Kg.	
xxi	Maximum maintenance weight	Kg.	
C	ACCESSORIES		
		Purchaser's Requirement	Vendor's Confirmation
i	Casing (Axial/Radial, Split/Non split)	Required	
ii	Back draft damper at outlet	Required	
iii	ON-OFF Damper at each fan's outlet	Required	
iv	Damper control (Manual/Automatic)	Required	
v	Inlet guide vanes	Not Required	
vi	IGV Control (Manual/Automatic)	Not Required	
vii	Impeller Washing system	Not Required	
viii	Common base frame for fan & motor	Required	
ix	Casing drain (Plugged/Isolation valve)	Required	
x	Rain hood	Not Required	
xi	Flexible (Rubberised canvass) connection at suction/discharge	Required	
xii	Painting (as per attached specs.)	Required	
xiii	V-belt drive package	Required	
xiv	Slide rail for motor	Required	
xv	Vibration Eliminators at base, Cushy Foot Type	Required	
xvi	Access door on casing	If Required	
xvii	Foundation nuts & bolts	Required	
xviii	Guards for moving parts, spark proof	Required	
xix	Lifting lugs	Not Required	
xx	Cooling disc/radiation shield	Not Required	
xxi	Foundation (Concrete/Structural/Floating)	Required	

xxii	Inlet/Outlet connection (Flanged/Non flanged)	Required	
xxiii	Inlet screen	Not Required	
xxiv	Antistatic belts in case of belt drive	Required	
D	MATERIAL OF CONSTRUCTION		
i	Casing	Carbon steel/Aluminium/Stainless steel	
ii	Impeller	Carbon steel/Aluminium/Stainless steel	
iii	Shaft		
iv	Shaft sleeve		
v	Damper/IGV	18 Gauge G.I.	
E	INSPECTION AND TESTING		
i	As per approved QAP.		

AIR COOLED SPLIT AIR CONDITIONING UNIT

A.	OPERATING CONDITIONS	
i.	Location of AC Units	
ii.	Area Classification	Safe
iii.	Make	
iv.	Model	
v.	Capacity of each unit	
	a) Tonnage (Nominal/ Actual at site conditions) TR	
	b) Air Quantity (CFM)	
vi.	Quantity (Nos.)	Working + Standby
vii.	Control	Inverter Controlled
viii.	Refrigerant	
ix.	Ambient temp. for selection of air cooled condensers	
x.	Overall Noise level dB(A)	
B.	OUTDOOR UNIT	
i.	COMPRESSOR	
a)	Make	
b)	Type	Rotary/Scroll
c)	Qty. of Compressors Per Unit (Nos.)	
d)	Power at Input Terminal	kW
e)	Enclosure	Open / Semi Hermetic / Hermetic
f)	Total Capacity at nominal conditions	TR
g)	Total Capacity at operating conditions	TR
ii.	CONDENSER	
a)	Type	Air Cooled
b)	Qty. of Condenser per Unit	Nos.
c)	Qty. of Condenser Fan per Unit	Nos.
d)	Fan Motor Rating	kW/ RPM
C.	INDOOR UNIT	
i.	BLOWER	
a)	Type	
b)	No. of blower per unit	Nos.
c)	Type of blades	Forward / Backward / Radial
d)	Air flow rate	CFM
e)	Static Pressure- Total/ External	mm WC / mm WC
f)	Motor rating	kW / RPM
ii.	AIR FILTER	

a)	Type	
b)	Clearance required for filter removal	
iii.	COOLING COIL	
a)	Coil size (length x height)	mm x mm
b)	Coil face velocity	FPM
D.	CONSTRUCTION FEATURES	
i.	OUTDOOR UNIT	
a)	SIZE L X D x H	mm x mm x mm
b)	Operating weight	kg
c)	Clearances required around unit	mm
ii.	INDOOR UNIT	
a)	SIZE L X D x H	mm x mm x mm
b)	Operating weight	kg
c)	Clearances required around unit	mm
E.	INSPECTION AND TESTING	
	Entire unit shall be subjected to production routine tests and performance / capacity test as per manufacturer's standard QAP and relevant code. Manufacturer shall furnish test certificates.	

A	OPERATING CONDITIONS	
i	Make	
ii	Model No	
iii	Capacity	
a	Tonnage (Nominal / Actual at site conditions)	TR
b	Air Quantity (Cfm)	
iv	Refrigerant (Type / Qty)	
v	Quantity (Nos)	____ (__ Working + __ Standby)
vi	Area Classification	Safe/Hazardous
vii	Overall noise level (DB)	
B	COMPRESSOR	
i	Make	
ii	Model No	
iii	Type	
iv	Quantity of Compressors per package units (Nos)	
v	Nominal capacity of each Compressor (TR)	
vi	Type of enclosure	Sealed/Open/Semi hermetic
vii	BKW	
viii	Motor (KW/RPM)	
C	WATER COOLED CONDENSER	
i	Make	
ii	Quantity of Condensers per package units (Nos)	
iii	Fouling factor, water side. (hr.m ² °C / kcal)	
iv	Cooling water IN / OUT temperature. (°C)	
v	Pressure drop, water side (Kg / cm ²)(g)	
vi	Cooling water flow rate. (m ³ /hr)	
vii	Water velocity inside tubes (m/sec)	
D	BLOWER	
i	Make	
ii	Type	Centrifugal
iii	Blade profile	Forward/Backward/Radial
iv	No. of blowers per package unit (Nos)	
v	Capacity of each blower (Cfm)	
vi	Impeller diameter / Speed (mm / RPM)	
vii	Static Pressure (mm WC)	50 (Minimum)
viii	Velocity at blower outlet (m/sec)	
ix	Drive arrangement	V-belt drive
x	Motor (KW/RPM)	
E	FILTERS AT PACKAGE UNIT INLET	
i	Make	
ii	Size of filter element (mm x mm x mm)	
iii	Quantity of filter elements (Nos)	
iv	Filter Face velocity (m/sec)	
v	Filtration efficiency (% , microns)	80% down to 20 micron particle size
vi	Pressure drop in clean condition (mm WC)	

vii	Maximum allowable pressure drop (mm WC)		
viii	Fixing		Flange/Channel
ix	Filtration media		Dry type reusable
F	COOLING COIL		
i	Make		
ii	Capacity (TR)		
iii	Total air flow rate (Cfm)		
iv	Face area (Sqm)		
v	Number of rows (Nos)		
vi	Pressure drop, air side(mm WC)		
vii	Fin spacing (FPI)		
viii	Bonding of fins		Hydraulically/Mechanically
ix	Coil face Velocity (m/sec)		
G	ACCESSORIES		
		Purchaser's Requirement	Vendor's Confirmation
i	Belt tensioner	Required	
ii	Guard for moving parts	Required	
iii	Insulated drain pan with drain connection	Required	
iv	First charge of refrigerant, oil, lubricants	Required	
v	Grease nipple for bearings	Required	
vi	Painting	Required	
vii	Drain piping	Required	
viii	V-belt drive packages with V-belts	Required	
ix	Anti vibration mounting	Required	
x	Lifting lugs	Required	
xi	Base frame	Required	
xii	On-Off damper at the outlet of each package unit	Required	
xiii	Back Draft damper at the outlet of each package unit	Required	
xiv	Condenser connection, waterside flange	Required	
xv	Gate valve at condenser inlet	Required	
xvi	Gate + Globe valve at condenser outlet	Required	
xvii	Strainer with brass mesh & bypass line with gate valve	Required	
xviii	Pressure gauge at condenser inlet and outlet	Required	
xix	Temperature gauge at condenser inlet and outlet	Required	
xx	Rotameter for water flow measurement	Required	
xxi	HP/LP cut out	Required	
xxii	Low oil pressure cut out	Required	
xxiii	Audio/visual annunciator	Required	
xxiv	Refrigerant control	Required	
xxv	Refrigerant piping	Required	
xxvi	Pressure relief valve	Required	
H	MATERIAL OF CONSTRUCTION		
i	CONDENSER		

a	Shell	
b	Tubes	
ii	FILTER	
a	Filter media	
iii	COOLING COIL	
a	Tubes	
b	Fins	
c	Frame/casing	
iv	BLOWER	
a	Impeller	
b	Shaft	
I	DIMENSIONS/WEIGHT	
i	Overall size	
ii	Overall weight	
	INSPECTION AND TESTING	
	As per EIL Standard Specification No. 6-61-0017	



**ANNEXURE-C
TO
DATASHEET LIST
(ROTATING EQUIPMENT)
STEAM GENERATION PACKAGE
TENDER No. B957-420-80-44-PG-T-7410**

**PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE
CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO
BINA PETCHEM & REFINERY EXPANSION PROJECT
(BPREP)**

OWNER : M/s BHARAT PETROLEUM COOPERATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

JOB NO : B957

0	07-01-2025	ISSUED AS TENDER INPUT	VS/SG	MG	TK
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

DATA SHEETS FOR ROTATING EQUIPMENT:

S. No.	Description	Doc. No.
1.	Datasheet- SPECIAL PURPOSE STEAM TURBINE	B957-420-80-42-DS-9981
2.	Datasheet- STEAM TURBINE DRIVER (SPP) (PERFORMANCE DATA)	B957-420-80-42-DS-9982
3.	Datasheet- DIESEL ENGINE	B957-420-80-42-DS-9983
4.	Datasheet- STEAM TURBINE GENERAL PURPOSE	B957-420-80-42-DS-9985
5.	Datasheet- GENERAL PURPOSE GEAR UNIT	B957-420-80-42-DS-9986
6.	Datasheet- ROTARY COMPRESSOR LOBE TYPE (ROOTS BLOWER)	B957-420-80-42-DS-9987
7.	Datasheet- HEAT EXCHANGERSHELL AND TUBE TYPE LUBE OIL COOLER	B957-420-80-42-DS-9988
8.	Datasheet- OIL SYSTEM (SCOPE & ATTACHMENT)	B957-420-80-42-DS-9989
9.	Datasheet- SPECIAL PURPOSE COUPLING	B957-420-80-42-DS-9990
10.	Datasheet- SPECIAL PURPOSE GEAR UNIT	B957-420-80-42-DS-9991
11.	Datasheet- FORCED DRAFT FANS	B957-420-80-42-DS-9992
12.	Datasheet- CENTRIFUGAL FAN	B957-420-80-42-DS-9993
13.	Datasheet- ROTARY PUMP	B957-420-80-42-DS-9994
14.	Datasheet- CONTROLLED VOLUME PUMP	B957-420-80-42-DS-9995
15.	Datasheet- CENTRIFUGAL PUMP (HORIZONTAL- GENERAL PURPOSE PROCESS SERVICE)	B957-420-80-42-DS-9996
16.	Datasheet- CENTRIFUGAL PUMP (VERTICAL)	B957-420-80-42-DS-9997
17.	Datasheet- CENTRIFUGAL PUMP (HORIZONTAL- SPECIALPURPOSE PROCESS)	B957-420-80-42-DS-9998
18.	Datasheet- CENTRIFUGAL PUMP (MULTISTAGE-SPP)	B957-420-80-42-DS-9999

Notes:

- Contractor shall furnish filled in the datasheets/ proformas separately for each equipment/ package after placement of order during detailed engineering. Datasheet/ proforma format shall be filled by respective equipment supplier (vendor) and shall be vetted by Contractor prior submission to Owner/ PMC for approval.
- Equipment for which no such data sheets/ proformas are provided by Owner/ PMC, the Contractor may use his standard data sheets/ proformas or of Equipment Manufacturer's standard data sheets/ proformas & furnish the same. The same shall be subject to review and approval of Owner/ PMC.
- Contractor/ Vendor to furnish all blank data.

**SPECIAL PURPOSE STEAM
TURBINE
(TYPICAL MDS)**

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1 GENERAL															
2 Project: BPREP						Job no.: B957									
3 Owner: M/s BPCL						Site: BINA, MP									
4 Purchaser:						Unit: STEAM GENERATION UNIT				Unit No.: 420					
5 Item No.:						Service:									
6 No. Required: Working ☐ Standby ☐						Driven Eqpt. Type: ☐ Pump ☐ Fan ☐ Other ☐									
7 Applicable to: ☒ Proposal ☐ Purchase ☐ As-Built															
8 NOTE: ☒ Scope, option & info. specified by Purchaser ☐ Info. reqd. from & option left to Vendor. Vendor to cross ☒ the selected option															
9 Manufacturer:						Model:				Driven Equipment Item No.:					
10 STEAM CONDITIONS (Refer Site & Utility Data enclosed with TENDER)															
11 ☒ INLET:						☒ EXHAUST:									
Normal		Kg/cm ² g:		°C TT:		Normal (design)		Kg/cm ² A:		°C TT:					
Maximum		Kg/cm ² g:		°C TT:		Maximum		Kg/cm ² A:		°C TT:					
Minimum		Kg/cm ² g:		°C TT:		Minimum		Kg/cm ² g:		°C TT:					
Design		Kg/cm ² g:		°C TT:		Design		Kg/cm ² g:		°C TT:					
16 ☐ EXTRACTION:						☐ INDUCTION:									
Normal		Kg/cm ² g:		°C TT:		Normal		Kg/cm ² g:		°C TT:					
Maximum		Kg/cm ² g:		°C TT:		Maximum		Kg/cm ² g:		°C TT:					
Minimum		Kg/cm ² g:		°C TT:		Minimum		Kg/cm ² g:		°C TT:					
Design		Kg/cm ² g:		°C TT:		Design		Kg/cm ² g:		°C TT:					
21 SITE /INSTALLATION / UTILITY DATA (Refer Site and Utility Data Enclosed in the TENDER)															
22 LOCATION:						☐ ELECTRIC POWER		Drivers		Heat-ing		Inst. / Control		Alarm / Shutdown	
☐ Indoor		☐ Heated		☒ Under Roof		☒ Outdoor		Volts							
☒ Unheated		☐ Partial Sides		☐ Grade		☒ Mezzanine		Phase							
☐ Winterization Required		☒ Tropicalization Required						Hertz							
☐ Low Temperature		☐ Corrosive Agents						Kw Avail.							
☐ Elect. area classification:		CL:		GP:		DIV:		☒ COOLING WATER:							
29 SITE DATA:						Temp. Inlet, °C:				Max. Return, °C:					
☐ Elevation, m:		☐ Baro. Pr kg/cm ² A/mmHgA:						Inlet Press. Nor., kg/cm ² g:				Design, kg/cm ² g:			
☐ Winter Temp, °C:		☐ Summer Temp., °C:						Max Return Press., kg/cm ² g:							
☐ Elevation, m:		☐ Design Wet Bulb, °C:						Max Allow. Press Drop, kg/cm ² g:							
☐ Unusual conditions:		☒ Dust		☒ Fumes				Water Source:							
Other: Refinery Atmosphere						Velocity, m/s:		Min.:		Max.:					
35 UTILITY CONDITIONS:						Fouling Factor, hr m ² °C/kcal:									
☐ Auxiliary Steam:		Max.		Normal		Min.		Design		☐ UTILITY CONSUMPTION:					
Inlet Pressure (kg/cm ² A)										Cooling Water, m ³ /Hr:		Inst. Air, m ³ /Hr:			
Inlet Temp. (°CTT)										Aux. Steam: Nor., kg/hr:		Maximum, kg/Hr:			
Exh. Pressure (kg/cm ² g)										Aux. Drivers: Elect., kW:		Steam, KW:			
Exh. Temperature °C										Heater(s), kW:		Other:			
Inst. Air Pressure (kg/cm ² g): Dew Point, °C:															
42 APPLICABLE CODES & STANDARDS															
43 API STANDARD – API 612 & Job specs, EIL Standard Spec															
44 Noise Specifications:															
☒ Applicable to Machine: 85 dBA @ 1m.						☐ Applicable to Neighbor-hood:									
☒ Acoustical Treatment: ☐ Yes ☒ No															
47 PERFORMANCE (Remark-1 & 2)															
Operating Points		SHAFT		INLET		INDUCT. / EXTRACT.		EXHAUST							
(Steam Turbine)		Power	Speed	Flow	Pressure	Temp.	Flow	Pressure	Temp.	Pressure	Temp.	Enthalpy			
		KW	RPM	kg/hr	kg/cm ² g	°C	kg/hr	kg/cm ² g	°C	kg/cm ² g	°C	Kcal/kg			
Rated															
Normal															
Minimum															
Other															
☒ Steam Rate, kg/kW-Hr		Normal:		Rated:		Induction: ☐ Controlled ☐ Uncontrolled									
☐ Induction Flow, kg/Hr		Minimum:		Maximum:											
☐ Extraction Flow, kg/Hr		Minimum:		Maximum:		Extraction: ☐ Controlled ☐ Uncontrolled									
58 Remarks:															
59 1. For inlet steam and exhaust steam conditions, refer site and utility data attached elsewhere with the tender. Performance details shall be duly filled in Doc. No. B957-420-80-42-DS-9982 and submitted with offer.															
60 2. Steam Turbine Rating shall correspond to min. inlet & max. exhaust conditions.															
61 CONSTRUCTION FEATURES															

**SPECIAL PURPOSE STEAM
TURBINE
(TYPICAL MDS)**

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62	Turbine Type:		☐ Backpressure		☐ Condensing		☐ Other	
63	☒ Speeds: Rated:						☒ Torsional Critical Speeds:	
64	Maximum Continuous, RPM:				Trip, RPM:		First Critical, rpm:	
65	Max. Allowable, RPM:				Second Critical, rpm:			
66	☒ Lateral Critical Speeds (damped): As per API612						Third Critical, rpm:	
67	First Critical, rpm:				Mode:		Fourth Critical, rpm:	
68	Second Critical, rpm:				Mode:		☒ Lateral Analysis Required	
69	Third Critical, rpm:				Mode:		☐ Undamped stiffness map Required	
70	Fourth Critical, rpm:				Mode:		☒ Train Torsional Analysis Required	
71	☒ Vibration (peak to peak) , μ M:							
72	CASINGS, NOZZLES & DIAPHRAGMS							
73	☒ Maximum Allowable Working Pressure						☒ Hydrostatic Test Pressure:	
74	☒ Inlet Sect., kg/cm ² g:		☒ Exh. Sect., kg/cm ² g:		☒ HP Casing, kg/cm ² g:		☒ Mid Casing, kg/cm ² g:	
75	☒ Induction/Extract. Section, kg/cm ² g:						☒ Exhaust Casing, kg/cm ² g:	
76	☐ Other, kg/cm ² g:						☐ Welded Nozzle Ring	
77	☒ Max Operating Temp. °C:						Diaphragm Blade attach.: ☐ integrally cast	
78	☒ Inlet Section, °C:		☒ Exh. Section, °C:		☐ Welded:			
79	☒ Induction/Extract. Section, °C:						☐ Other:	
80	☐ Other, °C:						Diaph. axial location: ☐ individually; ☐ stacked	
81	CASING CONNECTIONS							
82	Connection	☒ Size	☒ Facing	☒ Position	☒ Flanged or Studded	☐ Mating Flg. & Gasket by Vendor	Steam Flow (kg/hr)	
83							☒ Max.	☒ Min.
84	Inlet				Flanged			
85	Exhaust				Flanged			
86	Extraction				Flanged			
87	Induction			NA				
88								
89	PIPE CONNECTION		☐ Tapered		☐ Straight			
90	☒ ALLOWABLE FORCES & MOMENTS: (Refer Piping specs)						ROTATION: (Viewed from Steam Inlet End)	
91								
92		Inlet		Exhaust		Extract/Induct		
93		Force	Moment	Force	Moment	Force	Moment	
94		N	N-m	N	N-m	N	N-m	
95	Parallel To shaft							
96								
97	Vert.							
98	Horiz.							
99								
100	MATERIALS - Casings & Appurtenances:							
101	☐ High pressure casing:				☒ Steam path components < RC22			
102	☐ MID pressure casing:				☐ Special Low Temp. Matl. Requirements:			
103	☐ Exhaust casing:				☐ Diaphragm / Blade Carriers:			
104	☐ Steam Chest:				☐ Diaphragm Nozzles:			
105	☐ Nozzle Ring:				☐ Other:			
106					☐ Steam contaminants:			
107	MATERIALS - Rotating elements							
108	Shaft type:				☐ Final stg. blade length, mm: ☐ Max, mm:			
109	☐ Integral Wheels		☐ Built – Up		☐ Combination		☐ Shaft Ends: Dia, @ coupling (mm):	
110	☐ Double Extended				☐ Straight		☐ Taper, mm Per m:	
111	☐ No. of Stages:		☐ Bearing Span, mm:		☐ Keyed		☐ Single ☐ Double	
112	☐ Shaft Material:				☐ Hydraulic fit		☐ Integral Flange	
113	☐ Shaft Material under seals: ☐ Integral				☐ Field balancing rings required			
114	Applied By: ☐ Plating		☐ Sleeve		☐ Spray		☐ Number: ☐ Location:	
115	☐ Spray application methods:							
116	☐ Blades (buckets):		☐ Max Tip Speed, m/s:					
117	REMARKS:							
118								
119								
120								
121								
122								

123	DETAILS	Stage	Stage	Stage	Stage	Stage	Stage	Stage
124	☐ Wheel Material							
125	☐ Blade Material							
126	☐ Blade rotor type							
127	☐ Closure Piece type							
128	☐ Tie Wire Material							
129	☐ Shroud Material							
130	☐ Shroud Attac.							
131	☐ Pitch Diameter							
132	☐ Blade Height							
133	☐ Blade Type							
134	SHAFT SEALS							
135	DETAILS	INLET	EXHAUST	End seals:				
136	☐ Surface speed	m/s	m/s	Type: ☒ Labyrinth ☐ Other				
137	☐ Max Seal Press	kg/cm ² g	kg/cm ² g	☐ Material:				
138	☐ Steam leakage	kg/Hr	kg/Hr	Interstage seals:				
139	☐ Air leakage	Sm ³ /Hr	Sm ³ /Hr	Type: ☒ Labyrinth ☐ Other				
140	☐ Shaft Dia. @ Seal	mm.	mm.	☐ Material:				
141	☐ No. Rings per Seal			Remarks:				
142	☐) Press. Per Seal	kg/cm ²	kg/cm ²					
143	☐ Laby. Type (Stat./Rot.)							
144	☐ Material							
145	BEARINGS AND BEARING HOUSINGS							
146	Radial	Inlet	Exhaust	Thrust (Refer \$ \$)				
147	☒ Type	Tilting Pad		☒ Type		Tilting Pad		
148	☐ Manufacturer			☐ Manufacturer				
149	☐ Length	mm	mm	☐ Unit Load (Max)		Bar		Bar
150	☐ Shaft Dia.	mm	mm	☐ Unit Load (ULT.)		Bar		Bar
151	☐ Unit Load (act/allow)	N	N	☐ No. Pads				
152	☐ Base Material			☐ Area		mm ²		mm ²
153	☐ Babbitt Thickness	mm	mm	☐ Pivot: ctr/offset, %				
154	☐ No. Pads			☐ Pad Base Matl.				
155	☐ Load:B'twn / on pad			Lubrication:		☐ Flooded	☐ Directed	
156	☐ Pivot:ctr/offset, %			Thrust Collar:		☐ Integral	☐ Replaceable	
157	BEARING TEMPERATURE DEVICES: ☒ See API 670			VIBRATION DETECTORS: ☒ See API 670				
158	☐ Thermistors			☒ Type: Proximity ☐ Model:				
159	☐ Type:	POS Temp Coeff:	NEG Temp Coeff:	☐ Manufacturer:				
160	☐ Temp switch & indicator by:	☐ Purch	☐ Mfr	☒ No at each shaft brg: 2 ☒ Total No.: 4				
161	☐ Thermocouples			☒ Oscillator - Detectors supplied by: Vendor				
162	☐ Selector switch & indicator by:	☐ Purch	☐ Mfr	☐ Mfr: ☐ Model				
163	☒ Resistance temp. detectors			☒ Monitor supplied By: Vendor				
164	☒ Resistance Matl: Platinum	☒ Ohms: 100		☐ Location:		Enclosure:		
165	☒ Selector switch & indicator by:	☐ Purch	☒ Mfr	☐ Mfr.:		☐ Model:		
166	☒ Location-Journal Brg (\$)			☐ Scale range: Alarm:		☐ Set @ mills:		
167	☐ No.:	☐ EA. Pad:	☐ Every other pad, per brg:	☐ Shutdown:		☐ Set @ mills:	☐ Delay, sec:	
168	☐ Other:			AXIAL POSITION DETECTORS: ☒ See API 670				
169	☒ Location-Thrust Brg: (\$\$)			☒ Type: Proximity		☐ Model:		
170	☐ No.:	☐ EA. Pad:	☐ Every other pad, per brg:	☐ Manufr.:		☒ No. Req'd.: 2		
171	☐ Other:			☒ Oscillator-Demod. supplied by: Vendor				
172	☐ No.(inact):	EA. Pad:	Every other pad, per brg:	☐ Mfr.:		☐ Model		
173	☐ Other:			☐ Monitor supplied By: Vendor				
174	☒ Monitor supplied By: Vendor			☐ Location:		Enclosure:		
175	☐ Location:	Enclosure:		☐ Mfr.:		☐ Model:		
176	☐ Mfr.:	☐ Model:		☐ Scale range, Alarm:		☐ Set @ mills:		
177	☐ Scale range: Alarm:	☐ Set @ °C:		☐ Shutdown:		☐ Set @ mills:	☐ Delay, sec:	
178	☐ Shutdown:	☐ Set @ °C:	☐ Delay, sec:	☐ Load Cells, No. of pads:				
179	REMARKS: \$ \$: Max. Thrust Loading shall not exceed 50% of Design Load of Bearings.							
180	\$: Each Journal Bearing shall have RTD's in no less than 50% of the Shoes.							
181	\$\$: Each Thrust Bearing shall have RTD's in no less than 50% of Active Side & 2 in the Inactive Side.							
182	LCP → Local Control Panel; MCR → Main Control Room; CCR → Central Control Room							

183	LUBRICATION AND CONTROL OIL SYSTEM				
184	Reference Specifications API 614, and Job Spec		OIL REQUIREMENTS:	CONTROL OIL	LUBE OIL
185	Furnished by:	☐ Turbine Mfr. ☐ Others	☐ Nor. flow, m ³ /Hr		
186	☐ Separate for Turbine only		☐ Trans. flow, m ³ /Hr		
187	☒ Common with Driven Equipment + Gear + Couplings		☐ Pressure, kg/cm ² g		
188	+ Control Oil System + Trip System		☐ Temp., °C		
189	Turbine Mfr. to supply:		☐ Tot. heat rej., MJ/Hr		
190	☒ Control Oil Accumulator		☐ Oil type, HC/Synth.		
191	☒ Oil piping, upstream of filter, in ☒ SS ☐ CS		☐ Viscos., SSU @ 37.8°C		
192	☒ Oil piping, downstream of filter, in ☒ SS ☐ CS		☐ Filtration, :m		
193	☒ Oil drain header piping in ☒ SS ☐ CS		☐		
194	☒ Sight flow indicators		☐		
195	ACCESSORIES				
196	COUPLINGS AND GUARDS				
197	☒ See attached API-671 Data Sheet				
198	☒ Coupling furnished by: ☐ Steam Turbine Mfr. ☒ Driven Eqpt. Mfr.				
199	☐ Manufacturer:		☐ Type:	☐ Model:	
200	☒ Non-Sparking Coupling Guard furnished by: ☐ Steam Turbine Mfr. ☒ Driven Eqpt. Mfr.				
201	Type: ☒ Fully enclosed OR ☐ Semi Open ☐ Other				
202	Coupling details				
203	☐ Max O.D. , mm:		☒ Half coupling mounted by: ☐ Turbine Mfr. ☒ Driven Eqpt. Mfr.		
204	☐ Hub weight, kg:		☐ Idling adapter/solo moment simulator reqd.		
205	☐ Spacer Length, mm: ☐ Spacer weight, kg:				
206	☒ Lubrication Requirements ☐ Grease ☐ Cont. Oil Lube ☒ None ☐ Quantity per Hub, kg or m ³ /Hr:				
207	MOUNTING PLATES				
208	☒ Baseplates furnished by: ☐ Turbine Mfr. ☒ Driven Eqpt. Mfr.		☐ Soleplates furnished by: ☐ Turbine Mfr. ☐ Driven Eqpt. Mfr.		
209	☐ Under turbine only ☐ Other		Thickness, mm:		
210	☐ Open ☐ Non-skid decking		☐ Sub Plates reqd.		
211	☒ Drip Rim ☒ Leveling Pads		☒ Hold-down bolts furnished by: ☐ Turbine Mfr. ☒ Driven Eqpt. Mfr.		
212	☐ Column mounting ☐ Subplates reqd.		☒ Epoxy primer by: ☐ Turbine Mfr. ☐ Driven Eqpt. Mfr.		
213	☐ Leveling (chock) block required				
214	furnished by: ☐ Turbine Mfr. ☐ Driven Eqpt. Mfr.		☒ Anchor Bolts furnished by: ☐ Turbine Mfr. ☒ Driven Eqpt. Mfr.		
215	GEAR UNIT				
216	☐ Furnished By ☐ Turbine Mfr. ☐ Driven Eqpt. Mfr.		☐ Reference API Std. 613		☐ Other:
217	☐ See attached data sheet:				
218	INSTRUMENTATION AND CONTROLS (Refer Inst. Datasheet, P&ID and Job Spec)				
219	☐ Instruments and control panels shall be in accordance with		☐ API Std. 614, Chapter-2, Appendix-B Pages:		
220	the following attached data sheets		☐ API Std. 670 Appendix D, Pages:		
221	☐ Purchaser's data sheets:		☐ Annunc. per ISA:S 18-1 Option:		
222	☒ PROTECTIVE DEVICES (REFER P&ID)				
223	Protective Devices	Exhaust Relief Valve	Extraction relief valve	Vacuum breaker	Extraction NRV
224					
225	☐ Mounting Location				
226	☐ Set Relief Press. kg/cm ² g				
227	☐ Capacity, kg/Hr Steam				
228	☐ Valve Manufacturer				
229	☐ Valve Type				
230	☐ Valve sizing / rating				
231	☐ Flange Facing				
232	☒ Furnished By	Vendor	Vendor	Vendor	Vendor
233	☐ Quantity				
234	☐ Trip Valve ☒ Trip & Throttle Valve				
235	Location:	☒ Main Inlet ☐ Induction	☒ Strainer: Opening Size, (mm/mesh):		
236	Provided By:	☒ Turbine Mfr. ☐ Driven Eqpt. Mfr. ☐ Purchaser	☒ Material: SS		
237	☐ Manufacturer:	☐ Model:	☒ Temporary start-up Strainer, (mesh):		
238	☐ Main Inlet Size:	Rating/Facing:	☐ Stem Matl.:	Hardness, RC:	
239	☐ Induction Size:	Rating/Facing:	☐ Seat Matl.:	Hardness, RC:	
240	☐ Size:	Rating/Facing:	☐ Packing Matl.:	Leakoff, kg/hr:	
241	Constructional features	Inlet Induct	☐ Spring support of valve reqd.: ☐ By Turbine Vendor ☐ By Pur.		
242	Reset: ☐ Manual ☒ Hydraulic		Remarks:		

243	Trip:	☐ Local (Manual) ☐ Remote				
244	Exerciser:	☐ Local (Manual) ☐ Remote ☐ Fully Oil Oper.				
245	CONTROL VALVES:					
246	LOCATION	MAIN INLET	INDUCTION	INDUCTION / EXTRACTION	INDUCTION / EXTRACTION	NOTES
247						
248	☐ Trip Position (Open / Closed)					
249	☐ Number of valves					
250	☐ Provided By					
251	☐ Manufacturer					
252	☐ Connection Size					
253	☐ Rating					
254	☐ Facing (RF, RTJ, Other)					
255	☐ Action (cam, bar, other)					
256	☐ Stem Material					
257	☐ Stem Material hardness, RC					
258	☐ Seat Material					
259	☐ Seat Material hardness, RC					
260	☐ Packing Material					
261	☐ Packing Leakoff, kg/hr					
262	TURNING GEAR (AS RECOMMENDED BY VENDOR)			MISCELLANEOUS		
263	☐ Turning Gear Required ☒ Furnished By Vendor:			☒ Start-up assistance, Days:		
264	☐ Type: ☐ Speed, rpm:			☒ Vendor's review & comments on Purchaser's piping and foundation drawings		
265	☒ Engagement: ☒ Auto ☒ Manual			☒ Vendor witness initial alignment		
266	☐ Manufacturer: ☐ Model:			☒ Strainer (As per P&ID)		
267	☒ Mounted By: ☒ Turbine Vendor ☐ Driven Eqpt. Vendor			☒ Water washing connections (Remark-3)		
268	☐ Driver Ref. Spec.:			☐ Static conducting brushes		
269	Type: ☒ Electrical motor ☐ Other			☐ Targets ☐ Leveling Pads		
270	☐ Operator Station: ☐ Local ☐ Remote					
271	INSULATION & JACKETING (Rem.-6)			SPECIAL TOOLS		
272	☒ Blanket ☐ Other			☐ Coupling Ring and Plug Gauge		
273	☒ Jacketing Steel Box			☒ Hydraulic Coupling mounting/removal kit		
274	☐ Carbon Steel ☐ Stainless Steel			☐ Torque Wrenches		
275	☐ Extent:					
276	GOVERNOR					
277	Type:	☐ Mechanical	☒ Electronic	☒ NEMA Classification 'D'		
278		☐ Simplex	☒ Multi Processor	☒ MFR.: Woodward or eqv ☐ Model:		
279		☒ Supplied By: Turbine manufacturer				
280	STEAM TURBINE TYPE					
281	☐ Single valve single stage			☐ Single valve multi stage		
282	☒ Multi valve multi stage			☐ Single auto extraction		
283	☐ Double auto extraction			☐ Single auto extraction / induction		
284	☐ Double auto extraction / induction			☐ Other		
285	DRIVEN EQUIPMENT TYPE					
286	☐ Centrifugal Compressor			☐ Pump		
287	☐ Synchronous Generator			☐ Induction Generator		
288	☐ Fan			☐ Other		
289	SERVICE REQUIREMENTS					
290	☒ MECHANICAL DRIVE			☐ GENERATOR DRIVE (NOT APPLICABLE)		
291	☒ Speed Control By: Refer P&ID			☐ Droop Control		
292	Process Pressure			☐ Frequency Control		
293	Extraction	☒ Pressure ☐ Flow	☐ Load Control			
294	Induction	☐ Pressure ☐ Flow	☐ kW Control			
295	Turbine Inlet	☐ Pressure ☐ Flow	☐ kW Import/Export Control			
296	Turbine Exhaust	☐ Pressure ☐ Flow	☐ Load Shedding			
297			☐ Auto Synchronisation			
298			☐ Auto Voltage Regulation			
299			☐ Turbine Inlet Pressure Limiting ☐ Inlet Pressure Limiter			
300	Remark					
301	3. In case vendor recommends turbine washing system. Vendor shall include all hardware required for turbine washing during washing cycle of turbine. Vendor shall furnish a write up and schematic of washing system along with the offer indicating details of offered system.					
302						

303	MINIMUM INPUT/OUTPUT REQUIREMENTS					
304	DISCRETE INPUTS			DISCRETE OUTPUTS		
305	☐ Start or Reset			☐ Common Shutdown		
306	☐ Normal Stop			☐ Common Alarm		
307	☐ Emergency Trip			☐ Over-speed Trip rpm.		
308	☐ Raise Trip			☐ Remote Speed Set point Enabled		
309	☐ Lower Speed			☐ Pressure Control Enabled		
310	☐ Enable/Disable Remote speed Set-Point			☐ Flow Control Enabled		
311	☐ Ramp to Minimum Continuous			☐ Extraction Control Enabled		
312	☐ Over-speed Test Enable			☐ Induction Control Enabled		
313	☐ Enable Pressure Control			☐ Speed Pickup Alarm		
314	☐ Enable Alarm Clear/Acknowledge			☐ Other		
315	☐ Remote Alarm Clear/Acknowledge					
316	☐ Enable Auto Synchronization					
317	☐ Cascade Raise/Lower			ANALOG ACCESSORY OUTPUTS (4-20 mA)		
318	☐ Other			☐ Speed		
319	ANALOG INPUTS (4-20 mA)			☐ Speed Set Point		
320	☐ Remote Set Point			☐ Extraction Pressure		
321	☐ Process Pressure			☐ Extraction Pressure Set point		
322	☐ Extraction	☐ Pressure	☐ Flow	☐ Actuator Position		
323	☐ kW Ind. Load	☐ Pressure	☐ Flow	☐ Process Pressure		
324	☐ kW Import/Export			☐ KW		
325	☐ Other			☐ kW Import/Export		
326	GOVERNOR INSTALLATION REQUIREMENTS (Refer Instrumentation Job Specification)					
327	Location	☐ Local (At Turbine)	Mounting:	☐ Flush Mount in Panel		
328		☐ Remote (Control Room)		☐ Surface Mount		
329		☐ Other		☐ Vertical Rack		
330	Enclosure	☐ General Purpose	Power Source:		Single	Dual
331		☐ NEMA 4	110 VAC		☐	☐
332		☐ NEMA 4X	220 VAC		☐	☐
333		☐ NEMA Purged Type	110 VAC		☐	☐
334		☐ Explosion Proof	24 VDC		☐	☐
335	GOVERNOR CONTROL PANEL(Refer Instrumentation Job Specification) : ☐ Required ☐ Not Required					
336	Location	☐ Local (At Turbine)	Enclosure	☐ General Purpose		
337		☐ Remote (Control Room)		☐ NEMA 4		
338		☐ Other		☐ NEMA 4X		
339				☐ Explosion Proof		
340	Outputs from panel to governor			Inputs to panel from governor		
341	☐ Start			☐ Common Alarm Trip		
342	☐ Trip			☐ Trip Lamp		
343	☐ Raise			☐ Remote Set point Enabled Lamp		
344	☐ Lower			☐ Speed Set point Meter		
345	☐ Over speed Test			☐ Other		
346	☐ Ramp to Minimum Continuous					
347	☐ Remote Set point Enable/Disable					
348	☐ Reset					
349	☐ Other					
350	MISCELLANEOUS GOVERNOR DETAILS					
351	Governor Action on Loss of Remote Signal			☐ Locks on Last Value		
352				☐ Goes to Minimum Continuous		
353				☐ Goes to Maximum Continuous		
354	External Interface Device Type	☐ Printer	FORMAT:	☐ Graphic Display		
355		☐ CRT		☐ Tabular Data		
356				☐ Trending (Real Time)		
357				☐ Historical Archiving		
358	☐ Distributive Control System Manufacturer			☐ Model		
359	Data Transmission	☐ Serial Data Link		☐ Protocol		
360		☐ Discrete I/O		☐ Baud Rate ☐ 300	☐ 4800	
361		☐ Network Type		☐ 1200	☐ 9600	
362				☐ 2400	☐ 19200	

363	MAGNETIC SPEED PICKUP							
364	Manufacturer:		Model:		Installation: ☐ Dual ☐ Triple ☐ Installed Spares			
365	Governor Speed Pickup(s)		☒ No. Req'd.: 3		☐ Direct ☐ Tooth Wheel			
366					☐ Others			
367	TURBINE MOUNTED ACCESSORIES							
368	Actuator:		☒ Supplied By: Vendor		☐ Manufacturer:		☐ Model:	
369	Actuator Type		☒ Hydraulic ☐ Pneumatic		☐ Single Coil ☐ Multi-Coil		☐ Other	
370	Tachometer		☐ Manufacturer:		☐ Model:		☐ No. req'd.	
371			☐ Location(s):					
372	OVERSPEED TRIP							
373	☒ Furnished by Vendor				☒ No. of Speed Pickups:		☐ Type Tooth wheel	
374	☐ Manufacturer		☐ Model		☐ Other			
375	☒ Electronic Set Point rpm				☒ Speed Pickups furnished by: Turbine Vendor			
376	☒ Over-speed Shut-down requirements				☐ Solenoids shall:		☐ De-energize to Trip	
377	☐ 1 out of 2		☒ 2 out of 3 Voting Logic		☐ Energize to Trip			
378	☐ Other				☐ Contacts shall be:		☐ Normally Open	
379	☐ Mechanical Over-speed Set Point				☐ Normally Closed			
380	☐ Type:							
381	GLAND SEALING AND VACUUM SYSTEM							
382	System Per:		☒ Appendix-G1 ☐ Appendix-G2		☒ Vacuum System Furnished by: Vendor			
383			☐ Other		☐ Ship Loose ☐ Skid Mounted			
384	☐ Available header pressure		kg/cm ² g Temp. °C		☐ Other			
385	☐ Avail. seal steam supply press.		kg/cm ² g		☒ Gland Condenser, See Spec.: Refer D/s attached			
386	☐ Avail. seal steam supply temp.		°C		☒ Steam Ejector ☐ Steam Pressure kg/cm ² g			
387	☐ Sealing steam pressure		kg/cm ² g		☐ Flow kg/hr		☐ Steam Flow kg/hr	
388	☒ Sealing steam relief valve set pressure				☐ Vacuum Pump, See Spec.:			
389	Furnished by Vendor				☐ Condensate Receiver			
390	☒ Flow adjusting valves, Type: Auto				☐ Loop Seal Height			
391	Furnished by Vendor							
392	SHOP INSPECTION AND TESTING (Each Turbine)							
393	GENERAL							
394	☒ Shop Inspection					Mechanical running test		Observed
395	Extent:					☒ Contract Rotor		☒ Witness
396	Inspection and material testing:					☒ Spare Rotor		☒
397	☒ Final Assembly Records Required					☒ Test with Job Coupling		☒
398	Special Material Inspection & Testing Requirements					☒ Test Tape Record required		☒
399	* Component	M.P.	D.P.	R.T.	U.T.	Obsvd.	Witn.	☒
400	Trip and T&T Valve	✓		✓	✓	☒	☐	☒
401	Steam Chest	✓		✓	✓	☒	☐	☒
402	Casing	✓		✓	✓	☒	☐	☒
403	Piping		✓	✓		☒	☐	☒
404	Rotor	✓			✓	☒	☐	☒
405						Obsvd.	Witn.	☒
406	☒ Heat Stability					☒	☐	☒
407	☒ Cleanliness					☒	☐	☒
408	☒ Hardness					☒	☐	☒
409	☒ Hydrostatic Tests					☒	☐	☒
410	☒ Rotor Balance ☒ Standard					☒	☐	☒
411	☐ High Speed					☐	☐	☒
412	☒ Final Surface Inspection					☒	☐	☒
413	☒ Crating Inspection					☒	☐	☒
414	☐ Spare Rotor Fit					☐	☐	☒
415	☒ Casing Joint Leak Test					☐	☒	☒
416						☒ Governor Stability		☒
417						☒ Over speed Trip system		☒
418	* Certificates for all NDT Tests					☒ Residual Elec. & Mech. Runout		☒
419						☒ Check Brgs. & Seals		☒
420						☒ Use Job Vib. & Axial Probes		☒
421						☒ Rotor Insensitivity Test		☒
422								

**SPECIAL PURPOSE STEAM
TURBINE
(TYPICAL MDS)**

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423	MISCELLANEOUS			
424	PAINTING:		WEIGHTS (kgs):	
425	☒ Manufacturer's Standard		☐ Turbine	
426	☐ Other:		☐ Rotor	
427	☐		☐ Turbine Upper Half Casing	
428	Remarks:		☐ Maximum for Maintenance (Identify)	
429			☐ Trip / T&T Valve	
430			☐ Miscellaneous	
431			☐ Total Shipping Weight	
432				
433	SHIPMENT:			
434	☐ Domestic ☒ Export			
435	☒ Export Boxing Required		☒ Outdoor Storage for 12 months	
436	☒ Waterproof Boxing Required		☒ Spare Rotor Assembly Packaged for: Vertical with N2 purge	
437				
438	SPACE REQUIREMENTS:		VENDOR DRAWING & DATA REQUIREMENTS	
439	Component	Length (mm)	Width (mm)	Height (mm)
440	☐ Compl. Unit			☐ Appendix
441	☐ Cont. Panel			☒ Other: Refer Vendor Data Requirement enclosed.
442	☐ Other			☐ Progress Reports Required
443	☐ Other			Frequency:
444	REMARKS			
445	4. Turbine shall have removable insulation and metal jacketing. Jacket temperature shall not exceed 60 °C.			
446	5. This is a typical datasheet. Vendor shall furnish duly filled in datasheet during detail engineering.			
447	6. Refer Job Specification attached with tender for details.			
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DATE	REV	JOB ENGINEER	REV. & APPROVED BY

STEAM TURBINE DRIVER (SPP)

(PERFORMANCE DATA)

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Sr. No.	OPERATING CASES (Refer Driven Eqpt data sheet)	DRIVEN EQPT.		STEAM INLET			EXTRACTION-1 (HP-Steam)			EXTRACTION-2 (MP steam)			EXHAUST				STEAM RATE	STEAM TURBINE EFFICIENCY (%)
		Shaft Power	Shaft Speed	Flow	Press	Temp	Flow	Press	Temp	Flow	Press	Temp	Press	Temp	Enthalpy	Flow		
		kW	rpm	kg/hr	kg/cm ² g	°C	ton/hr	kg/cm ² g	°C	Kg/hr	kg/cm ² g	°C	Kg/cm ² A	°C	Kcal/kg	kg/hr		
1.																		
2.																		
3.																		
4.																		
5.																		
6.																		
7.																		
8.																		
9.																		
10.																		
STEAM TURBINE PERFORMANCE <i>Normal Inlet Conditions, & Normal Exhaust Conditions as per PDS</i>		1.1 x Max. BKW (corres. to rated optg. case of driven eqpt.)																
STEAM TURBINE RATING <i>Min. Inlet Conditions, & Max. Exhaust Conditions</i>		1.1 x Max. BKW (corres. to rated optg. case of driven eqpt.)																

STEAM TURBINE DRIVER (SPP)

(PERFORMANCE DATA)

Sr. No.	OPERATING CASES (Refer Driven Eqpt data sheet)	DRIVEN EQPT.		STEAM INLET			EXTRACTION-1 (HP-Steam)			EXTRACTION-2 (MP steam)			EXHAUST				STEAM RATE	STEAM TURBINE EFFICIEN CY (%)
		Shaft Power	Shaft Speed	Flow	Press	Temp	Flow	Press	Temp	Flow	Press	Temp	Press	Tem p	Enthal py	Flow		
		kW	rpm	kg/hr	kg/cm ² g	°C	ton/hr	kg/cm ² g	°C	Kg/hr	kg/cm ² g	°C	Kg/cm ² A	°C	Kcal/k g	kg/hr		
	STEAM TURBINE PERFORMANCE <i>Max. Inlet Conditions & Min. Exhaust Conditions as per PDS</i>	1.0 x BKW @ driven eqpt guarant eed case																
	STEAM TURBINE PERFORMANCE <i>Min Inlet Conditions, Max Exhaust Conditions</i>	1.0 x BKW @ driven eqpt guarant eed case																
	STEAM TURBINE PERFORMANCE <i>@ Nor. Inlet Conditions/ Nor. Exhaust Conditions</i>	1.0 x BKW @ driven eqpt guarant eed case																
	STEAM TURBINE PERFORMANCE <i>@ Max. Inlet Conditions/ Min. Exhaust Conditions</i>	Turn down case of driven eqpt operatio n																

§: Refer Process Datasheet & Site & Utility Data for details.

Notes:

1. All power & speed figures shall be at driven eqpt coupling.
2. Performance curves including correction curves for the specified conditions are required.
3. Correction curves for estimating Turbine performance at Off-design conditions or at Actual Site Conditions are also required.

1	GENERAL			
2	Project: BINA PETROCHEMICAL & REFINERY EXPANSION		Job No.: B957	
3	Owner: M/s BPCL		Site: BINA, MP	
4	Purchaser:		Unit: SGU	Unit No.: 420
5	Item No.:		Service:	
6	No. Reqd.:	Working:	Standby:	Driven Equipment Item no.:
7	Applicable to: ☒ Proposals ☐ Purchase ☐ As built			
8	Note: ☒ Scope option / information specified by Purchaser ☐ information required from / options left to vendor. Vendor to cross ☒ the selected option.			
9	SITE / INSTALLATION DATA			
10	Site Conditions		Location:	
11	Barom. Pressure(kg/cm ² a): ☐ Highest: ☐ Lowest: ☐ Avg.:		☐ Indoor ☐ Outdoor ☒ Grade	
12	Height above Mean Sea Level (m):		☐ Heated ☐ Unheated	
13	Ambient Air Temp.(°C): ☐ Max.: ☐ Min.:		☐ Under-roof ☐ Partial Sides	
14	Ambt. Air Temp. around the Engine(°C): ☐ Highest ☐ Lowest		☐ Closed Room With Air Ventilation System	
15	Relative Air Humidity at the Max. Ambient Air Temp.(%):		Electrical Area classification(Refer Electrical part)	
16	Water Vapour Pressure at the Max. Ambient Air Temp.(kg/cm ² A):		Class Group Division	
17	Wet Bulb Temp. (°C):		Dry Bulb Temp. (°C):	
18	Cooling Water Supply Temp. (°C):			
19	UTILITY DATA			
20	Cooling Water:			
21	Cooling Water Temp(°C)	Supply(Design/Max/Nor/Min):	Return(Max):	
22	Cooling Water Press(kg/cm ² g)	Supply(Design/Max/Nor/Min):	Return(Min):	
23	Cooling Water Characteristics:		DM Water Consumption:	
24	Instrument Air:			
25	Supply Pressure(Design/Max/Nor/Min)(kg/cm ² g):			
26	Supply Temp.(Design/Max/Nor/Min)(°C):		Dew pt.(°C)	
27	Electric Power (Refer Electrical Specification)			
28	Electric Supply:		Volts Hz	
29	Available during		Engine ☐ Starting ☐ Operations ☐ Shut-down	
30	Fuel Oil:			
31	Type of Fuel Oil: High Speed Diesel		Lower Calorific Value(kJ/kg):	
32	Fuel Oil Characteristics:			
33	APPLICABLE CODES & STANDARDS			
34	☒ EIL Standard spec. no. 6-43-0040 ☒ ISO 3046/ BS 5514 ☒ ISO: 8528 ☒ Others: Job Specification			
35	Noise specification: ☒ Applicable to m/c -- DG set shall meet noise and emission limits of Central & State Pollution Control Board			
36	☒ Acoustic Housing: ☒ Yes ☐ No			
37	Exhaust Gas Emission - Statutory requirement (if any): Refer Job Spec & Cl.2.6 of EIL Std. Spec. 6-43-0040			
38	☐ Listing/Approval of Engine Required From: ☐ UL/FM ☐ TAC			
39	☐ Air Receiver for Starting Air System		ASME SEC- VIII DIV 1 ☐ Air Compressor for Starting Air System Manufacturer's Std.	
40	☒ Shell and Tube type Exchangers:		Manufacturer's Std. ☒ Auxiliary Pumps: Manufacturer's Std.	
41	☒ Air Cooled Heat Exchangers/Radiator:		Manufacturer's Std. ☒ Other Tanks and Vessels: Manufacturer's Std.	
42	DRIVEN EQUIPMENT			
43	Driven Equipment: ☒ Elect. Generator ☐ Pump ☐ Other:			
44	Duty: ☐ Emergency ☐ Intermittent ☒ continuous			
45	Probable Period For Continuous Running: As per ISO:8528 for Prime Power Rating (PRP)			
46	Duration of Max. Load:		Duration of Min. Load:	
47	☐ Minimum BKW of the driven eqpt. kW:		@ RPM:	
48	☐ Rated BKW of the driven eqpt. kW:		@ RPM:	
49	☐ Maximum BKW of the driven eqpt. kW:		@ RPM:	
50	☐ For Mech. Drive Applications: Minimum site rating of the engine required		kW @ RPM	
51	(With 10 % Overload provision for One Hour within a period of 12 Hours of Operation).			
52	☒ For DG set application: Prime power Rating (PRP) as per ISO: 8528. The Net Power available at Alternator Terminals shall be			
53	<u>2000</u> KVA @ <u>6.6</u> KV with rated P.F. of <u>0.8</u> after accounting for Engine Deration for Site conditions & Alternator Efficiency with			
54	Engine Driving its all auxiliaries and power consumed by essential independent auxiliaries.			
55	Direction of Rotation of driven equipment viewed from Coupling End: ☐ CW ☐ CCW			
56	Method of Drive: ☐ Thru universal joint ☒ Direct thru Flexible Coupling ☐ V-Belts ☐ Gear Drive			
57	CONSTRUCTION FEATURES			
58	Manufacturer:		Engine Model:	
59	Type of Engine:	☐ Two-Stroke ☒ Four-Stroke	Engine Cooling: ☐ Air Cooled ☒ Water Cooled	
60	☐ Mech. Pressure-charged ☒ Turbo-Charged: ☐ With Charge Air Cooler ☐ Normally Aspirated			
61	☐ No. of Cylinders: ☐ Cylinder Arrangement:			

62	☐ Bore/Stroke(mm/mm):		☐ Compression Ratio:			
63	☒ Speed (rpm): (≤ 1500)		☐ Mean Piston Speed (m/sec.):			
64	PERFORMANCE					
65	☒ Rated Engine Power at Standard operating conditions as per ISO 3046/ BS 5514 (ISO Std. Power):		kW @ RPM			
66	(Using only the essential dependent Auxiliaries and with 10% Overload provision for One Hour within a period of 12 Hours of Operation).					
67	☒ Rated engine Power at Site conditions (Service Std. Power) (Guaranteed, No Negative Tolerance):		kW @ RPM			
68	(Using only the essential dependent Auxiliaries and with 10% Overload provision for One Hour within a period of 12 Hours of Operation).					
69	☐ Min. Engine site power at which Engine can be Operated Continuously.		kW @ RPM			
70	☐ Min. Engine Speed & corresponding site Power at which Engine can be Operated Continuously		RPM @ kW			
71	☐ Starting time required for full load operation (Seconds):					
72	☐ Direction of Rotation of Engine viewed from Coupling End		☐ CW ☐ CCW			
73	Air Flow Required for Operation of the Engine for:		☐ Combustion & Scavenging ☐ Cooling & Ventilation			
74	Essential dependent Auxiliaries are:					
75	☐ Engine Shaft Driven Radiator Fan	kW	☐ Engine Shaft Main LO Pump	kW		
76	☐ Engine Shaft Driven CW Pump	kW	☐ Engine Shaft Driven Fuel Oil Pump	kW		
77	Independent Auxiliaries are:					
78	☐ Electric Motor Driven Auxiliary LO Pump.	kW	☐ Electric Motor Driven Fuel Oil Transfer Pump.	kW		
79	☐ Electric Motor Driven CW Pump.	kW	☐ Electric Motor Driven Starting Air Compressor.	kW		
80	☐ Electric Motor Driven Radiator Fan	kW	☐ Electric Motor Driven Exhaust Fan	KW		
81	☐ Electric Motor Driven Fresh Air Fan	KW				
82	Specific Fuel Consumption:					
83	Description		Fuel Consumption, gm/kW-hr @ reference conditions ★			
84			ISO 3046 ★	Manufr's. Std. ★	Site ★	Manfr's. shop ★
85	(a)	Guaranteed Engine Rated Power				
86		(100 % Rating)				
87	(b)	75 % of (a)				
88	(c)	50 % of (a)				
89	(d)	110 % of (a)				
90	★ Standard Reference Conditions:					
91	--	Total Barometric Pressure, p_r , kg/cm ² A	(100 kPa)			
92	--	Atmospheric Temp., t_r , °C	25 (298°K)			
93	--	Relative Humidity, ϕ_r , %	30			
94	--	Charge Air Coolant Temp., t_{cr} , °C	25 (298°K)			
95	SPEED GOVERNING SYSTEM					
96	Type:	☐ Single Speed	☐ Multiple Speed	☐ All Speed (Variable Speed)		
97	Class of Accuracy:	☐ G1	☐ G2	☐ G3	☐ G4	(shall meet electrical specs)
98	Governor Type:	☒ Electronic	☐ Electro Hydraulic	☐ Mechanical		
99	Make:	Woodward or Equivalent			Model:	
100	Governor Control Mechanism:	☐ Manual			☐ Remote/ Auto	
101	STARTING SYSTEM					
102	Method of Starting	☒ Manual		☒ Automatic (through AMF)		
103	Method of Stopping	☒ Manual (Push button)		☒ Automatic		
104	Type of Cold Starting Aid:					
105	Type of Starting System:					
106	☐ Hand Starting with Starting Handle	☒ Battery Starting		☐ Air Starting through Pneumatic Motor		
107	☐ Air Starting through Air Injection into Cylinders			☐ Hydraulic Motor		
108	Battery Starting System: (Also refer Electrical Specification Enclosed Elsewhere)					
109	Battery Bank:	☐ Number:	Voltage	AH Capacity	Make:	
110	Cells per Bank	☐ Number	Voltage	AH Capacity		
111	☒ Starter Make/Rating:		☒ Dynamo Make/Rating:			
112	☒ Regulator and Cut-out:					
113	☒ Battery charging equipment including transformer, Static Rectifier, D.C. Ammeter, D.C. Voltmeter, Charge Rate selector switch					
114	and Charging Meter.					
115	☒ Inter connecting cable leads between battery charger & battery					
116	☒ Inter connecting cable leads between battery & engine Starter					
117	Note: Battery Bank shall be sized to provide minimum <u>SIX</u> consecutive starts of the engine under cold condition					
118	without recharging, with additional 10% spare capacity.					
119						
120						

121	Starting Air System: NOT APPLICABLE			
122	☐ Air Compressor Type:	☐ Reciprocating	☐ Screw	
123	Rated Capacity(m ³ /hr at Inlet Conditions):	Discharge Pressure (Kg/cm ² g):	BKW:	RPM:
124	☐ Air Compressor Driven by:	☐ Working by Electric Motor ☐ Standby by Diesel Engine		
125	Driver Rating kW:	RPM:	Volts/N/Hz.:	
126	☐ Air Receiver with Pressure Gauge, Relief Valve & Manual as well as Automatic (with Timer) Drain Valve:			
127	☐ Start-Stop Switch for Compressor	☐ Manual	☐ Automatic (Through Pressure switch on air receiver) with Selector switch	
128	No. of Air Receiver:	☐ One	☐ Two	Capacity of Each Air Receiver(M ³):
129	Note: Total Capacity of each air Receiver shall be suitable for atleast Six (6) consecutive starts.			
130	Other starting systems: Not applicable			
131				
132	COOLING SYSTEM (As per Manufacturer's Standard)			
133	Type:	☐ Open Circuit Cooling with Engine driven water circulating Pump.		
134	☐ Closed circuit cooling including:			
135	☐ Water Pump driven by:	☐ Driver Rating/Speed (KW/RPM):		
136	☐ Primary (Soft) circuit Piping with Temp. Control & Make-up tank.			
137	☐ Heat Exchanger with Anchor/Foundation Bolts			
138	☐ Secondary(Raw Water) circuit Piping with	☐ Strainers	☐ Pressure Regulating Valve	
139	☐ By-Pass Valve:	☐ Check Valve:		
140	Heat Exchanger Temp(EC) (Primary Circuit):	Inlet:	Outlet:	
141	Heat Exchanger Temp(EC) (Secondary Circuit):	Inlet:	Outlet:	
142	Water Pressure(Secondary circuit) Kg/cm ² (g):	Heat Exchanger Testing Pressure Kg/cm ² (g):		
143	☒ Radiator Cooling including Interconnecting Piping and:			
144	☒ Radiator with Temp. Control Valve	☒ Expansion/Make-Up water Tank		
145	☒ Fan Driven By: Engine Shaft	Rating/Speed (KW/RPM):		
146	☒ Engine/Motor Driven Water circulating Pumps: No.:	Rating/Speed (KW/RPM):		
147	☒ Engine Water Inlet/Outlet Temp(deg C):			
148	FRAME LUBRICATION SYSTEM (As per Manufacturer's Standard)			
149	Type:			
150	☐ Splash Lubrication			
151	☒ Force Feed Lubrication including Valves, oil Pump, Piping &:			
152	☒ Oil cooler type: (As per manufacturer standards)			
153	☒ Oil Filters	☐ Self Cleaning	☐ Duplex	☐ Paper Cartridge ☐ Simplex Filter self cleaning type (As per manufacturer standards)
154	☒ Pre-lube Oil Pump driven by:			
155	Pre-lubrication	☒ Manual	☒ Automatic at intervals of ___ hours. (Vendor to recommend)	
156	☐ Type/Grade of Lube Oil:	☒ Auto pre-lubrication pump shall be powered from mains.		
157	☐ Oil Sump capacity (litres):	☐ Oil consumption (Lph):		
158	☐ Oil Cooler testing Pressure (Kg/cm ² g):			
159	☐ Explosion Relief Valve for Crankcase			
160	FUEL SYSTEM			
161	Type:	☐ Gravity Feed System	☒ Fuel Lift Pump including	
162	☒ Fuel Filters	☐ Paper cartridge	☐ Duplex	
163	☒ Fuel Injection Pump	Make:	Model:	
164	☒ Daily Service Fuel Tank:	☐ Engine Mounted	☐ Wall Mounted	☐ Ground Mounted
165	☒ Capacity of Daily Service Tank(litres)	☒ Two Nos. of 990 litres	☐ For 6 hrs of continuous operation @ full load	
166		☐ For 12 hrs continuous operation @ full load	☐ For 24 hrs continuous operation @ full load	
167	☐ Fuel Float Tank	Ground Mounting with Base Plate		
168	☒ Motor Driven Fuel Transfer Pump (For unloading fuel from fuel tanker to daily service tank)			
169	☒ Fuel Piping and Fittings:			
170	☐ Fuel Piping from Transfer Pumps to Daily Tank	☒ Fuel Piping from Daily Tank to Engine		
171	☒ Overflow Pipes	☒ Vent Connection for Fuel Tank with Flame Arrester		
172	☒ Drain Valve for Fuel Tank	☒ Inspection and cleaning Hole for Fuel Tank (min 150 mm dia.)		
173	☒ Fill connection for Fuel Tank	☒ Level Switch in Fuel tank (For Low Alarm)		
174	☒ Shielded Level Gauge for fuel tank	☒ Float valve in fill connection	☒ Strainers	
175	AIR INLET SYSTEM			
176	☒ Suction Air Filter	☒ Air Inlet Ducting / Piping / Manifolds	☒ Inlet Silencer	
177	☒ Expansion Bellows	☒ All supports / Hangers		
178	ENGINE EXHAUST SYSTEM			
179	☒ Exhaust Manifolds / Ducting / Piping	☒ Exhaust Silencer (Residential Type)		
180	☒ Expansion Bellows	☒ Exhaust Stack/Chimney min height is 30m	☒ All supports/Hangers	☒ Thermal Insulation for complete Exhaust Piping
181				

182	CONTROLS & INSTRUMENTATION						
183	Hazardous Electrical Area Classification	NEC:	Class	Div.	Group (Refer Elec. Spec.)		
184		ISO:	Zone	Gas Group			
185							
186	Electric Supply: Refer Electrical Specification						
187	Lamps	: ±	24V;	AC/DC; φ;	±	Hz.	
188	Alarm Circuit	: ±	24V;	AC/DC; φ;	±	Hz.	
189	Trip Circuit	: ±	24V;	AC/DC; φ;	±	Hz.	
190	Control Circuit	: ±	24V;	AC/DC; φ;	±	Hz.	
191	Solenoid Valves	: ±	24V;	AC/DC; φ;	±	Hz.	
192							
193							
194	Notes						
195	1. Pre-Alarms to precede Trips.						
196	2. Instruments to be connected to junction boxes on skid and consoles.						
197	3. All Tubings, pipings, wiring between instruments and junction boxes, local gauge boards and local panels to be supplied by vendor.						
198	4. Instruments, safety and control devices specified herein are minimum required by customer. In case, in the opinion of vendor,						
199	additional devices are required, vendor shall specifically state so and include the same in his scope of supply.						
200	5. Vendor shall also refer to P&ID's enclosed and any additional instruments required as per P&ID's shall be included						
201	by vendor in his scope of supply.						
202	6. All switching devices (hardware/software) for prealarms, trips, trip alarm, and interlocking shall be in the vendor's scope.						
203							
204	Nomenclature			Location			
Loose Supply				Locally Mtd.	LGB Mtd.	LCP Mtd.	UCP
205							
206							
207							
208	■ AC Power On/Off Switch With Indication Lamp				■		
209	■ Control Power On/Off Switch With Indication Lamp				■		
210	■ Selector Switch A/M Station For L/O Pump Motor				■		
211	□ Selector Switch A/M Station For CW Pump Motor				□		
212	■ Start/Stop Push Button for L/O Pump Motor				■		
213	■ Start/stop Push Button for DG set				■		
214	■ Emergency Stop Push Button				■		
215	■ Lamp Test Push Button				■		
216	■ Alarm/Trip Acknowledge /Reset Push Button				■		
217	■ Lubricating Oil Heater 'ON' Indicating lamp				■		
218	■ Motor Interlock Against Start Without Pre-lubrication				■		
219							
220							
221	NOTE:						
222							
223	Legend:	LM: Local Mounted:	■ By Vendor	□ Others			
224		LGB: Local Gauge Board:	■ By Vendor	□ Others			
225		LCP: Local Control Panel:	■ By Vendor	□ Others			
226		UCP: Unit Control Panel:	□ By Vendor	□ Others			
227		PLC: Programmable Logic Control:	□ By Vendor	□ Others			
228		DCS: Distributed Control System:	□ By Vendor	□ Others			
229							
230	■ Items under LGB to be housed in the Engine Mounted Gauge Board						
231	■ Items under LCP to be housed in free standing type Local Engine Control Panel						
232	■ Electric Switches for Alarm and shutdowns to have _____ Enclosures (Refer Electrical Specification)						
233	■ Temp. gauges shall be Bimetallic Dial Type						
234	■ All wiring piping between Engine - Gauge Board - Control Panel in Vendor's Scope						
235							
236							
237							
238							
239							
240							

CONTROLS AND INSTRUMENTATION																
S.No.	DESCRIPTION	REQUIRED	Indication				A/V Annun. & Pre-Alarm				Trip & A/V Alarm Annun.					
			Gauge- Local Mounted	Gauge- LGB	Indicator -LP	Indicator – UCP	Repeat Signal to DCS/MP	Low - LP	Low - UCP	High - LP	High - UCP	Repeat Signal to PLC/DCS/MP	Low Low - LP	Low Low - UCP	High High - LP	High High- UCP
241	LUBRICATION SYSTEM															
242	- Reservoir Oil Level	■	■													
243	- Reservoir Temp.	□	□													
244	- Main/Std by L/O Pump Disch. Pr.	■	■													
245	- L/O Filter Diff. Pr.	■	■													
246	- L/O Supply Header Pressure	■		■			■					■				
247	- L/O Supply Header Temp.	■		■					■							
248	- Oil cooler Oil Outlet Temp.	□	□													
249	- Stand by Pump Start	■			■											
250	-															
251																
252	COOLING SYSTEM															
253	- Oil Cooler CW outlet temp.	■	■													
254	- CW Supply header flow	□	□													
255	- Sight Flow CW return each Cooler & Header	□														
256	- Local mount TSV on each isolatable circuit	□														
257	- Water level in make up water tank / Radiator	■	■													
258	- Engine Jacket C.W. Supply Temp. (Outlet of Radiator)	□														
259	- Engine Jacket C.W Return Temp. (Inlet of Radiator)	■							■					■		
260	For Closed Circuit Cooling (as applicable):															
261	- Coolant main/standby pump disch. Pr.															
262	- Coolant stand by pump start															
263	- Coolant supply header Pr.															
264	- Coolant supply header temp															
265	- Coolant cooler Outlet Temp.															
266	- Coolant reservoir Level (Make up water tank)															
267																
268																
269	STARTING SYSTEM (if applicable)															
270	- Air Receiver Pressure	□	□				□									
271																
272																
273	FUEL SYSTEM															
274	- Fuel Oil level in fuel tank	■	■				■									
275																
276	INLET AIR SYSTEM															
277	- Inlet Air filter - differential pressure	■	■													
278	- Boost Air (Turbo Charger) Disch. Pr. (if reqd.)	□	□													
279	-Charge Air Cooler Outlet - Air Temp. (if reqd.)	□	□													
280																
281	MISCELLANEOUS															
282	- Engine Vibrations	□								□						
283	- Engine Speed	■	■		■											
284	- Key Switch - Start & Push Button Stop	■			■											
285	- Engine Over-speed	■							■					■		
286	- Engine fails to start	■					■					■				
287	- Tacho-hour Meter	■			■											
288	-Engine running	■			■											
289																
290	Note: Instrumentations specified as minimum required. vendor shall include any other instruments if required for smooth, safe															
291	and Trouble free operation of the DG sets.															

292	MATERIAL		
293	Charge Air Cooler	Shell:	Tubes:
294	Water Cooler	Shell:	Tubes:
295	Air Cooler	Shell:	Tubes:
296	Air Receiver		
297	Fuel Tank: MS		
298	INSPECTION AND TESTING		
299		Witness	Observe
300	☐ Stage Inspection during Manufacture	☐	☐
301	☒ Full Load Test at Engine Manufacturer's Shop (Refer cl. 4.1.3 of EIL spec 6-43-0040)	☒	☐
302	☒ Fuel consumption & Governing Test at Engine Manufacturer's Shop (Refer cl. 4.1.3 of EIL spec 6-43-0040)	☒	☐
303	☒ Control Panel Functional Test at LP vendor's shop.	☒	☐
304	☒ Full Load Test for 4 hours & 10% overload test for 1 hour of Engine Generator set at Packager's shop	☒	☐
305	☐ No load Mechanical Run test at Packager's/Driven Eqpt. Mfr. Shop	☐	☐
306	☒ Site Testing of the DG Set (Refer Remark- 1)	☒	☐
307	Inspection/Testing Witnessed By: ☐ Others ☒ Owner/ Purchaser/ Representative		
308	WEIGHTS		
309	Net Weight of Engine with Mounted Ancillaries (kg):		
310	Heaviest part to be handled during erection and its weight (kg):		
311	Heaviest part to be handled during normal maintenance and its weight (kg):		
312	Recommended Crane capacity (Tons):	Crane Hook Height (m):	
313	MAINTENANCE DATA		
314	Expected Period of Running Between Top Overhauls:	Hours	
315	Expected Period of Running Between Main Overhauls:	Hours	
316	The Type and Grade of Lubricating Oil Recommended		
317	Lube Oil Consumption (kg/hr)/ (Litres/hr)		
318	Change of Lubricating Oil After:	Hours	
319	ACCESSORIES		
320	☒ Flywheel with Barring Device		
321	☒ Guards for Moving Parts		
322	☒ Common Base Plate for Engine - Driven equipment		
323	☒ Foundation/ Anchor Bolts, grouting material		
324	☒ Acoustic enclosure with ventilation system		
325	☒ Anti Vibration Pads (if required)		
326	☒ First Fill of Lubricating Oil and consumables (except fuel)		
327	☒ Torsional analysis report on Engine & Generator		
328	☒ Quotation for 2 years spares parts for Normal Operation and Maintenance along with unit prices		
329	☒ Separate Quotation for Five Years Annual Maintenance Contract		
330	☒ Site Storage, Erection & commissioning of DG Set		
331	☒ Purchaser's Training (refer Job Specification)		
332			
333	REMARKS		
334	1) DG Set shall be tested at site based on the available load so as to demonstrate power and voltage build- up at the alternator terminals.		
335	2) DG set shall be suitable for black start condition. For initial start as well as subsequent black start requirement, all facilities are considered in the vendor scope. Details of the offered system shall be furnished with offer.		
336			
337			
338			
339			
340			
341			
342			
343			
344			
345			
346			

Date	Rev	Job Engineer	Rev. & Approved By

1	GENERAL											
2	Project: BINA PETROCHEMICAL & REFINERY EXPANSION					Job No.: B957						
3	Owner: M/s BPCL					Site: BINA, MP		Unit No.: 420				
4	Purchaser:					Unit: STEAM GENERATION UNIT						
5	No. Required:		Working:		Standby:		Driven Equipment:					
6	Applicable to		☐ Proposal			☐ Purchase			☐ As-Built			
7	☒ Scope option & Information specified by purchaser ☐ Information Req'd. from & option left to vendor. Vendor to cross ☒ the selected option.											
8	Manufacturer:					Model:						
9	APPLICABLE CODES & STANDARDS											
10	API STANDARD 611 AND EIL STANDARD SPECIFICATION 6-43-0042.											
11	OPERATING CONDITIONS					PERFORMANCE						
12	OPERATING POINT		ABSORBED POWER (KW)		SPEED (RPM)		Operating Point / Steam Condition		No. of Hand Valves / Valves Open		Steam Rate, kg/kW-hr	
13	Normal						Pump Rated / Normal					
14	Rated						Pump Rated / (Min. Inlet, Max. Exhaust)					
15	Maximum (EOC)											
16	Minimum (@ Pump MCSF)						Turbine Rated / Normal					
17	TURBINE RATING						Turbine Rated / (Min. Inlet, Max. Exhaust)					
18	SITE / INSTALLATIONS DATA											
19	Application (Spared, Un-spared):					CONSTRUCTION FEATURES						
20	☐ Wide Speed Range ☒ Rapid start					Turbine Type		☒ Horiz. ☐ Vertical				
21	☐ Slow Roll Required ☐ Hand Valves Req.					☒ No of Stages: ONE (1)		Wheel Dia.(mm)				
22	☒ Duty: ☒ Continuous ☐ Standby					Rotor: ☐ Built-Up ☐ Int. Forged ☐ Overhung ☒ Between Brgs.						
23	☒ Unattended Auto Start					Blading		☐ 2 Row ☐ 3 Row ☐ Rateau				
24	Location ☐ Indoor ☒ Outdoor					Casing Split		☒ Axial ☐ Radial				
25	☐ Heated ☒ Unheated ☐ Under-roof ☒ W/o Roof					Casing Support		☒ Centerline ☐ Foot				
26	Ambient Temp. °C		Min.		Max.		☒ Vert. Jackscrews: ☒ Yes ☐ No					
27	Unusual Conditions ☒ Dust ☐ Salt Atm. ☒ Ref. Atm.					Vert. Turbine Flange ☐ NEMA "P" base ☐ Others						
28	Elect. Area Class		Group:		Div.		Trip Valve: ☒ Integral (Mfr. Std.) & Separate (Gate Valve) (Rem. 11)					
29	☐ Non-Hazardous					Inter-stage Seals		☐ Labyrinth ☐ Carbon				
30	Control Power		V _____ Ph. _____ Hz _____				End Seals		☒ Carbon Ring (No. _____) ☒ Brush Seals			
31	Aux. Motor		V _____ Ph. _____ Hz _____				☐ Labyrinth ☐ Carbon/Laby ☐ Dry Gas					
32	Allow. Sound Press Level		85 dBA @ 1m			☐ Type of Radial Bearings: ☐ Antifriction ☐ Sleeve						
33	UTILITY DATA					☐ Type of Thrust Bearings: ☐ Antifriction ☐ Tilting Pad						
34	Cooling Water:		Press (kg/cm²g):		ΔP (kg/cm²g):		Cal. thrust Load: _____ kN		☐ Brg's Mfr. Ultimate Rating: _____ kN			
35			Flow (m³/h):		ΔT (°C):		Thrust Collar: ☐ Replaceable ☐ Integral ☐ None					
36	Remarks:					☒ Turbine Suitable for auto start without warm-up						
37						☐ Lube Oil Viscosity ISO Grade:						
38	STEAM CONDITIONS (REM. 1)					☐ Lubrication ☐ Ring Oiled ☒ Pressure ☐ Grease						
39	STEAM COND.		MIN		NORMAL		MAX		DESIGN		☐ Oil Mist ☐ Purge Oil Mist ☐ Pure Oil Mist	
40	Inlet Pressure (kg/cm²g):										☒ Brg. Housing Oiler Type: Constant Level Sight Feed Oiler	
41	Inlet Temperature (deg. C):										☒ Brg. Housing Seal ☐ Seal supplier:	
42	Exhaust Pressure (kg/cm²g):										☒ CASING DESIGN (Rem. 3)	
43	Remarks:										INLET	
44											OUTLET	
45											Max. Allow. Press. (kg/cm²G)	
46											Max. Allow. Temp. (°C)	
47											Hydro Test Press (kg/cm²G)	
48	TURBINE DATA					CONNECTIONS						
49	☐ Allow Speed, RPM		Max.: _____ Min.: _____				SIZE		RATING		FACING	
50	☐ Max. Cont. Speed, RPM:		(1.05 x Turbine Rated Speed)					Inlet		POSITION		
51	☐ Trip Speed, RPM:		Blade Tip Vel., (mm/s):					Exhaust		Mating Parts furnished		
52	☐ First Critical Speed, RPM:							Drains (HP/EXP)				
53	☐ Exh. Temp. °C		Normal: _____ No Load: _____				STEAM CONTROL					
54	☐ Potential Max. Power, KW:					Governor Type		☒ Electronic ☐ Oil Relay ☐ Other				
55	☐ Max. Nozzle Steam Flow, kg/hr:					NEMA Class: D		Mfr.: _____				
56	☐ Rotation Facing Governor End		☐ CCW		☐ CW		Speed Changer:		☒ Manual ☐ Pneumatic ☒ Electronic			
57	☐ Driven Equipment Thrust (Vertical Turbine)					Mfr.: _____		Model: _____				
58	☒ Water Piping Furn. by		☒ Vendor		☐ Others		Controlled Variable		Operating Range		Controlled Signal	
59	☒ Oil Piping Furn. by		☒ Vendor		☐ Others		Speed		_____ To _____ RPM		_____ To _____ mA	
60	Remarks:					Speed		_____ To _____ RPM		_____ To _____ kg/cm²g		

60	MATERIALS						ACCESSORY EQUIPMENT BY VENDOR			
61	■ High Pressure Casing: CARBON STEEL Grade: _____						■ Remote Trip ■ Solenoid ■ Remote Start ■ Solenoid			
62	□ Exhaust Casing: _____ Grade: _____						□ Vacuum Breaker □ Automatic steam sealing System			
63	■ Nozzles: 11%-13% CHROME STEEL Grade: _____						□ Gland Vacuum Device: □ Water Eductor □ Steam Ejector			
64	■ Blading: 11%-13% CHROME STEEL Grade: _____						■ Sentinel Warning Valve ■ Auto start on Purchaser signal			
65	□ Wheels: _____ Grade: _____						■ Insulation Type: METAL INSULATION JACKET			
66	□ Shaft: _____ ■ Shaft Coating Under Packing: _____						■ Tachometer Type: DYNAMIC (with local and remote indication)			
67	Application Method: _____ □ Thickness: _____						Mfr.: _____ Model: _____			
68	■ Gov. Valve Trim: SS ■ Inlet Strainer: 18-8 SS _____						Mounted By: _____ □ Thermal Relief Valves			
69	□ Coupling Spacer Hubs □ Diaphragm (Disks) _____						□ Shut off valves for Shut Down Sensors ■ PSV/Vent Silencer			
70	ASTM Grade shall be indicated						■ Local Gauge Board with following Pressure Gauges:			
71	COUPLINGS						■ Throttle Steam □ First Stage			
72	Location	TURBINE		DRIVEN		■ Nozzle Ring ■ Exhaust				
73	Manufacturer					□ Liquid Filled Type Gauges				
74	Model					■ Instrument Panel (Local) ■ Base Mount □ Free Standing				
75	Rating (kW / 100 RPM)					□ Safety Switches & Control Devices by Vendor				
76	Lubrication					■ Blow of piping with silencer ■ Automatic Draining System (\$)				
77	Limited End Float					EXTERNAL LUBE OIL SYSTEM				
78	Spacer Length					□ Circulating □ Pressure				
79	Service Factor (≥ 1.5)					Vendor System as per API 611 for: ■ Turbine				
80	■ Turbine Vendor Mounts Half Coupling						■ Other: Gear Box			
81	Coupling Constructed to: API 611/ISO 14691/ISO 10441/API 671/OTHER						Oil System To be: ■ Console Type			
82	Coupling Balanced to: ISO 1940 1, Grade G6.3						□ Mounted on Baseplate			
83	Turbine Shaft: □ Taper □ Cylindrical □ Hydraulic Fit Hub						Oil System to include following equipment:			
84	ENGINEERING REQUIREMENTS						■ Standby Oil Pump: ■ Driver Type: Electric Motor			
85	■ Supply Engr. Data for Lateral/Torsional Analyses						■ Low Oil Pressure Alarm Transmitter			
86	■ Calcs. AND/OR Data for Separation Margin						■ Low Oil Pressure Trip			
87	■ Train Torsional Vibration Analysis						■ Heater ■ Electric □ Steam			
88	■ Residual Unbalance Check						■ Oil Drain Site Flow Indicators □ Hand operated standby pump			
89	□ Electrical and Mechanical						■ Bearing metal temp. sensors (¥) for: ■ Radial Brgs ■ Thrust Brgs			
90	■ Gears shall Conform to API Std. 677 (if applicable)						VIBRATION AND POSITION DETECTORS (Refer EDB-SME)			
91	□ Furnished by: □ Other						□ Furnish Provisions for Mounting Non-Contacting			
92	Gear Type: □ Single Helical						Vibration Probes			
93	■ Double Helical □ Epicyclic						□ Furn. Axial Position Probes □ No. Of Probes			
94	■ Submit Campbell And Goodman Diagrams						□ Mfr. □ Model			
95	Remarks:						□ Furn. Radial Probes □ No. Of Probes Per Bearing			
96	INSPECTION & TESTING (Also refer ITP enclosed elsewhere)						□ Mfr. □ Model			
97	□ 100% Ultrasonic Inspection After Rough Machining						□ Furn. Vel/Acc Transducers □ No. Per Bearing			
98	■ Special NDT Inspection of following parts:						□ Mfr. □ Model			
99	Casting Surface Inspection □ MSS SP-55 ■ Other (Rem.6)						Vib./Axial Monitors: Turbine Vendor Equipment Driven Eqpt. Purchaser			
100	■ Weld Inspection □ Special Inspection						Furnished By □ □ □ □			
101							Mounted By □ □ □ □			
102	COMPONENT	MAG. PART.	DYE PENET.	RADIO GRAPHIC TEST	ULTRA SONIC TEST	OBS	WITN.	MOUNTING PLATES		
103	□ T & T Valve	□	□	□	□	□	□	Type: ■ Base Plate □ Sole Plate		
104	□ STM Chest	□	□	□	□	□	□	Furn. By: □ Turbine Vendor ■ Driven Eqpt Vendor		
105	□ Casing	□	□	□	□	□	□	Equip. To Be Mounted: ■ Turbine □ Gear ■ Pump □ Generator		
106	□ Piping	□	□	□	□	□	□	□ Un-grouted Baseplate □ Suitable for Column Mounting		
107	□ Rotor	□	□	□	□	□	□	□ Turbine Vendor Furnishes Subplates		
108		□	□	□	□	□	□	WEIGHTS (kg)		
109	TESTS	Required	Witnessed	Observed	□ Turbine: □ Rotor:					
110	Hydrostatic	■	■	□	□ Turbine upper half casing: □ Baseplate:					
111	MRT (both main and spare rotor)	■	■	□	□ T&T valve:					
112	Bearing Oil Flow	□	□	□	□ Max. maintenance weight: □ Misc:					
113	Performance	□	□	□	□ Total shipping weight:					
114	Complete unit	□	□	□	PREPARATION FOR SHIPMENT					
115	Gear	□	□	□	Turbine Auxiliary Equipment and Spare Rotor Prepared For:					
116	Sound Level	■	□	■	■ Domestic Shipment ■ Export Shipment					
117	Aux. Equipment	□	□	□	■ Turbine Prepared for Extended Storage 12 Months					
118	Residual Unbalance Check	■	■	□	■ Spare Rotor Prepared For Extended Storage 36 Months					
119	Dynamic Balance	■	■	□						
120	Unitization at pump vendor's shop (Refer pump datasheet)	■	■	□	(\$) – Using Thermodynamic type steam traps					
121					(¥) – Along with temperature transmitters					

122	REMARKS:
123	1. CONTRACTOR to select back pressure turbine based on the package economics & utilization of steam levels within the package (subject to market availability & with proven track record). However, please note that in case any of the following conditions exist at the steam turbine inlet, then special purpose steam turbine (compliant to API 612 & EIL Std. Specification # 6-43-0043) shall be provided: - - Inlet pressure > 60 bar g; - Inlet temperature > 475 DEG C; - Speed > 6000 rpm; - Turbine rating > 1500 kW; - Driven equipment is usually un-spared or is in critical service.
124	2. Steam turbines shall be provided with DESUPERHEATER (along with all associated auxiliaries) if the exhaust temperature of turbine at any operating condition, including no load exhaust temperature exceeds the exhaust steam header design temperature. BFW shall be used for this Desuperheater. The type of Desuperheater shall be as per the instrumentation specification.
125	3. Maximum allowable working pressure shall not be less than _____ kg/cm ² g @ _____ °C [refer inlet steam header design conditions]. Vendor to indicate standard MAWP of the proposed steam turbine model.
126	4. Hydrostatic test pressure shall be 1.5 times the standard value of casing design pressure. Hydrostatic test for steam turbine casing shall be strictly carried out as per the requirements specified in Cl. # 8.3.2.2 of API 611, 5 th Ed.
127	5. The turbine shall be designed to deliver 110% of the maximum power required or end of curve power, whichever is higher, for any of the specified operation of the driven equipment with minimum steam inlet condition and maximum steam exhaust condition. Turbine rating shall not be lower than the motor rating of the stand-by pump unit. Any pressure losses due to vendor supplied line mounted instruments in the steam inlet line to be accounted for by the vendor during steam turbine sizing. Turbine shall be designed to operate with entire range of inlet and exhaust conditions.
128	6. Vendor standard NDT for turbine shall be performed.
129	7. Vendor to supply all mechanical, valves, instrumentation items, etc. marked as "VF" in the P&IDs enclosed elsewhere.
130	8. The steam turbine companion flanges, piping components and other instrumentation items like Pressure Safety Valve, Thermowell, Shutoff valve shall be IBR certified. Please refer to Instrumentation specification for further requirements.
131	9. For steam turbine, electronic governor (Peak 200) to be provided. Separate speed probes + transmitters (minimum 2 nos.) shall be provided for governor. Refer instrumentation specifications enclosed elsewhere.
132	10. Steam Turbine Over speed trip shall be based on 2 out of 3 (2003) voting logic. Speed probes + transmitters (three nos.) for over speed trip shall be provided. One separate speed probe + transmitter shall be provided for speed monitoring.
133	11. Unless otherwise specified, type of Separate Trip Valve shall be GATE VALVE.
134	12. For acceptable makes of the steam turbine (general purpose), refer vendor list attached elsewhere.
135	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.
136	14. This is typical datasheet. Contractor shall fill the datasheet for each items separately for preparation of enquiry documents and Owner/PMC's approval.

DATE	REV	JOB ENGINEER	REV. & APPROVED BY

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1	GENERAL			
2	Project:	BINA PETROCHEMICAL & REFINERY EXPANSION		Job No.: B957
3	Owner:	M/s BPCL		Site: BINA, MP
4	Purchaser:	M/s EIL		Unit: SGU Unit No.: 420
5	Item No.:	Service:		
6	No. reqd.:	Working:	Standby:	Driver Type: Driven Eqpt.:
7	Applicable to:	☐ Proposals ☐ Purchase ☐ As Built		
8	■: Scope, Option & Information specified by Purchaser. □: Information required from and options left to vendor. Vendor to cross (X) the selected option.			
9	Manufacturer:	Model:		
10	☐ RATING REQUIREMENTS		☐ BASIC GEAR DATA	
11	Driven Eqpt. Power (kW):	Nor.:	Ma	Mechanical rating: kW @ rpm
12	Driver Power (kW):	Rated:	Ma	Thermal rating: kW @ rpm
13	Gear rated power (kW):	(Rem. 1)	1.7 (min)	Full load power loss (kW): Mech. efficiency: (%)
14	Torque @ Max. Cont. Speed (kg-m):	Pitch line velocity (m/s):		
15	Max. Torque:	kg-m @	rpm	Tooth pitting index, "K": Actual: Allowable:
16	Rated speed (rpm):	Tangential load, "W _t " (kg):		
17	- Input	☐ Specified ☐ Nominal	Bending stress number S _t "W _t " Pinion Gear	
18	- Output	☐ Specified ☐ Nominal	Actual:	
19	Allow variation in gear ratio:	Allowable:		
20	Max continuous speed (rpm):	Material index no.:		
21	Trip speed (rpm):	Anticipated SPL: dBA @ m		
22	Gear service factor (Min.):	Journal static weight loads:		
23	Pinion/Gear Hardness:	Pinion: kg Gear: kg		
24	Shaft assembly designation:	WR ² referred to LS shaft (kg-mm ²):		
25	- HS shaft rot. facing coupling end	☐ CW ☐ CCW	Breakaway Torque (kgf-m) @ LS shaft:	
26	- LS shaft rot. facing coupling end	☐ CW ☐ CCW	Overhung Load Factor:	
27	HS shaft end:	☐ Cylindrical ☐ Taper ☐ 1-Key	☐ CONSTRUCTION FEATURES	
28	☐ 2-Keys ☐ Hydraulic taper ☐ Integral flange	Type of Gear ☐ Reducer ☐ Increaser		
29	LS shaft end:	☐ Cylindrical ☐ Taper ☐ 1-Key	☐ Single stage ☐ Double stage	
30	☐ 2-Keys ☐ Hydraulic taper ☐ Integral flange	☐ Single helical ☐ Double helical		
31	External loads:	☐ ☐ Other:		
32	Other operating conditions:	Teeth		
33	☐ INSTALLATION DATA		Number of teeth: Pinion: Gear:	
34	☐ Indoor ☐ Heated ☐ Under roof	Gear ratio Center Distance (mm):		
35	■ Outdoor ■ Unheated ☐ Partial sides	Pitch Dia: Pinion (mm) Gear (mm):		
36	☐ Grade ☐ Mezzanine ☐	Finish (RA):		
37	☐ Winterisation Required ☐ Tropicalization Required	AGMA Geometry factor "J":		
38	Electrical Area Class: Grp: Div.	Pinion: Gear:		
39	Max. allow. SPL: dBA @ m	Helix angle (E): Normal Pressure angle (E):		
40	Elevation (m): Barometer (kg/cm ² A):	Net face width, "Fw" (mm): Pinion L/D:		
41	Range of ambient temperatures:	Normal Diametrical Pitch: Backlash (mm):		
42	Dry Bulb Wet Bulb			
43	Minimum EC EC			
44	Normal EC EC	Manufacturing methods: Pinion Gear		
45	Maximum EC EC	Teeth generating process:		
46	Unusual Conditions ☐ Dust ☐ Fumes ☐ Others:	Teeth finishing process:		
47	☐ ADDITIONAL REQUIREMENTS		Teeth hardening method:	
48	MOUNTING PLATES		Pinion to shaft: ☐ Integral ☐ Shrunk-on	
49	☐ Gear furnished with:		Gear to shaft: ☐ Integral ☐ Shrunk-on	
50	☐ Baseplate ☐ Soleplate(s)		■ RADIAL BEARINGS	
51	☐ Baseplate suitable for column mounting:		Pinion Gear	
52	☐ Grout type: ☐ Epoxy ☐ Other:		Manufacturer	
53			Type	
54	☐ PAINTING: ☐ Mfr. Std. ☐		Diameter mm	
55	APPLICABLE SPECIFICATIONS		Length mm	
56	■ API Std. 677		Journal Velocity m/s	
57	☐ Other:		Loading kg/cm ²	
58			Clearance (min-max) mm	
59			Span mm	
60			L10 Life (Roller Elements) hrs	

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61	MISCELLANEOUS		■THRUST BEARING(S)		
62	☐ Torsional analysis by (2.6.1.8)	☐ Gear Vendor ☐ Other			Pinion Gear
63	☐ Lateral analysis by	☐ Gear Vendor ☐ Other	Location		
64	☐ Spare set of gear rotors		Manufacturer		
65	☐ Orientation of oil inlet and drain connection		Type		
66			Size		
67			Area mm ²		
68			Loading kg/cm ²		
69	■VIBRATION DETECTORS (As recommended by GB mfr.)		Rating kg/cm ²		
70	Radial :		L10 Life (Roller Elements) hrs		
71	☐ Manufacturer:		Int. thrust load N (✓)		
72	☐ No. at each shaft bearing	Total	Ext. thrust load N (✓)		
73	☐ Oscillator-Demodulators supplied by				
74	☐ Manufacturer		□COUPLING & GUARDS		
75	☐ Monitor supplied by				High Speed Low Speed
76	☐ Location	Enclosure	Coupling Manufacturer		
77	☐ Manufacturer		Coupling Furnished by		
78	☐ Alarm ☐ Shutdown		Coupling Type		
79	☐ Shutdown time delay	seconds	Coupling Model		
80	Axial:		Coupling Rating kW/100 rpm		
81	☐ Manufacturer:	No. Req'd.:	Coupling Lubrication		
82	☐ Location		Taper mm/m		
83	☐ Oscillator-Demodulators supplied by		Taper gauge furnished by		
84	☐ Manufacturer		Limited end float		
85	☐ Shutdown time delay	seconds	Mount coupling halves		
86	☐ Monitor supplied by		Cylindrical / 1-key		☐ ☐
87	☐ Location	Enclosure	Cylindrical / 2-keys		☐ ☐
88	☐ Manufacturer		Tapered / 1-key		☐ ☐
89	☐ Alarm ☐ Shutdown		Tapered / 2-keys		☐ ☐
90	☐ Shutdown time delay	seconds	Tapered / keyless		☐ ☐
91	Accelerometer:		Coupling Guard Type		
92	Manufacturer	No. Required	Cplg Guard furnished by		
93	Location		■PIPING CONNECTIONS		
94	Monitor supplied by		No.	Size	Type
95	■INSTRUMENTS		Service		
96	☐ Low Oil Pressure Alarm Switch:		Lube oil inlet		ANSI FLANGED B16.5 150# RF
97	☐ High Oil Temperature Alarm Switch:		Lube oil outlet		ANSI FLANGED B16.5 150# RF
98	■Temperature Measuring Devices (Rem-2)		Casing drain		ANSI FLANGED B16.5 150# RF
99	☐ Thermometers ☐ Thermocouples / RTD's		Vent		
100	☐ Liquid Filled Pressure Gauges:		Casing purge		
101	☐ Thermal Relief Valves:		■LUBRICATION REQUIREMENTS (Rem-3)		
102	□CONTRACT DATA		■Oil system furnished by: ☐Gear Vendor ☐Other:		
103	☐ Test data prior to shipment		☐ Oil Visc. cP @ 40EC cP @ 100EC		
104	☐ Progress reports		☐ Lubrication Requirements		
105	■SHIPMENTS		☐ Main Oil Pump: ☐ Shaft Driven ☐ Motor Driven		
106	Contract unit	Spares	☐ Standby Oil Pump: ☐ Yes ☐ No		
107	Export boxing (As applicable)	☐	☐ Oil Pump Casing: ☐ Cast Iron ☐ Steel		
108	Domestic boxing (As applicable)	☐	☐ Oil Cooler: ☐ Water Cooled ☐ Air Cooled		
109	Outdoor strg. over 12 months	☐	☐ Heaters Required: ☐ Yes ☐ No		
110	Fit-up & Assy. of mtd. acc. Acc	☐	Type: ☐ Electric with Thermostat ☐ Steam		
111	■ MATERIALS		☐ Duplex Filters: ☐ Yes ☐ No		
112	Gear Casing:	Oil Seals:	■ System Type: ☐Self-Contained Splash ☐Circulating ☐Pressurised		
113	Radial Bearings:		☐ Filters, Micron Rating:		
114	Thrust Bearing(s):		☐ Minimum Startup Oil Temperature (EC):(TO BE INDICATED BY GB MFR.)		
115	HS Shaft:	LS Shaft:	☐ Oil Flow (m ³ /hr):(TO BE INDICATED BY GB MFR.)		
116	Pinion(s):	Hardness:	☐ Oil Pressure (kg/cm ² ,A):(TO BE INDICATED BY GB MFR.)		
117	Gear Rim(s):	Hardness:	☐ Unit Power Loss (kW):		
118	Low Temp. Operation:		Reservoir: ☐ Gear Casing ☐ Separate		
119	REMARKS:				
120					
121	□INSPECTION AND TESTS		□WEIGHTS & DIMENSIONS		
122	Reqd.	Observe	Witness	Test log	Net Weight:

GENERAL PURPOSE
GEAR UNIT

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123	Shop Inspection	☒			Gear Box:	kg Auxiliaries:	kg
124	Cleanliness inspection	☒	☒	☐	Max. Maintenance Weight [Identify]:	kg	
125	Hardness verification Insp.	☒	☒	☐	Total Shipping Weight:	kg	
126	Mag. Particle Inspection	☒	☒	☐	Total Shipping Dimensions:	L: m W: m H: m	
127	Ultrasonic Inspection	☒	☒	☐			
128	Weld Inspection	☐	☐	☐	BEVEL MOUNTED GEAR BOX DATA		
129	Dismantle-Reassembly Insp.	☒	☐	☒	MOUNTING FLANGES		
130	Contact check	☒	☒	☐	☐ Clearance Fit with Jack	☐ Register Fit	
131	Contact check tape lift (2.5.2.2)	☒	☒	☐	CONSTRUCTION FEATURES:		
132	Axial stability check	☐	☐	☐	☐ Transverse Pressure Angle (E):		
133	Bearing Visual check	☒	☐	☒	Radial bearings:	Pinion	Gear
134	Axial stability check	☐	☐	☐	Manufacturer		
135	Residual Unbalance Check	☐	☐	☐	Type		
136	Mech. run test	☒	☐	☒	Class		
137	Extended mech. run test	☐	☐	☐	Cage Speed	m/s	
138	Mech. run test (Spare rotors)	☐	☐	☐	☐ B10 ☐ L10 Life	hrs	
139	Part or full load and full speed test	☐	☐	☐			
140	Full torque slow roll test	☒	☐	☒	Thrust bearings:	Pinion	Gear
141	Full torque static test	☐	☐	☐	Manufacturer		
142	Sound level test	☒	☐	☒	Type		
143	Mech. Run Test Couplings:				Class		
144	- Coupling Installed	☐	☐	☐	Cage Speed	m/s	
145	- Coupling hubs with Idlers	☐	☐	☐	☐ B10 ☐ L10 Life	hrs	
146	Use shop lube system	☐	☐	☐	Up Thrust Capacity	N	
147	Use job lube system	☐	☐	☐	Down Thrust Capacity	N	
148	Use shop vibration probes, etc.	☐	☐	☐			
149	Use job vibration probes, etc.	☐	☐	☐			
150	Final assembly maintenance &	☐	☐	☐			
151	running clearance						
152	Oil system cleanliness	☐	☐	☐			
153	Oil system casing joint tightness	☐	☐	☐			
154	Oil system leak test	☐	☐	☐			
155	Warning and protection devices	☐	☐	☐			
156							
157							
158							
159							
160							
161							
162							
163							
164	REMARKS:						
165	1. Gear Rated Power shall be min. equal to the max. installed power of the st. turb. driver as per Cl. 2.4.1.1 of API 677-2 nd Ed.						
166	2. In case type of bearings provided are hydrodynamic type, Bearing Temp. Monitoring Devices (As per API 670) including Platinum Res.						
167	Temp. detectors, monitors shall be supplied by vendor. Each Journal Brq. shall have RTD's in no less than 50 % of the shoes.						
168	Each Thrust Brq. shall RTD's in no less than 50 % of the Active Side and min. 2 Nos. in the inactive side.						
169	3. If GB mfr. Does not provide the Gear box lubrication system, the all associated scope requirements shall be met by packager.						
170							
171							
172							
173							
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175							
176							
177							

Date	Rev	Job Engineer	Rev. & Approved By

1	GENERAL							
2	Project: BINA PETROCHEMICAL & REFINERY EXPANSION				Job No.: B957			
3	Owner: M/s BPCL				Site: BINA, MP			
4	Purchas				Unit: SGU		Unit No.: 420	
5	Item				Service:			
6	No.	Working:		Standby:	Driver:	Working:		Standby:
7	Applicable to:		☐ Proposal		☐ Purchase		☐ As Built	
8	☒ : Scope, Option & Information specified by Purchaser. ☐ : Information required from and options left to vendor. Vendor to cross (☒) the selected option.							
9	Manufacturer:				Model:			
10	Place of Mfg.:							
11	Drive Arrangement: ☐ Direct Coupled ☐ Belt Driven ☐ Other:							
12	Driver(& Gear if reqd.) supplied & mounted by:				☐ Compressor Vendor		☐ Others	
13	Duty: ☐ Continuous ☐ Intermittent ☐ Standby							
14								
15								
16	OPERATING CONDITIONS (Refer Process Package)							
17	(all data on per unit basis)		Normal		Rated		Other Conditions	
18							A B C D	
19								
20	☒ Gas Handled (Also see Page)				AIR			
21	☐ Nm ³ /Hr (1.033 Kg/cm ² A, 0 EC Dry)							
22	☐ Weight Flow, kg/hr (Dry)							
23	☐ Weight Flow, kg/hr (Wet)							
24	Inlet conditions:		☐ Compressor Inlet Flange		☐ Suction Silencer Inlet Flange			
25	☐ Pressure (kg/cm ² A)							
26	☐ Temperature (EC)							
27	☐ Relative Humidity (%)							
28	☐ Molecular Weight (M)							
29	☐ C _p / C _v (K ₁) or (K _{avg})							
30	☐ Compressibility (Z ₁) or (Z _{avg})							
31	☐ Inlet Volume, (m ³ /hr) (Wet / Dry)							
32	Discharge conditions:		☐ Compressor Discharge Flange		☐ Discharge Silencer Outlet Flange			
33	☐ Pressure (kg/cm ² A)							
34	☐ Temperature (EC)							
35	☐ C _p / C _v (K ₁) or (K _{avg})							
36	☐ Compressibility (Z ₁) or (Z _{avg})							
37	Performance:							
38	☐ BkW Required (All losses Incl)							
39	☐ Speed (Rpm)							
40	☐ Pressure Ratio (R)							
41	☐ Volumetric Efficiency (%)							
42	☐ Silencer) P (kg/cm ²)							
43	☐ Certified Point							
44	☐ Performance Curve Number							
45	Process Control:							
46	☐ Bypass From To .							
47	☐ Bypass: ☐ Manual ☐ Auto							
48	☐ Speed Variation From % To %.							
49	☐ Other:							
50	☐							
51	Signal ☐ Source:							
52	☐ Type ☐ Electronic ☐ Pneumatic ☐ Other:							
53	☐ Range: for Pneumatic Control rpm @ kg/cm ² g & rpm @ kg/cm ² g.							
54	☐ Other:							
55	Remarks:							
56								
57								
58								
59								
60								

61 OPERATING CONDITIONS (Continued)								
62 Gas Analysis		63 Normal	63 Rated	63 Other Conditions				63 Remarks
63 ☐ Mol % ☐				A	B	C	D	
64	Constituent	MW						
65	Air	28.9						
66	Oxygen	32.0						
67	Nitrogen	28.0						
68	Water Vapour	18.0						
69	CO	28.0						
70	CO ₂	44.0						
71	H ₂ S	34.0						
72	Hydrogen	2.01						
73	Methane	16.0						
74	Ethylene	28.0						
75	Ethane	30.0						
76	Propylene	42.0						
77	Propane	44.0						
78	i-butane	58.1						
79	n-butane	58.1						
80	i-pentane	72.1						
81	n-pentane	72.1						
82	Hexane Plus							
83								
84								
85	Total							
86	Avg. Mol. Wt.							
87								
88 Location:				88 Noise Specifications:				
89	☐ Indoor	☐ Heated	☒ Under Roof	☐ Applicable to Machine:				
90	☒ Outdoor	☒ Unheated	☐ Partial Sides	See Specification:				
91	☐ Grade	☐ Mezzanine	☐	☐ Applicable to Neighbourhood:				
92	☐ Elect. Area Classification: Cl. Gr. Div.			See Specification:				
93	☐ Winterization Req'd	☐ Tropicalization Req'd.		☒ Acoustic Housing ☒ Yes (If Req'd) ☐ No				
94	94 Site Data:			94 Sound Level: 85 dBA @ 1 m.				
95	☐ Elevation (m):	☐ Barometer (kg/cm ² A):		Applicable Specifications:				
96	☐ Relative Humidity:			☐ API 619, 5 th Edition				
97	☐ Range Of Ambient Temperature (EC): Dry Bulb Wet Bulb			☒ Vendor having Unit Responsibility: Compressor vendor				
98	98 Site Rated(EC):			☒ Governing Specification (If Different): Job Spec.				
99	Normal(EC):							
100	Maximum(EC):			Painting:				
101	Minimum(EC):			☒ Manufacturer's Standard				
102	Unusual Conditions:			☐ Other				
103	☐ Dust ☐ Fumes							
104	☐ Others							
105				Shipment:				
106				☐ Domestic	☐ Export	☐ Export Boxing Req'd		
107	Remarks:							
108								
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120								

121 CONSTRUCTION FEATURES	
122 ☐ Speeds:	☐ Shaft:
123 Max. Continuous: RPM Trip: ___ RPM	Material: (Rem-2)
124 Max. Tip Speeds: m/s @ Max. Operating Speed	Dia @ Rotors (mm): Dia @ Coupling (mm):
125 Min. Allowable Speed: rpm	Shaft End: ☐ Tapered ☐ Cylindrical
126 ☐ Lateral Critical Speeds:	Max. Yield Strength (Kg/cm ²):
127 First Critical rpm	Shaft Hardness (BNH) (R _c):
128 ☐ Damped ☐ Undamped	☐ Shaft Sleeves:
129 ☐ Mode Shape	At Shaft Seals: Material:
130 Lateral Critical Speed - Basis:	
131 ☐ Damped Unbalance Response Analysis	☐ Timing Gears:
132 ☐ Shop Test	Pitch Line Dia. (mm): Type:
133 ☐ Other Type Analysis: (Specify)	Material:
134 ☐ Pocket Passing Frequency:	
135 ☐ Torsional Critical Speeds:	☐ Shaft Seals:
136 First Critical rpm	Shaft Seal for conveying chamber side:
137 Second Critical rpm	☐ Type:
138 ☐ Vibration:	
139 Allowable Level (:m): Test	Shaft seal for drive shaft side:
140 (Peak To Peak) (:m): Site	☐ Type:
141 ☐ Rotation Viewed From Compr. Driven End: ☐ CW ☐ CCW	
142 ☐ Casing:	
143 Model:	
144 Casing Split:	☐ Bearing housing construction:
145 Material: (Rem-2)	Type (Separate/Integral): Split:
146	Material:
147 Thickness (mm): Corrosion Allowance (mm):	☐ Radial bearings: (Identify highest loaded bearing)
148 ☐ Max. Working Pressure (Kg/cm ² G):	Type: Span (mm):
149 Max. Design Pressure (Kg/cm ² G):	Area (mm ²): Loading (N/mm ²): Act. Allow.
150 Relief Valve Setting (Kg/cm ² G): (Rem-1)	No. Pads Rotor on or Between Pads.
151 Margin for Accumulation (Kg/cm ² G):	Pad Material:
152 Test Pressure (Kg/cm ² G): Helium: Hydro:	Type Babbit: Thickness (mm):
153 Max. Allowable Temp.(EC): Min. Operating Temp (EC):	
154	☐ Temp. Sensors
155 Cooling Jacket: ☐ Yes ☐ No	☐ TC ☐ RTD Type
156 Radiograph Quality: ☐ Yes ☐ No	☐ No. per bearing:
157 ☐ Rotors:	
158 Diameter (mm):	☐ Thrust bearing: (Identify highest loaded bearing)
159 No. Lobes: Male: Female:	Location: Type:
160 Type:	Mfr.: Area(mm ²):
161 Type Fabrication:	Loading (N/mm ²): Act.: Allow.:
162 Material: (Rem-2)	Number of Pads:
163 Max. Yield Strength (kg/cm ²):	Pad Material:
164 Brinell Hardness: Max. Min.	Type Babbit: Thickness (mm):
165 Rotor Length to Diameter Ratio (L/D):	
166 Rotor Clearance (mm):	☐ Temp. Sensors
167 Max. Deflection (mm):	☐ TC ☐ RTD Type
168 ☐ Internally Cooled ☐ Uncooled	☐ No. per bearing: ☐ Active: ☐ Inactive:
169	
170 Remarks:	
171 1) In case the relief valve set pressure is not specified in Process Package, the same shall be 110% of differential pressure across	
172 Blower plus maximum suction pressure or downstream design pressure whichever is lower.	
173 2) For MOC refer Process Package.	
174	
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176	
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181	CONSTRUCTION FEATURES (Contd..)										
182	☐ Connections:					☐ Couplings:					
183	Casing:	Size	ANSI Rating	Facing	Position	☐ In accordance with: API 671				☐ Yes ☐ No	
184	Inlet					☐ Other: (Specify)					
185	Discharge						Driver - Compr.	Gear -			
186	Silencer:						or Driver - Gear	Or			
187	Inlet					☐ Make					
188	Discharge					☐ Model					
189	☐ Allowable Piping Forces and Moments:					☐ Lubrication					
190		Inlet		Discharge			☐ Mount Coupling Halves				
191		Force	Moment	Force	Moment	Force	Moment	☐ Spacer Reqd.			
192		Kg	kg-m	kg	kg-m	kg	kg-m	☐ Limited End Float Reqd.			
193	Axial							☐ Idling Adaptor Reqd.			
194	Vertical							☐ Coupling Rating(kW/100 rpm)			
195	Horiz. 90E							☐ Keyed(1) or (2) or Hydr. Fit.			
196		Force	Moment	Force	Moment	Force	Moment	Belt Drive Arrangement (if applicable)			
197		Kg	kg-m	kg	kg-m	kg	kg-m	☐ Motor pulley: ☐ dia(mm): ☐ material:			
198	Axial							☐ Compressor pulley: ☐ dia(mm): ☐ material:			
199	Vertical							☒ Belts: ☒ Type: V-Belt ☐ No.:			
200	Horiz. 90E							Baseplate & Soleplates:			
201	☐ Other Connections:					Sole plates for: ☐ Compressor ☐ Gear ☐ Driver					
202	Service:		No.	Size	Type	Baseplate:					
203	Lube Oil Inlet					☐ Under compr. only ☒ Other: Common for blower & E. motor					
204	Lube Oil Outlet					☐ Decked with non-skid deck plate ☐ Open					
205	Seal Oil Inlet					☒ Drip Rim ☐ With Open Drain ☐ Subplate					
206	Seal Oil Outlet					☐ Horizontal adjusting screws for equipment					
207	Casing Drains					☐ Suitable for Column Support					
208	Vents					☐ Suitable for Perimeter Support					
209	Cooling Water					☐ Epoxy Grout / Epoxy Primer					
210	Pressure Instr.					Lube Oil System					
211	Temperature Instr.					☐ Type: ☐ Splash Feed from self					
212	Purge For:					☐ Forced feed ☐ Grease					
213	Bearing Housing					☐ API 614 force feed Lube Oil System ☒ Manufr's Standard					
214	Between Brgs & Seal					☐ Oil Cooler: Type:					
215	Between Seal & Gas					☐ Oil Filter: ☐ Micron Rating					
216	☐ Oil Mist connection					☐ Heater ☐ Steam ☐ Electric: kW					
217						☐ Main Oil Pump Driven by:					
218							☐ Shaft	☐ Motor	☐ St Turbine		
219						☐ Standby Oil Pump Driven by:					
220							☐ Shaft	☐ Motor	☐ St Turbine		
221	UTILITIES										
222	☐ Utility Conditions:					☐ Total Utility Consumption:					
223	Steam:	Drivers			Heating	Cooling Water (m³/hr):					
224	Inlet: Min.	Kg/cm²G	°C.		Kg/cm²G	°C.	Steam Normal (Kg/hr):				
225	Nor.	Kg/cm²G	°C.		Kg/cm²G	°C.	Steam Maximum (Kg/hr):				
226	Max.	Kg/cm²G	°C.		Kg/cm²G	°C.	Instrument Air (Nm³/hr):				
227	Exhaust: Min.	Kg/cm²G	°C.		Kg/cm²G	°C.	kW (Driver) (KW):				
228	Nor.	Kg/cm²G	°C.		Kg/cm²G	°C.	kW (Auxiliaries) (KW):				
229	Max.	Kg/cm²G	°C.		Kg/cm²G	°C.	Heaters (KW):				
230	Electricity:						Purge Gas (Nm³/hr):				
231	Voltage:						Miscellaneous:				
232	Hertz						☒ Recommended Straight Run of Pipe Diameters Before				
233	Phase						Suction.				
234	Cooling Water:						☒ Vendor's Review & Comments on Purch.Piping & Foundation				
235	Temp. Inlet:	EC.	Max.	Return:	EC.	☐ Optical Alignment flats required on compr., gear & driver.					
236	Press. Norm.:	Kg/cm²G.	Design:	Kg/cm²G.	☐ Provision of water washing before opening casing by .						
237	Min. Return:	Kg/cm²G.	Max. Allow.	°P:	Kg/cm².	☐ Lateral Analysis Report Required.					
238	Water Source:						☐ Torsional Analysis Report Required.				
239	Instrument Air:						☐ Condensate Removal Equipment Required ☐ Yes ☐ No				
240	Max. Press.:	Kg/cm²G.	Min. Press.:	Kg/cm²G.	☒ Silencers furnished by: Vendor.						

241	SHOP INSPECTION & TESTS:				☐ Weights (kg):				
242		Reqd.	Witn.	Obs.	Total Compressor package with driver :				
243	Shop Inspection	☒			Compressor: :				
244	Hydrostatic	☒	☒	☐	Base Plate: :				
245	Helium Leak	☐	☐	☐	Driver: :				
246	Mechanical Run (Main) – 4 hr.	☒	☒	☐	Gear Upper case: :				
247	Mechanical Run Spare Rotor – 4 hr.	☒	☒	☐	Comp. rotor :				
248	Casing Leak Test	☐	☐	☐	Inter cooler: :				
249	Performance Test (Air)	☒	☒	☐	Inter cooler Bundle(s) :				
250	Complete Unit Test	☒	☒	☐	Aftercooler: :				
251	Pressure Compr. to full Optg. Pr.	☒	☒	☐	Aftercooler Bundle(s): :				
252	Disasmbly.-reasmbly. compr. After test	☒	☒	☐	Max. Erection Weight :				
253	Check Bearings & Seals after test	☒	☒	☐	Max. Maintenance Weight (Identify): :				
254	Sound Level Test (during MRT, for reference)	☒	☒	☐	Total Shipping Weight :				
255	Tandem	☒	☒	☒	Recommended Crane Capacity :				
256	Aux. Equipment	☒	☒	☒	☐ Space Requirements (m):				
257	Full Load Test	☒	☒	☒		Length	Width	Height	
258	Residual Unbalance Check	☒	☒	☒	Complete Unit				
259	Material Certificates	☒			Control Panel				
260					Off skid Intercooler				
261					Off skid Aftercooler				
262					Recommended crane hook height				
263					Maintenance space req. for compressor				
264					Maintenance space req. for cooler tubes				
265	CONTROLS & INSTRUMENTATION								
266	Hazardous Electrical Area Classification	NEC:	Class		Div.	Group			
267		ISO:	Zone			Gas Group			
268	Electric Supply:								
269	Lamps	:	∇ V; AC/DC; N;	∇	Hz.				
270	Alarm Circuit	:	∇ V; AC/DC; N;	∇	Hz.				
271	Trip Circuit	:	∇ V; AC/DC; N;	∇	Hz.				
272	Control Circuit	:	∇ V; AC/DC; N;	∇	Hz.				
273	Solenoid Valves	:	∇ V; AC/DC; N;	∇	Hz.				
274	Notes								
275	1. Pre-Alarms to preceed Trips.								
276	2. Instruments to be connected to junction boxes on skid and consoles .								
277	3. All Tubings, pipings, wiring between instruments and junction boxes, local gauge boards and local panels								
278	to be supplied by vendor.								
279	4. Instruments, safety and control devices specified herein are minimum required by customer. In case, in the opinion of vendor,								
280	vendor, additional devices are required, vendor shall specifically state so and include the same in his scope of supply.								
281	5. Vendor shall also refer to P&ID's enclosed and any additional instruments required as per P&ID's shall be included								
282	by vendor in his scope of supply.								
283	6. All switching devices (hardware/software) for prealarms ,trips ,trip alarm ,and interlocking shall be in the vendor's scope.								
284	Legend:	LM: Local Mounted:	☒ By Vendor	☐ Others					
285		LGB: Local Gage Board:	☒ By Vendor	☐ Others					
286		LCP: Local Control Panel:	☒ By Vendor	☐ Others					
287		UCP: Unit Control Panel:	☐ By Vendor	☐ Others					
288		PLC: Programmable Logic Control:	☐ By Vendor	☐ Others					
289		DCS: Distributed Control System:	☐ By Vendor	☐ Others					
290					Location				
291	Nomenclature				Loose	Local	LGB	LCP	UCP
292					Supply	Mtd.	Mtd.	Mtd.	
293	☒ AC Power On/Off Switch With Indication Lamp							Y	
294	☒ Control Power On/Off Switch With Indication Lamp							Y	
295	☒ Start/Stop Push Button Main Motor With Indication							Y	
296	☐ Emergency Stop Push Button								
297	☐ Lamp Test Push Button								
298	☐ Alarm/Trip Acknowledge /Reset Push Botton								
299									
300									
301	NOTE: Vendor to provide Contact/Signal for Execution in DCS.								

302	CONTROLS AND INSTRUMENTATION														
	DESCRIPTION	REQUIRED	Indication					A/V Annun. & Pre-Alarm					Trip & A/V Alarm		
			Gauge- L M	Gauge- LGB	Indicator -LP	Indicator - UCP	Repeat Signal to DCS/MP	Low - LP	Low - UCP	High - LP	High - UCP	Repeat Signal to PLC/DCS/MP	Low Low - LP	Low Low - UCP	High High - LP
303															
304															
305															
306															
307															
308															
309															
310															
311	COOLING SYSTEM														
312	-Inter/After/Oil Cooler: CW outlet temp.														
313	-CW Supply header flow														
314	-Sight Flow CW return each Cooler & Header														
315	-Local mount TSV on each isolatable circuit														
316	For closed circuit cooling:														
317	-Coolant main/standby pump disch. Pr.														
318	-Coolant stand by pump start														
319	-Coolant supply header Pr.														
320	-Coolant supply header temp														
321	-Coolant cooler Outlet Temp.														
322	-Coolant reservoir Level														
323	Process Gas System														
324	-Each stage inlet pressure														
325	-Each stage inlet temp.														
326	-Each stage disch. Pressure														
327	-Each stage disch. temp.														
328	-After Cooler Outlet temp.														
329	-After Cooler Outlet pressure														
330	Steam System (Turbine)														
331	-Main Steam Inlet Pressure														
332	-1st stage Steam Pressure														
333	-Steam Chest Pressure														
334	-Extraction Steam Pressure														
335	-Exhaust Steam Pressure														
336	-Steam Ejector Pressure														
337	-Trip & Throttle Valve Shut														
338	-Turbine Speed														
339	-Remote & High Speed Changer														
340	-Turbine Steam Seal Leakage														
341															
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359															
360	Legend: V: By Vendor; P: Purchaser														

361	ACCESSORIES			
362	☐ Inlet System			
363	☐ Air Intake System (for Air Compressor):			
364	☒ Intake air filter: Type: ☒ Dry ☐ Other:			
365	☒ Bird screen: ☒ Yes ☐ No ☒ Insect screen: ☒ YES ☐ NO ☒ Weather hood: ☒ YES ☐ NO			
366	First stage of filtration: ☐ Inertial ☐ Vane ☐ Not Applicable			
367	Second Stage of filtration: ☐ Panel ☐ Bag ☐ Cartridge			
368	Filter Media: ☐ Non Woven Felt ☐ Paper ☐ Other			
369	Method Of Cleaning Filter element: ☐ Self Cleaning ☐ Pulse Jet ☒ Washable Elements ☐			
370	☐ Prefab. Inlet Piping ☐ Supporting arrangement / supports for filter & inlet piping ☐ Ladder(s) & Platform(s) for filter			
371	☐ Location of filters outside, min. meters above the ground level/compressor mounting level			
372	☒ Suction Air Silencer in SS-300 series construction ☒ Prefabricated Air Inlet Piping in SS-300 series construction			
373	Remarks: Material of Construction of all Parts of Filter including Housing, Case of Elements, Element Supporting & Fixing System &			
374	all metal parts in the air flow path shall be series 300 SS.			
375	☐ Compressor Suction Block Valve		☐ With Limit Switch	
376	☐ Process Gas Suction Silencer			
377	☐ Process Gas Inlet Strainer / Filter	☐ Cone Type	☐ Built-in Suction Silencer	
378	☐ Suction Knock-out Drum with condensate removal facilities			
379	☐ Prefab. Inlet process Piping between Suction KO drum and Compressor Inlet Flange			
380	☐ Supporting arrangement / supports for filter & inlet piping			
381	☐ Ladder(s) & Platform(s) for filter maintenance			
382	☒ Expansion Joints in SS construction			
383	Remarks: Material of Construction of all Parts of Inlet Strainer/ Filter and piping etc. coming in contact with process Gas shall be			
384	☒ Interstage Piping/Coolers:			
385	☒ Prefabricated Piping upto final stage inlet (Having Material of construction S304/SS316) (in case blower offered is of more than 1 stage)			
386	☒ Expansion Joints in SS construction			
387	☐ Interstage Knock-out Drum with condensate removal facility			
388	☐ Intercooler(s)	Type:	☐ Shell & Tube Type	☐ Air Cooled
389	☐ Interstage Drain / Condensate Separator		☐ Integral with gas cooler	
390	☐ Discharge Piping/Coolers:			
391	☐ Prefabricated Piping from Compressor Discharge flange to aftercooler inlet (Having Material of construction)			
392	☒ Expansion Joints in SS construction			
393	☐ Discharge Knock-out Drum with condensate removal facilities			
394	☐ Aftercooler	Type:	☐ Shell & Tube Type	☐ Air Cooled
395	☐ Drain / Condensate Separator		☐ Integral with gas cooler	
396	☒ Discharge Silencer with SS internals			
397	☐ Compressor Discharge Non-Return Valve			
398	☐ Compressor Discharge Block Valve			
399	☐ Blow-off Piping (for air compressors):			
400	☐ Pre-fabricated Blow-off Piping in CS construction alongwith necessary valves, fittings, instrumentation, controls & supports terminated			
401	☐ Blow-off silencer in CS construction with SS internals			
402	Instrumentation & Controls:			
403	☒ Local instrumentation		☒ Local gauge board	
404	☒ Local control panel		☐ Unit control panel	
405				
406	☐ Protection Devices for	☐ Annunciators	☐ Interlocking System	
407	☐ Wiring upto terminal boxes within unit			
408	☐ Capacity Control System			
409	Miscellaneous:			
410	☒ Special Tools			
411	☒ Barring Gear (Turning Device) (if required)			
412	☒ Guards for moving parts			
413	☒ Compressor Relief Valve (Interstage & Discharge)			
414	☐ Vacuum Relief Valve with silencer			
415	☒ Thermal relief valves for each isolatable CW circuit			
416	☒ Anchor bolts for all items to be anchored			
417	☒ Cooling Water piping within the Vendor supplied equipment skid			
418	☐ Mating flanges with nuts, bolts and gaskets for all purchaser's interface connections.			
419	☒ Wiring & piping between equipment skid and panels			
420	☐ Installation liners & shims			
421	☒ Acoustic Enclosure for Compressor/ Gear/Driver equipped with fan driven forced ventilation system			

422	☐ Insulation materials for vessels	☐ Hot	☐ Cold	☐ Noise
423	☐ Compressor Bypass Valve			
424	Type::	☐ Auto controlled	☐ Manual	☐ With Limit Switch
425	☒ Anti-vibration pads (if required)			
426				
427				
428	Remarks:			
429	1) This is typical datasheet. Contractor shall fill the datasheet for each items separately for preparation of enquiry documents			
430	and Owner/PMC's approval.			
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Date	Rev	Job Engineer	Rev. & Approved By

HEAT EXCHANGER SHELL AND TUBE TYPE LUBE OIL COOLER

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Rev. No. A
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1 GENERAL													
Project:		BINA PETROCHEMICAL & REFINERY EXPANSION						Job No.:		B957			
Owner:		M/s BPCL						Site:		BINA, MP			
Purchaser:								Unit:		SGU		Unit No: 420	
Item No.:								Service:		Lube Oil Cooler			
No. Reqd:		Working:				Standby:							
Applicable to:		☐ Proposal		☐ Purchase		☐ As-Built							
8 ☒ Scope, Option & Information specified by Purchaser. ☐ Information required from and options left to vendor. Vendor to cross(☒) the selected option.													
Size		Type		AEW/ AES		Horiz / Vert		Connected in parallel/in series					
Surface per unit		m ²		Surface per shell		m ²		Shell per Unit		One		No. of Units One	
11 PERFORMANCE OF ONE UNIT (refer also site and utility data)													
				Shell side				Tube side					
				LUBE OIL				COOLING WATER					
Fluid circulated		kg/hr											
Total fluid entering		kg/hr											
Vapour		kg/hr											
Liquid		kg/hr											
Steam		kg/hr											
Non Condensables		kg/hr											
Fluid Vapourised or Condensed		kg/hr											
Steam Condensed		kg/hr											
Gravity – Liquid				In		Out							
Viscosity – Liquid		cP		In		Out							
Mol. Weight - Vap. / Non cond.													
Enthalpy / Latent Heat		kcal/kg											
Specific Heat		kcal/kg °C		In		Out							
Thermal Conductivity		kcal/hr m		Out									
Operating Temperature		°C		In		Out		In:		Out:			
Operating Pressure		kg/cm ² ,g		In		Out		In:		Out:			
No. of passes per shell													
Velocity		m/sec						Min / Max / Design: / /					
Pressure Drop		kg/cm ²		All.		Calc.		All.		Calc.			
Fouling Resistance		hr m ² °C/kcal		0.0002									
Heat Exchanged		kcal/hr						Weighted M.T.D. (corrected)					
Transfer Rate Service (kcal/hr m ² °C)		Clean:						Dirty:					
35 CONSTRUCTION (Of One Shell)													
Design Pressure		kg/cm ² ,g											
Test Pressure		kg/cm ² ,g		As per Code				As per Code					
Design Temperature		°C				T/Sht.							
No. of Tubes:		OD(in)(mm):		BWG min. thk.(mm):		Length(in)(mm):		Pitch(in)(mm)					
Shell		OD		ID		Long Baffle: ☐ Yes ☐ No		Sealing Strips: ☐ Yes ☐ No					
Baffles		Pitch(mm)		%Cut Dia		Area		Vert./Horiz./45°		Impinging Plate: ☐ Yes ☐ No			
42 MATERIALS (According to ASTM)				Gasket		Nozzle		Shell Side		Tube Side			
		XR SR						No. Φ		Series & Type		No. Φ Series & Type	
43 Shell		S N		CS		In		1		150#,WNRF		1 150#,WNRF	
45 Shell Cover		S N				Out		1		150#,WNRF		1 150#,WNRF	
46 Channel		S N				Vent							
47 Channel Cover		S N				Drain							
48 Flt. head cover		S N											
49 Shell Cover		Bolt-ing & nuts				Shell side (mm)		Tube side (mm)					
50 Shell Channel													
51 Floating Head													
52 Channel Cover				IT				Test Ring: ☒ Yes ☐ No		Test Flange: ☐ Yes ☒ No			
						Tube to Tube sheet joint:				☐ Welded ☒ Expanded			
53 Baffles/Tube Sprts				CA				Weights		Bundle		Empty Full of Water	
54 Tube Sheet		Naval Brass						(kgs)					
55 Tubes		Admir. Brass						APPLICABLE SPECS.		TEMA-C; ASME Sec.VIII Div.1;			
56 Legend: SR: Stress relief; XR: Radiography; IT: Insulation Thickness; CA: Corr. Allowance; S: Spot; N: Nil													
57 REMARKS:													
58 1. Shell Side Pressure test shall be done with oil. 2. Cooler shall be provided with 20% spare heat transfer area.													
59 3. Cooler tubes sizes shall be: 20 mm OD x 1.6 mm thk													
60 4. The design pressure of low pressure side shall be as a minimum 10/13 of the design pressure of the high pressure side.													
61 5. Further the low pressure piping upto the isolation valve shall also be designed for two third of the design pressure of the high-pressure side. 6. Minimum MOC is specified in this Datasheet. However, MOC shall be suitable for the water quality. Refer Basic Engineering Design Basis Part B enclosed with Process Package, for minimum metallurgy based on water qualities.													

HEAT EXCHANGER
SHELL AND TUBE TYPE
LUBE OIL COOLER

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62 7. For Design pressure/ temperature, fouling factor, velocity etc for tube side, refer Basic Engineering Design Basis Part B enclosed with Process Package. 8. Lube oil cooler sizing to be considered with 20-30 % overdesign margin.

Date	Rev	Job Engineer	Rev. & Approved By

1	GENERAL							
2	Project:	BINA PETROCHEMICAL & REFINERY EXPANSION			Job No.:	B957		
3	Owner:	M/s BPCL			Site:	BINA, MP		
4	Purchaser:				Unit:	SGU	Unit No.:	420
5	Eqpt. item no. for which Oil System is reqd.:				Service:			
6	Oil System item no.:				Mfr. of Oil System:			
7	No. of Eqpt. for which Oil System is reqd.:							
8	Applicable To	☒ Proposal ☐ Purchase ☐ As Built						
9	☒ Scope Option & Information specified by Purchaser		☐ Information Req'd. from & option left to vendor. Vendor to cross : the selected option.					
10								
11	APPLICABLE DOCUMENTS							
12	☒ Local Instruments and Panel Items as per			Instrumentation Specifications				
13	☒ Instruments Suppliers as per			Approved Vendor List				
14	☐ Special Purpose Oil System as per			API 614 and Job Specs				
15	☐ General Purpose Oil System as per			EDB (Rot. Eqpt.)				
16	☐ Dry Gas Seal Support Modules/System as per							
17	☒ Additional Documents			Data sheets, Job Specs,				
18	☒ Sound level as per			85 dBA @ 1mts (for the complete package)				
19	☒ Pumps as per			API 610/676 as applicable, Data Sheets				
20								
21	☒ Pump Driver (Motor) as per			Refer Electrical Specs.				
22	☒ Pump Driver (Turbine) as per			API 611, Data Sheets				
23	☐ Referenced Standard as per							
24	☐ Additional Documents							
25	☐ Additional Documents							
26	INSTALLATION DATA (Remark 2)				Site Data (Remark 2)			
27	☐ General site data included in specification				☐ Ambient Condition:			
28	☐ Utility data included in specification				☐ Min./Max. Temp.(°C):			
29	☐ Space available for Oil System(LxWxH),m:				☐ Relative Humidity:			
30	☒ Max. noise level not to exceed 85 dBA @ 1 meter distance.				☐ Corrosive Atmosphere:			
31	☐ Winterize		☒ Tropicalize		Utility Data (Remark 2)			
32	☒ Area Classification (Refer Electrical Specs)				☐ Electrical			
33	☐ Class				Voltage/Hertz/Phase:			
34	☐ Group				☐ Cooling Water			
35	☐ Division				☐ Water Source:			
36	☐ Or See				☐ Inlet Temp.(°C):			
37					☐ Max. Return (°C):			
38					☐ Pressure(Nor./Design),kg/cm²G:			
39					☐ Min. Return(kg/cm²G):			
40					☐ Max.)P(kg/cm²G):			
41	EQUIPMENT OIL REQUIREMENT							
42		Normal		After Trip				
43	Lube Oil:	Q:m³/hr	P:kg/cm²G	Q:m³/hr	P:kg/cm²G	☒ Steam for Drivers : refer bid package		
44	☒ Driven Eqpt.						Press.(kg/cm²G)	Temp.(°C)
45	☐ Driven Eqpt.					Inlet : Min.		
46	☐ Driven Eqpt.					Inlet : Nor.		
47	☒ Prime Mover					Inlet : Max./ Mech. Design		
48	☐ Gears					Exhaust : Min.		
49	☐ Coupling					Exhaust : Nor.		
50						Exhaust : Max./Mech. Design		
51	☒ Total:					☐ Steam for Heating :		
52	Control Oil:						Press. (kg/cm²G)	Temp. (°C)
53	☒ Normal					Inlet : Min.		
54	☒ Transient					Inlet : Nor.		
55	Seal Oil:					Inlet : Max./ Mech. Design		
56	☐ At:					Exhaust : Min.		
57	☐ At:					Exhaust : Nor.		
58	☐ At:					Exhaust : Max./Design		
59	☐ Total							
60	Grand Total							

61					
62	☐ Oil Type & Viscosity:		Location:		
63	☐ Required Heat Load(kW):		☐ Indoor	☐ Heated	☒ Under roof
64			☒ Outdoor	☒ Unheated	☐
65	☒ Preparation for Shipment:		Painting:		
66	☒ Install new filter and tag		☒ Component supplier standard		
67	☐ Include _____ sets of extra filter elements		☐ Unified per system supplier standard		
68	☐ Box extra sets with the _____ system		☐ Purchaser standard per		
69	Other Parts		☐		
70	☐		☐		
71	☐		☐ Weights(kg):		
72	System and Components:		Console		
73		Vendor's Standard	Purch. Specification	Panel	
74	☐ Domestic	☐	☐	☐ Dimensions(LxWxH):	
75	☒ Export	☒	☐	Console	
76	☒ Extended storage 12 months	☒	☐	Panel	
77	Spare Parts:				
78		Vendor's Standard	Purch. Specification		
79	☐ Domestic	☐	☐		
80	☒ Export	☒	☐		
81	☒ Extended storage 12 months	☒	☐		
82					
83					
84	Remarks				
85	1. Refer steam turbine data sheet enclosed				
86	2. Refer site condition and utility data.				
87					
88					
89					
90					
91					
92					
93					
94					
95					
96					
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98					
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112					
113					
114					

115	GENERAL			
116	Project:	BINA PETROCHEMICAL & REFINERY EXPANSION		Job No.: B957
117	Owner:	M/s BPCL		Site: BINA, MP
118	Purchaser:			Unit: SGU Purchaser:
119	Eqpt. Item No. for which oil system is reqd.:			Service :
120	Oil System Item No. :			Duty : Continuous / Intermittent
121	No. of units :	Working / Standby:		
122	Applicable to:	☒ Proposal ☐ Purchase ☐ As Built		
123	☒ Scope, Option & Info specified by Purchaser. ☐ Info required from and options left to vendor. Vendor to cross (X) the selected option.			
124	Oil system(s) for:			
125	Supplier:	Manufacturer:		
126	Overall System Typical Schematics		Fig. No.	Option No.
127	☐ Combined lube, seal & control oil system			
128	☐ Separate seal-oil system			
129	☐ Seal Module at Equipment			
130	☒ Lube / Control System		2A-8	
131	☒ Basic Oil supply module		2A-10	2A-17
132	☒ Lube Module at Equipment		2A-11	
133	☐ Drawing requirements			☐ Component Review
134	☐ Relief Valves to protect low pressure systems		☐ NO	☐ YES, For :
135	SUPPLY	Lube Oil	Seal Oil	BASIC SYSTEM DETAILS
136	☒ Separate Console	☒	☐	☐ Compressor Block-In time : Minutes
137	☐ Multiple Package	☐	☐	☐ Equipment Coast-Down time : Minutes
138	☐ Package No. 1			☐ Equipment Cool-Off time : Driver: Minutes
139	☐ Package No. 2			☐ Equipment Cool-Off time : Others: Minutes
140	☐ Package No. 3			☐ Minimum Start-up oil temperature °C
141	☐			☐ Settling Out Pressures kg/cm ² g
142	BASEPLATES:			☐ Process Relief Valve settings kg/cm ² g
143	☒ Point Support	☐ Grout Hole/Vent Holes		☐ Shop Test Conditions
144	☐ Epoxy Grout/Precoat			☐ Field Start-up/Run-In Conditions
145	COMPONENTS:			☐ Other Special Conditions
146	Piping & Tubing:			☐ Welding & Special Fabrication Requirements
147	☒ Material	SS304/SS316		☐ 100% Radiography
148	☐ Double Block & Bleeds			☐ Magnetic Particle
149	☐ Tight Shut off			☒ Liquid Penetrant
150	☐ Tube Fittings	Mfr.:	Model:	OIL CONDITIONERS
151	☒ Slip-on Flanges			☐ Purchaser's Item No.
152	☐ Through Studs required			☒ Service Used in
153	☐ Heat Tracing Req'd. by :	☐ Purchaser ☐ Vendor		☒ Type
154	☐ Special Requirements			☒ Portable, Or Mounted on
155	☒ Utilities manifolded to common connections			☐ Rated flow (m ³ /hr) of Oil
156	☒ Air			☒ Manufacturer
157	☒ Cooling Water			☐ Model
158	☒ Other: Vents and Drains			☒ Driver: For
159	☒ Instrument Test Valves required			☐ kW & Enclosure
160	☒ Valve heads vented to Reservoir			☐ V / Ph. / Hz.
161				☐ Water Removal Rate
162				☒ Material of Construction
163	DEGASSING DRUM	NOT APPLICABLE		
164	☐ Purchaser's Item No.			☐ Service Used in
165	☐ As per Fig. No's or Other Specs.			☐ Flow Control
166	☐ Operating Temperature (EC)			☐ Material
167	☐ Flow Rate : Normal Max. (m ³ /hr)			☐ Interior Coating
168	☐ Normal Retention Time (minutes)			☐ Oversize Vent
169	☐ Capacity : Normal Max. (m ³)			☐ Vent Relief Device
170	☐ Purge Gas : Type			☐ Omit Breather
171	☐ Required Flow (Nm ³ /hr)			☐ Code : Constrn. Stamp
172	☐ Type Heating Device			☐ Other
173	☐ Corrosion Allowance			☐ Other
174	☐ Design / Test Pressure (kg/cm ² g)			
175	☐ Other :	☐ Other:		

176	RESERVOIR									
177	Service Application	☐ Separate			☒ Lube/Control Combined			☐ Separate Seal		
178	☐ Purchaser's Item No.									
179	☒ Figure No.				2A-21					
180	☒ Include Options No.				a, b, c, d, f					
181	☒ Heater : Steam / Electric (S / E)				E					
182	☐ Heater in Sealed Tube									
183	☒ Material				SS 304					
184	☐ Normal Flow	m ³ /hr								
185	☐ Free Surface	m ²								
186	☒ Working Capacity	Minutes/Liters			5					
187	☒ Retention Capacity	Minutes/Liters			8					
188	☐ Rundown Capacity	Liters								
189	☐ Normal Operating Range	Liters								
190	☐ Charge Capacity	Liters								
191	☐ Insulation Clips	☐			☐			☐		
192	☒ Ladder with Hand-rail	☐			☒			☐		
193	☐ Hand-Rails on Top	☐			☐			☐		
194	☒ Non-skid Decking	☐			☒			☐		
195	☐ Flanged Vent									
196	☒ Oversize Flanged Vent				☒					
197	☐ Pressure Relief Device : Type & Mtrl.									
198	☒ Siphon Breaker	☐			☒			☐		
199	☐ Top Mounted Components permitted	☐			☐			☐		
200	☐ Top Mounted Components are									
201	☒ Submerged Components and Materials				No					
202	Approx. Dimensions (Tank Only): L x W X H (m)									
203										
204	PUMPS AND DRIVERS									
205	Service Application	☐ Lube Oil			☒ Lube/Control Oil			☐ Separate Seal Oil		☐ Boost Seal Oil
206										
207	☒ Figure No's :				2A-19					
208	☒ Including Option No's.				a, b, c					
209	☐ Emergency Pump System									
210	Pump Service	Main	Stdby	Emer	Main	Stdby	Emerg.	Main	Stdby	Emerg.
211	☐ Pump Item No.									
212	☒ Pump Type				Screw/Cent	Screw/Cent	Screw/Cent			
213	☐ Pump Data Sheet									
214	☒ Horiz. or Vertical (H / V)				H	H	H			
215	☐ Driver Item No.									
216	☒ Turbine Driver for				Yes					
217	☐ Turbine Data Sheet									
218	☒ Electric Motor Driver for					Yes				
219	☐ Electric Motor Data Sheet									
220	☒ Other Driver : Emergency AC Electric Motor						Yes			
221	☐ Other Driver : Data Sheet									
222	☒ Coupling Type				Fleximetallic with spacer					
223	☐ Booster Pumps Required									
224	☐ Booster Suction Protection									
225	☒ Solenoid Trip Valve				Yes					
226	☒ Auto Start				Yes	Yes	Yes			
227	☒ Rotary Pump Relief Valve by Purchaser/Vendor (P / V)				Yes					
228	REMARKS:									
229										
230										
231										
232										
233										
234										
235										

236	COOLERS :										
237	Service Application	☐ Lube		☒ Lube / Control		☐ Sep. Seal Oil					
238	☐ Purchaser's Item No.										
239	☒ Twin Units	☐		2A-17		☐					
240	☒ Include Option No's.			a, c							
241	☐ Water Side for Steam Heating	☐		☐		☐					
242	☐ Details on Data Sheet										
243	☐ Water Side Corrosion Allowance										
244	☐ Manufacturer										
245	☐ Model										
246	☒ TEMA Class			c							
247	☒ Fouling Factor : Water Side Oil Side			0.0004/0.0002							
248	☐ Heat Duty	kcal/hr									
249	☐ Tube : L x OD x BWG.										
250	☐ Design Test Pressure : Shell Side	kg/cm ² g									
251	☐ Design Test Pressure : Tube Side	kg/cm ² g									
252	☒ Code : Construction Stamp	☐		☐		☒		☐			
253	☐ Tube Water velocity Capacity :	m/s m ³ /hr									
254	☒ Material : Shell			SA 516 Gr. 70							
255	☒ Material : Channel & Covers			SA 516 Gr. 70							
256	☒ Material : Tube Sheets Tubes			Naval/Adm Brass							
257	☒ Removable Tube Bundle	☐		☒		☐					
258	☐ U – Bend Tubes permitted	☐		☐		☐					
259	☒ Oil Temperature Control Valve	☐		☒		☐					
260	FILTERS										
261	Service Application	☒ Lube, ☐ Seal		☐ Separate Control Oil		☐ Separate Seal Oil		☐ Booster Pump Disch. Oil		☐ Separate Coupling Oil	
262		☒ & Control Oil									
263	☐ Purchaser's Item No.										
264	☒ Twin	☒									
265	☐ Second filter for Control Oil	☐									
266	☒ Include Option No's.	2A-17, c									
267	☒ Filtration Level	Microns (Nominal)		10							
268	☐ Manufacturer										
269	☐ Model										
270	☐ Design Test Pressure	kg/cm ² g									
271	☒ Code : Construction Stamp	☒		☐		☐		☐		☐	
272	☐ Clean / Fail) P	kg/cm ²									
273	☒ Material : Case & Top	CS									
274	☐ Material : Cartridges										
275	☒ Furnish 4 Sets of Extra Cartridges :	☒ Per Service		☐ Per Filter (Extra over other spares)							
276	CONTINUOUS FLOW TRANSFER VALVES										
277	Service Application	☒ Lube, ☐ Seal		☐ Separate Control Oil		☐ Separate Seal Oil		☐ Booster Pump Disch. Oil		☐ Separate Coupling Oil	
278		☒ & Control Oil									
279	☒ Separate or Common for Coolers & Filters	☒		☐		☐		☐		☐	
280	☒ Tight Shut-off Req'd.	☒		☐		☐		☐		☐	
281	☒ Type	Two way, 6 Ported									
282	☐ Manufacturer										
283	☐ Model										
284	☐ With Lifting Jack	☐		☐		☐		☐		☐	
285	☐ Rating:	kg/cm ² g									
286	☒ Materials: Body	CS									
287	☒ Materials: Plug or Ball	SS 316									
288	☒ Materials: Trim	SS 316									
289											
290											
291											
292											
293											
294											
295											

296	ACCUMULATORS									
297	Service Application	Lube Oil		Control Oil		Seal Oil		Seal Oil Booster		
298	☐ Purchaser's Item No.									
299	☒ Required : Yes or No & Quantity	Yes		Yes						
300	☒ Service combined with	Pump Switch Over		C.O. Transients						
301	☐ Direct contact type	☐		☐		☐		☐		
302	☒ Bladder Type	2 A-15		2 A-15		☐		☐		
303	☒ Include Option No's.	a		a						
304	☐ Run-down minutes									
305	☐ Oil Temperature Control	☐		☐		☐		☐		
306	☐ Constant Pressure Regulator	☐		☐		☐		☐		
307	☐ Manufacturer									
308	☐ Model									
309	☐ Nominal Usable Capacity Liters									
310	☒ Material : Shell	SS		SS						
311	☐ Material : Bladder									
312	☐ Design Test Pressure kg/cm ² g									
313	☒ Code : Construction Stamp	☒	☐	☒	☐	☐	☐	☐	☐	
314	☒ Include : Charge Pressure Gauge plus	☒		☒		☐		☐		
315	☒ Manual Charge Valve or	☒		☒		☐		☐		
316	☒ Gas Supply Regulator	☒		☒		☐		☐		
317	OVERHEAD TANKS									
318	Service Application	Rundown Lube		Low Press. Seal		Med. Press. Seal		High Press.		
319	☒ Figure No.	2A-13 A								
320	☒ Required : Yes or No	Yes								
321	☐ Service combined with									
322	☐ Direct Contact Tank	☐		☐		☐		☐		
323	☐ Bladder Type	☐		☐		☐		☐		
324	☐ Include Option No's.									
325	☐ Capacity minutes / Liters									
326	☐ Blowdown Connection									
327	Rundown tanks (Fig. No.)	2A-13 A								
328	Overhead tanks (Fig. No.)									
329	☐ Corrosion Allowance									
330	☒ Material	SS ASTM A240								
331	☐ Total Capacity Liters									
332	☐ Design Test Pressure kg/cm ² g									
333	☒ Code : Construction Stamp	☒	☐	☐	☐	☐	☐	☐	☐	
334										
335	ACCUMULATOR UNITS (NOT APPLICABLE)									
336	☐ Purchaser's Item No.	Rundown Lube		Low Press. Seal		Med. Press. Seal		High Press.		
337	☐ Corrosion Allowance									
338	☐ Manufacturer & Quantity									
339	☐ Model									
340	☐ Material : Shell									
341	☐ Material : Bladder									
342	☐ Nominal Usable Capacity Litres									
343	☐ Design Test Pressure kg/cm ² g									
344	☐ Code : Construction Stamp	☐	☐	☐	☐	☐	☐	☐	☐	
345	TRAPS FOR INNER SEAL OIL (Oil Seals) NOT APPLICABLE									
346	☐ Service Application	Low Pressure Seal Oil		Med. Pressure Seal Oil		High Press. Seal Oil				
347	☐ Purchaser's Item No.									
348	☐ Seal - Gas Vent Piping Arrangement									
349	☐ Float Controlled	☐		☐		☐				
350	☐ Transmitter Controlled	☐		☐		☐				
351	☐ Pots only, For Manual Drain	☐		☐		☐				
352	☐ With : Valving	☐		☐		☐				
353	☐ Flush Level Glass	☐		☐		☐				
354	☐ High Level Switch	☐		☐		☐				
355	☐ Include Option No's.									
356	☐ Retention : Hours									
357	FLOAT TRAP (NOT APPLICABLE)	Low Pressure Seal Oil		Med. Pressure Seal Oil		High Press. Seal Oil				

358	☐ Manufacturer Model								
359	☐ Pressure Rating								
360	☐ Material : Body								
361	☐ Material : Float Trim								
362	☐ Drain Line piped to :								
363	DRAIN POT (NOT APPLICABLE)								
364	☐ Corrosion Allowance								
365	☐ Material								
366	☐ Design Test Pressure								
367	☐ Code : Construction Stamp	☐	☐	☐	☐	☐			
368	☐ Drain Line piped to :								
369	MIST ELIMINATOR (NOT APPLICABLE)								
370	☐ Corrosion Allowance								
371	☐ Material : Shell								
372	☐ Material : Demister Mesh								
373	☐ Design Test Pressure								
374	☐ Code : Construction Stamp	☐	☐	☐	☐	☐			
375	INSPECTION & TESTING								
376	SHOP TESTS :	Required	Witnessed	SHOP INSPECTION:					
377	☒ Cleanliness	☒	☒	☐ Compliance with Inspector's Checklist					
378	☒ Four Hour Run	☒	☒	☒ Required for System Assemblies					
379	☒ Check Controls	☒	☒	☒ Cleanliness prior to closure					
380	☒ Changeovers : Coolers / Filters	☒	☒	☒ Required for Major Components					
381	☒ One & Two Pump Operations	☒	☒	☒ Material Certifications to be furnished					
382	☒ Sound Level	☒	☒	☐ Special Examinations					
383	☒ Hydrotest Assembled System	☒	☒	☒ Code Construction / Stamp- ASME					
384	☒ Use for Complete Unit System Test	☒	☒	☒ Supply Certified copies of all Test Logs and Data					
385	☒ Certf. copies of all test logs & data	☒	☐	☐					
386	☐	☐	☐	☐					
387	☐	☐	☐	☐					
388	☐	☐	☐	☐					
389	☐	☐	☐	☐					
390	☐	☐	☐	☐					
391	REMARKS :								
392									
393									
394									
395									
396									
397									
398									
399									
400									
401									
402									
403									
404									
405									

DATE	REV	JOB ENGINEER	REVIEWED & APPROVED BY

1	GENERAL									
2	Project : BINA PETROCHEMICAL & REFINERY EXPANSION					Job No. : B957				
3	Owner : M/s BPCL					Site : BINA, MP				
4	Purchaser :					Unit : SGU Unit No.: 420				
5	Item No. :					Service :				
6	No. of Units :		Working :		Standby :					
7	Applicable to: ☐ Proposal ☐ Purchase ☐ As Built									
8	■ : Scope, Option & Information specified by Purchaser. □ : Information required from and options left to vendor. Vendor to cross (☒) the selected option.									
9	☐ Driver:		Type:		Manufacturer:		Model:			
10	Nameplate Power (kW):				Service Factor:		S.No.:		Tag No.:	
11	☐ Driven Unit:				Manufacturer:		Model:			
12	Serial No.:						Tag No.			
13	Coupling Type: ☐ Flexible Element ☐ Gear ☐ Quill Shaft ☐ Other:									
14	☐ Manufacturer:				Model:		Size:		Assy. Dwg. No.:	
15										
16	☐ CONDITIONS CONSIDERED FOR COUPLING SELECTION					☐ RATINGS				
17	Conditions		Torque (kgf-m)		@ rpm		Torque (kgf-m)		@ rpm	
18	Normal						Normal			
19	Driven Rated Load						Peak			
20	Maximum Steady State						Momentary			
21	Maximum Transient						Shaft Juncture (Driving)			
22	Trip Condition						Shaft Juncture (Driven)			
23	Continuous Cyclic									
24	Other:									
25	☐ Frequency of Transients (Events/Time):					☐ Non-synchronous exciting frequency:				
26	■ Coupling Minimum Required Service Factor, SF:					☐ Actual SF				
27	☐ Ambient Temperature (°C):		Maximum:			Minimum:				
28	Environment :		☐ Hyd. Chloride ☐ Hyd. Sulphide ☐ Other:							
29	LUBRICATION									
30	☐ Continuous ☐ Batch		■ Non-Lubricated		☐ Viscosity :		cP @		°C	
31	☐ Filtration Microns:				☐ Pressure (kg/cm²g)		☐ Temp. (°C):			
32					☐ Flow (m³/hr)					
33	COUPLING DATA									
34	☐ Shaft Separation (including thermal growth) (mm B.S.E):									
35	@ Ambient Temp.:				@ Normal Operation:				@ Maximum Transient:	
36	☐ Motor Rotor Float (mm):				☐ Limited End Float (mm):					
37	☐ Marine Type Required				☐ Flex-Hub Type Required (2.2.2)		☐ Electrically Insulated			
38	☐ Required Misalignment Capability :									
39	Steady State :		Angular (°) :		Parallel Offset (mm):		Axial (mm):			
40	Transient :		Angular (°) :		Parallel Offset (mm):		Axial (mm):			
41	☐ Maximum Allowable Misalignment :									
42	Steady State :		Angular (°) :		Parallel Offset (mm):		Axial (mm):			
43	Transient :		Angular (°) :		Parallel Offset (mm):		Axial (mm):			
44	☐ Component Balance -OR- ■ Component Balance & Assembly Check Balance -OR- ☐ Component Balance with Assy. Balance									
45	☐ Residual Unbalance Check of Assembled Couplings					☐ Balance Repeatability Check				
46	■ Check sensitivity of Balance Machine									
47	☐ Max. Allowable Residual Unbalance		g-mm		Driver End :		Driven End :			
48	☐ Max. Actual Residual Unbalance		g-mm		Driver End :		Driven End :			
49	☐ Torsional Stiffness (kg-mm/Rad):									
50	☐ WR² (kg-m²):				Driver End :		Driven End :			
51	☐ Spacer Lateral Natural Frequency :					☐ Torque Capacity of Hub/Shaft Interface for keyless fits (kgf-m):				
52	Flexible-Element Coupling:									
53	☐ Initial Deflection (mm):				☐ Pre-Stretch ☐ Compression		☐ Max. Axial Deflection (mm):			
54	☐ Calculated Axial Natural Frequency:					☐ Test of ANF:		☐ Actual ANF:		
55	☐ Maximum Enclosure Temperature at Max. Continuous speed (°C):									
56	REMARKS:									
57										
58										
59										
60										
61										

62	MATERIALS			
63	Component	Drive End Materials	Driven End Materials	
64	Hub / Flange			
65	Spacer			
66	Sleeve			
67	Flexible-Element			
68	Flexible-Element Guard			
69	Bolts			
70	Nuts			
71	☐ Protective Coating :		☐ Vendor Standard	☐ Other:
72	☐ Internal Teeth Hardness : Rockwell C		Drive End Actual :	Driven End Actual :
73	☐ External Teeth Hardness : Rockwell C		Drive End Actual :	Driven End Actual :
74	COUPLING HUB MACHINING			
75		Drive End	Driven End	
76	☐ Type (Integral / Cylindrical / Taper)			
77	☐ Keyed or Hydraulically Fitted			
78	☐ Taper (Note-1)			
79	☐ Keyway Dimensions and Number			
80	☐ Nominal Bore Diameter (mm)			
81	☐ Interference Fit (mm) : Max. Min.			
82	☐ Puller Holes			
83	☐ Trim Balance Holes			
84	COUPLING GUARD			
85	☐ Co-ordinator :		☐ Purge Gas:	☐ Dry Air Purge:
86	☐ Flanged Cylindrical :		☐ Base Mount:	☐ Purge Connection Size & Type:
87	☐ Air Tight:		☐ Oil Tight:	☐ Purge m ³ /hr Required:
88	☐ Spark Resistant		☐ Oil Mist Cooling	☐ Gas Cooling
89	☐ Transparent Window for Each Oil Spray Point:		☐ Contract Guard to be used during Shop Test	
90	☐ Vent Connection:		☐ Additional Guard Details:	
91	☐ 1 inch NPT with Filter Breather			
92	☐ 1 inch Flanged, Rating & Facing :			
93	ACCESSORIES (Vendor to mark & provide accessories as required)			
94	☐ Prime Eqpt. supplier to furnish one set of Plug & Ring Gauges (Appx. D)		☐ Hydraulic Installation/Removal Tooling (To include Hand	
95	☐ Lapping Tools		Pump(s), Pressure Gauge(s), Fittings & Hose(s)) By :	
96	☐ Drill Template for Internal Flanged Hubs by:		☐ Coupling Manufacturer ☐ Purchaser	
97	☐ Coupling Manufacturer ☐ Purchaser		☐ Puller By Coupling Manufacturer / Vendor	
98	☐ Two-Piece Stop Rings by Coupling Manufacturer		☐ Moment Simulator ☐ Solo Plate	
99	APPLICABLE SPECIFICATIONS		PREPARATION FOR SHIPMENT	
100	☐ API 671, 5 th Edit, Special Purpose Couplings, Job Spec.		☐ Outdoor Storage for more than 12 months	
101	☐ Others :		☐ Expected Storage Time (Months) :	
102	☐		☐ Shipping	☐ Domestic ☐ Storage ☐ Indoor
103	☐ Coordination Meeting Attendance Required		☐ Export	☐ Outdoor
104	REMARKS:			
105	1. 1° included angle / ½ dia. Inch. per foot length / ¾ dia. inch. per foot length			
106				
107				
108				
109				
110				
111				
112				
113				
114				
115				
116				
117				

Date	Rev	Job Engineer	Rev. & Approved By

SPECIAL PURPOSE GEAR UNIT

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Rev. No. A
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Format Rev.2 Issue Date-22/10/2014

GENERAL									
1 Project :		BINA PETROCHEMICAL & REFINERY EXPANSION				Job No. :		B957	
3 Owner :		M/s BPCL				Site :		BINA, MP	
4 Purchaser :						Unit :		SGU	
5 Item No. :						Service :			
6 No. reqd. :		Working:		Standby:		Driver Type:		Driven Eqpt.:	
7 Applicable to :		☐ Proposals				☐ Purchase		☐ As Built	
8 ☐ : Scope, Option & Information specified by Purchaser. ☐ : Information required from and options left to vendor. Vendor to cross (☒) the selected option.									
9 Manufacturer :					Model :				
☐ RATING REQUIREMENTS					☐ BASIC GEAR DATA				
11 Driven Eqpt. Power (kW):		Nor.:		Max.:		Mechanical rating :		kW @ rpm	
12 Driver Power (kW):		Rated:		Max.:		Full load power loss (kW):			
13 Gear rated power (kW):						Mechanical efficiency (%):			
14 Torque @ Max. Cont. Speed (kg-m):						Pitch line velocity (m/s):			
15 Max. Torque :		kg-m @		rpm		Tooth pitting index, "K" :		Actual: Allowble:	
16 Rated speed (rpm) :						Tangential load, "W _t " (kg):			
17 - Input		☐ Specified		☐ Nominal		Bending stress number S _t "W _t "		Pinion Gear	
18 - Output		☐ Specified		☐ Nominal		Actual :			
19 Allow variation in gear ratio :		±		%		Allowable :			
20 Max continuous speed (rpm) :						Material index no. :			
21 Trip speed (rpm) :						Anticipated SPL :		dBA @ 1.0 m	
22 Gear service factor:						Journal static weight loads :			
23 Pinion Hardness :						Pinion : kg		Gear: g	
24 Shaft assembly designation :						WR ² referred to LS shaft (kg-mm ²):			
25 - HS shaft rot. facing coupling end		☐ CW		☐ CCW		Breakaway Torque (kgf-m) @ LS shaft :			
26 - LS shaft rot. facing coupling end		☐ CW		☐ CCW					
27 HS shaft end :		☐ Cylindrical		☐ Taper		☐ 1-Key		☐ CONSTRUCTION FEATURES	
28 ☐ 2-Keys		☐ Hydraulic taper		☐ Integral flange		Type of Gear		☐ Reducer ☐ Increaser	
29 LS shaft end :		☐ Cylindrical		☐ Taper		☐ 1-Key		☐ Single stage ☐ Double stage	
30 ☐ 2-Keys		☐ Hydraulic taper		☐ Integral flange		☐ Single helical		☐ Double helical	
31 External loads :						☐ Epicyclic		☐	
32 Other operating conditions :						Teeth			
33 ☐ Indoor		☐ Heated		☒ Under roof		Number of teeth: Pinion:		Gear:	
35 ☒ Outdoor		☒ Unheated		☐ Partial sides		Gear ratio		Center Distance (mm):	
36 ☐ Grade		☐ Mezzanine		☐ Offshore		Pitch Dia: Pinion (mm)		Gear (mm):	
37 ☐ Winterisation Required		☒ Tropicalization Required				Finish (RA):			
38 Electrical Area Class:Ref.job spec		Grp:		Div.:		AGMA Geometry factor "J" :			
39 Max. allow. SPL :		dBA @		m		Pinion:		Gear :	
40 Elevation (m):		Barometer (kg/cm ² A):				Helix angle (°) :			
41 Range of ambient temperatures:						Normal pressure angle (°):			
42 Dry Bulb		Wet Bulb				Net face width, "Fw" (mm) :		Pinion L/D:	
43 Minimum °C		°C				Normal Diametrical Pitch:		Backlash (mm):	
44 Normal °C		°C				Tooth plating : ☐ Recommended ☐ Not Recommended			
45 Maximum °C		°C				MANUFACTURING METHODS			
46 Unusual Conditions		☐ Dust ☐ Fumes ☐ Others:				Teeth generated by the :		Process	
47 ☐ ADDITIONAL REQUIREMENTS						Teeth finished by the :		Process	
48 MOUNTING PLATES						Teeth hardening method :			
49 ☒ Gear suitable for Base plate mounting.						Gear to shaft : ☐ Integral ☐ Shrunk-on			
50 ☐ Baseplate		☐ Soleplate(s)		☐ Subplate(s)		Rim attachment :			
51 ☒ Mounting plate(s) furnished by :						☐ RADIAL BEARINGS			
52 ☒ Equipment on baseplate:						Pinion		Gear	
53 ☐ Baseplate with levelling pads :						Type			
54 ☐ Baseplate suitable for column mounting :						Diameter mm			
55 ☐ Grout type :		☐				Length mm			
56 ☐ PAINTING: ☐ Mfr.St ☐ Refer Doc. No.						Journal Velocity m/s			
57 APPLICABLE SPECIFICATIONS						Loading kg/cm ²			
58 ☒ API Std. 613, 6 th Ed., Job Specification						Clearance (min-max) mm			
59 ☐ Other :						Span mm			
60									

61	MISCELLANEOUS				☐ THRUST BEARING(S)			
62	☒ Undamped critical analysis report : with train ☒ Yes ☐ No						Pinion	Gear
63	☐ With damped rotor response analysis report				Location			
64	☒ Torsional analysis by ☐ Gear Vendor ☒ Other: Package Vendor				Manufacturer			
65	☐ Spare set of gear rotors				Type			
66	☐ Gear case furnished with inlet purge connection				Size			
67	☐ Orientation of oil inlet and drain connection				Area mm ²			
68					Loading kg/cm ²			
69	☒ VIBRATION DETECTORS				Rating kg/cm ²			
70	Radial:				Int. thrust load N (±)			
71	☒ Manufacturer:				Ext. thrust load N (±)			
72	☒ No. at each shaft bearing Two Total No.:				☐ COUPLING & GUARDS			
73	☒ Oscillator-Demodulators supplied by : Vendor						High Speed	Low Speed
74	☐ Manufacturer :				Coupling Manufacturer			
75	☒ Monitor supplied by : Vendor				Coupling Furnished by			
76	☒ Location Remote Panel Enclosure:				Coupling Type			
77	☐ Manufacturer:				Coupling Model			
78	☐ Alarm : ☐ Shutdown :				Coupling rating kW/100 rpm			
79	☐ Shutdown time delay seconds				Coupling Lubrication			
80	Axial :				Taper mm/m			
81	☒ Manufacturer: No. reqd.: Two on each thrust brg.				Taper gauge furnished by			
82	☒ Location: Remote Panel				Limited end float			
83	☒ Oscillator-Demodulators supplied by: Vendor				Mount coupling halves		☐	☐
84	☐ Manufacturer :				Cplg. gear pitch dia mm		☐	☐
85	☒ Monitor supplied by: Vendor				Cplg. pressure angle °		☐	☐
86	☒ Location: Remote Panel Enclosure				Cylindrical / 1-key		☐	☐
87	☐ Manufacturer:				Cylindrical / 2-keys		☐	☐
88	☐ Alarm : ☐ Shutdown :				Tapered / 1-key			
89	☐ Shutdown time delay seconds				Tapered / 2-keys			
90					Tapered / keyless			
91	Accelerometer: Each Bearing housing(X,Y,Z directions)- N.A.				☐ PIPING CONNECTIONS			
92	Manufacturer: No. Required						No.	Size
93	Location: Remote Control Panel				Service			Type
94	Monitor supplied by: Vendor				Lube oil inlet			
95					Lube oil outlet			
96	☒ INSTRUMENTS				Casing drain			
97	☐ Mercury Thermometers				Vent			
98	☒ Bearing metal temperature sensors (Remark -3)				Casing purge			
99	☒ CONTRACT DATA							
100	☐ Vendor's Representative at site							
101	☒ Test data prior to shipment				☐ LUBRICATION REQUIREMENTS			
102	☐ Progress reports				☒ Oil System Furnished by (Common with GT & Alt.)			
103	☒ SHIPMENTS				☐ Oil Visc.: cP @ 40°C cP @ 100°C			
104	Contract unit		Spares		Min. startup oil temperature		°C	
105	Export boxing ☐		☐		Unit oil flow(total)		m ³ / hr	
106	Domestic boxing ☐		☐		Unit oil pressure		kg/cm ² g	
107	Outdoor strg. over 12 months ☒		☒		Oil flow, Mesh		m ³ / hr	
108					Oil flow, HS Bearings		m ³ / hr	
109	MATERIALS				Oil flow, LS Bearings		m ³ / hr	
110	Gear Casing		Oil Seals		Oil flow, Thrust Bearing(s)		m ³ / hr	
111	Radial Bearings				Additional Requirements			
112	Thrust Bearing(s)				Filter breather location			
113	HS Shaft		LS Shaft					
114	Pinion(s)		Hardness					
115	Gear Rim(s)		Hardness					
116	Teeth core hardness: Pinion:		Gear :					
117	Low Temp. Operation							
118								
119								
120								

■ SHOP INSPECTION AND TESTS					□ GEAR DATA		
	Regd.	Observe	Witness	Test log			
121					Power loss each HS bearing		
122					Power loss each LS bearing		
123	Shop Inspection	■	■		Power loss each thrust bearing		
124	Cleanliness inspection	□	□	□	Power loss each thrust bearing		
125	Hardness verification Insp	■	■	□		Pinion	Gear
126	Dismantle-Reassembly Insp.	■	□	■	Outside diameter	mm	
127	Contact check	■	■	□	Root Diameter	mm	
128	Contact check tape lift (2.5.2.2)	□	□	□	Center Groove Diameter	mm	
129	Journal runout check	■	■	□	Durability Power		
130	Axial stability check	□	□	□	Strength Power		
131	Rotor balancing machine	□	□	□	Face overlap ratio		
132	Sensitivity Check				Transverse contact ratio		
133	Residual Unbalance Check	□	□	□	Length line of action	mm	
134	Mech. run test	■	□	■			
135	Mech. run test (Spare rotors)	□	□	□	□ WEIGHTS & DIMENSIONS		
136	Add'l mech. Test	□	□	□	Net Weight:		
137	Part or full load and full speed test	□	□	□	Gear Box :	kg	Auxiliaries : kg
138	Full torque slow roll test	□	□	□	Max. Maintenance Weight (Identify):		kg
139	Full torque static test	□	□	□	Total Shipping Weight :		
140	Back-to-back locked torque test	□	□	□	Total Shipping Dimensions:	L: m	W: m
141	Sound level test	■	□	■			
142	Add'l gear tooth test	□	□	□			
143	Use shop lube system	■	□	■			
144	Use job lube system	□	□	□			
145	Use shop vibration probes, etc.	□	□	□			
146	Use job vibration probes, etc.	■	□	■			
147	Other:	□	□	□			
148	Final assembly maintenance &	■	□	■			
149	running clearance						
150	Oil system cleanliness	■	■	□			
151	Oil system casing joint tightness	■	■	□			
152	Warning and protection devices	□	□	□			
153							
154							
155							
156							
157							
158							
159	REMARKS:						
160	1) For Electrical area classification , please refer Electrical specifications.						
161	2) Refer site & utility data attached elsewhere.						
162	3) Hydrodynamic radial bearings shall be fitted with at least two (2) temperature probes & Hydrodynamic thrust bearings shall be fitted with at least two (2) temperature probes each on active and inactive side.						
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							

Date	Rev	Job Engineer	Rev. & Approved By

1	GENERAL						
2	Project: BINA PETROCHEMICAL & REFINERY EXPANSION			Job No.: B957			
3	Owner: M/s BPCL			Site: BINA, MP		Unit No.: 420	
4	Purchaser:			Unit: SGU			
5	Item No.:			Service:			
6	No. Reqd.:	Working:	Stand-by:	Driver:	Type:		
7	Applicable to: ☐ Proposal ☐ Purchase ☐ As Built						
8	Note: ☒ Scope option/information specified by Purchaser ☐ information required from / options left to vendor. Vendor to cross ☒ the selected option.						
9	☐ Manufacturer:	☐ Model	☒ Fan Type / AMCA Argmt. #: SISW/DIDW / Arrangement #7				
10	Place of Mfrg. of Fan:						
11	Drive Arrgt. : ☒ Direct ☒ Thru Gear Box ☐ Thru Fluid ☐ Thru V-Belt Drive ☐ Other:						
12	Driver By: FAN VENDOR			Driver Mounted By: FAN VENDOR			
13	OPERATING CONDITIONS (REFER PROCESS DATA SHEET ATTACHED ELSEWHERE IN BID PACKAGE)						
14	(ALL DATA ON PER UNIT BASIS)		Design	Maximum	Normal	Minimum	Low Amb.
15							Unthrottled
16	☐ Optg. Case						
17	☒ Gas Handled (See Page _____)						
18	☐ Density	(kg/Nm ³)					
19	☐ Delivered (DRY)	(Nm ³ /sec)					
20	☐ Weight Flow	(kg/hr: Dry/Wet)					
21	INLET CONDITIONS:						
22	☐ Temperature (Max. / Normal)	(°C)					
23	☐ Relative Humidity	(%)					
24	☐ Molecular Weight	(Min.)					
25	☐ Inlet Volume	(am ³ /hr : Wet)					
26	☐ C _p / C _v (K ₁) or (K _{Avq})						
27	☐ Compressibility (Z ₁) or (Z _{Avq})						
28	☐ Static Pressure @ Sound Trunk	(mmWC)					
29	☐ Press. Loss Across Sound Trunk	(mmWC)					
30	☐ Static Pressure @ Inlet Dampers	(mmWC)					
31	☐ Static Pressure @ Fan Inlet	(mmWC)					
32	DISCHARGE CONDITIONS:						
33	☐ Static Pressure @ Fan Outlet	(mmWC)					
34	☐ Static Pressure @ Disch. Damper	(mmWC)					
35	☐ Diff. Pressure Disch. Damper	(mmWC)					
36	☐ Diff. Pressure Across Evase	(mmWC)					
37	☐ Static Pressure @ Evase Outlet	(mmWC)					
38	PERFORMANCE:						
39	☐ BkW Required @ Temp. (All losses Incl.) (kW)						
40	☒ Fan Speed (1000 rpm max.)	(RPM)					
41	☐ Guarantee Point						
42	☐ Performance Curve No.						
43	☐ Static Diff Pressure Across Fan	(mmWC)					
44	☐ Inlet Damper / Vane Position	(% of Open)					
45	☐ Discharge Damper Position	(% of Open)					
46	☐ Fan Static / Total or Overall Efficiency	(%)					
47	FAN CONTROL (REFER PROCESS DATASHEET ATTACHED ELSEWHERE IN THE BID PACKAGE)						
48	☒ Fan Control furnished by:		Fan Vendor				
49	☐ Control Signal Type:	Source:	Sensitivity:	Range:	☐ Auto Lock on failure		
50	Method:	☐ Inlet Damper: ☐ for isolation of Fan; ☐ for capacity regulation;		☐ Control	☐ Auto	☐ Manual	
51		☐ Outlet Damper: ☐ for positive isolation of Fan; ☐ Other:		☐ Control	☐ Auto	☐ Manual	
52		☐ Inlet Guide Vanes		☐ Control	☐ Auto	☐ Manual	
53		☐ Variable Speed through variable frequency drive (VFD)/Pole Switchable Motor		☐ Control	☐ Auto	☐ Manual	
54		☐ Variable Speed through Fluid Coupling		☐ Control	☐ Auto	☐ Manual	
55		☐ Starting Method:					
56		☐ Actuators: Type: ☐ Pneumatic Actuated ☐ Hydraulic ☐ Other:					
57	REMARKS:						
58	1. Sound trunk means Inlet Box / Inlet Silencer.						
59	2. Evase is a diffuser or a diverging discharge transition piece.						
60							

61	OPERATING CONDITIONS (REFER PROCESS DATASHEET ATTACHED ELSEWHERE IN THE BID PACKAGE)												
62	GAS ANALYSIS		Design		Maximum		OTHER CONDITIONS				REMARKS		
63	☐ Mole%	☐					Minimum						
64		M.W.	Wt%	Mol%	Wt%	Mol%	Wt%	Mol%					
65	Air	28.97											
66	Oxygen	32.00											
67	Nitrogen	28.02											
68	Water Vapor	18.02											
69	CO	28.01											
70	CO ₂	44.01											
71	H ₂ S	34.08											
72	HCl	36.47											
73	Cl ₂	70.91											
74	SO ₂	64.06											
75													
76													
77													
78	Total												
79	Avg. Mol. Wt. (DRY)												
80	Corrosives:												
81	☐ Corrosion / Erosion Caused By												
82	☐ Corrosion / Erosion Protection												
83	SITE / INSTALLATION DATA						SPECIFICATIONS						
84	Location:						Noise specifications:						
85	☐ Indoor	☐ Heated	☐ Under Roof				☒ Applicable to Machine: 85 dBA @ 1 m						
86	☒ Outdoor	☒ Unheated	☐ Partial Sides										
87	☒ Grade	☐	☐ At Elevation				☐ Applicable to Neighborhood:						
88	☐ Winterization Req'd.	☒ Tropicalization Req'd.					See Specification						
89	Site data: (Refer Site & Utility Data)						☐ Acoustic Housing (if req'd.) ☐ Yes; ☐ No						
90	☐ Elevation (m):	☐ Barometer (kg/cm ² A):					Applicable specifications:						
91	☐ Temperature	°C (Summer)		°C (Winter)		☒ Applicable Specification(s), EDB – Rot. Eqpt.							
92	☐ Wind load	kg/m ²		☐ Velocity	m/hr		☒ EIL Std. Spec. 6-42-0016						
93	Unusual conditions:						☒ API Std. 560						
94	☐ Dust	☐ Fumes											
95	☒ Other	Refinery Atmosphere											
96													
97	Electrical Area Classification (Refer Electrical Specs)						Painting:						
98	☐ Class:	Group:		Div.:		Temp. Class:		☐ Manufacturer's Standard					
99							☐ Other:						
100							Shipment:						
101							☒ Domestic ☐ Export ☐ Export Boxing Req'd						
102							☒ Outdoor Storage Period: <u>12</u> Months						
103							Erection:						
104							Shipped ☒ Assembled						
105							☐ Partially Assembled						
106							☒ Other (\$)						
107													
108													
109	REMARKS:												
110	\$: Voluminous parts shall be dispatched in loose condition with necessary support to avoid damage during transit.												
111	Small parts shall be crate packed and hardware shall be box packed.												
112													
113													
114													
115													
116													
117													
118													
119													
120													

CONSTRUCTION FEATURES									
121									
122 ■ Speeds (rpm): [1000 rpm Max.]					■ Shaft				
123 ☐ Max. Cont. Speed: ☐ Trip Speed:					Shaft Length (mm): Dia @ Wheel (mm):				
124 Max. Tip Speed m/sec @ Rated					☐ Material:				
125 m/sec @ MCS									
126 ■ Housing ■ Material: CS [IS-2062]					■ Impeller / Blades				
127 Suction: ☐ SISW (overhung) ■ SISW (between bearing)					☐ Coating Type ■ Material: CS [IS-2062]				
128 ■ DIDW (between bearing)					☐ Diameter (mm) ☐ No. of blades				
129 ■ Inlet Bell / Diffuser / Inlet Transition Piece					■ Type: ■ Backward Curved, Non-Overloading ■ Hollow Airfoil				
130 ■ Evase / Diffuser / Outlet Transition Piece					☐ Solid Airfoil / Single Thickness				
131 ☐ Insulation Type: Thickness: (mm):					☐ Fabrication method:				
132 ☐ Insulation Stud By:					■ Hub				
133 ■ Drains. No. / Size / Type / Loc.:					☐ Shrink Fit ☐ Keyed ☐ Other:				
134 ■ Fan Inlet Access Split for Rotor Removal: YES					☐ Positively Locked				
135 ☐ Manways: Size (mm): Type/Loc.:					☐ Material:				
136 ■ Bearing housing:					■ Shaft Sleeves:				
137 Split: Horizontal / Vertical Material: CS					Provided: ■ Yes ☐ No				
138 Type:					■ Material: SS316				
139 ■ Cooling required: ☐ None ■ Air Cooled/ Natural cooling									
140 ■ Water Cooled: m3/hr @ °C					■ Shaft Seals				
141 ☐ Radial Bearings (DE + NDE):					Type ☐ Labyrinth ☐ Packing ☐ Mechanical Seal				
142 Type: ☐ Hydrodynamic ☐ Antifriction ☐ Sleeve					Mech. Seals: Make: Model / Seal Code:				
143 ☐ Thrust Bearing:					No. of rings in Packing:				
144 Type: ☐ Flat Land ☐ Tapered Land ☐ Tilted Pad					MOC of Laby./Packing: Glass fiber / Asbestos				
145 ☐ Other:					Rotation viewed from coupling end: ☐ CW ☐ CCW				
146					GD ² value of Fan rotor:				
147 ☐ Temp. Detectors (Metal / Oil) ☐ Thrust ☐ Journal									
148 ☐ Type:					■ Main Connections: (By vendor)				
149					☐ Inlet: No.x Size: x mmx mm; Area (m ²):				
150 ☐ Lubrication for Fan Bearings					☐ Flange Size:				
151 Type: ☐ Ring Oil (constant level) ☐ Grease: NO					☐ Location / Orientation:				
152 ☐ Forced Feed					■ Exp. Joint: ■ Yes ☐ No; Furnished By: ■ Fan Mfr. ☐ Other:				
153 ■ Mtg. Pedestal ■ Yes ☐ No					☐ Outlet: No.x Size: x mmx mm; Area (m ²):				
154 ☐ Sole Plates ☐ Yes ☐ No					☐ Flange Size:				
155 ☐ Vibration detectors / Vibration Switch					☐ Location / Orientation:				
156 ☐ Allowable Vibration Limits:					■ Exp. Joint: ■ Yes ☐ No; Furnished By: ■ Fan Mfr. ☐ Other:				
157 ☐ :m, Peak to Peak: @ Location:									
158 ☐ mm/sec: @ Location:					☐ Other Connections:				
159 ☐ Seismic Sensor-Spot space(s) (provision for mtg.)					Service No. Size Type				
160 ☐ Seismic Sensor duly mounted					Lube Oil Inlet				
161 ■ Speed Detectors (On Outboard Bearing)					Lube Oil Outlet				
162 ■ Non-Contact Probe (Speed Sensing Element)					Cooling Water Inlet				
163 ☐ Speed Switch					Cooling Water Outlet				
164 ■ Other: Speed Transmitter					Condensate Drain				
165 ☐ Type: ☐ Model:					Other				
166 ☐ Manufacturer:					Pressure Gauge				
167 ■ Location: @ NDE of Fan Shaft					Temperature Gauge				
168 ■ Scale Range: 0 – 1000 rpm									
169 ☐ Weights (kg):					☐ Space Requirements (m):				
170 Fan Assy. Gear					L W H Remarks				
171 Rotors Fluid Cplg.					Fan Assembly				
172 Sound Trunk Other:					Fluid Coupling				
173 Evase Other:					Gear				
174 Driver #1 Max. Maintenance					Clutch				
175 Driver #2 Erection / Shipping					Driver #1				
176 Baseplate					Driver #2				
177					Complete Assembly				
178 REMARKS:									
179									
180									

CONSTRUCTION FEATURES (CONTINUED)						
181						
182	Fan Cleaning System:			Base-plates & Soleplates:		
183	☒ Required Cleaning Medium: Service Water			☐ Tri- Directional Adjusting Screws For Eqpt.		
184	☒ Furnished by: ☒ Fan Mfr. ☐ Other:			☐ Pilot Holes For Dowels		
185	MATERIALS:			☒ Type Grout: RCC ☐ Type Pre-coat:		
186	Part	Material	Material Specification	Soleplates For: ☒ Bearing Pedestals ☐ Gear		
187	Fan Housing / Casing			☒ Driver ☒ Fan Housing Support		
188	Shaft			Base-Plates		
189	Impeller / Blades			☒ Common (under Driver & Inboard bearing pedestal)		
190	Hub / Center Plate / Shrouds			☐ Fan Alone ☐ Other		
191	Shaft Sleeves			☒ Decking ☒ Non Skid ☐ Open Const		
192	Inlet Damper (Blade / Shaft)			☒ Drip Rim ☐ Open Drain		
193	Outlet Damper			Suitable For: ☐ Column Or ☒ Perimeter Support		
194	Inlet Guide Vanes			☐ Leveling Pads W / Removable Cover		
195	Inlet Bell			☐ Sub-sole Plates Required		
196	Ebase			☐ Anti-vibration Pads		
197	Inlet / Outlet Expansion Joint			☐ Suitable for support over elevated steel structure		
198	Inlet Trash Screen / Housing			☒ Suitable for support over concrete foundation		
199	Rain Hood(s)					
200	Inlet / Outlet Transition Piece					
201	Base plate					
202	Couplings	Driver - Fan				
203	☒ Coupling & Guard	Yes				
204	Furnished By	Fan Vendor				
205	☒ Type	Flexible Metallic with Spacer & Non-sparking guard				
206	☐ Mfg.					
207	☐ Model/Number					
208	☒ Lubrication	Dry				
209	☐ Mount Cplg. Halves	Yes				
210	- Fan	By Fan Vendor				
211	- Driver	By Fan Vendor				
212	- Gear	NA				
213	☐ Spacer Length					
214	☐ Ltd. End Float Req'd.					
215	☒ Coupling Guard Req'd.	Yes				
216	☒ Service Factor	1.5				
217	☐ Cplg. Rating kW/100 RPM					
218	☐ Keyed Or Hydr. Fit					
219	☐ Adapter (Solo) Plate(If Req'd.)					
220	☒ Materials (Coupling / Disc Pack)	CS / SS				
221	SHOP INSPECTION & TESTS					
222	Description	Observed	Witnessed	Description	Observed	Witnessed
223	☒ Shop Inspection	☐	☐	☐ Pressure Test	☐	☐
224	☒ Cleanliness Inspection	☐	☐	- Housing	☐	☐
225	☐ Hardness Verification	☐	☐	- Ducting	☐	☐
226	☐ Charpy Impact Testing	☐	☐	- Lube Oil System	☐	☐
227	☒ Shaft Run-out Check	☒	☐	☒ Performance Test	☐	☒
228	☒ Dyn. Bal. of both Rotor Assys. (Gr.2.5:ISO)	☒	☐	(as per BS:848)		
229	☒ Calibration Check Of Balancing Eqpt.	☒	☐	☒ NLMRT for 4 hours	☐	☒
230	☒ DP/MP test for Impeller / Casing Welds	☒	☐			
231	☒ US/LP test for shaft	☒	☐	☒ Damper functional test	☐	☒
232	☐ Assembly+Fit Up Check (Main/Spare rot)	☐	☐	☐ LO Console functional test	☐	☐
233	☐ Initial &/Or Final Alignment Check	☐	☐	☒ Functional / Simulation test LCP	☐	☒
234	☐ Gear Tooth Contact Check	☐	☐			
235	☒ Vibration Level Test (during MRT)	☐	☒	☒ QC Review	☐	☐
236	☒ Sound Level Test (during MRT)	☐	☒	☒ Dimens. & Visual Insp.	☐	☒
237	☒ Material Certf. : Casing/Impeller/Shaft/Slv.	☐	☐	☒ Pre-shipment Insp.	☐	☒
238	☐ Surface & Subsurface Insp.	☐		☐ Radiography of Butt welds	☐	☐
239	Type:	☐	☐			
240	☐ Casing tightness test with Helium	☐	☐			

241	ACCESSORIES	
242	■ Inlet Filter along with Bird/Insect Screen, Rain Hood (Separate for each fan)	■ Canopy for Motor(s)
243	□ Inlet Silencer (if required)	■ Foundation / Anchor Bolts
244	■ Complete Inlet Ducting, Prefabricated (Separate for each fan)	■ Jacking Bolts for Motor & Fan (2 Directions)
245	□ Insulation cleats on Fan scroll & inlet box	■ Vibration Eliminators / Anti Vibration Mountings
246	■ Expansion Joints / Flexible Connections: Fan Inlet	□ Prefabricated CW Piping & Fittings for Brg. Cooling
247	■ Expansion Joints / Flexible Connections: Fan Outlet	■ Impeller cleaning system complete with prefabricated piping & fittings
248	■ Companion flanges with gaskets, bolts & nuts: Fan Inlet (@ vendor's B/L)	■ All utility connections terminated with isolation valves at vendor's battery limits (Single point connections, with companion flanges, nuts, bolts & gaskets).
249	■ Companion flanges with gaskets, bolts & nuts: Fan Outlet (@ vendor's B/L)	
250	■ Casing Drain including inlet box drain, terminated at vendor's B/L	■ Inlet / Outlet Transition Pieces
251	with isolation valve (50 mm NB, minimum).	
252	■ Other accessories & instrumentation as per P&ID attached elsewhere.	■ Local Instruments including junc. box, as specified
253	□ Fluid Coupling complete with all associated auxiliary systems & instr. & controls	■ Local Control Panel(s) / LGB (s) [As required]
254	Make: _____ Model: _____	■ Mandatory / Insurance Spares, as specified
255	□ Variable speed drive system complete with all assoc. auxiliary sys. & controls	■ Quotation for Spares for 2 year normal operation
256	Make: _____ Model: _____	■ Commissioning Spares (as recommended)
257	■ Inlet Box Control Dampers (if reqd.): _____ Make: _____	■ Special tools / tackles (as recommended)
258	□ Damper (Inlet): Slide gate type, with optg. gears & linkages, for fan isolation.	■ Cabling / Tubing between Fan & Control Panel
259	■ Damper (Outlet): for fan isolation (if reqd). (Remark 3)	
260	REMARKS:	
261	3. The outlet damper shall be procured from specialty vendor.	
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DATE	REV.	JOB ENGINEER	REVIEWED & APPROVED BY

1	GENERAL						
2	Project:	BINA PETROCHEMICAL & REFINERY EXPANSION		Job No.:	B957		
3	Owner:	M/s BPCL		Site:	BINA, MP	Unit No.: 420	
4	Purchaser:			Unit:	SGU		
5	Item No.:			Service:			
6	No. Reqd.:	Working:	Standby:	Driver:		Type:	
7	Applicable to:	☒ Proposal ☐ Purchase ☐ As Built					
8	Note: ☒ Scope option/information specified by Purchaser ☐ information required from / options left to vendor. Vendor to cross ☒ the selected option.						
9	☐ Manufacturer:	☐ Model	☐ Fan Type / AMCA Argmt.# :				
10	Place of Mfrg. of Fan:						
11	Drive Arrgt. :	☒ Direct ☒ Thru Gear Box ☐ Thru Fluid ☐ Thru V-Belt Drive ☐ Other:					
12	Driver By: FAN VENDOR		Driver Mounted By: FAN VENDOR				
13	OPERATING CONDITIONS (REFER PROCESS DATASHEET)						
14	(ALL DATA ON PER UNIT BASIS)		Test Block	Design	Normal	Turndown	Startup
15							
16	☐ Optg. Case						
17	☐ Gas Handled: Air						
18	☐ Density (kg/Nm ³)						
19	☐ Delivered (DRY) (Nm ³ /sec)						
20	☐ Weight Flow (kg/hr: Dry/Wet)						
21	INLET CONDITIONS:						
22	☐ Temperature (Max. / Min.) (°C)						
23	☐ Relative Humidity (%)						
24	☐ Molecular Weight (Min.)						
25	☐ Inlet Volume (Nm ³ /hr : dry)						
26	☐ C _p / C _v (K ₁) or (K _{Avq})						
27	☐ Compressibility (Z ₁) or (Z _{Avq})						
28	☐ Static Pressure @ Sound Trunk (mmWC) (Note 2)						
29	☐ Press. Loss Across Sound Trunk (mmWC)						
30	☐ Static Pressure @ Inlet Dampers (mmWC)						
31	☐ Static Pressure @ Fan Inlet (mmWC)						
32	DISCHARGE CONDITIONS:						
33	☐ Static Pressure @ Fan Outlet (mmWC)						
34	☐ Static Pressure @ Disch. Damper (mmWC)						
35	☐ Diff. Pressure Disch. Damper (mmWC)						
36	☐ Diff. Pressure Across Evase (mmWC) (Note 3)						
37	☐ Static Pressure @ Evase Outlet (mmWC)						
38	PERFORMANCE:						
39	☐ BkW Required @ Temp. (All losses Incl.) (kW)						
40	☒ Fan Speed (1500 rpm max.) (RPM)						
41	☐ Guarantee Point						
42	☐ Performance Curve No.						
43	☐ Static Diff Pressure Across Fan (mmWC)						
44	☐ Inlet Damper / Vane Position (% of Open)						
45	☐ Discharge Damper Position (% of Open)						
46	☐ Fan Static / Total or Overall Efficiency (%)						
47	FAN CONTROL						
48	☒ Fan Control furnished by: Fan Vendor						
49	Control Signal Type:	Source:	Sensitivity:	Range:	☐ Auto Lock on failure		
50	Method:	☐ Inlet Damper: ☐ for isolation of Fan; ☐ for capacity regulation;			☐ Control	☐ Auto	☐ Manual
51		☐ Outlet Damper: ☐ for positive isolation of Fan; ☐ Other:			☐ Control	☐ Auto	☐ Manual
52		☒ Inlet Guide Vanes			☒ Control	☒ Auto	☒ Manual
53		☐ Variable Speed through variable frequency drive (VFD)/Pole Switchable Motor			☐ Control	☐ Auto	☐ Manual
54		☐ Variable Speed through Fluid Coupling			☐ Control	☐ Auto	☐ Manual
55		☐ Starting Method: 20% Testblock vol. @ 20°C					
56		☒ Actuators: Type: ☐ Pneumatic Actuated ☐ Electric Actuated ☐ Other:					
57	NOTES: 1. -deleted-						
58	2. Sound trunk means Inlet Box / Inlet Silencer.						
59	3. Evase is a diffuser or a diverging discharge transition piece.						
60							

61	OPERATING CONDITIONS (REFER PROCESS DATASHEET)												
62	GAS ANALYSIS						OTHER CONDITIONS						
63	☐ Mole%	☐	Design		Maximum		Normal		Minimum				REMARKS
64		M.W.	Wt%	Mol%	Wt%	Mol%	Wt%	Mol%	Wt%	Mol%			
65	Air	28.9											
66	Oxygen	32.00											
67	Nitrogen	28.02											
68	Water Vapor	18.02											
69	CO	28.01											
70	CO ₂	44.01											
71	H ₂ S	34.08											
72	HCl	36.47											
73	Cl ₂	70.91											
74	SO ₂	64.06											
75													
76													
77													
78	Total												
79	Avg. Mol. Wt. (DRY)												
80	Corrosives:												
81	☐ Corrosion / Erosion Caused By:												
82	☐ Corrosion / Erosion Protection:												
83	SITE / INSTALLATION DATA								SPECIFICATIONS				
84	Location:								Noise specifications:				
85	☐ Indoor	☐ Heated	☐ Under Roof						■ Applicable to Machine: 85 dBA @ 1 m				
86	■ Outdoor	■ Unheated	☐ Partial Sides										
87	■ Grade	☐	☐ At Elevation						■ Applicable to Neighborhood: 85 dBA @ 1 m				
88	☐ Winterization Req'd.	■ Tropicalization Req'd.							See Specification				
89	Site data: (Refer Site & Utility Data)								☐ Acoustic Housing (if req'd.) ☐ Yes; ☐ No				
90	☐ Elevation (m):	☐ Barometer (kg/cm ² A):							Applicable specifications:				
91	☐ Temperature		°C (Summer)			°C (Winter)						■ Job Specification(s) for RED, Electrical, Instr.	
92	☐ Wind load	kg/m ²		☐	Velocity		m/hr		■ EIL Process Package				
93	Unusual conditions:								■ EIL Std: 6-42-0002				
94	☐ Dust	☐ Fumes											
95	■ Other	Refinery Atmosphere											
96													
97	Electrical Area Classification (Refer Electrical Specs)								Painting:				
98	☐ Class:	Group:		Div.:		Temp. Class:		☐ Manufacturer's Standard					
99									■ Other: Refer requirement specified in PDS.				
100									Shipment:				
101	☐ Domestic	■ Export		■ Export Boxing Req'd									
102									■ Outdoor Storage Period: <u>TWELVE(12)</u> Months				
103									Erection:				
104									Shipped		■ Assembled		
105											☐ Partially Assembled		
106											■ Other (Note 5)		
107													
108													
109	NOTES:												
110	4. -deleted-												
111	5. Voluminous parts shall be dispatched in loose condition with necessary support to avoid damage during transit. Small parts												
112	shall be crate packed and hardware shall be box packed.												
113													
114													
115													
116													
117													
118													
119													
120													

121	CONSTRUCTION FEATURES									
122	Speeds (rpm):					Shaft				
123	☐ Max. Cont. Speed:		☐ Trip Speed:			Shaft Length (mm):		Dia @ Wheel (mm):		
124	Max. Tip Speed		m/sec @ Rated			☐ Material:				
125			m/sec @ MCS							
126	Housing					Impeller / Blades				
127	Suction: ☐ SISW (overhung) ☐ SISW (between bearing)					☐ Material (Remark-5) ☐ Coating Type				
128	☐ DIDW (between bearing)					☐ Diameter (mm) ☐ No. of blades				
129	☐ Inlet Bell / Diffuser / Inlet Transition Piece					☐ Type: ☐ Backward Curved, Non-Overloading ☐ Hollow Airfoil				
130	☐ Evase / Diffuser / Outlet Transition Piece					☐ Solid Airfoil / Single Thickness				
131	☐ Insulation Type Thickness: (mm):					☐ Fabrication method:				
132	☐ Insulation Stud By:					Hub				
133	☐ Drains. No. / Size / Type / Loc.:					☐ Shrink Fit		☐ Keyed		☐ Other:
134	☐ Fan Inlet Access Split for Rotor Removal: YES					☐ Positively Locked				
135	☐ Manways: Size (mm): Type/Loc.:					☐ Material:				
136	☐ Bearing housing:					Shaft Sleeves:				
137	Split: Horizontal / Vertical Material:					Provided: ☐ Yes ☐ No				
138	Type:					☐ Material: (Remark-5)				
139	☐ Cooling required: ☐ None ☐ Air Cooled									
140	☐ Water Cooled: m3/hr @ °C					Shaft Seals				
141	☐ Radial Bearings (DE + NDE):					Type ☐ Labyrinth		☐ Packing		☐ Mechanical Seal
142	Type: ☐ Hydrodynamic ☐ Antifriction ☐ Sleeve					Mech. Seals:		Make:		Model / Seal Code:
143	Thrust Bearing:					No. of rings in Packing:				
144	Type: ☐ Flat Land ☐ Tapered Land ☐ Tilted Pad					MOC of Laby./Packing:				
145	☐ Other:					Rotation viewed from coupling end: ☐ CW ☐ CCW				
146						GD ² value of Fan rotor:				
147	☐ Temp. Detectors (Metal / Oil) ☐ Thrust ☐ Journal									
148	☐ Type:					Main Connections: (By vendor)				
149						☐ Inlet: No.x Size: x mmx mm; Area (m ²) :				
150	☐ Lubrication for Fan Bearings					☐ Flange Size:				
151	Type: ☐ Ring Oil (constant level) ☐ Grease: NO					☐ Location / Orientation:				
152	☐ Forced Feed					☐ Exp. Joint: ☐ Yes ☐ No; Furnished By: ☐ Fan Mfr. ☐ Other:				
153	☐ Mtg. Pedestal		☐ Yes ☐ No			☐ Outlet: No.x Size: x mmx mm; Area (m ²) :				
154	☐ Sole Plates		☐ Yes ☐ No			☐ Flange Size:				
155	Vibration Probe along with Vibration Transmitter					Location / Orientation: At Fan Discharge				
156	☐ Allowable Vibration Limits:					Exp. Joint: ☐ Yes ☐ No; Furnished By: ☐ Fan Mfr. ☐ Other:				
157	☐ :m, Peak to Peak: @ Location:									
158	☐ mm/sec: @ Location:					Other Connections:				
159	☐ Seismic Sensor-Spot space(s) (provision for mtg.)					Service		No.		Size
160	☐ Seismic Sensor duly mounted					Lube Oil Inlet				
161	☐ Speed Detectors					Lube Oil Outlet				
162	☐ Non-Contact Probe					Cooling Water Inlet				
163	☐ Speed Switch					Cooling Water Outlet				
164	☐ Other:					Condensate Drain				
165	☐ Type: ☐ Model:					Other				
166	☐ Manufacturer:					Pressure Gauge				
167	☐ Location:					Temperature Gauge				
168	☐ Scale Range:									
169	☐ Weights (kg):					☐ Space Requirements (m):				
170	Fan Assy.		Gear					L		W
171	Rotors		Fluid Cplg.			Fan Assembly				H
172	Sound Trunk		Other:			Fluid Coupling				
173	Evase		Other:			Gear				
174	Driver #1		Max. Maintenance			Clutch				
175	Driver #2		Erection / Shipping			Driver #1				
176	Baseplate					Driver #2				
177						Complete Assembly				
178	NOTES:									
179	6. Refer remark no. 5.									
180	7. -deleted-									

181	CONSTRUCTION FEATURES (CONTINUED)					
182	Fan Cleaning System:			Base-plates & Soleplates:		
183	■ Required Cleaning Medium: WATER			☐ Tri- Directional Adjusting Screws For Eqpt.		
184	■ Furnished by: ■ Fan Mfr. ☐ Other:			☐ Pilot Holes For Dowels		
185	MATERIALS: (REFER REMARK NO. 5)			■ Type Grout: RCC ☐ Type Pre-coat:		
186	Part	Material	Material Specification	Soleplates For: ■ Bearing Pedestals ☐ Gear		
187	Fan Housing / Casing			■ Driver ■ Fan Housing Support		
188	Shaft			Base-Plates		
189	Impeller / Blades			■ Common (under Driver & Inboard bearing pedestal)		
190	Hub / Center Plate / Shrouds			☐ Fan Alone ☐ Other		
191	Shaft Sleeves			■ Decking ■ Non Skid ☐ Open Const		
192	Inlet Damper (Blade / Shaft)			■ Drip Rim ☐ Open Drain		
193	Outlet Damper			Suitable For: ☐ Column Or ■ Perimeter Support		
194	Inlet Guide Vanes			☐ Leveling Pads W / Removable Cover		
195	Inlet Bell			☐ Sub-sole Plates Required		
196	Ebase			■ Anti-vibration Pads		
197	Inlet / Outlet Expansion Joint			☐ Suitable for support over elevated steel structure		
198	Inlet Trash Screen / Housing			■ Suitable for support over concrete foundation		
199	Rain Hood(s)					
200	Inlet / Outlet Transition Piece					
201	Base plate					
202	Couplings		Driver - Fan			
203	■ Coupling & Guard		Yes			
204	Furnished By		Fan Vendor			
205	■ Type		Flexible Metallic with Spacer & Non-sparking guard			
206	☐ Mfg.					
207	☐ Model/Number					
208	■ Lubrication		Dry			
209	■ Mount Cplg. Halves		Yes			
210	- Fan		By Fan Vendor			
211	- Driver		By Fan Vendor			
212	- Gear		NA			
213	☐ Spacer Length					
214	☐ Ltd. End Float Reqd.					
215	■ Coupling Guard Reqd.		Yes			
216	■ Service Factor		1.5			
217	☐ Cplg. Rating kW/100 RPM					
218	☐ Keyed Or Hydr. Fit					
219	☐ Adapter (Solo) Plate(If Reqd.)					
220	■ Materials (Coupling / Disc Pack)		CS/SS			
221	SHOP INSPECTION & TESTS (EACH FAN)					
222	Description	Observed	Witnessed	Description	Observed	Witnessed
223	■ Shop Inspection	☐	☐	☐ Pressure Test	☐	☐
224	■ Cleanliness Inspection	☐	☐	- Housing	☐	☐
225	☐ Hardness Verification	☐	☐	- Ducting	☐	☐
226	☐ Charpy Impact Testing	☐	☐	- Lube Oil System	☐	☐
227	■ Shaft Run-out Check	■	☐	■ Performance Test	☐	■
228	■ Dyn. Bal. of both Rotor Assys. (Gr.2.5:ISO)	■	☐	(as per BS:848/AMCA 210)		
229	■ Calibration Check Of Balancing Eqpt.	■	☐	■ NLMRT for 4 hours	☐	■
230	■ DP/MP test for Impeller / Casing Welds	■	☐			
231	■ US/LP test for shaft	■	☐	☐ Damper functional test	☐	☐
232	☐ Assembly+Fit Up Check (Main/Spare rot)	☐	☐	☐ LO Console functional test	☐	☐
233	☐ Initial &/Or Final Alignment Check	☐	☐	■ Functional / Simulation test LCP	☐	■
234	☐ Gear Tooth Contact Check	☐	☐			
235	■ Vibration Level Test (during MRT)(for ref.)	☐	■	■ QC Review	☐	☐
236	■ Sound Level Test (during MRT)(for ref.)	☐	■	■ Dimens. & Visual Insp.	☐	■
237	■ Material Certf. : Casing/Impeller/Shaft/Slv.	☐	☐	■ Pre-shipment Insp.	☐	■
238	☐ Surface & Subsurface Insp.	☐	☐	☐ Radiography of Butt welds	☐	☐
239	Type:	☐	☐			
240	☐ Casing tightness test with Helium	☐	☐			

241	ACCESSORIES	
242	■ Inlet Stack along with Bird/Insect Screen, Rain Hood	■ Canopy for Motor(s)
243	■ Inlet Silencer (if required)	■ Foundation / Anchor Bolts
244	□ Complete Inlet Ducting, Prefabricated	■ Jacking Bolts for Motor & Fan (2 Directions)
245	□ Insulation cleats on Fan scroll & inlet box	■ Vibration Eliminators / Anti Vibration Mountings(as reqd.)
246	■ Expansion Joints / Flexible Connections: Fan Inlet	□ Prefabricated CW Piping & Fittings for Brg. Cooling
247	■ Expansion Joints / Flexible Connections: Fan Outlet	■ Impeller cleaning system complete with
248	□ By Contractor □ By Fan Vendor	prefabricated piping & fittings
249	■ Companion flanges with gaskets, bolts & nuts: Fan Inlet (@ vendor's B/L)	■ All utility connections terminated with isolation
250	■ Companion flanges with gaskets, bolts & nuts: Fan Outlet (@ vendor's B/L)	valves at vendor's battery limits (Single point
251	□ By Contractor □ By Fan Vendor	connections, with companion flanges, nuts, bolts & gaskets).
252	■ Casing Drain including inlet box drain, terminated at vendor's B/L	■ Inlet / Outlet Transition Pieces
253	with isolation valve (50 mm NB, minimum).	■ Local Instruments including junc. box, as specified
254	■ Other accessories & instrumentation as per P&ID attached elsewhere.	■ Local Control Panel(s) / LGB (s) [As required]
255	□ Fluid Coupling complete with all associated auxiliary systems & instr. & controls	■ Mandatory Spares, as specified
256	Make: Model:	■ Quotation for Spares for 2 year normal operation
257	□ Variable speed drive system complete with all assoc. auxiliary sys. & controls	■ Commissioning Spares (as recommended)
258	Make: Model:	■ Special tools / tackles (as recommended)
259	■ Inlet Box Control (IGV): Make:	■ Cabling / Tubing between Fan & Control Panel
260	□ Damper (Inlet): Slide gate type, with optg. gears & linkages, for fan isolation.	
261	□ Damper (Outlet): Slide gate type, with optg. gears & linkages, for fan isolation.	
262	NOTES:	
263	8. -deleted-	
264	9. Local Instruments indicated on P&ID are included in fan vendor's scope.	
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REMARKS

2. FAN DESIGN

- 2.1 All fans shall be provided with individual suction stacks. Permanent pressure loss across the inlet stack and in the outlet system between the fan outlet flange & the evase outlet flange are to be assessed by fan vendor and add the total losses to the pressure increase for sizing the fan.
- 2.2 Vendor shall furnish separate performance curves for all the operating cases, together with the surge line indicated, to justify the continued operation from minimum to maximum capacity at the operating speed(s).
- 2.3 "START/STOP" fan push buttons shall be considered in the local control station.
- 2.4 The fan sizing shall be done for the maximum capacity considering the maximum suction temperature.
- 2.5 The motor rating shall also be adequate for operation of fans at the specified minimum specified ambient conditions at the rated speed in unthrottled conditions.
- 2.6 Fan shall be suitable for continuous operation (mechanically) at 15°C above the maximum specified operating temperature.
- 2.7 Centrifugal fan manufacturer shall have single point responsibility for the complete package including Fan, drivers, coupling & silencer etc.
- 2.8 Centrifugal fans first critical speed of the rotor shall be higher than 120% of rated speed.(i.e. the rotor shall be "classically stiff" type)
- 2.9 Centrifugal fans casing shall be suitably split such that impeller assembly can be removed for maintenance without disturbing inlet and outlet ducting.
- 2.10 The inlet guide vane at fan inlet shall be provided with the following
 - An external guide vane position indicator
 - Spindles supported at both ends
 - Manual operation of guide vane from grade level shall
 - The guide vane ring protected by a dust cover (which shall allow full access to all parts for inspection)
- 2.11 **Unitisation:** The Fan, driver & all auxiliaries shall be supplied duly mounted on a common base-plate (except for specified loose items). Unitisation of each fan package along with driver and associated job auxiliaries shall be done in manufacturer's shop.
- 2.12 All rotating equipment base plates shall have jacking provision for levelling and jacking/levelling screws for alignment in horizontal and vertical planes.
- 2.13 Only Stainless Steel shims shall be provided for equipment alignment.

3. CAPACITY CONTROL

- 3.1 The capacity of the fan shall be regulated from field as well from DCS through actuated Inlet Guide vane.

4. MISCELLANEOUS

- 4.1 Bidder shall refer to process data sheet for specification, requirements and vendor's scope of supply / works. It may be noted that P&ID is indicative only & the actual scope of supply/work shall also take care of the requirements specified in the process data sheets, standard specifications etc.
5. MOC shall be suitable for the operating and design conditions. References for MOC for similar operating conditions shall also be furnished.

DATE	REV.	JOB ENGINEER	REVIEWED & APPROVED BY

1	GENERAL							
2	Project: BINA PETROCHEMICAL & REFINERY EXPANSION				Job no.: B957			
3	Owner: M/s BPCL				Site: BINA, MP			
4	Purchaser:				Unit: SGU		Unit No.: 420	
5	Item No.				Service: Lube Oil Pump			
6	No. Required:	Working:	stand by:	Driver:	Working:	Stand by:		
7	Applicable to		☐ Proposals	☐ Purchase		☐ As Built		
8	☒ Scope Option & Information specified by Purchaser ☐ Information required from & options left to vendor. Vendor to cross ☒ the selected Option							
9	Manufacturer:			Size & Type:		Model:		
10	OPERATING CONDITIONS							
11	☐ Liquid:			☐ Rated Capacity at PT (m ³ /hr): (@ Min. viscosity)				
12	☐ Pumping Temperature (°C) (Max / Min):			☐ Capacity (m ³ /hr): (@ Max. viscosity)				
13	☐ Specific Gravity at PT:			☐ Discharge Pressure (kg/cm ² , a) (Rated):				
14	☐ Vapour Pressure at PT (kg/cm ² , a):			☐ Suction Pressure (kg/cm ² , a) (Rated):				
15	☐ Viscosity at PT (Cp/Cst) (Min / Max):			☐ Differential Pressure (kg/cm ² , a):				
16	☐ Corrosion Erosion caused by:			☐ NPSH available (m):				
17	☐ Presence of Solids:			☐ Jacketing / Tracing Required		☐ Steam		☐ Electric
18	REMARKS:							
19	SITE / INSTALLATION / UTILITY DATA							
20	Location: ☐ Indoor		☐ Outdoor w/w/o roof		☐ Heated		☐ Unheated	
21	Site Temperature (°C):		Max:	Min:	☐ Elect. Area Hazard:		Div:	Class: Group:
22	☐ Available Steam Pr. (kg/cm ² g):		Min:	Nor:	Max:			
23	Temperature (°C)		Min:	Nor:	Max:			
24	REMARKS:							
25								
26	APPLICABLE CODES & STANDARDS							
27	APPLICABLE CODES & STANDARDS: API 676 4 th Edition							
28	PERFORMANCE @ min. viscosity @ max. viscosity							
29	☐ Rated Capacity (m ³ /hr)			☐ Direction of Rotation from Coupling End			☐ CW ☐ CCW	
30	☐ Pump (rpm)			☐ Relief Valve Set Pressure (kg/cm ² , g):				
31	☐ NPSH Required (m):			☐ Relief Valve Acc. Pressure (kg/cm ² , g):				
32	☐ Rated speed (rpm):			☐ BKW @ Max Viscosity (kW):				
33	☐ Displacement (m ³ /hr):			☐ BKW @ Relief Valve Setting (kW):				
34	☐ Volumetric efficiency (%):			☐ BKW at accumulation Pr.:				
35	☐ Mechanical Efficiency (%):			☐ Motor Rating (kW):				
36	☐ Overall Efficiency (%):			☐ Allowable Speed (rpm)		Max:	Min:	
37	REMARKS:							
38								
39	CONSTRUCTION FEATURES							
40	Nozzles	Size	Rating/Facing	Position	Nozzles	Size	Rating/Facing	Position
41	Suction				Jacket Inlet			
42	Discharge				Jacket Outlet			
43	Vent				C.W Supply			
44	Drain				C.W Return			
45	Gland / Flush				Steam Quenching			
46	PUMP TYPE: ☒ Gear or ☒ Screw				☐ Sliding Vane			
47	☐ External Gear	☐ Internal Gear			Gear Type	☐ Spur Gear	☐ Helical Gear	
48	☐ Twin Screw	☐ Triple Screw	☐ Progressive Cavity					
49	Rotor Mount:	☐ Between Brg.	☐ Overhung		☐ Packing:	☐ No. Of Rings:		
50	☒ Relief Valve: ☐ Built In ☒ Ext. & Loose supply by Vendor				Steam Jacketing:	☐ Casing	☐ Stuffing Box	☐ None
51	☐ Timing Gears: ☐ Yes ☐ No				☒ Mechanical Seals:			
52	☐ Bearing (Make/Model):				☐ Manufacturer and Model:			
53	☐ Lubrication Type for Bearing:				☐ Mech. Seal API Code:		☐ API 610 Seal Flush Plan:	
54	☐ Pumped Fluid	☐ Ring Oil	☐ Oil Mist		Piping for Seal Flush & Quench furnished by:			
55	☐ External	☐ Oil Flood	☐ Grease		☐ Pump Vendor		☐ Others	
56	☐ Maximum Allowable Working Pressure (kg/cm ² , g):				☐ Piping for Cooling / Heating furnished by:			
57	☐ Hydrostatic Test Pressure (kg/cm ² , g):				☐ Pump Vendor ☐ Others			
58	☐ Steam Jacket Design Pressure (kg/cm ² , g):							
59	REMARKS:							
60								
61								

62	MATERIALS					
63	☐ Stator Body / Casing:			☐ Sleeve(s):		
64	☐ Stator Liner / Insert:			☐ Bearing Housing:		
65	☐ End Plates:			☐ Timing Gears:		
66	☐ Rotor(s):			☐ Mounting / Base Plate:		
67	☐ Vanes:			☐ Discharge Piping:		
68	☐ Shaft:			☐ Gland(s):		
69	☐ Packing:	Mech. Seal Faces:	☐ Relief Valve:	Body:	Trim:	
70	REMARKS:					
71						
72	INSPECTION & TESTING					
73	Description	Required	Witnessed	Description	Required	Witnessed
74	Shop Inspection	■	☐	Performance Test	■	☐
75	Material Certificates	■	☐	NPSH Test	■	☐
76	Hydrostatic test (Casing & Jacket)	■	☐	R.V Set Functional Test	■	☐
77	Rotor Dyn. Balancing (Observed)	■	☐	Dismantle Inspection	■	☐
78	Mechanical Run	■	☐			
79	REMARKS:					
80						
81	DRIVER					
82	■ Type of Driver:		■ Elec. Motor	☐ Steam Turbine	☐ Other:	
83	■ Driver Supplied & mounted by Pump Manufacturer			☐ Driver Supplied and mounted by other		
84	☐ Driver kW:			☐ Speed (rpm):		
85	REMARKS:					
86						
87	DRIVE MECHANISM					
88	■ Direct Coupled	☐ V- Belt	☐ Variable Speed	☐ Gear	☐ Gear Make:	
89	☐ Coupling Make:	■ Coupling Type: Flexi-Metallic (Flexible Element)		■ Coupling Guard (Non-sparking type)		
90	REMARKS:					
91						
92	BASE PLATE					
93	■ By Pump Manufacturer		■ Common Base plate for pump driver, auxiliaries			
94	☐ Drain rim type	☐ Drip tray type	☐ Overall Size (lxbxh) (mm):			
95	REMARKS:					
96						
97	WEIGHT					
98	☐ Pump only (kg):	☐ Driver (kg):	☐ Gear Box (kg):			
99	☐ Base plate (kg):	☐ Misc. (kg):	☐ Total Weight (kg):			
100	REMARKS:					
101						
102	REMARKS					
103	1. Pump casing design pressure shall not be less than kg/cm ² @ °C					
104	2. Mechanical Seal shall be one from the vendor list attached elsewhere in inquiry documents.					
105	3. Driver rating shall be suitable for start up & operation of pump at max. viscosity of lube oil (heater out of operation)					
106	4. Driver for standby pump shall be suitable for auto-start.					
107	5. Vendor to furnish this datasheet duly filled in, during detailed engg. stage along with general reference list of the offered pump model to justify the field provenness of the same.					
108	6. The motor nameplate rating shall be at least 110% of the power corresponding to relief valve set pressure at maximum specified viscosity.					
109	7. Pump shall be selected for the max. Capacity at minimum viscosity and the max differential pressure.					
110	8. NPSH margin shall be 1.0 m as a minimum.					
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DATE	REV	JOB ENGINEER	REV. & APPROVED BY

Format Rev.0 Issue Date-22/10/2014

1	GENERAL			
2	Project: BINA PETROCHEMICAL & REFINERY EXPANSION		Job no.: B957	
3	Owner: M/s BPCL		Site: BINA, MP	
4	Purchaser:		Unit: SGU	Unit no.: 420
5	Item No.:		Service:	
6	No. Required:	Working:	Std by:	Driver: Working: Std by:
7	Applicable to ☐ Proposals		☐ Purchase ☐ As Built	
8	☒ Scope Option & Information specified by Purchaser ☐ Information required from & options left to vendor. Vendor to cross [X] the selected Option			
9	Manufacturer:		Size & Type:	Model:
10	OPERATING CONDITIONS			
11	☐ Liquid:		☐ Capacity at PT (l/hr)/(m ³ /hr):	
12	☐ Pumping Temperature (°C)(Nor/Max.):		Min:	Nor: Rated:
13	☐ Specific Gravity at PT:		☐ Discharge Pressure (kg/cm ² ,a):	
14	☐ Vapour Pressure at PT(kg/cm ² ,a):		Min:	Nor: Rated:
15	☐ Viscosity at PT(Cp/Cst):		☐ Suction Pressure (kg/cm ² ,a):	
16	☐ Corrosion Erosion caused by:		Min:	Nor: Rated:
17	☐ Presence of Solids:		☐ Differential Pressure (kg/cm ²):	
18	☐ NPSH Available (w/o acceleration head) (m):		Min:	Nor: Rated:
19	SITE / INSTALLATION DATA			
20	Location: ☐ Indoor ☐ Outdoor w/w/o roof		☐ Heated	☐ Unheated
21	Site Temperature(°C):		Max: Min: ☐ Elect. Area Hazard:	Div: Class: Group:
22	APPLICABLE CODES & STANDARDS			
23	Job Spec, EIL STANDARD SPECIFICATION 6-41-0021, API STANDARD 675 3 rd Ed.			
24	PERFORMANCE			
25	☐ Number of feeds:		☐ Plunger Speed (stroke/min): (≤ 100)	
26	☐ Rated Capacity (l/hr)/ (m ³ /hr):		☐ Plunger Diameter (mm):	
27	☐ Acceleration Head (m):		☐ Cylinder Diameter (mm): ☐ Length of Stroke (mm):	
28	☐ Plunger Linear speed (m/s):		☐ Pump Relief Valve Set Pressure (kg/cm ² ,g):	
29	☐ Volumetric efficiency (%):[≤ 90%]		☐ Pump Head MAWP (kg/cm ² ,g):	
30	☐ Mechanical Eff. (%): ☐ Overall Eff. (%):		☐ Hydro test Pressure (kg/cm ² ,g):	
31	☐ NPSH Required (m):		☐ Flow Repeatability:	
32	☐ BkW Rated (kW): ☐ BkW at R.V. Set Pr.:		☐ Thrust on plunger (kgf):	
33	☐ Packing Type: ☐ No. Of rings:		☐ Design Plunger Thrust (kgf):	
34	CONSTRUCTON FEATURES			
35	Nozzles		Size / ANSI Rating	Facing
36	Pump Suction			
37	Pump Discharge			
38	Suction Manifold (for multi head pumps)			
39	Discharge Manifold (for multi head pumps)			
40	Relief Valve	Inlet		
41		Outlet		
42	Pulsation	Inlet		
43	Suction	Outlet		
44	Pulsation	Inlet		
45	Discharge	Outlet		
46	LIQUID END			
47	Type: ☒ Diaphragm ☐ Plunger	☐ Valves per feed: ☐ Suction: ☐ Discharge:		
48	No. of Heads: ☐ Simplex; ☐ Duplex; ☐ Multiplex	☐ Valve type		
49	Diaphragm Type: ☐ Single	☒ Double or ☒ Sandwich		
50	MATERIALS			
51	☐ Liquid End:		☐ Packing:	
52	☐ Contour Plate:		☐ Valve:	
53	☐ Hydraulic Diaphragm:		☐ Valve Guide:	
54	☐ Plunger:		☐ Valve Body:	
55	☐ Lantern Ring:		☐ Valve Gasket:	
56	☐ Packing Gland:		☐ Relief Valve:	Body:
57	☐ Calibration Pot:		☐ Suction/Discharge Pulsation Dampener:	
58	Remarks:			
59				
60				

Format Rev.0 Issue Date-22/10/2014

SHOP INSPECTION & TESTS (EACH PUMP)						
	Description	Required	Witnessed	Description	Required	Witnessed
61						
62	Hydrostatic	■	■	Material Certificates	■	--
63	Performance Test	■	■	Shop Inspection	■	□
64	Steady State Accr.	■	■	Dismantle & Insp. after test	■	■
65	Repeatability	■	■	R.V. Set Pressure Function Test	■	■
66	Linearity	■	■	Diaphragm Rupture Detection (Functional)	■	■
67						
68	DRIVER					
69	■ Type of Driver:	■ Elec. Motor:		□ Steam Driven:	□ Air Motor:	
70	■ Driver Supplied & mounted by Pump Manufacturer			□ Driver Supplied & mounted by others		
71	□ Driver kW:			□ Speed (rpm):		
72	WEIGHTS					
73	□ Pump with Driver & Base Frame (Kg):	□ Relief Valve (Kg):				
74	□ Skid size (lxbxh) (m):	□ Total Weight (Kg):				
75	□ Suction Pulsation Dampener (Kg):	□ Discharge Pulsation Dampener (Kg):				
76	□ Skid Size (lxbxh) (m):	□ Total Weight (Kg):				
77	CONTROLS					
78	Type of Stroke Control:					
79	□ Manual	□ Automatic	□ Remote		□ Local	
80	Signal:					
81	□ Pneumatic (kg/cm ² g):	□ Minimum:		□ Maximum:		
82	□ Electronic (mA):	□ Minimum:		□ Maximum:		
83	Remarks:					
84	ACCESSORIES					
85	■ Speed Reducer supplied & mounted by Pump Manufacturer:			■ Relief Valve supplied & mounted by Pump Manufacturer:		
86	Make:			Make:		
87	■ Integral	□ Separate	□ Internal		■ External	
88	□ Model	□ Gear Ratio:	□ Suction and Discharge manifold piping supplied & mounted by Pump Manufacturer			
89	■ Common Base Plate under: Pump, gear box & driver			□ Back Pressure Valve		
90	■ Coupling supplied & mounted by Pump Manufacturer:			□ Calibration Pot: □ At Suction □ At Discharge		
91	Make:			□ Common to all pump units □ Separate		
92	□ Type:	■ Gas Pre-charging Kit (If reqd.)		□ With Level Gauge		
93				■ Puls. Dampener (Suct.) (See Rem 3) Type:		
94				■ Puls. Dampener (Disch.) (See Rem 4) Type:		
95				■ Diaphragm Rupture Detection System (PDT->PAH contacts@ DCS)		
96						
97	REMARKS					
98	1. Pump casing design pressure shall not be less than _____ kg/cm ² g @ _____ °C					
99	2. Pump manufacturer shall supply & mount Calibration Pot, if the same is specified.					
100	3. Pump manufacturer shall supply & mount Suction pulsation dampener, if the same is required to reduce the NPSHR.					
101	4. Pump manufacturer shall supply & mount Discharge pulsation dampener to limit the pulsations within ±3%					
102	5. For acceleration head loss, Equivalent Suction piping length (m): _____; Suction pipe diameter (mm): _____					
103	6. The pump vendor shall calculate the acceleration head. Calculations for Acceleration head & NPSHR shall be furnished. The pump vendor shall ensure that NPSHA is greater than "Acceleration Head + NPSHR" by a margin of at least 1.0 meter, either by proper selection of pump speed or by proper valve design or else by providing a suction side volume bottle.					
104	6. The pump manufacturer shall supply Controlled Volume pump unit complete with speed reducer, driver, calibration pot, suction pulsation dampener (if reqd. or specified), discharge pulsation dampener, suction & discharge manifold piping duly prefabricated for multi-head pumps, relief valves, back pressure valve, instrumentation etc. all duly mounted on a single common base plate, in the pump manufacturer's shop prior to shop testing.					
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DATE	REV	JOB ENGINEER	REVIEWED & APPROVED BY

**CENTRIFUGAL PUMP
(HORIZONTAL - GENERAL
PURPOSE PROCESS SERVICE)**

**Document No.
B957-420-80-42-DS-9996
Rev. No. A
Page 1 of 2**

1	GENERAL										
2	Project: BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT					Job No.: B957					
3	Owner: M/s BPCL					Site: BINA, MP					
4	Purchaser:					Unit: SGU			Unit No: 420		
5	Item No.:					Service:					
6	No. Reqd.:		Working:		Standby:		Parallel Operation Required:			☐ Yes ☐ No	
7	Applicable to ☐ Proposal		☐ Purchase		☐ As Built						
8	☒ Scope option & Information specified by purchaser ☐ Information Reqd. from & option left to vendor. Vendor to cross ☒ the selected option.										
9	Driver: Working		Standby		Driver Supplied & Mounted By:			☐ Pump Mfr. ☐ Other			
10	OPERATING CONDITIONS (Refer Process Package)										
11	Liquid Handled					Capacity (m ³ /hr): Min/Nor/Rated:					
12	Pumping Temp. (°C):		Normal		Max.		Discharge Pressure (kg/cm ² ,A):				
13	Specific Gravity at P.T./15°C:					Suction Pressure: Nor./ Max. (kg/cm ² ,A):					
14	Vapour Pressure at P.T. (kg/cm ² ,A):					Diff. Pressure (kg/cm ²) @ Rated Capacity:					
15	Viscosity at P.T. (cP/est):		Corr./Eros. By:		Diff. Head (m) @ Rated Capacity:						
16	Solids in suspension		☐ Yes ☐ No		Size:		%		NPSH Available (m):		
17	MANUFACTURERS SPECIFICATIONS										
18	Pump Manufacturer:					Model No.:					
19	CONSTRUCTION					PERFORMANCE					
20	Casing Mounting: ☐ Centerline ☐ Foot ☐ Inline					Proposal Curve No.					
21	Casing Split: ☐ Axial ☒ Radial					Visc. Corr. Factor: C ₀ C _Q C _H					
22	Type: ☐ Single Volute ☐ Double Volute ☐ Diffuser					NPSH Reqd. (Water) (m): F/L Speed (rpm):					
23	Casing Connection: ☒ Vent ☒ Drain ☐ Gauge					No. of stages: Efficiency (%):					
24	Nozzles		Size		ANSI Rating		Facing		Position		
25	Suction					Rated BKW(0% Tol.): kW Max.BKW rtd. Imp.:					
26	Discharge					BKW @ MCF(Δ=1.0): kW Rec. Driver Rating: (kW)					
27	Imp. N (mm)		Max. Rated:		Min. Type:		Closed / Semi open		MCF (m ³ /hr):Stable Thermal		
28	Brg.: Type/No.		Radial:		Thrust:		Lub: Oil		M.A.W.P @ 15°C/P.T./Design Temp.(kg/cm ² ,G):		
29	Cplg.:Make/Type: Fleximetl w spacer Nonspark Guard ☒ Yes ☐ No					Hydrostatic Test pressure (kg/cm ² ,G):					
30	Driver Half cplg. mounted by: ☒ Pump Mfr. ☐ Others					Rotation facing coupling end: ☐ CW ☐ CCW					
31	Packing Type: Size: No. of rings:					Seal flush/ Quench plan: Material:					
32	Mech. Seal: Make		Model:		API Code:		Ext. seal flush fluid: LPM: @ Kg/cm ² G/ EC				
33	Base Plate Drain Rim Type :		☒ Yes ☐ No		Fdn. Bolts: ☒ Yes ☐ No		Seal Barrier fluid: LPM: @ Kg/cm ² G/ EC				
34	Throat Bush: ☒ Yes ☐ No		Matl.:		Bal. Device: ☐ Yes ☐ No		Ext. quench fluid: LPM: @ Kg/cm ² G/ EC				
35	Materials (API-610 Matl. Class):		(Rem.4)		MOC		ASTM Grades		C.W. Plan : LPM: @ Kg/cm ² G/ EC		
36	I - Cast Iron (Ductile)		Casing						Weight(kg): Pump+Base+Coupling: Driver:		
37	B - Bronze		Impeller						AUXILIARY PIPING INTERFACE CONNECTIONS (All interface conns. shall be termtd. with a flng. block valves)		
38	S - Carbon Steel		Inner Case parts								
39	C - 11-13% Chr. Stl.		Sleeve Packed						Size Rating (ANSI) Facing		
40	h - Hardened		Sleeve Seal						Lantern Ring Inlet/Outlet		
41	f - Faced		Casing ring		H-BHN				Ext. Seal flush fluid Inlet/Outlet		
42	K - SS 304		Impeller ring		50(min)				Seal Quench fluid Inlet		
43	L - SS 316		Shaft						Seal pot vent/ drain		
44	X - AISI 410		Throttle Bush						Casing vent/ drain		
45	Y		Throat Bush						C.W Inlet/ Outlet		
46	Z		Balance Drum						Base plate drain (only flanged)		
47	☐ Driver suitable for Pump starting with open Disc. Valve condition.									Casing steam jacket	
48	INSPECTION & TESTS (EACH PUMP)										
49			Witness		Observe				Witness Observe		
50	☒ Shop Test / Inspection		☐		☒		☒ NPSH As Reqd. ☐ Per Spec. ☐ Mandatory		☒		
51	☒ Material Certificates		☐		☒		☒ Dismantle Insp. & Re-assembly after Test (Rem. 6)		☒		
52	☒ Hydrostatic		☐		☒		☒ Visual, dimension and skid completeness check		☐		
53	☒ Performance/Sound Level (Rem. 5)		☒		☐		☐ Check for direction of rotation of pump.		☐		
54	Applicable Specification: EIL Standard Specification 6-41-0002 Rev. 5, Job Specifications										
55	REMARKS: - 1) Max. allowable casing working pressure shall not be less than _____ kg/cm ² g @ _____ °C.										
56	2) Down Stream Design Pressure is _____ kg/cm ² g. Maximum shut-off, considering max suction pressure, including all tolerances shall not exceed this value.										
57	3) Accessories and Instrumentation shall be as per EIL approved vendors only.										
58	4) MOC shall be as specified in process package.										
59	5) For Horizontal centrifugal pumps with driver rating up to 55kW, witnessing of mechanical run test, NPSH test (as applicable) &										
60	performance test is not required at vendor's shop – Reviewing of manufacturer's shop test reports shall be considered as adequate.										
61	For Horizontal Centrifugal pump above 55kW and upto 160 kW, witnessing of mechanical run test, performance test and NPSH test (as										
62	applicable) shall be limited to 1/Tag. - Reviewing of manufacturer's shop test reports shall be considered enough for balance units.										
63	Balance units.										

64	6) Dismantle Inspection of pump after performance test shall be applicable only in case of abnormality in mechanical behavior (such
65	as excessive noise & vibration, bearing temperature rise, etc.) during performance test.
66	7) This is typical datasheet. Contractor shall fill the datasheet for each items separately for preparation of enquiry documents and
67	Owner/PMC's approval.

Date	Rev	Job Engineer	Rev. & Approved By

**CENTRIFUGAL PUMP
(VERTICAL)**

Document No.
B957-420-80-42-DS-9997
Rev. No. A
Page 1 of 4

1	GENERAL				
2	Project: BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT		EIL Job No.: B957		
3	Owner: M/s BPCL		Site: BINA, MP		
4	Purchaser:		Unit: SGU		Unit No.: 420
5	Item No.:		Service:		
6	No. Reqd:	Working:	Standby:	Parallel Operation Required:	☐ Yes ☐ No
7	Applicable to ☐ Proposal ☐ Purchase ☐ As Built				
8	☒ Scope, option & Info. specified by purchaser ☐ Info. Required from & option left to vendor. Vendor to cross ☒ the selected option.				
9	Driver: Working:		Driver Supplied & Mounted By: ☐ Pump Mfr. ☐ Other		
10	OPERATING CONDITIONS (Refer Process Package)				
11	Liquid Handled		Capacity (m ³ /hr): Min/Nor/Rated:		
12	Pumping Temperature (°C) Min./Nor./Max:		Discharge Pressure (kg/cm ² , A):		
13	Specific Gravity at P.T./15°C:		Suction Pressure: Nor./ Max. (kg/cm ² A):		
14	Vap. Pressure at P.T. (kg/cm ² , A):		Diff. Pressure (kg/cm ²) @ Rated Capacity:		
15	Viscosity at P.T. (cSt):		Diff. Head (m) @ Rated Capacity:		
16	Corr./Eros. Caused by:		NPSH Available (m):		
17	MANUFACTURER'S SPECIFICATIONS				
18	Pump Manufacturer:		Model No.:		
19	CONSTRUCTION		Bowl Head Calculations: (m) (Rem.-8)		
20	Pump Type:		Differential Head at Discharge Flange:		
21	☒ Vertical Sump (VS4) Or ☒ Turbine(VS1) ☐ Submerged Motor		Diff. Between Minimum Liquid Level/		
22	☐ Vertical Double Casing		Minimum Submergence Level and bottom of		
23	☐ Single Volute ☐ Double ☐ Diffuser		mounting plate (whichever is higher):		
24	Casing Connections: ☒ Vent ☒ Drain ☐ Gauge		Thickness of Mounting Plate:		
25	Line Shaft:		Diff. Between Mounting Plate Level and		
26	☒ Open ☐ Enclosed		Discharge. Flange Centerline/Top of Flange:		
27	Shaft Dia. (mm): No. of Shaft Segments:		Friction losses in Suction Strainer:		
28	Spacing between Shaft Guide Bushing (mm):		Friction losses in Column/Discharge Pipe:		
29	Coupling: Make		Total (Bowl) Differential Head (m):		
30	Type: Flexible metallic				
31	Non-spark Guard: ☒ Yes ☐ No		PERFORMANCE		
32	Line Shaft Coupling Type:		Proposal Curve No.		
33	☐ Threaded ☒ Muff-Type		Visc. Corr. Factor: C ₀ C _Q C _H		
34	Column Type: ☐ Threaded ☒ Flanged		NPSH Reqd. (Water) (m): F/L Speed (rpm):		
35	Column NB (mm): No. of Col. Segments:		No. of stages:		
36	Nozzles	Size	ANSI Rating	Facing	Position
37	Suction				
38	Discharge				
39	Imp.Dia (mm)	Max:	Rated:	Min:	Type:
40	Guide Bushing:	Material:	No.		
41	Guide Bushing Lubrication:		Max. head rated imp.(m):		
42	☒ Pumpage / Self ☐ Oil ☐ Other		Cap @ BEP(m ³ /hr):		
43	☒ No Pre-lubrication Required		MCF (m ³ /hr):Stable Thermal		
44	Driver Half cplg. mtd. by: ☒ Pump Mfr. ☐ Others		M.A.W.P @ 15°C/P.T./Design Temp.(kg/cm ² ,G):		
45	Packing: Not Applicable Size: No. of rings:		Hydrostatic Test pressure (kg/cm ² ,G):		
46	Mech. Seal: Make		Rotation facing coupling end: ☐ CW ☐ CCW		
47	Model: API Code:		Seal flush/ Quench plan: Material:		
48	Mounting Plate: ☒ Yes ☐ No Fnd. Bolts: ☐ Yes ☐ No		C.W. Plan: Material:		
49	Mtg Plate Gasket: ☒ Yes ☐ No Mntg. Bolts: ☒ Yes ☐ No		Ext. seal flush fluid: LPM: kg/cm ² G/ °C		
50	Motor Mtg Stool: ☒ Yes ☐ No		Seal Barrier fluid: LPM: kg/cm ² G/ °C		
51	Balancing Device: ☐ Yes ☐ No		Ext. quench fluid: LPM: kg/cm ² G/ °C		
52	Suction Strainer: ☒ Yes ☐ No Material: SS		C.W. Reqmt. LPM: kg/cm ² G/ °C		
53	Type: Mesh Size:		Thrust (kg) Up: Max. Min.		
54			Thrust (kg) Down: Max. Min.		
55	NOTES:		WEIGHT DATA:		
56			Weight of the Pump (kg):		
57			Weight of the Mounting. Plate (kg):		
58			Weight of the Mounting. Stool (kg):		
59			Weight of the Driver (kg):		
60			Total Weight of the Pump Unit (kg):		
61					

INSPECTION & TESTS (EACH PUMP)						
	Witness	Observe		Witness	Observe	
62						
63						
64	☐	☐	Shop Test / Inspection	☐	☐	NPSH Test / Min. Submergence Test As Reqd. ☐ Per spec. ☒ Mandatory
65	☐	☐	Material Certificates	☐	☐	Dismantle Insp. & Re-assembly after Test (Rem. 11)
66	☒	☐	Hydrostatic	☒	☐	Visual, dimension and skid completeness check
67	☒	☐	Performance/Sound Level	☐	☐	Check for direction of rotation of pump.
68	Materials Class (API 610): Rem.10					
69	Materials:		MOC	ASTM Grades		AUXILIARY PIPING INTERFACE
70	Casing (External)			(All interface conn. shall be termntd. with a flng. block valves)		
71	Impeller				Size	Rating(ANSI)
72	Inner Case parts					Facing
73	Sleeve Packed / Stuffing Box					
74	Sleeve Seal					
75	Casing wear ring	2H-				Seal Quench fluid Inlet
76	Impeller wear ring	50(Min.)				Seal pot vent/ drain
77	Shaft Driver					C.W Inlet/ Outlet
78	Shaft Intermediate					Base plate drain (only flanged)
79	Shaft Pump					
80	Column / Column Flange					Steam Inlet/Outlet for Jacket
81	Mounting Plate					
82	Discharge Pipe					
83	Throttle Bush					
84						
85	Legend: I-Cast Iron; B-Bronze; S-Carbon Steel; C-11 to 13% Chr Stl; h-Hardened; f-Faced; K-SS 304; L-SS 316; X-AISI 410					
86	☐ Driver suitable for Pump starting with open Discharge Valve condition.					
87	Applicable Specification:					
88	REMARKS:- 1) Maximum allowable casing working pressure shall not be less than ____ kg/cm ² ,g @ ____ °C.					
89	2) Down Stream Design Pressure is ____ kg/cm ² ,g. The same shall not be exceeded in any circumstance.					
90	3) This pump item is to be installed in Vessel (Vessel item no. _____).					
91	4) Accessories & Instrumentation shall be as per approved makes only.					
92	5) Guide bush (line shaft) bearings to be suitable for dry-running & start-up.					
93	6) Discharge pressure is supposed to be indicated at the pump discharge flange located above mounting plate. Vendor should calculate the bowl head based on the installation depth of the pump. Calculations for arriving at the bowl head shall be furnished along with the data sheet.					
94	7) The dimensions for the mounting plate, bolting, gaskets etc. shall be as per the following standards. For Sizes ≤ 24 inches: ASME B16.5, For Sizes > 24 inches: ASME B16.47 Series B.					
95	8) Pump vendor shall furnish during the detailed engineering, the filled in datasheet along with the Dimensional Details (Sheet 3 of 4 is for VS1 type pump & Sheet 4 of 4 is for VS4 type pump), bowl head calculations, based on vessel drawing.					
96	9) Performance / Characteristics curves of the pumps shall be furnished by the bidder along with datasheet.					
97	10) MOC shall be as specified in process package.					
98	11) Dismantle Inspection of pump after performance test shall be applicable only in case of abnormality in mechanical behavior					
99	(such as excessive noise & vibration, bearing temperature rise, etc.) during performance test.					
100	12) Studs/ bolts (wetted) shall be of SS-316.					
101	13) Minimum submergence is to be advised by Vendor and must be ensured that it is within boot.					
102	18) The pump mounting plate shall be of standard thickness. The thickness of mounting plate shall be not be less than the flange thickness specified in ASME B 16.5 / ASME B 16.47 Series B as a minimum or as required by vendor whichever is higher.					
103	19) Material of construction for mounting flange/plate shall be SA 105/SA 516 GR 60/70. Material of construction for Mounting fasteners shall be SA – 193 Gr B7 / SA – 194 Gr. 2H.					
104						
105						
106						
107						

Date	Rev	Job Engineer	Rev. & Approved By

VERTICALLY SUSPENDED SINGLE CASING DIFFUSER PUMP (VESSEL MOUNTED), TYPE-VS1

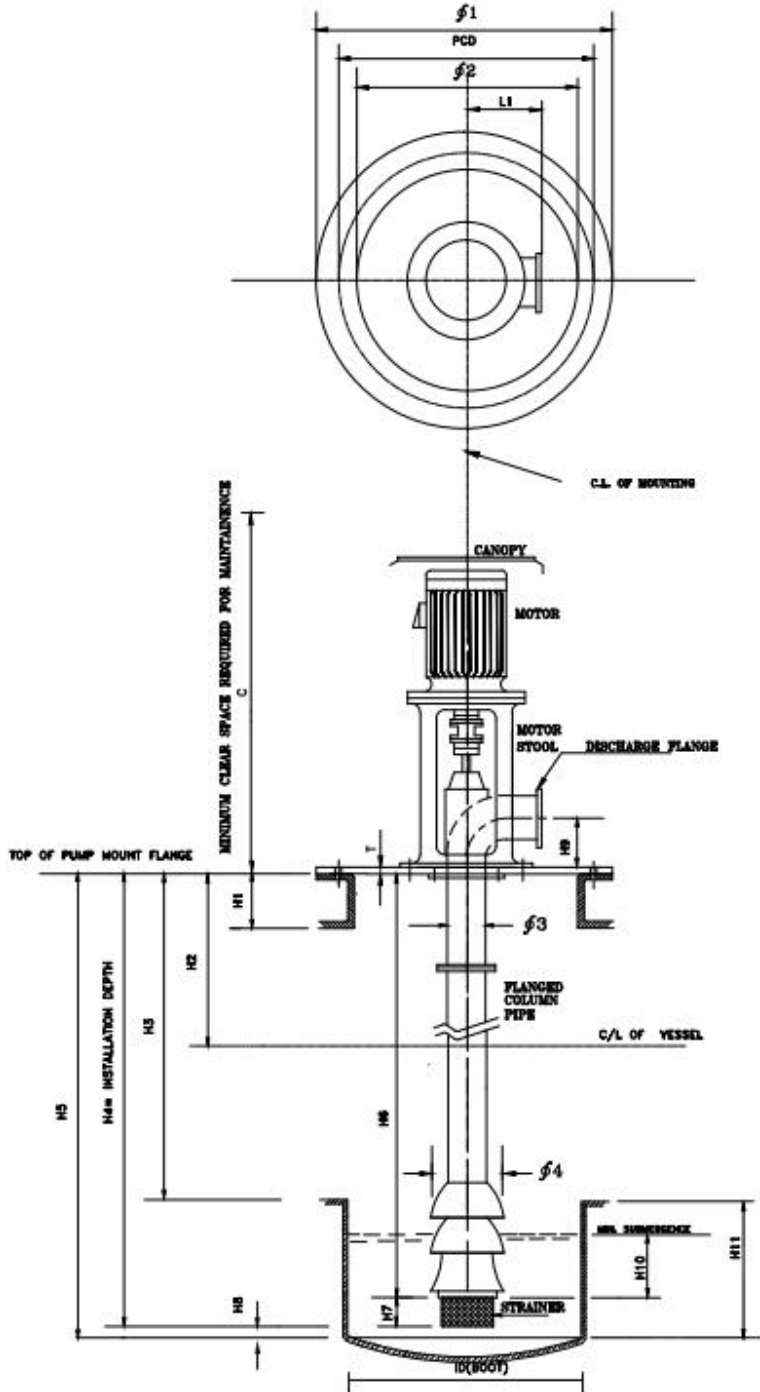
PUMP ITEM NO: _____

VESSEL ITEM NO: _____

VENDOR SHALL FURNISH FOLLOWING
DIMENSIONS IN MM.

S.NO	DESCRIPTION	DIMENSIONS(mm)
1.	$\phi 1$ (*)	
2	PCD (*)	
3	$\phi 2$ (P)	
4	$\phi 3$ (*)	
5	$\phi 4$ (*)	
6	ID(BOOT) (P)	
7	L1 (*)	
8	H1 (P)	
9	H2 (P)	
10	H3 (P)	
11	H4 (*)	
12	H5 (P)	
13	H6 (*)	
14	H7 (*)	
15	H8 (*)	
16	H9 (*)	
17	H10 (*)	
18	H11 (P)	
19	C (*)	
20	T (*)	(45 MM)
21		
22		
23		

(*) - BY VENDOR
(P) - BY PURCHASER



NOTE: 1) MINIMUM SUBMERGENCE (i.e. H10) SHOULD BE AVAILABLE WITHIN THE BOOT TO ENSURE COMPLETE EVACUATION OF THE VESSEL.

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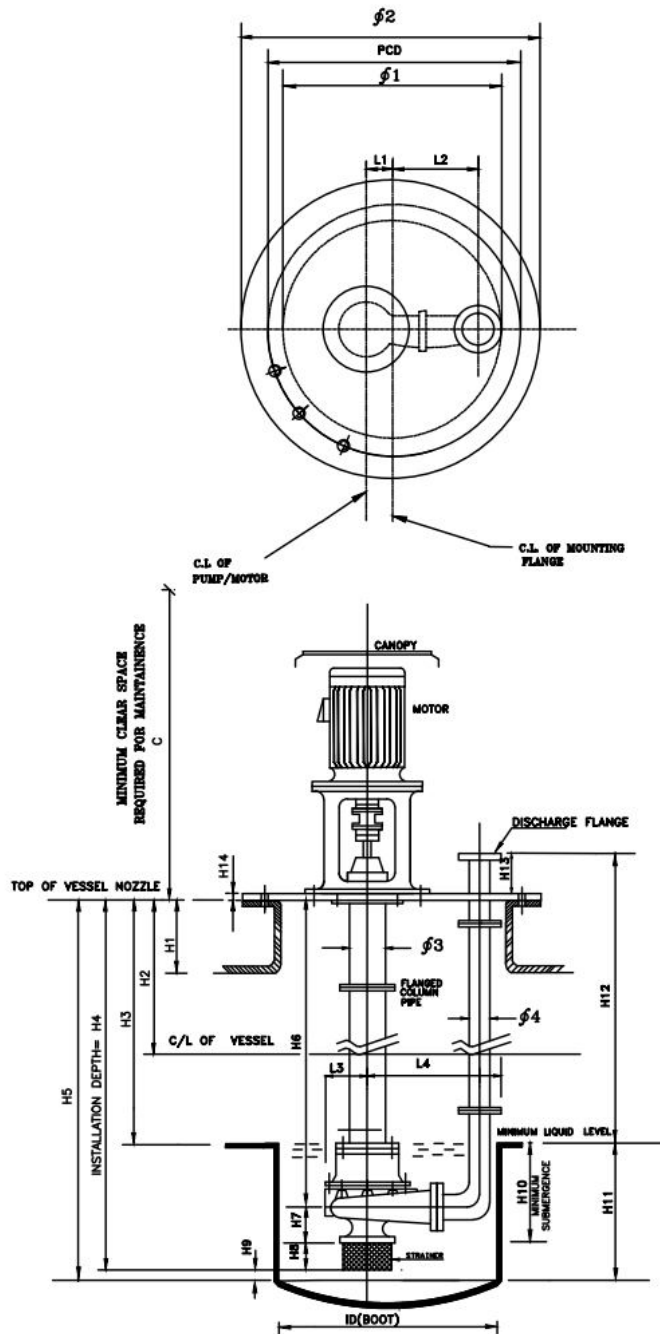
Format no. 1645-SK-105B Rev 1

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VERTICALLY SUSPENDED SINGLE CASING VOLUTE LINE-SHAFT DRIVEN SUMP PUMP (VESSEL MOUNTED), TYPE-VS4

PUMP ITEM NO: _____

VESSEL ITEM NO: _____



NOTE: 1) MINIMUM SUBMERGENCE (i.e. H10) SHOULD BE AVAILABLE WITHIN THE BOOT TO ENSURE COMPLETE EVACUATION OF THE VESSEL. MINIMUM LIQUID LEVEL, THEREFORE SHALL BE THE SAME AS BOTTOM LEVEL OF THE TANK AS SHOWN.

S.NO	DESCRIPTION	DIMENSIONS(mm)
1.	φ1 (*)	
2	PCD (*)	
3	φ2 (*)	
4	ID(BOOT)(*)	
5	φ3 (*)	
6	φ4 (*)	
7	L1 (*)	
8	L2 (*)	
9	L3 (*)	
10	L4 (*)	
11	H1 (P)	
12	H2 (P)	
13	H3 (P)	
14	H4 (*)	(H6+H7+H8)
15	H5 (*)	(H4+H9)
16	H6 (*)	
17	H7 (*)	
18	H8 (*)	
19	H9 (*)	
20	H10(*)	
21	H11 (*)	(H5-H3)
22	H12 (*)	(H3+H14+H13)
23	H13 (*)	(180 min.)
24	H14(*)	(45 min.)
25	C	

(*) - BY VENDOR
(P) - BY PURCHASER

Date	Rev	Prep By	Rev & appr By

**CENTRIFUGAL PUMP
(HORIZONTAL-
SPECIALPURPOSE PROCESS)**

Document No.
B957-420-80-42-DS-9998
Rev. No. A
Page 1 of 1

1	GENERAL									
2	Project:	BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT				Job No.:	B957			
3	Owner:	M/s BPCL				Site:	BINA, MP			
4	Purchaser:					Unit:	SGU		Unit No: 420	
5	Item No.:					Service:				
6	No. Reqd.:	Working:		Standby:		Parallel Operation Required:		☐ Yes ☐ No		
7	Applicable to	☐ Proposal ☐ Purchase				☐ As Built				
8	☒ Scope option & Information specified by purchaser ☐ Information Reqd. from & option left to vendor. Vendor to cross ☒ the selected option.									
9	Driver: Working			Standby			Driver Supplied & Mounted By:	☒ Pump Mfr. ☐ Other		
10	OPERATING CONDITIONS (Refer Process Package)									
11	Liquid Handled					Capacity (m ³ /hr): Min/Nor/Rated:				
12	Pumping Temp. (°C):	Normal		Max.		Discharge Pressure (kg/cm ² , g):				
13	Specific Gravity at P.T./15°C:					Suction Pressure: Rated/ Max. (kg/cm ² , g):				
14	Vapour Pressure at P.T. (kg/cm ² , A):					Diff. Pressure (kg/cm ²) @ Rated Capacity:				
15	Viscosity at P.T. (cP/cst):			Corr./Eros. By:	Nature of liquid:		Diff. Head (m) @ Rated Capacity:			
16	Solids in suspension	☐ Yes ☐ No		Size:	%		NPSH Available (m):			
17	MANUFACTURERS SPECIFICATIONS									
18	Pump Manufacturer:					Model No.:				
19	CONSTRUCTION	☐ OH2 ☐ BB2 ☐ OH6				PERFORMANCE				
20	Casing Mounting:	☒ Centerline ☐ Foot ☐ Inline				Proposal Curve No.				
21	Casing Split:	☐ Axial ☒ Radial				Visc. Corr. Factor: C ₁		C ₀		C _H
22	Type:	☐ Single Volute ☐ Double Volute ☐ Diffuser				NPSH Req'd. (Water) (m):		F/L Speed (rpm):		
23	Casing Connection:	☒ Vent ☒ Drain ☐ Gauge				No. of stages:		Efficiency (%):		
24	Nozzles	Size	ANSI Rating		Facing	Position	Rated BkW (0% Tol.):		kW	Max.BkW rtd. Imp.:
25	Suction					BkW @ MCF(p=1.0):		kW	Rec. Driver Rating: (kW)	
26	Discharge					Max.head rtd imp. (m):		Cap@ BEP(m ³ /hr):		
27	Imp.Φ (mm)	Max:	Rated:		Min:	Type: Closed	MCF (m ³ /hr): Stable		Thermal	
28	Brg.: Type/No. Radial:	Thrust:		Lub: Oil		M.A.W.P @ 15°C/P.T./Design Temp. (kg/cm ² , G):				
29	Cplg.: Make/Type:	Fleximet w spacer		Nonspark Guard ☒ Yes ☐ No		Hydrostatic Test pressure (kg/cm ² , G):				
30	Driver Half cplg. mounted by:	☒ Pump Mfr. ☐ Others				Rotation facing coupling end:		☐ CW ☐ CCW		
31	Packing Type:	NA		Size:	No. of rings:		Seal flush/ Quench plan:		Material: SS 316	
32	Mech. Seal: Make	Model:		API Code:		Ext. seal flush fluid:		LPM: @ Kg/cm ² / °C		
33	Base Plate Drain Rim Type :	☒ Yes ☐ No		Fdn. Bolts:	☒ Yes ☐ No		Seal Barrier fluid:		LPM: @ Kg/cm ² / °C	
34	Throat Bush:	☒ Yes ☐ No		Matl.:	Bal. Device: ☐ Yes ☐ No		Ext. quench fluid:		LPM: @ Kg/cm ² / °C	
35	Materials (API-610 Matl. Class):	Refer Process Pkg.		MOC	ASTM Grades		C.W. Plan:		LPM: @ Kg/cm ² / °C	
36	I - Cast Iron (Ductile)	Casing				Weight(kg): Pump+Base+Coupling:		Driver:		
37	B – Bronze	Impeller				AUXILIARY PIPING INTERFACE CONNECTIONS (All interface conn.shall be termntd.with a flng. block valves)				
38	S - Carbon Steel	Inner Case parts								
39	C - 11-13% Chr. Stl.	Sleeve Packed						Size	Rating(ANSI)	Facing
40	h – Hardened	Sleeve Seal				Lantern Ring Inlet/Outlet				
41	f – Faced	Casing ring		ΔH- BHN		Ext. Seal flush fluid Inlet/Outlet				
42	K -SS 304	Impeller ring		50 (min.)		Seal Quench fluid Inlet				
43	L -SS 316	Shaft				Seal pot vent/ drain				
44	X - AISI 4140	Throttle Bush				Casing vent/ drain				
45		Throat Bush				C.W Inlet/ Outlet				
46	Z	Balance Drum				Base plate drain (only flanged)				
47	☐ Driver suitable for Pump starting with open Disc. Valve condition.					Casing steam jacket				
48	INSPECTION & TESTS (EACH PUMP)									
49		Witness		Observe				Witness		Observe
50	☒ Shop Test / Inspection	☐		☐		☒ NPSH As Req'd. ☒ Per Spec. ☐ Mandatory		☒		☐
51	☒ Material Certificates	☐		☐		☒ Dismantle Insp. & Re-assembly after Test		☒		☐
52	☒ Hydrostatic	☒		☐		☒ Unitisation/Dimensional Check		☒		☐
53	☒ Performance/Sound Level	☒		☐		☒ Check for direction of rotation of pump & driver.		☒		☐
54	Applicable Specification: API Std. 610, 12th Edition, along with EIL Std. Spec. No. 6-41-0008, Job Specification									
55	REMARKS: - 1) Max. allowable casing working pressure shall not be less than _____ kg/cm ² g @ _____°C.									
56	2) Down Stream Design Pressure is _____kg/cm ² g. Maximum shut-off, considering max suction pressure, including all tolerances shall not exceed this value.									
57	3) Accessories and Instrumentation shall be as per EIL approved vendors only.									
58	4) Unitization of Pump and Driver shall be done in pump manufacturer's shop.									
59	5) This datasheet must be duly filled in by vendor/contractor. Contractor shall review/ approve and then shall submit this datasheet, along with PMC approved process datasheet, for PMC review.									

Date	Rev	Job Engineer	Rev. & Approved By

**CENTRIFUGAL PUMP
(MULTISTAGE-SPP)**

1	GENERAL									
2	Project: BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT					Job No.: B957				
3	Owner: M/s BPCL					Site: BINA, MP				
4	Purchaser:					Unit: SGU			Unit No.: 420	
5	Item No.:					Service:				
6	No. Required:		Working:		Standby:		Driver Type: Working:		Standby:	
7	Applicable to ☐ Proposals					☐ Purchase			☐ As Built	
8	☒ Scope, Option & Information Specified by Purchaser ☐ Information required from and options left to vendor. Vendor to cross ☒ the selected option									
9	Manufacturer:					Model:				
10	Driver supplied & mounted by:					☒ Pump Manufacturer			☐ Other	
11	Gear (If reqd.) supplied & mounted by:					☐ Pump Manufacturer			☐ Other	
12	Applicable Code & Standards: Job Spec, API 610 12th edition, EIL Std. Spec. No. 6-41-0008									
13										
14	OPERATING CONDITIONDS					SITE AND UTILITY DATA				
15	☐ Capacity (m ³ /hr)					Location: ☐ Indoor ☐ Heated ☐ Underroof				
16	Normal:		Rated:		Other:		☐ Outdoor ☐ Unheated ☐ Grade ☐ Partial Side			
17	☐ Suct. Pressure (kg/cm ² G) [Max./Rated]:					☐ Mezzanine ☐ Other:				
18	☐ Discharge Pressure (kg/cm ² G):					☐ Electrical Area Classification:				
19	☐ Differential Pressure (kg/cm ²):					Class		Group		Division
20	☐ Differential Head (m)		NPSHA (m)			☐ Winterization Required			☐ Topicalization Required	
21	☐ Process Variations					☐ Site Data:				
22	☐ Starting Conditions					☐ Altitude (m):		☐ Barometer (kg/cm ² G):		
23	☐ Service:		☐ Continuous		☐ Intermittent (Start/Day)		☐ Range of Amb.Temp.(deg C): Min./Max.			
24	☐ Parallel Operation Required		☐ Yes		☐ No		☐ Relative Humidity (%): Min./Max.			
25	PERFORMANCE					☐ Unusual Conditions:				
26	Proposal Curve No.					☐ Dust		☐ Fumes		☐ Other
27	Visc. Correction Factor C _n / C _Q / C _H :					☐ Utility Conditions:				
28	☐ NPSH Req'd. (m)		F/L Speed (rpm):			☐ Steam:		Driver		Heating
29	☒ No. of Stages: <=10		Efficiency (%):			☐ Press.		@ °C		@ °C
30	☐ Rated BkW (+/- 0% Tol.):					☐ Press.		@ °C		@ °C
31	☐ Max. BkW Rtd. Implr. (kW):									
32	☐ BkW @ MCF (Δ=1) (kW):									
33	☐ Recom. Driver Rating (kW):					☐ Electricity: Drivers Heating Control Shutdown				
34	☐ Max. Head @ Rated Impeller (m):					☐ Voltage				
35	☐ Capacity @ BEP(m ³ /hr):					☐ Hertz				
36	☐ Min. Cont. Flow (m ³ /hr):		Stable:		Thermal:		☐ Phase			
37	☐ Preferred Operating Region(m ³ /hr): To					☐ Cooling Water:				
38	☐ Allowable Operating Region(m ³ /hr): To					☐ Temp. Inlet (deg C):		Max. Return (deg C):		
39	☐ Suction Specific Speed:					☐ Pressure: Nor. (kg/cm ² G)		Design (kg/cm ² G):		
40	☐ Max. Sound Pressure Level Allowable(dBA):					☐ Return: Min. (kg/cm ² G)		Max. Allow. P(kg/cm ² G):		
41	☐ Expected Sound Pressure Level(dBA):					☐ Water Source:				
42						☐ Chloride Concentration (PPM):				
43	CONSTRUCTION					☐ Instrument Air Pressure (kg/cm ² G):				
44	☐ PUMP TYPE:					Max.		Min.		
45	☐ BB Axially Split, Multistage					LIQUID				
46	☐ BB Radially Split, Multistage: ☐ Single Casing ☐ Double Casing					☐ Type/Name of Liquid:				
47	☐ Vert. Suspended Double Casing: ☐ Diffuser ☐ Volute					☐ Pumping Temperature(EC):				
48	Nozzle Connections:					Normal		Max.		Min.
49		Size	Rating	Facing	Position	☐ Vapour Pressure(kg/cm ² A):		@ °C		
50	Suction					☐ Relative Density (Specific Gravity):				
51	Discharge					Normal		Max.		Min.
52	Balance Drum					☐ Specific Heat (Cp) kJ/kg°C				
53	☐ Impeller Diameter (mm):					☐ Viscosity(cP/cst) @PT		@ °C		
54	Rated:		Max.		Min.		☐ Max. Viscosity(cP/cst)		@ °C	
55	☐ Pressure Casing Connections:					☐ Corrosive/Erosive Agent:				
56		No.	Size	Type		☐ Chloride Concentration (PPM):				
57	☒ Drain			With Valve		☐ H2S Concentration (PPM):				
58	☒ Vent			With Valve		☐ Hazardous		☐ Flammable		☐ Other
59	☐ Pressure Gage									
60	☐ Temp. Gauge									

CENTRIFUGAL PUMP (MULTISTAGE-SPP)

				MATERIAL		
				Material Class (API-610):	MOC	ASTM Grades
61						
62						
63	Press. Casing Conn. Contd.			Casing		
64		No.	Size	Type	Barrel	
65	☐ Warm Up				Inner Casing	
66	☐ Balance/Leak off				Impeller (Suction)	
67	☐ Cylindrical Threads Required				Impeller (Others)	
68	■ Casing Mounting:			Shaft Sleeve		
69	■ Centerline ☐ Near Centerline ☐ Foot			Interstage Sleeve		
70	☐ Separate Mounting Plate ☐ In-Line			Casing Wearing Ring	ΔH-BHN	
71	☐ Casing ☐ Axial ☐ Radial			Imp. Wearing Ring	=50 (min)	
72	■ Casing Type:			Shaft		
73	☐ Single Volute ☐ Multiple Volute ☐ Diffuser			Throat Bush		
74	■ Between Bearings ☐ Barrel			Throttle Bush		
75	■ Case Pressure Rating:			Diffuser		
76	■ MAWP (kg/cm ² G): @ EC			Drive Shaft		
77	■ Hydrotest Pressure (kg/cm ² G): 1.5 X MAWP			Intermediate Shaft		
78	■ Suction Press. Region must be Designed for MAWP			Pump Shaft		
79	☐ Rotation (Viewed from Coupling End):			Bearing for Intermediate Shaft		
80	☐ CW ☐ CCW			Column Pipe		
81	■ Impellers Individually Secured					
82	■ SHAFT:					
83	☐ Shaft Dia. at Coupling		mm			
84	☐ Shaft Dia. Between Bearings		mm			
85	☐ Span Between Bearings		mm	Legends: I- Cast Iron, B- Bronze, S- Carbon Steel, C- 11-13% Chr. Stl.,		
86	☐ Span Between Brg. & Impeller		mm	h- Hardened, f- Faced, K- SS 304, L-SS 316		
87	Remark:			X		
88				Y		
89				Z		
90						
91	Couplings: Driver-Pump					
92	☐ Make:			Remarks:		
93	☐ Model:					
94	☐ Coupling Rating (kW/100 RPM):					
95	☐ Lubrication:					
96	☐ Limited End Float Required:					
97	☐ Spacer Length: mm					
98	■ Service Factor: 1.5 minimum					
99	■ Driver Half Coupling Mounted By:					
100	■ Pump Mfr. ☐ Driver Mfr. ☐ Purchaser					
101	☐ Coupling Per API 671					
102	■ Base Plate:					
103	☐ API Base Plate Number: ☐ Non Grout Const.					
104	Remark:					
105						
106						
107	Bearings And Lubrication					
108	☐ Bearing Type Number:					
109	■ Radial					
110	■ Thrust					
111	☐ Review and Approve Thrust Bearing Size					
112	☐ Lubrication:					
113	☐ Grease ☐ Flood ☐ Ring Oil					
114	☐ Flinger ☐ Purge Oil Mist ☐ Pure Oil Mist					
115	☐ Constant Level Oiler Preference					
116	☐ Pressure Lub. System: ☐ API 610 ☐ API 614					
117	☐ Oil Viscosity ISO Grade					
118	☐ Oil Heater Required: ☐ Electric ☐ Steam					
119	☐ Oil Pressure to be greater than Coolant Press.					
120	Remarks:					

CENTRIFUGAL PUMP (MULTISTAGE-SPP)

121	MECHANICAL SEAL OR PACKING		Steam and Cooling Water Piping	
122	☐ Seal Data:		☐ Cooling Water Piping Plan	
123	☐ See Attached API 682 Data Sheet		☐ Cooling Water Requirement (m ³ /hr):	
124	☐ Non-API 682 Seal		Seal Jacket/Brg Hsg	@ kg/cm ²
125	☐ API Seal Code		Seal Heat Xchanger	@ kg/cm ²
126	☐ Seal Manufacturer		Quench	@ kg/cm ²
127	☐ Size and Type		☐ Total Cooling Water (m ³ /hr):	
128	☐ Manufacturer Code:		☐ Steam Piping:	
129	Seal Chamber Data		☐ Tubing	☐ Piping
130	☐ Temperature (EC):		Remark:	
131	☐ Pressure (kg/cm ² G):			
132	☐ Flow (m ³ /hr):			
133	☐ Seal Chamber Size:			
134	☐ Total Length (mm)	☐ Clear Length(mm)		
135	Seal Construction:			
136	☒ Sleeve Material: SS		Instrumentation	
137	☒ Gland Material: SS		☐ Vibration	
138	☒ Aux. Seal Device: Floating Throttle Bush		☐ Non-Contacting (API 670)	☐ Transducer
139	☐ Jacket Required:	☐ Yes ☐ No.	☐ Provision for mounting only	
140	☐ Gland Taps:		☒ Flat surface required	
141	☒ Flush (F)	☐ Drain (D)	☐ See attached API 670 Data Sheet	
142	☒ Barrier/Buffer (F)	☐ Quench (Q)	☐ Monitors and Cables	
143	☐ Cooling (C)	☐ Lubrication (G)		
144	☐ Heating (H)	☐ Leakage	Remark:	
145	☒ Pumped Fluid (P)	☐ Balance Fluid (E)		
146	☐ External Fluid Injection (X)			
147	Seal Fluids Requirement and Available Flush Liquid:			
148	Note: If flush liquid is pumpage liquid (As in flush piping			
149	plan 11 to 41) following flush liquid data is not required.			
150	☐ Supply Temperature (°C)		Temperature and Pressure:	
151	Max.	Min.	☐ Radial Brg. Metal Temp.	☐ Thrust Brg. Metal Temp.
152	☐ Relative Density (Sp. Gr.)	@ °C	☐ Provision for Instruments only	
153	☐ Name of Liquid		☐ See attached API 670 Data Sheet	
154	☐ Specific Heat, cP (kJ/kg°C):		☐ Temp. Gauge (With Thermowell).	
155	☐ Vapour Press. (kg/cm ² A):	@ °C	Other	
156	☐ Hazardous	☐ Flammable ☐ Other	☐ Pressure Gauge Type	
157	☐ Flow Rate (m ³ /hr):	Max. Min.	☐ Location	
158	☐ Press. Req'd. (kg/cm ² G):	Max. Min.	Remark:	
159	☐ Temp. Required (°C):	Max. Min.		
160	Barrier/Buffer Fluid:		Motor Driver: See Electrical Specification	
161	☐ Supply Temp.:	Max. Min.	Surface Penetration and Paint:	
162	☐ Relative Density (Sp Gg.)	@ °C	☐ Manufacturer's Standard	
163	☐ Name of Fluid:		☐ Other (See below)	
164	☐ Vapour Pressure (kg/cm ² A):	@ °C	Pump	
165	☐ Hazardous	☐ Flammable ☐ Other	☒ Pump surface penetration:	
166	☐ Flow Rate (m ³ /hr):	Max. Min.	☒ Primer	
167	☐ Pressure Required (kg/cm ² G):	Max. Min.	☒ Finish Coat	
168	☐ Temp. Required (°C):	Max. Min.	Base Plate	
169	Quench Fluid:		☒ Base Plate Surface Preparation	
170	☐ Name of Liquid:		☒ Primer	
171	☐ Flow Rate (m ³ /hr):		☒ Finish Coat	
172	Seal Flush Piping:		Shipment	
173	☐ Seal Flush Piping Plan:		☐ Domestic	☐ Export ☐ Export Boxing Required
174	☐ Tubing	☐ Carbon Steel	☒ Outdoor Storage more than 12 months	
175	☐ Pipe	☒ Stainless Steel	Spare Rotor Assembly Packaged for:	
176	☐ Aux. Flush Plan:		☐ Horizontal Storage	☒ Vertical Storage
177	☐ Tubing	☐ Carbon Steel	☐ Type of Shipping Preparation	
178	☐ Pipe	☐ Stainless Steel	Remark:	
179				
180				

**CENTRIFUGAL PUMP
(MULTISTAGE-SPP)**

181	Mechanical Seal OR Packing (Contd.)			
182	■ Piping Assembly:			☐ Weights
183	☐ Threaded	☐ Unions	☐ Socket Welded	☐ Motor Driven:
184	☐ Flanged	☒ Tube Type Fitting		☐ Weight of Pump (kg):
185	☐ Pressure Switch (Plan 52/53) Type			☐ Weight of Base Plate (kg):
186	☐ Pressure Gauge (Plan 52/53)			☐ Weight of Motor (kg):
187	☐ Level Switch (Plan 52/53) Type			☐ Weight of Gear (kg):
188	☐ Level Gauge (Plan 52/53)			☐ Total Weight (kg):
189	☐ Temp. Indicator (Plan 21,22,23,32,41)			☐ Turbine Driven
190	☐ Heat Exchanger (Plan 52/53)			☐ Weight of Baseplate (kg):
191	Remark:			☐ Weight of Turbine (kg):
192				☐ Weight of Gear (kg):
193	☐ Packing Data:			☐ Total Weight (kg):
194	☐ Manufacturer:			Remark:
195	☐ Type:			
196	☐ Size	☐ No. of Rings		
197	☐ Packing Injection Required:			Other Purchase Requirement
198	☐ Flow (m ³ /hr):	@	°C	☒ Coordination Meeting Required
199	☐ Lantern Ring:			☒ Review Foundation Drawings
200				☒ Review Piping Drawings
201	SHOP INSPECTION AND TESTS (EACH PUMP)			☒ Observe Piping Check
202	☒ Review Vendor's QA Programme			☒ Observe Initial Alignment Check
203	☒ Performance Curve Approval			☒ Check Alignment at Operating Temp.
204	☒ Shop Inspection			☐ Connection Design Approval
205	☐ Test With Substitute Seal			☐ Hydrodynamic Thrust Bearing Size Review Req'd.
206	TESTS	WITNESS	OBSERVE	☒ Lateral Analysis Req'd.
207	☒ Hydrostatic	☒	☐	☒ Rotor Dynamic Balance
208	☒ Performance	☒	☐	☐ Mount Seal Reservoir off Base Plate
209	☒ NPSH, if req'd as per spec	☒	☐	☒ Installation List in Proposal
210	☒ Complete Unit Test, if req'd as per spec	☒	☐	☒ Spare Rotor Vertical Storage
211	☒ Sound Level Test	☒	☐	☒ Torsional Analysis/Report
212	☒ Cleanliness prior to Final Assembly	☒	☐	☒ Progress Report Req'd.
213	☒ Nozzle Load Test, if req'd.	☒	☐	☐ Driver suitable for pump starting with open disch. valve condition.
214	☒ Auxiliary Equipment Test	☒	☐	
215	☒ Remove/Insp. Hyd.dyn. Brgs After Test:	☒	☐	Remark:
216	☒ Visual, Dimension & Skid Completeness Check	☒	☐	GENERAL REMARKS
217	☒ Rotor Dynamic Balancing (Both Main & Spare Rotor)	☐	☒	1) Max. allowable Casing Working Pressure shall not be
218	☒ Unitization/ Check of direction of rotation of pump	☐	☒	less than ____ kg/cm ² G @ ____°C.
219	☒ Material Certificates Required			2) Down stream Design Pressure is ____ kg/cm ² G. Maximum shut-off, considering max suction pressure, including all tolerances shall not exceed this value.
220	☒ Casing	☒ Impeller		3) Accessories and Instrumentation shall be as per
221	☒ Shaft	☐ Other		EIL approved vendors only.
222	☐ Casing Repair Procedure Approval Required.			4) Unitization of Pump, Gear (If Req'd.) and Driver shall be done in
223	☒ Inspection Required for Connection Welds			Pump Manufacturer's shop.
224	☐ MAG Practice	☒ Liquid Penetrant		5) Dismantle inspection of pump after performance test shall be
225	☒ Radiographic	☒ Ultrasonic		applicable only in case of abnormality in mechanical behavior viz.
226	☒ Inspection Required for Casting			excessive noise, vibration, bearing temperature rise etc. during
227	☒ MAG Practice	☐ Liquid Penetrant		performance test
228	☐ Radiographic	☒ Ultrasonic		6) Complete unit test, when applicable, shall be carried out for each
229	☐ Additional Inspection Required for			pump in a tag no. (i.e. for both working & standby units).
230	☐ MAG Practice	☐ Liquid Penetrant		
231	☐ Radiographic	☐ Ultrasonic		
232	☐ Alternate Acceptance Criteria (See Remarks):			
233	☐ Hardness Test Required for			
234	☐ Wetting Agent Hydrotest			
235	☒ Vendor Submit Test Procedures			
236	☒ Record Final Assembly Running			
237	☒ Inspection Check List			

DATE	REV	JOB ENGINEER	REV. & APPROVED BY

LIST OF STANDARD SPECIFICATION (STATIC & MACHINERY EQUIPMENT)

STEAM GENERATION PACKAGE TENDER No. B957-420-80-44-PG-T-7410

ANNEXURE-A	:	STATIC EQUIPMENT
ANNEXURE-B	:	PACKAGED EQUIPMENT
ANNEXURE-C	:	ROTATING EQUIPMENT



ANNEXURE-A : STATIC EQUIPMENT LIST OF STANDARD SPECIFICATIONS (STATIC & MACHINERY EQUIPMENT)

STEAM GENERATION PACKAGE

TENDER No. B957-420-80-44-PG-T-7410

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE
CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO
BINA PETCHEM & REFINERY EXPANSION PROJECT
(BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

JOB NO : B957

0	16-01-2025	ISSUED AS TENDER INPUTS	SRIKANTH	VIVEK	PB
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

1. PRESSURE VESSELS, STORAGE TANKS, MIXER / AGITATOR & VENT SILENCERS

Sr. No.	TITLE	SPECIFICATION No.
1.	General specification for pressure vessels.	6-12-0001
2.	Standard specification for boiler quality carbon steel plates.	6-12-0011
3.	Standard specification for weldable structural quality steel plates for tanks and vessels	6-12-0014
4.	Standard specification of pressure vessels for package items	6-12-0030
5.	Standard specification for storage tanks	6-13-0053
6.	Standard specification of storage tanks for package items	6-12-0031
7.	Standard specification for mechanical agitators	6-26-0001
8.	Specification for Hardness requirement	6-15-0091

2. SHELL & TUBE HEAT EXCHANGERS AND AIR-COOLED HEAT EXCHANGERS

Sr. No.	TITLE	SPECIFICATION No.
1.	General specification for shell & tube heat exchangers	6-15-0001
2.	Standard specification for welded tube to tube-sheet joint	6-15-0003
3.	Standard specification for expanded tube to tube-sheet joint	6-15-0004
4.	Standard specification for U-tubes	6-15-0006
5.	Specification for vendor-designed shell and tube heat exchangers	6-15-0021
6.	General specification for air cooled heat exchangers	6-15-0071
7.	Specification for Hardness requirement	6-15-0091

3. GENERAL (APPLICABLE TO ALL STATIC EQUIPMENT)

Sr. No.	TITLE	SPECIFICATION No.
1.	Standard specification for erection of equipment & machinery	6-76-0001
2.	Specification for quality management system requirements from bidders	6-78-0001
3.	Specification for documentation requirements from contractors	6-78-0002

4.	Material requirements for carbon steel components used in sour service in petroleum refinery environments	6-79-0013
5.	Specification for surface preparation and protective coating system.	B957-000-06-42-PLS-0001
6.	Standard specification for positive material identification at vendor's works.	6-81-0001
7.	Inspection & Test Plan for Heat Exchangers	6-81-0009
8.	Inspection & Test Plan for Air cooled heat exchangers	6-81-0010
9.	Inspection & Test Plan for Pressure Vessels	6-81-0011
10.	ITP for stainless steel pressure vessels / columns	6-81-0014
11.	Standard specification for health, safety & environment (HSE) management at construction sites	6-82-0001

4. PRESSURE VESSELS, STORAGE TANKS, MIXER / AGITATOR & VENT SILENCERS

Sr. No.	TITLE	STANDARD No.
1	Vessel Tolerances	7-12-0001
2	Support for horizontal vessel	7-12-0002
3	Skirt base details	7-12-0004
4	Skirt opening details	7-12-0005
5	Angle leg support	7-12-0006
6	Pipe leg support	7-12-0007
7	Bracket support for vertical vessels	7-12-0008
8	Manhole with hinged cover	7-12-0009
9	Manhole with davit	7-12-0010
10	Ladder rungs for manhole/demister	7-12-0011
11	Retaining plate	7-12-0012
12	Nozzle reinforcement and projection (for Vessel)	7-12-0013
13	Pad nozzles for vessels	7-12-0014
14	Standard bolt hole orientation	7-12-0015
15	Internal flanges	7-12-0018
16	Vortex breakers	7-12-0019
17	Inlet deflector baffle	7-12-0020
18	Support ring & bolting bar	7-12-0021

Sr. No.	TITLE	STANDARD No.
19	Support ring sizes for packed tower's internals	7-12-0022
20	Pipe davit	7-12-0023
21	Fire proofing and insulation supports	7-12-0025
22	Earthing lug.	7-12-0026
23	Name plate.	7-12-0027
24	Manufacturer name plate	7-12-0028
25	Bracket for name plate.	7-12-0029
26	Supports for internal feed pipe	7-12-0032
27	Hot insulation supports for horizontal vessel.	7-12-0033
28	Typical details of wire mesh demister and its supports	7-12-0036
29	Allowable nozzle loads	7-12-0038
30	Earth connections	7-13-0001
31	Anchor chair	7-13-0002
32	Hot insulation supports for storage tanks	7-13-0003
33	Storage tank steam coil	7-13-0004
34	Jet mixer	7-13-0005
35	Level indicator supports	7-13-0006
36	Gauge hatch with cover	7-13-0007
37	Foam system	7-13-0008
38	Drain outlet (for tanks).	7-13-0009
39	Caged ladder for fixed roof tank	7-13-0010
40	Name plates (for tank)	7-13-0012
41	Spiral stairway and hand railing for cone roof / floating roof tanks	7-13-0013
42	Still well for level transmitter	7-13-0022
43	Still-well for temperature element (cone roof tanks).	7-13-0023
44	Steel ladder joint details	7-68-0509
45	Roof structure for cone roof tanks, joint details	7-68-0680
46	Roof structure for cone roof tanks (as applicable	7-68-0661
47	Format for Agitator/Mixer datasheet	B957-999-80-42-DS-0001

5. SHELL & TUBE HEAT EXCHANGERS and AIR - COOLED HEAT EXCHANGERS

Sr. No.	TITLE	STANDARD No.
1.	Part Details	7-15-0001
2.	Type of non-standard gaskets	7-15-0002
3.	Support for vertical exchangers	7-15-0003
4.	Support for horizontal exchangers	7-15-0004
5.	Tube hole preparing and roller expanding	7-15-0006
6.	Sliding/deflector strips to tube sheet welding details	7-15-0007
7.	Eye bolt detail	7-15-0008
8.	Method of fastening nuts to tie rods	7-15-0009
9.	Jack screw tapping arrangement	7-15-0010
10.	Fixing detail of dowel pins	7-15-0011
11.	Couplings & Plugs	7-15-0012
12.	Lifting lug detail	7-15-0013
13.	Davit for heat exchangers	7-15-0014
14.	Earthing lug	7-15-0016
15.	Name plate for shell and tube exchangers	7-15-0017
16.	Warning plates	7-15-0018
17.	Tolerances for shell & tube heat exchangers	7-15-0019
18.	Detail of sealing strip assembly for two pass shell.	7-15-0021
19.	Half tube supports	7-15-0101
20.	Flanged header and cover plate detail	7-15-0103
21.	Tapped header and cover plate detail	7-15-0104
22.	Frame standard - stationary header fixing.	7-15-0105
23.	Frame end top.	7-15-0106
24.	Frame standard tube support top.	7-15-0107

25.	Frame standard - floating header support.	7-15-0108
26.	Frame bracing detail.	7-15-0109
27.	Tube support bottom beam detail.	7-15-0110
28.	Tube access plug	7-15-0111
29.	Jack screws (cover type header).	7-15-0113
30.	Lifting lug for cover plate	7-15-0114
31.	Frame standard lifting lug.	7-15-0115
32.	Fabrication tolerances	7-15-0116
33.	Name plate	7-15-0117
34.	Tolerances and general notes for gaskets.	7-15-0118
35.	Tube bundle frame detail (equal tube in each row).	7-15-0121
36.	Tube bundle frame detail with spacer.	7-15-0122
37.	Tube bundle frame detail (unequal tubes in rows).	7-15-0123
38.	Stiffening strips for nozzles less than 3" NB	7-15-0142

Notes:

1. Contractor shall furnish filled in the datasheets / proformas separately for each equipment / package after placement of order during detailed engineering. Datasheet / proforma format (attached elsewhere with the tender) shall be filled by respective equipment supplier (vendor) and shall be vetted by Contractor prior submission to Owner / EIL for approval.
2. Equipment for which no such data sheets/ proformas are provided by Owner/ PMC, the Contractor may use his standard data sheets/ proformas or of Equipment Manufacturer's standard data sheets/ proformas & furnish the same.
3. Contractor/ Vendor to furnish all blank data.
4. In case any EIL std spec / EIL std. is required due to cross reference, the same shall be provided to the contractor during detailed engineering or whenever required by Contractor.

Annexure-B

LIST OF STANDARD SPECIFICATION (SME - PACKAGED EQUIPMENT) STEAM GENERATION PACKAGE

TENDER No. B957-420-80-44-PG-T-7410

PROJECT	:	MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)
OWNER	:	BHARAT PETROLEUM CORPORATION LIMITED (BPCL)
EPCM	:	ENGINEERS INDIA LIMITED
EIL JOB No.	:	B957

0	03.02.2025	ISSUED WITH TENDER	KJS	AK	KCP
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

**LIST OF STANDARD SPECIFICATION
(SME - PACKAGED EQUIPMENT)
FOR
STEAM GENERATION PACKAGE**

Sl. No.	Doc. No.	Title Description of Standard Specification/ ITP
1.	6-41-0003	Standard Specification for Centrifugal Pumps (Water Service)
2.	6-48-0002	Standard specification for E.O.T. Crane
3.	6-48-0003	Standard specification for H.O.T. crane
4.	6-61-0017	Standard specification for air conditioning system
5.	6-61-0014	Standard Specification for Electric Wire Rope Hoist
6.	6-61-0015	Standard Specification for Chain Pulley Block
7.	6-78-0001	Quality management system requirements from Bidders
8.	6-78-0002	Documentation requirement from Contractors
9.	6-78-0003	Documentation requirement from Suppliers
10.	6-81-0035	Inspection & Test Plan for Chain Pulley Block/ Winch
11.	6-81-0154	Inspection and test plan for air conditioning package
12.	6-81-0032	ITP for EOT crane
13.	6-81-0142	Inspection & Test Plan for Electric Hoist
14.	6-81-0136	Inspection and test plan for H.O.T. crane
15.	7-76-0103	Instructions to Vendor for Site Performance Guarantee Requirements for Package Units

LIST OF STANDARD SPECIFICATIONS

(STATIC & MACHINERY EQUIPMENT)

ANNEXURE-C (ROTATING EQUIPMENT)

FOR

STEAM GENERATION PACKAGE

TENDER No. B957-420-80-44-PG-T-7410

PROJECT	:	MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)
UNIT No.	:	420
OWNER	:	M/s BHARAT PETROLEUM CORPORATION LIMITED (BPCL)
LOCATION	:	BINA, MP, INDIA
PMC	:	ENGINEERS INDIA LIMITED
EIL JOB No.	:	B957

A	07/01/2025	ISSUED AS TENDER INPUT	VS/SG/	MG/	TK/
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

ANNEXURE-C **SMED-II (ROTATING EQUIPMENT)**

Applicable Standard specifications & ITPs for the respective rotating equipment:

Sl. No.	Title	Document No.
1.	Standard Specification for Centrifugal Pumps (General Purpose)	6-41-0002
2.	Standard Specification for Centrifugal Pumps (Water Service)	6-41-0003
3.	Standard Specification For Centrifugal Pumps (Special Purpose Process Service).	6-41-0008
4.	Standard Specification For Positive Displacement Pumps – Reciprocating	6-41-0020
5.	Standard Specification for Positive Displacement Pumps - Controlled Volume	6-41-0021
6.	Standard Specification for Positive Displacement Pumps – Rotary	6-41-0022
7.	Standard Specification for Dosing Packages (Skid Mounted)	6-41-0301
8.	Standard Specification For Centrifugal Fans	6-42-0002
9.	Standard Specification For Induced Draft / Forced Draft Fans	6-42-0016
10.	Standard Specification for General Purpose Steam Turbine	6-43-0042
11.	Standard Specification for Special Purpose Steam Turbine	6-43-0043
12.	Standard Specification for Diesel Engine & DG Set	6-43-0040
13.	Standard Specification for Erection of Equipment & Machinery	6-76-0001
14.	Specification for Quality management system requirements from Bidders	6-78-0001
15.	Specification for Documentation requirement from Contractors	6-78-0002
16.	Specification for Documentation requirement from Suppliers	6-78-0003
17.	Inspection & Test Plan for Pump Centrifugal Horizontal (Special Purpose Process)	6-81-0024
18.	Inspection & Test Plan for Pump Centrifugal Horizontal (General Purpose Process)	6-81-0037
19.	Inspection & Test Plan for Pump Centrifugal Horizontal (General Water Service)	6-81-0038
20.	Inspection & Test Plan for Pump Centrifugal Horizontal (Large Capacity Water Service)	6-81-0039

Sl. No.	Title	Document No.
21.	Inspection & Test Plan for Pump Centrifugal Vertical (General Purpose Process)	6-81-0040
22.	Inspection & Test Plan for Pump Centrifugal Canned Motor Type (Special Purpose Process)	6-81-0041
23.	Inspection & Test Plan for Pump Centrifugal Vertical (General Water Service)	6-81-0042
24.	Inspection & Test Plan for Pump Centrifugal Vertical (Large Capacity Water Service)	6-81-0043
25.	Inspection & Test Plan for Pump Centrifugal - Boiler Feed	6-81-0044
26.	Inspection & Test Plan for Pump Centrifugal Multistage (Special Purpose Process)	6-81-0047
27.	Inspection & Test Plan for Centrifugal Pumps (High Speed Integrally Geared)	6-81-0048
28.	Inspection & Test Plan for Pump Rotary Screw Type	6-81-0050
29.	Inspection & Test Plan for Pump Rotary Gear Type	6-81-0051
30.	Inspection & Test Plan for Pump Reciprocating (Controlled Volume)	6-81-0052
31.	Inspection & Test Plan for Diesel Generating Set	6-81-0059
32.	Inspection & Test Plan for Dosing Package	6-81-0301
33.	Standard for orientation of seal pot & connections of centrifugal pumps	7-44-0321
34.	Inspection and Test Plan for Blower / Turbo Centrifugal Fan	6-81-0055
35.	Inspection and Test Plan for Steam Turbine (GPP)	6-81-0057
36.	Inspection and Test Plan for Steam Turbine (SPP)	6-81-0058
37.	Inspection and Test Plan for FD Fan	6-81-0054

MANDATORY SPARE LIST

(STATIC & MACHINERY EQUIPMENT)

STEAM GENERATION PACKAGE

TENDER No. B957-420-80-44-PG-T-7410

ANNEXURE-A	:	STATIC EQUIPMENT
ANNEXURE-B	:	PACKAGED EQUIPMENT
ANNEXURE-C	:	ROTATING EQUIPMENT

**ANNEXURE-A : STATIC EQUIPMENT
MANDATORY SPARE LIST
(STATIC & MACHINERY EQUIPMENT)**

STEAM GENERATION PACKAGE

TENDER No. B957-420-80-44-PG-T-7410

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE
CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO
BINA PETCHEM & REFINERY EXPANSION PROJECT
(BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

JOB NO : B957

0	16-01-2025	ISSUED AS TENDER INPUTS	SRIKANTH	VIVEK	PB
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

A. MANDATORY SPARES FOR STATIC EQUIPMENT

A.1 PRESSURE VESSELS / COLUMNS /TANK

Sl. No	Part Description	Quantity Required
1	Bolting for each nozzle with blind/ companion flange and for each pad nozzle	10 % (Min. 2 nos.) for each nozzle
2	Gaskets for each nozzle with blind/ companion flange and for each pad nozzle	200 %
3	Bolting for internal flanges	10 % (Min. 2 nos.)
4	Gasket for internal flanges	200 %
5	Bolts, nuts, clamps, spares for demister	10 % (Min. 4 nos.) for each size / type
6	Sight/light glasses assembly complete with bolting and gasket	400% of each installed glass

A.2 HEAT EXCHANGERS

S. No	Part Description	Quantity Required
1.	Gaskets	400% (incase of PHE, gaskets referred are only Nozzle gaskets)
2.	Bolting	20% (Minimum 4 Studs and 8 Nuts per joint)

A.3 AGITATORS

Sl. No	Part Description	Quantity Required
1	Bearings for Gear reducer	One set per Tag No.
2	Gasket for agitator mounting nozzle	400% for each flanged / bolted connections for Agitator/ motor assembly.
3	Bolting for agitator mounting nozzle	10 % (minimum 2 sets) for each flanged / bolted connections for Agitator/ motor assembly.
4	Oil seal for gear box	2 sets
5	Mechanical Seal	100% of installed quantity
6	Bearing for Agitator	100% of installed quantity
7	Internal Bolting for Agitator	10 %(minimum 2 nos.) for each installed fasteners.
8	Filter for Oil Lubrication System	25% (Min. 1 no.) for each installed filter for Oil Lubrication system.

A.4 AIR COOLED HEAT EXCHANGER

Sl. No	Part Description	Quantity Required
1	Gasket for header cover & nozzles with blind flange	400 %
2	Gaskets for plugs	200 %
3	Plugs	20 %
4	Belts	100 %
5	Bolts & Nuts for all nozzle with BF & Cover plate	20 %
6	Diaphragm Actuator with positioner for each type of auto variable pitch fan, in case Diaphragm actuator with positioned type of control is used. *	One Set

(*) In case of any other type of control system, vendor recommended spares for their selected type of auto variable pitch fan shall be provided.

GENERAL NOTES:

- Wherever % age is identified, contractor shall supply next rounded figure.
- All spares supplied by contractor shall be properly wrapped and packed so that spares will be preserved in as new condition under the normal condition of storage envisaged and shall be properly tagged & coded so that at a later stage the same can be identified. Packing list shall be furnished so that parts can be identified without uncrating.
- Prices of Mandatory Spares shall be included in the quoted price.
- The mandatory spares shall be supplied to Owner. These spares shall not be used during construction, erection or commissioning.
- Mandatory spare list mentioned/specified in EDB and standard specifications shall be superseded by this document. Spares for the Items not covered in the above list shall be supplied as per respective standard specification.

Annexure-B
MANDATORY SPARE LIST
(SME - PACKAGED EQUIPMENT)
STEAM GENERATION PACKAGE
TENDER No. B957-420-80-44-PG-T-7410

PROJECT	:	MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)
OWNER	:	BHARAT PETROLEUM CORPORATION LIMITED (BPCL)
EPCM	:	ENGINEERS INDIA LIMITED
EIL JOB No.	:	B957

0	22.01.2025	ISSUED WITH TENDER	KJS	AK	KCP
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

SL. No.	DESCRIPTION	QUANTITY
1.	Air Conditioning System	
1.1	For all VCR based Air-conditioning system except Window/Split AC [for each building]	
1.1.1	Refrigerant	One full charge along with storage cylinders for one unit of each AC System.
1.2	Chilled Water Pumps (if applicable)	As per cl. no. 3.7.1 of Rotating Equipment Design Basis.

MANDATORY SPARES
(STATIC & MACHINERY EQUIPMENT)
Annexure-C (Rotating Equipment)

FOR

STEAM GENERATION PACKAGE

TENDER No. B957-420-80-44-PG-T-7410

PROJECT	:	MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)
UNIT NO.	:	420
OWNER	:	M/s BHARAT PETROLEUM CORPORATION LIMITED (BPCL)
LOCATION	:	BINA, MP, INDIA
PMC	:	ENGINEERS INDIA LIMITED
EIL JOB NO.	:	B957

Annexure-C

A	07/01/2025	ISSUED AS TENDER INPUT	VS/SG/	MG/	TK/
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

SMED-II (ROTATING EQUIPMENT)

MANDATORY SPARES FOR ROTATING EQUIPMENT

Mandatory spare parts for all Rotating Equipment items shall be as per Engineering Design Basis- S&ME (Doc. No.: **B857-999-80-43-EDB-1001 Clause 3.7.1**) attached with the Tender document.

SCOPE OF SUPPLY / WORKS (STATIC & MACHINERY EQUIPMENT)

STEAM GENERATION PACKAGE TENDER No. B957-420-80-44-PG-T-7410

ANNEXURE-A	:	STATIC EQUIPMENT
ANNEXURE-B	:	PACKAGED EQUIPMENT
ANNEXURE-C	:	ROTATING EQUIPMENT

**ANNEXURE-A : STATIC EQUIPMENT
SCOPE OF WORK / SUPPLY
(STATIC & MACHINERY EQUIPMENT)**

STEAM GENERATION PACKAGE

TENDER No. B957-420-80-44-PG-T-7410

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE
CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO
BINA PETCHEM & REFINERY EXPANSION PROJECT
(BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

JOB NO : B957

0	16-01-2025	ISSUED AS TENDER INPUTS	SRIKANTH	VIVEK	PB
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

1. SCOPE OF WORK/SUPPLY

1.1 SCOPE OF WORK

1.1.1 GENERAL

The scope of Static Equipment under this tender shall include complete design, detail engineering and supply of all the equipment including internals covered in the Steam Generation Package at BPREP, BPCL-Bina as per specifications, job specification and all the referred standards enclosed with the bid documents.

Scope of work shall include but shall not be limited to the following:

- Thermal design using HTRI software (in case of S&T heat exchangers and air cooled heat exchanger), Mechanical design including internals, detailed engineering and preparation of fabrication drawings, procurement, supply of equipment as per the Package, material testing and inspection, shop/site fabrication, assembly, stage wise and final inspection by third party inspection agency, shop testing, PWHT/Stress relieving, Providing Painting and sacrificial Anodes for Cathodic protection, packing (seaworthy when imported) & forwarding, transportation to site, storage, preservation, construction, erection, field testing, chemical cleaning, calibration, surface preparation, shop & field painting, any additional cleaning required by licensor, insulation, fire proofing, fitting of internal and external attachments, pre-commissioning, commissioning and Performance Guarantee tests and complete documentation activities relating to:
 - Pressure Vessels
 - Storage tanks
 - Shell & tube heat exchangers
 - Air cooled heat exchangers
 - Mixer / Agitators
 - Silencer/Vent Silencers
 - Site Fabricated / Worksite built equipment
- Submission of all mechanical design calculations, engineering drawings, fabrication drawings.
- Detailed engineering of equipment including all mountings, accessories & bought-out items for vessels, tanks, shell & tube heat exchangers, air cooled heat exchangers, mixers/agitators ,silencer/vent silencers etc.
- Vendor drawings & documents for review by OWNER/CONSULTANT shall be in accordance with the vendor data requirement (Doc. No. B957-420-80-42-VDR-7410)
- Obtaining approvals from OWNER/CONSULTANT on Drawings and Documentation.
- Obtaining statutory approvals for equipment falling under purview of Indian Boiler Regulations.
- Supply of "as built" documentation and QC dossiers.

The above-mentioned activities shall be carried out in accordance with OWNER/CONSULTANT Engineering Design Basis, applicable codes and all technical requirements covered in the bid package. CONTRACTOR shall strictly follow the above documents.

1.1.2 CONFLICT

In case of conflict between the above referenced documents, the same shall be reported in writing to OWNER/CONSULTANT for clarification and resolution before proceeding with the job. However, it shall be resolved considering the most stringent in the following order:

- i. Requirements specified in this document
- ii. Job Specifications
- iii. Engineering Design Basis
- iv. Standard specifications/ Standards
- v. Applicable Codes

The scope of work as defined herein, shall be read in conjunction with Engineering Design Basis, & Standard Specifications.

1.2 SCOPE OF SUPPLY

1.2.1 CONTRACTOR'S SCOPE SHALL INCLUDE BUT SHALL NOT BE LIMITED TO THE FOLLOWING:-

- Procurement and supply of all raw materials (Metallic & non metallic) and consumables required for fabrication of all process equipment & tanks covered in the package.
- Complete internals like Spray Nozzles, Trays/Packing, support plate, bed limiter, bed support grid, strainer, vortex breaker, distributor, all Tower Trays, feed pipes, including supports, Companion Flanges including bolting and spares etc. as applicable.
- Supply of Insulating material, primer & finish paints, fire proofing materials wherever required.
- Supply of materials / equipment required for blast cleaning / chemical cleaning.
- Supply of Mandatory spares
- Supply of accessories like test rings, test flanges, dummy shells, torque wrench, bolt tensioner etc. as required for heat exchangers.
- Supply of all tools & tackles, equipment, consumable / non consumable materials required for inspection and testing (i.e. NDT, hydrotesting, performance testing etc.).

- Supply of all material required for completion of storage tanks including all accessories.
- Supply of slot dipping device for pressurized tanks where gauge hatch has been specified, when the tank is gas blanketed.
- Preparation and supply of check lists for all types of equipment to ensure their correct installation, alignment, assembly, levelling, grouting and completion.
- Supply of all other materials whether specifically mentioned or not but required for completion of the job in all respect as per bid package.
- All external/internal attachment including nozzle, piping clip, ladder/platform clip, insulation clip, fire protection attachment, internals/ internal supports as deemed necessary for successful completion of project.

NOTES:-

1. Ensure all inspection and tests are conducted for all equipment at Vendor's shops/site as specified in Bid Document, Job Specifications, Codes and Standards.
2. CONTRACTOR shall ensure presence of equipment manufacturer (Vendor) at WORKSITE for supervision of erection and during commissioning for Equipments as required.
3. CONTRACTOR shall ensure that Mandatory Spares for all equipment as specified in the Bid Document are procured and handed over to the OWNER together with the main equipment prior to commissioning.



Annexure-B
SCOPE OF SUPPLY / WORKS
(SME - PACKAGED EQUIPMENT)
STEAM GENERATION PACKAGE
TENDER No. B957-420-80-44-PG-T-7410

PROJECT	:	MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)
OWNER	:	BHARAT PETROLEUM CORPORATION LIMITED (BPCL)
EPCM	:	ENGINEERS INDIA LIMITED
EIL JOB No.	:	B957

0	03.02.2025	ISSUED WITH TENDER	KJS	AK	KCP
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

1.0 GENERAL

- 1.1 The intent of this document is to outline **Contractor's Scope** for all packaged equipment/items including all associated works viz. electrical, instrumentation, structural, painting etc. as required for **Steam Generation Package** for **BINA PETCHEM & REFINERY EXPANSION PROJECT** of BPCL.
- 1.2 This document shall be read in conjunction with Job Specification, Document No. B957-420-80-42-SP-7410 (Annexure-B).
- 1.3 It is not the intent of purchaser to specify every piece of equipment/item but nevertheless any item not specifically mentioned but required as per good engineering practice and for the safe and trouble-free operation of the system shall be deemed to have been specified and in the scope of Contractor, without any implication in price or schedule.
- 1.4 All the items / facilities shall comply with applicable national and international codes & standards as well as any statutory regulation in existence particularly for that item/package.
- 1.5 All equipment shall be sourced from Owner / PMC approved vendor list attached with tender document.

2.0 SCOPE OF WORK/SERVICE

- 2.1 Contractor's scope of work shall include design, engineering, procurement, manufacture, painting, inspection, packing, supply, transportation, site storage, installation, insulation, testing, commissioning and performance guarantee test run of all packaged equipment, as described in this document, job specification, attachments and documents/drawings referred therein forming a part of the tender document. Contractor shall also ensure the presence of Original Equipment Manufacturer (OEM) for supervision during erection and commissioning of critical equipment.
- 2.2 Contractor shall supply commissioning spares as required during commissioning of all equipment. Contractor shall procure spares from the original equipment manufacturers (as per their recommendation) and shall make them available at site well before the start of commissioning activities. Prices for the same shall be included in the lump sum quoted price.
- 2.3 Quotation (itemized price list along with recommended quantity) for spares required for two years' normal operation and maintenance as recommended by the OEM (Original Equipment Manufacturer) shall be provided during detailed engineering. Owner shall order these spares separately.
- 2.4 Contractor shall supply Special tools and tackles as recommended by OEM for erection, operation and maintenance of the offered equipment. Prices for the same shall be included in the lump sum quoted price.
- 2.5 Contractor shall prepare procurement specification as per the requirements given in Job Specification & Datasheets and other standards/ standard Specifications referred therein for purchase of equipment. Contractor/Vendor shall work out equipment sizing wherever applicable for engineering as per Design Requirements, Specific Requirements, data sheet and specification.

- 2.6 Electrical and Instrumentation works for all equipment shall be as per respective specification attached elsewhere in the tender.
- 2.7 Access platforms, ladders for equipment, machinery, instruments and valves requiring approach for manual operation, monitoring and maintenance.
- 2.8 First fill of all lubricants, hydraulic oils, refrigerants, consumables etc. and replenishment of any loss of these during commissioning, trial runs & PG testing and for operation & maintenance of six (6) months after handover of steam generation package to Owner for all equipment.
- 2.9 Contractor shall prepare technical specification, data sheet of all such equipment where Consultant technical specification is not available in the tender document.
- 2.10 Contractor shall submit drawings, documents, specification, inspection & test reports, performance test procedures etc. as defined in Doc. No. B957-420-80-42-VDR-7410 attached elsewhere in the tender document.
- 2.11 Painting (Primer & finish) shall be done as per painting specification attached elsewhere in the tender document.
- 2.12 "On site" training to Owner's personnel for operation & maintenance including supply of all training materials.
- 2.13 Third Party Inspection shall be as per commercial part of tender document.
- 2.14 Obtaining all statutory clearances, permits from local, statutory and other bodies, as applicable, as per commercial part of the tender document.

3.0 SCOPE OF SUPPLY

- 3.1 Contractor's scope of supply shall include, but not limited to the following mechanical equipment / facilities, complete in all respects:

Sl. No.	ITEM	TAG NO.	QTY.	REMARKS
1.0	Air Conditioning (AC) System for Buildings (i.e. Substation, SRR etc.)			
	Air conditioning areas/ rooms of each Building shall be catered by Water cooled AC System. Contractor shall select type of AC system (Water cooled Package AC System or Water cooled Centralized AC System) based on actual cooling capacity requirement in line with selection criteria specified in Engineering design basis (Doc. No. B857-999-80-42-EDB-1001). Refer Cl. no. 3.1.1, 3.1.2 and 3.1.3 below for more details.	Tag No. to be assigned by Contractor	Lot	*Refer Architectural Drawing of Substation / SRR for the areas to be air-conditioned. *Tonnage capacity of Air Conditioning System shall be selected considering de-rating of machines with respect to actual design

Sl. No.	ITEM	TAG NO.	QTY.	REMARKS
				conditions as specified in tender documents.
2.0	Split AC System (i.e. For Operator Cabin, if any)			
	Air-conditioning requirements for Individual area/room up to 5 TR and where no specific RH requirement is envisaged, may be provided with single/multiple Inverter controlled Split AC units (5-star rating).	Tag No. to be assigned by Contractor	Lot	*Quantity of Split AC units shall be decided by Contractor based on PMC/ Owner's approved heat load calculation. *One (1) no. standby Split AC unit shall also be considered for each operator cabin/ air-conditioned area.
3.0	MATERIAL HANDLING FACILITY			
	Requisite number of EOT/HOT Crane, monorails, Chain Pulley Blocks, Electric Hoists and davits for maintenance of equipment, wherever required.	Tag No. to be assigned by Contractor	Lot	Contractor to work out the quantity, capacity and location of CPB/ Electric Wire Rope Hoist/ EOT Crane/ HOT Crane based on material handling/ maintenance philosophy study and engineering design basis.

3.1.1 **Central Air-Conditioning System with Water Cooled Condensing Units and Dx Coil AHUs (if applicable) shall comprise of but not limited to the following for each system:**

Sl. No.	Quantity	Description
1.	NW+1SB	Water cooled Condensing Units comprising of reciprocating/scroll compressor, electric motor for the compressor, drive package with guard, water cooled condenser, interconnected insulated refrigerant piping complete with necessary fittings, control and line accessories, cubicle type gauge panel. N: No. of Working Units
2.	Lot	Horizontal double skin Air-handling Units (AHUs) comprising of fan section with fan, fan motor and belt drive package with guard, filter section, coil section with dedicated Dx coil (min.4 rows deep) vibration isolation pads etc.

Sl. No.	Quantity	Description
3.	Lot	Cooling water supply & return piping network with T-type suction strainer with bypass arrangement, pressure gauges & temperature gauges at inlet and outlet, thermal safety valve, flow indicator in supply line (orifice plate & DP Transmitter), reducer, pipes, fittings & valves as per piping material specification attached elsewhere in the tender. Gate/Globe Valve shall be provided in supply and return cooling water piping respectively.
4.	Lot	Fresh air arrangement comprising of: a) Intake louvers, b) Bird screen, c) Side Access chemical filter unit (CFU) complete with fresh air fan and drive motor (1W+1S) and fresh air filters etc. d) Volume control damper, e) G.I. ducting for interconnections, f) Electrically operated combined fire & smoke damper. g) Fire resistant flexible connection between ducting and fresh air fan/CFU inlet.
5.	Lot	Two-stage air filtration In first stage, pre-filters shall be provided at upstream of AHU. Pre-filters shall have filtering capacity of 90% efficiency upto 10 microns for AHU. In second stage, fine filters shall be provided with filtering efficiency of 95% down to 5 microns. Manometer across fine filters, one pressure switch and pilot light on panel shall be provided to indicate dirty condition of filter. Fine filters shall be mounted in AHU only. <i>For maintenance of pre filter & fine filter, separate access door with sufficient space to be provided. Placement of pre filter and fine filter side by side is not acceptable.</i>
6.	Lot	Insulated supply air ducting as per IS:655/SMACNA or equivalent/superior international standards complete with volume control damper, guide vanes, fire resistant flexible connection between AHU and ducting, duct supporting arrangement with anchor fasteners etc.
7.	Lot	Anodized aluminium supply air diffusers with volume control dampers or Anodized aluminium supply air grilles with volume control dampers. <i>Supply air grilles in the supply air system are acceptable only if diffuser cannot be accommodated in the available space or grilles are being used in unmanned area subject to Owner/EIL approval.</i>
8.	Lot	Anodized aluminium return air grilles/ diffusers (<i>return air grilles to be provided all along the slits</i>).

Sl. No.	Quantity	Description
9.	Lot	Electrically operated spring return fail safe type combined fire & smoke damper in supply air and return air paths.
10.	Lot	Duct mounted strip finned electric heaters complete with heating and safety thermostat with suitable inspection window for heater maintenance.
11.	Lot	Pan type Humidifier (in stainless steel construction) to meet specified humidity requirement, complete with piping, fittings, valves, float valve, immersion heater, heating thermostat, humidistat, insulation and also provided with low water level switch interlocked to water heater and float valve on make-up water line.
12.	Lot	Carbon steel (IS:1239, black, heavy schedule)/ UPVC piping network with fittings to collect condensate from AHU and discharge to nearest rainwater shaft/ drain outside the building at grade level. <i>Condensate line shall have water seal arrangement and fully insulated.</i>
13.	Lot	Controls, Instruments and safety devices required for smooth and unattended operation of equipment/plants as per instrumentation specifications attached.
14.	Lot	Plant room ventilation system.
15.	Lot	Foundation/ Fixing nuts and bolts, virgin neoprene vibration isolation pads (as applicable) for Condensing Units, AHUs, CFU, etc.
16.	Lot	Civil works like: a) Foundation blocks for Condensing unit, AHUs, Chemical filters etc. b) Grouting of equipment, including supply of grouting material. c) Supply and fixing of steel supports for duct/cable/pipe/tubing etc. d) Breaking and making good of openings in wall. e) Temporary scaffolding related to erection, testing and commissioning.
17.	Lot	Structural steel works as required for equipment support and base frame of equipment.
18.	Lot	Electrical panels and electrical works as per electrical specification attached elsewhere in the tender.
19.	Lot	Self-standing/ wall mounted audio-visual annunciation panel for motors/ Air Heaters status and temperature/ pressure instruments/ controls as required.
20.	Lot	First fill of lubricants, refrigerant required for equipment during erection and upto successful commissioning.
21.	Lot	Commissioning Spares.

Sl. No.	Quantity	Description
22.	Lot	Mandatory spares as per Mandatory Spares List (Doc. No.: B957-420-80-42-SL-7410, Annexure-B) attached with tender.
23.	Lot	Itemized list of Spare parts for two years normal operation and maintenance for the Air conditioning system.
24.	1 Set	Special tools and tackles shall be minimum as per Cl. No. 8.0 of EIL Std. spec. 6-61-0017 over and above vendor's recommendation.
25.	Lot	Drawings and documents as per Vendor Data Requirement (Doc. No. B957-420-80-42-VDR-7410) attached elsewhere with this tender.

3.1.2 **Central Air-Conditioning System with Water Cooled Chillers and Chilled Water Coil AHUs (if applicable) shall comprise of but not limited to the following for each system:**

Sl. No.	Quantity	Description
1.	NW+1SB	Water cooled Chillers comprising of scroll compressor/ screw compressor/ centrifugal compressor, electric motor for the compressor, drive package with guard, water cooled shell & tube type condenser, insulated shell & tube type evaporator, interconnected insulated refrigerant piping complete with necessary fittings, control and line accessories, cubicle type gauge panel. N: No. of Working Units
2.	Lot	Horizontal double skin Air Handling Units (AHUs) comprising of fan section with fan, fan motor and belt drive package with guard, filter section, coil section with chilled water coil (min. 4 rows deep), vibration isolation pads etc.
3.	Lot	Cooling water supply & return piping network with T-type suction strainer with bypass arrangement, pressure gauges & temperature gauges at inlet and outlet, thermal safety valve, flow indicator in supply line (orifice plate & DP Transmitter), reducer, pipes, fittings & valves as per piping material specification attached elsewhere in the tender. Gate/Globe Valve shall be provided in supply and return cooling water piping respectively.
4.	1W + 1S	Chilled water recirculating pumps as per EIL Standard Specification 6-41-0003 each with CI casing, Bronze Impeller & Carbon Steel (EN-8) shaft, mechanical seal along with motors, base frames, pressure transmitter with Block & Bleed valves, Temperature sensor and transmitters with thermowells, non return valves, Y/T strainer with block and bypass valves etc. <i>All piping / tubing for connection of pressure / temperature sensors shall be of SS-316.</i>
5.	Lot	Insulated supply and return chilled water piping including fittings

Sl. No.	Quantity	Description
		and valves (including 3-way modulating valve & proportionating thermostat for CHW lines) as per piping material specification attached elsewhere in the tender, instruments like pressure gauges, temperature gauges, temperature transmitter at inlet and outlet. Gate/Globe valve shall be provided in supply and return chilled water piping respectively.
6.	Lot	Cold insulation of Evaporators, Chilled water pumps, Chilled water supply & return piping with valves & fittings as per EIL Standard Specification for Air-conditioning System.
7.	Lot	Flow meters including weld neck flanges, orifice plate, flow transmitter, gaskets, nuts & bolts etc. for - Chilled water supply line - Cooling water supply line at each chiller - At AHU (Bypass Rotameter at chilled water supply line)
8.	Lot	Interconnecting piping, fittings, valves and accessories for Instrument air lines as per piping material specification attached elsewhere in the tender.
9.	Lot	Fresh air arrangement comprising of: a) Intake louvers, b) Bird screen, c) Side Access chemical filter unit (CFU) complete with fresh air fan and drive motor (1W+1S) and fresh air filters etc. d) Volume control damper, e) G.I. ducting for interconnections, f) Electrically operated combined fire & smoke damper. g) Fire resistant flexible connection between ducting and fresh air fan/ CFU inlet.
10.	Lot	Two-stage air filtration In first stage, pre-filters shall be provided at upstream of AHU. Pre-filters shall have filtering capacity of 90% efficiency upto 10 microns. In second stage, fine filters shall be provided with filtering efficiency of 95% down to 5 microns. Manometer across fine filters, one pressure switch and pilot light on panel shall be provided to indicate dirty condition of filter. Fine filters shall be mounted in AHU only. <i>For maintenance of pre filter & fine filter, separate access door with sufficient space to be provided. Placement of pre filter and fine filter side by side is not acceptable.</i>
11.	Lot	Insulated supply air ducting as per IS:655/SMACNA or equivalent/superior international standards complete with volume control damper, guide vanes, fire resistant flexible connection

Sl. No.	Quantity	Description
		between AHU and ducting, duct supporting arrangement with anchor fasteners etc.
12.	Lot	Anodized aluminium supply air diffusers with volume control dampers or Anodized aluminium supply air grilles with volume control dampers. <i>Supply air grilles in the supply air system are acceptable only if diffuser cannot be accommodated in the available space or grilles are being used in unmanned area subject to Owner/EIL approval.</i>
13.	Lot	Anodized aluminium return air grilles/ diffusers (<i>return air grilles to be provided all along the slits</i>).
14.	Lot	Electrically operated spring return fail safe type combined fire & smoke damper in supply air and return air paths.
15.	Lot	Duct mounted strip finned electric heaters complete with heating and safety thermostat with suitable inspection window for heater maintenance.
16.	Lot	Pan type Humidifier (in stainless steel construction) to meet specified humidity requirement complete with piping, fittings, valves, float valve, immersion heater, heating thermostat, humidistat, insulation and also provided with low water level switch interlocked to water heater and float valve on make-up water line.
17.	Lot	Closed pressurized Expansion tank complete with pressurization unit, piping, fittings, valves and instrumentation.
18.	Lot	Carbon steel (IS:1239, black, heavy schedule)/ UPVC piping network with fittings to collect condensate from AHU and discharge to nearest rainwater shaft/ drain outside the building at grade level. <i>Condensate line shall have water seal arrangement and fully insulated.</i>
19.	Lot	Controls, Instruments and safety devices required for smooth and unattended operation of equipment/plants as per instrumentation specifications attached.
20.	Lot	Plant room ventilation system.
21.	Lot	Foundation/ Fixing nuts and bolts, virgin neoprene vibration isolation pads for, Chillers, Chilled Water Pumps, AHUs, CFU, etc.
22.	Lot	Civil works like: a) Foundation blocks for chillers, chilled water pumps, AHUs, Chemical filters etc. b) Grouting of equipment, including supply of grouting material. c) Supply and fixing of steel supports for duct/cable/pipe/tubing etc. d) Breaking and making good of openings in wall. e) Temporary scaffolding related to erection, testing and

Sl. No.	Quantity	Description
		commissioning.
23.	Lot	Structural steel works as required for equipment support and base frame of equipment.
24.	Lot	Electrical panels and electrical works as per electrical specification attached elsewhere in the tender.
25.	Lot	Self-standing/ wall mounted audio-visual annunciation panel for motors/ Air Heaters status and temperature/ pressure instruments/ controls as required.
26.	Lot	First fill of lubricants, refrigerant required for equipment during erection and upto successful commissioning.
27.	Lot	Commissioning Spares.
28.	Lot	Mandatory spares as per Mandatory Spares List (Doc. No. B957-420-80-42-SL-7410, Annexure-B) attached with tender.
29.	Lot	Itemized list of Spare parts for two years normal operation and maintenance.
30.	1 Set	Special tools and tackles shall be minimum as per Cl. No. 8.0 of EIL Std. spec. 6-61-0017 over and above vendor's recommendation.
31.	Lot	Drawings and documents as per Vendor Data Requirement (Doc. No. B957-420-80-42-VDR-7410) attached elsewhere with this tender.

3.1.3 Air-Conditioning System with Water Cooled Packaged AC Units (if applicable) shall comprise of but not limited to the following for each system:

Sl. No.	Quantity	Description
1.	No. of working + Standby Units as per EDB	Water cooled Packaged Units microprocessor-based control panel comprising scroll compressor/ reciprocating compressor, electric motor for the compressor, water cooled condenser with supports, evaporator, interconnected insulated refrigerant piping complete with necessary fittings, control and line accessories including pre-filter, first charge of refrigerant gas and oil.
2.	Lot	Fresh air arrangement comprising of: a) Intake louvers, b) Bird screen, c) Side Access chemical filter unit (CFU) complete with fresh air fan and drive motor (1W+1S) and fresh air filters etc. d) Volume control damper, e) G.I. ducting for interconnections, f) Electrically operated combined fire & smoke damper g) Fire resistant flexible connection between ducting and fresh air

Sl. No.	Quantity	Description
		fan/ CFU inlet.
3.	Lot	Insulated supply air ducting as per IS-655 complete with volume control damper, guide vanes, fire resistant flexible connection between Packaged Unit and ducting, air flow switch in main supply air ducts, duct supporting arrangement with anchor fasteners etc.
4.	Lot	Two-stage air filtration In first stage, pre-filters shall be provided at upstream of packaged unit. Pre-filters shall have filtering capacity of 80% efficiency upto 20 microns. In second stage, Fine filter section comprising of 18 Gauge G.I. plenum with necessary maintenance windows, filter mounting frame, fine filter (95% efficiency down to 5 micron), Manometer across fine filters, one pressure switch and pilot light on panel to indicate dirty condition of filter.
5.	Lot	Anodized aluminium supply air diffusers/grilles with volume control dampers and anodized aluminum return air grilles/ diffusers (<i>return air grilles to be provided all along the slits</i>).
6.	Lot	Electrically operated spring return fail safe type combined fire & smoke damper in supply air and return air paths.
7.	Lot	Duct mounted strip finned electric heaters complete with heating and safety thermostat with suitable inspection window for heater maintenance.
8.	Lot	Pan type Humidifier (in stainless steel construction) to meet specified humidity requirement complete with piping, fittings, valves, float valve, immersion heater, heating thermostat, humidistat, insulation and also provided with low water level switch interlocked to water heater and float valve on make-up water line.
9.	Lot	Supply & return cooling water piping network with T-type suction strainer with bypass arrangement, pressure gauges & temperature gauges at inlet and outlet, thermal safety valve, flow indicator in supply line (orifice plate & DP Transmitter type), reducer, pipes, fittings & valves as per piping material specification attached elsewhere in the tender. Gate/Globe Valve shall be provided in supply and return cooling water piping respectively.
10.	Lot	Carbon steel (IS-1239, black, heavy schedule)/ UPVC piping network with fittings to collect condensate from Packaged Units and discharge to nearest rainwater shaft/ drain outside the building at grade level. <i>Condensate line shall have water seal arrangement and fully insulated.</i>
11.	Lot	Controls, Instruments and safety devices required for smooth and unattended operation of equipment/plants.
12.	Lot	Foundation nuts and bolts, virgin neoprene vibration isolation pads for Packaged Units, CFU, etc.
13.	Lot	Civil works like:

Sl. No.	Quantity	Description
		a) Foundation blocks for packaged units, chemical filter etc. b) Grouting of equipment, including supply of grouting material. c) Supply and fixing of steel supports for duct/cable/pipe/tubing etc. d) Breaking and making good of openings in wall. e) Temporary scaffolding related to erection, testing and commissioning.
14.	Lot	Structural steel works as required for equipment support and base frame of equipment.
15.	Lot	Electrical panels and electrical works as per Electrical Specification attached elsewhere in the tender.
16.	Lot	Self standing/ wall mounted audio-visual annunciation panel for motors/ Air Heaters status and temperature/ pressure instruments/ controls as required.
17.	Lot	First fill of lubricants and refrigerant required for equipment during erection and upto successful commissioning.
18.	Lot	Commissioning Spares.
19.	Lot	Mandatory spares as per Mandatory Spares List (Doc. No. B957-420-80-42-SL-7410, Annexure-B) attached with tender.
20.	Lot	Itemized list of Spare parts for two years normal operation and maintenance.
21.	1 Set	Special tools and tackles shall be minimum as per Cl. No. 8.0 of EIL Std spec. 6-61-0017 over and above vendor's recommendation.
22.	Lot	Drawings and documents as per Vendor Data Requirement (Doc. No. B957-420-80-42-VDR-7410) attached elsewhere with this tender.

SCOPE OF WORK / SUPPLY
(STATIC & MACHINERY EQUIPMENT)
Annexure-C (Rotating Equipment)
FOR
STEAM GENERATION PACKAGE
TENDER No. B957-420-80-44-PG-T-7410

PROJECT	:	MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)
UNIT NO.	:	420
OWNER	:	M/s BHARAT PETROLEUM CORPORATION LIMITED (BPCL)
LOCATION	:	BINA, MP, INDIA
PMC	:	ENGINEERS INDIA LIMITED
EIL JOB NO.	:	B957

A	07/01/2025	ISSUED AS TENDER INPUT	VS/SG	MG	TK
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

ANNEXURE-C **(ROTATING EQUIPMENT)**

1.0 GENERAL

- 1.1 CONTRACTOR's Scope of work shall include Design, Engineering, Procurement, inspection, testing, supply including spares (mandatory spares, commissioning spares & special tools/tackles), installation, hook up, pre-commissioning, commissioning & guarantee of the following:

All Rotating Equipment such as Centrifugal Pumps, Rotary Pumps, Fans, Dosing Pumps, Dosing Skids, DG Set, Rotary Air Blowers etc. complete with all auxiliaries & accessories, required as per the Process Package for Steam Generation Package for BPREP Project at Bina, MP.

The requirements laid down in this specification are the minimum requirements and the same should not be interpreted as limiting, whereby the CONTRACTOR is relieved of meeting the Performance Guarantee. This document shall be read in conjunction with Job Specification for Static & Machinery Equipment (**Doc. No.: B957-420-80-42-SP-7410**) and Engineering Design Basis- S&ME (**Doc. No.: B857-999-80-42-EDB-1001**).

- 1.2 It is not the intent of purchaser to specify every piece of equipment/item but nevertheless any item not specifically mentioned but required as per good engineering practice and for the safe and trouble-free operation of the system shall be deemed to have been specified and in the scope of CONTRACTOR, without any implication in price or schedule.
- 1.3 All rotating equipment shall meet the requirements specified in applicable documents in the tender package. Equipment shall also comply with applicable national and international codes & standards as well as any statutory regulation in existence particularly for that item/package.
- 1.4 CONTRACTOR shall procure all the rotating equipment from the approved vendors listed elsewhere in the bid package.
- 1.5 Selection of each rotating equipment shall be based on proven track record of supply and reliable operation in the specified application and shall confirm to selection criteria as per requirement specified in document in package.

2.0 SCOPE OF SUPPLY/ WORK

For complete list of Rotating Equipment items, CONTRACTOR to refer Process Package/ design basis.

- 2.1 CONTRACTOR shall prepare the enquiry specifications / documents for each Rotating Equipment and materials to be procured including spare parts for erection & commissioning, mandatory spares (as applicable), and list of spare parts for two-year normal operation and special tools & tackles.
- 2.2 CONTRACTOR shall procure each Rotating Equipment Package consisting of driver, driven equipment, all associated auxiliary systems, instrumentation & controls etc. from the Single Point Responsibility Vendor as defined in Engineering Design Basis- S&ME (Rotating Equipment). No separate procurement of driver, auxiliaries or any other critical item of the package by CONTRACTOR is allowed.

- 2.3 CONTRACTOR shall fill all the required data / information in the partially filled in Equipment data sheets formats forming part of the bid package for preparation of enquiry specifications / documents.
- 2.4 CONTRACTOR shall carry out the bid evaluation for the offers received from EIL approved vendors against his enquiry documents and shall finalize the successful vendor. CONTRACTOR shall ensure the following requirements while placing the orders of rotating equipment:
- Ensuring that equipment meets the specified operating conditions and stipulated technical specifications, as specified in the bid package.
 - Ensuring that equipment meets the experience criteria (EC) as specified in the bid package and obtaining approval of the same.
- 2.5 CONTRACTOR shall submit the following documents (duly reviewed by CONTRACTOR) of finally selected equipment make/model, in one lot, for obtaining approval of Owner/PMC during detail engineering:
- Filled in Equipment Data Sheet along with performance curves (as applicable) along with a copy of approved process data sheet.
 - Filled in Experience Record Proforma (to justify meeting vendor's & equipment's past experience in line with bid package requirements) along with General reference List
 - List of deviations* (if any), specific to the equipment
 - List of Mandatory Spares
 - Equipment Manufacturer's Latest Catalogue, General Arrangement Drawing & Schematic drawing / P&ID for the proposed model shall also be submitted along with the above documents.
- Note *:** *Deviations to specified standards & codes (if any), shall be subject to review & approval of Owner/ PMC during detail engineering & only those deviations shall be permitted which are technically infeasible to meet, provided suitable justification for the same is furnished. Deviations, which can be complied with extra cost and or time implication, shall not be permitted.*
- 2.6 CONTRACTOR shall prepare & submit a **detailed Purchase Requisition for each Rotating Equipment Package**. The same shall include the following as minimum:
- Vendor's scope of supply / work
 - Equipment Mechanical Datasheet & Performance curves (PMC Approved) along with Process Datasheet (PMC approved)
 - Experience Record Proforma (PMC Approved)
 - List of Agreed Deviations if any (PMC Approved)
 - List of Mandatory spares (PMC Approved)
 - List of Erection & Commissioning spares
 - List of Special tools & tackles (as per OEM recommendation)
 - Detailed Vendor Data (i.e. GA drawing; C/S drawing; Layout drawing, P&ID, Utility Data, Elec. Load Data, Weight Data etc.)
 - Inspection Test Plan (approved copy)
 - Equipment manufacturer's General Reference List and Manufacturer's Catalogue.
- 2.7 CONTRACTOR shall carry out the detailed review and approval of data sheets, engineering & fabrication drawings and other technical data furnished by the respective Equipment Vendor in order to ensure a safe, smooth and reliable operation at site.
- 2.8 CONTRACTOR shall submit to the Owner / PMC, all engineering drawings / documents / data as specified in "Vendor Data Requirements-Static & Machinery Equipment" (**B957-420-80-42-VDR-7410**) forming part of the bid package.

- 2.9 For all rotating equipment in the unit covered in the subject bid package, CONTRACTOR shall ensure that all Mandatory spares, as listed in the Engineering Design Basis – S&ME (Rotating Equipment) are ordered on equipment vendor and the same shall be supplied and handed over to the Owner along with the equipment.
- 2.10 Besides the Mandatory Spares, CONTRACTOR shall furnish during detailed engineering, list of spares recommended by the Equipment Vendor for two-year normal operation along with firm unit prices and ensure that the spare parts for two-year normal operation, if ordered by the Owner, are procured from equipment vendor and supplied to the Owner.
- 2.11 CONTRACTOR shall include all the Erection & Commissioning spares, as required in the Equipment Vendor's scope. CONTRACTOR shall procure the same from the Equipment Vendors and make it available well before erection/commissioning of equipment /plant. In case, any additional spares are required and consumed during erection & commissioning, CONTRACTOR shall provide the same at no additional cost to the Owner. Any un-used erection & commissioning spares shall be retained at Owner's end without cost implications.
- 2.12 CONTRACTOR shall include all Special Tools & Tackles, as recommended by respective Equipment Vendor, in the Equipment Vendor's scope and the same shall form part of scope of supply by CONTRACTOR to Owner.
- 2.13 CONTRACTOR shall ensure that, all inspection and tests are conducted for all equipment at Vendor's shop / site as specified in bid package. CONTRACTOR shall also submit the schedule of witnessed tests of all Rotating Equipment well in advance.
- 2.14 CONTRACTOR shall carry out the erection of all Rotating Equipment at the specified location on the properly designed & casted foundation as per bid document. Foundation Design shall be suitable for Foundation Loads (Static & Dynamic Loads, as applicable) and be in line with the Foundation Drawing provided by respective Rotating Equipment Vendor.
- 2.15 CONTRACTOR shall carry out interface engineering and provide inter-connections at all interface points like Main Process Interface at inlet, outlet and inter-stage including each stage spill back recycle loop, utility connections, sealing fluid connections etc. on as applicable basis.
- 2.16 Painting shall be done as per painting specification attached elsewhere in the Bid Package.
- 2.17 3-D modeling as per requirement specified elsewhere in the tender document shall be done by the CONTRACTOR.
- 2.18 CONTRACTOR's scope shall include complete supply, transportation of equipment package from vendor's shop to site, receipt of material at site, handling at site and arrangement for proper storage at site shall be as per the requirements indicated in the Tender Document.
- 2.19 Equipment, which is transported by sea, shall have sea-worthy packing. The CONTRACTOR shall strictly follow the recommended preservation procedures during the complete period of storage for all equipment.
- 2.20 CONTRACTOR shall note that consumables, lubricants etc. required for startup and commissioning of Rotating Equipment shall be included in CONTRACTOR's scope of supply. A consolidated list for all rotating equipment shall be provided indicating type of lubricant, grease, oil etc. giving specifications, quantities, brand name and their equivalent.
- 2.21 EPC CONTRACTOR shall supply & install all maintenance facilities sized for handling the heaviest single piece of equipment for maintenance (i.e. Maximum Maintenance Weight). The maintenance facilities like EOT/ HOT cranes, chain pulley blocks and monorails for respective Rotating equipment shall be provided. EPC CONTRACTOR shall provide sufficient space for maintenance, dismantling and platforms for maintenance. These facilities shall be as per requirements given in 'Engineering Design Basis- Rotating Equipment'.
- 2.22 Statutory approval wherever required shall be obtained by the CONTRACTOR.

- 2.23 CONTRACTOR shall carry out the pre-commissioning and commissioning activity at site for all Rotating Equipment. Refer Specification No. **6-76-0001** (Standard Specification for Erection of equipment & machinery) for details.
- 2.24 CONTRACTOR shall ensure the presence of equipment manufacturer (Vendor) at site for supervision of erection, pre-commissioning, site testing and commissioning activities of all Rotating Equipment (including dismantling and boxing up of equipment at site).

JOB SPECIFICATION **(STATIC & MACHINERY EQUIPMENT)**

STEAM GENERATION PACKAGE **TENDER No. B957-420-80-44-PG-T-7410**

ANNEXURE-A	:	STATIC EQUIPMENT
ANNEXURE-B	:	PACKAGED EQUIPMENT
ANNEXURE-C	:	ROTATING EQUIPMENT

ANNEXURE-A : STATIC EQUIPMENT JOB SPECIFICATION (STATIC & MACHINERY EQUIPMENT)

STEAM GENERATION PACKAGE TENDER No. B957-420-80-44-PG-T-7410

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE
CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO
BINA PETCHEM & REFINERY EXPANSION PROJECT
(BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

JOB NO : B957

0	16-01-2025	ISSUED AS TENDER INPUTS	SRIKANTH	VIVEK	PB
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

1.0 SCOPE

- 1.1 This specification covers the supply of Static Equipment (Pressure vessels, Storage Tanks, Shell & Tube Heat Exchangers, Air Cooled Heat Exchangers, Mixer/Agitator, Vent Silencers including their internals etc.) for Steam Generation Package of BPREP, BPCL-Bina, in accordance with this job specification, specifications, standards and codes etc. listed in the bid document.

This specification provides the additional technical requirements along with the requirements of standard specification 6-12-0030 (Pressure Vessels), 6-12-0031 (Storage Tanks), 6-15-0021 (Shell & Tube heat exchangers), 6-15-0071 (Air Cooled heat exchangers) and 6-26-0001 (Mechanical agitators), and is intended to supplement the main scope of work and supply defined elsewhere in the bid package.

2.0 GENERAL

2.1 Definitions

- Contractor means the successful bidder on whom the order is placed.
- Vendor means the designer and/or supplier of static equipment as defined in clause 1 above.

2.2 Codes

All Codes referred to in various general specifications form a part of this specification; latest editions apply.

2.3 Deviations

Deviations are not acceptable in general.

Any clarification/conflicts/ambiguity shall be discussed at pre-bid stage only and once having done so, the contractor shall ensure that the offer is in strict compliance to the requirements specified in the engineering design basis, job specification, scope of work/supply, standard specification/standards and Inspection & test plans etc. attached with this tender.

For successful contractor any deviation at the execution stage, which becomes unavoidable, shall be immediately submitted for Owner/EIL approval and contractor shall not proceed with such deviations till its acceptance by Owner/EIL. Time taken/delay, if any, in processing of deviation permit or its rejection shall be solely to contractor's account.

2.4 Conflict

In case of conflict between this specification and other specifications, Codes and data sheets, it shall be referred to EIL/Owner for clarification and the decision of EIL/ Owner shall be final & binding on Contractor, without any cost & delivery implications. However, it shall be resolved considering the most stringent in the following order:

- Statutory requirements
- Requirements specified in this document/ SOW
- Data Sheet
- Standard specifications/ Standards
- Applicable Codes

2.5 Safety

It is the intent of Owner that operational hazards are reduced to a minimum. Vendor shall use sound engineering judgment to complete an installation that will perform the required process function without compromising this aspect.

2.6 Vendor pre qualification

2.6.1 DESIGN

Equipment shall be designed by the EPC Contractor himself if he is an established designer of static equipment (Reactor, Column, Vessel, S&T Heat Exchanger etc. (as applicable)) and during last 07 (seven) years reckoned from the last day of the month immediately preceding the month in which the bid due date falls (incase of extended bid due date original bid due date shall be considered) must have designed & engineered, atleast 1 (One) equipment of each type as mentioned above, working for similar service or in Hydrocarbon / Refinery / Petrochemical / Fertilizer / Gas Processing Complex / Marketing Terminals of hydrocarbon service industry.

- 2.6.1.1 In case, EPC contractor doesn't meet above qualification, EPC Contractor having single point responsibility may engage Engineering Subcontractor/ Equipment Vendor (As per Cl. No. 2.6.2 below) for carrying out design activity, who meets the criteria stated above.
- 2.6.1.2 For EPC Contractor/ Engineering Subcontractor/ Equipment Vendor, reference list along with backup documents like Purchase order, approved design calculation, approved drawing indicating service, metallurgy, size etc. of past supply shall be furnished to demonstrate engineering capability. Decision of Owner/EIL shall be binding in the above respect.

2.7 FABRICATION

Refer Vendor/Sub-vendor list attached elsewhere in the tender.

2.8 Vendor Documentation

2.8.1 Master document index

Master document index with submission date must be submitted within 15 days after award of contract. Following order of submission of document must be adhered to:

- i) Pre-qualification details of the Vendor
- ii) Master document index with schedule of submissions.

- iii) Mechanical design calculations
- iv) Detailed drawings/documents.

Vendor to note that EIL review of documents/ drawings will be limited to one LIN Storage tank & bullet, one vessel based on Material of Construction. The rest of documents/ drawings will be retained for information only. However it shall be the Contractor's responsibility to ensure that comments given on the EIL reviewed documents/ drawings are incorporated for the documents/ drawings in information category too. The list of documents/ drawings under review/ Information category will be identified by EIL after award of Contract.

All the Vendor drawings/documents must be reviewed and approved by Contractor before submission to EIL. Unchecked drawings and documents without revisions no. clearly marked shall not be reviewed. Successive reviews of the same drawings shall apply only with respect to EIL's comments on the previous submission.

All drawings/documents submitted to EIL shall be legible and of good quality. Illegible drawings/documents shall be returned back without EIL review and any delay in approval of such drawings/documents shall be to Contractor's account.

Any drawings/documents once reviewed by EIL in Code-1 shall not be submitted again (incorporating some other changes) for EIL review. However if some change is really necessary the same shall be brought to EIL notice separately through design change note for review/information and shall be incorporated in as built drawings.

2.8.2 Fabrication drawings

Contractor/Vendor must prepare fabrication drawings and other documents and submit these for EIL review as per Vendor Data requirement. Vendor to fabricate and supply the equipment based on his responsibility of ensuring compliance to Process Data sheets, Licensor's specifications, Codes, EIL specifications & standards etc.

Documents Required with Bid

- List of References of similar jobs.
- Replies to Technical checklist statement.

2.8.3 Design Software

All mechanical design calculations shall be done with proven software capable of carrying out design in free mode. No manual calculation shall be accepted.

2.9 WIND AND EARTHQUAKE CONSIDERATION

- a) Design of equipment including anchor chair shall be carried out considering Wind Load as per IS 875 (latest).
- b) Seismic loads shall be calculated in accordance with Site Specific Seismic Spectra & IS 1893- Latest Edition. Site Specific Seismic Spectra is enclosed with the package.

3.0 SPECIFIC JOB REQUIREMENTS

3.1 Pressure Vessels and Storage Tanks

3.1.1 General

- 3.1.1.1 Mechanical design of pressure vessels, (i.e. design of shell, heads, internals, supports, Anchor bolts, wt. calculation, wind and seismic analysis, RF pad etc.) shall be performed by vendor, approved for design, as per relevant code as defined in specification shall be carried out by the vendor approved for design. Type of supports shall be selected based on Equipment layout.
- 3.1.1.2 Complete design of Tank, Tank mixer/agitator (i.e. design of shell, bottom, roof, roof structure, curb angle, spiral stairway, ladder, top & intermediate platform, RF pads, wind girders, compression area checking, counter balancing weight, anchorage requirement, gauge hatch, still well for instrument connections etc.) as per specifications / standards and codes shall be carried out by the CONTRACTOR.
- 3.1.1.3 Fabrication, erection of tanks, hydrotesting and other testing etc., installation of accessories at site, as per codes, specifications and standards.
- 3.1.1.4 Carrying out calibration of tanks including getting approval from competent authorities. Calculations for calibration to be submitted to OWNER/CONSULTANT for prior approval shall be as per standard no. IS: 2007 and IS: 2008. All instruments and tools such as strapping tapes, pre-calibrated water meters and other accessories, as required for calibration, shall be arranged by the CONTRACTOR at his own cost.
- 3.1.1.5 Inside/outside painting; epoxy painting & rubber lining of tanks shall be carried out based on product stored and as per painting specifications enclosed elsewhere in bid package.
- 3.1.1.6 The design, supply, inspection and testing of mechanical mixers/agitators with auxiliaries and accessories shall be as per EIL spec 6-26-0001. Blank data sheet of mixer/agitators (2 sheets) are enclosed with bid package. Bidder shall submit duly filled in mixer data sheet separately for each mixer.
- 3.1.1.7 All nozzles shall be **set-in** type. Set-on type nozzles are not permitted.
- 3.1.1.8 All internals shall be designed for full load condition. For welded internals, twice the corrosion allowance shall be considered. Removable internal parts shall be designed with single corrosion allowance. All bolted internals shall be provided with SS bolts and two nuts.

3.1.1.9 Anchor Bolts:

- a) Tensile allowable stress for foundation anchor bolt: 1400 kg/cm²
- b) Shear stress of bolts: 1100 kg/cm².

The above values are maximum to be considered. No further increase on above on account of wind or seismic loading is allowed. The values specified above are including wind and seismic loading.

3.1.1.10 All vertical equipment shall be provided with two lifting lugs. Lifting lugs shall be designed with minimum impact factor of 1.5. No nozzle or other vital attachments on the equipment being lifted shall be used as supporting or lifting points other than those which have been specifically designed and designated for the purpose.

3.1.1.11 Fabrication tolerances indicated in EIL Standards shall be adhered to.

3.1.1.12 Nozzles upto 50 mm NB size shall be stiffened with 2 number of 40 mm wide x 6 mm thick stiffeners welded at 90 apart.

3.1.1.13 Vessel diameter 300 mm NB and below shall be made from seamless pipe only.

3.1.1.14 Nozzle connections used for vessels shall not be less than 40 mm NB.

3.1.1.15 Rolling direction of plate for shell shall be lengthwise.

3.1.1.16 Vessel with demister, safety valve size 3" and above shall be provided with pipe davit of min. 500 Kg. capacity.

3.1.1.17 Vessel shall be transported to site in single piece.

3.1.2 Design Requirements

3.1.2.1 All vessels shall be designed by CONTRACTOR as per ASME Sec. VIII Div. 1 (latest edition including latest addenda) and as per IBR (latest edition) as applicable in accordance with design data enclosed with the package. All tanks shall be designed by CONTRACTOR as per API 650 (latest edition). All design calculations shall be made considering all loads for erection, operating and hydrotest condition.

3.1.2.2 Manhole for IBR vessels shall be designed by contractor meeting the IBR requirements.

3.1.2.3 All flat bottom storage tanks shall be designed, fabricated and tested as per API-650/API-620(latest edition). For acid tanks, supported on pier type foundation, the bottom plate shall be designed as per IS-803. For acid tanks the bottom and roof plate joints shall be of butt welded construction. Also, these tanks shall be provided with external roof structure

3.1.2.4 FLAT heads (top or Bottom) if any shall be adequately stiffened to limit the deflection to $t/2$, where t is the thickness of the flat head.

3.1.2.6 Buried vessels shall be designed for external pressure arising from soil load in addition to the design external pressure if any. It shall also be checked for buoyancy in case of pit flooding with water

3.1.3 Material of construction

3.1.3.1 Material of construction of the equipment shall be as per Process Data Sheet if enclosed elsewhere in the package. However, for all material selection of vessels including non pressure part shall be strictly in accordance with Annexure-III of Spec. 6-12-0030. (It shall not be considered as "General Guideline". It is mandatory to follow this table.)

3.1.3.2 For IBR vessels all materials used shall meet the IBR requirements in addition to ASME / EIL specification.

3.1.3.3 SA 516 Gr. 60 shall be used for CS vessel/tanks under hydrogen, amine, caustic, sulphur and wet H₂S or lethal service.

3.1.3.4 All CS materials specified as HIC (in Process Datasheet) shall meet the requirements of specification 6-79-0013 (as applicable).

3.1.3.5 Unless otherwise specified elsewhere, minimum external corrosion allowance for carbon steel buried vessel shall be of 1.5 mm.

3.2 Shell & Tube Heat exchangers

3.2.1 For mechanical design & fabrication following requirements shall be complied with in addition to requirements specified in code, specification no. 6-15-0021 & other specifications enclosed in bid package.

3.2.2 All S&T heat exchanger shall be designed by CONTRACTOR as per ASME Sec. VIII Div. 1 (latest edition), TEMA Class R (latest edition) and IBR (latest edition) as applicable in accordance with design data enclosed with the package. All design calculations shall be made considering all loads for erection, operating and hydrotest condition.

3.2.3 Thermal design of heat exchangers shall be performed by vendor using HTRI software, approved for design, as per relevant code as defined in specification shall be carried out by the vendor approved for design.

3.2.4 All fixed tubesheet exchangers must be designed for all conditions stipulated in such as shell start up, tube start up, operating condition and any other upset conditions etc. Generating these conditions would be a part of LSTK contractor's residual process work wherever not specified.

3.2.5 Wherever Hydrogen, amine, caustic, sulphur, Sour, or wet H₂S or Lethal service has been specified, following requirements shall be met as minimum in addition to requirements specified in the Licensor specification / datasheet.

- i) All weld joints to be 100% radiographed.
- ii) All CS & LAS parts to be PWHT & hardness of base metal, weld metal & heat affected zone to be limited as per 6-15-0091.

- 3.2.6 Wherever HIC is specified in thermal data sheet all requirements of clause 2.2.1(e) of specification 6-15-0001 shall be met as minimum requirement in addition to requirement specified in the Licensor specification/datasheet.
- 3.2.7 If radiography is being substituted by UST for the final closing seam as permitted by the Code, magnetic particle examination shall be carried out in addition to UST.
- 3.2.8 For floating head and other internal flanges minimum bolt size shall be M20.
- 3.2.9 Wherever spiral wound gaskets are specified for girth & floating head flanges following minimum requirements shall be followed. For shell diameter < 450 mm, minimum 10 wide gasket shall be used and when shell diameter is in between 450 and 1000 mm, minimum 13 wide gasket shall be used. In both cases, gasket shall be 4.5 thk with 4 wide/ 3.2 thick nose and 13 wide/3.2 thick inner centering ring. For shell diameter > 1000 mm, minimum 16 wide gasket shall be 6.35 thick with graphite filler with 4 wide/4.5 thick nose & 13 wide/4.5 thick inner centering ring. For internal components like impingement plate, pass partition plate & baffles etc., the minimum thickness shall be twice the corrosion allowance.
- CAF gaskets are not permitted. However, CAF filler for jacketed & spiral wound gasket may be used for non-critical services. For critical services like Hydrogen service, Wet H₂S service etc. only graphite filler shall be used (CAF filler is not permitted).
- 3.2.10 All the condensers and coolers shall be provided with epoxy painting and sacrificial anodes on channel and floating head cover to minimize waterside corrosion.
- 3.2.11 Painting / colour coding of equipment and components and insulation shall be as specified elsewhere in the package.
- 3.2.12 The heat exchangers should have free movement at sliding end on the supports to avoid any restriction during thermal expansion. The saddle of the exchanger should be at centre of the foundation bolt slot during erection. Sliding end of Exchangers shall be painted as "CAUTION-SLIDING END" in black on the primer coating in the shop. Only SS shims shall be used for equipment alignment.
- 3.2.13 All nozzles on S&T exchanger shall be **set-in** type. Set-on type nozzles are not permitted.
- 3.2.14 During welding of nozzles in exchanger, if back gouging is required, gauging electrodes should be used instead of grinding to avoid/minimise the reduction in the thickness of nozzle pipe.
- 3.2.15 Test rings and test flanges for exchangers are to be provided wherever required.
- 3.2.16 While deciding on the location of heat exchanger in the equipment layout it should be ensured that there is no restriction in complete opening of the channel, shell and floating head covers, manhole covers, bundle removal etc. Sufficient unobstructed space shall be provided in between two exchangers so as to allow a man to pass through for maintenance. Heat exchangers shall be suitably spaced such that shell or tube inlet/outlet piping does not foul with floating head cover creating maintenance problems.
- 3.2.17 All the RTJ ring gaskets should have proper marking stamped with metallurgical certificate available.

- 3.2.18 Metric threads shall be used for all non-standard flanges. However, for standard flanges, type of threads, flange face, gaskets & bolting shall be as per piping material specification and P&ID.
- 3.2.19 In addition to stamping, the specifications and manufacturers symbol as specified in ASME Material Specifications, on one of the ends the size of the studs shall be clearly punch marked. Similarly, the nuts shall have the size punch marked on one of the faces. In case of tapped hole the size shall be punch marked near the hole without disturbing the gasket seating area. Further for all alloy / SS metallurgy bolts and nuts shall also be identified by distinct colour marking at the stud end / bolt side face.
- 3.2.20 Equipment supports for horizontal heat exchangers shall be designed to withstand a pulling force of not less than 1.5 times the bundle weight, taken at the centerline of the exchangers. Analysis shall be based on L.P.Zick's criterion. The exchanger support shall also be adequate to ensure structural stability of the exchanger in basic configuration as required considering all superimposed loads. Detailed calculations shall be submitted to this effect. Vertical exchangers shall be supported by lugs welded to wrapper plate in such a way that the shell is not overstressed or deformed. Alternate methods such as skirts, lugs or trunions may be considered where necessary. The shear stress for support shall be limited to 40% of the material yield.

In case of stacked exchangers, the lower(s) of stacked exchangers shall be designed to appropriately consider the load of upper shell(s) without distorting the lower shell and causing bending of tube bundles.

- 3.2.21 For removable bundles, eye bolts shall be provided on the channel side face of stationary tubesheet and located approximately diametrically opposite. In case of four eye bolts, these shall be spaced along the circumference of tube sheet at approximately diametrically opposite ends. Eye bolt size shall be selected based on a bundle pulling force of 1.5 times bundle weight. Eye bolt holes shall not be drilled through the tubesheet thickness. Location to be such as to distribute loads on tube sheet evenly.
- 3.2.22 All process nozzles shall be provided with one 1.5"NB multi purpose nozzle connection with blind flange. Nozzle flange facing and rating shall be same as process nozzle.
- 3.2.23 Davits shall be provided for removal channel covers and shell covers.
- 3.2.24 Material of construction
- For CS heat exchangers, wherever hardness is limited to 200 BHN use of SA 516 Gr.70 shall not be used.

Wherever, CS is specified as material in data sheets, following shall be followed:

SA 516 Gr 60/Gr 70	-	Plates
SA 179	-	Tubes @
SA 266 Gr. 4	-	Non-standard forgings

SA 106 Gr B	-	Pipes
SA 105	-	Nozzle flanges, blind flanges, plugs etc.
SA 193 B7 &		
SA 194 Gr 2H/ Gr 4	-	Studs & nuts for external bolting

@ For IBR items SA 192 tubes instead of SA 179 tubes may be acceptable, provided

- i) Tubes shall be procured in cold drawn condition
- ii) The hardness of the tubes shall be limited to 72 HRB max.

- Wherever, SS is specified as material in data sheets, following shall be followed:

SA 240 Gr*	-	Plates
SA 213 Gr*	-	Tubes
SA 965 Gr*	-	Non-standard forgings
SA 312 Gr*	-	Pipes
SA 182 Gr*	-	Nozzle flanges, blind flanges, plugs etc.
SA 193 B7 &		
SA 194 Gr 2H/ Gr 4	-	Studs & nuts for external bolting

* SS Grade as specified in data sheet.

3.2.25 Interchangeability of tube bundles

Wherever possible, heat exchangers shall be designed for maximum interchangeability of tube bundles by incorporating necessary adjustments in tube sheet and flange dimensions. The interchangeability shall be ensured in shop by physical insertion of bundle in shell. List of interchangeable bundles is to be submitted to OWNER by the CONTRACTOR at the time of handing over.

3.2.26 Erection

Erection requirements of exchangers shall be as per erection specification enclosed elsewhere in package.

3.3 Air Cooled Heat Exchangers

3.3.1 For mechanical design & fabrication following requirements shall be complied with in addition to requirements specified in code, specification no. 6-15-0021, 6-15-0071 & other specifications enclosed in bid package.

3.3.2 All air cooled heat exchanger shall be designed by CONTRACTOR as per ASME Sec. VIII Div. 1 (latest edition) and API 661 (latest edition) in accordance with

design data enclosed with the package. All design calculations shall be made considering all loads for erection, operating and hydrotest condition.

- 3.3.3 Thermal design of Air cooler shall be performed by vendor using HTRI software, approved for design, as per relevant code as defined in specification shall be carried out by the vendor approved for design.
- 3.3.4 Wherever Hydrogen, amine, caustic, sulphur, Sour, or wet H₂S or Lethal service has been specified following requirements shall be met as minimum in addition to requirements specified in the datasheet.
- i) All weld joints to be 100% radiographed.
 - ii) All CS & LAS parts to be PWHT & hardness of base metal, weld metal & heat affected zone to be limited as per 6-15-0091.
- 3.3.5 Wherever HIC is specified, all requirements of specifications 6-15-0001 and 6-15-0071 respectively shall be met as minimum requirement.
- 3.3.6 If radiography is being substituted by UST for the final closing seam as permitted by the Code, magnetic particle examination shall be carried out in addition to UST.
- 3.3.7 All Air Coolers shall be provided with epoxy painting and sacrificial anodes on channel and floating head cover to minimize waterside corrosion. Painting / colour coding of equipment and components and insulation shall be as specified elsewhere in the package.
- 3.3.8 During welding of nozzles, if back gouging is required, gauging electrodes should be used instead of grinding to avoid/minimise the reduction in the thickness of nozzle pipe.
- 3.3.9 Metric threads shall be used for all non-standard flanges. However, for standard flanges, type of threads, flange face, gaskets & bolting shall be as per piping material specification and P&ID.
- 3.3.10 All process nozzles shall be provided with one 1.5"NB multi purpose nozzle connection with blind flange. Nozzle flange facing and rating shall be same as process nozzle.
- 3.3.11 Material of construction
- For CS air cooled heat exchangers, wherever hardness is limited to 200 BHN use of SA 516 Gr.70 shall not be used.

Wherever, CS is specified as material in data sheets, following shall be followed:

SA 516 Gr 60/Gr 70	-	Plates
SA 179	-	Tubes
SA 266 Gr. Cl.4	-	Non-standard forgings
SA 106 Gr B	-	Pipes
SA 105	-	Nozzle flanges, blind flanges, plugs etc.
SA 193 B7 & SA 194 2H	-	Studs & nuts for external bolting

- IS 2062 / SA 283 GR. C - All structural, plenums, tube bundle frames of ACHE (min. UTS 42 kg/cm² & min. yield strength 26 kg/cm²)
- Aluminum - Half Tube supports of ACHE tube bundle, fan blades

SB209 Alloy 1060 Aluminum - Fins.

- Wherever, SS is specified as material in data sheets, following shall be followed:

- SA 240 Gr* - Plates
- SA 213 Gr* - Tubes
- SA 965 Gr* - Non-standard forgings
- SA 312 Gr* - Pipes
- SA 182 Gr* - Nozzle flanges, blind flanges, plugs etc.
- SA 193 B7 & SA 194 2H - Studs & nuts for external bolting

* SS Grade as specified in data sheet.

3.3.12 Tube to tubesheet joint

Tube to tubesheet joint shall be as per clause of 6-15-0071.

3.3.13 Maintenance

- All the air cooler components shall be designed in such a manner that they can be maintained and lubricated from the maintenance platform without dismantling or shutting the complete equipment. All lubrication points shall be accessible from the maintenance platform. Vendor to provide necessary SS tubing for the same.
- For maintenance of fan & motor, min headroom clearance of 2200 mm shall be kept.
- Fan cage shall be provided with a hinged man way to access the fan. Vendor shall provide adequate guards for motor to avoid ingress of rainwater into motor.

3.4 AGITATOR

Complete design, supply, inspection and testing based upon Licensor specifications and standard spec for mechanical agitators (6-26-0001) shall be carried out by contractor. Contractor to furnish filled in data sheet as per attached format for each agitator.

Mixer / agitator's with shaft length more than 1.6 meter has to be supported and

clamped at different heights or shaft has to be provided with end bearing support so that there is no wobbling at the impeller end. Bidder shall also provide necessary access for maintenance of mixer / equipment.

3.5 SILENCER/VENT SILENCER

- 3.5.1 The design shall be such as to limit the noise level to 85 dBA at one meter (perpendicular) distance from silencer discharge.
- 3.5.2 All pressure parts (inlet pipe, diffuser pipe, diffuser pipe cover etc.) shall be designed in accordance with ASME Sec. VIII Div. 1 for the designed conditions specified in data sheet. Non pressure carbon steel parts shall have minimum thickness of 6.0 mm excluding the corrosion allowance. The Rain hood/Cowl shall have minimum thickness of 3.0 mm.
- 3.5.3 Mineral wool or glass fibre of suitable density shall be used for acoustic insulation.
- 3.5.4 Silencer shall be located outside the building, unless specified otherwise.
- 3.5.5 Silencers venting to atmosphere shall be provided with rain hood and bird screen.

4.0 SPARES

MANDATORY SPARES: Contractor shall supply mechanical mandatory spares as per mandatory spare list (Doc. No. B957-999-80-42-SL-7410.). All the mandatory spares shall be procured from OEM only. The price of these mandatory spare shall be included in his lump sum quoted price.

ERECTION AND COMMISSIONING SPARES. (To be included in Quoted Price): For Equipment's Erection and Commissioning Spare Parts shall be supplied along with the main equipment as per equipment manufacturer's recommendations. However, for Vessels & tanks, One set of gasket for each installed gasket and 10% (min. 4 sets) of stud with 2-nuts for each installed gasketed joints shall be supplied as a minimum. Any commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment contractor. Any leftover (unused) spares after commissioning, out of those included by contractor in his offer, shall be handed over to the owner.

RECOMMENDED SPARES FOR NORMAL OPERATION & MAINTENANCE (Itemised price to be given; NOT to be included in quoted price): As per static equipment manufacturer's recommendations, a quotation for spare parts for two-year normal operation (over and above mandatory spares) along with unit price shall be submitted post order for customer to order the same separately.

SPECIAL TOOLS AND TACKLES: Special Tools and Tackles shall be supplied along with the main equipment as per equipment manufacturer's recommendations, EIL/ Licenser Standard specification and other guidelines attached or referred elsewhere along with Bid. The list of such recommended special tools/tackles shall be submitted after award of contract.

5.0 PAINTING

The surface preparation, primer and finish painting on internal/external surfaces or both shall conform to the requirements of process data sheet / bid package

requirement covered elsewhere in tender.

6.0 EQUIPMENT LAYOUT

It shall be the responsibility of Contractor to co-ordinate with his piping & structure with respect to piping loads, nozzle orientation etc. Contractor shall do the piping layout such that the minimum loads are transmitted to the nozzles and which shall be clearly specified. All loading imposed on nozzles shall be fully analyzed to examine its acceptability within permissible code limits. However, as a minimum, all nozzles for vessels/exchangers shall be designed for piping load 7-12-0038.

7.0 INSPECTION

- 7.1 For Equipment, Stage wise & final inspection shall be carried out by EIL/Owner.
- 7.2 Contractor shall ensure that all alloy steel and stainless steel material are properly identified and finally check tested by a PMI analyzer before dispatch of equipment as per 6-81-0001.
- 7.3 In addition to stamping of the specifications & manufacturer's symbol as specified in ASME material specifications, size shall be clearly punch marked on one of the ends of the stud. Similarly the nuts shall have the size punch marked on one of the faces. In case of tapped hole the size shall be punch marked near the hole without disturbing the gasket seating area. Further for all alloy/SS metallurgy bolts & nuts shall also be identified by distinct color marking at the stud end/bolt side face.
- 7.4 Equipment's shall be subjected to inspection by Owner/its authorized representative who shall have access to inspect the equipment at any stage during manufacture. During inspection, material certificates, shop test data, certificates for bought out components and other relevant information shall be furnished and testing done as required so as to ascertain that the specifications and quality is complied with.
- 7.5 Inspection test plan shall be developed by the Contractor & approved by EIL/Owner. It must specify various stages of inspection.
- 7.6 Any comments by EIL/Owner shall be complied with without time & cost implication.

8.0 GUARANTEE

- 8.1 Contractor shall have final & total responsibility for the design & supply of all equipment supplied under this specification. Contractor shall repair/replace the damaged part during guarantee period at his own cost. The Contractor shall be completely responsible for the compliance to Datasheet, specifications requirement, Code requirements, Mechanical design, detailing, fabrication, materials and workmanship of the Equipment as per the stipulations of the tender and its attachments. In this regard, it may be noted that review by Owner / Consultant shall not relieve the Contractor of his responsibility of meeting all requirements and ensuring satisfactory guarantee of the equipment.
- 8.2 Contractor shall agree to repair/replace any part of equipment/components free of cost and with no loss of time if:
 - a) Equipment designed by vendor does not meet process/ performance requirements during performance test.



DOCUMENT No.
ANNEXURE-A
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Annexure-B

JOB SPECIFICATION
(SME - PACKAGED EQUIPMENT)

STEAM GENERATION PACKAGE

TENDER No. B957-420-80-44-PG-T-7410

PROJECT	:	MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)
OWNER	:	BHARAT PETROLEUM CORPORATION LIMITED (BPCL)
EPCM	:	ENGINEERS INDIA LIMITED
EIL JOB No.	:	B957

0	03.02.2025	ISSUED WITH TENDER	KJS	AK	KCP
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

1.0 GENERAL

- 1.1** Specific requirements and guidelines pertaining to individual equipment and system are listed in subsequent sections. However, following general considerations have to be kept in view for all items while formulating their specifications and procurement engineering activities:
- 1.1.1** Reliability in service (assessed from Contractors' relevant track record and improved by incorporating certain minimum design features or requirements in the specifications).
- 1.1.2** All equipment/packages shall be sourced from Owner / PMC approved vendor list attached elsewhere in the tender document. For the items not covered in above vendor list, Contractor shall submit the credentials (past experience/ reference list, technical/ manufacturing capability etc.) of the selected vendor in support of his proven track record and the same shall be subject to acceptance of Owner/PMC during detail engineering. Non-acceptance of a particular proposed vendor due to any reasons whatsoever shall not be a cause of schedule and cost implication.
- 1.1.3** All equipment shall be of proven design. Prototypes, new designs, or extensive modifications of standard designs are unacceptable.
- 1.1.4** Compliance with applicable national or international codes and standards as well as any statutory regulation in existence for a specific item.
- 1.1.5** Service reliability, ease of operation and maintenance including any necessary measures for ensuring safety of personnel and equipment as well as a conducive working environment.
- 1.1.6** Standardization of components, wherever feasible.
- 1.1.7** Adherence to any limitations of space available for the equipment and its operation / maintenance.
- 1.1.8** The size and weight of equipment / package shall preferably be kept minimum.
- 1.1.9** Facility for any known future expansion of plant capacity with a minimum of modifications or shutdown.
- 1.1.10** Equipment shall be designed for the given site condition. Extreme climatic/ environment conditions shall be taken into consideration while selection of equipment, materials and arrangement/ provisions.
- 1.2** Specifications forming a part of the Bid Document indicate a minimum standard of quality for materials, fabrication and/or erection of the proposed equipment. Responsibility for complete compliance to these specifications shall rest with the Contractor. It will be Contractor's responsibility to obtain clarification from Owner's representative, wherever necessary, which in all cases shall be final and binding.
- 1.3** All equipment and materials supplied or installed under these specifications shall be installed in accordance with sound engineering principles and good fabrication and construction practice (no omission from these specifications shall relieve the Contractor from his responsibility).

- 1.4** All equipment and materials fabricated and installed under these specifications shall conform to the latest editions of the applicable codes and standards cited in the bid documents. No omission in the project instructions shall be construed as relieving the Contractor of his responsibility to ascertain these requirements, to perform work and furnish material in accordance with the codes specified.
- 1.5** Design life referred in the process design basis / design criteria shall be considered.
- 1.6** Contractor shall develop technical specification of equipment taking into consideration the requirements defined in engineering design basis, job specifications, data sheets and standard specifications etc. pertaining to equipment and other disciplines such as electrical, structural etc. (as applicable) attached with the tender.
- 1.7** All equipment to be supplied shall be designed for optimum utility consumption requirements.
- 1.8** Equipment/ packages shall be complete in all respects and any item or feature not covered in the specification but essential for proper operation shall be included by the Contractor. Also, the plant shall conform in all respects to high standards of engineering design, state of art technology, and reliability in continuous operation.
- 1.9 MATERIAL OF CONSTRUCTION AND METALLURGY**
- 1.9.1** All materials and equipment shall be new and unused.
- 1.9.2** All materials supplied under these specifications shall be adequate for the proposed service.
- 1.9.3** Corrosion allowance and safety factor shall be within good engineering practice subject to the minimum as stated in the relevant specifications/ data sheets.
- 1.9.4** Selection of material for each component of equipment shall be based on the design pressure, temperature and other conditions of operation and in no case shall be inferior to the material indicated in Process Basic Design Engineering Package (BDEP).
- 1.10 SAFETY**
- 1.10.1** It is the intent of the Owner that operational hazards be reduced to a minimum. Contractor shall use sound engineering judgment to complete an installation that will perform the required function without compromising this aim.
- 1.10.2** Noise limits and vibration limits shall be minimized. Noise limit shall be limited to 85 dBA at 1 m distance from the source unless otherwise specified. In general, OSHA requirements shall be complied with.
- 1.10.3** All electrical devices shall meet the requirements for the area classification in which they are installed.
- 1.10.4** Painting shall comply to the requirement as per specification attached with the bid package.

2.0 CODES AND STANDARDS

- 2.1** The main codes and standards applicable for equipment or system are indicated in the respective standard specification.
- 2.2** The list of applicable EIL standard specifications/ITPs is as given below. Contractor shall refer the applicable standard specifications and codes (latest version) referred therein for the item or system and make part of respective equipment specification in compliance with all such standard specifications.

Sl. No.	Doc. No.	Title Description of Standard Specification/ ITP
1.	6-41-0003	Standard Specification for Centrifugal Pumps (Water Service)
2.	6-48-0002	Standard specification for E.O.T. Crane
3.	6-48-0003	Standard specification for H.O.T. crane
4.	6-61-0017	Standard specification for air conditioning system
5.	6-61-0014	Standard Specification for Electric Wire Rope Hoist
6.	6-61-0015	Standard Specification for Chain Pulley Block
7.	6-78-0001	Quality management system requirements from Bidders
8.	6-78-0002	Documentation requirement from Contractors
9.	6-78-0003	Documentation requirement from Suppliers
10.	6-81-0035	Inspection & Test Plan for Chain Pulley Block/ Winch
11.	6-81-0154	Inspection and test plan for air conditioning package
12.	6-81-0032	ITP for EOT crane
13.	6-81-0142	Inspection & Test Plan for Electric Hoist
14.	6-81-0136	Inspection and test plan for H.O.T. crane
15.	7-76-0103	Instructions to Vendor for Site Performance Guarantee Requirements for Package Units

3.0 TECHNICAL REQUIREMENTS

3.1 AIR CONDITIONING SYSTEM

- 3.1.1** AC System shall be provided for all Buildings as specified in Scope of Works (Doc. No. B957-420-80-42-SOW-7410_Annexure-B).
- 3.1.2** **The entire work of design, engineering, equipment selection, installation, commissioning and performance testing of equipment/ systems shall be executed by one of the owner's / EIL approved vendor list for Air Conditioning System attached elsewhere in the tender.**
- 3.1.3** The Contractor shall submit HVAC system configuration for Owner/ EIL's approval before starting the detail engineering work.
- 3.1.4** Contractor shall be solely responsible to demonstrate the specified inside conditions throughout the year irrespective of any variation in the outside condition.
- 3.1.5 Engineering Design Basis for Air conditioning system:**

Contractor shall refer Cl. No. 2.4.1 of Engineering Design Basis (Doc. No.: B857-999-80-42-EDB-1001, Rev. 0) for Air conditioning System design requirements including outdoor & indoor design conditions along with following applicable amendments.

Sr. No.	EDB cl. No./ Page No.	Existing clause	Modifications
1	2.3.0 (12) / page 30/106	"Heat exchanger inside the Packages like Air-conditioning system, Compressed air and Nitrogen Plant, Instrument air dryer package, Extruder and Pelletiser Package, Pneumatic Conveying Package and other utility packages not handling hydrocarbons shall be as per TEMA C unless otherwise specified in Licensor specification/Process datasheet."	"Heat exchanger inside the Packages like Compressed air and Nitrogen Plant, Instrument air dryer package, Extruder and Pelletiser Package, Pneumatic Conveying Package and other utility packages not handling hydrocarbons shall be as per TEMA C unless otherwise specified in Licensor specification/Process datasheet."
2	2.4.1.1(2.3) / page 30/106	"Reciprocating/scroll compressor shall be used up to 80 TR and screw compressor for 81-160 TR. Centrifugal Compressor (oil free) shall be used for 161 TR and above."	"Reciprocating/scroll compressor shall be used up to 80 TR and screw compressor for 81-250 TR. Centrifugal Compressor shall be used for 251 TR and above."
3	2.4.1.1(3) page 31/106	"Combined Fire & Smoke Dampers shall be pneumatically operated for Control Room and Satellite rack room building. For other buildings, Combined Fire & Smoke Dampers shall be electrically operated motorized spring return type. All combined fire & smoke dampers shall be fail safe type (Closed position under power failure) and shall be UL-555 and UL-555S certified. Blast damper in fresh air intake shall be provided for blast proof buildings."	"Combined Fire & Smoke Dampers shall be pneumatically operated for Control Room and Satellite rack room building. For other buildings, Combined Fire & Smoke Dampers shall be electrically operated motorized spring return type. All combined fire & smoke dampers shall be fail safe type (Closed position under power failure) and shall be UL-555 and UL-555S certified. RCC hood shall be provided at the fresh air intake for all the blast proof buildings. In case RCC hood is not provided, the Blast Damper in fresh air intake shall be provided for blast proof buildings."
4	2.4.1.1(4) page 31/106	"Air Conditioning equipment shall be interlocked with gas/smoke detection and firefighting systems. For Control room and Satellite rack room, required hydrocarbon and toxic gas detection system shall be provided in the fresh air duct as per OISD Standard."	"Air Conditioning equipment shall be interlocked with gas & smoke detection and firefighting systems. For Control Room, Satellite Rack Room & Substation Buildings, provision for installation Hydrocarbon & Toxic Gas (H2S) detection system shall also be made in fresh air duct."
5	2.4.1.1(5) page 31/106	"Minimum one (1) air change / hr or 17 CFM per person whichever is higher shall be considered for calculating fresh air quantity for all air-conditioned buildings except Switchgear Hall of Substation. For Switch gear hall of Substation, minimum two (2) air changes/hr or 17 CFM per person, whichever is	"Minimum one (1) air change / hr or 17 CFM per person whichever is higher shall be considered for calculating fresh air quantity for all buildings. Licensor's specification & ASHRAE guidelines shall also be followed for calculating fresh air/ventilation requirement, wherever applicable."

Sr. No.	EDB cl. No./ Page No.	Existing clause	Modifications
		higher shall be considered. Licensor's specification shall also be followed for calculating fresh air/ventilation requirement, wherever applicable."	
6	2.4.1.1(7) page 31/106	"Chemical laboratory Air Conditioning shall be once through system (i.e. no return air duct). Common header for compatible fumes can be provided with common fans (1 working + 1 standby). Chemical storage room/warehouse air conditioning and ventilation shall be as per Licensor's requirement."	"Once through AC system (i.e. no return air) shall be considered for areas like Chemical Laboratory Room / Chemical Storage Warehouse based on the requirements. Wherever feasible and wherever any mixing of return air is not allowed, Heat Recovery Wheel may also be considered."
7	2.4.1.2(1) page 31/106	"Column "area" of the table Control Room Building with all associated rooms including UPS and Battery Charger Room "	"Column "area" of the table SRR, Control Room Building with all associated rooms including UPS and Battery Charger Room"
8	2.4.1.2(3), (4), (5) page 31,32 /106	"Column "DBT, Deg C" of the table 26 ± 1 (For Cooling)/ 19 ± 1 (For Heating)	"Column "DBT, Deg C" of the table 26 ± 1 (For Cooling) Heating not required"
9	2.4.1.3 (Note 2) page 32/106	"Design temperature for sizing of air-cooled heat exchanger/condenser shall be 42 deg C (Peak ambient temperature)"	"Design temperature for sizing of air-cooled heat exchanger/condenser shall be 46 deg C (Peak ambient temperature)"
10	2.2.1, 2.4.1.1(2.2c), 2.4.1.1(2.4), 2.7.1	Clauses related with VAR/VAM based AC System	Vapour Absorption Refrigeration (VAR) based AC System shall not be considered, therefore, VAR/VAM related points in the referred clauses stand deleted.

Other Design Requirements

Description	Requirement
Under/over deck insulation	Shall be provided for the areas to be air-conditioned as indicated in respective building architectural drawings.
Refrigerant	As per EDB
Fouling Factor for Cooling Water (as applicable)	0.0004 hr-m ² -DEG C/kcal
Fouling Factor for Chilled Water (as applicable)	0.0002 hr-m ² -DEG C/kcal
Temperature of chilled water entering Chiller (as applicable)	12.2° C
Temperature of chilled water leaving Chiller (as applicable)	6.6° C
Equipment Heat Dissipation Load (Electrical + Electronic/Instrumentation)	Contractor to furnish during detailed engineering and consider the same for Heat load calculation.
Light Load	5 W/m ²
Room Occupancy	To be decided by Contractor during detailed engineering based on EIL/Owner inputs.
Outdoor (fresh) Air	As per EDB
Hours of operation	24 hours/day, 365 days

- 3.1.6 Contractor shall consider heat dissipation from electrical/electronic equipment of equipment, Lighting Load & Occupancy etc. while estimating the capacity of air-conditioning system for Buildings.
- 3.1.7 Safety factor shall be considered as minimum 12.5% in respect of Room Sensible Heat and minimum 10% in respect of Room Latent Heat.
- 3.1.8 AHUs shall provide cooling and dehumidification in summer/ monsoon by handling mixture of fresh and return air. Reheating shall be provided in monsoon to achieve specified inside conditions by means of finned strip heaters actuated by humidistat, backed up by safety thermostat. Winter heating shall be achieved by finned strip heaters actuated by heating thermostat backed-up by safety thermostat.
- 3.1.9 Electric heaters shall be provided inside the duct/plenum in properly distributed number of banks.
- 3.1.10 Pan type humidifier in stainless steel construction shall be provided to meet specified humidity requirement in winter season.
- 3.1.11 All combined fire and smoke dampers shall be fail safe type (closed position under power failure) and shall be UL-555 & UL-555S certified. Combined fire & smoke dampers shall meet clean agent zoning requirements, as applicable.
- 3.1.12 Combined fire damper & smoke damper shall be selected for maximum face velocity limited to 1800 fpm when these are installed at main supply air ducts and 1200 fpm when installed at return air paths/openings.

- 3.1.13 Supply air ducts shall be provided with air flow switch which shall trigger alarm in case of no/ low air flow.
- 3.1.14 Velocity of return air shall be restricted to 300 fpm at return air slit.
- 3.1.15 Chipping of RCC slab for duct hangers is not allowed. Contractor shall provide anchor fasteners. Complete supporting structure for duct/cable/pipe/tubing etc. shall be provided by Contractor.
- 3.1.16 Contractor shall ensure that fixing arrangement of diffusers is such that there is no load on false ceiling. Size of diffusers shall match with light fittings. Diffusers shall be firmly fixed with the ductwork.
- 3.1.17 Supply air shall be distributed through insulated supply air duct and return air will be sucked back to the system through the space between false ceiling & RCC roof. Return air shall be sucked through insulated air duct where false ceiling is not provided/ available.
- 3.1.18 All the air-conditioning equipment, electrical, instrumentation and controls shall be suitable for electrical area classifications in which they are installed.
- 3.1.19 PLC/ Microprocessor based control system shall be provided for all air conditioning system.
- 3.1.20 Chilled Water Pumps shall be designed for outdoor installation. However, same can be installed inside plant room also if space is available.
- 3.1.21 All foundations including requisite multi-layer virgin neoprene pads shall be provided by the Contractor between foundation blocks & equipment e.g. Chiller unit, AHU etc.
- 3.1.22 For other technical requirements, refer EIL Standard Specifications for Air Conditioning System (Doc. No. 6-61-0017).

3.2 INVERTER CONTROLLED SPLIT A.C.

- 3.2.1 Inverter controlled split air conditioners (wherever required as per Scope of Work, Doc. No. B957-420-80-42-SOW-7410, Annexure-B) shall be complete with all accessories, fittings, remote controller. Split unit shall be provided with wall mounted indoor (evaporating) unit and remotely located air cooled outdoor (condensing) unit with insulated refrigerant piping, controls and line accessories, initial charge of refrigerant. Associated electrical and civil works (e.g. civil work related to concealing of refrigerant piping, condensate piping to the nearest drain, cabling in AC space and outside upto the outdoor unit) as required including the structural steel framework, pedestal to mount the indoor/outdoor units, supports for indoor/outdoor units, supports & clamps for refrigerant piping/cables, hold down nuts & bolts shall also be in Contractor's scope.
- 3.2.2 All Split air conditioning units shall be 5 star rated and suitable for stabiliser free operation and supplied with factory charged Non-CFC & Non-ODP environmental friendly refrigerants (i.e. R-32/R-134a/ R-407a/ R-407c /R-410a etc.).
- 3.2.3 Spares for commissioning and start up.

3.2.4 Make of Split ACs shall be selected from the vendor list attached with the tender.

3.3 MATERIAL HANDLING EQUIPMENT/ FACILITY (Tag No. to be assigned by Contractor)

3.3.1 Requirements of Material Handling Equipment/ Facility, if found necessary in 3D model reviews over and above the ones already considered by the contractor, the same shall be provided by the contractor without any cost and time implication to Owner.

3.3.2 For site testing of material handling equipment, Contractor shall arrange the test load. The contractor shall make his own arrangements for shifting of test loads available at various locations inside the plant, to the erection place where load testing will be carried out for the material handling equipment.

3.3.3 Suitable monorail shall be provided for accommodating Chain pulley Blocks and Electric Wire Rope Hoist.

3.3.4 Chain Pulley Block/Electric Hoist shall be of compact design. Ease of installation & maintenance of the same shall be ensured by Contractor.

3.3.5 CHAIN PULLEY BLOCK

- a) Chain Pulley Block shall be provided for handling equipment / component weighing 10 MT or less and / or lift less than 10 m or where frequency of maintenance/operation is very less. However, in cases with lifting weighing is more than 10 MT and/or lift is more than 10 m but frequency of operation is very less, Chain Pulley Blocks may also be considered.
- b) All Chain Pulley Blocks shall be spark-resistant construction irrespective of hazardous area classifications.
- c) Chain Pulley Blocks shall be complete with geared trolleys, adequate length of hand chain & load chain, trough for collecting load chain etc.
- d) The minimum capacity of chain pulley blocks with monorail shall be weight of the largest components to be handled plus design margin of 10% as a minimum, rounded off to nearest standard capacity. Wherever two chain pulley blocks are required, each of 75% capacity of the total weight shall be provided.
- e) Chain pulley blocks of standard capacities shall be provided.
- f) Trolley mounted CP Blocks shall be of detachable type suitable for mounting on geared trolleys of same rating/capacities.
- g) Required manual effort for Chain Pulley Block shall be as per the stipulations of IS 3832.
- h) The duty class of Chain Pulley Block shall be minimum M2 class as per IS 3832.
- i) Self-braking system for holding the load in any position shall be provided.

- j) For other technical requirements, refer EIL Standard Specification for Chain Pulley Block (Doc. No. 6-61-0015).

3.3.6 ELECTRIC WIRE ROPE HOIST

- a) Electrically Operated Wire Rope Hoist with trolley shall be provided for handling equipment / component weighing 10 MT or above and / or lift more than 10 m or where frequency of maintenance/operation is relatively high. However, in cases where lifting weight is less than 10 MT and/ or lift is less than 10 m but frequency of operation is high or required for continuous operation, Electric Hoist shall be considered.
- b) For electric hoists, festoon type cable trolleys shall be considered.
- c) Electric hoist shall be operated from floor using a push button type pendent.
- d) The capacity of the Electric Hoist shall be decided based on heaviest equipment to be handled during maintenance with 10% margin.
- e) Up to 16 MT capacity Electric Wire Rope Hoist shall be as per IS 3938. For capacity above 16 MT, Electric hoist shall be manufacturer's standard based on satisfactory Proven Track Record.
- f) Class designation for Electric hoist intended for maintenance shall be considered as 2 as per IS 3938. Class designation of electric hoist for process and continuous operation shall be considered as 4 as per IS 3938.
- g) For other technical requirements, refer EIL Standard Specification for Electric Wire Rope Hoist (Doc. No. 6-61-0014).

3.3.7 E.O.T. CRANE

For technical specifications of E.O.T. Crane, refer Engineering Design Basis-SME (Doc. No.: B857-999-80-42-EDB-1001) and EIL Standard specification for E.O.T. Crane (Doc. No. 6-48-0002).

3.3.8 H.O.T. CRANE

For technical specifications of H.O.T. Crane, refer Engineering Design Basis-SME (Doc. No.: B857-999-80-42-EDB-1001) and EIL Standard specification for H.O.T. Crane (Doc. No. 6-48-0003).

4.0 INSPECTION AND TESTING

4.1 General

- 4.1.1 Equipment shall be subjected to stage-wise expediting, inspection and testing at manufacturer's works by approved third party inspection agency (TPIA). Contractor shall submit Quality Assurance (QA) procedure before commencement of fabrication. Approved QA procedure shall form the basis for equipment inspection.
- 4.1.2 For Inspection and Testing at Works and at Site, Contractor shall comply with the Approved Quality Assurance Plan.

- 4.1.3 Any or all the tests, at Owner's option, shall be witnessed by PMC / Owner apart from TPIA. However, such inspection shall be regarded as check-up and in no way absolve the vendor of his responsibility.
- 4.1.4 Contractor shall comply with the inspection & test requirements as mentioned in EIL Standard Specifications/ ITP of respective equipment attached with the bid package.

5.0 PERFORMANCE GUARANTEE

5.1 General

- 5.1.1 Contractor shall be fully responsible for design and manufacturing work as well as the smooth functioning of the equipment covered under this specification as a minimum.
- 5.1.2 The system shall be performance tested at site after commissioning. The guaranteed parameters shall be checked during the performance test. The performance testing procedures shall be mutually decided after finalization of order.
- 5.1.3 Necessary Instruments for performance testing shall be arranged by the contractor, and calibrated before undertaking the performance test.
- 5.1.4 All equipment and component parts shall be guaranteed by the Contractor against faulty design, defective material or poor workmanship for a period stipulated in the bid package.
- 5.1.5 If any equipment or component(s) fail to perform the stipulated duty or malfunction, contractor shall rectify, modify, replace or make good the defective equipment/component(s) free of cost on notification by the purchaser within a reasonable time period mutually agreed upon.
- 5.1.6 Performance guarantee of "Air Conditioning System" shall be provided at site as per clause no. 4.4 of Standard Specification for Air conditioning System (Doc. no. 6-61-0017) attached with bid package.
- 5.1.7 Performance guarantee of "EOT Crane" shall be provided at site as per clause no. 4.3 of Standard Specification for EOT crane (Doc. no. 6-48-0002) attached with bid package.
- 5.1.8 Performance guarantee of "HOT Crane" shall be provided at site as per clause no. 4.3 of Standard Specification for HOT crane (Doc. no. 6-48-0003) attached with bid package.
- 5.1.9 Performance guarantee of "Electric Hoist" shall be demonstrated at site as per Cl. No. 4.3 of Standard Specification for Electric Hoist (Doc. No.6-61-0014) attached with Tender.

6.0 PROTECTION AND PAINTING

Surface preparation and painting for all equipment shall be as per painting specification attached with the bid package.

7.0 ORDER OF PRECEDENCE

In case of any conflict/ inconsistency among various documents attached/ referred, following order of precedence shall govern:

- Scope of Work/ Supply (Static & Machinery Equipment)
- Job Specification (Static & Machinery Equipment)
- Engineering Design Basis-SME
- EIL Standard Specification
- IS Codes & Standards
- Vendor's Standard

However, any conflict / discrepancy noticed by Contractor in the aforementioned documents shall be submitted to EIL/ Owner for approval and EIL/Owner's decision shall be final without any commercial Implication to Owner.

JOB SPECIFICATION
(STATIC & MACHINERY EQUIPMENT)
ANNEXURE-C (ROTATING EQUIPMENT)
FOR
STEAM GENERATION PACKAGE
TENDER No. B957-420-80-44-PG-T-7410

PROJECT	:	MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)
UNIT NO.	:	420
OWNER	:	M/s BHARAT PETROLEUM CORPORATION LIMITED (BPCL)
LOCATION	:	BINA, MP, INDIA
PMC	:	ENGINEERS INDIA LIMITED
EIL JOB NO.	:	B957

A	07/01/2025	ISSUED AS TENDER INPUT	VS/SG	MG	TK
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

ANNEXURE-C **SMED-II (ROTATING EQUIPMENT)**

SECTION-1: GENERAL

1.1 SCOPE

1.1.1 This specification shall be read in conjunction with Engineering Design Basis- SME (Rotating Equipment) (Doc. No. B857-999-80-42-EDB-1001) and Scope of Supply/ Work (Doc. No.: B957-420-80-42-SOW-7410) enclosed with the bid package. The requirements specified herein are in addition to the requirements as specified in the referred documents.

1.1.2 This Specification along with Engineering Design Basis- Rotating Equipment and Scope of Supply/ Work covers the design criteria for the purpose of carrying out Engineering for Procurement of various rotating equipment rotating equipment coming in the Steam Generation Package (**Tender no. B957-420-80-44-PG-T-7410**) for BPREP Project at BPCL, Bina, MP.

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

1.1.3 The intent of this specification is to supplement, highlight & elaborate the requirements as given in Process datasheet, Mechanical Datasheets, Standard Specifications etc. as listed under list of attachments & enclosed with bid package and other applicable standards referred to in datasheets and specifications.

1.1.4 CONTRACTOR shall develop technical specification for each equipment taking into consideration the requirements defined in engineering design basis, this job specifications, data sheets, EIL standard specifications etc. pertaining to equipment and other disciplines such as electrical, instrumentation, piping etc (as applicable) attached with bid package.

1.1.5 Compliance with this specification shall not relieve the CONTRACTOR/ Vendor of the responsibility of furnishing equipment and auxiliaries of proper design, materials and workmanship to meet specified operating conditions including normal case of operation and transient case of operations (i.e. initial start up, start up, emergency, trip, settle out condition etc.).

1.1.6 In case the CONTRACTOR/ Vendor (i.e. respective equipment vendor) considers requirement of additional instruments, controls, safety devices and any other accessories/ auxiliaries essential for safe & satisfactory operation of the equipment, he shall consider the same in his scope of supply.

1.2 ORDER OF PRECEDENCE

1.2.1 Contractor shall follow complete scope requirements stated in all the documents as per tender and shall not read documents in isolation. A single particular document does not hold complete information and contractor shall comply with requirements of all documents in totality.

1.2.2 In case of conflict between this Job Specification and other attached and/or referred specifications w.r.t. technical details, the following order of precedence shall govern. However, scope of supply/work & services as mentioned in all the documents shall be complied by the contractor without any exemption.

- a) Statutory requirements
- b) Process Package (PDS, P&IDs, etc.)
- c) Scope of Supply/ Works (Static & Machinery Equipment)
- d) This Job Specification
- e) Engineering Design Basis- SME (B857-999-80-42-EDB-1001)
- f) Mechanical Datasheets
- g) Standard Specifications
- h) Other referred codes and standards

In case of any ambiguity in the requirements specified in tender, the **stringent of the same shall be applicable**. The contractor shall bring out the same to the notice of Owner/PMC and shall ask for clarification. Owner/PMC decision on the subject matter shall be FINAL & BINDING in this regard and to be complied by the contractor without any cost / time implications to Owner/PMC.

1.2.3 Applicable edition of API for Rotating Equipment & Auxiliaries, shall be governed by Owner's Approved Engineering Design Basis (Static & Machinery Equipment) attached with the tender document.

1.3 EQUIPMENT SELECTION AND SIZING CRITERIA

1.3.1 All rotating equipment & drivers (including gear units and couplings if any) shall be designed to perform satisfactorily under specified start up conditions, part load operation, and maximum differential pressure operation and relief valve set pressure and up to full speed/maximum continuous speed.

1.4 EQUIPMENT SPARING PHILOSOPHY

1.4.1 The Equipment Sparing philosophy including warehouse spare requirement shall be as specified in the Process Package and/or tender document.

1.5 ASSOCIATED ACCESSORIES AND AUXILIARY SYSTEMS

1.5.1 All rotating equipment, drivers, auxiliary systems, instrumentation and control systems, shall be provided with all necessary electrical and safety devices as applicable or required for safe and reliable operation of the unit

CONTRACTOR in his scope of supply and work shall also include the hardware required over and above what is specified, for safe and satisfactory operation of the equipment package.

1.5.2 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 respective electrical/instrument specification attached with the relevant sections of the tender document /order.

1.6 INSTALLATION CRITERIA

- 1.6.1 All critical equipment intended to be mounted directly on foundation, without base plate and having flat mounted surface shall be grouted as recommended by OEM vendor/supplier.
- 1.6.2 All rotating equipment base plates shall have jacking provision for levelling and screws for alignment. The jacking bolts shall be of SS.
- 1.6.3 Only Stainless-Steel shims shall be used for equipment alignment. Shim thickness shall be minimum 3mm.
- 1.6.4 All rotating equipment shall be unitized along with their drivers at the location as defined in Cl. No. 3.3.2 (UNITISATION) of Engineering Design Basis (SME).
- 1.6.5 Thermal relief valves shall be provided for components that may be blocked in by isolation valves including any cooling water return circuit piping of a cooler or a jacket.
- 1.6.6 For all equipment located on grade level, the height of foundation shall be minimized for easy accessibility, when it is not possible to do so suitable working platform shall be provided around the equipment for ease of operability and maintenance.

1.7 SITE AND UTILITY DATA

- 1.7.1 For site & utility data, refer process/thermal design basis. Note that any additional utility required or utility required at different conditions shall be generated by the CONTRACTOR.
- 1.7.2 Suitable pressure drop of 0.5 kg/cm² shall be considered for import/ export of utilities from unit battery limit to vendor battery limit and vice versa.

1.8 DESIGN CONSIDERATIONS

- 1.8.1 For operating parameters/conditions for various rotating equipment, CONTRACTOR shall refer to respective process datasheet attached elsewhere in the tender package.

1.9 EXPERIENCE CRITERIA (EC)

- 1.9.1 All Rotating Equipment shall meet the Experience Criteria* as specified in this Job specification or in the standard specification of the relevant rotating equipment, as applicable. Rotating Equipment Vendor shall completely fill the Experience Record Proforma enclosed with the tender & submit to EIL to amply prove that the offered Rotating Equipment meet the Experience Criteria for technical acceptance.

** An Indian Subsidiary (enlisted with EIL) of Foreign Principal can also be qualified based on prevalent 'Make in India' Policy of EIL (Annexure-B).*

- 1.9.2 Unless otherwise specified, vendor's offering shall be a model, size and design which has a past supply reference of field operation at operating conditions similar to those specified (i.e. proto-types are not acceptable). The equipment model/ frame offered shall be from regular manufacturing range of the Vendor from EIL approved

manufacturing unit/ works. Vendor shall quote only for those equipment & models/ model-series for which he is enlisted/ approved by EIL.

Note: *It is CONTRACTOR's responsibility to ensure that respective vendor's offering is in line with their enlistment with EIL. Refer Project Vendor List attached elsewhere with the tender document for details.*

1.10 SHOP & SITE INSPECTION & TESTING

1.10.1 Inspection & Testing requirements have been detailed out in Engineering Design Basis- Static & Machinery Equipment, this specification, Mechanical Datasheets, EIL Standard Specifications, codes & standards attached with or referred in the tender document.

1.10.2 CONTRACTOR/Vendor shall submit details of all test procedures for approval by purchaser at least 6 weeks prior to scheduled test date.

1.10.3 Field Trial Run Test/ Site Test

- i. Field trial run test at site for each package shall be done under the supervision of respective equipment vendor. This test shall be done with available media and load to ensure satisfactory performance, safe, smooth, reliable operation, mechanical integrity and sound level of the complete package.
- ii. Modifications/ additions/ changes as required to resolve/ correct any fault in the rotating equipment package, detected during field trial run test shall be in that rotating equipment vendor's scope without any time/ cost implications to the purchaser.
- iii. Duration of field trial run test for package shall be 72 hours. The duration of 72 hours shall be on sustained basis i.e. process interruptions shall be allowed to cumulate, however machine related interruptions shall not be counted.
- iv. If any additional equipment/ instruments are necessary in addition to those in rotating equipment vendor's scope of supply for the purpose of testing & measurement, that rotating equipment vendor shall bring them to site duly calibrated and shall take them back after successful completion. All utility and safety systems shall be operating during the test.

1.11 MATERIAL OF CONSTRUCTION

1.11.1 Material of construction of equipment/components shall be as per Process Package attached with tender document.

1.11.2 Materials offered for the equipment/components shall be suitable for the specified service, operating & design conditions, location and environment.

1.11.3 Material of construction of Lube Oil Coolers shall also comply with requirements specified in the process package.

1.11.4 Also refer Engineering Design Basis – SME (Rotating Equipment) & Process Package for additional requirement.

1.12 REQUIREMENT OF MODULARIZATION

- 1.12.1 The design engineering and supply shall be carried out in such a way that all the sections of the package are supplied in skids or modules along with electrical and instrumentation works as part of module only. Skids shall be fabricated in such a way that it shall require minimal field joints & site welding.
- 1.12.2 All interconnecting piping between skids/ modules shall also be fully prefabricated, tested and delivered to site, so that only hook-up connections are required to be done at site. However, Contractor to check suitability of transporting such items to site.
- 1.12.3 All skids along with interconnected piping shall be assembled and match marked at vendor's works for easy assembly at site.

1.13 PAINTING

- 1.13.1 Refer Job Specification for Surface preparation & Protective Coating and other Painting Specification, attached with the tender document.

SECTION-2: SPECIAL REQUIREMENTS

2.1 CENTRIFUGAL PUMPS (SPECIAL PURPOSE PROCESS)

- 2.1.1 Centrifugal Pump (Special Purpose Process) shall meet requirements as specified in the Process Data Sheet, P&IDs, this Job specification, Engineering Design Basis – Static & Machinery Eqpt., API 610, EIL Std. Spec. 6-41-0008 and other Specification referred therein.
- 2.1.2 As a minimum, Pump Vendor's scope of supply shall include but not limited to the following:
- Centrifugal Pump, driver along with fixing bolts, anchor bolts and shim etc.
 - Flexible metallic coupling.
 - Mechanical Seal & Sealing System including API seal plans, piping and appurtenances.
 - Common base plate for pump & motor along with all foundation anchor bolts and nuts.
 - All auxiliary & associated piping within & between pump skid, Lube oil skid etc.
 - Lube Oil system mounted on separate skid.
 - Mandatory spares, Erection & Commissioning spares, Special tools & tackles.
 - Quotation for two years operation & maintenance spares.
 - All specified inspection and testing.
 - All Electrical & Instrumentation items.
 - Automatic recirculation valve (as required).
 - Painting, preparation of shipment & packaging.
 - Supervision of erection, commissioning & field trial run test at site.
 - Additional items not specified in the bid package, but recommended by vendor for safe, smooth and efficient operation of the complete package
- 2.1.3 Unless specified otherwise, pumps shall be directly driven by electric motor & pumps driven through gearbox are not acceptable.
- 2.1.4 For each pump, minimum continuous flow of the offered pump model shall be less than the 'Normal Flow' as indicated in the respective process data sheet. Continuous flow by-pass is not envisaged, unless specified in respective Process Datasheet. Pumps offered with continuous flow bypass shall be REJECTED.
- 2.1.5 Maximum flow case with max. Differential Head as defined in pump process datasheet shall be considered as rated case.
- 2.1.6 Pump performance curves shall be continuously rising from rated point or from end of curve (as applicable) to shut off irrespective of no pump operation below pump MCF. Achieving Head rise from Rated to shut off by using orifice plate or any other means is not acceptable.
- 2.1.7 Pumps shall meet all the specified cases indicated in the Process Data Sheet and shall be designed for the worst case specified in the Process Data Sheet. The driver and other accessories shall be designed to meet all the cases specified. In case of pump in multiple case of operation extra head that is generated for other cases shall

be killed by the downstream control valve. However, guaranteed case shall be considered for rated flow with actual differential head generated by the pump.

- 2.1.8 All high temperature pumps with hot circulation provision shall have provision of hot liquid circulation from pump bottom to suction line. This ensures uniform heating of complete pump.

Note: Pump in hot service shall be provided with insulation for personal protection. CONTRACTOR to ensure the same.

- 2.1.9 Unless otherwise specified, Pumps where difference between NPSHA and NPSHR from quoted minimum flow to rated flow is less than 1.0 meter are not acceptable. The said NPSHR value shall correspond to the maximum value of NPSHR from rated flow down to the recommended minimum continuous stable flow specified by the vendor. Additionally, in case of parallel operation and/or auto start against open discharge valve condition, NPSHR at end of curve shall not exceed specified NPSHA. Vendor to offer their suitable model considering the same, as the same is a rejection criterion. Problems, if any, shall be highlighted during pre-bid stage. Pumps fitted with inducers for reducing NPSHR are not acceptable.

Note: Elevation considered for NPSHA calculation is indicated in each pump PDS. Actual difference in PDS specified pump centerline elevation & Actual pump centerline elevation shall be considered for calculating NPSH margin requirements. Pump foundation height to be considered as approx. 300 mm above grade level.

- 2.1.10 Maximum Discharge Pressure of Pump considering maximum shut off pressure (with 0% +ve tolerance) with maximum suction pressure and maximum specific gravity at pumping temperature shall not exceed downstream design pressure.
- 2.1.11 Maximum Allowable Working Pressure & Maximum Allowable Working Temperature of the pumps shall neither be less than Design Pressure (i.e estimated shut-off pressure) & Design Temperature specified in the respective pump process data sheet nor less than those specified in specifications, codes & standards. The pressure containing pump casing shall not be de-rated from their design MAWP and the applied hydrostatic test pressure shall be selected accordingly. The pump casing shall also be suitable for operation at discharge pressure (calculated considering normal suction pressure & maximum differential pressure) developed at pump minimum flow with specific gravity= 1.0 (i.e. water), this is required during shop performance test with water at rated speed.
- 2.1.12 Vendor to also note that pump pressure- temperature rating selection shall be in accordance with P-T de-ration curve for the offered pump model for the offered MOC and offered rating. Vendor to furnish P-T de-ration curve/ hydrostatic test report for the offered pump model for the quoted MOC & pressure rating in support of the quoted MAWP. Minimum MAWP @ 15°C & hydrostatic test pressure for the offered pump model shall be as per the following table: -

S. NO.	PUMP RATING	MAWP @ 15°C (BAR(G))	HYDROSTATIC TEST PRESSURE (BAR(G))
1	#300	40	60
2	#600	80	120

2.1.13 For congealing service (where pour point is more than min. ambient temperature), the pump & stuffing box shall be jacketed with steam to ensure fluid inside pump & seal does not congeal. Pumps with congealing process fluid shall be either steam traced or steam jacketed by vendor. Vendor shall furnish field proven past references of the proposed method (i.e. steam tracing or steam jacketing) for the offered pump. Unless otherwise specified, LP steam shall be used. Cleats for insulations shall be provided by pump vendor. However, supply & installation of insulation material shall be done by mechanical contractor at site. Pump vendor to recommend type/ specification/ minimum thickness of insulation material. Condensate from each pump steam jacketing outlet shall be provided with steam trap which shall be supplied by pump vendor.

2.1.14 Steam Turbine driver, wherever specified, shall conform to API 611/ API 612 (as applicable), Datasheets, EIL Standard Specification, Engineering Design Basis – SME (Rotating Equipment) & other specifications as per tender document.

2.1.15 In case of external fluids (pressurised seal flushing fluids, steam, cooling water, etc.) are used, complete system (pump, seal and seal systems) shall also be suitable for design conditions of external fluids.

2.1.16 MULTISTAGE PUMPS

2.1.16.1 Maximum number of stages shall not exceed Twelve (12) stage for Centrifugal Horizontal Pumps.

2.1.16.2 Balance piston or Balance Drum shall necessarily be provided for designs where all axial thrust is cumulative (i.e. all impellers facing the same direction) to reduce the axial thrust. Balancing Disc shall not be employed to balance thrust. The balance line shall be connected to pump suction within the pump confines or to suction vessel (as recommended by Pump OEM).

Note: Pump Vendor P&ID (and associated CONTRACTOR P&ID) shall clearly indicate Balance Leak off Line and its tie in point connections so as to avoid issues during installation.

Vendor to ensure that Balance Leak Off (BLO) flow is added to the rated capacity of the pump and pump sizing shall be done accordingly. Correlation showing the extent of wear to balance line flow shall also be provided.

The balance line shall be provided with pressure gauge and pressure relief valve. In case balance line is located inside the barrel, it is not possible to mount instrument, the same shall not be provided.

Balance line shall utilize flange joints. Screwed connections are not allowed. BLO line shall be designed for casing MAWP.

2.1.16.3 Vendor shall indicate the Dry Critical Speed, 1st and 2nd Wet Critical Speeds for the Rotors of Pumps and shall comply with separation margin w.r.t. operating speeds as per API Std. 610 and shall also furnish the following details for Rotor during detail engineering stage:

(a) Critical speed map showing operation speeds Vs First critical and Second critical speeds (wet and dry) in the X-axis and Y-axis respectively for

- (i) Design clearance (100% clearances)
- (ii) Retirement clearance (200% clearance)
- (b) A sketch showing the following details for each rotor:
 - (i) Weight of Rotor assembly excluding bearings.
 - (ii) Shaft diameter (at impeller, seal and bearing area) and weight.
 - (iii) Span between bearings.
 - (iv) Design speed for which the Pump rotor is designed.
 - (v) Natural deflection of the Rotor;
 - (vi) Diameters & Clearances between Stator and Rotor at all wearing and other close clearance points - quantify.

Also, a Rotor setting Diagram with clearances, deflection etc. shall be furnished both at Running and Retirement clearances.

2.1.16.3 Impeller of multistage pumps shall be positively locked against axial movement in the direction opposite to normal hydraulic thrust.

2.1.16.4 Each Centrifugal Horizontal Multistage Pump driven by Elec. Motor with force feed lubrication system shall undergo with Complete Unit Test (i.e. No-Load String Test) at pump vendor shop.

Complete unit test shall be carried out along with job gear box (if applicable), job motor drivers, job seal and job probes and shall be performed for at least 4 hours at pump manufacturer's shop.

2.1.17 Type of bearings for pumps shall, as a minimum, meet the requirements specified in Cl. 6.10 of API 610 12th edition and shall be as per vendor's standard proven design. Vendor must furnish adequate past supply references, in his offer, of having supplied similar bearing designs with similar lube oil system for similar services (speeds and power ratings) to justify meeting the qualification requirement specified. Vendor shall provide details in the ERP (attached elsewhere) for selected radial and thrust bearings such as type (Antifriction/sleeve/tilting pad, as applicable) to justify the provenness of the offered design.

Vendor shall also provide calculations as per API 610 (Cl. 6.10.1 & Table 10) to justify that the offered type of bearings meets the minimum requirements specified therein.

2.1.18 Pressurized Lube Oil System

- (a) Pressurized Lubrication system, if required, shall be as per API 610 12th edition. The lube oil system shall be console type, mounted separately at adequate level difference from the main pump skid so as to ensure positive drain to tank of return lube oil and to maintain bearing oil temperature rise within the limits specified in applicable specs & API standards. Pressurised Lubrication system shall be dedicated for each pump unit i.e. separate lube oil system shall be provided for working & standby units. The lube oil console shall be located adjacent to the main pump & driver skid. All components in the lube oil system shall be of minimum SS material of construction.

- (b) The lube oil cooler shall be as per Engineering Design Basis-Static & Machinery Equipment, lube oil cooler data sheets, TEMA-C, this specification. Filters & other pressure vessels included in lube oil system shall be as per ASME Sec. VIII Div.1.
- (c) Electric heating arrangement for lube oil reservoir may be provided (if required). The minimum retention time for the reservoir sizing shall be 3 minutes based upon normal oil flow and total reservoir volume below the minimum operating level. Also the reservoir shall be sized to provide rundown capacity of at least 10% more than the amount of oil contained in all components, bearing housing and return oil piping of the L.O. system.
- (d) The main lube oil pump shall be shaft driven. The standby lube oil pump shall be motor driven and shall be of identical characteristic as main pump. The pump capacity shall be based on maximum system usage plus a minimum of 10% and motor shall also be rated to operate at lowest ambient viscosity of oil of rated capacity.
- (e) Alarms and shutdown system shall be installed with provisions for testing while the lubrication system remains in operation. Such testing shall be possible by an operator with the use of tools or test equipment provided by vendor.
- (f) Lube oil reservoirs shall be Stainless Steel (SS) construction.
- (g) Lube oil cooler sizing to be considered with 20-30 % overdesign margin.
- (h) All lube oil piping (supply & return) along with flanges, fittings & valves shall be SS construction. Any tubing required shall be of SS with compression type fittings of like material.
- (i) In addition to figure B.8 of API 610 12th edition, lube oil system shall have following additional instruments in vendor's scope.
 - SS Lube oil reservoir with level gauge & level transmitter with low level alarm indication in Local Control Panel, Unit Control Panel & DCS.
 - High Pressure Transmitter at upstream of check valve on main lube oil pump discharge line.
 - High Temperature Transmitter at downstream of cooler with alarm indication in Main Control Panel.
 - Oil filter shall be duplex type. Oil filter shall have High Differential pressure Transmitter with alarm indication in Main Control Panel.
 - Pressure indicator at lube oil inlet line of each bearing location.
 - Temperature indicator along with sight flow glass in each LO return line to LO Reservoir.

2.1.19 For Pump-Electric Motor Trains requiring Ring Oil/ Splash Lubrication, shall meet the following as specified below:

- All pumps shall be provided with desiccant breather, watchdog constant level oiler, separate oil sample point (if in case separate sample point is not possible it must be through bearing housing drain & bearing isolator suitable for normal splash lubrication).
- Constant level oiler shall be of suitable glass only. Plastic body oilers are not acceptable. Moreover, the oiler shall be provided with metallic- protective mesh.

- Bearing isolators, provided for the pumps where shaft passes through the bearing housing, shall be of replaceable non- contact type and shall meet the requirements of API Std. 610 12th Ed. A magnetic isolator is preferred.
- For oil lubrication, the oil ring/ flinger shall be of non- ferrous material.

2.1.20 Mechanical Shaft Seals

- (a) Seal Type & seal plan are specified in Process Package. However, Pump Vendor shall obtain seal vendor's recommendation and furnish the same during detailed engineering. In case, the seal vendor's recommendation is not in agreement with seal plan indicated in Process Package, the vendor shall furnish the proposed seal plan along with seal vendor recommendation for Owner/ PMC review/ approval during detailed engineering and provide the finally approved seal plan without any cost & time implication.
- (b) Seal and Sealing System shall be suitable for Design Temperature as defined in respective equipment PDS.
- (c) Engineered Seal shall be provided for following, as a minimum:
 - For congealing service (where pour point is more than min. ambient temperature, and also within 20 Deg. C of min. ambient temperature).
 - For Process fluids with slurry & solids.
 - Pumps with shut off pressure more than 40 bar G.
 - Also refer API Std. 682 Annexure A specifically for Engineered Seals selection.
- (d) Mechanical seals to be suitable for maximum shut-off pressure/ casing design pressure under static conditions for pusher type seals. For Bellows seal, mechanical seal shall be suitable up to bellows design pressure, as a minimum.

In case of Sealing Plan 52/53B (wherever applicable) (also refer special Requirements for seal flushing plans), the complete sealing system along with instruments and all accessories shall be mounted/ installed on the pump base plate.
- (e) The seal system temperature for seal plan 52 shall not exceed 70°C during normal operation.
- (f) Mechanical seals shall be from one of the makes specified in Vendor list attached with bid package.
- (g) Seal and Seal systems (i.e. Mechanical Seals & Seal Flushing Plans, as the case may be, shall be supplied by Seal OEM).
- (h) Stuffing Box Dimensions shall be as per API Standard 610.
- (i) The complete sealing system along with instruments and all accessories shall be mounted/ installed on the pump base plate. In case of between bearing pumps there shall be two such independent units, one each for each stuffing box and both the system shall be mounted on the same side to allow for maintenance of the pump.

Aux. Seals/ Flushing Systems & Plans/ Cooling Systems & Plans shall be as per API 682 requirements.

Vendor shall furnish recommended Buffer/ Barrier Fluids for each pump item. When specified, the buffer fluid shall be a synthetic fluid suitable for the seal operating environment and approved by the mechanical seal supplier. Consideration shall be given to minimize the number of fluids the end user/ refiner has to stock.

- (j) Orientation of seal pot and auxiliary connections: The interface points for auxiliary connections (i.e. cooling water supply/return, other connections etc.) as well as the seal reservoir & cooler (i.e. for seal plan 52,53B) shall be located on the Left-Hand Side, when viewed from non-drive end of pump, of the pump skid. All the seal plans shall be towards suction of the pump keeping both sides coupling portion open for maintenance activities. Also refer "Standard for orientation of seal pot and connections of centrifugal pumps (**Doc# 7-44-0321**)" enclosed with bid package.
- (k) Mirror image of seal pot arrangement to have a clear passage in between the pumps, when two pumps are placed in one bay.
- (l) For congealing service, the stuffing box shall be jacketed with steam to ensure fluid inside seal does not congeal.
- (m) Instrumentation associated with Mechanical seal plan shall be as per the instrumentation specifications, data sheets etc.
- (n) API Seal plan 23 shall have venting to flare header and PT at seal inlet.
- (o) For seal flushing plans, piping material shall be of Stainless Steel. For cooling water plans, piping material shall be carbon steel. All piping connections shall be threaded / flanged. No ferrules / unions shall be provided in seal flushing lines.
- (p) Refer "Annexure A-Seal Plans" for "Special Requirements for Seal Flushing Plan 23/32/52/53B/54".
- (q) In case the offered mechanical seal is intended to be supplied by the Indian counterparts of the seal manufacturers, following requirements shall be met:
 - For Standard Mechanical Seals, for which SQT has been conducted by the principal, critical components such as Bellows, Springs and Seal Faces shall be sourced from their principals.
 - For Engineered Seals, the complete mechanical seal along with sleeve and gland plate shall be sourced from their Principal. Seal drawings shall be from Principal/duly vetted by Principal.
- (r) In case of External pressurised seal flushing fluids are used, complete system (pump, Seal and seal systems) shall also be suitable for design conditions of external flushing fluids.
- (s) Any seal offered under "Engineered Seal" category or when seal area/stuffing box is subjected to operating pressure $\geq 20 \text{ kg/cm}^2\text{g}$ (i.e. seals having MDSP $\geq 20 \text{ kg/cm}^2\text{g}$) shall undergo Seal Acceptance Test (SAT).

- All seals installed in one pump per item/ tag shall undergo SAT as per following:
“Four-hour static test, four-hour dynamic test and one-hour cyclic test with test fluid selection as per API 682 and test conditions commensurate with either API 682 test conditions or the conditions expected during operation in normal as well as start-up/ shut down conditions, whichever is more stringent. However, for temperature, API limit of 260 °C may be followed for testing in case of high temperature application.” Propane testing, as per API 682 4th edition conditions, shall be carried out only for liquids with S.G. < 0.6 & pumping temperature of -5 deg C to 176 deg C or for all flashing hydrocarbons with pumping temperature < -5 deg C. Additionally, for propane testing, in case operating pressures are higher than API Std. 682 4th edition test conditions, additional seal acceptance testing with Diesel/Mineral oil (as applicable) shall be carried out at actual operating pressures (as per above).

SAT certificates shall be furnished as a part of final documentation.

2.1.21 Auxiliary Piping

- (a) All auxiliary piping interface connections shall be flanged terminated with a gate valve at the equipment battery limit (i.e. at the edge of the base plate).
- (b) As a minimum Piping material shall be Stainless Steel (SS 316) for Seal Flushing Plans.
- (c) Purchaser shall provide / receive cooling water at single point inlet / outlet at the edge of base plate of each Pump for seal cooler & bearing housing (if applicable). The terminating flanges shall be of ¾" (minimum) size. Vendor shall provide sight flow glass at each cooling water outlet.
- (d) Between Bearing Pumps with two Seal Pots configuration shall have the drains of both the Seal Pots combined downstream of the individual drain isolation valves and shall be terminated at the edge of the base plate.
- (e) All customer piping interfacing will be done towards the base plate edge of non-drive end (NDE) of pump. As such all terminations including seal system drain shall be terminated at the base plate edge of non-drive end (NDE) of pump.
- (f) In case, non-standard sizes or different from line rating nozzles are unavoidable, companion flanges along with gaskets and fasteners shall be included in the scope of the pump vendor.

2.1.22 For technical requirement for Couplings, Machine Health Monitoring System, Lube Oil Coolers etc., refer elsewhere in this Job Specification, Engineering Design Basis-Static & Machinery Equipment, EIL Standard Specification, Mechanical Datasheet etc.

2.1.23 Minimum MOC of centrifugal pumps (special purpose process) shall be carbon steel (API 610 material class S5). Wherever, cast iron is specified as pump MOC in process datasheet for centrifugal pump (special purpose process), CONTRACTOR to

provide API 610 Material Class S5 or higher metallurgy. It is CONTRACTOR responsibility to ensure the suitability of the proposed MOC to the specified service operating and design conditions.

- 2.1.24 Baseplates shall be provided with 2" flanged connection.
- 2.1.25 Equipment along with the drivers shall be procured from the respective driven equipment manufacturers as skid mounted units with all accessories, auxiliaries along with auxiliary piping.
- 2.1.26 A gate valve & a magnetic drain plug shall be provided for all centrifugal pumps bearing housings.
- 2.1.27 3D bulls' eye (360-degree view) to be provided in pump bearing housing for the easy monitoring of oil level and prevent lube oil related failures.
- 2.1.28 Oil Sight Glass for visual oil inspection to inspect oil & drain water to be provided in the bearing housing to identify and prevent lube oil related failures.
- 2.1.29 Rotary equipment OEM to mention the suffix and prefix of the antifriction bearings in part list instead of mentioning only bearing numbers. Antifriction bearings make to be of either SKF or FAG.
- 2.1.30 The suspended length of sump pump shall have Proven Track Record and customer real feedback to be provided to prevent the recurring failures of pump.
- 2.1.31 The rotary equipment OEM should include a Unique Part Number of each item listed in the equipment cross section drg., seal drawings to facilitate the identification of interchangeable spare parts by the user.
- 2.1.32 Where cooling plans are used (As per Annex B of API 610, 12th Ed), the BIDDER shall design cooling water piping considering flow rate required and cooling water pressure and inlet temperature specified by the PURCHASER. However, the header and branch piping shall have following minimum sizes:
- The main cooling water supply header, to which branch pipes are connected for supply of cooling water to individual bearings shall be of minimum 1.5" N.B.
 - The cooling water return header shall be of minimum 1.5" N.B.
 - Branch pipes for supply of cooling water to individual bearings shall be of minimum 3/4" N.B.
 - Branch pipes for cooling water return from the individual bearings shall be of minimum 3/4" N.B.

2.2 Special Requirements for Multistage Centrifugal Pumps (Boiler Feed Water)
(In addition to the special requirements mentioned above)

- 2.2.1 In addition to the above stated requirements for Centrifugal Pumps, the following are applicable for BFW pumps:
- (a) In case ARC valve is included as minimum flow protection, ARC Valve shall be in pump vendor's scope and pump & driver sizing shall include pressure drop across ARC Valve in addition to rated differential head.
- 2.2.2 **Steam Turbine** (driving BFW pump): If forced feed lubrication is applicable, the same shall be as specified below: -

- (i) The lube oil system shall conform to API standard 614 and attached data sheets and other specifications. Console type common lube oil system shall be supplied for the complete BFW pump package.
- (ii) The lube oil / control oil system shall be equipped with Oil reservoir, Electric Motor driven main & standby lube oil pump, Emergency DC motor driven emergency lube oil pump and an overhead run-down tank, accumulators, twin filters, Shell & Tube type oil cooler, and all necessary valves, fittings, gauges etc. as required by purchaser's specifications.
- (iii) The material of construction of lube oil reservoir, lube oil supply and return piping, valve internals etc. shall be of Series 300 Stainless Steel.
- (iv) All inter-connecting lube oil piping from oil console to various consumption points in the equipment, including fittings, valves, instruments and supports shall be included in the vendor's scope of supply. Lube oil piping within package, oil console and lube oil run down tank shall also be in vendor's scope of supply. Vendor shall engineer the system and furnish detailed P&IDs as well as the piping drawings for the interconnecting piping for purchaser's review/ approval during detail engineering stage.
- (v) Reservoirs, pumps, coolers, filters and control valves shall be provided in an assembled console. Console shall have a steel base plate with rim and drip lip for drainage.
- (vi) Following lube oil pump driving arrangement is envisaged.
Main Lube oil Pump: MOP shall be main equipment shaft driven
(Note# if MOP is not Main equipment Shaft driven then MOP shall be steam turbine driven)
Standby Lube oil Pump: Driven by AC Motor
Emergency Lube Oil Pump: Driven by AC Motor with Emergency supply
- Lube Oil pumps and their driver shall meet the requirements as specified in:
- Lube oil system data sheets
 - API Std. 610
 - API Std 676
- (vii) Filters & Oil Coolers
- Filters and coolers shall be fitted with valved vents and drains.
 - Filters and coolers shall have valved interconnections to permit filling with oil after maintenance. Vents of the filters and coolers shall be routed to lube oil reservoir with sight flow glasses to ensure small amount of flow continuously through the standby filter or cooler to facilitate quick changeover.
 - Cooling water composition is specified on site and utility data attached elsewhere. Vendor shall check compatibility of the specified/offered metallurgy with respect to the cooling water composition and offer/confirm the MOC accordingly.
 - Lube oil cooler shall be water- cooled shell & tube type heat exchanger as per TEMA 'C' with oil in shell and water in tube. The oil side operating pressure shall be higher than the water side operating pressure. The low pressure (LP) side shall preferably

be with a design pressure at least equal to (10/13) of high pressure (HP) side design pressure. MOC shall be suitable for the specified service and shall be in- line with API- 614 & Mechanical Datasheet requirements.

- Vendor shall design the lube oil consoles from the point of view of easy accessibility, 500mm(min) free space around and maintainability of the major pieces of equipment such as coolers, pumps, drivers, control valves, filters etc. Vendor to ensure easy personal movement and no criss crossing of piping in the consoles. Vendor shall not consider his standard congested consoles but shall design the layout in spread out manner. The layout shall be furnished for review and approval by the purchaser during detailed engineering.
- One portable (trolley mounted) pump with necessary hose piping, valves, connections etc. shall be provided for emptying/filling the main reservoirs. Pump shall be electric motor driven with a motor cable of 20 m length, hose pipe of 10 m length at suction and discharge and plug to suit the area classification and motor rating.
- One portable (trolley mounted) oil purifier/conditioner with necessary hose piping, valves, connections etc. shall be provided. Pump shall be electric motor driven with a motor cable of 20 m length, hose pipe of 10 m length at suction and discharge and plug to suit the area classification and motor rating. The capacity shall be sufficient for conditioning the total requirement in approximately 12 hrs.

If forced feed lubrication is required for BFW pump also, the same shall be common to that of steam turbine.

2.2.3 Instrumentation and Control

- Vendor shall refer to the data sheets, instrumentation requirements, specifications and standards attached and referred to in the bid package document for the purpose of instrumentation requirements included in the vendor's scope of supply.
- All alarms and trip annunciations shall be provided in the MCR with a repeat indication to the LCP.
- All trips (except those related to machine monitoring system shall be based on 2oo3 voting logics.
- Any additional instrumentation required for the safe operation of the pump shall be clearly indicated by the vendors and the same shall be included in their supply.
- One Local Panel for each multistage pump train shall be provided.
- Machine monitoring system shall be provided for all pump items provided with force feed lubricated sleeve/hydrodynamic bearings. The same shall be as per the requirements specified in EDB-SME.
- Vibration Measurement and Monitoring System shall be as per the requirements specified in EDB-SME.
- Temperature Measurement and Monitoring System shall be as per the requirements specified in EDB-SME.
- Machine Monitoring for Pumps provided with Ring Oil Lubrication shall be as per the requirements specified in EDB-SME.

2.2.4 Inspection and Testing

In addition to the inspection and tests defined in the datasheets, specifications, codes and standards the following witnessed tests for each pump set shall be carried out as a minimum.

L.O. system (if applicable): cleanliness, four-hour run, check controls, change over (filters), one & two pump operation at L.O. system manufacturer's shop.

2.3 STEAM TURBINE (GENERAL PURPOSE PROCESS)

2.3.1 Steam Turbine (General Purpose) shall meet requirements as specified in the Process Data Sheet, P&IDs, this Job specification, Engineering Design Basis – Static & Machinery Eqpt., EIL standard Spec.# 6-43-0042, API 611 and other Specification referred therein. Steam consumption shall be guaranteed for the power corresponding to pump guarantee rated point at normal steam inlet, normal extraction (where applicable).

2.3.2 CONTRACTOR to select back pressure turbine based on the utilization of steam levels within the package (subject to market availability & with proven track record). However, please note that in case any of the following conditions exist at the steam turbine inlet, then special purpose steam turbine (compliant to API 612 & EIL Std. Specification # 6-43-0043) shall be provided: -

- Inlet pressure > 60 bar g;
- Inlet temperature > 475 DEG C;
- Speed > 6000 rpm;
- Turbine rating > 3000 kW;
- Driven equipment is usually un-spared or is in critical service.

<This supersedes the contradicting requirement specified elsewhere in the tender>

2.3.3 The turbine rating shall be 110% of rated power of the pump. The turbine shall be capable of delivering this power at the minimum inlet pressure and maximum exhaust pressure. Also, the turbine shall be capable of delivering 10% extra power over the rated power by opening the hand valves.

2.3.4 Turbine rating as a minimum shall be equal to motor rating of motor driven pump.

2.4 ROTARY PUMP (SCREW TYPE)

2.4.1 Rotary Pump shall meet the requirements as specified in Process Data Sheet, P&IDs, this Job specification, Engineering Design Basis – Static & Machinery Eqpt., EIL Specification 6-41-0022, API Std. 676 and other Specification referred therein.

2.4.2 Pumps shall be designed to meet the operating condition as stipulated in the equipment data sheet. Also, it shall be selected for specified capacity at minimum specified viscosity and the specified discharge pressure (maximum differential pressure).

2.4.3 Vendor shall provide complete performance curves, including differential pressure, efficiency, NPSH_R, and power expressed as functions of flow rate at the specified viscosity.

2.4.4 Vendor shall recommend pump speed for the specified service considering such factors as NPSH_A, NPSH_R, maximum fluid viscosity, solids and abrasive content, wear allowance if required.

- 2.4.5 If pumping fluid is congealing in nature, Steam jacketed (fully) pump shall be provided. Vendor shall furnish field proven past references for steam jacketing. Cleats for insulations shall be provided by pump vendor. However, supply & installation of insulation material shall be done by CONTRACTOR at site. Pump vendor to recommend type/ specification/ minimum thickness of insulation material. Condensate from each pump steam jacketing outlet shall be provided with steam trap which shall be supplied by pump vendor.
- 2.4.6 Electric Motor (driver) synchronous speed shall not exceed 3000 RPM.
- 2.4.7 Line Mounted Relief Valves shall be supplied by pump vendor.
- 2.4.8 Maximum allowable working pressure & temperature of the equipment shall not be less than the Design Pressure/RV Accumulation Pressure & Temperature specified in the data sheet nor less than those specified in specifications, codes & standards.
- 2.4.9 Recommended rating for driver shall be higher of 110% of rated BKW (including all transmission losses) or 105% of BKW @ relieve valve set pressure. The driver rating, including service factor, shall be suitable for operation at 100 % of the PSV accumulation pressure (Percentage Accumulation shall be 10% for PSV Set Pressure). The driver shall not be overloading over the entire range of operation.
- 2.4.10 Suction flange rating shall be same as that of discharge flange for all pumps.
- 2.4.11. Type of bearings for pumps shall, as a minimum, shall meet the requirements specified in Cl. 6.10 of API 676 3rd Ed. and shall be as per vendor's standard proven design. Vendor must furnish adequate past supply references, in his offer, of having supplied similar bearing designs with similar lubrication system for similar services (speeds and power ratings) to justify offered bearing design.
- 2.4.12. Mechanical Seals shall be as per manufacturer's standard (past proven for the specified service) and of single balanced cartridge type.
- 2.4.13. The offered seal type/selection, based on proven service in similar applications shall be substantiated by references along with the offer.
- 2.4.14. Applicable seal plan for FO pump shall be 02,62. In case any alternate seal plan is proposed (duly substantiated by past supply references in similar applications), same shall be highlighted by the vendor.
- API Plan 02: Stuffing box heating with Steam shall be provided by vendor. Steam inlet / out connection at vendor b/l shall be provided. Any pressure reducing device (if required) shall be considered in vendor's scope.
 - API Plan 62: Inlet connection for Plan 62 quenching shall be equipped with Needle valve, Pressure Gauge, NRV, SAPCV, PSV (if req. for protection of mechanical seal) etc within vendor's b/l.
- 2.4.15. CONTRACTOR shall provide/receive Steam at single point Inlet/ outlet at the edge of baseplate of each pump for jacketing of casing & stuffing box and plan 62 quenching. The terminating flanges shall be of 3/4" (minimum) size. The interface points for auxiliary connections (i.e. LP/MP Steam, other connections etc.) shall be located on the Left-Hand Side, when viewed from non-drive end of pump, of the pump skid.

- 2.4.16 Interface connection for Pump Suction, Discharge, Vent, Drain, Relief Valve, Steam Inlet / Outlet etc., shall be WNRF type as per ANSI B16.5.

2.4 CENTRIFUGAL PUMPS (GENERAL PURPOSE PROCESS)

- 2.5.1 Centrifugal Pump (GPP) shall meet requirements as specified in the Process Data Sheet, P&IDs, this Job specification, Engineering Design Basis – Static & Machinery Eqpt., EIL Std. Spec. 6-41-0002 and other Specification referred therein.
- 2.5.2 Unless otherwise specified, Mechanical seals shall be of Cartridge design. Balanced mechanical seals shall be provided for centrifugal pumps (general purpose process service).
- 2.5.3 For cooling water plans & seal flushing plans, piping material shall be of Stainless Steel.
- 2.5.4 The total head capacity curve of the pump should be continuously rising towards the shut-off.
- 2.5.5 Suction flange rating shall be same as that of discharge flange for all pumps.
- 2.5.6 Baseplates shall be provided with 2" flanged connection.
- 2.5.7 Equipment along with the drivers shall be procured from the respective driven equipment manufacturers as skid mounted units with all accessories, auxiliaries along with auxiliary piping.
- 2.5.8 A gate valve & a magnetic drain plug shall be provided for all centrifugal pumps bearing housings.
- 2.5.9 3D bulls' eye (360-degree view) to be provided in pump bearing housing for the easy monitoring of oil level and prevent lube oil related failures.
- 2.5.10 Oil Sight Glass for visual oil inspection to inspect oil & drain water to be provided in the bearing housing to identify and prevent lube oil related failures.
- 2.5.11 Rotary equipment OEM to mention the suffix and prefix of the antifriction bearings in part list instead of mentioning only bearing numbers. Antifriction bearings make to be of either SKF or FAG.
- 2.5.12 The suspended length of sump pump shall have Proven Track Record and customer real feedback to be provided to prevent the recurring failures of pump.
- 2.5.13 The rotary equipment OEM should include a Unique Part Number of each item listed in the equipment cross section drg., seal drawings to facilitate the identification of interchangeable spare parts by the user.

2.6 CENTRIFUGAL FANS

- 2.6.1 Centrifugal Fans shall meet requirements as specified in the Process Data Sheet, P&IDs, this Job specification, Engineering Design Basis, EIL Std. Spec. 6-42-0002 and other Specification referred therein.
- 2.6.2 The Fan, Driver and auxiliaries shall be suitable for unsheltered outdoor installation and shall perform its duty without reservation under the worst combination of ambient conditions specified in the bid document.

2.6.3 Fan vendor shall supply silencers at inlet & outlet to meet the specified noise levels for the complete package and guarantee the same at site. If required to meet the specified noise level, acoustic enclosures shall be provided.

2.6.4 Total pressure losses in the inlet system including inlet strainer(s), inlet silencer(s) etc. to arrive at the operating suction pressure at Fan inlet flange, shall be considered.

Similarly, to arrive at the operating discharge pressure at Fan outlet, total pressure losses in the outlet system between Fan outlet flange & the evase outlet flange shall also be considered.

To arrive at the total differential pressure across the Fan, consider the discharge pressure indicated above, add the pressure losses at inlet side & outlet side of Fan.

2.6.6 Vendor shall furnish separate performance curves for all the operating cases & all various operating speeds, together with the surge line indicated, to justify the continued operation from minimum to maximum capacity at the operating speed.

2.6.7 Fan sizing shall be done for the maximum capacity considering the maximum suction temperature. However, the driver, in addition to meet the requirements indicated, shall be sized for operation at low ambient temperature and un-throttled service (i.e. for maximum mass flow rate). The driver for the fan shall be sized for a minimum of 110% of the maximum power requirement under any operating condition.

2.6.8 Fan shall be suitable for continuous operation (mechanically) at 60°C above the maximum specified operating temperature.

2.6.9 Bearing oil lubrication shall be ring oil / splash as per manufacturer's standard for the offered bearings.

2.6.10 Inspection & Tests
Inspection and Test requirements have been detailed out in data sheets, specifications for various equipment and referred codes and standards.

2.6.11 Fan Housings shall be of cast or fabricated construction, suitably stiffened to avoid drumming, and shall be split to permit the removal of the impeller and the shaft without disturbing the bearing pedestals. In case of fabricated construction Minimum plate thickness shall be 6.0 mm and shall be of butt-welded construction.

2.6.12 A drain connection with block valve and blind flange shall be provided at the lowest point of the casing and inlet box(es)

2.6.13 Impeller shall be of cast or fabricated and welded construction. Cast impellers, if offered, shall be of one-piece construction, machined all over except on the internal fluid passages.

2.6.14 Impellers shall be positively locked to the shaft.

2.6.15 Shaft seals shall be such as to permit removal for inspection and replacement without disturbing the shaft or bearings.

- 2.6.16 The complete rotor along with coupling half shall be dynamically balanced to Grade 2.5 as per ISO 1940 prior to assembly.
- 2.6.17 Antifriction bearings, if provided, shall be selected for a minimum L-10 life of 25,000 hours.
- 2.6.18 Journal type bearings when used, shall have replaceable liners or shells, and shall be horizontally split.
- 2.6.19 Fans with antifriction bearings shall be preferably provided with shaft sleeve under the bearings.
- 2.6.20 Allowable Vibration Limit shall be 60 microns p-p up to 1000 rpm.
- 2.6.21 Damper or variable guide vane operating mechanism shall be of corrosion resistant material.
- 2.6.22 Fan blades shall be backward curved design.
- 2.6.23 The electric motor driver rating shall also be adequate for operation of the fans at the minimum specified fluid temperature (specified in data sheet) at rated speed in un-throttled conditions.
- 2.6.24 Special Design Requirements: -
- First critical speed of the rotor shall be higher than 120% of rated speed.
 - The fan/ blower casing shall be suitably split such that impeller assembly can be removed for maintenance without disturbing inlet and outlet ducting.
 - SS Bolt and nuts shall be provided for the split casing joints of fans/blowers for corrosive services.
 - Fans operating in hot gas service shall be provided with a deflector plate or other suitable provision between shaft seal and bearing housing to deflect hot gas leakage away from the bearing housing.
 - Inlet guide vanes, if specified, shall be provided with following:
 - a. An external guide vane position indicator.
 - b. Spindles shall be supported at both ends.
 - c. Manual operation of guide vane from grade level shall be possible.
 - d. The guide vane ring shall be protected by a dust cover which shall allow full access to all parts for inspection.
 - e. Dampers shall be louver type with opposed blade.
- 2.6.25 Seal Air Fans & Scanner Air Fans can be manufacturer's standard (subject to market availability & proven track record in similar applications)

2.7 FORCED DRAFT FANS

- 2.7.1 FD Fan shall meet all the requirements specified in Process Data Sheet, P&IDs, this Job specification, Engineering Design Basis – Static & Machinery Eqpt., EIL Specification 6-42-0016 and other Specification referred therein.
- 2.7.2 As specified in process package, FD Fan shall be provided with Dual Drive – Electric Motor Drive and Back Pressure Type Steam Turbine Drive, each sized independently to cater to total load requirement, with Automatic Changeover Clutch.

Fan shall be provided complete with Inlet Screen, Venturi, Inlet Guide Vane Control, Coupling & Coupling Guards, Safety Devices etc.
Provision shall be made to enable to start FD Fan from DCS as well as Local.

- 2.7.3 FD Fan Steam Turbine Drive: CONTRACTOR to select back pressure turbine based on the utilization of steam levels within the package (subject to market availability & with proven track record). However, please note that in case any of the following conditions exist at the steam turbine inlet, then special purpose steam turbine (compliant to API 612 & EIL Std. Specification # 6-43-0043) shall be provided: -
- Inlet pressure > 60 bar g;
 - Inlet temperature > 475 DEG C;
 - Speed > 6000 rpm;
 - Turbine rating > 3000 kW;
 - Driven equipment is usually un-spared or is in critical service.
- <This supersedes the contradicting requirement specified elsewhere in the tender>

Normally FD Fan air flow shall be controlled with speed control of the steam turbine keeping IGV under full open condition.

- 2.7.4 In case the FD Fan being run with Electric Motor, flow control shall be achieved by means of Inlet Guide Vane Control only. Auto start facility shall be provided to enable start of Motor Drive in case of failure of Steam Turbine Drive.
- 2.7.5 Electric motor drives shall have a maximum continuous rating (MCR) (i.e. service factor equal to one) not less than 110% of greatest power required (also considering all transmission losses including coupling losses) for any of the specified operating conditions.
- 2.7.6 Ambient air temperature varies between minimum and maximum. As such the Fan shall be sized for a capacity considering maximum ambient temperature.
Driver shall be sized to take care of additional mass flow rate corresponding to minimum ambient temperature without considering any speed change/throttling.
Steam Turbine Driver Rating shall be at least equal to the Electric Motor Rating.
- 2.7.7 CONTRACTOR shall consider suitable losses at fan inlet/exhaust while sizing the fan/driver.
- 2.7.8 FD Fan shall be provided with its individual suction stack with inlet trash screen, rain hood of corrosion resistant material and flow element. Suction stack shall be of self-supporting type made of steel. The elevation of the suction stack shall be minimum 6.0 meters from Grade. If flow measurement in suction is required or specified in tender documents, the height of stack shall be governed by Upstream/Downstream straight lengths requirements for the accuracy in flow measurement. The supporting structure shall be provided by the CONTRACTOR.
- 2.7.9 All characteristic curves shall refer capacity to the normal intake conditions specified on the data sheets. Performance curves shall be based on actual performance tests of identical equipment including inlet boxes. Performance curve shall indicate operating points and expected surge line.
- 2.7.10 Speed indication for each of fans shall be made available at local panel as well as at Remote.

2.7.11 The local panel shall contain Push Buttons for start/stop, speed indicator in addition to Ammeter for the Motor. Other instrumentation required for safe operation of the unit shall also be provided by the CONTRACTOR.

2.7.12 Fan Housing and Nozzles

- a) Fan housing shall be butt-welded plate construction with scroll housing. Fan inlet box shall be split with bolted, flanged and gasketed connection for rotor removal and for providing access without disturbing the duct connections or bearing pedestals. The inlet cones shall be bolt on type to permit removal of the rotor. Adequate stiffeners shall be provided to form a rigid housing and also to avoid drumming.
- b) Inlet and outlet nozzles shall terminate in duct type flanges. Facing of all connection shall be adequate to prevent leakage when supplied with appropriate gasketing and bolting.

2.7.13 Shaft Sleeves and Seals

Shaft seals shall be provided at housing shaft openings to minimize leakage. Seals shall be designed to permit replacement from outside of the housing without disturbing the shaft or bearings.

2.7.14 Bearing Housing & Lubrication

- a) Bearings shall be supported on rigid independent pedestals and sole plate outside the fan housing so as to be unaffected by vibration, differential expansion or by other forces from fan housing.
- b) FD Fan shall be provided with Mfr's Standard Oil Lubrication System. Offered system shall be a proven system having adequate past supply experience for similar sized fans. When oil lubrication is provided, same shall be of disc or ring lubricated with self contained reservoirs in each housing, inspection ports, drains, constant level oilers and mesh protected.
- c) Bearing housing shall be provided with double shaft seals to prevent oil leakage or contamination. Bearing type and housing cooling shall be as per mfg. meeting the tender requirement and the same shall be field proven design considering the design load.
- d) Thrust collars shall be provided in the inboard bearings. Thrust bearing area shall be designed for fan operating with one inlet damper closed. Shaft thrust collars shall be integral or installed with a substantial shrink fit. Thrust faces shall be machined after collar installation to assure proper concentricity. Split thrust collars are not acceptable.

2.7.15 Cleaning

FD fans shall have provision for cleaning of all elements inside the fan housing by water jets cleaning system shall be designed for use when fan is in running condition.

2.7.16 Suction screen

A protective screen (bird & Insect screen) should be provided at the inlet. Vendor shall offer a suitable screen with its mounting frame and the connecting duct/pipe up to the fan inlet.

- 2.7.17 Fan manufacturer shall furnish silencers and/or acoustical treatment necessary to limit the noise level on the intake of FD fans. If required, fan manufacturer shall provide acoustical treatment for FD fan housings to meet the above noise level.
- 2.7.18 FD fans shall be provided with Aerofoil design type blades. Skin thickness shall be minimum 2.5 mm for hollow shaped construction.
- 2.7.19 Inspection & Tests
Inspection and tests as defined in the datasheets, specifications, codes and standards shall be applicable for the FD fans.
- 2.7.20 Fan Housings shall be of cast or fabricated construction, suitably stiffened to avoid drumming, and shall be split to permit the removal of the impeller and the shaft without disturbing the bearing pedestals. In case of fabricated construction Minimum plate thickness shall be 6.0 mm and shall be of butt-welded construction.
- 2.7.21 A drain connection with block valve and blind flange shall be provided at the lowest point of the casing and inlet box(es)
- 2.7.22 Impeller shall be of cast or fabricated and welded construction. Cast impellers, if offered, shall be of one-piece construction, machined all over except on the internal fluid passages.
- 2.7.23 Impellers shall be positively locked to the shaft.
- 2.7.24 Shaft seals shall be such as to permit removal for inspection and replacement without disturbing the shaft or bearings.
- 2.7.25 The complete rotor along with coupling half shall be dynamically balanced to Grade 2.5 as per ISO 1940 prior to assembly.
- 2.7.26 Antifriction bearings, if provided, shall be selected for a minimum L-10 life of 25,000 hours.
- 2.7.27 Journal type bearings when used, shall have replaceable liners or shells, and shall be horizontally split.
- 2.7.28 Fans with antifriction bearings shall be preferably provided with shaft sleeve under the bearings.
- 2.7.29 Allowable Vibration Limit shall be 60 microns p-p up to 1000 rpm.
- 2.7.30 Damper or variable guide vane operating mechanism shall be of corrosion resistant material.
- 2.7.31 Fan blades shall be backward curved design.
- 2.7.32 The electric motor driver rating shall also be adequate for operation of the fans at the minimum specified fluid temperature (specified in data sheet) at rated speed in un-throttled conditions.
- 2.7.33 Special Design Requirements: -
 - First critical speed of the rotor shall be higher than 120% of rated speed.

- The fan/ blower casing shall be suitably split such that impeller assembly can be removed for maintenance without disturbing inlet and outlet ducting.
- SS Bolt and nuts shall be provided for the split casing joints of fans/blowers for corrosive services.
- Fans operating in hot gas service shall be provided with a deflector plate or other suitable provision between shaft seal and bearing housing to deflect hot gas leakage away from the bearing housing.
- Inlet guide vanes, if specified, shall be provided with following:
 - a. An external guide vane position indicator.
 - b. Spindles shall be supported at both ends.
 - c. Manual operation of guide vane from grade level shall be possible.
 - d. The guide vane ring shall be protected by a dust cover which shall allow full access to all parts for inspection.
 - e. Dampers shall be louver type with opposed blade.

2.8 POSITIVE DISPLACEMENT PUMP CONTROLLED VOLUME

- 2.8.1 Pump shall meet the requirements as specified in Process Data Sheet, P&IDs, this Job specification, API Std. 675 and EIL standard specification 6-41-0021.
- 2.8.2 Operating speed shall not be more than 100 strokes per minute.
- 2.8.3 Controlled Volume pumps shall be of double/sandwich diaphragm type with rupture detection system achieved through a pressure transmitter & a pressure gauge.
- 2.8.4 Pump unit complete with speed reducer, driver, suction pulsation dampener (if required or specified) & discharge pulsation dampener, calibration pot, suction and discharge manifold piping duly pre-fabricated for multi-head pumps, external relief valves, instrumentation & controls for diaphragm rupture detection system & automatic capacity control (as specified) etc. shall be mounted on a common baseplate and shall be supplied as a skid mounted package.
- 2.8.5 Controlled volume pumps shall have positive return stroke mechanism. Controlled volume pump with lost motion design or with spring return stroke mechanism shall not be permitted.
- 2.8.6 If automatic capacity control is required for any pump item, CONTRACTOR shall provide 4-20 mA electronic signal for each of these pumps separately. All the necessary instruments required for automatic stroke adjustment shall be in vendor's scope of supply. In addition to the above, vendor shall provide necessary arrangement for manual stroke adjustment.
- 2.8.7 Only one number & common gas charging kit for discharge pulsation dampener (bladder / diaphragm, gas charged type) shall be supplied for a particular pump item tag.
- 2.8.8 Strainers / Filters shall be provided before inlet of each pump as per respective P&IDs.

2.9 CHEMICAL DOSING SKIDS

- 2.9.1 Dosing packages shall meet requirements as specified in approved Process package, this Job specification, Engineering Design Basis – Static & Machinery Equipment, EIL Std. Spec. 6-41-0301 and other Specification referred therein.

2.9.2 Dosing Skid Vendor's scope of supply for chemical dosing package shall include but not limited to the following:

- Chemical storage vessels / tanks of required capacity as per process data sheets.
- Double/Sandwich Diaphragm type Positive displacement pump (controlled volume) of required capacity as per process data sheets, each complete with its diaphragm rupture detection system (i.e. pressure indicator & pressure switch) for generating alarm in case of diaphragm rupture, external safety relief valve conforming to API standard, suction pulsation dampener, discharge pulsation dampener, flexible metallic coupling and electric motor driver, mounted on a common base plate.
- Calibration cylinder (wherever specified) as per the system requirement.
- Y-Type/T- Type Suction strainers as required or indicated in the P& IDs.
- Necessary interconnecting piping, valves, fittings as required or indicated in the P&IDs.
- Necessary instrumentation & controls as per P&IDs, Line List and Instrumentation Job Specification.
- Plant air operated diaphragm type drum unloading pumps (wherever specified), each complete with air dryer requiring no electric power, air filter regulator with pressure gauge, bleed type master air valve, air discharge muffler, air side external relief valve (manufacturer's standard), liquid discharge side check valve, drain valve and adapter for mounting the pump on the chemical drum.
- Skid mounted junction boxes & interconnecting cabling for instruments as indicated in the Instrumentation Job Specification enclosed elsewhere in the tender.
- Skid mounted Local control station (LCS) for the electric motor drivers of metering pumps, as described in electrical specification enclosed elsewhere in the tender.
- Interconnecting cabling and other electrical items as detailed in electrical job specification enclosed elsewhere in the tender.
- Common base plate (suitable for four-point lift) for each chemical dosing package with lifting lugs & leveling jackscrews.
- All foundation/anchor bolts, SS Shims, nuts and washers required for each skid.
- Access ladders and platforms, as required for safe and easy access to tank/ vessel, valves, man-ways and instrument connections.
- Drum racks i.e. space/platform (as specified) for keeping chemical drums/barrels.
- Mandatory spares for metering pumps & their drivers.
- Quotation for recommended spare parts for two years normal operation for metering pumps & their drivers.
- Commissioning spares, as recommended by the bidder for chemical dosing package.
- Special tools & tackles, as recommended by the bidder for chemical dosing package.
- Documents, drawings and other deliverables as per "Vendor Data Requirement" sheet enclosed with the tender.
- Any other item(s) not covered in this specification, Process Data Sheets and P&IDs but required for safe & smooth operation of the chemical dosing package.

2.9.3 Equipment shall meet the duty requirements and performance parameters as specified in process data sheets for dosing systems.

2.9.4 Equipment shall be designed for outdoor, without-roof and hazardous area location.

2.9.5 Strainers / Filters shall be provided before inlet of each pump as per respective P&IDs.

2.9.6 Modification to Standard Specification: Mandatory spares for items (i.e. Electrical, Instrumentation, Static Equipment items, Rotating Equipment items etc.) which are part of Dosing Packages, shall be as per the respective section (i.e. as per Electrical, Instrumentation, Equipment Division) of the Tender.

2.10 ROTARY AIR BLOWERS (LOBE TYPE)

2.10.1 Scope of Supply

CONTRACTOR shall ensure that components and auxiliary equipments to make a complete blower unit requiring only location in place and hooking up of piping and wiring and piping for operation and maintenance aspects are included in manufacturer's scope. These shall include but not limited to the following for each unit

- Blower with Electric Motor driver.
- Common base plate for entire train with grounding lugs.
- Inlet and Exhaust Silencer.
- Inlet and outlet Bellows (SS).
- Skid mounted gauge board with Pressure gauge and Temp gauge for Suction, Intermediate and Discharge conditions.
- Acoustic Housing for complete Blower/Motor Package. (if required)
- Pressure Relief valve.
- Differential Temperature Transmitter for high discharge temperature Indication/Alarm at control room/LCP
- Differential Temperature Transmitter for actuating high discharge temperature trip.
- Differential Pressure Transmitter for Indication/Alarm at control room/LCP.
- Differential Pressure switch for actuating High Differential pressure trip.
- Vibration Isolators for the complete Package.
- Ventilation systems

2.10.2 The Blower [Rotary Lobe type] and associated equipment shall conform to this Job Spec. forming part of the inquiry document.

2.10.3 The Blower shall be selected so as to fully meet the requirements specified in data sheets forming part of the inquiry document.

2.10.4 All components shall be designed to withstand continuous operation for a minimum of 8000 hrs. after start-up.

2.10.5 Discharge air shall be OIL FREE.

2.10.6 Suitable air intake filter shall be provided. The filter construction shall have suitable provision for preventing water ingress into the filter due to rains and shall have a bird screen. Monitoring of diff. pressure with high diff. pressure alarm across filter is to be provided.

2.10.7 Blower shall provide the specified mass flow rate, or greater, at the specified discharge pressure at all ambient conditions.

2.10.8 Casing MAWP shall be at least equal to PRV set pressure.

- 2.10.9 Blower packages shall be designed to perform satisfactorily under specified operating conditions, maximum differential pressure operation at relief valve set pressure.
- 2.10.10 Vendor shall consider all losses in suction and discharge side from battery limit to respective flanges.
- 2.10.11 The rated BKW shall be guaranteed with zero % positive tolerance including all transmission losses.
- 2.10.12 Electric motor shall also be sized such that operating power is less than the motor nameplate power at all operating & ambient conditions. Operation into the motor service factor is not allowed. Vendor shall confirm operating power at low ambient conditions.
- 2.10.13 The balancing of rotating element shall be carried out along with the coupling half. Balancing shall be as per grade 2.5 of ISO-1940.
- 2.10.14 The blower, drive motor and all the associated auxiliaries shall be mounted on a common base plate.
- 2.10.15 Vibration isolation pads, if required, shall be in vendor's scope of supply.
- 2.10.16 The support frame shall be provided with foundation bolts & bolt holes to permit bolting the blower to the foundation.
- 2.10.17 Type of lubrication shall be as per vendor's standard proven design for similar speed & power ratings for the offered model.
- 2.10.18 The radial and thrust bearings and associated lubrication system shall be of vendor's standard field proven type for similar application. The force feed lube oil system (if required) shall be common to blower and driver. The Lube oil system shall be located on the base plate.
- 2.10.19 If force feed lube oil system is required, all lube oil piping from oil consoles to the equipment including fittings, valves, instruments and supports shall be included in vendor's scope of supply. Vendor shall engineer the system and furnish detailed P&IDs as well as the piping drawings for the interconnecting piping as for PMC review and approval during detail engineering stage.
- 2.10.20 If force feed lube oil system is required, reservoirs, filters and control valves shall also be provided.
- 2.10.21 Type of Sealing System shall be as per vendor's standard proven design for similar speed & power ratings for the offered model in similar service.
- 2.10.22 All the hardware, piping, valves and instrumentation associated with sealing system shall be in vendor's scope and same shall be supplied duly assembled/ mounted on the skid.
- 2.10.23 Acoustic Enclosure & Ventilation System:
- a) *In order to meet the specified noise level of 85 dBA @ 1m, if required, an acoustic enclosure over the package shall be provided with enclosure ventilation system (as required).*
 - b) *The acoustic enclosure shall be provided over the blower & shall be self-supporting, de-mountable structure, usually of the closed-fitting hood type, mounted on the base plate, to limit the noise within specified limits. The steel*

panels shall be galvanized & steel framework sections shall be prime painted. Locally mounted instruments shall be placed outside the enclosure & mounted on the LGB/LCP. The enclosure shall be constructed with fire resistant materials. All enclosures shall be free of any depression or crevices where water or dust might collect.

c) The enclosure ventilation system (as required) shall be fitted with two no. (one working and one standby) explosion proof electric motor driven fans, designed to prevent build-up of a hazardous atmosphere inside the enclosure with only one ventilation fan operating. Each fan shall be sized for 125% of total design flow required.

d) Any instrument & electrical items which are located inside the enclosure shall be suitable for applicable area classification as per tender document.

2.10.24 All piping, fittings, valves etc. specified in vendor's scope of supply shall conform to the technical requirements specified in the relevant codes and standards. However, all interfaces shall conform to employer's requirements specified in the P&ID's and respective Piping Material Specification (PMS) enclosed with MR.

2.10.25 All interconnecting distribution piping to various consumption points within Vendor's Battery Limit, tubing, cabling, and supports including isolation valves at the tie-up points of vendor's battery limit shall be engineered, designed and supplied by the vendor. All Piping shall be supplied prefabricated with minimum field joints and as a commercial length, where prefabrication is not possible due to general erection constraints.

2.10.26 Vendor shall terminate all the drains at the grade level with isolation valves for further connection to employer CBD / OWS system. Also, vendor shall terminate all the Blower-casing drains manifolded to single connection at the grade level for further connection to employer CBD / OWS system.

2.11 GEAR UNITS

2.11.1 Offered special purpose gearbox shall meet the experience criteria as specified in clause no. 3.4.9 of Engineering Design Basis (S&ME).

2.11.2 Gearbox for rotating equipment, which are spared, shall conform to API Std. 677. Beyond 1500 kW, Gear box shall be as per API Std. 613. Minimum Service Factor shall be 1.7 over driver rating.

2.11.3 Gearbox shall meet the requirements of mechanical data sheet, this job specification, API 677/613.

2.11.3 Gearbox housing shall be sealed against loss of lubricants or against the entrance of water or any foreign matter.

2.11.4 The gear mechanical efficiency shall not be less than 97% at rated load and speed.

2.11.5 INSPECTION AND TESTING

Following test shall be witnessed at Gear Box vendor's works by owner's inspecting agency:

- Hardness verification.
- Contact check
- Journal run-out test.
- Mechanical run test.

2.12 SPECIAL PURPOSE STEAM TURBINE COMPLIANT TO API 612

2.12.1 Vendor to ensure that the offered model shall not be a prototype. The model / frame offered shall be from the regular manufacturing range of the vendor from EIL approved manufacturing Unit / Works.

2.12.2 The steam turbine driver shall be of special-purpose back pressure type. Inlet & Outlet parameters of steam turbine shall be as described in the Process Data sheet. Turbine shall be designed to operate with entire range of relevant inlet and exhaust conditions.

Note: Unless otherwise specified, Suitable pressure drop of 0.5 kg/cm² shall be considered for import/export of utilities from unit battery limit to vendor battery limit and vice versa.

2.12.3. Steam Turbine shall be designed to deliver at least 110% of maximum power required for any of the specified operating conditions of respective driven equipment at its corresponding speed with minimum inlet steam and maximum exhaust steam conditions as specified process datasheet.

2.12.4. Steam consumption shall be guaranteed for the power corresponding to driven equipment guarantee point at normal steam inlet & normal exhaust conditions.

2.12.5. Steam Turbine shall also be designed to cater to the shaft power requirement of driven equipment during start-up case with minimum steam inlet and maximum exhaust steam conditions.

2.12.6 Spare rotor shall be dynamically balanced to same degree as the main rotor installed in the equipment. Both main and spare rotors shall have these residual unbalances verified.

2.12.7. The steam turbine and the driven equipment shall be mounted on a common base plate. If found infeasible due to transportation constraints, driven equipment and steam turbine can be supplied with individual base plates, which can be integrated (i.e. bolted / dowelled), at site. For this, horizontal and vertical jackscrews shall be provided for ease in alignment.

2.12.8 **Steam turbine sizing:**

Unless otherwise specified,

1. Back Pressure Type

- a) Steam turbine shall be capable of delivering the turbine rated power (i.e. 110% of driven equipment max. power for any of the specified operating conditions) at its corresponding speed with coincident minimum specified steam inlet condition, maximum specified steam exhaust condition.
- b) Steam turbine shall be capable of delivering 100% of the maximum power required by the driven equipment for any of the specified operating conditions at its corresponding speed with coincident minimum specified steam inlet condition, maximum specified steam exhaust condition.

- c) The turbine shall be designed to continuously operate at maximum continuous speed and at any other speed within the range specified with a maximum continuous speed of at least 105 % of rated speed.
- d) The turbine shall be designed to continuously operate at turbine rated power and speed with maximum specified steam inlet conditions and minimum as well as maximum specified steam exhaust condition.
- e) The turbine shall be designed to continuously operate at the lowest speed at which maximum torque is required with minimum specified steam inlet conditions and maximum specified exhaust conditions.
- f) The turbine shall be designed to operate with variations from rated steam conditions and steam purity limits as specified in process specification attached with tender.
- g) Steam turbine shall be optimized and selected for normal operation of the compressor with normal inlet steam conditions, normal steam extraction pressure and steam condensation as per Process specification. The inlet steam consumption shall be guaranteed for the above case.

2.12.9 Turning Gear

The vendor shall supply a suitable turning device driven by AC Motor with a provision to permit manual operation of the turning gear. All the associated control features shall also be supplied by the vendor.

2.12.10 Governor

Electronic type governor shall be provided. For details, refer instrumentation specification attached elsewhere in the MR.

2.12.11 Trip valves/Combined Trip and Throttle valve

A separate independent trip valve(s) or a combined trip and throttle valve(s) as recommended by the vendor (Steam Turbine manufacturer) shall be provided for each Steam inlet by the vendor.

2.12.12 Insulation and Jacketing

As recommended by the vendor (i.e. Steam turbine manufacturer), the turbine shall be supplied duly insulated and jacketed. As per good engineering practice, the insulation and jacketing shall extend over all parts of the Turbine casing that can reach a normal operating temperature of 60°C or higher and shall be sealed in a way so as to prevent water ingress.

2.12.13 Washing system for steam turbine

A suitable washing system for steam turbine along with all necessary instrumentation and controls shall be provided by the vendor as per vendor recommendation.

2.12.14 Lube Oil Systems

The lube oil/ control oil system shall be console type & shall be common to driven equipment train. The turbine control oil (as applicable) shall also be supplied from the lube oil console. The Lube oil console shall be located at the grade level within the shelter. The complete area around the machines at the mezzanine floor level under the shelter shall be covered by working platform.

- 2.12.15 Unless otherwise specified, in case of Steam Turbine driven packages, the lube oil/control oil system shall be equipped with the following. Also refer Process Package for Licensor/Process/Electrical requirements.

Main LO Pump	Aux. LO Pump	Emer. LO Pump	LO Overhead Rundown Tank	Accumulators
Yes (Unless otherwise specified: Steam Turbine driven, Back pressure type)	Yes (Unless otherwise specified: AC Elec. Motor driven with Normal AC source)	Yes (Unless otherwise specified: AC Elec. Motor driven with Emergency AC source)	Yes	Yes

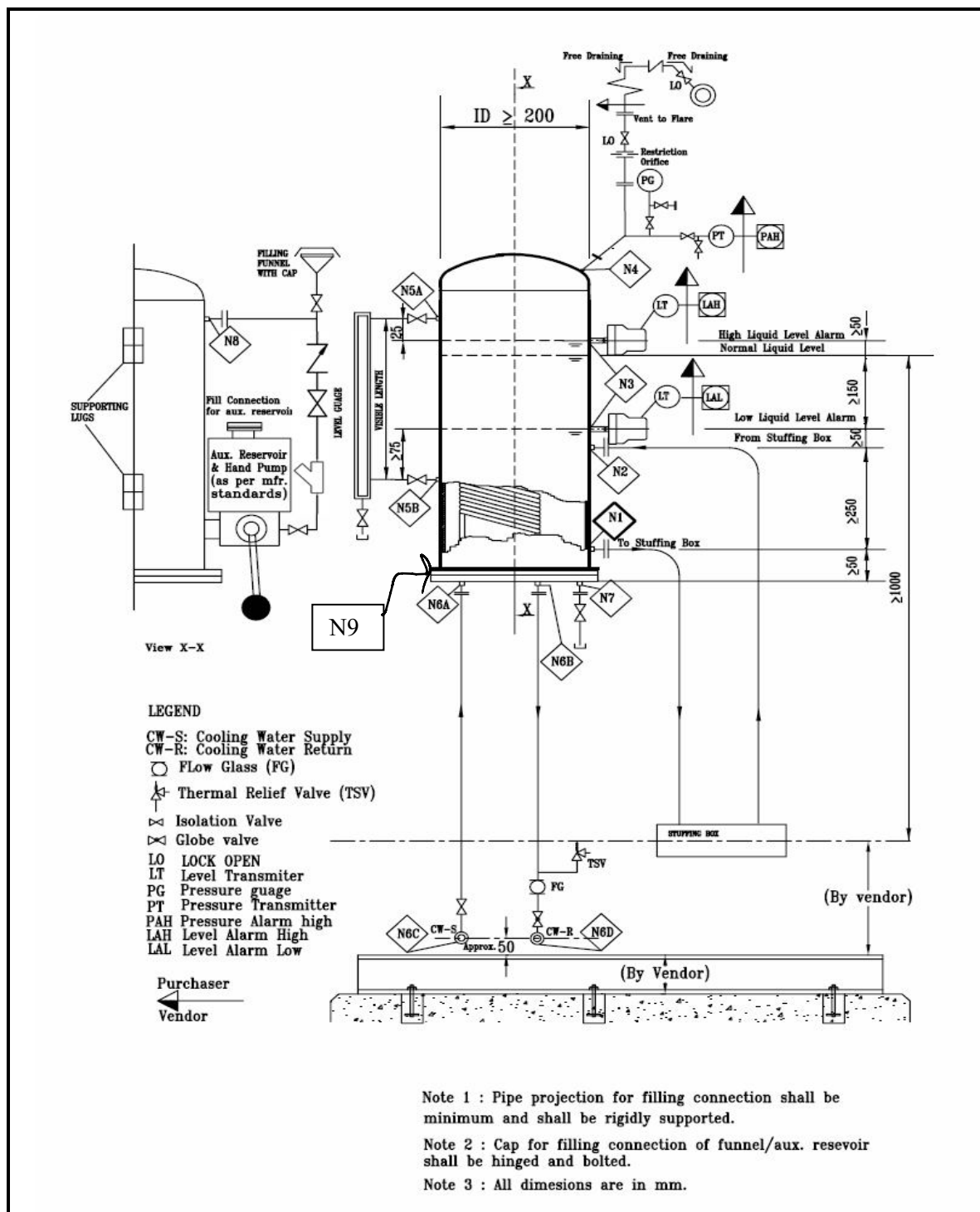
Design shall ensure adequate supply of lube oil to driven equipment train during the driven equipment train coast down period and cool-off time period, in the event of train shutdown.

- 2.12.16 All lube oil piping from oil consoles to the equipment including fittings, valves, instruments and supports shall be included in vendor's scope of supply. Vendor shall engineer the system and furnish detailed P&IDs as well as the piping drawings for the interconnecting piping as for purchaser's review and approval during detail engineering stage.
- 2.12.17 Lube oil supply header line shall be provided with analyzer capable of detecting water present in oil in forms of dissolved, emulsified and free water state. The device shall be to monitor the water content in the oil continuous basis and the real-time data shall be available in DCS. For more details, refer Instrumentation specs.
- 2.12.18 Reservoirs, pumps, coolers, filters and control valves shall be provided in an assembled console. Console shall have a steel baseplate with rim and drip lip for drainage.
- 2.12.19 Material of Construction of Lube Oil Reservoir and piping shall be stainless steel.
- 2.12.20 Steam Turbine and Associated System as per API612 complete with the following as per Process Package:
- Main Steam Turbine Driver compliant to API612.
 - Governing System for Steam Turbine.
 - Electronic over-speed trip system for main turbine.
 - Expansion bellows, as recommended by vendor.
 - Barring/Turning Gear with electric motor driver.
 - Turbine insulation & jacketing [Blanket (Removable) Type].
 - Sentinel Valve for Main & Aux. Steam Turbine Driver.
 - Inlet steam strainer with piping spool piece for Main Steam Turbine Driver.
 - Inlet steam strainer with piping spool piece for Aux. Steam Turbine Driver.
 - Turbine trip & throttle valve and Governing valve for Main & Aux. Steam Turbine Driver.
 - Turbine washing system with all hardware.
 - Warm up vent silencer at inlet, extraction & exhaust lines (as required) of main steam turbine driver.
 - Warm up vent silencer at inlet & exhaust lines of auxiliary steam turbine.
 - PSVs (1W+1S) at Main Steam Turbine Driver Exhaust and Extraction line.
 - PSVs (1W+1S) at Aux. Steam Turbine Driver (back pressure type) exhaust line.
 - Complete De-superheaters assembly in main steam turbine driver exhaust/ extraction steam line along with BFW control valve, dual strainer & PSVs in BFW line and all necessary instrumentation.
(In case of trip, suitable control to seize BFW flow shall be provided to avoid header flooding, water hammer etc. Also, suitable instrumentation & control is to be provided in exhaust/ extraction line to identify and prevent De-superheater& BFW control valve failure case).
 - De-superheater in auxiliary steam turbine exhaust steam line along with BFW control valve, dual strainer & PSVs (1W+1S) in BFW line and all necessary instrumentation.

(In case of trip, suitable control to seize BFW flow shall be provided to avoid header flooding, water hammer etc. Also, suitable instrumentation & control is to be provided in exhaust line to identify and prevent De-superheater & BFW control valve failure case).

ANNEXURE-A: (SPECIAL REQUIREMENTS/ SKETCHES FOR SEAL PLANS)

1. TYPICAL SKETCH FOR API SEAL PIPING PLAN 52



- (1) One no. Temperature Gauge (TG) in to stuffing box line shall be provided & supplied by Vendor.
- (2) One no. Temperature Gauge (TG) in the cooling water return line shall be provided & supplied by Vendor.

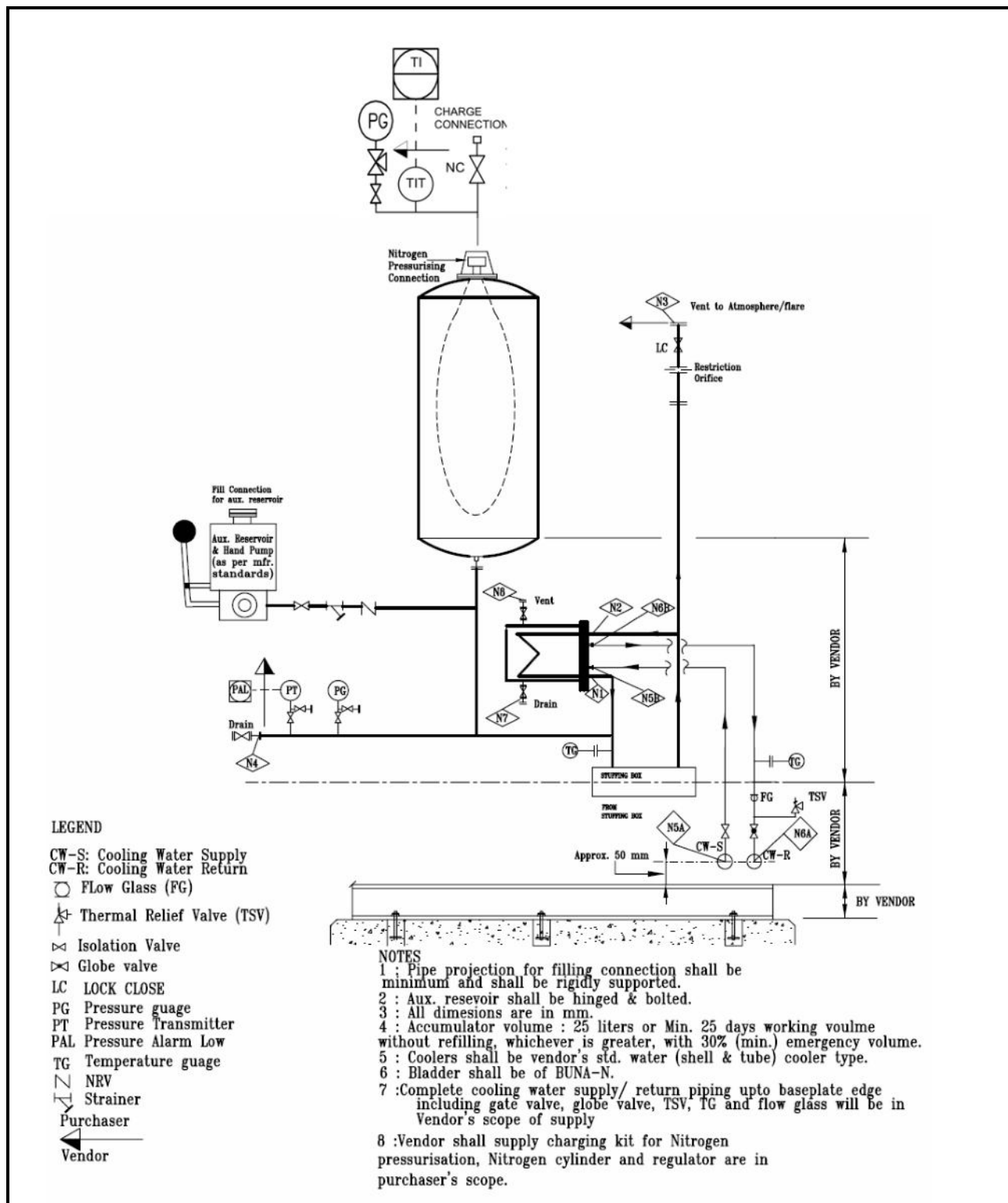
2. SPECIAL REQUIREMENTS FOR API SEAL PIPING PLAN 52

DESIGN PARAMETERS (for 52)				
Optg. Pressure (kg/cm²g) / Optg. Temp (°C)		:	As per respective pump data sheets	
Design Pressure (kg/cm²g) / Design Temp (°C)		:	42.0 (min.) / Ambient (min.) §	
Hydro test pressure (kg/cm²g):		:	1.5 times Design Pressure	
Shell		:	SS 316L (Sch 40 S)	
Head		:	SS 316L	
Gasket		:	SS 304/316: Spiral Wound Gasket	
§ The design of sealing system shall be as per the design parameters indicated above or pressure temperature rating equal to the maximum discharge pressure & temperature of the pump casing, whichever is higher.				
API SEAL PLAN 52				
NOZZLE SCHEDULE				
Nozzle	Service	Size, mm (")	Min. ANSI Rating §	Flange type
N1	To: Stuffing Box	20 (3/4")	300#	SWRF
N2	Return: Stuffing Box	20 (3/4")	300#	SWRF
N3	For Level transmitter	Refer Instr. Spec	300#	SWRF
N4	Reservoir vent to Flare	20 (3/4")	300#	SWRF
N5 A/B	For Level Indicator	20 (3/4")	300#	SWRF
N6 A/B	Cooling Water Supply/Return (at reservoir)	20 (3/4")	300#	SWRF
N6 C/D	Cooling Water Supply/Return (at grade)	20 (3/4")	150#	SWRF
N7	Reservoir Drain	20 (3/4")	300#	SWRF
N8	Filling Nozzle	20 (3/4")	300#	SWRF
N9	Reservoir Bottom Flange	200 (8")	300#	SWRF
INSTRUMENTS				
Description	Function	Required	Remarks	
Pressure Gauge (PG)	Press. Indication	YES		
Pressure Trans. (PT)	Press. High Alarm	YES		
Temp. Safety Valve (TSV)	--	YES		
Restr. Orifice (RO)	--	YES		
Flow Glass (FG)	--	YES		
Temp. Gauge (TG)	Temp. Indicator	YES		
Level Transmitter (LT)	Level high alarm	YES		
Level Transmitter (LT)	Level low alarm	YES		
Level Gauge (LG)	Level indicator	YES		

Remarks:

- The fluid reservoir shall be arranged in accordance with the schematic shown in the drawing.
- The reservoir and piping shall be designed, fabricated & tested in accordance with
 - ISO 15649/ASME B 31.3 using Piping component
 - ASME Sec VIII Div 1
- The complete seal system for each stuffing box including the reservoir shall be arranged as one skid and supported/bolted to the base plate in a manner that the projection of any equipment/instruments falls within the confines of base plate. The reservoir and the accessories to be mounted on a structural support furnished by the manufacturer and should not be affected by the pump vibration. In case of between bearing pumps there shall be two such units, one each for each stuffing box mounted on opposite ends of the pump.
- The mechanical design of auxiliary piping shall achieve the following:
 - Proper support and protection to prevent damage from vibration or from shipment, operation & maintenance.
 - Proper flexibility and normal accessibility for operation, maintenance and thorough cleaning.
 - Installation in a neat and orderly arrangement adapted to the contour of the machine without obstructing access openings.
 - Elimination of air pockets by the use of valved vents or non-accumulating piping arrangements.
 - Complete drainage through low points without dis-assembly of piping, seal or gland components.
 - Reduce the number of potential emission sources and pressure drops by minimising the use of threaded connections, flanges, fittings and valves.
- Refer Instrumentation specification for detailed specification of instruments.
- Flange type specified in the table above is for sealing system design of 300# rating. Wherever the sealing system design exceeds 300# rating the flange type for complete sealing system (including coolers etc.) shall be as per standard ASME B 16.5.

3. TYPICAL SKETCH FOR API SEAL PIPING PLAN 53B



The pressure alarm for re-filling Piping Plan 53B shall be on the basis of a fixed alarm set point (a pressure alarm without a temperature bias). Figure F.17 of API Std. 682 4th Ed. illustrates a fixed alarm strategy. Accordingly, temperature transmitter (refer Figure G.19 of API Std. 682 4th Ed.) for measuring gas temperature in the bladder of auxiliary seal system is not applicable.

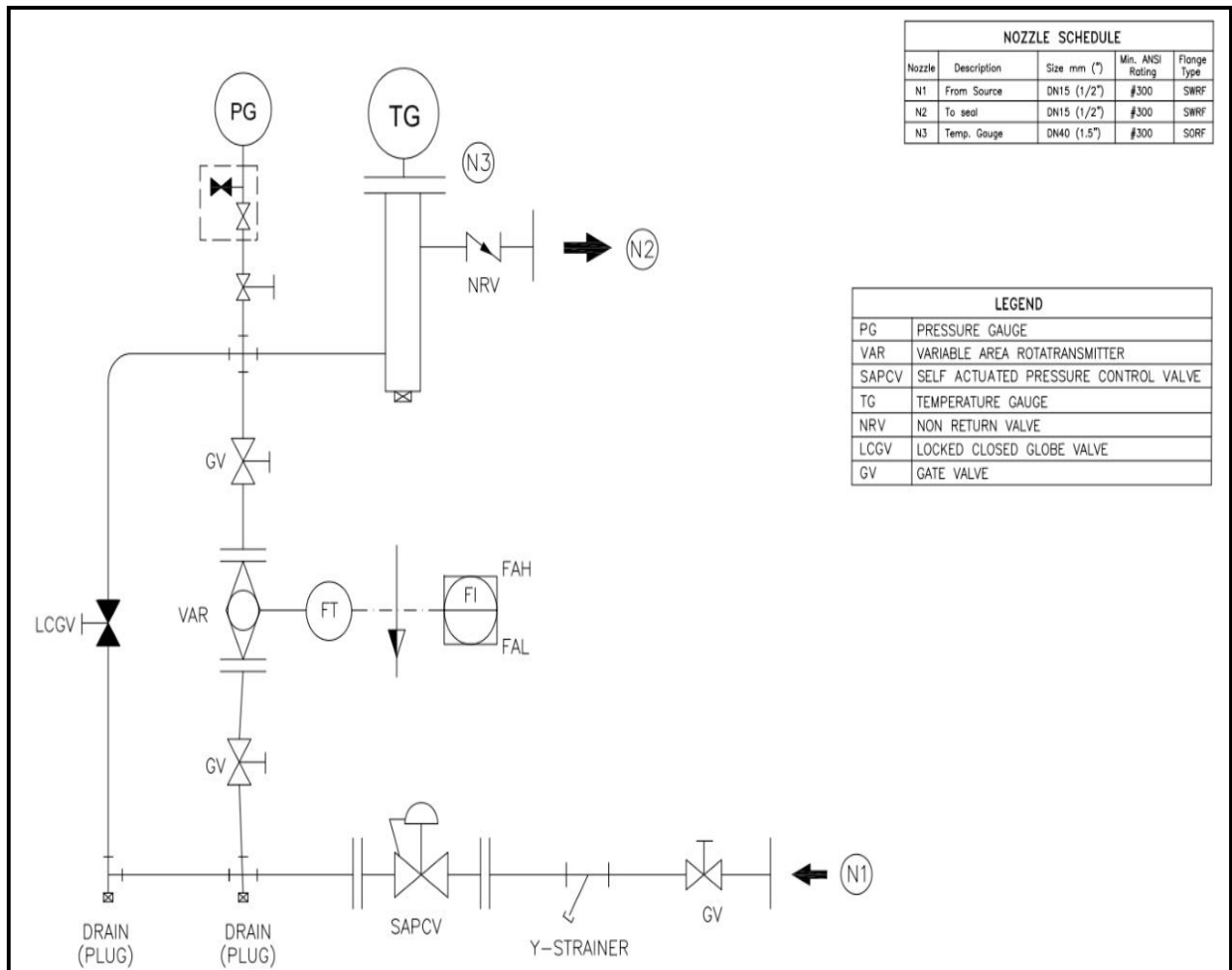
4. SPECIAL REQUIREMENTS FOR API SEAL PIPING PLAN 53B

DESIGN PARAMETERS (for Plan 53B)								
Optg. Pressure (kg/cm²g) / Optg. Temp (°C)					: As per respective pump data sheets			
Design Pressure (kg/cm²g) / Design Temp (°C)					: 42.0 (min.) / Ambient (min.) §			
Hydro test pressure (kg/cm²g):					: 1.5 times Design Pressure			
MOC of Reservoir					: SS 316L			
MOC of Bladder					: BUNA-N			
§ Sealing system shall be designed for shutoff pressure/casing design pressure at design temperature.								
NOZZLE SCHEDULE					INSTRUMENTS			
Nozzle	Service	Size, mm (")	Min. ANSI Rating §	Flange type (Rem. 6)	Description	Function	Required	Remarks
N1	To: Stuffing Box	20 (3/4")	300#	SWRF	Temperature Gauge (TG) (Barrier Fluid)	Temperature Indication Local	YES	
N2	From: Stuffing Box	20 (3/4")	300#	SWRF	Pressure Gauge (PG) (Barrier Fluid)	Press. Indication Local	YES	
N3	Stuffing Box Vent	20 (3/4")	300#	SWRF	Pressure Transmitter (PT)	Press. Alarm Low (PAL)	YES	
N4	Stuffing Box Drain	20 (3/4")	300#	SWRF	Temp. Safety Valve (TSV)	--	YES	
N5 A	Cooling water Supply @ grade	20 (3/4")	150#	SWRF	Restr. Orifice (RO)	--	YES	
N5 B	Cooling Water Inlet	20 (3/4")	300#	SWRF	Flow Glass (FG)	--	YES	
N6 A	Cooling Water Return @ grade	20 (3/4")	150#	SWRF	Temperature Gauge (TG) (CW-R)	Temperature Indication Local	YES	
N6 B	Cooling Water Outlet	20 (3/4")	300#	SWRF				
N7	Cooler Drain	15 (1/2")	300#	NPT (F)				
N8	Cooler Vent	15 (1/2")	300#	NPT (F)				

REMARKS

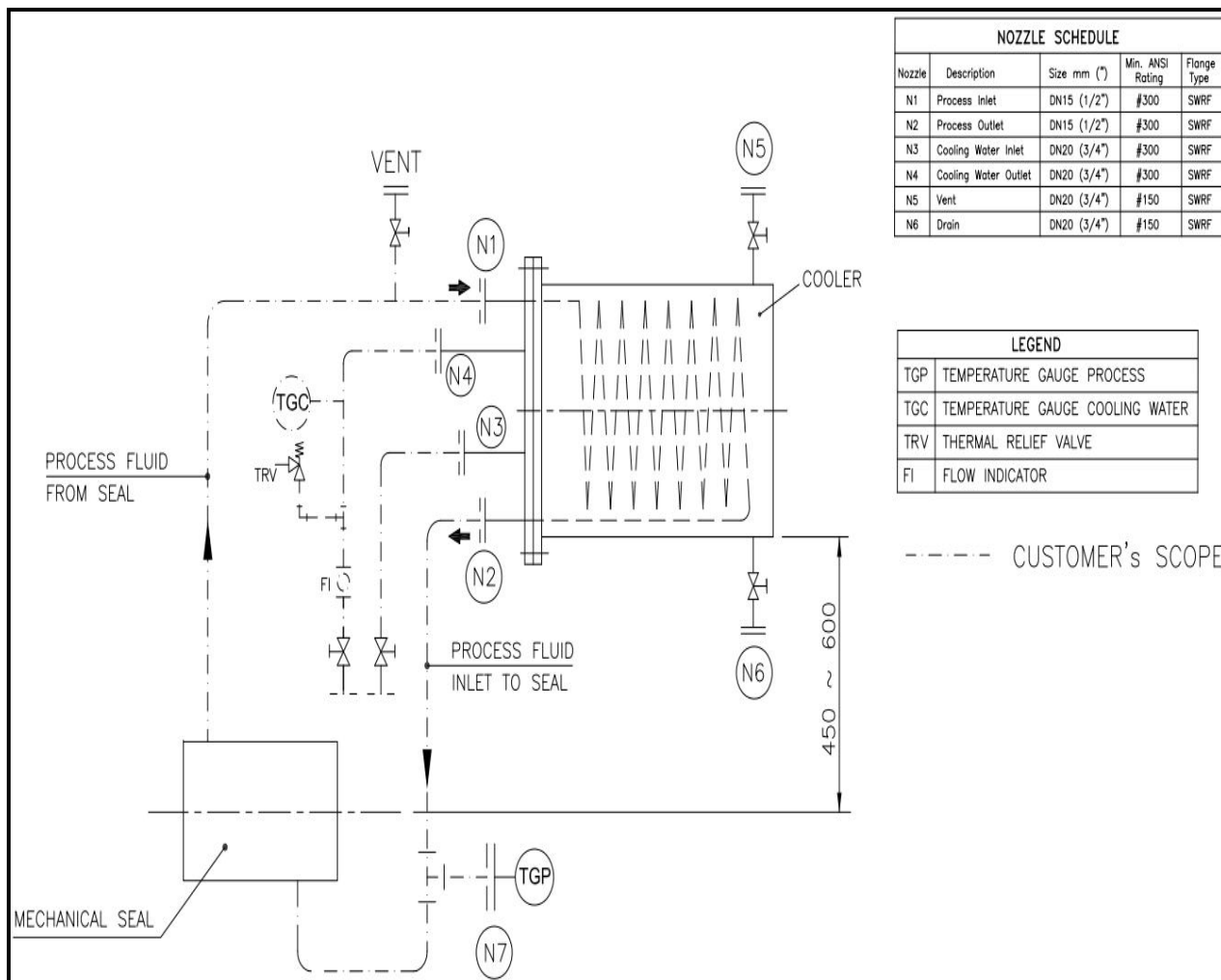
- The Barrier fluid reservoir shall be arranged in accordance with the schematic shown in the drawing.
- The reservoir and piping shall be designed, fabricated & tested in accordance with
 - ISO 15649/ASME B 31.3 using Piping component
 - ASME Sec VIII Div 1
- The complete seal system for each stuffing box including the reservoir shall be arranged as one skid and supported/bolted to the base plate in a manner that the projection of any equipment/instruments falls within the confines of base plate. The reservoir and the accessories to be mounted on a structural support furnished by the manufacturer and should not be affected by the pump vibration. In case of between bearing pumps there shall be two such units, one each for each stuffing box mounted on opposite ends of the pump.
- The mechanical design of auxiliary piping shall achieve the following:
 - Proper support and protection to prevent damage from vibration or from shipment, operation & maintenance.
 - Proper flexibility and normal accessibility for operation, maintenance and thorough cleaning.
 - Installation in a neat and orderly arrangement adapted to the contour of the machine without obstructing access openings.
 - Elimination of air pockets by the use of valved vents or non-accumulating piping arrangements.
 - Complete drainage through low points without dis-assembly of piping, seal or gland components.
 - Reduce the number of potential emission sources and pressure drops by minimising the use of threaded connections, flanges, fittings and valves.
- Refer Instrumentation specification for details of instruments.
- Flange type specified in the table above is for sealing system design of 300# rating. Wherever the sealing system design exceeds 300# rating the flange type for complete sealing system (including coolers etc.) shall be as per standard ASME B 16.5.

5. TYPICAL SKETCH FOR API SEAL PIPING PLAN 32

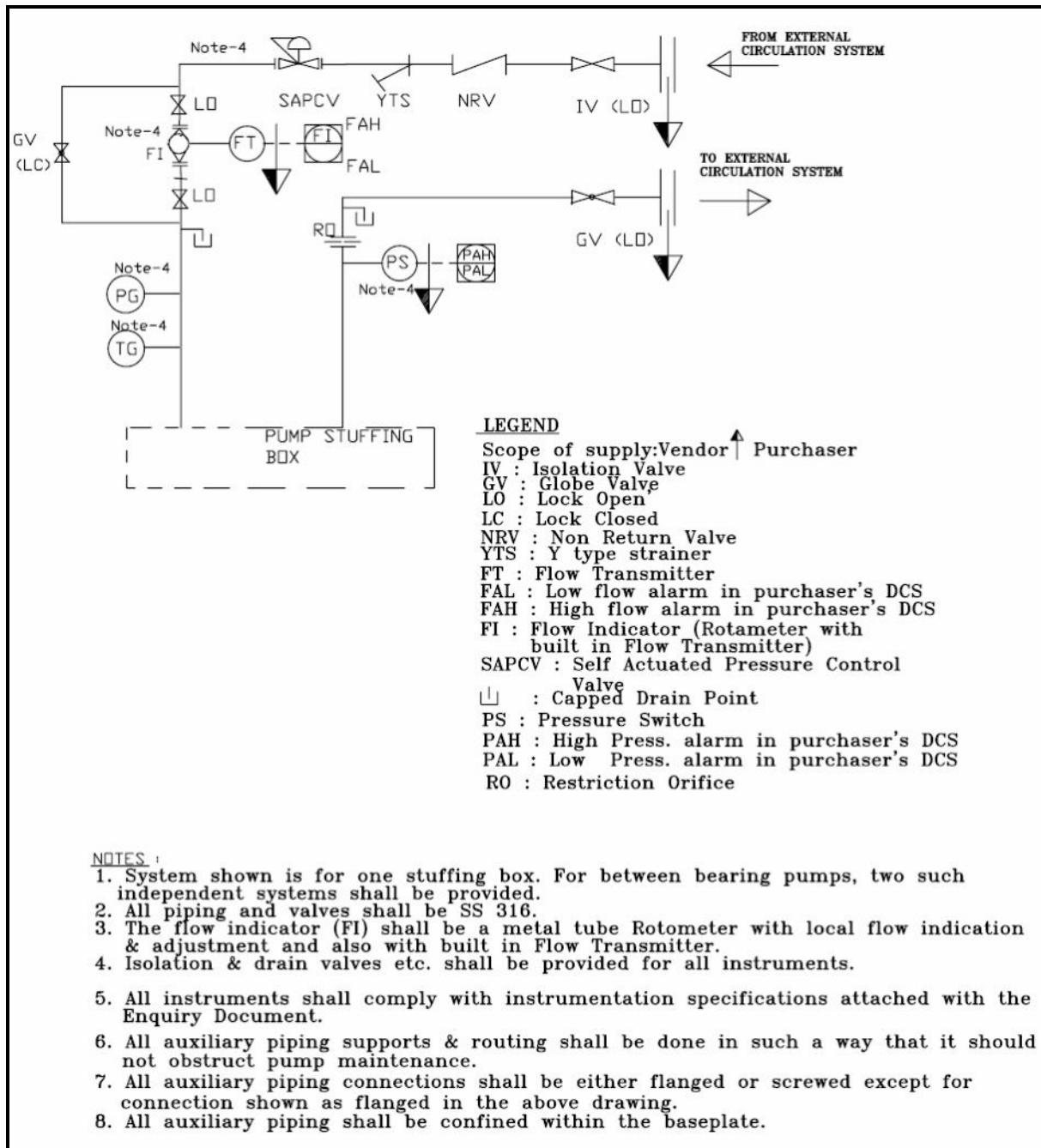


1. System shown is for one stuffing box. For between bearing pumps, two such independent systems shall be provided.
2. All piping and valves shall be SS 316.
3. The flow indicator (FI) shall be a metal tube Rotometer with local flow indication & adjustment and also with built in Flow Transmitter.
4. Isolation & drain valves etc. for instruments shall be provided.
5. All instruments shall comply with Instrumentation specifications attached with the Enquiry Document.
6. All auxiliary piping supports & routing shall be done in such a way that it should not obstruct pump maintenance.
7. All auxiliary piping connections shall be either flanged or screwed except for connection shown as flanged in the above drawing.
8. All auxiliary piping shall be confined within the baseplate.

6. TYPICAL SKETCH FOR API SEAL PIPING PLAN 23



7. TYPICAL SKETCH FOR API SEAL PIPING PLAN 54

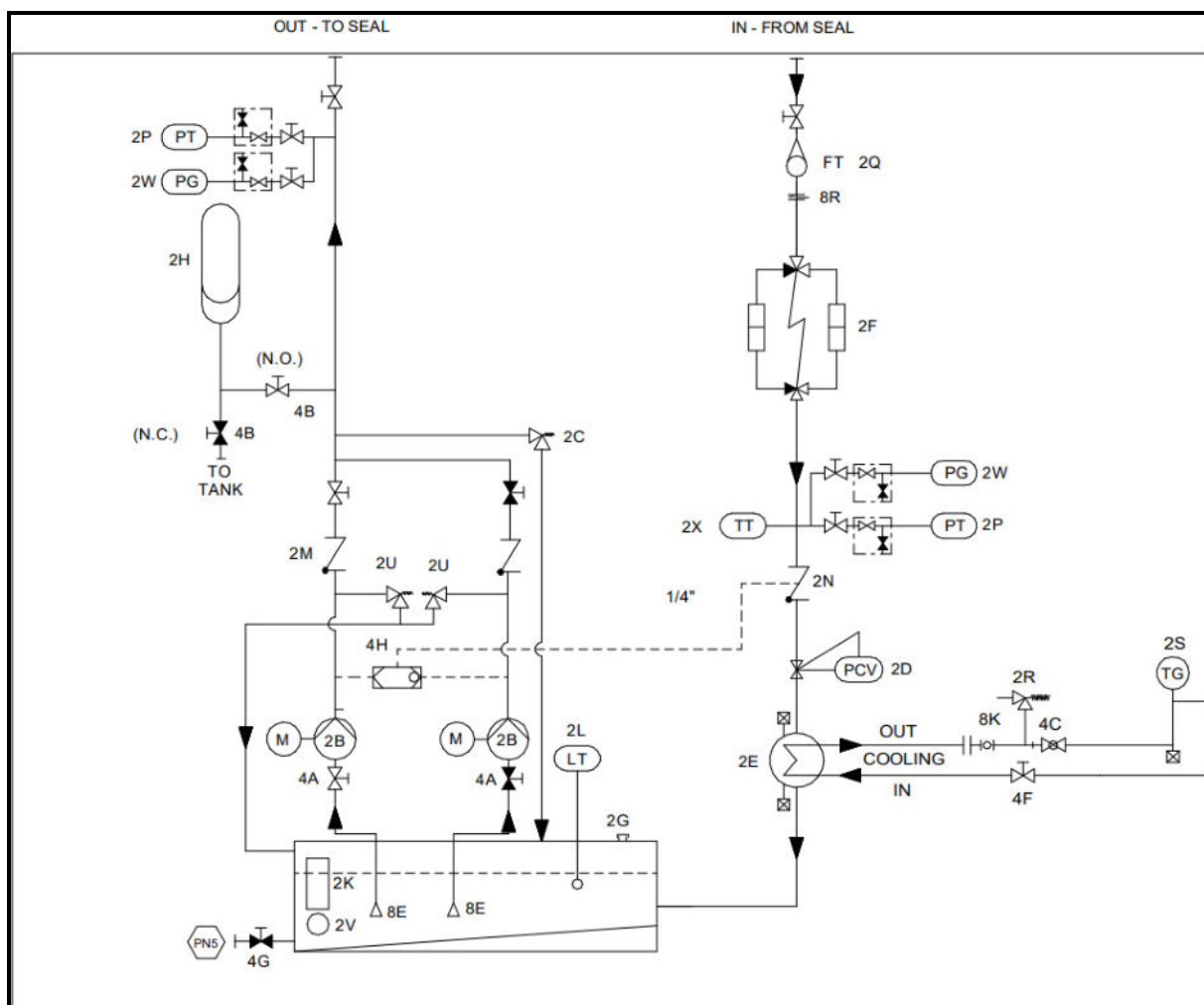


9. Only transmitter shall be considered. Switches are not permitted.

SEAL PLAN 54

For meeting barrier fluid pressure requirement, each stuffing box shall be provided with dedicated External Barrier Fluid Skid contacting 2 nos. API pump with driver motor (working & stand-by) with auto-start/auto-changeover option, along with SS tank, necessary auxiliaries (like heat exchanger, Pressure Accumulator, PG, PT, LG, LT, TG, TT, PRV, TRV, NRV, PSV/TSV, FT/FE, RotaMeter, Duplex filter, Back pressure control valve etc.), SS piping, etc. duly mounted on a separate baseplate along with drip pan. SS interconnecting piping between pump skid & seal plan 54

skid(s) shall be in vendor's scope of supply. Typical sketch for plan 54 skid is indicated below: -



ANNEXURE-B: POLICY ON MAKE IN INDIA

The bidder (Indian as well as Foreign) to qualify has to offer equipment¹ with proven track record (PTR)² and meeting the technical specifications laid out in the Material Requisition.

ALTERNATIVELY In order to encourage Foreign bidders to setup manufacturing facilities in India through subsidiaries (where the **FOREIGN PRINCIPALS HOLD AT-LEAST 51% SHARES**), 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 PTR² 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 and enlisted with EIL.

In case, the bidder is an Indian manufacturer who is a Subsidiary (*Principal holding at least 51% shares*) of a Foreign Principal (as defined above) 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:

Qualification Criteria for Foreign Principal (Foreign Principal or another 51% or above subsidiary (called "Group Company") of the Foreign Principal or of 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 Bidder is seeking to bid.
2. The Principal or the Group Company shall already be enlisted either with EIL OR is in Licensor's vendor list, for the same product line³.
3. The Principal or the Group Company shall have executed at least two orders for the same product line³, within the last five years.

Note: All the above criteria shall be met by the same company whose PTR² is being considered.

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.
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. The bidder and the principal or the bidder and the Group Company shall ensure that scope / activity matrix shall

¹Equipment: The term "Equipment" is applied to Centrifugal Pumps-SPP.

²Proven Track Record (PTR): The essence of PTR should be to accept **equipment which are not prototype and are field proven for similar operating conditions**.

³Same Product Line **for Principal or Group Company**: Same type of Equipment being sought (e.g. if a Centrifugal Pump-SPP is being envisaged, the same product line would imply a Centrifugal pump-SPP having equal or higher than offered driver power).

delineate according to the experience and capability of the Indian subsidiary vis-à-vis the company whose PTR² is being considered.

3. The Bidder shall have engineering facility, corresponding to matrix cited above, duly approved by the Principal or the Group Company, as the case may be.
4. The Bidder shall be enlisted with EIL for the same product line³.
5. The Bidder shall have executed and supplied minimum two equipment orders in the same product line⁴ in the last SEVEN (07) years.
6. 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
7. The Bidder shall either source critical components (such as casing, impeller & bearing bracket) **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.
8. The Bidder shall have Manufacturing, Assembly and Testing facility for the proposed scope.
9. 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.
10. The Principal or the Group Company shall furnish a "Corporate Guarantee" from an authorized signatory committing their continued support to the Bidder, till defect liability period, to ensure that Buyer's interests are protected.

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

- General Reference list of Principal or the Group Company for the same product line, for the last five years.
- General Reference list of the bidder for the same product line. General reference list shall be elaborated enough to establish PTR of machine in line with qualification criteria as specified above.
- Filled-in PTR of Principal/Group Company, to qualify as per S. No. A.1 & A.3 above.
- Filled-in PTR of bidder, to qualify as per S. No. B.5 above.
- Certificate of Incorporation of the Bidder

⁴Same Product Line **for Principal or Group Company**: Same type of Equipment being sought (e.g. if a Centrifugal Pump-SPP is being envisaged, the same product line would imply a Centrifugal pump-SPP having equal or higher than offered driver power).

- Documents for establishing the bidder as a subsidiary of the Foreign Principal (Principal holding at least 51% shares), to qualify as per S. No. B.1 above.
- Documents for establishing the relationship of the group company, if applicable.
- Scope / Activity Matrix between Principal/Group Company & bidder, duly approved by Principal/Group Company, to qualify as per S. No. B.2 above & as per S. No. B.6 above
- List of critical components sourcing from Principal/Group Company, as per S. No. B.7 above.
- Letter from Principal/Group Company, to qualify as per S. No. B.3 & B.8 above.
- Letter from Principal/Group Company, to qualify as per S. No. B.9 above.
- Enlistment Letter for Principal/Group Company, to qualify as per S. No. A.2 above.
- Enlistment Letter for bidder, to qualify as per S. No. B.4 above.
- Corporate Guarantee of the Principal/Group Company (in the format provided by EIL), to qualify as per S. No. B.10 above.

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

TECHNICAL CONFIRMATION LIST (STATIC & MACHINERY EQUIPMENT)

STEAM GENERATION PACKAGE TENDER No. B957-420-80-44-PG-T-7410

ANNEXURE-A	:	STATIC EQUIPMENT
ANNEXURE-B	:	PACKAGED EQUIPMENT
ANNEXURE-C	:	ROTATING EQUIPMENT

**ANNEXURE-A : STATIC EQUIPMENT
TECHNICAL CONFIRMATION LIST
(STATIC & MACHINERY EQUIPMENT)**

STEAM GENERATION PACKAGE

TENDER No. B957-420-80-44-PG-T-7410

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE
CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO
BINA PETCHEM & REFINERY EXPANSION PROJECT
(BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

JOB NO : B957

0	16-01-2025	ISSUED AS TENDER INPUTS	SRIKANTH	VIVEK	PB
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

Bidder to note that **bidder's quotation shall be evaluated (technically) based on bidder's reply/confirmation to this technical checklist only. Bidder's offer shall be considered incomplete and may not be considered for technical evaluation by purchaser if duly filled-in, signed & stamped check list is not submitted along with bid.** Bidder is required to give categorical reply to each point of this technical checklist, so that bidder's offer can be properly evaluated.

Bidder's reply "Not Confirmed" is not warranted and may lead to technical rejection of their bid. However, Bidder may provide certain clarification, incase absolutely necessary, without deviating to bid requirement. Written confirmation shall have precedence over any clarification whatsoever.

Sl. No.	Description	BIDDER'S ANSWER (Confirmed / Not Confirmed)
1.	Bidder to confirm that there is no technical deviation in their offer w.r.t. the tender specification/ technical amendment (if any).	
2.	Confirm that the bidder has quoted for the total scope of supply & services for all equipment/ package as specified in the tender. Any deviation to this requirement may lead to the bid being considered as incomplete and liable for rejection.	
3.	Bidder to note that data sheets, drawings and other technical details are not required with offer, however if submitted with bid shall be retained for information only. Bidder's documents/ drawings shall be reviewed as per the "Vendor Data Requirement (Doc No. B957-999-80-42-VDR-4220)" during post order stage for checking/ ensuring compliance with Tender specification/ Contract requirement. Confirm compliance.	
4.	Bidder to note that, if any comment arises during detail engineering from EIL/ Owner (to ensure compliance with Tender Specification/Contract requirement), same shall be incorporated by Bidder without any time and price implication. Confirm compliance.	
5.	Confirm that all equipment/packages shall be sourced as per Project Supplier list attached elsewhere in the tender.	
6.	Bidder to confirm that the list of recommended spares for two (2) years' of normal operation & maintenance with itemized price along with quantity shall be provided after placement of order . These spares shall be ordered separately at the discretion of Owner. (Price for the same shall not be included in the Quoted Price)	
7.	Confirm that Commissioning Spares for all equipment/ packages, as required have been included by the bidder in the quoted lump sum price.	
8.	Bidder to confirm that in case during commissioning, additional spares are required over and above the quoted commissioning spares, then the same shall be supplied by bidder without any time and commercial implication.	

Sl. No.	Description	BIDDER'S ANSWER (Confirmed / Not Confirmed)
9.	Bidder to confirm that Mandatory Spares as mentioned in tender (Refer Doc. No. B957-999-80-42-SL-4220) shall be supplied and the cost of mandatory spares has been included in the quoted lump sum price..	
10.	Confirm that special tools and tackles , as required, for their normal operation and maintenance have been included by the bidder in the quoted lump sum price .	
11.	Bidder to confirm that ITP requirements for various items of package shall be complied.	
12.	Confirm that all the documents before submission for OWNER/ EIL's review shall be duly checked and approved by Contractor.	
13.	Confirm that all specifications / documents listed in the bid package have been received.	
14.	Contractor to confirm that the requirement for Design/ Engineering and procurement for equipment & internals shall be as per Job specification (Static Equipment).	
15.	Confirm performance, mechanical and structural design, material & workmanship guarantee of offered equipment (including equipment and internals from vendor/ supplier/ sub-supplier) as per bid document.	
16.	Confirm that for all equipment wherever hot forming and subsequent heat treatment is involved, adopted procedure shall not impair the mechanical properties of the material beyond the limits specified in respective material specification.	
17.	Confirm that for all equipment, post weld heat treatment & non-destructive testing like radiography, ultrasonic testing, magnetic particle/dye penetrant examination etc. shall be conducted as per specifications / bid package / code.	
18.	Confirm compliance to all statutory requirements for the equipment falling under respective statutory authority like IBR/ PESO.	

Notes :-

- The Bidder shall indicate his reply in the space provided in the Technical Questionnaire. In case space provided is not adequate, the reply may be furnished separately under suitably numbered annexes / attachments duly referred against the comment / query.
- The Compliance Statements / Queries are required to be categorically confirmed / answered by the bidder and the completely filled in Tech Questionnaire shall be submitted together with the Bid.

Bidder's Seal with date

Signature of Authorised Representative

1.



**TECHNICAL CONFIRMATION LIST
(SME - PACKAGED EQUIPMENT)
FOR
STEAM GENERATION PACKAGE**

**Annexure-B
DOCUMENT No.
B957-420-80-42-TCL-7410
Rev. 0
Page 1 of 4**

**Annexure-B
TECHNICAL CONFIRMATION LIST
(SME - PACKAGED EQUIPMENT)
STEAM GENERATION PACKAGE**

TENDER No. B957-420-80-44-PG-T-7410

PROJECT	:	MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)
OWNER	:	BHARAT PETROLEUM CORPORATION LIMITED (BPCL)
EPCM	:	ENGINEERS INDIA LIMITED
EIL JOB No.	:	B957

0	03.02.2025	ISSUED WITH TENDER	KJS	AK	KCP
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

Bidder shall furnish duly filled and signed technical confirmation list and deviation list, if any, alongwith bid which will form the basis for technical evaluation of bid.

Bidder is required to give categorical reply to each point of this technical confirmation list so that bidder's offer could accordingly be evaluated.

Bidder's reply "Not Confirmed" is not warranted and may lead to technical rejection of their bid. However, Bidder may provide certain clarification, incase absolutely necessary, without deviating to bid requirement.

Sl. No.	Description	BIDDER'S ANSWER (Confirmed / Not Confirmed)
1.	The scope of work and battery limits shall be in compliance with the tender document. All other equipment, materials and work not explicitly mentioned but nevertheless required to fulfil the system and functional requirements shall be deemed to have been included in the scope of Bidder with no additional cost and time implication to the Owner. Please Confirm.	
2.	Bidder to note that no deviations are allowed from the tender specifications. However, if it is inevitable, clause-wise deviation, against the tender specifications shall be duly consolidated at one place, under Exceptions / Deviations List in the format enclosed with the tender and shall be submitted with the bid. In case, no exception / deviation list is furnished, it will be presumed that all requirements of tender are fully complied with. Any exceptions /deviations made by the Bidder elsewhere in their offer shall not be taken cognizance of and all such exceptions / deviations shall be deemed as null and void. Confirm compliance.	
3.	Technical Amendments, if any, on the Tender Specifications shall be considered part of Tender Specifications itself and shall be strictly adhered to by the Bidder. Confirm compliance.	
4.	Bidder to note that data sheets, drawings and other technical details are not required with offer and the same, if submitted with bid, shall be treated as preliminary and retained for records only. Vendor's documents/ drawings shall be reviewed as per the "Vendor Data Requirements (Doc. No. B957-420-80-42-VDR-7410)" during post order stage for checking/ ensuring compliance with Tender specifications / Contract requirements. Owner/EIL comments shall be binding on Contractor without any commercial implication to the	

Sl. No.	Description	BIDDER'S ANSWER (Confirmed / Not Confirmed)
	Owner. Confirm compliance.	
5.	Bidder to confirm that in the event of order, all drawings, documents and data shall be furnished in accordance with Vendor Data Requirements (Doc. No. B957-420-80-42-VDR-7410).	
6.	Bidder to confirm that all the documents/drawings shall be duly checked and approved by Contractor before submission of the same for OWNER/ EIL review/approval.	
7.	Bidder to confirm that makes of all equipment shall be as per approved Vendor List attached with the tender documents. For any item, where no vendor list is provided in the tender document, the vendor proposed by Contractor shall have sufficient Proven Track Record (PTR) and shall be subject to Owner / EIL approval during detailed engineering without any commercial implication to Owner/EIL.	
8.	Bidder to confirm that the material of construction of equipment/ components shall be same or superior to those specified in the Tender Documents.	
9.	Bidder to confirm categorically that following have been included by them in their quoted lump sum price. a. Commissioning spares, as required, for all equipment b. Special tools and tackles for all equipment, as required. c. Training services to the OWNER's personnel at site for all equipment	
10.	Bidder to confirm that all consumables, lubricants, hydraulic oils, refrigerants etc. for initial charge and replenishment of any loss of these during commissioning, trial runs & PG testing and for operation & maintenance of six (6) months after handover of steam generation package to Owner for all equipment have been included in the bidder's proposal.	
11.	Bidder to confirm that the list of recommended spares for two (2) years of normal operation & maintenance with itemized price along with quantity (as recommended by the Original Equipment Manufacturer) shall be provided for all equipment after placement of order.	
12.	Bidder to confirm that Mandatory Spares as mentioned in tender (Refer doc. No. Annexure-B B957-420-80-42-SL-	



**TECHNICAL CONFIRMATION LIST
(SME - PACKAGED EQUIPMENT)
FOR STEAM GENERATION
PACKAGE**

**Annexure-B
DOCUMENT No.
B957-420-80-42-TCL-7410
Rev. 0
Page 4 of 4**

Sl. No.	Description	BIDDER'S ANSWER (Confirmed / Not Confirmed)
	7410) are included in their offer and same shall be supplied by them.	
13.	Bidder to confirm that the Inspection & Testing requirements as specified in the tender shall be complied. All necessary equipment as required for carrying out Inspection and Testing as stipulated in Tender documents shall be in the scope of the Bidder.	
14.	Bidder to confirm that the Performance Guarantee requirements as specified in the tender Specifications shall be complied.	

Bidder's Seal with date

Signature of Authorised Representative

TECHNICAL CONFIRMATION LIST

(STATIC & MACHINERY EQUIPMENT)

ANNEXURE-C (ROTATING EQUIPMENT)

FOR

STEAM GENERATION SYSTEM

TENDER No. B957-420-80-44-PG-T-7410

PROJECT	:	MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)
UNIT No.	:	420
OWNER	:	M/s BHARAT PETROLEUM CORPORATION LIMITED (BPCL)
LOCATION	:	BINA, MP, INDIA
PMC	:	ENGINEERS INDIA LIMITED
EIL JOB No.	:	B957

A	07/01/2025	ISSUED AS TENDER INPUT	VS/SG	MG	TK
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

ANNEXURE-C **SMED-II (ROTATING EQUIPMENT)**

Bidder to note that **bidder's quotation shall be evaluated (technically) based on bidder's reply/confirmation to this technical confirmation list only. Bidder's offer shall be considered incomplete and may not be considered for technical evaluation by purchaser if duly filled-in, signed & stamped technical confirmation list is not submitted along with bid.** Bidder is required to give categorical reply to each point of this technical confirmation list, so that bidder's offer can be properly evaluated.

Bidder's reply "Not Confirmed" is not warranted and may lead to technical rejection of their bid. However, Bidder may provide certain clarification, incase absolutely necessary, without deviating to bid requirement. Written confirmation shall have precedence over any clarification whatsoever.

Sl. No.	Description	BIDDER'S ANSWER (Confirmed / Not Confirmed)
1.	Please note that this is a "No deviation" bid. Bidder to submit all their clarification during the pre-bid query stage only. No further deviation/ clarifications shall be allowed in the technical offer. Bidder to confirm that there is no technical deviation in their offer w.r.t. the tender specification & technical amendment (if any).	
2.	Confirm that the bidder has quoted for the total scope of supply & services for all equipment/ package as specified in the tender. Any deviation to this requirement may lead to the bid being considered as incomplete and liable for rejection.	
3.	Bidder to note that data sheets, drawings and other technical details are not required with offer, however if submitted with bid shall be retained for information only. Vendor's documents/ drawings shall be reviewed as per the "Vendor Data Requirement (Doc No. B957-420-80-42-VDR-7410)" during post order stage for checking/ ensuring compliance with Tender specification/ Contract requirement. Confirm compliance.	
4.	Confirm that all equipment shall be procured from the approved vendors listed elsewhere in the bid package.	
5.	Bidder to confirm that complete Rotating Equipment Package consisting of driver, driven equipment, all associated auxiliary systems, instrumentation & controls etc. is procured from the Single Point Responsibility Vendor defined for various Rotating Equipment Package in Engineering Design Basis. No separate procurement of driver, auxiliaries or any other accessories of the package by Contractor is allowed.	
6.	Bidder to confirm that following requirements are met while	

Sl. No.	Description	BIDDER'S ANSWER (Confirmed / Not Confirmed)
	placing the orders of rotating equipment: (a) Ensuring that equipment meets the specified operating conditions and meets the stipulated technical specifications, enclosed with the bid package. (b) Ensuring equipment meets the experience criteria (EC) as specified in the bid package and obtaining approval of the same.	
7.	Bidder to confirm that all rotating equipment shall comply with applicable national and international codes & standards as well as any statutory regulation in existence particularly for that item/package.	
8.	Contractor to confirm that following documents (duly reviewed by contractor) of finally selected equipment make/model, are submitted in one lot, for obtaining approval of Owner/PMC during detail engineering: - Filled in Equipment Data Sheet along with performance curves (as applicable) along with a copy of approved process data sheet. - Filled in Experience Record Proforma (to justify meeting vendor's & equipment's past experience in line with bid package requirements) along with General reference List - List of deviations (if any) to the bid package specifications, specific to the equipment - Equipment Manufacturer's Latest Catalogue, General Arrangement Drawing & Schematic drawing / P&ID for the proposed model shall also be submitted along with the above documents.	
9.	Bidder to note that, if any comment arises during detail engineering from EIL/ Owner (to ensure compliance with Tender Specification/Contract requirement), same shall be incorporated by vendor without any time and price implication. Confirm compliance.	
10.	Bidder to confirm that the material of construction of equipment/components shall be as per Process Package attached with Tender document.	
11.	Confirm that Commissioning Spares for all equipment/ packages, as required have been included by the bidder in the quoted lump sum price.	
12.	Bidder to confirm that in case during commissioning, additional spares are required over and above the quoted commissioning spares, then the same shall be supplied by bidder without any time and commercial implication.	

Sl. No.	Description	BIDDER'S ANSWER (Confirmed / Not Confirmed)
13.	Bidder to confirm that Mandatory Spares as mentioned in tender (Refer Doc. No. B957-420-80-42-SL-7410) shall be supplied and the cost of mandatory spares has been included in the quoted lump sum price.	
14.	Bidder to confirm that the list of recommended spares for two (2) years of normal operation & maintenance with itemized price along with quantity (as recommended by the Original Equipment Manufacturer) for all equipment/ packages shall be provided after placement of order. As a minimum this list shall include spares enclosed elsewhere in the tender. Owner shall order these spares separately, if required.	
15.	Confirm that special tools and tackles for each equipment/package, as required, for their normal operation and maintenance have been included by the bidder in the quoted lump sum price.	
16.	Confirm that the Inspection & Testing requirements as specified in the tender shall be complied.	
17.	Confirm that all consumables, chemicals, lubricants, sealing fluid, etc. for startup & commissioning of all equipment/ packages have been included in the bidder's proposal.	
18.	Confirm that in the event of order, all drawings, documents and data shall be furnished in accordance with "Vendor Data Requirements" (B957-420-80-42-VDR-7410).	
19.	Confirm that all the documents before submission for OWNER/ EIL's review shall be duly checked and reviewed by Contractor.	

Bidder's Seal with date

Signature of Authorised Representative

VENDOR DATA REQUIREMENTS FOR STEAM GENERATION PACKAGE (SMED)

0	03-FEB-2025	ISSUED WITH TENDER	KJS	AK	KCP
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

VENDOR DATA REQUIREMENTS

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

AGITATOR

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	AGITATOR GA DWG, DETAIL DRGS CATALOGUE ETC.			✓	✓	
2.	MECHANICAL DESIGN CALCULATION OF TANKS			✓	✓	
3.	MECHANICAL DESIGN CALCULATION OF VESSEL INCLUDING WRC ANALYSIS & LIFTING ANALYSIS			✓	✓	
4.	MECHANICAL DESIGN CALCULATION FOR HEATEXCHANGER			✓	✓	
5.	DETAILS OF INTERNALS OF VESSEL			✓	✓	
6.	DETAILS OF INTERNALS OF TANKS			✓	✓	

AIR COOLED HEAT EXCHANGERS

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	GENERAL ARRANGEMENT DRAWING SHOWING BUNDLES WITH NOZZLE LOCATION & ORIENTATION, SERVICE PLATFORMS, STAIRS, LADDERS, DETAILS OF COLUMN SUPPORTS, CLEARANCE ETC. (DRAWN TO SCALE)		✓		✓	
2.	DETAILED FABRICATION DRAWINGS OF BUNDLE & FRAME DRAWN TO SCALE INCLUDING TUBE BUNDLE DRAWING WITH MATERIAL SPECIFICATIONS SHOWING THICKNESS, DIMENSIONS, COMPONENT DETAIL, CORROSION ALLOWANCE, NOZZLE LOCATION AND ORIENTATION, TUBE TO TUBE SHEET JOINT DETAIL			✓	✓	
3.	DRIVE SELECTION, MOTOR SUSPENSION, FAN AND PULLEY GUARDS, BEARING BLOCK DETAILS, QD BUSH DETAILS, INLET CONE DETAILS ETC			✓	✓	
4.	FAN PERFORMANCE CURVES/LOUVERS PERFORMANCE CURVES			✓	✓	
5.	FOR AUTO VARIABLE FANS: SCHEMATIC CONTROL DIAGRAM FOR AUTOMATIC CONTROL PITCH ADJUSTMENT			✓	✓	

**VENDOR DATA REQUIREMENTS
FOR
STEAM GENERATION PACKAGE (SMED)**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
6.	FOR AUTO VARIABLE FANS: HOOK-UP SCHEME.			✓	✓	
7.	DRAWINGS OF STRUCTURALS, PLENUM CHAMBERS (DRAWN TO SCALE)			✓	✓	
8.	DESIGN CALCULATIONS FOR STRUCTURALS			✓	✓	
9.	LIST OF SPARE PARTS WITH DETAILS			✓	✓	
10.	MANUFACTURER'S DATA REPORT @				✓	
11.	INSPECTION AND TESTING PLAN @				✓	
12.	WELDING PROCEDURES AND QUALIFICATION TEST REPORTS @				✓	
13.	DESTRUCTIVE AND NON-DESTRUCTIVE TEST REPORTS @				✓	
14.	MATERIAL TEST CERTIFICATES @				✓	
15.	RADIOGRAPHIC EXAMINATION REPORTS WITH FILMS @				✓	
16.	HEAT TREATMENT PROCEDURE AND TIME TEMPERATURE CHARTS @				✓	
17.	COMPLETION CERTIFICATES (INCLUDING INSPECTION CERTIFICATE, HYDROSTATIC TEST CERTIFICATE, LOCAL CODE REQUIREMENTS, RUBBING OF CODE STAMP AND NAME PLATE ETC.)				✓	
18.	PACKING AND FORWARDING INSTRUCTIONS @				✓	

COLUMNS AND VESSELS

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	GENERAL ARRANGEMENT DRAWING INDICATING DESIGN DATA FABRICATED EQUIPMENT WEIGHT, GENERAL NOTES, NOZZLE SCHEDULE, DETAIL OF SHELL, HEADS, SUPPORTING ARRANGEMENT, MAIN WELD SEAMS, NOZZLE ORIENTATION PLAN, CUTTING LAYOUT ETC.		✓		✓	
2.	DETAIL OF NOZZLES, MANHOLES, ACCESSORIES ETC			✓	✓	
3.	DETAIL OF INTERNALS SUCH AS TRAY, TRAY SUPPORT RING, BOLTING BARS.			✓	✓	
4.	DETAILS OF DEMISTER.			✓	✓	
5.	DETAILS OF PACKING SUPPORT, DEMISTER SUPPORTS, GRATINGS, AND GRATING SUPPORTS.			✓	✓	
6.	DETAIL OF INTERNAL DISTRIBUTOR.			✓	✓	

**VENDOR DATA REQUIREMENTS
FOR
STEAM GENERATION PACKAGE (SMED)**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
7.	DETAIL OF EXTERNAL CLIPS SUCH AS LADDER, PLATFORM, PIPE SUPPORT.			✓	✓	
8.	DETAIL OF INSULATION, FIRE PROOFING			✓	✓	
9.	DETAIL OF PIPE DAVIT			✓	✓	
10.	DETAIL OF LIFTING LUG, TRUNION AND TAILING LUG ETC.			✓	✓	
11.	SHELL DEVELOPMENT DRAWINGS INCORPORATING ALL ATTACHMENTS AND WELD SEAMS			✓	✓	
12.	CERTIFIED 'AS BUILT' DRAWINGS INCORPORATING ACTUAL DIMENSIONS AND MATERIAL USED, DULY CERTIFIED BY THE INSPECTOR@				✓	
13.	DATA FOLDER AS PER SPECIFICATION@				✓	
14.	INSPECTION AND TESTING PLAN @				✓	
15.	WELDING PROCEDURES AND QUALIFICATION TEST REPORTS @				✓	
16.	DESTRUCTIVE AND NON-DESTRUCTIVE TEST REPORTS @				✓	
17.	MATERIAL TEST CERTIFICATES @				✓	
18.	RADIOGRAPHIC EXAMINATION REPORTS WITH FILMS @				✓	
19.	HEAT TREATMENT PROCEDURE AND TIME TEMPERATURE CHARTS @				✓	
20.	CODE CERTIFICATES (INCLUDING INSPECTION CERTIFICATE, HYDROSTATIC TEST CERTIFICATE, LOCAL CODE REQUIREMENTS, RUBBING OF CODE STAMP AND NAME PLATE ETC.) @				✓	
21.	PACKING AND FORWARDING INSTRUCTIONS @				✓	

ROTATING EQUIPMENT

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Technical Confirmation List (Rotating Equipment) duly completed, signed & stamped, with categorical confirmation to each of the clauses of the same.	✓				
2.	Document Control Index (DCI) or Drawing & Documentation Schedule (This shall be the first document to be submitted by the Bidder immediately after order)					The detailed requirement of drawings / documents shall be finalized in the DCI

**VENDOR DATA REQUIREMENTS
FOR
STEAM GENERATION PACKAGE (SMED)**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
3.	Final Vendor Selection Data (FVSD) document containing: a) Duly filled in Equipment data sheets and Performance Curves along with final approved respective Process Datasheets. b) Duly filled in Experience Record Proforma c) Equipment Manufacturers Latest Catalogue & General Reference List for the proposed model d) Vendor specific deviations (only technically infeasible) to specified standards & codes (if any) as well as EIL Standard Specifications. Note: Only after firm and final approval of FVSD (without any HOLDS/Open points), PR shall be submitted to Owner/PMC for review.		✓			
4.	PURCHASE REQUISITIONS Purchase Requisitions containing following documents, as a minimum: a) Process Data Sheet/ P&IDs (approved copy). b) Duly filled in equipment data sheets (approved copy) & Performance curves (approved copy), for all cases. c) Filled in Experience record format (approved copy) d) Equipment manufacturer's general reference list & manufacturer's catalogue. e) List of Agreed Deviations (approved copy) f) Scope of supply / work, List of Mandatory spares, List of Commissioning spares, List of 2 years O&M Spares and List of Special tools / tackles g) Site & Utility Data / Specifications h) Applicable EDB, data sheets, job specifications, PMS/VMS, etc. of respective departments i) Utility data sheets j) Applicable Vendor list k) Applicable Painting Specifications, Site Spectra, etc. l) Detailed Vendor Data Requirements (i.e. GA drawing; C/S drawing; Layout drawing, P&ID etc.) of all equipment & components supplied by vendor. m) Applicable Owner/ PMC documents n) Applicable Standards & Specifications o) Applicable Inspection Test Plan (@) Note: Only after firm and final approval of PR (without any HOLDS/Open points), applicable vendor documents (after review and final approval by contractor) shall be submitted to Owner/PMC for review.			✓	✓	All documents to be submitted in one lot for each rotating equipment/package
5.	Overall General Arrangement Drawing showing the driver, driven equipment and other auxiliary equipment (like sealing system, lube oil system, panels etc.) along with interface/ terminal points, location, maintenance space, erection & maintenance weights, capacity & hook height for maintenance etc.			✓	✓	

**VENDOR DATA REQUIREMENTS
FOR
STEAM GENERATION PACKAGE (SMED)**

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
6.	P & I Diagram with bill of material for process, lube oil system, seal system, nitrogen, instrument air, cooling water, steam systems etc. for the complete package		✓		✓	
7.	Utility consumption list (start up, normal operation & shutdown), consumables / Lubricants / Chemical consumption lists			✓	✓	
8.	Shop test procedures including mechanical running test, performance test, complete unit test, site test etc. as applicable				✓	@
9.	Final vendor documentation/data-book covering all contractor reviewed/approved documents including all PR/PO, data sheet, curves, GAD/PID, plot plan, cross sectional drawing, bill of material, utility data, spares list (mandatory, commissioning spares, 2 years O&M), list of special tools and tackles, lubrication schedule, Lateral analysis reports, Train torsional analysis reports, dynamic balancing reports, Residual Unbalance check / Damped unbalance response Analysis, simulation & study reports, test procedures, Mech Run Test Procedure, Performance Test Procedure, Hydro Test Procedure, Site Test Procedure, NPSH Test Procedure, catalog, installation manual, O&M manual, inspection and test records, etc for all equipment/component including auxiliaries and ancillaries.				✓	Multidisciplinary

HEAT EXCHANGERS

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	GENERAL ARRANGEMENT DRAWING INDICATING DESIGN DATA FABRICATED EQUIPMENT WEIGHT, GENERAL NOTES, NOZZLE SCHEDULE, DETAIL OF SHELL, HEADS, SUPPORTING ARRANGEMENT, MAIN WELD SEAMS, NOZZLE ORIENTATION PLAN, CUTTING LAYOUT ETC.		✓		✓	
2.	TUBE BUNDLE DETAILS			✓	✓	
3.	DETAIL OF NOZZLES AND EXCHANGER SUPPORT			✓	✓	
4.	DETAILS OF GASKETS			✓	✓	
5.	LIST OF SPARE PARTS WITH DETAILS			✓	✓	
6.	MANUFACTURER'S DATA REPORT@				✓	
7.	HEAT EXCHANGER DETAILED DRAWINGS AND PARTS LIST			✓	✓	

**VENDOR DATA REQUIREMENTS
FOR
STEAM GENERATION PACKAGE (SMED)**

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
8.	PROCEDURE FOR PICKLING & PASSIVATION (FOR SS ITEMS ONLY) @				✓	
9.	INSPECTION AND TESTING PLAN @				✓	
10.	WELDING PROCEDURES AND QUALIFICATION TEST REPORTS @				✓	
11.	DESTRUCTIVE AND NON-DESTRUCTIVE TEST REPORTS @				✓	
12.	MATERIAL TEST CERTIFICATES @				✓	
13.	RADIOGRAPHIC EXAMINATION REPORTS WITH FILMS @				✓	
14.	HEAT TREATMENT PROCEDURE AND TIME TEMPERATURE CHARTS @				✓	
15.	CODE CERTIFICATES (INCLUDING INSPECTION CERTIFICATE, HYDROSTATIC TEST CERTIFICATE, LOCAL CODE REQUIREMENTS, RUBBING OF CODE STAMP AND NAME PLATE ETC.) @				✓	
16.	PACKING AND FORWARDING INSTRUCTIONS @				✓	

STORAGE TANKS

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	GENERAL ARRANGEMENT DRAWINGS OF TANKS		✓		✓	
2.	BOTTOM AND ANNULAR RING LAYOUT & WELD DETAILS.			✓	✓	
3.	DETAIL OF SUMP FOR DRAIN NOZZLES			✓	✓	
4.	SHELL PLATE LAYOUT (SHOWING LOCATION OF NOZZLES & MANHOLES)			✓	✓	
5.	DETAILS OF WIND GIRDERS			✓	✓	
6.	SPIRAL STAIRWAYS, INTERMEDIATE & TOP PLATFORMS			✓	✓	
7.	ROOF PLATE LAYOUT & WELD DETAILS.			✓	✓	
8.	ROOF STRUCTURE DETAILS			✓	✓	
9.	DETAILS OF NOZZLES ON SHELL			✓	✓	
10.	DETAILS OF NOZZLES ON ROOF			✓	✓	
11.	DETAIL OF INTERNALS LIKE GUIDE ROLLERS, ROOF STOPPERS, STILL WELLS, DIP PIPE, HEATING COIL, FOAM SEAL (PRIMARY & SECONDARY) ETC.			✓	✓	

**VENDOR DATA REQUIREMENTS
FOR
STEAM GENERATION PACKAGE (SMED)**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
12.	DESIGN CALCULATIONS FOR FLOATING ROOF FOR BUOYANCY, STABILITY, TILTING, LEG SUPPORTS, BLEEDER VENTS, ROOF DRAIN, RIM VENT, EMERGENCY DRAIN ETC			✓	✓	
13.	FLOATING ROOF DETAILS			✓	✓	
14.	DETAILS OF FOAM & COOLING SYSTEM			✓	✓	
15.	INFORMATION ON ALL BOUGHT OUT COMPONENTS I.E VENDORS, SIZE, MODEL NO., CATALOGUES, INSTALLATION & OPERATING MANUAL, DRAWINGS AND CALCULATIONS AS APPLICABLE			✓	✓	
16.	INSPECTION AND TESTING PLAN @				✓	
17.	WELDING PROCEDURES AND QUALIFICATION TEST REPORTS @				✓	
18.	DESTRUCTIVE AND NON-DESTRUCTIVE TEST REPORTS @				✓	
19.	MATERIAL TEST CERTIFICATES @				✓	
20.	RADIOGRAPHIC EXAMINATION REPORTS WITH FILMS @				✓	
21.	HEAT TREATMENT PROCEDURE AND TIME TEMPERATURE CHARTS @				✓	
22.	COMPLETION CERTIFICATES (INCLUDING INSPECTION CERTIFICATE, HYDROSTATIC TEST CERTIFICATE, LOCAL CODE REQUIREMENTS)				✓	

FOR INDIVIDUAL EQUIPMENT (MATERIAL HANDLING EQUIPMENT LIKE EOT/HOT CRANE, ELECTRIC HOIST CHAIN PULLEY BLOCK ETC.)

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Document Control Index		✓		✓	submission through VDMS
2.	Filled-in Technical Confirmation List (Static & Machinery Equipment-Packaged Equipment)(doc no.Annexure-B-B957-420-80-42-TCL-7410)	✓				
3.	Filled-in Mechanical Data Sheet for individual equipment separately.		✓		✓	
4.	Crane Clearance Diagram (For EOT/HOT Crane),As applicable		✓		✓	
5.	GA Drawing and cross -section drg. of of each equipment with individual parts showing major dimensions, MOC with individual equipment weight, wheel load & rail fixing details		✓		✓	
6.	Equipment Sizing/Selection and Power Calculation			✓	✓	

**VENDOR DATA REQUIREMENTS
FOR
STEAM GENERATION PACKAGE (SMED)**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
7.	List of Special Tools & Tackles (as applicable)			✓	✓	
8.	Purchase Requisition			✓	✓	
9.	QAPs, ITPs, Test certificates etc					@
10.	Installation, operation & maintenance manuals containing all certified drawings & documents			✓	✓	
11.	Performance Guarantee Test Procedure as applicable		✓		✓	
12.	Drg./Doc. Required for Electrical/Instrumentation/Architecture					Refer Respective dept. VDR
13.	List of recommended spare parts for 2(two) years normal operation and maintenance (with itemized price)			✓	✓	
14.	List of commissioning spares				✓	
15.	Utility Consumption Figures			✓	✓	

AIR CONDITIONING SYSTEM FOR BUILDING

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Document Control Index (DCI)			✓	✓	submission through VDMS
2.	Filled-in Technical Confirmation List (Static & Machinery Equipment-Packaged Equipment)(doc no.Annexure-B-B957-420-80-42-TCL-7410)	✓				
3.	Filled in Data Sheets		✓		✓	
4.	Cooling/Heating Load Calculation and de-rating calculation of main HVAC Equipment as per AHRI.		✓		✓	
5.	Ducting layout , Air conditioning plant layout, AHU room layout, Piping and Equipment layout, including battery limit interface drawings for each building		✓		✓	
6.	Basic design calculations, performance data, vendor catalogues for equipment selection, characteristics performance curves for individual components			✓	✓	
7.	GA drawing and cross-section drg. of individual equipment/showing major dimensions and MOC including nozzle orientation details, characteristic performance curve for individual equipment			✓	✓	
8.	Chilled water piping schematics and layouts as applicable			✓	✓	
9.	P&ID with write up on operation, interlocks and trips and Scheme Drawings			✓	✓	
10.	Battery limit (interface) drawing / information		✓		✓	

**VENDOR DATA REQUIREMENTS
FOR
STEAM GENERATION PACKAGE (SMED)**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
11.	List of bought-out items with makes		✓		✓	
12.	Equipment load data and foundation/anchor plan with pocket details			✓	✓	
13.	Torque speed characteristics (motor & driven equipment), Characteristic performance curve and selection table for individual equipment			✓	✓	
14.	Utility consumption figures (with power consumption)			✓	✓	
15.	List of recommended spare parts for Two (2) years normal operation & maintenance with itemized price			✓	✓	
16.	List of Mandatory Spares		✓		✓	
17.	List of Commissioning Spares			✓	✓	
18.	List of Special Tools & Tackles			✓	✓	
19.	Pre-commissioning and Commissioning Procedure			✓	✓	
20.	Performance Guarantee Test Procedure as applicable		✓		✓	
21.	Installation, operation & maintenance manuals containing all certified drawings & documents			✓	✓	
22.	Quality Assurance Plans, ITPs and applicable tests certificates and reports				✓	@
23.	Drg./Doc. Required for Electrical/Instrumentation/Architecture				✓	Refer Respective dept. VDR
24.	Purchase Requisition			✓	✓	

Notes :

1. "TICK" denotes applicability.
2. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
3. All post order documents shall be submitted / approved through EIL eDMS portal.
4. Final documentation shall be submitted in hard copy (Six prints) and soft (two CDs/DVDs) in addition to submission through EIL eDMS.
5. Refer - 6-78-0001: Specification for quality management system from Bidders.
6. Refer - 6-78-0003: Specification for documentation requirement from Suppliers.
7. All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
8. Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
9. "@" indicates submission of documents to Inspection Agency.
10. Bill of Material shall form part of the respective drawing.
11. Drawings/documents not listed in VDR shall be returned without review.
12. EIL approval in Code-1/Code-R/Code-2 of vendor's / contractor's drawing & document shall not relieve the vendor/contractor from responsibility to supply equipment/services as per requisition/ITB/RFQ.
13. Final documentation shall be submitted in hard copy (Six prints) and soft (three CDs/DVDs) in addition to

submission through EIL eDMS and BPCL EPPDMS.

14. Successful bidder to submit DCI (DOCUMENT CONTROL INDEX) and all the contractor data through vendor

portal (<http://edocx.eil.co.in/vportal>) only. The detail guidelines for Uploading the document on vendor portal are available on the site itself. Successful bidder to submit the entire document as scheduled document only. All post order documents shall be submitted / approved through EIL eDMS portal.

DCI shall be prepared by the contractor based on the VDR and submitted within 15 days from the date of FOA. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI). The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).

15. All drawings shall be thoroughly checked and duly signed by contractor. Unchecked drawings and drawings without revisions clearly marked shall be returned without review. Successive review of the same drawing shall apply only to latest data sheet/comments on the previous revision. Drawings and documents returned to contractor for revision shall be resubmitted preferably within 10 days of receipt.

16. Contractor shall note that the vendor drawing for the following standard components (as applicable) shall not be reviewed by EIL. It shall be solely vendor's responsibility to ensure the correctness of these drawings as per EIL / LICENSOR Standards and Drawings. If any discrepancy/mistake is found at a later date the vendor shall rectify the same at his time and cost.

17. All fabrication drawings submitted by contractor to EIL shall be retained for information only. Submission of documents to EIL for information shall not be a HOLD point for fabrication. Contractor can proceed with fabrication based on requirements of requisition. Any clarification required from EIL shall be obtained prior to proceeding with fabrication of the equipment. However, it is EILs prerogative to review fabrication drawings at its discretion and EIL comments in line with requirements of requisition shall be incorporated by contractor without any cost and delivery implications.

18. Refer - 6-78-0002: Specification for documentation requirements from Contractors.

JOB SPECIFICATION FOR DEAERATOR PACKAGE (Mass Transfer Mechanical & System)

FOR

STEAM GENERATION PACKAGE (TENDER No. B957-420-80-44-PG-T-7410)

PROJECT : BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT, (BPREP)

UNIT NO. : 420

OWNER : M/s BHARAT PETROLEUM CORPORATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

JOB NO. : B957

0	17.01.2025	ISSUED WITH TENDER	VM	VKY	PG
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

1.0 SCOPE

The intent of this document is to outline the minimum requirements for Design (including sizing), Engineering, Procurement of materials and bought out items, Fabrication, Inspection, Testing, Assembly, Painting, Insulation, Process and mechanical guarantees, Supply including supply of Mandatory & commissioning Spares, Erection, Assistance of package vendor at Site during Pre-commissioning & Commissioning activities for Deaerator Package consisting of Deaerating Tower along-with Storage Vessel complete with internals like Spray Nozzles, Trays etc., Instrumentation, Piping, Pipe fittings and Valves etc. in accordance with the Process package, Process Data sheets, P&ID, Engineering Design Basis, this Specification other enclosed Specifications / Standards / Drawings, applicable codes for Deaerator and Steam Generation Package for BPCL-Bina for Bina Petrochemical and Refinery Expansion Project.

This Job specification provides additional technical requirements to be read in conjunction with the requirements of other Specifications & Engineering Design Basis Doc. No. B857-999-80-42-EDB-1001 and is intended to supplement the main scope of work and supply defined in Doc. No. B957-420-80-46-SOW-7410 enclosed elsewhere in the tender document.

All equipment and materials supplied as per above specifications and drawings/data sheets shall conform to sound engineering principles and good fabrication and construction practices. No omission from these specifications shall relieve the vendor of his responsibility to complete the work in all respect. All materials supplied shall be new and adequate for the proposed service.

2.0 GENERAL

2.1 Definitions

Contractor means the successful bidder on whom the order is placed. Vendor means the designer and / or supplier of Deaerator Package.

2.2 Codes and standards

The Design, Engineering, Fabrication, Inspection, Testing and Supply shall conform to Codes and Standards referred to in Engineering Design Basis & Standard Specification No. 6-14-0019 attached elsewhere in bid package.

2.3 Deviations

Deviations are not acceptable. However, Deviations only with intent to improve upon the Equipment life/performance may be quoted separately and it shall be OWNER/EIL prerogative to accept them.

2.4 Order of precedence

In the event of conflict, most stringent requirement in following order of precedence shall govern:

- a) Statutory Requirement
- b) Process Data Sheet / P&ID

- c) Job specification
- d) Standards & Specifications
- e) Codes

However in event of conflict it shall be the duty of the Contractor to bring it to Owner / EIL attention for resolution and resolve it before proceeding with the fabrication. Owner / EIL decision shall be final and binding without any cost and delivery implications.

2.5 Safety

It is the intent of Owner that operational hazards are reduced to a minimum. Bidder shall use sound engineering judgment to complete an installation that will perform the required process function without compromising this aspect.

2.6 Design Software

All Mechanical design calculations shall be done with proven & reputed international software capable of carrying out design in free mode. No manual calculation shall be accepted. For Equipment & certain parts of equipment, where international software is not available, duly validated & approved In-House software will be accepted. Contractor/Vendor shall submit the validation report for verification when demanded.

2.7 Vendor Selection

Contractor shall procure Deaerator Package from EIL vendor list (Item Code 12LQ) included at clause 10.0 of this specification.

2.8 Contractor Documentation

2.8.1 Master document index

Master document index with submission date must be submitted within 15 days after award of contract. Contractor to refer VDR enclosed with the Tender and submit drawings / documents post order in following sequence:

- i) Master Document Control Index (DCI) with schedule of submissions.
- ii) Details for selection of sub-supplier / sub-vendor.
- iii) Purchase specification.
- iv) PFD and P&ID's
- v) Datasheets and Process / Thermal calculations.
- vi) Design loading data for design of supporting structure.
- vii) Mechanical design calculations.
- viii) Equipment GADs and Engineering drawings.
- ix) Detailed fabrication drawings.

2.8.2 Fabrication drawings

Based on reviewed Mechanical Engineering Data sheets / GAD's, Vendor must prepare fabrication drawings and other documents. Fabrication drawings submitted shall only be for information and Vendor to fabricate and supply the equipment based on his responsibility of ensuring compliance to GAD's, Codes, EIL specifications & standards etc.

All drawings/documents submitted to EIL shall be legible and of good quality. Illegible drawings/documents shall be returned back without EIL review and any delay in approval of such drawings/documents shall be to contractor's account. Also, all drawings prepared by vendor shall be reviewed and approved by the Contractor before submission to EIL. Drawings / Documents which are not in compliance to above shall be returned without review in void category.

2.9 **Shop & Field Painting**

Shop & Field Painting shall be in accordance with the Painting Specification attached elsewhere in the tender document.

2.10 **Wind Consideration**

Wind loads shall be calculated as per information provided in the EDB Doc. No. B857-999-80-42-EDB-1001 and Structural input attached elsewhere in the tender document.

2.11 **Earthquake consideration**

Seismic forces shall be based on IS: 1893 (Part 1 & 4) and project specific recommendations & Seismic Design Basis whichever is more stringent. Seismic Design Basis is attached elsewhere in the Tender document.

2.12 **General Design requirements**

- a) All nozzles of size 50 NB and below shall be provided with 2 nos. stiffeners 50 wide x 6 thickness located at 90° apart.
- b) Unless otherwise specified, all distributors shall be provided with minimum one vent & drain hole suitably.
- c) Deaerating Tower shall be a separate section to be mounted on the Storage Vessel.

3.0 **SPECIFIC TECHNICAL REQUIREMENTS**

3.1 **General**

- a) Mechanical Design of Deaerator Vessel and Storage Tank (i.e. design of shell, heads, supports, anchor bolts, weight calculation, wind and seismic analysis, foundation loadings, RF pad etc.) shall be performed as per relevant code/specifications.
- b) Local load analysis of all Process Nozzles for all Equipment shall be carried out as per WRC-107 (for nozzles on dish head) and WRC-297 (for nozzles on cylindrical shell).

For Toricones, WRC shall be carried out considering larger diameter of the Cone. Finite Element Analysis (FEA) is also an acceptable alternative for Local Load analysis.

Unless otherwise specified, minimum allowable Nozzle loads shall be as per EIL Std.7-12-0038. Contractor is advised to carry out Piping design analysis so as to limit the Piping loads on the Storage Vessel & Deaerating Tower as per the above document. In case, due to any reason, the actual Piping loads on Equipment increases from the above document, it shall be the responsibility of the Contractor to ensure the Design of the Equipment accordingly. Further, actual piping loads need to be indicated on Equipment GAD.

3.2 Design requirements

- 3.2.1 Type of Deaerator shall be 'Spray cum Tray type' as per HEI only i.e. separate vessels for storage and deaeration.
- 3.2.2 Deaerating Tower and Storage Vessel shall be designed as per the latest editions of codes (Refer Engineering Design Basis) / licensor's specifications, as applicable, in accordance with Design data, Engineering design basis, this Specification and applicable specifications enclosed with the package. All design calculations shall be made considering all loads for erection, operating and hydro-test condition taking into account wind & seismic load suitably. Saddle analysis for Horizontal equipments shall be based on LP Zick's criteria. Supports shall be designed to facilitate thermal expansion. Sliding saddle shall have either slotted holes with low friction pads or SS rollers for facilitating thermal movements. SS rollers shall be checked against crushing under maximum equipment load.
- 3.2.3 Material of construction of the Equipment shall be as per Process Data sheets, enclosed elsewhere in the package. Non pressure structural supporting parts shall be IS 2062 Gr. B (E 250 Quality B) for skirts, angle legs, Brackets etc. & SA 106 Gr. B for Pipe legs, unless the Equipment is in LTCS service, for which the non pressure structural supporting parts shall be of same MOC as Shell.
- 3.2.4 For all Carbon steel vessels in package units where MOC has not been specified, SA 516 GR 70/60 shall be used depending upon services as mentioned above.
- 3.2.5 Unless otherwise specified, Equipment gaskets shall be spiral wound with grafoil filler with CS outer ring & SS 304/304L/316/316L/321 etc. winding with compatible Inner ring as per ASME B 16.20 for raised face type flanges.
- 3.2.6 All nozzles shall be **set-in** type. Set-on type nozzles are not permitted.
- 3.2.7 Horizontal vessels shall be provided with lifting lugs based on erection scheme & wherever mandated. Lifting lug / Trunnions shall be located such that there shall be no fouling of lifting wire sling with external attachments during erection.
- 3.2.8 Wherever the fluid from the Nozzle is impinging directly on the Shell, suitable wear plate shall be provided locally.
- 3.2.9 Unless otherwise specified, the Vortex breakers shall be provided as per applicable EIL standard.

- 3.2.10 All components (internals for deaerator section) coming in contact with wet oxygen shall conform to SS304L.
- 3.2.11 The joint between Deaerator tower and the storage vessel shall be analyzed for the local stresses at the junction arising due to the hydrotest / operating weight of the deaerator tower (with internals) and the wind/seismic loads, whichever are governing.
- 3.2.12 The internals must be of robust mechanical design and capable of withstanding thermal, hydraulic and transport shock loads. All internals shall be of removable type to facilitate installation/removal of the same through the vessel manholes.
- 3.2.13 Standard Specification for Pressure Vessel for Package Items (No. 6-12-0030) shall be applicable for Deaerator Vessels.
- 3.2.14 Design and Engineering of Deaerator shall be carried out based on EIL Standard Specification No. 6-14-0019.
- 3.2.15 The deaerator storage vessel shall be supported only on two saddles (i.e. Fixed and Sliding).

3.3 Fabrication Requirement

- i) All pressure bearing butt weld shall be full penetration, double welded joints. When second side welding is not possible due to inaccessibility, single sided butt weld joints with root run by TIG may be used to ensure full penetration. Nozzles, manways and their reinforcement pads shall be attached to vessel with full penetration welds. All weld seams shall be clear of nozzles, manholes and stiffening rings etc.
- ii) Minimum course width shall be 1 meter. Maximum no. of longitudinal seams shall be as follows:
- | | | |
|---|---|--------|
| (a) Vessels up to 2 meter diameter | : | 1 seam |
| (b) Vessels from 2 meter up to 4 meter dia. | : | 2 seam |
| (c) Vessels from 4 meter up to 6 meter dia. | : | 3 seam |
- iii) The head shall preferably be 2:1 semi-ellipsoidal.
- iv) Dished ends shall preferably be of seamless construction. However, dished ends with one chordal weld seam are acceptable. In such cases, the width of chordal plate shall not be less than one third of the blank diameter and chordal seam shall clear nozzle opening. Intermediate heat treatment, if considered necessary, shall be carried out by the fabricator.
- v) Whenever a dished end is made of more than two plates, it must have a seamless crown plate.
- vi) Whenever a nozzle or a manhole is positioned at the centre of the dished end, the crown plate should be larger than the nozzle /manhole reinforcing pad.
- vii) All flange bolts shall straddle principal centre-line.
- viii) All nozzles fabricated from plate, irrespective of thickness of plate, shall be 100% radiographed.

- ix) All nozzles to shell welds (Root and Final run) shall be examined by magnetic particle/dye penetration test.
- x) Flange joints shall be provided for Deaerator dome when operating under positive pressure.
- xi) Deaerator storage vessel and Deaerator Vessel are to be transported to the site separately. However, vendor shall carry out "Hydro test" in fully assembled condition before dispatch to site.
- xii) Gaskets used for hydro testing of vessels shall be of the same specification as service gaskets and the fabricator shall supply new gaskets for manholes and nozzles with blind flanges apart from spares. Gaskets used for hydro test shall not be used for actual hook up.
- xiii) All surfaces for SS parts shall be pickled and passivated as per ASTM after fabrication.
- xiv) All CS welds of Deaerator and storage vessel are required to be Post weld heat treated. Hardness of welds shall not exceed 200 BHN.

4.0 SPARES

- 4.1 Mandatory spares for Deaerator Package shall be supplied as detailed in document no. B957-420-80-46-SL-7410 and shall be included in base price.
- 4.2 Erection and Commissioning spares shall be supplied as detailed in EIL Standard specification no. 6-14-0019 and shall be included in the base price.
- 4.3 List of two years operation & maintenance spares (over and above mandatory spares), recommended by Vendor shall be provided separately with item wise price.

5.0 PIPING & INSTRUMENTATION

Detailed scope of work/supply for Instrumentation and Piping items including documentation requirement shall be as per the Instrumentation and Piping Specification including attachments enclosed elsewhere in the bid package.

6.0 INSPECTION

- 6.1 For Equipment, Stage wise & final inspection shall be carried out by EIL.
- 6.2 For IBR Equipment, Inspection & Document approval shall be carried out by IBR & the same shall be the responsibility of the Contractor /Vendor.
- 6.3 For Equipment falling under PESO, Inspection & Document approval shall be carried out by PESO & the same shall be the responsibility of the Contractor.
- 6.4 Contractor/Vendor shall carry out various tests as per applicable codes/standards. Any or all test including hydro test shall be witnessed at Owner's option by its authorized representative / agency.
- 6.5 Equipment shall be subjected to inspection by EIL / Owner / its authorized representative who shall have access to inspect the equipment at any stage during manufacture. During

inspection, material certificates, shop test data, certificates for bought out components and other relevant information shall be furnished and testing done as required so as to ascertain that the specifications and quality is complied with.

- 6.6 Inspection test plan shall be developed by the Contractor & approved by EIL. It must specify various stages of inspection.

7.0 DOCUMENT / DRAWINGS

- 7.1 Submission of required drawings/documents shall be the responsibility of Contractor. In the event of contractor / vendor's failure to meet this requirement the supply of equipment shall be considered as incomplete.
- 7.2 Vendor to refer VDR enclosed with the Tender and submit drawings / documents in sequence as defined.
- 7.3 Documents/drawings review shall be as per Doc No. B957-420-80-46-VDR-7410 attached elsewhere in the bid package.

8.0 PROTECTION AND DISPATCH

- 8.1 After completion of all testing and inspection, the inside of complete equipment shall be thoroughly drained and dried out. Equipment shall be completely dried by passing hot air for sufficient time until no further increase in relative humidity of outgoing air is observed. Dry out shall be done simultaneously on both shell and tube sides. After drying, the equipment shall be purged and filled with dry N₂ at 0.25 kg/cm². The equipment shall be provided with pressure gauge to monitor N₂ pressure, and ½" non-return valve. All threaded holes, other than tell-tale holes for testing, shall be suitably protected with steel bar plugs. All nozzles not provided with blind flange shall be provided with steel covers, temporary gaskets and bolts.
- 8.2 The equipment item number, PO number and Owner name and address shall be painted in bold white paint letters written with stencil on the Equipment.
- 8.3 No Equipment shall be released for shipment until it has been approved by Inspection Agency. Equipment shall be securely anchored for dispatch in order to prevent any shifting and damage during transportation. Packaging shall be suitable for rail or road transport and also sea worthy. Spares shall be dispatched separately in a box and marked with PO number, item number and Owner's name and address.
- 8.4 Supplier shall provide sling mark identification on all Equipment with respect to centre of gravity of the equipment.
- 8.5 No equipment shall be dispatched until a written clearance is obtained from Owner/EIL regarding Piping Clips and Structural Cleats on individual equipment.
- 8.6 Vessels shall be suitably anchored to avoid damage during transportation. All flanges shall be blinded with steel plates and gasket to avoid damage of flange face.
- 8.7 After inspection & testing at vendor's shop, various items / components including delicate instruments, controls, Electrical components, internals etc. of Deaerator package shall be packed in seaworthy packing for transportation to site.

- 8.8 Transportation of Storage tank and Deaerator tower/vessel of the Deaerator Package from shop to designated place at site inside the Refinery premises is in the scope of the Contractor / Vendor. Further, Contractor / Vendor to note that Equipment transportation/movement during transit & especially inside the Refinery premises may call for the use of SPMT platform vehicle, for easy maneuvering, which should be properly assessed & included by the contractor / Vendor as part of his responsibility. Thus, Contractor / Vendor to select the transportation logistics accordingly. Necessary unloading/loading into the SPMT trailer bed, if required, shall be in the scope of the Contractor / Vendor.
- 8.9 Transportation of equipment shall be governed by commercial conditions. It is the sole responsibility of contractor to adhere to the rules of all statutory authorities enforced time to time in the Transportation sector during movement at their risk & cost. However, in general, the following shall be strictly complied with.
- a) The Package / Equipment with length upto 20 meter, width upto 4.0 meter, height upto 4.0 meter and weight upto 32 MT can be transported on Mechanical Trailers. However, additional support is to be given for the length to avoid overhanging.
 - b) The Equipment / Package where any of the dimension (Length, Width, Height or Weight) exceeds the limits indicated in Point no. a) above, shall compulsorily be transported by Hydraulic Axles in compliance to all statutory norms of the authorities concerned.
 - c) For the movement of Hydraulic axles, the GPS tracking system shall be installed on the prime movers(s) of the vehicle(s). The operational password for the GPS tracking system shall be provided to EIL/ Owner, to enable all concerned to monitor movement enroute.
- 8.10 Over Dimension (OD)/ Overweight Consignment (OWC) shall be transported to site following all the guidelines/requirements listed in Ministry of Road Transport & Highways. MORTH approval shall be taken before commencement of transportation by Road & copy of same shall be submitted to EIL. Movement should not commence without MORTH approval.
- 8.11 The maximum transportable dimensions / weight in a single package from the port / indigenous suppliers' works to site by road /multimodal shall be accessed in the beginning of the project activities by conducting feasibility study by the Contractor. Based on the study, Contractor shall finalize the transportation philosophy of all Equipment from Vendor works to site. The same shall be submitted to OWNER/EIL for review/information.

9.0 GUARANTEE

- 9.1 Contractor shall have final & total responsibility for the design & supply of all equipment supplied under this specification. Contractor shall repair/replace the damaged part during guarantee period at his own cost. The Contractor shall be completely responsible for the compliance to Datasheet, specifications requirement, Code requirements, Mechanical design, detailing, fabrication, materials and workmanship of the Equipment as per the stipulations of the tender and its attachments. In this regard, it may be noted that review by Owner / EIL shall not relieve the Contractor of his responsibility of meeting all requirements and ensuring satisfactory guarantee of the equipment.
- 9.2 Contractor shall agree to repair/replace any part of equipment/components free of cost and with no loss of time if:

- (i) Equipment designed by vendor does not meet process/ performance requirements during performance test.
 - (ii) Selected metallurgy wherever in vendor scope is not suitable for intended service.
 - (iii) There is defect in material or workmanship and/or it does not comply with this specification's requirements.
 - (iv) It does not comply with various requirements of the bid document agreed to by vendor at the time of order.
- 9.3 Owner / EIL or his authorized representative's inspection or approval of vendor's drawings / documents or deviations shall in no way absolve the vendor or reduce his responsibility towards this guarantee.
- 9.4 The guarantee period and financial liabilities of the contractor shall be as per Owner's commercial terms and conditions.

10.0 VENDOR LIST

Sr. No.	SUPPLIER NAME	Remarks
Item Code: 12LQ Description: DEAERATOR		
Approved Suppliers		
1.	VIJAY TANKS & VESSELS PVT LTD., VADODRA	Collaborator / Design back up agency: M/s Termochimica Impianti, SRL, Italy.
2.	TECHNO PROCESS EQUIPMENTS (INDIA) PV. LTD, AHMEDABAD	Collaborator / Design back up agency: M/s Kansas City Deaerator, USA
3.	GRAND PRIX ENGINEERING PVT LTD., FARIDABAD	Collaborator / Design back up agency: M/s Termochimica Impianti, SRL, Italy.



MANDATORY SPARES FOR DEAERATOR PACKAGE (Mass Transfer Mechanical & System)

FOR

STEAM GENERATION PACKAGE (TENDER No. B957-420-80-44-PG-T-7410)

PROJECT : BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT, (BPREP)

UNIT NO. : 420

OWNER : M/s BHARAT PETROLEUM CORPORATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

JOB NO. : B957

0	17.01.2025	ISSUED WITH TENDER	VM	VKY	PG
Rev. No.	Date	Purpose	Prepared By	Checked By	Approved By

1. DEAERATOR / STORAGE TANK

This section defines the Philosophy for mandatory spares to be supplied by the Contractor as part of the contract for Deaerator Package.

Sl. No	Part Description	Quantity Required
1	Bolting for each pair of mating flanges, interconnecting nozzles, nozzle with blind flanges & Manhole etc.	20 % of studs and nuts (Min. 4 nos. of studs & 8 no. of nuts).
2	Gaskets (other than those used for testing and / or during transportation)	400 % (of each type & size)
3	Bolting for Internals	10 % bolt/ nuts and clamp assemblies (Min. 10 nos of each size).
4	Gasket or Tapes for internals & internal flanges.	100 % (each type & size).
5.	Random packing (if applicable)	10%
6.	Spray Nozzles	25 % (Min 5 Nos. of each type & size)

GENERAL NOTES:

- Wherever % age is identified, contractor shall supply next rounded figure.
- All spares supplied by contractor shall be properly wrapped and packed so that spares will be preserved in as new condition under the normal condition of storage envisaged and shall be properly tagged & coded so that at a later stage the same can be identified. Packing list shall be furnished so that parts can be identified without uncrating.
- The mandatory spares shall be supplied to Owner. These spares shall not be used during construction, erection or commissioning.
- The above list excludes spares for Thermal Process, Refractory, Instrumentation, Electrical, Piping & other discipline etc. Bidder to refer the specification of other departments / discipline attached elsewhere in the Tender for the supply of spares.
- Post award, vendor shall provide price break up of each type of mandatory spares after code-1 approval of the mandatory spares list and quantity. These values will be required by Owner for entry into their SAP system.



SCOPE OF WORK/SUPPLY FOR DEAERATOR PACKAGE (Mass Transfer Mechanical & System)

FOR

STEAM GENERATION PACKAGE (TENDER No. B957-420-80-44-PG-T-7410)

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1.0 GENERAL

The Scope under this contract shall include Complete Design & Detail Engineering, Sizing (wherever applicable), Procurement, Fabrication, Assembly, Testing, Inspection, Painting, Insulation, Packing & forwarding, Supply including supply of all Spares, Transportation, Receiving at site, Site handling, Site storage & preservation, Site local transportation, Site assembly, Erection & alignment, Installation /Interface hook ups, Insulation & final painting, Trial run, Pre commissioning, Commissioning and Performance guarantee including PGTR at site, Hazop study, 3-D modelling etc. w.r.t Deaerator Package in accordance with the Process Data sheets, P&IDs, Job Specifications, Engineering Design basis, this Specification, other enclosed Specifications /Standards/Drawings, applicable codes and instructions of Engineer-in-charge.

The Deaerator Package shall be required for Steam Generation Package of BPCL, Bina for Bina Petrochemical & Refinery Expansion Project.

It is not the intent to completely specify all the details of design and construction. Nevertheless, the Equipment shall conform in all respects to high standards of Engineering, Design and Workmanship. Any Equipment/ Item not specifically mentioned in this specification, but required to make the Deaerator package complete, safe, operable and consistent with good engineering practices shall be provided by the Contractor at no extra cost and shall be deemed to have been included in scope of supply.

This scope of work / supply document shall be read in conjunction with other interface departments (Thermal/Hydraulic, Structure, Civil, Piping, Instrumentation, Electrical etc.) scope of work / supply attached elsewhere in tender.

2.0 SCOPE OF WORK

Scope of work (as required for the completeness of the job) shall include, but not be limited to the following:

- Process, thermal & hydraulic design, wherever required, including sizing of the Equipment.
- Preparation of Datasheet
- Preparation of Instruments, Valves and other bought-out items datasheet
- Complete Mechanical and Structural design (including stress analysis, FEA etc. as required).
- Complete Mechanical Design of all Internals, as applicable.
- Detail engineering of the Equipment including all internals, mountings, accessories & bought-out items.
- Preparation / Submission of System GAD, Equipment GAD and all other engineering drawings and Vendor documents for review of Owner/EIL/Licensor and obtaining approval for the same including statutory approval (wherever required).
- Procurement of all materials including all Internals/accessories/attachments etc.
- Trial assembly of all Internals at shop.

- Fabrication, Assembly, Inspection, PWHT, Testing (including NDT, Hydrotest, Pneumatic test, vacuum test, etc.), Painting, packing (seaworthy when imported), forwarding, transportation to site etc.
- Stage wise and final inspection.
- Storage, handling and preservation at site.
- Obtaining statutory approvals.
- Site erection.
- Fitting of Internal and External attachments/accessories.
- Fabrication and Installation of all accessories such as ladders, platforms, tailing lugs with stiffening arrangement, lifting lugs as required for Deaerator.
- Surface preparation, Primer and final painting, Insulation.
- Trial runs.
- Field testing including Performance and Guarantee run tests, vibration tests, noise level tests etc.
- Pre-commissioning and commissioning.
- Performance Guarantee as applicable.
- Documentation as per Vendor data requirements.
- Any other requirement for safe & smooth operation.

3.0 INSTRUCTIONS TO CONTRACTOR:

- i) Contractor/ Vendor shall develop the Feed to AFC (Approved for Construction) status, taking into account the requirements of Design Basis, Specifications, Standards, Codes etc.
- ii) All drawings including sub-vendor's drawings shall be thoroughly checked & stamped by Contractor prior to submitted to Owner/EIL/Licenser.
- iii) Contractor/Vendor shall strictly comply with the Design requirements stipulated in the Package.
- iv) After award of contract, Contractor shall arrange a kick off meeting with the following agenda:
 - a) Review & finalization of Document Control Index.
 - b) Any clarification on the data sheets & specifications enclosed in tender document.
 - c) Identification of critical documents which need to be reviewed on priority as per VDR.

- v) Documents submitted for review and information shall be strictly as per Vendor data requirements enclosed elsewhere in tender document. All comments received from Owner/Consultant/Licensors shall be complied with by the Contractor (within two weeks / as agreed during finalization of DCI) without any cost & time implication.
- vi) Design calculations for internal and external pressure, wind and seismic loads in all combinations, Special loading combination provided by Licensor, stress analysis, local load analysis etc. shall be furnished by Contractor for EIL/Owner review as per VDR.
- vii) Design calculations shall be submitted by Contractor to EIL as per VDR. However, it is EIL's prerogative to select any item for review and in case any major problems are observed with these calculations, all other calculations and fabrication drawings will be returned without any further review. After incorporation of comments, Contractor shall submit the entire lot again and EIL at its own discretion will review any of items again and balance will be retained for information.
- viii) Purchase Requisitions for Deaerator Package covering requirements for design, forming, welding, heat treatment, preservation during storage period, including all specifications relevant to the package shall be submitted.
- ix) The Contractor shall, during Detail Engineering, fully define all Equipment/Items required to meet the performance requirements for the above package.
- x) It shall be the sole responsibility of Contractor to co-ordinate with other disciplines like piping, structure, Instrumentation for compatibility of the Deaerator Package with respect to piping loads on nozzles, nozzle orientation, foundation loads, anchor bolts location/size of instrument nozzles etc.
- xi) Contractor to ensure all Inspection and tests are conducted for all equipment at Vendor's shops /site as specified in tender Document, Engineering Design Basis, Specifications, Codes and Standards.
- xii) Contractor shall mark actual erection weight on name plate & center of gravity on equipment (C.G.) for erection purpose.
- xiii) It shall be stencilled that "Equipment is stress-relieved and no welding shall be permitted after PWHT" on all stress relieved Equipment at the time of dispatch.
- xiv) Internals shall be erected at Vendor's shop to the extent possible. Else, erection of internals at site shall be carried out by the Contractor under the supervision of the internal supplier.

4.0 SCOPE OF SUPPLY

Contractor's scope of supply shall include, but shall not be limited to, the following: -

- Deaerator vessel along with Storage Tank.
- Complete internals like strainer, vortex breaker, distributor, all Tower Trays, feed pipes, including supports, Companion Flanges including bolting and spares etc. as required.
- Mandatory spares.
- Erection and commissioning spares.

- Insulating material, primer & paints, wherever required.
- Arranging of all equipment tools & tackles including all materials required for inspection, testing (i.e. NDT, hydro testing, performance testing etc.) & erection.
- Arranging of all tools & tackles and cranes for the erection of all equipment.
- Preparation and providing of check lists for all types of equipment to ensure their correct installation, alignment, assembly, leveling, grouting and completion.
- All other materials whether specifically mentioned or not but required for completion of the job in all respect as per tender document.

Notes:

- a) Contractor shall ensure that Mandatory Spares for all equipment as specified in the Tender Document are procured and handed over to the Owner together with the main equipment prior to Commissioning.
- b) Contractor shall ensure that Commissioning spares for all equipment are procured in time and are available before commissioning of the Plant / Equipment.
- c) Contractor shall ensure that special tools and tackles for all equipment as required for equipment assembly / maintenance are handed over to the owner with the main equipment.
- d) Contractor shall ensure that Proprietary Equipment shall be procured strictly from the manufacturer / supplier mentioned in the Process Package and no equivalent alternate design from other manufacturer / supplier shall be considered.
- e) Contractor shall ensure that all other Equipment are procured from approved vendors listed elsewhere in the package.

5.0 EQUIPMENT ERECTION/ INSTALLATION BY CONTRACTOR

- Contractor shall be responsible for personnel and for their safety.
- Contractor shall ensure all permits including Hot Work Permits where required are in place prior to commencement of applicable work. This includes contractor's permits as applicable and OWNER permits.
- Contractor shall be responsible for the transportation of all equipment to the erection location. Equipment which are transported by sea shall have sea-worthy packing. Recommended preservation procedures shall be strictly followed by the Contractor during the period of storage for all equipment.
- Arranging cranes for the erection of complete system.
- Contractor shall be responsible throughout the duration of the CONTRACT for any loss or damage to equipment. Any such loss or damage shall be brought to the immediate attention of OWNER/EIL and arrangements made for repair or replacement of item.
- Contractor shall at all times perform his work in a completely safe manner in strict accordance with both industry and WORKSITE safety practices.

- No nozzles or other vital attachments on the equipment being lifted shall be used as supporting or lifting points other than those which have been specifically designed and designated for the purpose.
- Contractor shall be responsible for the maintenance and protection of all equipment for the duration of the work, in accordance with vendor Preservation Check List.
- Contractor shall be responsible for completing all work in accordance with the work time schedule.
- Contractor shall provide specifications for the erection/installation of all equipment which include special requirements as advised by Vendors and shall fully detail all the requirements for the accurate, safe and technically correct erection/installation of the equipment;
- Contractor shall comply with the requirements of Mechanical Completion as described in the tender document.



LIST OF STANDARDS & SPECIFICATIONS FOR DEAERATOR PACKAGE

(Mass Transfer Mechanical & System)

FOR

STEAM GENERATION PACKAGE

(TENDER No. B957-420-80-44-PG-T-7410)

PROJECT : BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT, (BPREP)

UNIT NO. : 420

OWNER : M/s BHARAT PETROLEUM CORPORATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

JOB NO. : B957

0	17.01.2025	ISSUED WITH TENDER	VM	VKY	PG
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1.0 SPECIFICATIONS

S. No.	Description	Specification No.	Revision No.
1.	General specification for pressure vessels.	6-12-0001	7
2.	Supplementary specification for carbon steel vessels.	6-12-0002	9
3.	Standard specification for boiler quality carbon steel plates.	6-12-0011	9
4.	Standard specification for pressure vessels for package items.	6-12-0030	9
5.	Standard specification for Un-engineered Deaerator	6-14-0019	2
6.	Specification for quality management system requirements from bidders	6-78-0001	2
7.	Specification for documentation requirements from contractor	6-78-0002	2

2.0 STANDARDS

S.No	Description	Standard No.	Revision No.
1.	Vessel Tolerances	7-12-0001	7
2.	Support for horizontal vessel	7-12-0002	7
3.	Wooden pillows for saddle support.	7-12-0003	7
4.	Manhole with davit	7-12-0010	8
5.	Ladder rungs for manhole/demister	7-12-0011	7
6.	Nozzle reinforcement and projection	7-12-0013	7
7.	Pad nozzles for vessels	7-12-0014	7
8.	Standard bolt hole orientation	7-12-0015	7
9.	Internal flanges	7-12-0018	7
10.	Vortex breakers	7-12-0019	7
11.	Inlet deflector baffle	7-12-0020	7
12.	Lifting lug	7-12-0024	9

S.No	Description	Standard No.	Revision No.
13.	Earthing lug	7-12-0026	7
14.	Name plate	7-12-0027	7
15.	Manufacturer name plate	7-12-0028	7
16.	Bracket for name plate	7-12-0029	7
17.	Supports for internal feed pipe	7-12-0032	6
18.	Hot insulation supports for horizontal vessel.	7-12-0033	6
19.	Allowable nozzle loads	7-12-0038	2

3. INSPECTION & TEST PLAN (ITP)

S. No.	Description	Specification No.	Revision No.
1.	PMI at Supplier Works	6-81-0001	4
2.	ITP for Pressure Vessel / Column- CS	6-81-0011	4
3.	ITP for Stainless Steel Pressure vessel / Columns	6-81-0014	4
4.	ITP for Spray Nozzles	6-81-0113	5



इंजीनियर्स
इंडिया लिमिटेड
(भारत सरकार का उपक्रम)

ENGINEERS
INDIA LIMITED
(A Govt. of India Undertaking)

TECHNICAL CONFIRMATION LIST
FOR DEAERATOR PACKAGE
(MTMS)

Document No.
B957-420-80-46-TCL-7410

Rev. 0

Page 1 of 3

TECHNICAL CONFIRMATION LIST FOR DEAERATOR PACKAGE

(Mass Transfer Mechanical & System)

FOR

STEAM GENERATION PACKAGE

(TENDER No. B957-420-80-44-PG-T-7410)

PROJECT : BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT, (BPREP)

UNIT NO. : 420

OWNER : M/s BHARAT PETROLEUM CORPORATION LIMITED

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Sl. No.	Description	BIDDER'S ANSWER (Confirmed / Not Confirmed)
1.0	<u>Deaerator Package</u>	
a)	Confirm that offer is in line with the requirements as mentioned in Job specification, Scope of work/ supply and applicable documents enclosed along with Tender. Confirm compliance.	
b)	Contractor to Confirm that type of Deaerator shall be of 'Spray Cum Tray Type' only with separate storage vessel and Deaerator vessel.	
c)	Contractor to confirm that the Performance Guarantees requirements and Performance Guarantee Test Run requirements shall be complied with.	
d)	Contractor / Deaerator Package Vendor to confirm that Performance guarantees for the Deaerator are in line with Licensor's PDS.	
e)	Contractor to confirm that Deaerator package shall be sourced from Vendors listed in clause 10.0 of Job specification (Doc. No. B957-420-80-46-SP-7410).	
f)	Contractor/ Package vendor to Confirm that all items of package shall be procured from EIL approved suppliers only.	

Bidder's Seal with date

Signature of Authorised Representative



इंजीनियर्स
इंडिया लिमिटेड
(भारत सरकार का उपक्रम)



ENGINEERS
INDIA LIMITED
(A Govt. of India Undertaking)

TECHNICAL CONFIRMATION LIST
FOR DEAERATOR PACKAGE
(MTMS)

Document No.
B957-420-80-46-TCL-7410
Rev. 0
Page 3 of 3

TECHNICAL COMPLIANCE STATEMENT

(TO BE SIGNED BY BIDDER'S PRINCIPAL CORPORATE LEVEL SIGNATORY ON COMPANY LETTERHEAD)

I, ON BEHALF OF M/s _____ CONFIRM THAT THE PROPOSAL
FOR **DEAERATOR PACKAGE** QUOTED BY M/s _____
**FOR STEAM GENERATION PACKAGE OF BINA PETROCHEMICAL AND REFINERY EXPANSION
PROJECT OF M/S BHARAT PETROLEUM CORPORATION LTD. AGAINST TENDER No. B957-420-80-
44-PG-T-7410** IS IN TOTAL COMPLIANCE TO THE FOLLOWING:

- A. SCOPE OF SUPPLY AND WORK
- B. JOB SPECIFICATIONS
- C. BATTERY LIMIT/INTERFACE REQUIREMENTS
- D. TECHNICAL AMENDMENT IF APPLICABLE
- E. ANY OTHER DOCUMENT ATTACHED AS PART OF TENDER

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

(SIGNATURE WITH SEAL)

VENDOR DATA REQUIREMENTS FOR DEAERATOR PACKAGE

0	21-JAN-2025	ISSUED WITH TENDER	VM	VKY	PG
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

VENDOR DATA REQUIREMENTS

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

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Technical Confirmation List & Compliance Statement duly filled in signed & stamped. (Doc. No. B957-420-80-46-TCL-7410).	✓				
2.	Purchase specification (PS/PR) for Deaerator package.		✓			
3.	Process datasheet for Deaerator and Instruments.			✓	✓	
4.	Deaerator Vessel sizing and Process /Hydraulic design calculations.			✓	✓	
5.	Heat and mass balance calculations for the deaerator at start up, normal and maximum loads.			✓		
6.	PFD and P&ID			✓		
7.	Overall GAD (PLAN and ELEVATION) showing all the equipment, piping, Instruments etc.			✓	✓	
8.	Design Load data, base plate with details of bolt, and design forces at support level alongwith calculation			✓	✓	
9.	Equipment GADs (Deaerator and Storage Vessel) alongwith all details of Internals of deaerator.		✓		✓	
10.	As built drawing of all equipment's / components of complete deaerator package.			✓	✓	
11.	Mechanical design calculations & FEA (if applicable)			✓		
12.	Consolidated list of Mandatory spares		✓		✓	
13.	List of erection / commissioning spares including special tools and tackles as per vendor's recommendation			✓	✓	
14.	Site Installation Procedure, instructions, guidelines & check lists for complete deaerator system.			✓	✓	
15.	Guaranteed parameters are to be demonstrated during PGTR.			✓	✓	
16.	Preservation procedure			✓		
17.	Installation, operation and maintenance manual for complete package.			✓	✓	
18.	Material Test Certificates		✓		✓	@
19.	Welding Procedure and Qualification Records			✓	✓	@
20.	Hydrotest record and name plate rubbing		✓		✓	@
21.	Quality assurance Plan		✓		✓	@

**VENDOR DATA REQUIREMENTS
FOR
DEAERATOR PACKAGE**

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
22.	Inspection Records/Data			✓	✓	@
23.	Heat treatment charts, stress relieving charts etc.			✓	✓	@

Notes :

1. "TICK" denotes applicability.
2. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
3. All post order documents shall be submitted / approved through EIL eDMS portal.
4. Final documentation shall be submitted in hard copy (Six prints) and soft (two pendrives) in addition to submission through EIL eDMS.
5. Refer - 6-78-0001: Specification for quality management system from Bidders.
6. Refer - 6-78-0002: Specification for documentation requirements from Contractors.
7. All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
8. Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
9. "@" indicates submission of documents to Inspection Agency.
10. Bill of Material shall form part of the respective drawing.



इंजीनियर्स
इंडिया लिमिटेड
(भारत पेट्रोलेम कॉ. लिमिटेड)

ENGINEERS
INDIA LIMITED
(A Govt. of India Undertaking)

JOB SPECIFICATION
FOR
INSULATION SYSTEM OF VHP LINE

DOCUMENT No.
B957-420-06-43-IL01
Rev-A

Page 1 of 10

JOB SPECIFICATION FOR INSULATION SYSTEM OF VHP LINE STEAM GENERATION PACKAGE

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BREP)

UNIT : STEAM GENERATION PACKAGE (420)

CLIENT : BHARAT PETROLEUM CORPORATION LIMITED

PMC : ENGINEERS INDIA LIMITED

JOB NO. : B957

A	04.02.2025	ISSUED FOR TENDER	VT	PP	PS
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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1.0 INTRODUCTION

Bharat Petroleum Corporation Limited (BPCL), Bina Refinery (BR) has embarked on Petrochemical Diversification Plan and as a part of further expansion of Petrochemical portfolio, it is intended to set up world scale Ethylene Cracker & Associated Units and Ethylene and Propylene based Petrochemical units for its diversification to Petrochemicals along with expansion of its refinery capacity to about 11 MMTPA. To cater to the requirement of steam in this project, a new Steam generating unit is planned. Utility Boiler shall be a part of this unit. EIL is providing EPCM services for this project.

1.1 Scope

Intent of this specification is to outline the minimum technical requirements for insulation of 24" VHP ISBL line after MSSV to B/L of steam generation package. Based on standards and specifications, appended in the tender, the contractor shall select appropriate insulation materials, develop insulation drawings, application procedures, quality control procedures, supply and install insulation meeting specified technical requirements

Aspects for HSE for execution of the job shall be separately addressed by the contractor meeting requirements of health, safety and environment practices of BPCL.

1.2 Project specific documents / standards

Following documents are referred while preparing this specification.

B957-420-80-44-DB-3201 : Design Basis/ Philosophy Steam Generation Package, Bina Petchem and Refinery Expansion Project.

1.3 Reference Codes and Standards

Following standards shall form part of this specification.

ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C165	Measuring Compressive Properties of Thermal Insulations
ASTM C177	Standard Test Method for steady-state heat flux measurement and thermal transmission properties by means of the guarded-hot plate apparatus
ASTM C203	Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
ASTM C302	Test Method for Dimensions and Density of Preformed Pipe-Covering-Type Thermal Insulation
ASTM C303	Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation
ASTM C356	Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat
ASTM C421	Standard Test Method for Tumbling Friability of Preformed Block-Type and Preformed Pipe-Covering-Type Thermal Insulation
ASTM C446	Standard Test Method for Breaking Load and Calculated Modulus of Rupture of Preformed Insulation for Pipes
ASTM C474	Standard Test Methods for Joint Treatment Materials for Gypsum Board Construction
ASTM C533	Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C591	Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

ASTM C871	Standard test method for chemical analysis of thermal insulation materials for leachable chlorides, fluorides, silicate and sodium ions.
ASTM C1616	Standard Test Method for Determining the Moisture Content of Organic and Inorganic Insulation Materials by Weight
ASTM C1729	Standard Specification for Aluminum Jacketing for Insulation
ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
ASTM D903	Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
ASTM D1000	Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
ASTM D1475	Standard Test Method for Density of Liquid Coatings, Inks, and Related Products
ASTM D1621	Standard Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM D1644	Standard Test Methods for Nonvolatile Content of Varnishes
ASTM D2240	Standard Test Method for Rubber Property—Durometer Hardness
ASTM D3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D6226	Standard Test Method for Open Cell Content of Rigid Cellular Plastics
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Material
ASTM E96	Standard Test Methods for Water Vapor Transmission of Materials
ASTM F1249	Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
SSPC-SP-6	Steel Structure Painting Council Standard for surface preparation
IS 5688	Methods of test for preformed block-type and pipe covering type thermal insulation
IS 9428	Preformed Calcium Silicate Insulation (for temperature up to 950°C

1.4 Specific abbreviations

Term	Definition
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
SSPC	Society for Protective Coatings
IS	Indian Standard
MOC	Material of Construction
VHP	Very High Pressure
MSSV	Main Steam Stop Valve
PIR	Rigid Polyisocyanurate
CNC	Computer Numerical Control
HCFC	Hydrochlorofluorocarbons
PET	Polyethylene Terephthalate
VOC	Volatile organic content
ITP	Inspection & Test Plan
QAP	Quality Assurance Plan
BPCL	Bharat Petroleum Corporation Limited
MSDS	Material Safety Data Sheet
EIL	Engineers India Limited
PMC	Project Management Consultant
HSE	Health and Safety Executive

2.0 CONFLICTS & DIFFERENCES

- 2.1 In case of difference arises between Project Specifications and Codes & Standards, the following order of precedence shall be considered:
- EIL Job specification for refractory lining of Steam Generation Package (B957-420-06-43-IL01)
 - Applicable International Codes and Standards
 - Proven references of design of Utility boilers in similar service
 - Approved drawings, documents prepared by contractor
 - BPCL HSE Management Systems and Standards, BPCL Codes and Standards
 - International Oil & Gas Industry Codes, Standards, and Recommended practices (all where specified in above or, where none of the above is applicable, as proposed by Contractor and approved by Company).
- 2.2 In the event of an inconsistency, conflict, or discrepancy between any of the standards, specifications and regulatory requirements noted herein, the most stringent and safest requirement applicable to the project will prevail. Contractor shall be responsible to provide its own interpretation of the most stringent requirement; in writing; for EIL/BPCL review and approval before proceeding with procurement / application of insulation. Any technical deviation shall be sought by the contractor only through the concession request format, however, EIL/BPCL decision shall be final.
- 2.3 Documentation dates
- Requirements of certificates / test reports, if any that specifies a time period in this specification, bid due date shall be referred for determining the validity of such certificate / test report.

3.0 INSULATION DESIGN

VHP line insulation system shall consist of multilayer insulation of calcium silicate and PIR applied with joint sealants, protected from moisture/ water vapor ingress by multiplex foil / Butyl wrap and covered with metal cladding.

3.1. Components of insulation systems

VHP line insulation system shall consist of:

- Inner layer- Prefabricated calcium silicate
- Outer layer- Preformed PIR
- Multiplex foil- Intermediate and outer layer of Calcium silicate insulation
- Butyl wrap- Between PIR insulation and metallic cladding
- Joint sealant for PIR
- Joint sealant for metal cladding

3.2. Insulation thickness

Total insulation thickness: 365 mm

Inner layer: 290 mm Calcium silicate

Outer layer: 75 mm PIR

3.3. Extent of insulation

- Instrument lead lines, branch lines, instrument connections etc. shall be insulated up to a length of at least four (4) times the insulation thickness or 300mm whichever is greater. Insulation system same as the main piping shall be applied to the extensions.
- Valves and fittings shall be insulated with appropriate insulation compatible and equivalent to the insulation as that of adjoining piping.

- c) All flanged joints shall be insulated with removable box insulation compatible and equivalent to the insulation as that of adjoining piping.
- d) Items like bonnet of valves above the packing glands, display like nameplates, stampings, inspection code etc. shall be specially designed and insulated so that the display is not covered by insulation.

3.4. Painting under insulation

Pipeline shall be protected from corrosion by providing appropriate painting under insulation mentioned in elsewhere in the tender.

4.0 MATERIALS & ACCESSORIES

All materials used for insulation shall be freshly procured. Material shall be supplied, dry, shall be non-sulfurous, rot proof, vermin proof, non-injurious to health and non-corrosive to steel, shall not disintegrate, settle, change its form of composition, in a detrimental way during service. Typical details/ minimum technical requirement of the major insulation materials and accessories are given in this specification.

4.1. Calcium Silicate

Calcium silicate pipe sections shall be supplied in the form of either in the form of molded pipe sections or block cut into required shape/ pipe sections using a CNC machine, shall conform to general classification of IS 9428 (950 grade) or ASTM equivalent C533 TYPE II, shall be suitable for continuous service up to 927°C. Material shall conform to the general classifications of respective ASTM / IS code and meet the following minimum properties

Properties		Values	Remarks
Density (kg/m ³) as per ASTM C302/303 / IS 5688		240-350	Batch test (Note-1)
Linear shrinkage at 927 ^o C for 24hrs, (%) max, IS 5688 / ASTM C-356		2	
Moisture content, weight %, max., ASTM C1616		20	
Water absorption, volume (%) as per ASTM C533, max.		3	
Compressive strength (of dry sample) at 5% deformation, kPa	ASTM C165 OR	688	
	IS 5688	415	
Heat resistance after exposure to 927 ^o C for 24hrs, as per IS 5688	(%) loss in weight, max	15	
	Compressive strength at 10% deformation, kPa, max	345	
Flexural strength min. (kPa) as per ASTM C203/C446		344	
Mass loss by tumbling, max, % after first 10 minutes, ASTM C421		20	
Leachable Chloride as per ASTM C871, ppm, max		50	
Alkalinity, pH as per ASTM C-871		6-10.5	
Thermal conductivity (W/mK) max. at mean temperature as per IS 9490 / ASTM C-177 (Note-1,2)	(+) 204 ^o C	0.088	Type test (Note-2)
	(+) 316 ^o C	0.097	
	(+) 427 ^o C	0.105	
	(+) 538 ^o C	0.111	
Note-1: The type test certificate shall not be older than 2 years			
Note-2: For thermal conductivity determination for pipe / curved segment, a representative flat slab may be used for performing the tests.			

4.2. PIR

PIR rigid foam shall be performed into free rise buns made from HCFC free chemicals and then cut into required shape/ pipe sections using a CNC machine. Material shall be chemically inert, moisture free, rot and vermin proof not disintegrate, settle, change its form

or composition in a detrimental way while in service. PIR rigid foam shall conform to general classification of ASTM C591 Grade-2 Type-II and meet the following specification:

Characteristics		Value	Remarks
Bulk density (kg/m ³), ASTM-C302/ ASTM -D1622		40	Batch test (Note-1)
Closed Cell content (%), ASTM D-6226 Procedure-2		95	
Chloride content (ppm) ASTM C 871, Procedure 2, max		60	
pH (ASTM C 871)		6-7	
Water vapour transmission (ng/Pa-s-m), ASTM E-96 method-A at 23°C & 50% RH, max.		5.1	
Compressive strength at 10% deformation (kPa), ASTM D 1621, min.		240	Type test (Note-2)
Flame spread Index (ASTM E84), max.		25	
Thermal conductivity of 180 days aged sample at mean temp (W/mK) ASTM C-177, max.	(+) 10 deg C	0.026	
	(-) 20 deg C	0.027	

Note-1: Supplier shall provide test certificate for each production batch

Note-2: The type test certificate shall not be older than 2 years

4.3. Multiplex Foil

Multiplex laminated foil (~50-micron thickness) consisting of one aluminium foil (25μ) sandwiched between two 12μ polyester films). Materials shall have following characteristics:

Characteristics	Values
Service temperature range (°C)	-60 to 120
Volumetric mass (kg/dm ³)	1.93
Tensile Strength, MPa	100
Yield Strength, N/cm	70
Tear resistance, g/mm	400
Water Vapour Permeability, ASTM E96 Procedure E (Metric perms)	0.0007

4.4. Sealing tape for multiplex foil

Sealing tape shall be a three-layer laminated foil (~50-micron thickness) made of aluminium & polyester (25μ aluminum foil sandwiched between two 12μ polyester films. Material shall have following properties.

Characteristics	Values
Total thickness exclusive of adhesive layer	50 μm
Temperature range	+120°C to -45°C
Volumetric mass	1.93 kg / dm ³
Water vapour permeability in acc. with ASTM E 96, procedure E (37.8°C, 90% R.H.)	Max. 10.10-6 g / (m ² .h.mmHg)

4.5. Polymeric membrane barrier

The polymeric membrane is a self-adhesive heavy-duty laminate and is comprised of elastomeric modified butyl rubber (1.2mm) with PET (12μm) /AL (25μm) /PET (12μm) foil backing. The membrane shall be able to produce a vapor tight, weather resistant cover over the insulation. The material shall be supplied in the form of rolls with thickness 1.2-1.3mm. The material shall meet the following properties as minimum.

Characteristics	Values
Service temperature range (°C)	-60 to 120
Tensile strength (N/cm), Min., ASTM D1000	55
Elongation at break (%), ASTM D412	40

Puncture resistance (N), Min. ASTM E154		350
Peeling Strength, N/cm, min, ASTM D903		20
Surface Burning Characteristic, ASTM E84	Flame Spread Index	15
	Smoke Developed	25
Water Vapour Permeability, ASTM E96 Procedure E (Metric perms)		0.00

4.6. Joints Sealant for PIR Insulation

The joint sealant for joints between insulation blocks shall be compatible with the base insulation material and suitable for the temperature range to which it is exposed. Typical material and technical requirement for PIR insulation system is specified below. Proposed materials shall be technically equivalent and shall have proven reference for use in a temperature range and shall meet the minimum technical requirement given below

General Characteristics	Combustibility/ fire resistance	Water vapour permeance (max)
Average 82% volume solid as per ASTM D2369	Flame spread and fuel contribution negligible when used as 3.2 mm wide sealant between joints of incombustible insulation blocks	Negligible when measured across 3.2 mm wide sealant between joints of impermeable insulation blocks

4.7. Adhesive for Calcium silicate Insulation

Sodium silicate-based adhesive is a high-temperature resistance adhesive forms bonds by evaporation of water, which is used to bond calcium silicate. The total soluble silicate (% wt.) in adhesive shall be minimum 38 and matter insoluble in water shall be maximum 0.2 wt%. The sodium silicate-based adhesive in a dry state is soluble in water and therefore should be suitably protected if used in an application where moisture can be encountered.

Characteristics		Values
Service temperature range (°C)		10 to 538
Density (kg/l), ASTM D1475		1.44-1.68
Non-volatile content (wt. %), ASTM D1644		54-70
Volatile organic content (VOC), (g/l) ASTM D3960		0
Hardness (Shore-C), Min. ASTM D2240		65
Resistance to Cracking, ASTM C474		No cracking
Leachable chloride (ppm), ASTM C871		<60
pH, ASTM C871		11-12
Surface Burning Characteristic, ASTM E84	Flame Spread Index	0
	Smoke Developed	0

4.8. Joint sealant for joints of metal cladding

The technical requirement and typical material for joint sealant of metal cladding is specified below. Proposed materials shall be technically equivalent and shall have proven reference for use in a temperature range and shall meet the minimum technical requirement given below

General Characteristics	Combustibility/ fire resistance	Water vapour permeance (max)
Average 52% volume solid as per ASTM C461	FSI (flame spread index) ≤ 20 as per ASTM E-84, tested on a 6.3mm inorganic reinforced cement board with DFT ~2mm	0.0092 metric perms (as per ASTM F-1249 with DFT 2.8mm)

4.9. Outer Cladding

Unless otherwise mentioned, aluminium jacketing shall be used as weather protection cladding up to temperature 550 deg C. Aluminium cladding shall be as per ASTM C1729, Class-A having polysurlyn lamination on inside surface and shall meet the requirements of ASTM B209 alloy 3003 H14.

4.10. Banding

Band to secure last layer of PIR insulation materials shall be stainless steel to ASTM A-167 304. For aluminium cladding, aluminium band (Aluminium 99.5, temper H14) in accordance with ASTM B-209M shall be used. The band shall be 20 mm width x 24 SWG.

5.0 APPLICATION

5.1 General

The insulation system needs to be installed in dry condition. The contractor shall be responsible for developing a detailed application procedure specific to the lining system and materials concerning for different area. Minimum technical requirements specific to some typical applications are given in this specification as a guideline and information. The detail insulation application procedure shall be approved by EIL/BPCL prior to startup of work.

5.2 Surface preparation and painting under insulation

Surface of the piping shall have suitable painting for prevention of corrosion under insulation. Quality of paint, necessary surface preparation, coating application and thickness shall be as per painting specification appended elsewhere in the tender.

5.3 Storage

- Materials shall be stored in appropriate manner meeting specific handling and storage conditions as per respective manufacturer's recommendation.
- Insulation materials must be stored under covered shed and protected against any damage, from delivery to finish cladding.
- Insulation material slabs and sections shall be stored on a flat surface in a horizontal position. Insulation material shall never be stacked directly on the ground.

5.4 Application of insulation blocks

- PIR and calcium silicate shall be installed from prefabricated pipe sections only.
- Calcium silicate pipe sections shall be installed to the pipe dry. Longitudinal and circumferential joints shall be glued with calcium silicate based adhesive.
- Subsequent layers of calcium silicate shall be placed one above another with adhesive/adhesive tape as appropriate. All longitudinal and circumferential joints are glued to adjoining sections.
- Apply multiplex foil over the after 2nd layer and final layer of calcium silicate insulation. The foil shall be cut to size correctly and shall be installed with dots of adhesive at the surface, tightly stretched and without air inclusions. The joint shall be sealed with multiplex tape of aluminum/polyester.
- Outer layer PIR (75mm) fabricated into pipe sections shall be installed dry over Calcium Silicate. Both longitudinal and circumferential joints shall be staggered, glued with PIR sealant.
- PIR insulation shall be secured with SS band (SS304)
- Apply polymeric membrane over the PIR insulation with min. 50mm overlap followed by metal cladding.
- Insulation shall terminate near flanges at a gap to allow opening/ closing of bolts. For fittings, the insulation shall be completed by applying cut segments of the same insulation sections used for pipes.

- i) Removable covers shall be provided over all flanges and valves. Loose fill mineral wool backed up by slab insulation of thickness equal to that an adjacent pipe shall be applied. Stainless steel covers over the valves and flanges shall be fitted with quick release clips.

5.5 Application of Aluminium cladding

- a) Al cladding with one side poly-surlyn laminate shall be supplied in sheets. The sheets shall be rolled to outer diameter keeping the poly-surlyn laminated face inside.
- b) The rolled sheets shall be wrapped over the outermost insulation layer after the application of polymeric membrane. The cladding shall have overlapped at least 50mm in both longitudinal and circumferential directions. Cladding shall be secured in position by means of Al- band at interval of 400mm.
- c) All longitudinal and circumferential joints of metal sheeting shall be sealed with suitable approved non-hardening elastomeric mastic sealer.
- d) The cladding shall be installed such that entrapped moisture, if any at the time of installation can be drained. At horizontal piping, in the middle between two supports, at the lowest point, drain holes shall be provided, min.1 hole / 6 m, dia. 10 mm.

5.6 Protection of partially completed job

Each day's work shall be planned properly so finish with insulation and cladding. Ongoing jobs shall be protected from rain water by tarpaulins cover.

6.0 HSE REQUIREMENT

The contractor responsible for the refractory installation shall be fully conversant and meet the HSE requirements of BPCL. The contractor shall strictly adhere to safety instructions and MSDS requirements of the insulation material/ ancillary products and application. The contractor shall provide adequate personnel protection and safety gears like hand gloves, masks, spectacles etc. as necessary for compliance to MSDS safety requirements to the workmen on the job.

7.0 DOCUMENTS REQUIRED FROM CONTRACTOR

POST ORDER STAGE THE CONTRACTOR SHALL SUBMIT

- a) Manufacturer's datasheet for the insulation and ancillaries materials.
- b) Manufacturer's compliance datasheet for insulation and ancillaries material.
- c) Quality control plan for insulation material supply and application
- d) Inspection Test plan for insulation material supply and application
- e) Test certificate of insulation & ancillary materials duly endorsed by inspection agency
- f) Insulation details drawing
- g) Method statement for insulation application procedure including HSE requirement.
- h) Proven references for supply of insulation material used under similar condition
- i) Credential of insulation designer/applicator agencies
- j) List of engineers/ supervisors along with their qualification and experiences of personnel to be deputed by the insulation applicator for insulation installation on demand.

JOB SPECIFICATION FOR REFRACTORY LINING OF STEAM GENERATION PACKAGE

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BREP)

UNIT : STEAM GENERATION PACKAGE (420)

CLIENT : BHARAT PETROLEUM CORPORATION LIMITED

PMC : ENGINEERS INDIA LIMITED

JOB NO. : B957

A	31.1.2025	ISSUED FOR TENDER	SG	PP	PS
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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1.0 INTRODUCTION

Bharat Petroleum Corporation Limited (BPCL), Bina Refinery (BR) has embarked on Petrochemical Diversification Plan and as a part of further expansion of Petrochemical portfolio, it is intended to set up world scale Ethylene Cracker & Associated Units and Ethylene and Propylene based Petrochemical units for its diversification to Petrochemicals along with expansion of its refinery capacity to about 11 MMTPA. To cater to the requirement of steam in this project, a new Steam generating unit is planned. Utility Boiler shall be a part of this unit. EIL is providing EPCM services for this project.

1.1 Scope

Intent of this specification is to outline minimum technical requirements for detail engineering of refractory lining design, preparation of drawings and documentation, supply, application, dry-out and quality control of refractory lining in Utility boiler of Steam generation Package.

Based on standards and specifications, appended in the tender, the contractor shall select appropriate refractory materials, develop refractory lining drawings, application procedures, quality control procedures, supply and install refractory lining and carry out dry out of the installed refractory meeting specified technical requirements

Aspects for HSE for execution of the job shall be separately addressed by the contractor meeting requirements of health, safety and environment practices of BPCL.

1.2 Project specific documents / standards

Following documents are referred while preparing this specification.

B957-420-80-44-DB-3201 : Design Basis/ Philosophy Steam Generation Package, Bina Petchem and Refinery Expansion Project.

1.3 Reference Codes and Standards

Unless otherwise specified, latest edition of following standards shall be used for refractory design, supply, installation and quality control.

ASTM Standards and Specifications

ASTM C401	Standard Classification of Alumina and Alumina Silicate Castables
ASTM C133	Cold Crushing Strength & Modulus of Rupture of Refractory
ASTM C134	Size & Bulk Density of Refractory Brick & Insulating Firebrick
ASTM C269	Method of Test for Permanent Linear Change on Firing of Castable
ASTM C862	Preparing Refractory Concrete Specimens by Casting
ASTM C865	Firing Refractory Concrete Specimens
6-79-0024	Standard Specification for HSE Requirement for Refractory

Other Standards and Specifications

API 936	Refractory Installation Quality Control - Inspection and Testing Monolithic Refractory Linings and Materials

1.4 Specific abbreviations

Term	Definition
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
MOC	Material of Construction

GA	General Arrangement
ITP	Inspection & Test Plan
QAP	Quality Assurance Plan
TPI	Third-Party Inspection
MR	Material Requisition
CF	Ceramic Fiber
BD	Bulk density
CCS	Cold crushing strength
PLC	Permanent linear change
BPCL	Bharat Petroleum Corporation Limited
MSDS	Material Safety Data Sheet
EIL	Engineers India Limited
PMC	Project Management Consultant
HSE	Health and Safety Executive

2.0 CONFLICTS & DIFFERENCES

- 2.1 In case of difference arises between Project Specifications and Codes & Standards, the following order of precedence shall be considered:
- a) EIL Job specification for refractory lining of Steam Generation Package (B957-420-06-43-RM01)
 - b) Applicable International Codes and Standards
 - c) Proven references of design of Utility boilers in similar service
 - d) Approved drawings, documents prepared by contractor
 - e) BPCL HSE Management Systems and Standards, BPCL Codes and Standards
 - f) International Oil & Gas Industry Codes, Standards, and Recommended practices (all where specified in above or, where none of the above is applicable, as proposed by Contractor and approved by Company).
- 2.2 In the event of an inconsistency, conflict, or discrepancy between any of the standards, specifications and regulatory requirements noted herein, the most stringent and safest requirement applicable to the project will prevail. Contractor shall be responsible to provide its own interpretation of the most stringent requirement; in writing; for EIL/BPCL review and approval before proceeding with procurement / application of insulation. Any technical deviation shall be sought by the contractor only through the concession request format, however, EIL/BPCL decision shall be final.
- 2.3 Documentation dates
- Requirements of certificates / test reports, if any that specifies a time period in this specification, bid due date shall be referred for determining the validity of such certificate / test report.

3.0 TECHNICAL REQUIREMENT

- 3.1. The contractor shall prepare GA drawing with basic refractory design information (eg.. thickness, material type, anchors etc.), refractory lining drawings, application procedure, quality control plan, Inspection test plan for refractory application and dry out schedule for proposed refractory types.
- 3.2. For shop lined items, the refractory lined sections shall be supplied in dried out condition from shop. If application to be carried out at site, dry out shall be done at ground prior to erection.
- 3.3. The Contractor shall have / outsource experienced supervisors for quality control of refractory application and dry out.

- 3.4. Contractor shall mobilize minimum test facility at site and shop and experienced operators for testing and quality control of castable applications as per API 936 requirements.
- 3.5. Method statement for refractory application shall include details of applicator pre-qualification, material re-qualification testing, storage, type of mixer, form work, panel joints, procedure for mixing & application, curing, field sampling testing and application records, formats for quality records etc. for each type of refractory like castables, bricks & ceramic modules.
- 3.6. Refractory installation requires stage inspection at various stages such as surface preparation, anchor welding, mixing, application, dry out etc. The contractor shall prepare an inspection test plan (ITP) for stage inspections/ check points for refractory application & dry out and define responsibility & authority of quality control at each step. The ITP shall be approved by BPCL/EIL.

4.0 REFRACTORY DESIGN & MATERIAL SELECTION

4.1. Utility Boiler

- a) The extent of refractory lining inside the boiler and ducting shall be considered by the boiler designer based on proven design practices, operating temperature and flue gas compositions.
- b) Refractory lining system shall be suitably selected and designed for the maximum and minimum operating temperature; acid dew point criteria specified in datasheet. In absence of specific ambient information, standard ambient temperature 42°C, still air & 0.9 surface emissivity shall be considered for the refractory design.
- c) The refractory design shall be suitable for the mechanical design conditions and such that it meets design limits for casing temperature, as applicable.
- d) Refractory lining around burner and adjacent walls are generally exposed to thermal shock, which shall be suitably designed with spalling resistant castable refractory. Andalusite based 60% alumina dense castable type-C13 as per EIL specification 6-79-0029 is recommended.
- e) Anchor shall be minimum SS 316L, selected based on tip temperature (generally 25 mm inside the hot face). For tip temperature up to 760 deg C, SS 316L may be used, above this SS 310 shall be used. Minimum anchor density shall be 22/m². V and Y type anchors of appropriate design/ diameter depending on the type of lining (single or double layer, dense or insulating) shall be used.

4.2. Stack

- a) Stack shell shall be designed based on proven practice of boiler vendor and in such a way that it is maintained above acid dew point under all operating cases.
- b) Stack shall be internally refractory lined for the entire height and quality of castable shall be minimum 2100 kg/m³ density, 50% Al₂O₃ quality having low iron (<1.5% Fe₂O₃), type C12 as per EIL specification 6-79-0029. Min thickness shall be 75mm. Anchor for the castable lining shall be 6mm dia. V anchors in SS 316L at 300x300 staggered spacing (approx. 22 anchors/ sq-m). Refractory type, thickness and MOC may be upgraded by the package vendor if so necessary.

c) Stack refractory lining along with external insulation (incase required) shall maintain the casing temperature above a specified minimum considering acid dew point criteria given elsewhere in the datasheet/ EIL specification.

- 4.3. Boiler manufacturer shall mention design condition for refractory lining such as min/max wind speed, ambient temperatures, operating temperatures and permissible casing temperature in their datasheet. This information however shall be in line with EIL requirement, if any mentioned in tender/MR and subsequently approved by BPCL/EIL.
- 4.4. Drawings shall provide details pertaining to installation of castable lining, anchor design & spacing, dimensions and details of lining pattern around manhole & other openings, nozzle etc.
- 4.5. Anchors for shall be provided with plastic cap at tip.
- 4.6. Any metallic intrusions through castable lining shall be wrapped with 3 mm thk ceramic paper (~150 kg/m³ density).
- 4.7. Anchors shall be shop fabricated followed by solution annealing.
- 4.8. Refractory vendor shall be selected based on proven references for similar services.

5.0 REFRACTORY APPLICATION

- 5.1 For the purpose of on-site testing of refractory samples to ensure quality of castable application, the contractor shall establish necessary test facilities for refractory re-qualification/ revalidation, applicator pre-qualification and testing of regular field samples for density, CCS, PLC meeting quality control requirement of API 936.
- 5.2 The contractor shall mobilize required number of mixer, vibrators and necessary masonry tools, arrange supply of cold potable water required for refractory application and quality checks. The facilities shall include but not limited to the following:
 - a) Pan mixer
 - b) Water chiller
 - c) Weighing machine
 - d) Thermometer
 - e) Moulds for field sample testing
 - f) Vibrator
 - g) Shuttering materials, screw jacks
 - h) Air condition chamber for material storage
 - i) Mock-up arrangement for pre-qualification
 - j) Sample cutting facility
- 5.3 Material that shows evidence of minor damage or moisture exposure OR has been exposed to beyond recommended storage temperature, shall not be used unless tested and certified by the refractory inspector.
- 5.4 Before the actual application begins, for each type of castable, refractory applicator shall demonstrate the skill of the application crew by a MOCK UP. The mock-up application shall be carried out resembling the actual application conditions. Test samples shall be taken during each mock up, which shall be tested for Bulk density, CCS & PLC as per applicable standards. Parameters maintained in successful mock-up i.e. water percentage, mixing time, application methods etc. shall be maintained during actual application.

- 5.5 For each day's installation, representative production samples in required size shall be taken from the castable mix and tested for Bulk density & CCS as per applicable standards and proper traceability shall be maintained with respect to application area.
- 5.6 The average physical properties of each sample (for example if the sample consists of 3 test specimens, average of the 3 shall be taken) shall meet the criteria defined below. Permissible limits of variation in test results from the approved datasheet for as-installed refractory shall be as under:

- a) CCS : (-) 10% of datasheet value, (+) allowed
- b) Bulk Density : ($\pm$) 80 kg/m³
- c) PLC : 10% of datasheet value

Variation beyond the above limits may call for rejection. A re-testing may be permitted at the discretion of owner/ EIL engineer-in-charge at construction site. Failure in re-testing shall cause for rejection of the lining in installed area.

- 5.7 The surface to which the refractory lining is to be installed shall be dry and clean.
- 5.8 All mechanical work, pressure testing/ hydro test shall be completed before refractory application.
- 5.9 Castable lining shall be cured for 24 hours after application, during which the applied castable surface must be kept moist by covering with wet gunny bags and protected from direct heat.
- 5.10 During the curing period of 24 hours and preferably for the next 24 hours of natural drying too, there should not be any movement/ rotation of the lined vessel.
- 5.11 Records of application and testing and proper traceability of the samples with respect to application area shall be maintained.
- 5.12 The refractory lining after installation shall be inspected for physical defects and test results of the field samples shall be verified. The contractor shall obtain clearance in writing from the inspector before going ahead for dry out.
- 5.13 The quality of water to be used in mixing shall be checked for compliance as per API 936 guidelines specifications.
- 5.14 The application surface, refractory material and the water to be used in mixing shall be within the temperature range specified by API 936. Water from chiller to be used to meet any cooling requirement.
- 5.15 Welding of anchors shall be appropriate for the given lining thickness. The contractor shall carry out the installation and offer for inspection/ checking by appropriate authority at different stages as per approved QAP.

6.0 DRY OUT

- 6.1 All castable lined refractory shall be heat dried out before it is put in service.
- 6.2 Refractory installations carried out outside project site shall be dried out before dispatch. Installations carried out at site shall be dried out before erection.
- 6.3 Dry out shall be performed to minimum temperature specified in this procedure. Higher temperature, if recommended by refractory supplier shall be followed. The heating, cooling

and soaking at different temperatures shall be in accordance with API 936 or recommended by refractory manufacturer, whichever is stringent.

- 6.4 The contractor shall prepare dry-out procedures, heating schedule, sketches with the location of burners/ heat source, thermocouples, list of tools and tackles etc. specific to the refractory types. The dry out procedure shall be approved by EIL.
- 6.5 Dry out (in all cases) shall be performed by circulating hot air/ flue gas generated by burning oil/ gas using auxiliary burners. Burners shall be installed to avoid overheating damage to refractory, refractory supports, and other components. The number and size of burners shall be sufficient to achieve the required temperature schedules. Direct flame impingement on refractory surfaces is not allowed.
- 6.6 Burners shall be equipped with air blowers capable of maintaining excess combustion air at all times. The blowers shall also be capable of moving air through the lined parts at velocities high enough to evenly heat all areas of the refractory being dried. Burners shall have a capacity of at least 50% excess air at maximum intended firing rate.
- 6.7 The volume of air passing through the lined equipment must be sufficient to avoid saturation before it reaches the outlet. Blower capacity shall be sized such that a minimum 60 m³ hot air is circulated per hour per square meter of refractory surface.
- 6.8 The dry out temperature shall be 650°C, or maximum operating temperature to which the area is exposed to during operation (if the same is lower than 650°C). Stack and Ducting in the downstream of boiler shall be dried out to a minimum of 260°C. Higher dry out temperature, if specified by refractory supplier shall apply.
- 6.9 All necessary tools, tackles & consumables (including fuel) for carrying out the dry out shall be in contractor scope.
- 6.10 Dry out shall be performed by an agency having past experience in similar job. Credential of the dry out agency shall be reviewed in detail at post order stage.
- 6.11 Detail arrangements of Dry out of refractory lining shall be inspected and certified by the refractory inspector

7.0 INSPECTION

- 7.1 Refractory installations shall be inspected stage wise as per installation test plan, to be approved by owner/ EIL. The contractor shall prepare the ITP which shall address inspection activity and the inspection authority for each stage as per agreed inspection philosophy of the project.
- 7.2 Contractor shall submit an inspection schedule as per approved ITP and raise inspection call at least one week prior to each stage inspection.
- 7.3 Refractory installations must be carried out by personnel having previous experience in similar job. The refractory application crew shall have a qualified and experienced refractory supervisor, who shall ensure refractory installation meeting stage wise quality control before offering the same for inspection by TPI/ BPCL/ EIL (as applicable).
- 7.4 In the event inspection of refractory installations is under TPI (usually applicable for refractory installation at fabrication shop), the refractory inspector to be engaged by TPI should be API 936 certified and meet the minimum competency criteria of API -936. Copy of API 936 certificate of the inspector should be submitted to BPCL/ EIL.

- 7.5 In addition to the TPI inspection, owner/ EIL refractory specialist may inspect the refractory installation at any stage. Non-compliance if identified at any stage by owner/ EIL shall be rectified by the contractor without any cost and time implication.
- 7.6 Inspection by BPCL/EIL by no means shall relieve the contractor from his responsibility. Any abnormalities/defects observed, identified at any stage during installation and /or pre/post dry out shall be replaced by the contractor at his cost.
- 7.7 Any refractory equipment at site in refractory lined condition shall be inspected by owner/EIL after reaching to site. Any defects identified shall be rectified / repaired by contractor before erection.
- 7.8 Repair, if necessary, in any refractory lining shall be brought to the notice of owner/ EIL and repair procedure submitted for review by owner/ EIL specialist before carrying out the repair.

8.0 GENERAL REQUIREMENTS

- 8.1 Procurement of castables, mortars which have shelf life, shall be suitably planned to minimize storage time.
- 8.2 Details of refractory work executed each day shall be maintained in a log book approved by the Engineer-in-Charge which shall include the types and quality of refractory materials, name of the manufacturer, section numbers etc.
- 8.3 Sufficient number of qualified and experienced supervisors to be deployed in each shift to take care of all activities at site. One exclusive supervisor shall be engaged to take care of the quality aspect of refractory lining job.
- 8.4 The contractor shall carry out the various tests as enumerated in the technical specifications. All the tests either on the field or at outside laboratories concerning the execution of the work and supply of materials by the contractor shall be carried out by the contractor.
- 8.5 All results of inspection and tests will be recorded in the inspection reports, proforma of which will be approved by the Engineer-in-Charge. These reports shall form part of the completion documents.

9.0 HSE REQUIREMENT

- 9.1 Contractor shall prepare HSE risk assessment analysis and requirements which shall be part of the application procedure. HSE requirement shall be considered for refractory storage, mixing, application, dry out, anchor welding etc.
- 9.2 Contractor shall follow EIL standard 6-79-0024 for HSE requirements for all the activities for refractory application.
- 9.3 The contractor responsible for the refractory installation shall be fully conversant and meet the HSE requirements of BPCL. The contractor shall strictly adhere to safety instructions and MSDS requirements of the refractory material/ ancillary products and application. The contractor shall provide adequate personnel protection and safety gears like hand gloves, masks, spectacles etc. as necessary for compliance to MSDS safety requirements to the workmen on the job.

10.0 DOCUMENTS REQUIRED FROM CONTRACTOR

POST ORDER STAGE THE CONTRACTOR SHALL SUBMIT

- a) Manufacturer's product datasheet and compliance datasheet of the refractory material.
- b) Proven reference of proposed refractory lining design & material
- c) Test certificate of refractory and ancillaries' materials
- d) Refractory detail drawings & heat transfer calculations (if applicable).
- e) Refractory lining schedule
- f) Method statement for refractory installation, Quality control for application, Dry out schedule & procedure
- g) Refractory lining preservation during transportation & site
- h) Refractory lining modularization philosophy
- i) Information on testing arrangement of on-site samples
- j) HSE to be followed during refractory application

VENDOR DATA REQUIREMENTS FOR REFRACTORY LINING AND INSULATION SYSTEM OF STEAM GENERATION SYSTEM

A	05-FEB-2025	ISSUED FOR TENDER	VT	PP	PS
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

VENDOR DATA REQUIREMENTS

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

VENDOR DATA REQUIREMENTS FOR REFRACTORY LINING AND INSULATION SYSTEM OF STEAM GENERATION SYSTEM

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Manufacturer's product datasheet and compliance datasheet of the refractory material as well as insulation and ancillaries .		✓		✓	
2.	Method statement for refractory installation, Quality control for application, Dry out schedule & procedure		✓		✓	
3.	Refractory detail drawings & heat transfer calculations (if applicable)		✓		✓	
4.	Quality control plan and Inspection Test Plan for refractory and insulation material supply and application		✓		✓	
5.	Method statement for insulation application procedure including HSE requirement		✓		✓	
6.	Test certificate of refractory, insulation and ancillaries' materials		✓		✓	
7.	Refractory lining preservation during transportation & site and modularization philosophy		✓		✓	
8.	Proven reference of proposed refractory lining design & material, insulation material used under similar condition			✓		
9.	Credential of insulation designer/applicator agency			✓		

Notes :

- "TICK" denotes applicability.
- Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
- All post order documents shall be submitted / approved through EIL eDMS portal.
- Final documentation shall be submitted in hard copy (Six prints) and soft (two CDs/DVDs) in addition to submission through EIL eDMS.
- Refer - 6-78-0001: Specification for quality management system from Bidders.
- Refer - 6-78-0002: Specification for documentation requirements from Contractors.
- Refer - 6-78-0003: Specification for documentation requirement from Suppliers.
- All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
- Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).

**VENDOR DATA REQUIREMENTS
FOR
REFRACTORY LINING AND INSULATION
SYSTEM OF STEAM GENERATION
SYSTEM**

10. "@" indicates submission of documents to Inspection Agency.



TECHNICAL COMPLIANCE FOR REFRACTORY LINING AND INSULATION SYSTEM OF STEAM GENERATION PACKAGE (SMMS)

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BREP)

OWNER : M/s BHARAT PETROLEUM CORPORATION LIMITED

PMC : ENGINEERS INDIA LIMITED

JOB NO. : B957

A	04/02/2025	ISSUED FOR TENDER	VT	PP	PS
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by



**TECHNICAL COMPLIANCE: REFRACTORY LINING OF STEAM
GENERATION SYSTEM**

SI No.	COMPLIANCE STATEMENT/QUERY	BIDDER'S REPLY
1.	Please CONFIRM that refractory lining design, selection of refractory and ancillaries' items, installation, quality control, testing, and any other activities associated to refractory lining of steam generation system shall be carried out as per EIL job specification B957-420-06-43-RM01.	
2.	Please CONFIRM that bidder shall submit all deliverables as per EIL document number B957-420-06-43-RM01 and as per the sequence mentioned in EIL VDR B957-420-06-43-VDR-0001	
3.	Please CONFIRM all requirements mentioned in EIL specification B957-420-06-43-RM01 to carry out the job have been fully understood by bidder and will be met.	

NOTE: DEVIATIONS APPEARING ELSEWHERE IN THE OFFER
SHALL NOT BE CONSIDERED.

BIDDER'S NAME:

BIDDER'S SIGNATURE
AND SEAL / STAMP

DATE:



TECHNICAL COMPLIANCE
FOR
REFRACTORY LINING AND
INSULATION SYSTEM OF STEAM
GENERATION PACKAGE
(SMMS)

**TECHNICAL COMPLIANCE: INSULATION OF VHP LINE OF STEAM
GENERATION SYSTEM**

SI No.	COMPLIANCE STATEMENT/QUERY	BIDDER'S REPLY
1.	Please CONFIRM that insulation design, selection of insulation and ancillaries items, installation, quality control, testing, and any other activities associated to Insulation of VHP Line shall be carried out as per EIL job specification B957-420-06-43-IL01.	
2.	Please CONFIRM that bidder shall submit all deliverables as per EIL document number B957-420-06-43-IL01 and as per the sequence mentioned in EIL VDR B957-420-06-43-VDR-0001	
3.	Please CONFIRM all requirements mentioned in EIL specification B957-420-06-43-IL01 to carry out the job have been fully understood by bidder and will be met.	

NOTE: DEVIATIONS APPEARING ELSEWHERE IN THE OFFER
SHALL NOT BE CONSIDERED.

BIDDER'S NAME:

BIDDER'S SIGNATURE
AND SEAL / STAMP

DATE:



WELDING SPECIFICATION CHARTS FOR PIPING CLASSES (SMMS DIVISION)

PROJECT : EPCC TENDER FOR POLYPROPYLENE & BUTENE-1
UNIT OF BINA PETCHEM & REFINERY EXPANTION
PROJECT (BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION LIMITED

PMC : ENGINEERS INDIA LIMITED

JOB NO. : B957

C	20-12-2024	ISSUED FOR TENDER	U KUMAR	P CHOWDHARY	R CHITARA
B	28-11-2024	REISSUED FOR FEED	U KUMAR	P CHOWDHARY	R CHITARA
A	08-11-2024	ISSUED FOR FEED	U KUMAR	P CHOWDHARY	R CHITARA
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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WSC FOR PIPING CLASSES: A4A, A42A, A43A, A46A, B4A, B42A, B43A, B46A, D4A, D42A	9
WSC FOR PIPING CLASSES: A20K, A21K, A23K, A24K, A28K, B20K, D20K, D21K, ...	10
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GENERAL NOTES

1.1 Scope :

This document covers the Welding Specification for the piping classes covered in the Piping Material Specification (B957-6-44-0005-PMC01Rev. B dated 22.08.24). WPS and PQR for the field fabrication and erection of piping system shall be made in conformity with this document. In case of any conflict between this document and Piping Material Specification for any piping class, the most stringent requirement shall be followed.

1.2 This document shall be read in conjunction with the latest revisions/editions of the following documents:

a) ASME Boiler and Pressure Vessel Codes

Section II Part C – Specification for Welding Rods, Electrodes, and Filler Metals

Section V – Nondestructive Examination

Section IX - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

b) ASME B31.3, Process Piping

c) ASTM E10, Standard Test Method for Brinell Hardness of Metallic Materials

d) Job Specification for Non Destructive Examination Requirements of Piping, B957-6-44-0016

e) Welding Specification for Fabrication of Piping, 6-77-0001 Rev.5. and B957-000-06-41-WSP-0001.

1.3 GTAW process can be applied in place of SMAW process with a corresponding suitable filler metal for the application.

1.4 Abbreviations:

GTAW : Gas Tungsten Arc Welding

PMS : Piping Material Specification

PQR : Procedure Qualification Record

SMAW : Shielded Metal Arc Welding

WSC : Welding Specification Chart

WPS : Welding Procedure Specification

1.5 ASME B31.3 PWHT thickness exemption for P no. 1 materials is not permitted for material thickness greater than 1.5 inch (38mm).

1.6 Revision B of this document:

A1K, A32A, A3K, A41A, A42A, A43A, A44A, A44K, A45A, A45K, A46A, A91A, A94A, A95A, A96A, A97A, B41A, B42A, B43A, B44A, B44K, B45A, B45K, B46A, B55A, D42A, J95A piping classes added.

WSC FOR PIPING CLASSES: A1A, A21A, A32A, A41A, A44A, A45A, B1A, B21A, B41A, B44A, B45A, D1A, F25A				
MATERIAL SPECIFICATIONS	PIPES	ASTM A 106 GR.B, ASTM A 53 TYPE E GRADE B, ASTM A 672 GR.B60 CL.12		
	FITTINGS	ASTM A 105, ASTM A234 GR.WPB, ASTM A 234 GR.WPB-W		
	FLANGES	ASTM A 105		
	OTHERS	-		
BASE METAL 'P' NO	1			
WELDING PROCESS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: GTAW / SMAW (NOTE-1, 2)	FILLER PASS: GTAW / SMAW (NOTE-2)	ROOT PASS: GTAW / SMAW (NOTE-1, 2)	FILLER PASS: GTAW / SMAW (NOTE-2)
	FILLET JOINTS/ SOCKET JOINTS: SMAW/GTAW			
WELDING MATERIALS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: ER70S-2 / E6010	FILLER PASS: ER70S-2 / E7016 / E7018	ROOT PASS: ER70S-2 / E6010	FILLER PASS: ER70S-2 / E7016 / E7018
	FILLET JOINT/SOCKET JOINT: E7016 / E7018/ ER70S-2			
	BACKING RING: -		CONSUMABLE INSERT: -	
JOINT PREPARATION	ASME B31.3			
GASES	PURGING: -		SHIELDING: ARGON	
GAS COMPOSITION	PURGING: -		SHIELDING: 99.997%	
PREHEATING (NOTE-3)	PREHEAT TEMP: 10°C MIN/ 100°C FOR THK >25 mm		INTERPASS TEMP.: ----	
POST HEATING: --				
POST WELD HEAT TREATMENT	HOLDING TEMP---		HOLDING TIME: ----	
	RATE OF HEATING: ---		MIN. HOLDING TIME: ---	
	METHOD OF COOLING: ---		RATE OF COOLING: ---	
MECHANICAL PROPERTY REQUIREMENTS	CHARPY 'V' NOTCH VALUE:		MIN: -	AVERAGE: -
	AT TEMPERATURE:		-	
	HARDNESS:			
CODE OF FABRICATION	ASME B31.3			

TECHNICAL NOTES:

- 1 THE ROOT PASS FOR SINGLE SIDE WELDING SHALL BE DONE BY GTAW PROCESS
- 2 GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER.
- 3 PRE-HEAT TEMPERATURE OF ATLEAST 50°C SHALL BE PROVIDED FOR THE FIRST TWO PASSES FOR THK>=12.5 mm & ≤ 25 mm.

WSC FOR PIPING CLASSES: A24A, B24A, B27A, B28A, D28A				
MATERIAL SPECIFICATIONS	PIPES	ASTM A 106 GR.B, ASTM A 53 TYPE E GRADE B, ASTM A 672 GRADE C 70 CLASS 32		
	FITTINGS	ASTM A 105, ASTM A234 GR.WPB, ASTM A 234, GRADE WPB-W		
	FLANGES	ASTM A 105		
	OTHERS	-		
BASE METAL 'P' NO	1			
WELDING PROCESS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: GTAW	FILLER PASS: GTAW / SMAW (NOTE-2)	ROOT PASS: GTAW / SMAW (NOTE-1, 2,3)	FILLER PASS: GTAW / SMAW (NOTE- 2)
	FILLET JOINTS/ SOCKET JOINTS: SMAW/GTAW			
WELDING MATERIALS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: ER70S-2	FILLER PASS: ER70S-2 / E7016 / E7018	ROOT PASS: ER70S-2 / E6010	FILLER PASS: ER70S-2 / E7016 / E7018
	FILLET JOINT/SOCKET JOINT: E7016 / E7018/ ER70S-2			
	BACKING RING: -		CONSUMABLE INSERT: -	
JOINT PREPARATION	ASME B31.3			
GASES	PURGING: -		SHIELDING: ARGON	
GAS COMPOSITION	PURGING: -		SHIELDING: 99.997%	
PREHEATING (NOTE-3)	PREHEAT TEMP: 10°C MIN/ 100°C FOR THK >25 mm		INTERPASS TEMP.: ----	
POST HEATING: --				
POST WELD HEAT TREATMENT	HOLDING TEMP---		HOLDING TIME: ----	
	RATE OF HEATING: ---		MIN. HOLDING TIME: ---	
	METHOD OF COOLING: ---		RATE OF COOLING: ---	
MECHANICAL PROPERTY REQUIREMENTS	CHARPY 'V' NOTCH VALUE:		MIN: -	AVERAGE: -
	AT TEMPERATURE:		-	
	HARDNESS:			
CODE OF FABRICATION	ASME B31.3			

TECHNICAL NOTES:

- 1 THE ROOT PASS FOR SINGLE SIDE WELDING SHALL BE DONE BY GTAW PROCESS
- 2 GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER.
- 3 FOR PIPING CLASS B27A & B28A, GTAW SHALL BE USED FOR THE ROOT PASS OF ALL WELDS.
- 4 PRE-HEAT TEMPERATURE OF ATLEAST 50°C SHALL BE PROVIDED FOR THE FIRST TWO PASSES FOR THK>=12.5 mm & ≤ 25 mm.

WSC FOR PIPING CLASSES: B55A, D55A				
MATERIAL SPECIFICATIONS	PIPES	ASTM A 106 GR.B		
	FITTINGS	ASTM A 105, ASTM A234 GR.WPB		
	FLANGES	ASTM A 105		
	OTHERS	-		
BASE METAL 'P' NO	1			
WELDING PROCESS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: GTAW / SMAW (NOTE- 1,2)	FILLERPASS: GTAW / SMAW (NOTE-1)	ROOTPASS: GTAW / SMAW (NOTE-1,2)	FILLER PASS: GTAW / SMAW (NOTE-1)
	FILLET JOINTS/ SOCKET JOINTS: SMAW/GTAW			
WELDING MATERIALS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: ER70S-2 / E6010	FILLER PASS: ER70S-2/ E7016/E7018	ROOT PASS: ER70S-2 / E6010	FILLER PASS: ER70S-2/ E7016/E7018
	FILLET JOINT/SOCKET JOINT: E7016/E7018/ ER70S-2			
	BACKING RING: -		CONSUMABLE INSERT: -	
JOINT PREPARATION	ASME B31.3			
GASES	PURGING: ---		SHIELDING: ARGON	
GAS COMPOSITION	PURGING: ---		SHIELDING: 99.997%	
PREHEATING(NOTE-3)	PREHEAT TEMP: 10°C MIN./100°C (FOR THK>25 MM)		INTERPASS TEMP.: ---	
POST HEATING: -				
POST WELD HEAT TREATMENT (NOTE-5)	HOLDING TEMP: -		HOLDING TIME: -	
	RATE OF HEATING: -		MIN. HOLDING TIME: -	
	METHOD OF COOLING: -		RATE OF COOLING: -	
MECHANICAL PROPERTY REQUIREMENTS (NOTE-4)	CHARPY 'V' NOTCH VALUE:		MIN: 20J	AVERAGE: 27J
	AT TEMPERATURE:		-	
	HARDNESS: 200 BHN MAX. (NOTE-5)			
CODE OF FABRICATION	ASME B31.3			

TECHNICAL NOTES:

- GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER.
- THE ROOT PASS FOR SINGLE SIDE WELDING SHALL BE DONE BY GTAW PROCESS.
- PRE-HEAT TEMPERATURE OF ATLEAST 50°C SHALL BE PROVIDED FOR THE FIRST TWO PASSES FOR THK >=12.7 MM & <= 25 MM.
- CHARPY V-NOTCH IMPACT TESTING OF WELD METAL SHALL BE CARIED OUT DURING WELDING PROCEDURE QUALIFICATION FOR THE PIPE WALL THICKNESS OVER 20 MM. IMPACT TESTING SHALL BE CARRIED OUT AT -(MINUS) 29°C.
- PWHT SHALL BE DONE FOR PIPING WELDS HAVING NOMINAL THICKNESS >19 MM AS PER LATEST EDITION OF ASME B31 3. HARDNESS SHALL BE MEASURED AFTER PWHT.

WSC FOR PIPING CLASSES: A3A, A91A, A94A, A95A, A96A, A97A, J2A, J95A				
MATERIAL SPECIFICATIONS	PIPES	ASTM A 106 GR.B , IS-3589 GR.410, IS-1239		
	FITTINGS	ASTM A 105, ASTM A234 GR.WPB, ASTM A234 GR.WPB-W, IS-3589 GR.410, ASTM A 285 GR.C, IS-1239		
	FLANGES	ASTM A 105		
	OTHERS	-		
BASE METAL 'P' NO	1, Unassigned (IS-3589, IS-1239)			
WELDING PROCESS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: GTAW /SMAW	FILLER PASS: SMAW (NOTE-1)	ROOT PASS GTAW /SMAW	FILLER PASS: SMAW (NOTE-1)
	FILLET JOINTS/ SOCKET JOINTS: SMAW/GTAW			
WELDING MATERIALS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: ER70S-2/E6010	FILLER PASS: E6013/E7016/E7018	ROOT PASS: ER70S-2/ E6010	FILLER PASS: E6013/E7016/E7018
	FILLET JOINT/SOCKET JOINT: E6013/ E7016/E7018/ ER70S-2			
BACKING RING: -		CONSUMABLE INSERT: -		
JOINT PREPARATION	ASME B31.3			
GASES	PURGING: -		SHIELDING: ARGON	
GAS COMPOSITION	PURGING: -		SHIELDING: 99.997%	
PREHEATING (NOTE-2)	PREHEAT TEMP: 10°C MIN/100°C FOR THK >25 mm		INTERPASS TEMP.: ---	
POST HEATING: ---				
POST WELD HEAT TREATMENT	HOLDING TEMP: --		HOLDING TIME: ---	
	RATE OF HEATING: ---		MIN. HOLDING TIME: ---	
	METHOD OF COOLING: ---		RATE OF COOLING: ---	
MECHANICAL PROPERTY REQUIREMENTS	CHARPY 'V' NOTCH VALUE:		MIN: -	AVERAGE: -
	AT TEMPERATURE:		-	
	HARDNESS:			
CODE OF FABRICATION	ASME B31.3			

TECHNICAL NOTES:

- GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER.
- PRE-HEAT TEMPERATURE OF ATLEAST 50°C SHALL BE PROVIDED FOR THE FIRST TWO PASSES FOR THK >=12.5 MM & <=25MM.
- THREADED JOINTS FOR J2A & J95A PIPING CLASS SHALL BE MADE WITH 1" PTFE JOINING TAPE.

WSC FOR PIPING CLASSES: A2A, B2A, D2A				
MATERIAL SPECIFICATIONS	PIPES	ASTM A106 GR. B, ASTM A672 GR. B60 CL.12		
	FITTINGS	ASTM A 105, ASTM A234 GR.WPB, ASTM A234 GR.WPB-W		
	FLANGES	ASTM A 105		
	OTHERS	-		
BASE METAL 'P' NO	1			
WELDING PROCESS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: GTAW / SMAW (NOTE 1)	FILLER PASS: GTAW / SMAW (NOTE 1)	ROOT PASS: GTAW / SMAW (NOTE-1)	FILLER PASS: GTAW / SMAW (NOTE-1)
	FILLET JOINTS/ SOCKET JOINTS: SMAW/GTAW			
WELDING MATERIALS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: ER70S-2 / E6010	FILLER PASS: ER70S-2 / E7016/E7018	ROOT PASS: ER70S-2/ E6010	FILLER PASS: ER70S-2 / E7016/ E7018
	FILLET JOINT/SOCKET JOINT: E7016/E7018/ER70S-2			
	BACKING RING: -		CONSUMABLE INSERT: -	
JOINT PREPARATION	ASME B31.3 & IBR			
GASES	PURGING: -		SHIELDING: ARGON	
GAS COMPOSITION	PURGING: -		SHIELDING: 99.997%	
PREHEATING (NOTE-2)	PREHEAT TEMP: 10°C MIN/ 100°C FOR THK >25 mm		INTERPASS TEMP: ---: -	
POST HEATING: ---				
POST WELD HEAT TREATMENT (NOTE-3)	HOLDING TEMP: -		HOLDING TIME: -	
	RATE OF HEATING: -		MIN. HOLDING TIME: -	
	METHOD OF COOLING: -		RATE OF COOLING: -	
MECHANICAL PROPERTY REQUIREMENTS	CHARPY 'V' NOTCH VALUE:		MIN: -	AVERAGE: -
	AT TEMPERATURE:		-	
	HARDNESS:			
CODE OF FABRICATION	ASME B31.3& IBR			

TECHNICAL NOTES:

- GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER. THE ROOT PASS FOR SINGLE SIDE WELDING SHALL BE DONE BY GTAW PROCESS.
- PRE-HEAT TEMPERATURE OF ATLEAST 50°C SHALL BE PROVIDED FOR THE FIRST TWO PASSES FOR THK>= 12.7MM & ≤ 25 MM.
- PWHT SHALL BE DONE AS PER IBR FOR WALL THICKNESS EXCEEDING 20MM.

WSC FOR PIPING CLASSES: A4A, A42A, A43A, A46A, B4A, B42A, B43A, B46A, D4A, D42A				
MATERIAL SPECIFICATIONS	PIPES	ASTM A 333 GR.6		
	FITTINGS	ASTM A 350 GR.LF2 CL.1, ASTM A 420 GR.WPL6		
	FLANGES	ASTM A 350 GR.LF2 CL.1		
	OTHERS	-		
BASE METAL 'P' NO	1			
WELDING PROCESS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: GTAW	FILLERPASS: GTAW / SMAW (NOTE-2)	ROOTPASS: GTAW	FILLER PASS: GTAW / SMAW (NOTE-2)
	FILLET JOINTS/ SOCKET JOINTS: SMAW/GTAW			
WELDING MATERIALS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: ER 80SNI 1 (NOTE-1)	FILLER PASS: ER 80SNI 1 /E7018-1 (NOTE-1)	ROOT PASS: ER80S-Ni1 (NOTE-1)	FILLER PASS: ER 80SNI 1 /E7018-1 (NOTE-1)
	FILLET JOINT/SOCKET JOINT: E7018 -1/: ER 80SNI 1 (NOTE-1)			
	BACKING RING: -		CONSUMABLE INSERT: -	
JOINT PREPARATION	ASME B31.3			
GASES	PURGING: -		SHIELDING: ARGON	
GAS COMPOSITION	PURGING: -		SHIELDING: 99.997%	
PREHEATING (NOTE-3)	PREHEAT TEMP: 10°C MIN/ 100°C FOR THK >25 mm		INTERPASS TEMP.: 315°C MAX.	
POST HEATING: -				
POST WELD HEAT TREATMENT	HOLDING TEMP: -		HOLDING TIME: -	
	RATE OF HEATING: -		MIN. HOLDING TIME: -	
	METHOD OF COOLING: -		RATE OF COOLING: -	
MECHANICAL PROPERTY REQUIREMENTS (NOTE-4)	CHARPY 'V' NOTCH VALUE:		MIN: 20 J	AVERAGE: 27 J
	AT TEMPERATURE:		-45 DEG C	
	HARDNESS:			
CODE OF FABRICATION	ASME B31.3			

TECHNICAL NOTES:

- ALL BATCHES OF WELDING CONSUMABLES SHALL BE IMPACT TESTED AT - 45°C. FOR B4A PIPING CLASS, IMPACT TEST OF WELDING CONSUMABLES BATCH SHALL BE PERFORMED AT - 46°C.
- GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMTER 2" AND SMALLER.
- PRE-HEAT TEMPERATURE OF ATLEAST 50°C SHALL BE PROVIDED FOR THE FIRST TWO PASSES FOR THK >=12.7 MM & <= 25 MM.
- DURING PQR, IMPACT TESTING SHALL BE CARRIED OUT AT – (MINUS) 45°C. FOR B4A PIPING CLASS, IMPACT TESTING SHALL BE CARRIED OUT AT – (MINUS) 46°C.

WSC FOR PIPING CLASSES: A20K, A21K, A23K, A24K, A28K, B20K, D20K, D21K,					
MATERIAL SPECIFICATIONS	PIPES	ASTM A 312 TP304/304L, ASTM A 358 TP304/304L CL.2			
	FITTINGS	ASTM A 182 DUAL GRADE F304 / 304L, ASTM A 403 GR.WP304/304L-S, ASTM A403 GR.WP304/304LWX			
	FLANGES	ASTM A 182 GR.F304/304L			
	OTHERS	-			
BASE METAL `P` NO	8				
WELDING PROCESS	GROOVE JOINTS				
	BUTT		OTHER THAN BUTT		
	ROOT PASS: GTAW	FILLERPASS: GTAW/SAW (NOTE-1)	ROOTPASS: GTAW/SAW (NOTE-1)	FILLER GTAW/ (NOTE-1)	PASS: SAW
	FILLET JOINTS/ SOCKET JOINTS: SMAW/GTAW				
WELDING MATERIALS	GROOVE JOINTS				
	BUTT		OTHER THAN BUTT		
	ROOT PASS: ER308L	FILLER PASS: : ER308L / E308L-15/16	ROOT PASS: ER308L / E308L-15/16	FILLER ER308L/ E308L-15/16	PASS :
	FILLET JOINT/SOCKET JOINT: E308L-15/16 /ER308L				
	BACKING RING: -		CONSUMABLE INSERT: -		
JOINT PREPARATION	ASME B31.3				
GASES	PURGING: - ARGON		SHIELDING: ARGON		
GAS COMPOSITION	PURGING: - 99.997 %		SHIELDING: 99.997 %		
PREHEATING	PREHEAT TEMP: 10 °C		INTERPASS TEMP.: 175°C MAX.		
POST HEATING: -					
POST WELD HEAT TREATMENT	HOLDING TEMP: -		HOLDING TIME: -		
	RATE OF HEATING: -		MIN. HOLDING TIME: -		
	METHOD OF COOLING: -		RATE OF COOLING: -		
MECHANICAL PROPERTY REQUIREMENTS	CHARPY `V` NOTCH VALUE:		MIN:	AVERAGE:	
	AT TEMPERATURE:		-		
	HARDNESS: -				
CODE OF FABRICATION	ASME B31.3				

TECHNICAL NOTES:

1. GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER.

WSC FOR PIPING CLASSES: A42K, B42K, B46K, D42K, D54K, F55K					
MATERIAL SPECIFICATIONS	PIPES	ASTM A 312 TP304/304L			
	FITTINGS	ASTM A 182 GR.F304/304L, ASTM A 403 GR.WP304/304L-S, ASTM A 403 DUAL GRADE WP-WX 304 / 304L			
	FLANGES	ASTM A 182 GR.F304/304L			
	OTHERS	-			
BASE METAL 'P' NO	8				
WELDING PROCESS	GROOVE JOINTS				
	BUTT		OTHER THAN BUTT		
	ROOT PASS: GTAW	FILLERPASS: GTAW/SAW (NOTE-1)	ROOTPASS: GTAW/SAW (NOTE-1,2)	FILLER GTAW/ (NOTE-1)	PASS: SAW
	FILLET JOINTS/ SOCKET JOINTS: SMAW/GTAW				
WELDING MATERIALS	GROOVE JOINTS				
	BUTT		OTHER THAN BUTT		
	ROOT PASS: ER308L (NOTE-2,3)	FILLER PASS:ER308L E308L-15/16 (NOTE-2,3)	ROOT PASS: ER308L / E308L-15/16 (NOTE-2,3)	FILLER ER308L/ E308L-15/16 (NOTE-2,3)	PASS :
	FILLET JOINT/SOCKET JOINT: E308L-15/16 /ER308L (NOTE-2,3)				
	BACKING RING: -		CONSUMABLE INSERT: -		
JOINT PREPARATION	ASME B31.3				
GASES	PURGING: - ARGON		SHIELDING: ARGON		
GAS COMPOSITION	PURGING: - 99.997 %		SHIELDING: 99.997 %		
PREHEATING	PREHEAT TEMP: 10 °C		INTERPASS TEMP.: 175°C MAX.		
POST HEATING: -					
POST WELD HEAT TREATMENT	HOLDING TEMP: -		HOLDING TIME: -		
	RATE OF HEATING: -		MIN. HOLDING TIME: -		
	METHOD OF COOLING: -		RATE OF COOLING: -		
MECHANICAL PROPERTY REQUIREMENTS	CHARPY 'V' NOTCH VALUE:		MIN: 0.38MM	AVERAGE: 0.38MM	
	AT TEMPERATURE:		MINUS (-) 196°C		
	HARDNESS:				
CODE OF FABRICATION	ASME B31.3				

TECHNICAL NOTES:

- GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER.
- FOR PIPING CLASS B46K, GTAW SHALL BE USED FOR THE ROOT PASS OF ALL WELDS.
- ALL THE BATCHES OF FILLER MATERIALS SHALL HAVE GUARANTEED MINIMUM AS WELDED IMPACT VALUE OF 0.38 MM LATERAL EXPANSION AT MINUS (-) 196°C AT SITE. ALL THE FIVE VALUES SHALL BE OVER 0.38 MM.
- FERRITE NUMBER IN THE WELDING CONSUMABLES SHALL BE GREATER THAN 1.

WSC FOR PIPING CLASSES: A28M				
MATERIAL SPECIFICATIONS	PIPES	ASTM A 312 TP316/316L DUAL		
	FITTINGS	ASTM A 182 GR.F316/316L DUAL, ASTM A403GR.WP316/316L-WX DUAL		
	FLANGES	ASTM A 182 GR.F316/316L DUAL		
	OTHERS	-		
BASE METAL `P` NO	8			
WELDING PROCESS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: GTAW	FILLERPASS: GTAW/SAW	ROOTPASS: GTAW/SAW	FILLER PASS: GTAW/ SAW
	FILLET JOINTS/ SOCKET JOINTS: SMAW/GTAW			
WELDING MATERIALS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: ER316L(NOTE-1)	FILLER PASS: : ER316L/ E316L-15/16(NOTE-1)	ROOT PASS: ER316L/ E316L-15/16(NOTE-1)	FILLER PASS : ER316L/ E316L-15/16(NOTE-1)
	FILLET JOINT/SOCKET JOINT: ER316L/ E316L-15/16 (NOTE-1)			
	BACKING RING: -		CONSUMABLE INSERT: -	
JOINT PREPARATION	ASME B31.3			
GASES	PURGING: - ARGON		SHIELDING: ARGON	
GAS COMPOSITION	PURGING: - 99.997 %		SHIELDING: 99.997 %	
PREHEATING	PREHEAT TEMP: 10 °C MIN.		INTERPASS TEMP.: 175°C MAX.	
POST HEATING: -				
POST WELD HEAT TREATMENT	HOLDING TEMP: -		HOLDING TIME: -	
	RATE OF HEATING: -		MIN. HOLDING TIME: -	
	METHOD OF COOLING: -		RATE OF COOLING: -	
MECHANICAL PROPERTY REQUIREMENTS	CHARPY `V` NOTCH VALUE:		MIN:	AVERAGE:
	AT TEMPERATURE:		-	
	HARDNESS: -			
CODE OF FABRICATION	ASME B31.3			

TECHNICAL NOTES:

1. GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER.

WSC FOR PIPING CLASSES: A1K, A3K, A44K, A45K, B44K, B45K				
MATERIAL SPECIFICATIONS	PIPES	ASTM A 312 TP304, ASTM A 358 TP304 CL.1		
	FITTINGS	ASTM A 182 GR.F304, ASTM A 403 GR.WP304-S, ASTM A 403 GR.WP304-WX		
	FLANGES	ASTM A 182 GR.F304		
	OTHERS	-		
BASE METAL 'P' NO	8			
WELDING PROCESS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: GTAW	FILLERPASS: GTAW/SAW	ROOTPASS: GTAW/SAW	FILLER PASS: GTAW/ SAW
	FILLET JOINTS/ SOCKET JOINTS: SAW/GTAW			
WELDING MATERIALS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: ER308/ER308L	FILLER PASS: ER308/ER308L/ E308-15/16/ E308L-15/16 (NOTE-1)	ROOT PASS: ER308/ER308L/ E308-15/16/ E308L-15/16 (NOTE-1)	FILLER PASS: ER308/ER308L/ E308-15/16/ E308L-15/16 (NOTE-1)
	FILLET JOINT/SOCKET JOINT: E308-15/16/ E308L-15/16 /ER308 / ER 308L			
	BACKING RING: -		CONSUMABLE INSERT: -	
JOINT PREPARATION	ASME B31.3			
GASES	PURGING: - ARGON		SHIELDING: ARGON	
GAS COMPOSITION	PURGING: - 99.997 %		SHIELDING: 99.997 %	
PREHEATING	PREHEAT TEMP: 10 °C		INTERPASS TEMP.: 175°C MAX.	
POST HEATING: -				
POST WELD HEAT TREATMENT	HOLDING TEMP: -		HOLDING TIME: -	
	RATE OF HEATING: -		MIN. HOLDING TIME: -	
	METHOD OF COOLING: -		RATE OF COOLING: -	
MECHANICAL PROPERTY REQUIREMENTS	CHARPY 'V' NOTCH VALUE:		MIN: -	AVERAGE: -
	AT TEMPERATURE:		-	
	HARDNESS: -			
CODE OF FABRICATION	ASME B31.3			

TECHNICAL NOTES:

1. GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER.

WELDING SPECIFICATION FOR FABRICATION OF PIPING

(SMMS DIVISION)

PROJECT : EPCC TENDER FOR POLYPROPYLENE & BUTENE-1
UNIT OF BINA PETCHEM & REFINERY EXPANTION
PROJECT (BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION LIMITED

PMC : ENGINEERS INDIA LIMITED

JOB NO. : B957

0	24-12-2024	ISSUED FOR TENDER	Uttam	Prabhakar	R Chitara
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

AMENDMENTS/ADDITIONAL REQUIREMENTS

Specification No.: 6-77-0001 Rev.5

Title: Welding specification for fabrication of piping

Following amendments/additional requirements shall be applicable:

1. Addition in Clause 5.0:

5.9: The ferrite number of the austenitic welds shall be in the range of 3FN to 8FN unless otherwise specified in the welding specification chart for piping. The ferrite number shall be measured during welding procedure qualification.

2. Modification of Clause 14.2 (e) as : New PQR shall be established for this job.

3. Addition in Clause 14.6 (a):

Wherever MPI is required for inspection of alloy steel welds, use WFMPI instead of MPI.

- 4.

5. Addition in Clause 14.8:

Hardness checking of alloy steel welds (P No. 4, 5A, 5B, 15E) shall be verified using the standard blocks having same P No..



JOB SPECIFICATION FOR PRETREATMENT CUM ON-STREAM CLEANING OF RECIRCULATING FRESH COOLING WATER SYSTEM

PROJECT : PMC SERVICES FOR POLYPROPYLENE UNIT
& BUTENE-1 OF BINA PETCHEM & REFINERY
EXPANTION PROJECT, (BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION
LIMITED

PMC : ENGINEERS INDIA LIMITED

JOB NO. : B925

0	08/11/2024	ISSUED AS JOB SPECIFICATION	JATIN	SAHIL	S. SRIDHAR
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

CONTENT

- 1.0 GENERAL
- 2.0 PRE-TREATMENT INSPECTION
- 3.0 FLUSHING
- 4.0 CLEANING WITH LOW pH WATER
- 5.0 PHOSPHATE / PHOSPHONATE CLEANING CUM PASSIVATION
- 6.0 MONITORING
- 7.0 PRE-TREATMENT EVALUATION
- 8.0 SPECIFICATION OF CHEMICALS
- 9.0 SAFETY PRECAUTION
- 10.0 TECHNICAL SUPERVISION

ANNEXURE-I: TEST PROCEDURE FOR INHIBITOR EFFICIENCY

Abbreviations:

CS	:	Carbon Steel
CW	:	Cooling Water
CI	:	Corrosion Inhibitor
HEDP	:	Hydroxy Ethylidene Diphosphonic acid
SHMP	:	Sodium Hexa-Meta Phosphate
ATMP	:	Amino Tri-Methylene Phosphoric acid
TSS	:	Total suspended solids

1.0 GENERAL

- 1.1 This recommended procedure provides the measures for on-stream cleaning and passivation of CS metal surfaces of CW system. The pretreatment involves two steps as follows:

- i. Thorough cleaning of the metal surface.
- ii. Development of a protective (passive) film on the metal surface.

Pre-treatment applies to all metals except SS (Stainless Steel) and SDSS but is directed primarily to CS surfaces. Pre-treatment applies to pipeline, piping, coolers and any equipment which will come in contact with the cooling water.

Exchangers whose cooling water side MOC is other than CS (like SS & SDSS) need not be included for cleaning cum passivation procedure as per this procedure.

- 1.2 This specification defines the procedure for the chemical cleaning and passivation. However, EPC/LSTK Contractor shall prepare the detailed chemical cleaning markup on the applicable P&IDs and submit for EIL review & approval.
- 1.3 Normally microbiological fouling, deposits of phosphates, iron oxides and calcium carbonate scales are expected on CW side. For effective film formation/maintenance by the CI, the metal surfaces shall be free from the foulants and deposits. Fouled surfaces can give rise to severe pitting and localized corrosion.
- 1.4 Pre-cleaning cum passivation shall be applied to the entire CW system.
- 1.5 After the pre-treatment is over, the system shall be rapidly switched over to the regular chemical treatment by a suitable specialized CW treatment chemical agency for continuous protection of passivated CW exchangers.
- 1.6 In case of pre-cleaning cum passivation of isolated units (like new units in an existing plant or non-availability of cooling tower sump/pumps), contractor shall arrange the following:
- a) Temporary tanks of suitable volume.
 - b) Pumps (1 working + 1 standby) of suitable capacity and head to maintain min. flow velocity of 1.5 m/s and full bore flow.
 - c) Temporary piping from temporary tank to unit cooling water inlet and outlet headers.
- 1.7 Where lines are required to be chemically cleaned, the limit of cleaning in branch lines (which are not marked or not necessary) shall be to the first block valve or flange.

2.0 PRE-TREATMENT INSPECTION

Prior to pre-treatment, the equipment shall be inspected and if found to contain excessive corrosion products, deposits or foulant, the equipment shall be cleaned with an appropriate cleaning procedure. The CW treatment vendor shall ensure the completion of the cleaning and inspection.

3.0 FLUSHING

- 3.1 Cooling tower basin and sump should be filled with fresh water, drained and cleaned. All sludge should be mechanically removed if required.
- 3.2 All coolers/exchangers shall be kept isolated during entire period of flushing. Prior to the flushing, jump-over shall be provided at the inlet & outlet of the exchangers in such a manner that exchangers can be taken into line at a later stage quickly.
- 3.3 Provision shall be made to flush out water at dead ends of all units. Permanent dummieing /capping of farthest ends of CW circuits (both supply and return headers) shall be carried out only after flushing of the circuits. Necessary temporary piping to discharge chemical cleaning effluent away from process units shall be made by the contractor.
- 3.4 Start filling the system with fresh water for open flushing. Open flushing is to be carried out thoroughly to remove all extraneous matter, loose scales, corrosion products, microbiological debris, mud, lumber chips, paper etc from entire CW system. Once the system is filled, return water to the CW tower is to be drained from the blow down valves. Also, intermittent blowdown from lowest drain points in the unit shall be done during open flushing. Flushing is to be carried out till return water is visibly clear.
- 3.5 Fill the system with fresh water with the blow down valve closed and start circulating the water. All exchangers shall remain offline. Intermittent blow down are to be carried out from cell basin and from the unit lowest points.
- 3.6 Open the blow down valve and flush the system with fresh raw water make up for 24 hours. At the end of closed flushing, blow down water quality shall be equal to make-up fresh water.

4.0 CLEANING WITH LOW pH WATER

- 4.1 All the equipment, headers, piping and coolers shall be taken into circuit and the system shall be put into circulation. Blow down shall be stopped. However coolers/exchangers shall be kept isolated during the initial stage for the first 24 hrs of low pH cleaning.
- 4.2 The pH of circulating water shall be adjusted in the range of 4.5-5.0 by addition of sulphuric acid.
- 4.3 Before addition of acid for low pH cleaning, approx. 1% or manufacturers recommended dosage of Corrosion Inhibitor (Rodine-92 or equivalent) shall be added to sulphuric acid. Prior to the start of chemical cleaning, Contractor shall demonstrate the efficiency of CI by using CS coupons dipped in non inhibited and inhibited acid solutions as per the annexure-I.
- 4.4 The pH shall be held in this range for at least 24 hours. Intermittent blow down/draining is required from blinded or isolated lines, equipments, exchangers etc.
- 4.5 Thereafter blow down is to be carried out to reduce TSS & iron content. Those lines which are isolated or blinded shall be thoroughly open flushed. Subsequently, makeup water is added to raise the pH to 6.5. Blow down is to be carried out till TSS and iron content of make-up and effluent water are same.

- 4.6 All jump-over provided at exchangers are to be removed and exchangers are to be taken into line.
- 4.7 The pH shall be adjusted to 5.0-5.5 by addition of inhibited acid and circulation shall be continued.
- 4.8 After 48 hours of circulation, blow down shall be started & continued till suspended solids/Turbidity are < 30 mg/l/30 NTU or close to the make-up water quality.

5.0 PHOSPHATE / PHOSPHONATE CLEANING CUM PASSIVATION

- 5.1 The pH of the circulating water shall be adjusted in the range of 7.5- 8.0 by reducing the acid dose and shall be held in this range throughout the phosphate / phosphonate cleaning operation. All blow down from the system shall be closed.
- 5.2 Organo Phosphonate HEDP shall be added by gravity to build up a level of 80-100 mg/l as PO_4 . HEDP shall be dosed very slowly as this will depress the pH of the CW. If necessary, caustic soda may be added in CW system to maintain pH in the range of 7.5-8.0.
- 5.3 SHMP solution shall be added to build up a level of 40-50 mg/l as PO_4 . SHMP shall be dosed after HEDP addition is complete and pH is stabilized.
- 5.4 When phosphate / phosphonate levels and pH are stabilized, preferably ethylene oxide based non-ionic surfactant or alkyl aryl sulphonate based anionic surface active agents @ 30 mg/l (based on total hold up) shall be dosed slowly. This shall also be dosed at the same rate again after 24 hours. This will produce foam in the system. Hence precautions shall be taken for operation of CW pumps.
- 5.5 Circulation shall be continued under this condition for a period of 7 days and following levels of chemicals shall be maintained in the CW system for this period:

SHMP as PO_4	40-50 mg/l
Organo phosphonate as PO_4 (HEDP, 50-60% active acid content)	80-100 mg/l
pH	7.5 –8.0
Non ionic/anionic surfactant (the calculated quantity shall be based on 30 mg/l and added twice only as given in sub clause 5.4)	30 mg/l

- 5.6 After circulating for 7 days, the system shall be given a heavy blow down without pH adjustment. Regular treatment shall be started when TSS is less than 30 mg/l or close to make up water quality and HEDP is less than 10mg/l as PO_4 .

6.0 MONITORING

The pH, phosphate and phosphonate levels shall be monitored regularly throughout the entire operation and recommended levels shall be maintained.

Frequency of analysis is as follows:

During cleaning with low pH water (clause 4.0) *

pH	:	Once in two hours
TSS/Turbidity	:	Once in four hours
Iron content (Fe)	:	Once in four hours

During phosphate cleaning (clause 5.0) *

pH	:	Once in two hours
Inorganic phosphate	:	Once in two hours
Organic phosphate (Phosphonate):	:	Once in four hours
Iron content (Fe)	:	Once in four hours

*One sample from each unit shall also be collected for analysis.

Before starting the pre-cleaning, contractor shall submit all necessary laboratory analysis procedures for review. Contractor shall make arrangements to set-up a fully equipped laboratory with all the necessary chemicals and instruments along with a qualified chemist prior to the start-up for pre-cleaning. Supply of all the reagents and chemicals are in contractors' scope.

7.0 PRE-TREATMENT EVALUATION

To assure that cleaning and passivation have been effective, a slightly rusted CS corrosion specimen shall be inserted into standard coupon testing assembly fitted to the CW return line or the specimen may be immersed in the cold water channel of the cooling tower and shall be inspected visually from time to time. A standard corrosion coupon may be inserted in the corrosion rack at the cooling tower. This may be used to evaluate the efficiency of the passivation along with the rusted coupon observation. Standard coupon shall show a thin uniform passivation layer. Cleaned and passivated surfaces of any piping or exchangers shall contain no loose rust.

8.0 SPECIFICATION OF CHEMICALS

The chemicals shall conform to the following specifications:

Organo phosphonate (HEDP, active acid content 50-60%)	Testing as per ASTM D515-72 and To be obtained from reputed manufacturer.
SHMP	IS : 574 (latest)
H ₂ SO ₄ (98%)	IS : 266 (latest)
Caustic Soda	Technical grade as per IS:252 (latest)

Contractor shall submit relevant test certificates of his chemicals as a proof of presence of minimum active ingredients in the respective chemical products.

9.0 SAFETY PRECAUTIONS

Normal safety precautions shall be taken for handling of chemicals. Protective clothing and safety items shall be used to prevent any injury during the pre-treatment

operation. Temporary barricades shall be provided around the area where acid and alkali is being handled and entry in to the barricaded area shall be strict with proper safety gears. Contractor shall bring only flame proof pumps and equipment.

NOTES:

1. CW System shall be started with the above pre-treatment program prior to normal treatment.
2. HEDP shall only be used. ATMP shall not be used.
3. During on-stream cleaning, if CW temperature exceeds 40°C, SHMP level as specified in sub clause nos. 5.3 and 5.5 shall be reduced to 20-25mg/l as PO₄.
4. Approximate chemicals requirement for 1000 m³ hold up of CW system:

Organo phosphonate (HEDP, active acid content 50-60%)	140-180 Kg to maintain level of 80-100 mg/l as PO ₄
SHMP	50-60 Kg to maintain a level of 40-50 mg/l as PO ₄
Surfactant	30 Kg To maintain a level of 30 mg/l

Actual requirement of chemicals shall be calculated based on actual hold-up of the system and dosage to maintain specified levels. Further additions of chemicals will depend on laboratory results and to be dosed to maintain specified levels for entire operation.

10.0 TECHNICAL SUPERVISION

The chemical cleaning operation shall be conducted under close chemical controls by the contractor and EIL site. The EIL site may have technical guidance from SMMS.

ANNEXURE-I

TEST PROCEDURE FOR INHIBITOR EFFICIENCY

1.0 PREPARATION OF TEST COUPONS

CS coupons of size 7.5cm x 5cm shall be cut from hot rolled (AISI 1020 or equivalent grade) steel strip or plate. The edges and sharp corners shall be ground smooth. A 5mm diameter hole shall be provided for suspension. The coupons thus prepared shall be used in the tests.

2.0 IDENTIFICATION

The coupons shall be provided with letters and/ or number at one corner using punch.

3.0 SURFACE PREPARATION

For conducting the test to determine inhibitor efficiency, the coupons shall be free from mill-scale by grinding followed by polishing using emery paper. The final surface shall be made bright using emery paper. Coupons for conducting the test of action of cleaning solution in removing mill-scale shall be with the mill scale on. All the coupons shall be weighed separately correct to 1mg using a balance.

4.0 CLEANING SOLUTION

The cleaning solution is the inhibited sulphuric acid. Before addition of acid for low pH cleaning, approx. 1% (or in recommend dosage) CI shall be added to sulphuric acid. The pH of sulphuric acid solution shall be in the range of 4.5-5.0. The solution thus prepared, shall be used for conducting the tests.

5.0 TESTS FOR INHIBITOR EFFICIENCY

Test shall be carried out in duplicates in glass containers preferably in one litre capacity beakers. One litre of cleaning solution each shall be transferred to beakers and the solution shall be heated to the maximum temperature in the specified range for the process. The coupons shall be completely exposed to the action of the acid by suspension from the hole so that the upper edge shall be at least 1cm below the liquid surface. The temperature shall be held as above through-out the duration of the test.

- 5.1 Identical test shall be carried out using un-inhibited acid of the strength equivalent to that of the cleaning solution.
- 5.2 After the exposure of the coupons to the cleaning solution for the duration of actual cleaning, all the coupons shall be removed from the acid solution and cleaned in running tap water to remove acid and finally in distilled water. The coupons shall be dried and transferred to desiccator before weighing.
- 5.3 The weight loss of the coupons shall be determined and the corrosion rates shall be calculated. The average corrosion rate of the coupons exposed to the cleaning solution shall be less than 3% of the average rate thus obtained for the coupons exposed to un-inhibited acid. (I.e. percent corrosion inhibition shall be 97% (min.). Approval of the Engineer-in-Charge shall be obtained for the inhibitor efficiency obtained in the test.



JOB SPECIFICATION FOR DEGREASING OF CARBON STEEL PIPING VESSELS & EQUIPMENT IN AMINE SERVICE

PROJECT : PMC SERVICES FOR POLYPROPYLENE UNIT
& BUTENE-1 OF BINA PETCHEM & REFINERY
EXPANTION PROJECT, (BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION
LIMITED

PMC : ENGINEERS INDIA LIMITED

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1.0 INTENT

This specification governs the requirements of degreasing for Carbon Steel piping, vessels & equipment in amine service. The degreasing of carbon steel piping shall be done by circulation method with 1-2% Sodium Carbonate (Soda Ash) solution and 200 ppm of non-foaming type non-ionic surfactant at 60-80°C temperature till oil and grease level in circulating degreasing liquid become constant.

2.0 SCOPE OF WORK

Scope of work by Contractor shall consist of carrying out degreasing of piping and vessels as indicated in the applicable P & IDs. Work shall include supply of all chemicals, temporary facilities, auxiliaries, boilers & heating coils for heating, laboratory chemicals and equipments, thermometers, valves, pressure gauges, safety gears etc required for satisfactory completion of work. The contractor should make a preliminary assessment of the site conditions and its existing facilities especially availability of HP/MP steam, circulating pumps. Amine tanks etc to make a final assessment of the temporary facilities, auxiliaries and spares that has to be arranged by him for deployment at site. Required numbers of skilled operating and supervisory staff for the degreasing operation need to be deployed by the contractor so as to ensure continuous availability of manpower during the entire operation.

- 2.1** This specification defines the procedure for the degreasing. However, EPC/LSTK Contractor shall prepare the detailed degreasing markup on the applicable P&IDs and submit for EIL review & approval.

3.0 OPERATING CONDITIONS

- 3.1** Degreasing Chemical: 1-2% Sodium Carbonate Solution (Soda Ash) + 200 ppm of non-foaming type non-ionic surfactant (Periminol OTS of M/s. ICI Chemicals, Thane / Surfa Additive X 100 from Kun Chem. Mumbai / M/s. Navdeep Chemicals, Baroda or equivalent).
- 3.2** Degreasing Temperature: 60-80°C.
- 3.3** Potable water can be used for making solution of the degreasing chemical. Heating of the chemical solution can be carried out by steam injection in the solution hold-up tank. In the case of plant steam is not available, then contractor has to arrange his own heating facility by auxiliary boiler or heating coils. If the circuit contain SS piping, vessels & equipment then entire degreasing including flushing shall be done with DM water.
- 3.4** Degreasing period: Degreasing process shall be considered complete when oil and grease level in circulating degreasing liquid becomes constant.

- 3.5** Existing Amine Tank/Pump shall be used as hold-up tank for preparation of degreasing chemical solution. Existing amine pump can be used for transferring chemical solution to the piping/ vessel and circulation.

One additional pump of adequate capacity needs to be kept as *standby* by Contractor which will be taken back by him after completion of work.

4.0 DEGREASING PROCEDURE

4.1 Preparation of Temporary Circuit :

The cleaning shall be carried out by filling and circulating the specified solution in the specified sequence and conditions. Temporary piping and pump of appropriate capacity minimum 100 HP suitable for chemical cleaning to be used for the purpose. All necessary temporary piping, fittings, flanges, pumps, heater coils(if plant steam is not available for heating), boilers, thermometers, flow meter, pressure gauges and temperature gauges, valves, spares, temporary chemical analysis facility with all accessories required for conducting test during cleaning operation, chemicals and safety accessories shall be made available at site prior to chemical cleaning.

- 4.2** Fill the entire circuit with water. Circulate the water with amine pump. Increase the temperature to 60-80°C by MP/HP steam heating in amine tank / sump. Start adding required quantity of soda ash gradually in the amine tank/sump to attain a concentration of 1-2% in the circulating solution followed by 200 ppm non-foaming non-ionic surfactant. Continue circulation of the soda-ash to solution containing surfactant while maintaining the temperature at 60-80°C and monitoring concentration of soda-ash in the circulating solution at 1 hour interval. Follow all permissible operational procedures, including for draining of circulation chemical, as required for safe operation.

Monitor oil / grease every 4 hours in circulating degreasing solution. Continue circulation until oil / grease becomes constant. Drain under permissible conditions. Rinse by several filling and draining operation with DM water. Water used for rinsing shall be DM water only. If amine sump is used for receiving de-aerated water, additional pump will be required to transfer the solution to the circuit.

5.0 NEUTRALIZATION AND DISPOSAL

The necessary arrangement e.g. HDPE Tank / temporary neutralization pit shall be made for complete neutralization of surfactant and disposal system. Prior to discharging of the effluent in the sewer system, it shall be analysed and if necessary, additional chemicals shall be added for neutralisation so that discharged mixtures shall have pH of approximately 7.0 in order to prevent any damage to paving, manholes and sewers etc. Permission shall be taken from the Owner for disposal of neutralized effluent into storm water drain / nearest effluent pit.

6.0 PRECAUTIONS

- 6.1 All piping and vessels shall be taken into circuit for degreasing. Strainers, demisters, activated carbon media, storage tanks and drainage system shall, however, be isolated.
- 6.2 All insulation jobs shall be completed before starting degreasing operations.



JOB SPECIFICATION FOR CHEMICAL CLEANING OF BOILERS BY ALKALI BOIL OUT METHOD

PROJECT : PMC SERVICES FOR POLYPROPYLENE UNIT
& BUTENE-1 OF BINA PETCHEM & REFINERY
EXPANTION PROJECT, (BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION
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- 1.0 GENERAL
- 2.0 SEQUENCE OF OPERATION
- 3.0 CHEMICALS
- 4.0 EQUIPMENT AND ACCESSORIES
- 5.0 ALKALI BOIL OUT PROCEDURE
- 6.0 PRESERVATION
- 7.0 REQUIREMENT OF CHEMICALS
- 8.0 PRE-CHECKLIST

1.0 GENERAL

This specification describes the steps for pre-commissioning Alkali boil out chemical cleaning of CS steam generation boilers. The purpose of alkali boil out is to remove oil, grease, coating materials, foreign matter etc from the boiler internals. This specification is intended for carbon steel surfaces, materials other than carbon steel should not come in contact with the boil out solutions. Filters, venturies, instruments etc., which are sensitive to alkali boil out solutions should be dropped before alkali boil out. Entire steam generating loop starting from BFW inlet to steam drum, risers and downcomers etc. shall be taken into alkali boil out.

2.0 SEQUENCE OF OPERATION

The sequence of operation shall be as follows:

- 2.1 Flushing with DM water / BFW (Boiler Feed Water)
- 2.2 Alkali boil out with Tri sodium phosphate (TSP) and Caustic soda.
- 2.3 Final flushing with DM/ BFW water

3.0 CHEMICALS

The following chemicals are recommended for use in chemical cleaning operations:

- 3.1 Trisodium phosphate, technical grade, conforming to IS:573
- 3.2 Caustic soda technical grade conforming to IS : 252
- 3.3 DM water / B.F. water should be used for preparation of chemical solutions and flushing/rinsing.

4.0 EQUIPMENT AND ACCESSORIES

The equipment and accessories consists of a tank, temporary piping, valves and pumps of appropriate capacity suitable to maintain good velocity (about 0.5 m/sec.), If circulation method is used. All necessary fittings, flanges, heater coils, gasket, thermometers, hydrometers, test coupons, spares, lab facilities for chemicals and safety accessories for operation personnel shall be made available at site prior to alkali boil out. Refer section 8.0 for pre-checklist.

5.0 ALKALI BOIL OUT PROCEDURE

Alkali boil out shall be carried out with 0.5 wt %. Tri sodium phosphate (Na_3PO_4) + 0.30 wt % Caustic soda (NaOH), under actual firing condition of the boiler at half the working pressure for about 24 hours.

- (a) Filling of the boiler with D.M. Water upto the bottom of the drum.
- (b) Addition of alkali solution into the boiler drums from top manhole.
- (c) Filling of boiler up to normal operating level.

(d) Fire the boiler and raise the pressures gradually to half the working pressure.

(e) Alkali solution of specified concentration should be held at this pressure for about 24 hours with hourly blow down from all individual valves intermittently for 1-2 minutes to remove accumulated sludge & deposits etc. The normal level in the drum is to be maintained with makeup water.

(f) Boiler water samples to be taken every two hours for analysis of pH, alkalinity, phosphate, oil, conductivity and silica.

(g) After alkali boil-out, boiler is to be cooled down to 80°C and drain the alkali solution. Flushing and rinsing with D.M. water till pH of inlet & outlet is same.

Note:

1. In case, the firing of boiler is not possible, the above procedure shall be followed by circulation method.

6.0 PRESERVATION

After draining the rinsed water, the system can be taken into circuit or should be completely filled up with Ammoniated hydrazine solution containing 200-300 ppm of Hydrazine at pH 9.5 (with addition of ammonia) for short duration.

7.0 REQUIREMENT OF CHEMICALS

Approximate chemicals required for 1 M3 hold up of system

- Tri sodium Phosphate 6 kg
- Caustic Soda 6 kg

The holdup may be taken as hold-up of steam drums, condensers, interconnecting piping and min. liquid level of 300 mm from bottom of the tank.

8.0 PRE-CHECKLIST

- 1) The stainless steel internal from steam drum shall be removed and kept outside during alkali boil out. Alkali boil out is not good for stainless steel.
- 2) Ensure mechanically remove as much oil and grease as possible and boiler is completely flushed with fresh water from drums and headers before alkaline boiling out.
- 3) Check all drum internals for tightness of bolted parts.
- 4) Ensure there is no loose materials, nuts, bolts, washers, etc. should be left inside the drum and All boiler instruments, leads and sampling line should be isolated

except drum sampling and direct reading level gauge glass (better use temporary gauge glass) in drum.

- 5) Ensure secondary Steam Separators (Scrubbers) can be kept outside the drum as chemicals can stick inside the corrugated surfaces which would be very difficult to clean afterwards. These parts can be mechanically cleaned before fitting into the drum after Alkali Boil Out.
- 6) Ensure all instrument impulse pipes connected to drum except those minimum required during Boiler Pressure-raising should be isolated during the boil-out.
- 7) Ensure hydro test of boiler is completed before alkali.
- 8) Ensure that all temporary anchors made in the boiler during erection has been removed and boiler is free to expand.
- 9) Ensure all expansion reading indicator are erected properly.
- 10) Before introducing chemical to the boiler, particular care should be taken to eliminate possible leaks in the pressure parts and adequate precautions should be taken to protect personnel in the event leaks occur.



JOB SPECIFICATION FOR EXTERNAL CHEMICAL CLEANING AND PASSIVATION OF SS WELDS AND FITTINGS OF TANKS AND PIPES

PROJECT : PMC SERVICES FOR POLYPROPYLENE UNIT
& BUTENE-1 OF BINA PETCHEM & REFINERY
EXPANTION PROJECT, (BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION
LIMITED

PMC : ENGINEERS INDIA LIMITED

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- 1.0 SEQUENCE OF OPERATION
- 2.0 PICKLING PROCEDURE

RECOMMENDED PROCEDURE FOR EXTERNAL CHEMICAL CLEANING AND PASSIVATION OF WELD JOINTS OF SS TANKS AND PIPES

1.0 SEQUENCE OF OPERATION

The sequence of operation shall be as follows:

- 1.1 Wash with D.M. water
- 1.2 Applying the acid pickling paste.
- 1.3 Final wash with DM water

2.0 PICKLING & PASSIVATION PROCEDURE

- 2.1 Wash the girth weld joints, tees elbows of SS with DM water.
- 2.2 Prepare a paste with 15% concentration Nitric acid (on 100% purity basis), 0.1% hydrofluoric acid (on 100% purity basis) and with required quantity of Silica insulation fine grog of 0-0.5mm size with minimum 85% SiO₂. Apply the paste on SS welds joints, and fittings which needs to be cleaned, with a uniform thickness. Allow the paste to be on the surfaces for about 30 minutes.
- 2.3 Remove the acid paste and wash with DM water thoroughly without any traces of paste.

JOB SPECIFICATION FOR PRETREATMENT CUM ON-STREAM CLEANING OF RECIRCULATING FRESH COOLING WATER SYSTEM (SMMS)

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE
CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO
BINA PETCHEM & REFINERY EXPANSION PROJECT
(BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

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- 2.0 PRE-TREATMENT INSPECTION
- 3.0 FLUSHING
- 4.0 CLEANING WITH LOW pH WATER
- 5.0 PHOSPHATE / PHOSPHONATE CLEANING CUM PASSIVATION
- 6.0 MONITORING
- 7.0 PRE-TREATMENT EVALUATION
- 8.0 SPECIFICATION OF CHEMICALS
- 9.0 SAFETY PRECAUTION
- 10.0 TECHNICAL SUPERVISION

ANNEXURE-I: TEST PROCEDURE FOR INHIBITOR EFFICIENCY

Abbreviations:

CS	:	Carbon Steel
CW	:	Cooling Water
CI	:	Corrosion Inhibitor
HEDP	:	Hydroxy Ethylidene Diphosphonic acid
SHMP	:	Sodium Hexa-Meta Phosphate
ATMP	:	Amino Tri-Methylene Phosphoric acid
TSS	:	Total suspended solids

1.0 GENERAL

- 1.1 This recommended procedure provides the measures for on-stream cleaning and passivation of CS metal surfaces of CW system. The pretreatment involves two steps as follows:

- i. Thorough cleaning of the metal surface.
- ii. Development of a protective (passive) film on the metal surface.

Pre-treatment applies to all metals except SS (Stainless Steel) and SDSS but is directed primarily to CS surfaces. Pre-treatment applies to pipeline, piping, coolers and any equipment which will come in contact with the cooling water.

Exchangers whose cooling water side MOC is other than CS (like SS & SDSS) need not be included for cleaning cum passivation procedure as per this procedure.

- 1.2 This specification defines the procedure for the chemical cleaning and passivation. However, EPC/LSTK Contractor shall prepare the detailed chemical cleaning markup on the applicable P&IDs and submit for EIL review & approval.
- 1.3 Normally microbiological fouling, deposits of phosphates, iron oxides and calcium carbonate scales are expected on CW side. For effective film formation/maintenance by the CI, the metal surfaces shall be free from the foulants and deposits. Fouled surfaces can give rise to severe pitting and localized corrosion.
- 1.4 Pre-cleaning cum passivation shall be applied to the entire CW system.
- 1.5 After the pre-treatment is over, the system shall be rapidly switched over to the regular chemical treatment by a suitable specialized CW treatment chemical agency for continuous protection of passivated CW exchangers.
- 1.6 In case of pre-cleaning cum passivation of isolated units (like new units in an existing plant or non-availability of cooling tower sump/pumps), contractor shall arrange the following:
- a) Temporary tanks of suitable volume.
 - b) Pumps (1 working + 1 standby) of suitable capacity and head to maintain min. flow velocity of 1.5 m/s and full bore flow.
 - c) Temporary piping from temporary tank to unit cooling water inlet and outlet headers.
- 1.7 Where lines are required to be chemically cleaned, the limit of cleaning in branch lines (which are not marked or not necessary) shall be to the first block valve or flange.

2.0 PRE-TREATMENT INSPECTION

Prior to pre-treatment, the equipment shall be inspected and if found to contain excessive corrosion products, deposits or foulant, the equipment shall be cleaned with an appropriate cleaning procedure. The CW treatment vendor shall ensure the completion of the cleaning and inspection.

3.0 FLUSHING

- 3.1 Cooling tower basin and sump should be filled with fresh water, drained and cleaned. All sludge should be mechanically removed if required.
- 3.2 All coolers/exchangers shall be kept isolated during entire period of flushing. Prior to the flushing, jump-over shall be provided at the inlet & outlet of the exchangers in such a manner that exchangers can be taken into line at a later stage quickly.
- 3.3 Provision shall be made to flush out water at dead ends of all units. Permanent dummieing /capping of farthest ends of CW circuits (both supply and return headers) shall be carried out only after flushing of the circuits. Necessary temporary piping to discharge chemical cleaning effluent away from process units shall be made by the contractor.
- 3.4 Start filling the system with fresh water for open flushing. Open flushing is to be carried out thoroughly to remove all extraneous matter, loose scales, corrosion products, microbiological debris, mud, lumber chips, paper etc from entire CW system. Once the system is filled, return water to the CW tower is to be drained from the blow down valves. Also, intermittent blowdown from lowest drain points in the unit shall be done during open flushing. Flushing is to be carried out till return water is visibly clear.
- 3.5 Fill the system with fresh water with the blow down valve closed and start circulating the water. All exchangers shall remain offline. Intermittent blow down are to be carried out from cell basin and from the unit lowest points.
- 3.6 Open the blow down valve and flush the system with fresh raw water make up for 24 hours. At the end of closed flushing, blow down water quality shall be equal to make-up fresh water.

4.0 CLEANING WITH LOW pH WATER

- 4.1 All the equipment, headers, piping and coolers shall be taken into circuit and the system shall be put into circulation. Blow down shall be stopped. However coolers/exchangers shall be kept isolated during the initial stage for the first 24 hrs of low pH cleaning.
- 4.2 The pH of circulating water shall be adjusted in the range of 4.5-5.0 by addition of sulphuric acid.
- 4.3 Before addition of acid for low pH cleaning, approx. 1% or manufacturers recommended dosage of Corrosion Inhibitor (Rodine-92 or equivalent) shall be added to sulphuric acid. Prior to the start of chemical cleaning, Contractor shall demonstrate the efficiency of CI by using CS coupons dipped in non inhibited and inhibited acid solutions as per the annexure-I.
- 4.4 The pH shall be held in this range for at least 24 hours. Intermittent blow down/draining is required from blinded or isolated lines, equipments, exchangers etc.
- 4.5 Thereafter blow down is to be carried out to reduce TSS & iron content. Those lines which are isolated or blinded shall be thoroughly open flushed. Subsequently, makeup water is added to raise the pH to 6.5. Blow down is to be carried out till TSS and iron content of make-up and effluent water are same.

- 4.6 All jump-over provided at exchangers are to be removed and exchangers are to be taken into line.
- 4.7 The pH shall be adjusted to 5.0-5.5 by addition of inhibited acid and circulation shall be continued.
- 4.8 After 48 hours of circulation, blow down shall be started & continued till suspended solids/Turbidity are < 30 mg/l/30 NTU or close to the make-up water quality.

5.0 PHOSPHATE / PHOSPHONATE CLEANING CUM PASSIVATION

- 5.1 The pH of the circulating water shall be adjusted in the range of 7.5- 8.0 by reducing the acid dose and shall be held in this range throughout the phosphate / phosphonate cleaning operation. All blow down from the system shall be closed.
- 5.2 Organo Phosphonate HEDP shall be added by gravity to build up a level of 80-100 mg/l as PO_4 . HEDP shall be dosed very slowly as this will depress the pH of the CW. If necessary, caustic soda may be added in CW system to maintain pH in the range of 7.5-8.0.
- 5.3 SHMP solution shall be added to build up a level of 40-50 mg/l as PO_4 . SHMP shall be dosed after HEDP addition is complete and pH is stabilized.
- 5.4 When phosphate / phosphonate levels and pH are stabilized, preferably ethylene oxide based non-ionic surfactant or alkyl aryl sulphonate based anionic surface active agents @ 30 mg/l (based on total hold up) shall be dosed slowly. This shall also be dosed at the same rate again after 24 hours. This will produce foam in the system. Hence precautions shall be taken for operation of CW pumps.
- 5.5 Circulation shall be continued under this condition for a period of 7 days and following levels of chemicals shall be maintained in the CW system for this period:

SHMP as PO_4	40-50 mg/l
Organo phosphonate as PO_4 (HEDP, 50-60% active acid content)	80-100 mg/l
pH	7.5 –8.0
Non ionic/anionic surfactant (the calculated quantity shall be based on 30 mg/l and added twice only as given in sub clause 5.4)	30 mg/l

- 5.6 After circulating for 7 days, the system shall be given a heavy blow down without pH adjustment. Regular treatment shall be started when TSS is less than 30 mg/l or close to make up water quality and HEDP is less than 10mg/l as PO_4 .

6.0 MONITORING

The pH, phosphate and phosphonate levels shall be monitored regularly throughout the entire operation and recommended levels shall be maintained.

Frequency of analysis is as follows:

During cleaning with low pH water (clause 4.0) *

pH	:	Once in two hours
TSS/Turbidity	:	Once in four hours
Iron content (Fe)	:	Once in four hours

During phosphate cleaning (clause 5.0) *

pH	:	Once in two hours
Inorganic phosphate	:	Once in two hours
Organic phosphate (Phosphonate):	:	Once in four hours
Iron content (Fe)	:	Once in four hours

*One sample from each unit shall also be collected for analysis.

Before starting the pre-cleaning, contractor shall submit all necessary laboratory analysis procedures for review. Contractor shall make arrangements to set-up a fully equipped laboratory with all the necessary chemicals and instruments along with a qualified chemist prior to the start-up for pre-cleaning. Supply of all the reagents and chemicals are in contractors' scope.

7.0 PRE-TREATMENT EVALUATION

To assure that cleaning and passivation have been effective, a slightly rusted CS corrosion specimen shall be inserted into standard coupon testing assembly fitted to the CW return line or the specimen may be immersed in the cold water channel of the cooling tower and shall be inspected visually from time to time. A standard corrosion coupon may be inserted in the corrosion rack at the cooling tower. This may be used to evaluate the efficiency of the passivation along with the rusted coupon observation. Standard coupon shall show a thin uniform passivation layer. Cleaned and passivated surfaces of any piping or exchangers shall contain no loose rust.

8.0 SPECIFICATION OF CHEMICALS

The chemicals shall conform to the following specifications:

Organo phosphonate (HEDP, active acid content 50-60%)	Testing as per ASTM D515-72 and To be obtained from reputed manufacturer.
SHMP	IS : 574 (latest)
H ₂ SO ₄ (98%)	IS : 266 (latest)
Caustic Soda	Technical grade as per IS:252 (latest)

Contractor shall submit relevant test certificates of his chemicals as a proof of presence of minimum active ingredients in the respective chemical products.

9.0 SAFETY PRECAUTIONS

Normal safety precautions shall be taken for handling of chemicals. Protective clothing and safety items shall be used to prevent any injury during the pre-treatment

operation. Temporary barricades shall be provided around the area where acid and alkali is being handled and entry in to the barricaded area shall be strict with proper safety gears. Contractor shall bring only flame proof pumps and equipment.

NOTES:

1. CW System shall be started with the above pre-treatment program prior to normal treatment.
2. HEDP shall only be used. ATMP shall not be used.
3. During on-stream cleaning, if CW temperature exceeds 40°C, SHMP level as specified in sub clause nos. 5.3 and 5.5 shall be reduced to 20-25mg/l as PO₄.
4. Approximate chemicals requirement for 1000 m³ hold up of CW system:

Organo phosphonate (HEDP, active acid content 50-60%)	140-180 Kg to maintain level of 80-100 mg/l as PO ₄
SHMP	50-60 Kg to maintain a level of 40-50 mg/l as PO ₄
Surfactant	30 Kg To maintain a level of 30 mg/l

Actual requirement of chemicals shall be calculated based on actual hold-up of the system and dosage to maintain specified levels. Further additions of chemicals will depend on laboratory results and to be dosed to maintain specified levels for entire operation.

10.0 TECHNICAL SUPERVISION

The chemical cleaning operation shall be conducted under close chemical controls by the contractor and EIL site. The EIL site may have technical guidance from SMMS.

ANNEXURE-I

TEST PROCEDURE FOR INHIBITOR EFFICIENCY

1.0 PREPARATION OF TEST COUPONS

CS coupons of size 7.5cm x 5cm shall be cut from hot rolled (AISI 1020 or equivalent grade) steel strip or plate. The edges and sharp corners shall be ground smooth. A 5mm diameter hole shall be provided for suspension. The coupons thus prepared shall be used in the tests.

2.0 IDENTIFICATION

The coupons shall be provided with letters and/ or number at one corner using punch.

3.0 SURFACE PREPARATION

For conducting the test to determine inhibitor efficiency, the coupons shall be free from mill-scale by grinding followed by polishing using emery paper. The final surface shall be made bright using emery paper. Coupons for conducting the test of action of cleaning solution in removing mill-scale shall be with the mill scale on. All the coupons shall be weighed separately correct to 1mg using a balance.

4.0 CLEANING SOLUTION

The cleaning solution is the inhibited sulphuric acid. Before addition of acid for low pH cleaning, approx. 1% (or in recommend dosage) CI shall be added to sulphuric acid. The pH of sulphuric acid solution shall be in the range of 4.5-5.0. The solution thus prepared, shall be used for conducting the tests.

5.0 TESTS FOR INHIBITOR EFFICIENCY

Test shall be carried out in duplicates in glass containers preferably in one litre capacity beakers. One litre of cleaning solution each shall be transferred to beakers and the solution shall be heated to the maximum temperature in the specified range for the process. The coupons shall be completely exposed to the action of the acid by suspension from the hole so that the upper edge shall be at least 1cm below the liquid surface. The temperature shall be held as above through-out the duration of the test.

- 5.1 Identical test shall be carried out using un-inhibited acid of the strength equivalent to that of the cleaning solution.
- 5.2 After the exposure of the coupons to the cleaning solution for the duration of actual cleaning, all the coupons shall be removed from the acid solution and cleaned in running tap water to remove acid and finally in distilled water. The coupons shall be dried and transferred to desiccator before weighing.
- 5.3 The weight loss of the coupons shall be determined and the corrosion rates shall be calculated. The average corrosion rate of the coupons exposed to the cleaning solution shall be less than 3% of the average rate thus obtained for the coupons exposed to un-inhibited acid. (I.e. percent corrosion inhibition shall be 97% (min.). Approval of the Engineer-in-Charge shall be obtained for the inhibitor efficiency obtained in the test.



JOB SPECIFICATION FOR CHEMICAL CLEANING OF VHP / HP STEAM PIPING (SMMS)

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE
CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO
BINA PETCHEM & REFINERY EXPANSION PROJECT
(BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

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- 1.0 SCOPE
- 2.0 OBJECTIVE
- 3.0 SEQUENCE OF OPERATION
- 4.0 PREPARATION OF TEMPORARY CIRCUITS
- 5.0 PROCEDURE
- 6.0 CHEMICALS
- 7.0 NEUTRALISATION AND DISPOSAL
- 8.0 SAFETY PRECAUTIONS

1.0 SCOPE

This technical specification covers the minimum requirement for chemical cleaning and passivation of the fabricated and erected carbon steel VHP/HP Steam piping at site prior to commissioning by chemical circulation method.

This specification defines the procedure for the chemical cleaning. However, EPC/LSTK Contractor shall prepare the detailed chemical cleaning markup on the applicable P&IDs and submit for EIL review & approval.

2.0 OBJECTIVE

The objective of chemical cleaning of carbon steel VHP/HP Steam piping is to remove the loose rust, dislodging the burs, welding slag and mill scales adhering to the internal surfaces of piping. This procedure specifies the method of cleaning and passivation of internal surface of piping based on the use of inhibited ammoniated citric acid followed by passivation with Tri sodium phosphate (Na_3PO_4) + Sodium nitrate (NaNO_2) circulation. Any deviation to this specification should be recorded and discussed with OWNER/EIL prior to application.

3.0 SEQUENCE OF OPERATION

The cleaning of piping shall be carried out in the following sequence:-

- (a) Flushing with potable water to remove dirt, dust, loose rust and foreign matter followed by DM / BFW water flushing.
- (b) Degreasing with Sodium Hydroxide (caustic Soda).
- (c) Flushing with DM/ BFW till inlet and outlet water pH is same.
- (d) Circulating with ammoniated inhibited citric acid
- (e) Flushing with DM/ BFW
- (f) Circulating with Tri sodium phosphate (Na_3PO_4) + Sodium Nitrite (NaNO_2)
- (g) Drain, dry and take the system into service
- (h) If the pipe is not taken into service immediately after drying the pipe should be filled with N_2 and capped at both ends.

4.0 PREPARATION OF TEMPORARY CIRCUITS:

Temporary piping, pumps of suitable capacity, fittings, flanges, tanks, gaskets, heating arrangement, hydrometers, valves, test coupons, spares, laboratory facilities with all accessories required for conducting tests during cleaning operation, chemicals and safety accessories for operation, qualified personnel etc. shall be arranged by contractor at site prior to cleaning operation. The contractor of chemical cleaning shall prepare all the necessary temporary chemical cleaning circuits at site and submit for approval by owner before execution. Quantity of chemicals required should be calculated based on the total hold-up volume. Pumps of suitable capacity shall be arranged at site by the contractor.

5.0 PROCEDURE

- 5.1 The circuit (Loop) shall be checked with circulation of potable water to check tightness. Any leakage if observed to be attended and tightened.
- 5.2 The circuit shall be flushed initially with potable water to remove all extraneous matter, dirt and dust etc. followed by DM water flushing.
- 5.3 Filling and circulation of sodium Hydroxide (caustic soda) solution of 1% wt in DM/BFW (concentration on 100% purity basis) at 65-75°C temperature for 2 hrs.
- 5.4 Drain the sodium Hydroxide solution. Fill with DM/BFW and drain. The operation of rinsing with DM water should be continued till pH of water at inlet and outlet ends are same.
- 5.5 Filling and circulation of ammoniated citric acid of 3% concentration (on 100% purity basis) by weight in DM/BFW with pH being adjusted to 3.5 - 4.0 with ammonia and 0.1% corrosion inhibitor Rodine- 92 or equivalent by weight. The temperature of circulating citric acid solution should be 80°C. The circulation should be continued for 6 hrs. or till iron and acid concentration are stabilized.
- 5.6 During circulation of ammoniated citric acid, the total iron content of the circulating solution should not exceed 5000 mg/litre (with 3% w/w citric acid solution) and pH should be maintained at 3.5-4.0. If at any stage total iron content exceeds 5000 mg/liter, the acid should be drained in part and replaced with fresh acid.
- 5.7 Drain the citric acid and rinse with DM/BFW. Fill with DM/BFW and the operation of rinsing should be continued till pH at inlet and outlet ends of water are same.
- 5.8 Fill with Tri Sodium phosphate (1%) + Sodium Nitrite(0.5%) by weight (on 100% purity basis) and circulate for 2 hrs. drain, allow to self dry and finally dry with compressed instrument air.
- 5.9 If the pipe is not taken into service immediately after drying, the pipe should be filled with N2 and capped at both ends.
- 5.10 Suitable highpressure pumps with necessary flow rate should be provided by the contractor to maintain good velocity (preferably 0.5-1.0 M/Sec.) throughout operations of chemical cleaning and there should be effective return of flow from the outlet and the vent.

6.0 CHEMICALS & UTILITIES

Chemicals used for chemical cleaning should conform to the following specifications.

- 6.1 Citric acid monohydrate conforming to IS : 5464-1970-Gr.2 (latest edition)
- 6.2 Rodine 92 or equivalent
- 6.3 Ammonia (Technical grade.)
- 6.4 Sodium Hydroxide (NaOH) Technical grade conforming to IS:252 latest edition
- 6.5 Tri sodium phosphate (Na_3PO_4) technical grade as per IS :573
- 6.6 NaNO_2 IS-879-1981 (latest edition)
- 6.7 Potable water (chlorides 50ppm maximum)
- 6.8 DM water

7.0 NEUTRALIZATION AND DISPOSAL OF CHEMICALS

The necessary arrangement for neutralization like HDPE tank/temporary neutralization pit shall be made available for complete neutralization of pickling acids and alkalis. Prior to discharging of effluent in the sewer system, it shall be analyzed and if necessary, additional chemicals shall be added for complete neutralization so that discharged mixtures shall have pH 7.0 in order to prevent any damage to

paving, manholes and sewers etc. Permission shall be taken from engineer-in-charge/OWNER for disposal of neutralized effluent into storm water drain / nearest Effluent pit etc.

8.0 SAFETY PRECAUTIONS

The alkali and acid solutions involved for chemical cleaning are corrosive for the skin and proper care shall be taken in the handling of the chemicals.



JOB SPECIFICATION FOR CHEMICAL CLEANING OF BOILERS BY ALKALI BOIL OUT METHOD (SMMS)

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE
CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO
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(BPREP)

OWNER : M/s BHARAT PETROLEUM COOPERATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

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- 1.0 GENERAL
- 2.0 SEQUENCE OF OPERATION
- 3.0 CHEMICALS
- 4.0 EQUIPMENT AND ACCESSORIES
- 5.0 ALKALI BOIL OUT PROCEDURE
- 6.0 PRESERVATION
- 7.0 REQUIREMENT OF CHEMICALS
- 8.0 PRE-CHECKLIST
- 9.0 NEUTRAILIZATION AND DISPOSAL

1.0 GENERAL

This specification describes the steps for pre-commissioning Alkali boil out chemical cleaning of CS steam generation boilers. The purpose of alkali boil out is to remove oil, grease, coating materials, foreign matter etc from the boiler internals. This specification is intended for carbon steel surfaces, materials other than carbon steel should not come in contact with the boil out solutions. Filters, venturies, instruments etc., which are sensitive to alkali boil out solutions should be dropped before alkali boil out. Entire steam generating loop starting from BFW inlet to steam drum, risers and downcomers etc. shall be taken into alkali boil out.

This specification defines the procedure for the alkali boilout. However, EPC/LSTK Contractor shall prepare the detailed markup on the applicable P&IDs and submit for EIL review & approval.

2.0 SEQUENCE OF OPERATION

The sequence of operation shall be as follows:

- 2.1 Flushing with DM water / BFW (Boiler Feed Water)
- 2.2 Alkali boil out with Tri sodium phosphate (TSP) and Caustic soda.
- 2.3 Final flushing with DM/ BFW water

3.0 CHEMICALS

The following chemicals are recommended for use in chemical cleaning operations:

- 3.1 Trisodium phosphate, technical grade, conforming to IS:573
- 3.2 Caustic soda technical grade conforming to IS : 252
- 3.3 DM water / B.F. water should be used for preparation of chemical solutions and flushing/rinsing.

4.0 EQUIPMENT AND ACCESSORIES

The equipment and accessories consists of a tank, temporary piping, valves and pumps of appropriate capacity suitable to maintain good velocity (about 0.5 m/sec.), If circulation method is used. All necessary fittings, flanges, heater coils, gasket, thermometers, hydrometers, test coupons, spares, lab facilities for chemicals and safety accessories for operation personnel shall be made available at site prior to alkali boil out. Refer section 8.0 for pre-checklist.

5.0 ALKALI BOIL OUT PROCEDURE

Alkali boil out shall be carried out with 0.5 wt %. Tri sodium phosphate (Na_3PO_4) + 0.30 wt % Caustic soda (NaOH), under actual firing condition of the boiler at half the working pressure for about 24 hours.

- (a) Filling of the boiler with D.M. Water upto the bottom of the drum.
- (b) Addition of alkali solution into the boiler drums from top manhole.
- (c) Filling of boiler up to normal operating level.

- (d) Fire the boiler and raise the pressures gradually to half the working pressure.
- (e) Alkali solution of specified concentration should be held at this pressure for about 24 hours with hourly blow down from all individual valves intermittently for 1-2 minutes to remove accumulated sludge & deposits etc. The normal level in the drum is to be maintained with makeup water.
- (f) Boiler water samples to be taken every two hours for analysis of pH, alkalinity, phosphate, oil, conductivity and silica.
- (g) After alkali boil-out, boiler is to be cooled down to 80°C and drain the alkali solution. Flushing and rinsing with D.M. water till pH of inlet & outlet is same.

Note:

1. In case, the firing of boiler is not possible, the above procedure shall be followed by circulation method.

6.0 PRESERVATION

After draining the rinsed water, the system can be taken into circuit or should be completely filled up with Ammoniated hydrazine solution containing 200-300 ppm of Hydrazine at pH 9.5 (with addition of ammonia) for short duration.

7.0 REQUIREMENT OF CHEMICALS

Approximate chemicals required for 1 M3 hold up of system

- Tri sodium Phosphate	6 kg
- Caustic Soda	6 kg

The holdup may be taken as hold-up of steam drums, condensers, interconnecting piping and min. liquid level of 300 mm from bottom of the tank.

8.0 PRE-CHECKLIST

- 1) The stainless steel internal from steam drum shall be removed and kept outside during alkali boil out. Alkali boil out is not good for stainless steel.
- 2) Ensure mechanically remove as much oil and grease as possible and boiler is completely flushed with fresh water from drums and headers before alkaline boiling out.
- 3) Check all drum internals for tightness of bolted parts.
- 4) Ensure there is no loose materials, nuts, bolts, washers, etc. should be left inside the drum and All boiler instruments, leads and sampling line should be isolated except drum sampling and direct reading level gauge glass (better use temporary gauge glass) in drum.
- 5) Ensure secondary Steam Separators (Scrubbers) can be kept outside the drum as chemicals can stick inside the corrugated surfaces which would be very difficult to

clean afterwards. These parts can be mechanically cleaned before fitting into the drum after Alkali Boil Out.

- 6) Ensure all instrument impulse pipes connected to drum except those minimum required during Boiler Pressure-raising should be isolated during the boil-out.
- 7) Ensure hydro test of boiler is completed before alkali.
- 8) Ensure that all temporary anchors made in the boiler during erection has been removed and boiler is free to expand.
- 9) Ensure all expansion reading indicator are erected properly.
- 10) Before introducing chemical to the boiler, particular care should be taken to eliminate possible leaks in the pressure parts and adequate precautions should be taken to protect personnel in the event leaks occur.

9.0 NEUTRALIZATION AND DISPOSAL

Contractor shall finalize the disposal scheme in consultation with OWNER/PMC before start of the chemical cleaning activity and shall comply to all the necessary OWNER's requirements. The contractor shall make necessary arrangement for complete neutralization of all effluents like acids & alkalis. The effluents shall be analyzed before discharging and if necessary, additional chemicals shall be added for neutralization so that discharged mixtures shall have pH ~7.0.



JOB SPECIFICATION FOR EXTERNAL CHEMICAL CLEANING AND PASSIVATION OF SS WELDS AND FITTINGS OF TANKS AND PIPES (SMMS)

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE
CRACKER UNIT AND UTILITIES & OFFSITES
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1.0	SEQUENCE OF OPERATION
2.0	PICKLING PROCEDURE

RECOMMENDED PROCEDURE FOR EXTERNAL CHEMICAL CLEANING AND PASSIVATION OF WELD JOINTS OF SS TANKS AND PIPES

1.0 SEQUENCE OF OPERATION

The sequence of operation shall be as follows:

- 1.1 Wash with D.M. water
- 1.2 Applying the acid pickling paste.
- 1.3 Final wash with DM water

2.0 PICKLING & PASSIVATION PROCEDURE

- 2.1 Wash the girth weld joints, tees elbows of SS with DM water.
- 2.2 Prepare a paste with 15% concentration Nitric acid (on 100% purity basis), 0.1% hydrofluoric acid (on 100% purity basis) and with required quantity of Silica insulation fine grog of 0-0.5mm size with minimum 85% SiO₂. Apply the paste on SS welds joints, and fittings which needs to be cleaned, with a uniform thickness. Allow the paste to be on the surfaces for about 30 minutes.
- 2.3 Remove the acid paste and wash with DM water thoroughly without any traces of paste.

JOB SPECIFICATION FOR SURFACE PREPARATION AND PROTECTIVE COATING (SMMS)

**PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE
CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO
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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
OEM	:	Original Equipment Manufacturer
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
EIC	:	Engineer-In-Charge
SMMS	:	Specialist Materials & Maintenance Services

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1.0 GENERAL

- 1.1 This 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 in consultation with EIL-SMMS.
- 1.2 This specification covers the requirement for protective coating for new construction, revamp and refurbishment.

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 coatings on external surfaces of items mentioned in clause 2.2 of this specification and quality control, inspection & testing of the coating systems. The items listed in clause 2.2 and the heading of tables of paint systems are non-exhaustive. 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 contract requirement, technical data sheets and drawings etc.

As a special requirement of this PROJECT, Contractor/fabricator/supplier of insulated equipment like vessels, reactors, columns and equipment shall identify the type of under insulation coating required based on the criticality of the equipment in consultation with BPCL/EIL. Prior approval of BPCL/EIL is a mandatory requirement in this case.

2.2 Extent of work covered in this specification

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

- a. All Carbon Steel structures.
- b. All Carbon Steel and Alloy steel piping, equipment, valves, fittings & stacks.
- c. All Carbon Steel and Alloy steel tanks.
- d. Tanks internal as per applicable datasheets, drawings & contract requirements.
- e. All insulated CS, LAS, & alloy steel pipes, equipment, vessels, reactors, valves, fittings & stacks.
- f. All insulated SS, DSS & SDSS pipes, equipment, vessels, reactors valves, fittings, vessels & stacks.
- g. All insulated critical CS, LTCS. SS & alloy steel equipment like vessels, reactors, column & equipment

(application of Thermally sprayed aluminum coating based on the criticality)

- h. All structural steel supports, walkways, handrails, ladders, platforms etc.
- i. Flare lines, external surfaces of steel chimney with or without refractory lining and internal surfaces of steel chimney without refractory lining.
- j. RCC structures as per applicable drawings/relevant documents.

2.2.2 Marking and Identification of painted items:

- a. Identification of color bands on all piping, as required, including aluminum cladding over insulation, galvanized, SS and nonferrous piping.
- b. Identification lettering/ numbering on all painted surfaces of equipment/piping, aluminum cladding over insulation, galvanized, SS and non-ferrous piping.
- c. Marking / identification signs on painted surfaces of equipment and piping including hazardous service.

2.2.3 Supply and prequalification testing of all primers, paints and all other materials required for painting (other than OWNER supplied materials)

2.2.4 Application of pre-erection/fabrication and shop primer.

2.2.5 Repair work of damaged pre-erection/ fabrication and shop primer and weld joints in the field/site before and after erection.

2.2.6 Quality control, testing and inspection during all stages of work (surface preparation, application of coating and testing of applied coating).

2.2.7 Exclusions:

- (a). All metallic surfaces do require painting except for following materials. These materials are not painted unless specified by the contractual provisions and the same shall be painted as per the relevant specifications:
 - Un-insulated stainless steel.
 - Plastic and/or plastic-coated materials.
 - Galvanized Iron.
 - Aluminum.
 - Ni-Alloys.
 - Glass.
 - Ceramics.
 - Machined surfaces.

- Label and names plates.

Note: Galvanized steel doesn't require painting for corrosion protection. However, if painting is mandated due to OWNERS instructions/contractual provision/ for colour coding requirement mentioned in this specification or by OWNER, then the coating system in Table 4.0 shall be followed.

- (b). This specification does not include fire retardant paints/intumescent epoxy coatings, and the EIL specification B957-999-06-43-IF01 addresses the same.

3.0 REFERENCE CODES & STANDARDS

3.1 Latest editions of the following codes and standards are applicable for the work covered by this specification:

American Society for Testing and Materials (ASTM):

ASTM Volume 6.01	Paint - Tests for Chemical, Physical, and Optical Properties; Appearance
ASTM Volume 6.03	Paint -- Pigments, Polymers, Resins, Naval Stores, Cellulosic Esters, and Ink Vehicles
ASTM D6677	Standard Test Method for Evaluating Adhesion by Knife
ASTM D5894	Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D870	Standard Practice for Testing Water Resistance of Coatings Using Water Immersion
ASTM D2485	Standard Test Methods for Evaluating Coatings for High Temperature Service
ASTM D2247	Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D4060	Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D4752	Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D4940	Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blast Cleaning Abrasives
ASTM D4285	Standard Test Method for Indicating Oil or Water in Compressed Air
ASTM D543	Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents

ASTM C868	Standard Test Method for Chemical Resistance of Protective Linings
ASTM G42	Standard Test Method for Cathodic Disbonding of Pipeline Coatings Subjected to Elevated Temperatures
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D1475	Standard Test Method for Density of Liquid Coatings, Inks, and Related Products
ASTM D823	Standard Practices for Producing Films of Uniform Thickness of Paint, Coatings and Related Products on Test Panel
ASTM D2369	Standard Test Method for Volatile Content of Coatings
ASTM D1640/D1640M-14	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings
ASTM D522/D522M	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1044	Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion
ASTM D1849	Standard Test Method for Package Stability of Paint
ASTM D2247	Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity
ASTM D5146	Standard Guide to Testing Solvent-Borne Architectural Coatings
ASTM D4258	Standard Practice for Surface Cleaning Concrete for Coating
ASTM D4259	Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application

Steel Structures Painting Council (SSPC)

SSPC SP-1	Solvent cleaning
SSPC Painting manual Vol.1	Good Painting practices
SSPC Painting manual Vol.2	Systems & specification
SSPC VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC AB1	Mineral and Slag Abrasives
SSPC PA 2	Measurement of Dry Paint Thickness with Magnetic Gauges

Association for Materials Protection and Performance (AMPP)

NACE RP 0287	Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape
NACE SP 0198	Control of Corrosion under Thermal Insulation and Fireproofing Materials

NACE SP 0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

International Organization for Standardization (ISO):

ISO 12944	Corrosion Protection of steel Structures by Protective Paint System
ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles- Specifications and test methods.
ISO 8501-1/ SIS-05 59 00	Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness— Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
ISO 8502-3	Preparation of steel substrates before application of paints and related products -Tests for the assessment of surface cleanliness - Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)
ISO 8502-9	Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness—Part 9: Field method for the conductometric determination of water-soluble salts
ISO 2808	Paints and varnishes - Determination of film thickness
ISO 2811	Paints and varnishes — Determination of density

Other Standards

IS 5	Colors for ready mix paints and enamel
NORSOK M-501	Surface preparation and protective coating
RAL CLASSIC	Color matching system
ACI 308	External Curing of Cast-in-Place Concrete— Specification
ACI 301	Specifications for Structural Concrete
ACI 562	Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures
ACI 546	Concrete repair guide

4.0 SURFACE PREPARATION

4.1 General

Adhesion of the paint film to the surface depends largely on the degree of cleanliness of the metal surface and proper surface preparation have large contribution to the success of the paint protective system. Following method shall be employed for surface preparation:

- Abrasive blast cleaning: Applicable in all cases.
- Mechanical or power tool cleaning: Shall be used for repair & touch up, and any other area due to practical constraints with prior permission from EIL Engineer-in charge.

4.2 Applicable Standards:

Latest editions of the following codes and standards are applicable for the surface preparation work:

TABLE-1: SURFACE PREPARATION STANDARDS

Sl. No.	GRADE OF SURFACE CLEANLINESS	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)		
		ISO 8501-1/ SIS-05 59 00	SSPC, USA	NACE, USA
1.	Solvent cleaning	-	SSPC-SP-1	-
2.	Manual or hand tool cleaning	St 2	SSPC-SP-2	-
3.	Mechanical or power tool cleaning	St 3	SSPC-SP-3	-
4.	White metal	Sa 3	SSPC-SP-5	NACE No.1
5.	Near white metal	Sa 2½	SSPC-SP-10	NACE No.2
6.	Commercial Blast	Sa 2	SSPC-SP-6	NACE No.3
7.	Brush-off Blast for SS, galvanized steel and non-ferrous metals	-	SSPC-SP-16	-
8.	Surface Preparation of Concrete	-	SSPC-SP-13	NACE No.6

4.3 Sequence of surface preparation:

4.3.1 Solvent Cleaning

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

4.3.2 Blast cleaning with abrasives

The surfaces shall be blast cleaned using one of the abrasives listed below and at an appropriate distance & angle depending on nozzle size maintaining constant velocity and pressure.

- 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.
- On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust. 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. If possible, a vacuum collector shall be installed to collect and recycle the abrasives.

- d. Surface roughness profile: The surface roughness profile for carbon steel and low alloy steels to be coated shall be in accordance with the written recommendations of the paint Manufacturer and shall be measured as per ASTM D4417, method B. When roughness profile is not specified by the paint Manufacturer, then surface roughness profile as specified below in this specification shall be followed.
- The surface roughness profile shall be between 40 µm and 70 µm for coatings up to thickness 500 µm and between 70 µm and 125 µm for coating systems over 500 µm thickness. In all cases, the surface roughness shall have a sharp angular profile.
 - If stainless steel, hot dip galvanised or non-ferrous metal surfaces are to be painted then blast cleaning shall be carried out as per SSPC-SP-16, using a fine non-iron containing abrasive.
 - On galvanised surfaces, the zinc layer shall not be damaged; a smooth uniform surface roughness shall be achieved. No defects such as break through or crisping of the zinc layer shall occur. The surface roughness shall be in the range of 20 µm to 30 µm or as agreed with the paint Manufacturer.
- e. Abrasives: Abrasive for use in blast cleaning steels shall be in accordance with ISO 8504-2. Steel or iron grit is commonly used as recyclable abrasives. When steel shot is used, it shall be used together with steel grit. The shot content of such a mix shall not exceed 67 %. For blasting stainless steel, non-(free) iron containing abrasive shall be used, e.g. Garnet or aluminium oxide. Abrasives used for blast cleaning shall be free from oil, grease, moisture, chloride contamination etc. and shall have crystalline silica not more than 1%.

Test methods for abrasives shall be in accordance with the tests specified in the ISO 11125 and ISO 11127 series for metallic and non-metallic abrasives respectively. Each batch of abrasive should be tested to check that the abrasive meets the requirements as specified in the relevant ISO standard. The conductivity of non-metallic abrasives to be used for stainless steels shall be maximum 15 mS/m. For all other non-metallic abrasives, the conductivity shall not exceed 25 mS/m. OWNER/PMC shall approve the use of alternative abrasive materials. Abrasive used shall be as per following specification:

Type	Generic Name	Standard
Metallic	Iron grit	ISO 11124-2
	Steel grit	ISO 11124-3
Natural mineral	Staurolite	ISO 11126-9
	Garnet	ISO 11126-10
Synthetic material	Aluminium oxide	ISO 11126-7
	Cu Slag	ISO 11126-3

Note:

Aluminum oxide or other abrasive (free from any chloride or iron/steel contamination) shall be used for blasting stainless steel. Copper slag and sand shall not be used.

4.3.3 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.

4.4 General Notes for surface preparation/blasting and paint application:

- a. Surface shall not be coated in rain, wind or in an environment where injurious airborne elements exist.
- b. Surface shall not be coated when the steel surface temperature is less than 3°C above dew point.
- c. Surface shall not be coated, when the relative humidity is greater than 85%.
- d. Surface shall not be coated when the temperature is below 10°C and the ambient/substrate temperature is below the paint manufacturers recommended temperature of application and curing.
- e. Surface shall not be coated when surface temperature is greater than 40°C (unless a higher temperature is agreed by the paint manufacturer)
- f. The paint application shall not be done when the wind speed exceeds 20 km per hour.
- g. The illuminance during coating and inspection shall be at least 500 Lux.

4.5 Use of Dehumidifier

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 more than 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.

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.

4.6 Surface preparation of concrete:

The external surface of RCC to be painted shall be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed and surface shall be prepared as per SSPC-SP-13.

5.0 COATING APPLICATION

- 5.1 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. 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.
- 5.2 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.
- 5.3 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.
- 5.4 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.
- 5.5 Airless spray application shall be in accordance with steel structure paint manual Vol.1 & Vol.2 by SSPC, USA
- 5.6 Brush application of paint shall be in accordance with the following:
 - a. Brushes shall be of a style and quality that will enable proper application of paint.
 - b. Round or oval brushes are most suitable for rivets, bolts, irregular 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 Applied paint should have the desired wet film thickness specified by manufacturer. 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 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.
- 5.9 Unless otherwise instructed, final 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 like NDT are completed as well as after completion of steam blowing.

5.10 Drying of coated surfaces

- 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.
- No paint shall be force dried under conditions which will cause chalking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.
- No drier shall be added to paint on the job unless specifically called for in the manufacturers' specification for the paint.
- Paint shall be protected from rain, condensation, contamination, snow and freezing until dried to the fullest extent practicable.

5.11 Spot repair of damaged primer

- 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.
- 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 shall be applied (as per the applicable design temperature and in conjunction with Table-3) wherever damage was observed on pre-erection / pre fabrication or shop primer.

- If damaged areas are found to be extensive and spread over large areas (as required by Engineer-in charge), 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-8/ F-9 or F-16, as applicable, for the intended design temperature. (See note of Table-3). If the prepared surface lies adjacent to a sound coated surface, the surface preparation shall overlap the coated surface by at least 50mm. The remainder of existing coated surface shall be properly protected with shields or screens to prevent any possible damage to the coating.

5.12 Equipment:

- a. 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.
- b. All paint spraying equipment, including mixers, shall be thoroughly cleaned before mixing of new materials. All coating materials shall be mixed and thoroughly stirred in accordance with the instructions of the paint Manufacturer. Sufficient agitation to maintain good mixing shall be applied until the product is used. If air is entrapped in the product during mixing/stirring, sufficient time should be allowed for the air bubbles to escape before application. Only thinners specified by the paint Manufacturer shall be used.

5.13 Shop coating

- a. Shop coated equipment (coated with primer & finishing coat) should not be repainted unless paint is damaged. Repair of primer shall be carried out as per Table-3 of paint systems depending upon the compatibility of paint. Intermediate and final coats over repaired primer shall be as per applicable tables mentioned in this specification. The recommendations of paint manufacturer's datasheets including maximum overcoat interval shall be followed and recorded in the coating inspection logbook.
- c. 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.
- d. For package units/Items/ OEM equipment, shop primer & coating system should be as per the paint system given in this specification. However, manufacturers' standard may be followed after review by EIL but shall adhere to the minimum DFT specified in ISO-12944-5; C5 (Very high durability). For system under insulation, minimum guidelines as per NACE RP 0198 shall be followed.

In this case, guarantee of the coating system lies with package supplier/OEM. EIL's decision in this regard is final and binding on Supplier/Contractor/manufacturer.

5.14 Guidelines for Documentation / records

- 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.
- Daily progress report with details of weather conditions, particular of applications, no. of coats, overcoating intervals, pot life and type of materials applied, anomalies, progress of work versus program.
- Results of measurement of temperatures, relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.
- Particulars of surface preparation and paint application during trials and during the work.
- Details of non-compliance, rejects and repairs.
- Type of testing equipment and calibration.
- Code and batch numbers of paint materials used.

Note: The coating applicator must maintain a job record consisting of all the information as per 5.12.b. to 5.12.g above as well as the approved procedure of work (5.12.a. above). The job record consisting of information in accordance to 5.12.b. to 5.12.g shall be entered on daily basis and should be daily signed by Engineer-in-charge. A sample template for daily coating inspection report is given in Annexure-III as reference.

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	F9
Technical name	Epoxy Zinc Phosphate Primer	Cold Galvanizing product	Etch Primer/Wash Primer	Inorganic zinc silicate coating
Type and composition	Two component polyamide cured epoxy resin medium, pigmented with zinc phosphate.	One pack synthetic resin-based zinc galvanizing containing min 92% of electrolytic zinc	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.	Inorganic zinc silicate Coating containing zinc content min. 80%. Shall pass MEK rub test as per

		dust of 99.95% purity.		ASTM D4752 with resistance rating >4
Volume solids % Minimum	49	37	9	57
DFT per coat, μ	40-50	40-50	8-10	65-75
Theoretical covering capacity in m^2 /coat/ litre	9.8-12.2	3.4-4.4 m^2 /kg	9.0-11.2	7.6-8.8
Weight per liter in Kg/litre (min.)	1.4 $\pm$ 0.05	2.67 kg at 15°C	1.2 $\pm$ 0.05	2.3
Touch dry at 30°C (max.)	30 min.	10 min.	2 hrs.	0.5 hrs.
Hard dry at 30°C (max.), Hrs.	8	24	24	12 hrs.
Over-coating interval, hrs. *Note 11	Min. 8	Min. 4	Min. 4-6	Min. 12 hrs. at 20°C & 50% RH
Pot life at 30°C for two Component paints, hrs.	6 - 8	NA	NA	4-6
Adhesion (ASTM D 4541)	>7	NA	NA	>5
Temperature resistance (min) °C (ASTM D 2485) *Note 8	80 (Method A)	50 (Method A)	NA	400 (Method B)

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	Single pack Plasticized chlorinated rubber based	F-6A Two- Pack Aromatic polyamine cured epoxy resin medium suitably	Two pack, cured with Amine Adduct;

	paint (free of alkyd/polyester resins).	medium with chemical and weather resistant pigments.	pigmented. F-6B: polyamide cured epoxy resin medium suitably pigmented.	catalyzed epoxy resin suitably pigmented
Volume Solids % (min.)	40	36	57	98
DFT per coat, μ	30-40	30-40	100-125	300-450
Theoretical covering capacity in m^2 /coat/litre	10-13.3	9-12	4.6-5.7	2-3.9
Weight per liter in Kg/litre (min.)	1.15	1.15	1.42	1.40
Touch dry at 30°C (max)	30 min.	30 min.	3 hrs.	3 hrs.
Hard dry at 30°C (max.).	8 hrs.	8 hrs.	16 hrs.	16 hrs.
Full cure at 30°C (for immersion/ high temperature service)	NA	NA	5 days	5 days
Over-coating Interval, hrs. *Note 11	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-11	F-12	F19
Technical name	High build coal tar epoxy coating.	Self-priming type surface tolerant high build epoxy coating (complete rust control Coating)	Heat resistant synthetic medium based two pack Aluminum Paint suitable up to 250°C dry temp. *Note: 10	Heat resistant silicone Aluminum Paint suitable up to 540°C dry temp.	High build Epoxy Ceramic Filled tank liner Type and composition: High build Epoxy Novolac Ceramic Filled tank liner for sustained immersion service in Hydrocarbon cargoes, refinery distillates, furnace oils etc., kept at elevated
Volume Solids % Minimum.	62	75	35	18	-
DFT per coat in μm	100-125	100-125	15-20	15-20	150-200
Theoretical covering capacity in $\text{m}^2/\text{coat}/\text{litre}$	5-6.2	6-7.5	17.5-23.3	9-12	3.5-4.7
Weight per liter in Kg/litre (min.)	1.40	1.41	0.95	1.00	-
Touch dry at 30°C (maximum)	4 hrs.	3 hrs.	3 hrs.	0.5 hrs.	2-3 hrs.
Hard dry at 30°C (maximum),	48 hrs.	24 hrs.	12 hrs	24 hrs.	10 hrs.
Full cure 30°C (for immersion /high Temperature service.)	5 days	5 days	NA	NA	-
Over-coating interval, hrs. *Note 11	Min. 24 hrs Max.5days	Min. 10	Min. 24	Min. 24	Min: 12 Hrs. Max: 3 days

Pot life at 30°C for two components Paints, hrs.	4-6	1.5	NA	NA	1-2 hrs.
Adhesion MPa (ASTM D 4541)	>5	>5	NA	NA	-
Temperature resistance (min.) °C (ASTM D 2485) *Note 8	80 (Method A)	80 (Method A)	250 (Method A)	540 (Method B)	180 (Method A)

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 CS/SS piping	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	100-125	100-125	300-450	500-600
Theoretical covering capacity in m ² /coat/ litre	5.4-6.7	6.7-8.9	4-5	2.2-3.3	1.6-2

Weight per liter in Kg/litre (min.)	1.45	1.65	>1.3	1.7	>1.2
Touch dry at 30°C (max)	4 hrs.	3 hrs.	1 hrs.	2 hrs.	2 hrs.
Hard dry at 30°C (max).	24 hrs.	24 hrs.	16 hrs.	24 hrs.	4 hrs.
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 *Note 11	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 ² (ASTM D 638)
Temperature resistance (min.) °C (ASTM D 2485) *Note 8	125 (Method A)	150 (Method A)	650 (Method B)	200 (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. 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. Internationally recognized & acceptable testing method shall be used for lab testing wherever testing standards are not mentioned.
6. 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 in consultation with EIL-SMMS.
7. Temperature resistance tests (ASTM D2485) shall be carried out for minimum required temperature resistance indicated.
8. 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.
9. F6-C shall be suitable for drinking water service and should have certification from competent authority.
10. Alkyd type paint system have potential flaking problems and therefore, F11 shall not be alkyd type.
11. Maximum overcoat interval shall be as per Paint manufacturer's datasheet.

7.0 SELECTION OF COATING SYSTEMS

The external coating system for EIL projects should be selected based on the C5 environment (very high durability) as per ISO12944-2, design temperature, involved services of the steel substrate and plant location.

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

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

7.1 Classification based on plant location:

- a) Plant located in inland area (more than 50 km from coast).

- For offsite areas and utilities: Table-5 to be followed.
 - For process units, DM plant, CPP and Cooling towers, ETP, RWTP: Table-6/7 as applicable to be followed.
- b) Plant located on sea coast or within 50 km from sea coast.
- For process units, DM plant, CPP, Cooling tower, ETP, RWTP, offsite & utilities etc.: Table-6/7 as applicable to be followed.
- c) For external surface of above ground tanks, Table-8 to be followed for all locations (inland or coastal)

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

(For all un-insulated CS, LTCS & alloy 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 80	SSPC-SP-3	1 coat of F-8 @ 125 μ DFT/coat+ 1 coat of P-6 @ 40 μ DFT/coat	165	See Note-1 below and clause 5.11
3.2	81 to 250	SSPC-SP-11	1 coat of F-9 @ 65-75 μ DFT/coat + 1 coat of F-11 @ 20 μ DFT/coat	85-95	
3.2	251 to 400	SSPC-SP-11	1 coat of F-9 @ 65-75 μ DFT/coat + 1 coat of F-12 @ 20 μ DFT/coat	85-95	
3.3	401 to 550	SSPC-SP-3	1 coat of F-16 @ 125 μ DFT/coat	125	

Note for Table-3:

1. The application and repair of pre-erection/pre-fabrication and 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 as per Engineer In charge discretion, entire primer shall be removed by blasting to achieve SSPC-SP-10 and surfaces shall be suitably primer coated as mentioned in Table 5.0 to Table 18.0. After the repairs of the primer, suitable intermediate and final coats shall be applied as per applicable coating systems mentioned in Table 5.0 to Table 18.0.

TABLE-4: COATING SYSTEM FOR GALVANIZED ITEMS (Refer clause 2.2.7)

Sl. No.	Design Temp. in °C	Coating System	Total DFT in Microns (min.)	Remarks
4.1	Up to 60	Hot Dip Galvanizing with thickness as per ISO 1461, Surface preparation over galvanization as per SSPC SP 16 & ISO 12944-4; 1 coat of F-6B @ 100μ DFT/coat + 1 coat of F-2 @ 40 microns DFT/coat	140μ of finish coat (excluding the thickness of galvanizing)	Special primers like etch primer (surface preparation) may also be considered for coating on galvanized surfaces

Notes for Table-4:

1. F-6B shall be modified type and suitable for coating over galvanization. Paint suppliers confirmation is mandatory.
2. Repair of the damaged areas of galvanized coatings due to welding during erection shall be carried out as per recommended practice ISO 1461, using cold galvanizing spray process. Organic paint systems are not acceptable for the repair.
3. 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 F-6B @ 100μ DFT/coat + 1 coat of F-2 @ 40μ DFT/coat).
4. Galvanized gratings don't require painting in general until otherwise specified elsewhere or as per the requirement of the OWNER. Galvanized items may 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 SYSTEMS FOR INLAND PLANTS (OFFSITES & UTILITIES)

(For all new un-insulated above ground CS, LTCS & Alloy steel piping, equipment, structures, valves, Vessels & columns, stacks etc.)

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Intermediate Coat	Finish Coat		
5.1	-45 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/coat	-	-	65-75	a. No over-coating shall be done on

5.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat + 1 coat of P-6 @ 40 μ DFT/ coat	1 coat of F-6B @ 100 μ DFT/coat	1 coat of F-2 @ 40 μ DFT/coat	245-255	F-9. b. Surface profile for F-9 shall be 30- 40 μ m c. F11 shall not be Alkyd type.
5.3	81 to 250	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat + 1 coats of F-11 @ 20 μ DFT/coat	-	1 coats of F- 11 @ 20 μ DFT/coat	105-115	d. F-12 shall be ambient temperature curing type
5.4	251 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75 μ DFT/coat + 1 coats of F-12 @ 20 μ DFT/coat	-	1 coats of F- 12 @ 20 μ DFT/coat	105-115	
5.5	401-650	SSPC-SP-10; 1 coat of F-16 @ 125 μ	-	1 coat of F-16 @ 125 μ	250-300	-

TABLE-6: COATING SYSTEMS FOR CORROSIVE AREAS (PROCESS UNITS, COOLING TOWER, DM, CPP, ETP, RWTP etc.)

(For all new un-insulated above ground CS, LTCS & Alloy steel piping, equipment, structures, valves, vessels & columns, furnace stacks etc.)

Sl. No.	Design Temp. °C	Surface Preparation & Pre- erection/Shop Primer	Coating System		Total DFT in Microns (min.)	Remarks
			Intermediate coat	Finish Coat		
6.1	-45 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75 μ	-	-	65-75	a)No over coating on F-9

6.2	-14 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	345-355	is allowed b) F-12 shall be ambient temperature curing type c) F11 shall not be Alkyd type.
6.3	81 to 250	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/coat + 1 coats of F-11 @ 20μ DFT/coat	-	1 coat of F- 11 @ 20μ DFT/coat	105-115	d) Surface profile for F-9 shall be 30-40 μm
6.4	251 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/ coat + 1 coats of F- 12 @ 20μ DFT/coat	-	1 coat of F-12 @ 20μ DFT/coat	105-115	
6.5	401-650	SSPC-SP-10; 1 coat of F-16 @ 125 μ	-	1 coat of F- 16 @ 125 μ	250-300	-

NOTES for TABLE-5 & TABLE-6:

- 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 contract document and scope of work.
- 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.
- Flare line within unit or offsite areas shall be coated as per clause 6.4 of Table-6.

4. For external surface of RCC Chimney, 2 coats of F-6 B@ 100 μ DFT/coat to obtain a total DFT of 200 μ shall be applied after proper surface preparation as per guidelines in clause 4.6. Suitable PU top coat shall also be considered.
5. At the site, shop primer coated prefabricated items/structures/equipment/vessels shall be stored in the shed area and contractor shall brush off any chalking observed with emery paper, prior to application of subsequent coats.

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

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 steel items: screens, walk way bridges, clarifier/thickener scrapping mechanism, baffles, Media filters/vessels (PSF, DMF, MMF, & ACF etc.), vertical pumps, CS/MS tanks/ vessels and structures.					
	-14 to 80	SSPS-SP-10	1 coat of F-9 @ 65-75µ DFT/coat + 1 coat of P-6 @ 40 µ DFT/ coat	2 coats of F-6B @100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat (2x100+40= 240)	345-355	Note 1
7.2	For internal surfaces of steel items: all effluent handling units such as TPI, DAF, tube settlers, clarifiers, tanks, sludge tanks and sewage tank, wet slop oil tanks etc., scrapping mechanism in clarifier etc.					
	-14 to 80	SSPS-SP-10	1 coat of F-15 @ 100µ DFT/coat.	2 coats of F-15 @100µ DFT/coat (2x100=200)	300	-
7.3	All R.C.C./concrete surfaces exposed to effluent water / liquid such as tanks, structures, drains etc., all effluent handling units such as API, TPI, DAF, tube settlers, clarifiers, tanks, sumps, sludge sumps/tanks and sewage sumps/tank, wet slop oil sump/tanks etc.					
	-14 to 80	As per clause 4.6 of this specification	Epoxy screed lining		3000	Note 1
7.4	Internal surface of equipment like Media filters/vessels (PSF, DMF, MMF, & ACF etc.), activated carbon filters, alkaline, acids & other high corrosive service					
	Up to 90	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	Note-2

NOTES for TABLE-7:

- Contractor shall follow manufacturer recommendations to develop epoxy screed lining procedure for EIL review and approval.
- This coating system is applicable in conjunction with relevant PDS of the equipment.

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

(except for crude tanks. Refer Annexure-II for Crude Oil Tanks painting)

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 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat	2 coats of F-6B @ 100µ DFT /coat + 1 coat of F-2 @ 40µ DFT/ coat	345-355	
8.1.2	81 to 450	SSPC-SP-10	1coat of F-9 @ 65-75µ DFT/coat	1 coat of F-16 @ 125 µ DFT / coat	190-200	
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 @ 65-75µ DFT/ coat	3 coats of F-7@ 150µ DFT/coat (3x150=450)	515-525	-
8.2.2	81 to 200	SSPC-SP-10	1 coat of F-17 primer @ 400µ DFT/ coat	1 coat of F-17 finish coat @ 400µ DFT/ coat	800-825	Note-4
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	SSPC SP-10	1 coat of F-16 @ 125 μ	2 coat of F-16 @ 125 μ /coat	375	Note-3

Notes for TABLE-8:

- All paint coating application including primer for tanks shall be carried out at field after erection and completion of entire welding.
- For underside of bottom plate as per clause no.8.3.1:
 - Painting shall be carried out before laying the bottom plate for tanks with non-Post Weld Heat Treatment (PWHT).
 - For tanks with PWHT, painting shall be carried out after PWHT.
 - In case tank is not lifted during PWHT then painting shall be applied before laying the bottom plate.
- This coating system is also applicable for temperature ranges not covered in 8.2 above.
- This coating system is also applicable for bottom plates having MOC as Stainless Steel.

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

(except for all crude tanks. Refer Annexure-II for Crude Oil Tanks)

Sl. No.	Design Temp. in °C	Surface Preparation	Coating system		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
9.1	Internal surface of cone roof with supporting structures, top shell course for free board height, underside of floating roof, oil side surface of pontoons, support structures and ladders and other CS internals etc., inside of bottom plate, internal surface of bare shell for 1.5 mtr from bottom, for storing petroleum products and intermediates such as Isomerate, Reformate, NHT / CCR / DHT feed, HSD, Gasoline, Naphtha, SKO, MS - Motor Spirits, LCGO, MTBE and Dry Slop.					
9.1.1	-14 to 45	SSPC-SP-10	1 coat of F-9 @ 65-75 μ DFT/coat	-	65-75	-

9.1.2	46 to 90	SSPC-SP-10	1 coat of F-15 primer @ 100μ DFT/ coat	1 coat of F-15 intermediate coat @ 100μ DFT/coat + 1 coat of F-15 finish coat @ 100μ DFT/ coat	300	-
9.2	Internal surface of cone roof with supporting structures, top shell course for free board height, underside of floating roof, oil side surface of pontoons, support structures and ladders and other CS internals etc., inside of bottom plate, internal surface of bare shell for 1.5 mtr from bottom, for storing petroleum products and intermediates such as VR, VGO, IFO/RFO, HCGO and Black Slop and other high temp. hydrocarbons					
9.2.1	91 to 150	SSPC-SP-10	-	1 coat of F-17 @ 400μ DFT/coat	400	-
9.2.2	151 to 180	SSPC-SP-10	-	3 Coat of F-18 @ 125	375	F-19 shall be suitable for immersion service of the given products
9.3	Amine and Sour water storage tank All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.3.1	up to 90	SSPC-SP-10	1 coat of F-15 primer @ 100μ DFT/ coat	1 coat of F-15 intermediate coat @ 100μ DFT/coat + 1 coat of F-15 finish coat @ 100μ DFT/ coat	300	-
9.4	Potable, Raw, Fire water, De-mineralized (DM) water & Condensates etc. All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.4.1	-14 to 60	SSPC-SP-10	1 Coat of F-6A @ 100μ DFT/coat	1 coat of F-6C @ 300-350 μ DFT/ coat	400-450	-
9.4.2	61 to 150	SSPC-SP-10	1 coat of F-15 primer @ 100μ DFT/ coat	1 coat of F-15 intermediate coat @ 100μ DFT/coat + 1 coat of F-15 finish coat @ 100μ DFT/ coat (100+100=200)	300	-
9.5	Hydrochloric acid (HCl) 10 % All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					

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, hexene, benzene, xylene and toluene etc.: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
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: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.7.1	All	SSPC-SP-10	-	3 coats of F-17 @ 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 @ 100μ DFT/ coat	1 coat of F-15 intermediate coat @ 100μ DFT/coat + 1 coat of F-15 finish coat @ 100μ DFT/ coat (100+100=200)	300	-
9.8.3	151 to 200	SSPC-SP-10	-	1 coat of F-17 @ 400μ DFT/coat	400	-
9.9	Alkalis up to 50 % concentration: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.9.1	Up to 60°C	SSPC-SP-10	1 coat of F-15 primer @ 100μ DFT/ coat	2 Coats of F-6 A @ 100μ DFT/coat (2x100=200)	300	-
9.10	Internal surface of underside of floating roof, bottom plate, complete shell course for full tank height, including immersed gauge pipe, still well etc. and their supporting structure, ladders and other CS internals etc. for storing ATF-Aviation Turbine Fuel .					

9.10.1	Up to 80°C	SSPC-SP-10	1 coat of primer* @ 75µ DFT/ coat	1 Coats of F-6 C @ 300µ DFT/coat (1x300=300)	375	Primer shall be compatible with F6C. F6C shall comply with the requirements of EI-standard 1541. Shade of the paint shall be Off-white.
9.11	Internal surface of underside of fixed roof and supporting structure for internal floating roof tank for storing ATF-Aviation Turbine Fuel .					
9.11.1	Up to 80°C	SSPC-SP-10	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat	2 coats of F-6A @ 100µ DFT /coat	305	

General Note for Table-9: The list of surfaces to be painted are not exhaustive. All internal surfaces of all type of tanks including structural items shall be coated as per the above table. No CS surface shall be kept un-painted.

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 Micro ns (min.)	Remarks
			Surface Preparation & Primer	Finish Coat		
10.1	Underground carbon steel plant piping.					
10.1.1	25 to 80	-	As per document B957-000-06-42-PLS-04	3layer polyethylene (3LPE) coating as per document B957-000-06-42- PLS-04	3.5 mm	--

10.1.2	81 to 200	-	SSPC-SP-10; 1 coat of F-17 primer @400 μ DFT/ coat	1 coat of F-17 @ 400 DFT/coat	800	-
10.1.3	201 to 400	SSPC-SP -10	1 coat of F-16 primer @125 μ DFT/ coat	2 coats of F-16 @125 μ DFT/ coat	375	Note 1
10.2	External side of underground vessels					
10.2.1	-45 to 80	SSPC-SP -10; 1 coat of F-9 @ 65-75 μ DFT/ coat + 1 coat of F-7 @ 100 μ DFT/coat	-	2 coats of F-7 @ 100 μ DFT/coat	365- 375	-
10.2.2	81 to 200	SSPC-SP -10	1 coat of F-17 primer @400 μ DFT/ coat	1 coat of F-17 @400 μ DFT/ coat	800	-
10.2.3	201 to 400	SSPC-SP -10	1 coat of F-16 primer @125 μ DFT/ coat	2 coats of F-16 @125 μ DFT/ coat	375	-

Notes for TABLE-10:

- Coating system as per Sl. No. 10.1.3 is applicable for underground CBD line subjected to higher temperature (201-400 deg. C) and in cyclic service. Contractor shall submit suitable product datasheet, PTR and test certificate, for EIL review and approval.

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

(For insulated piping, equipment, storage vessels, tanks, columns etc. of CS, LTCS, Alloy steel, SS, DSS and SDSS 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 Alloy steel Piping, Storage tanks, Vessels, Equipment etc.					
11.1.1	-45 to 125	SSPC-SP-10; 1coat of F-15 @ 100µ DFT/coat	None	2 coats of F-15 @100µ DFT/coat	300	Note 1
11.1.2	126 to 560	SSPC-SP-10; 1 coat of F-16 @ 125µ DFT/coat	None	1 coat F-16 @ 125µ DFT/coat	250	
For Carbon steel, LTCS and Alloy steel Critical equipment like vessels, reactors, columns & equipment						
11.1.3	200-540	Temporary oil based varnish coating to be provided for transport and storage	Thermally Sprayed Aluminium coating (TSAC) Refer ANNEXURE-I			Critical equipment is identified through respective data sheets. Note 4
11.2	Stainless Steel, Duplex Stainless steel, Super Duplex stainless steel & Piping, Tanks, Vessels & Equipment etc.					
11.2.1	-45 to 125	SSPC-SP-16; (15-25µ surface profile) 1 coat of F-15 @100 µ DFT/coat	None	2 coats of F-15 @100µ DFT/coat	300	Note 1
11.2.2	126 to 650	SSPC-SP-16; (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, DSS, SDSS & Alloy Steels (Note-1)					

11.3.1	-45 to 150 (Note-1)	SSPC-SP-10 For CS, LTCS & Alloy steel. SSPC-SP-16 for SS; (15-25μ surface profile) 1 coat of F-15 @100 μ DFT/coat	None	2 coats of F-15 @100μ DFT/coat	300	Note-2&3
11.3.2	-180 to 650	SSPC-SP-10 for CS, LTCS & Alloy steel. SSPC-SP-16 for SS (15-25μ surface profile) 1 coat of F-16 @ 125μ DFT/coat	None	1 coat of F-16 @ 125μ DFT/coat	250	

Notes for TABLE 11

- Coating system for any other design temperature range not covered in Sr. No. 11.1 & Sr. No. 11.2 shall be as per Sr. No. 11.3.2.
- 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.
- Alternatively, for this temperature range, 1 coat of F-17 @ 400 μ is also acceptable.
- For all insulated CS, LTCS & LAS vessels, reactors, column & equipment, Contractor/supplier shall verify with BPCL/EIL for applicability of TSA as under insulation coating.

General notes for TABLE-11:

- "Cyclic Service" is characterized by rapid or periodical temperature fluctuation or temperature cycles or as defined in the process datasheet.
- The blasting abrasives for SS and alloy steels shall be aluminum oxide or garnet only.
- The coating system applicable for any other temperature range shall be reviewed if it is encountered.

TABLE-12: INTERNAL COATING SYSTEMS FOR WATER SIDE COMPONENTS OF CS, SS, DSS & NON-FERROUS HEAT EXCHANGERS

Sl. No.	Design Temp. in °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 for CS and SSPC-SP-16 for SS	1 coat of F-15 @ 100 μ DFT/coat	2 coats of F-15 @ 100 μ DFT/coat	300	-
12.2	81 to 200	SSPC-SP-10 for CS and SSPC-SP-16 for SS	-	2 coats of F-17 @ 400μ/coat	800	-

Note for Table-12:

- Coating systems are applicable as per requirement specified in the data sheets of the respective exchangers or equipment.

TABLE-13: COATING SYSTEMS FOR CORROSIVE AREAS - BROWN FIELD PAINTING (REVAMP, REFURBISHMENT AND MAINTENANCE)

(For all existing un-insulated above ground CS, LTCS & Alloy steel piping, equipment, structures, valves, vessels & columns, furnace stacks etc.)

Sl. No.	Design Temp. °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total DFT in Microns (min.)	Remarks
			Intermediate Coat	Finish Coat		
13.1	-45 to -15	SSPC-SP-3; 1coat of F-8 @ 100μ	-	-	100	-
13.2	-14 to 80	SSPC-SP-3; 1coat of F-8 @ 100μ DFT/ coat	2 coats of F-6B @ 100 μ DFT/coat	1 coat of F-2 @ 40μ DFT/coat	340	
13.3	81-650	SSPC-SP-3; 1 coat of F-16 @ 125 μ	-	1 coat of F-16 @ 125 μ	250-300	-

**TABLE-14: EXTERNAL AND INTERNAL COATING SYSTEM FOR CRUDE OIL TANKS PAINTINGS
(REFER ANNEXURE-II)**

TABLE-15: COATING SYSTEMS FOR GI TOWERS

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
15.1	Up to 80	SSPC-SP-3	1 coat of F-8 @ 100 µ DFT/coat	1 coats of F-2@ 40 µ DFT/coat	140	Shade shall be as per defense requirement.

TABLE-16: COATING SYSTEMS FOR STREET POLES

Sl. No.	Description	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
16.1	Street Light Poles	SSPC-SP-3	1 coat of P-6 @ 40 µ DFT/coat	2 coats of F-2@ 40 µ DFT/coat	120	-

Note for Table-15 & 16:

- For revamp and refurbishment, surface preparation shall be SSPC-SP3 and coating system shall be same as mentioned in Table 15 & 16.

TABLE-17: COATING SYSTEMS FOR PSV

Sl. No.	Description	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
17.1	PSV, PRV, PV, RV, TRV	SSPC-SP10/SP-3	1 coat of F-8 @ 100 μ DFT/coat	1 coats of F-2@ 40 μ DFT/coat	140	- LPG service: RAL 5013 (cobalt blue) - Conventional type: RAL 3024 (Luminous Red) - Bellow Type: RAL 1026 (Luminous yellow color)

TABLE-18: TEMPERATURE INDICATING PAINT

Sl. No.	Description	Max Temp °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
				Primer	Finish paint		
18.1	Cold Collector, Transfer line, TPR & PG boiler inlet channel at HGU	400	Note-1				

Notes for TABLE-18:

- Contractor shall propose suitable product for the temperature indicative paint application in the given temperature range, and submit their datasheet, Past Track Record and test certificate, for EIL review and approval.

GENERAL NOTES FOR TABLE: 5 TO 18

- For uninsulated or insulated items, 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. The list of items is not exhaustive.

2. At the site, shop primer coated prefabricated items/structures/equipment/vessels shall be stored in the shed area and contractor shall brush off any chalking observed with emery paper, prior to application of subsequent coats.

8.0 GUIDELINES FOR STORAGE & HANDLING

- 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 /Materials safety datasheet shall be followed for storage and handling of paint materials.

Note: This standard doesn't address all the safety concerns if any, associated with its use. It is responsibility of the user of this specification to establish appropriate safety and health practice and determine the applicability of regulatory limitations prior to use.

9.0 COLOUR CODE, IDENTIFICATION AND MARKING

- 9.1 For identification of pipelines, the following color-coding scheme shall be followed (except for ATF)

TABLE-19: COLOR CODING

SR. No.	SERVICE	RECOMMENDED COLOUR FOR PAINT SYSTEM	RAL COLOUR CODE	
			BASE COLOUR	BAND COLOUR
HYDROCARBON LINES (UNINSULATED)				
1	CRUDE SOUR	Basalt Grey with 1 deep orange band	7012	2011
2	CRUDE SWEET	Basalt Grey with 1 signal red band	7012	3001
3	LUBE OILS	Basalt Grey with 1 grass green band	7012	6010
4	FLARE LINES	White Aluminum	9006	
5	LPG	Deep Orange with 1 oxide red band	2011	3009
6	PROPYLENE	Deep Orange with 2 Cobalt blue bands	2011	5013
7	NAPTHA	Deep Orange with 1 grass green band	2011	6010
8	M.S.	Deep Orange with 1 Basalt Grey band	2011	7012

9	AV. GASOLINE (96 RON)	Deep Orange with 1 band each of grass green, white and signal red bands	2011	6010	9010	3001
10	GASOLINE (regular, leaded)	Deep Orange with 1 Jet black band	2011			9005
11	GASOLINE (premium, leaded)	Deep Orange with 1 Cobalt blue band	2011			5013
12	GASOLINE (white)	Deep Orange with 1 white band	2011			9010
13	GASOLINE (Aviation 100/130)	Deep Orange with 1 signal red band	2011			3001
14	GASOLINE (Aviation 115/145)	Deep Orange with 1 traffic purple band	2011			4006
15	N-PENTANE	Deep Orange with 2 Cobalt blue bands	2011			5013
16	DIESEL OIL (White)	Oxide red with 1 white band	3009			9010
17	DIESEL OIL (Black)	Oxide red with 1 traffic yellow band	3009			1023
18	KEROSENE	Oxide red with 1 grass green band	3009			6010
19	HY. KEROSENE	Oxide red with 2 grass green bands	3009			6010
20	DISULFIDE OIL (EX-MEROX)	Oxide red with 1 jet black band	3009			9005
21	M.T.O	Oxide red with 3 grass green bands	3009			6010
22	DHPPA	Oxide red with 2 white bands	3009			9010
23	FLUSHING OIL	Oxide red with 2 jet black bands	3009			9005
24	LAB FS	Oxide red with 2 Basalt Grey bands	3009			7012
25	LAB RS	Oxide red with 3 Basalt Grey bands	3009			7012
26	LAB (Off. Spec)	Oxide red with 1 light grey band	3009			7035
27	N-PARAFFIN	Oxide red with 1 Cobalt blue band	3009			5013
28	HEAVY ALKYLATE	Oxide red with signal 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 copper brown bands	9006			8004
32	TOULENE	Clay Brown with 1 traffic yellow band	8003			1023
33	BENZENE	Clay Brown with 1 grass green band	8003			6010
34	LAB PRODUCT	Clay Brown with 1 Cobalt blue band	8003			5013
35	FUEL OIL	Jet Black with 1 traffic yellow band	9005			1023

36	FULE OIL (Aromatic rich)	Jet Black with 2 traffic yellow bands	9005	1023
37	ASPHALT	Jet Black with 1 white band	9005	9010
38	SLOP AND WASTE OILS	Jet Black with 1 deep orange band	9005	2011
39	SLOP AROMATICS	Jet Black with 2 deep orange bands	9005	2011
CHEMICAL LINES				
40	TRI-SODIUM PHOSPHATE	Lemon Yellow with 1 violet blue band	1012	5000
41	CAUSTIC SODA	Lemon Yellow with 1 jet black band	1012	9005
42	SODIUM CHLORIDE	Lemon Yellow with 1 white band	1012	9010
43	AMMONIA	Lemon Yellow with 1 Cobalt blue band	1012	5013
44	CORROSION INHIBITOR	Lemon Yellow with 1 Aluminum band	1012	9006
45	HEXAMETA PHOSPHATE	Lemon Yellow with 2 jet black bands	1012	9005
46	ACID LINES	Golden Yellow with 1 signal red band	1004	3001
47	RICH AMINE	Lemon Yellow with 2 Cobalt blue bands	1012	5013
48	LEAN AMINE	Lemon Yellow with 3 Cobalt blue bands	1012	5013
49	SOLVENT	Lemon Yellow with 1 grass green band	1012	6010
50	LCS	Lemon Yellow with 1 Blue Grey	1012	7031
WATER LINES				
51	RAW WATER	Yellow Green with 1 jet black band	6018	9005
52	INDUSTRIAL WATER	Yellow Green with 2 signal red band	6018	3001
53	TREATED WATER	Yellow Green with 1 oxide red band	6018	3009
54	DRINKING WATER	Yellow Green with 1 grass green band	6018	6010
55	COOLING WATER	Yellow Green with 1 light brown band	6018	1011

56	SERVICE WATER	Yellow Green with 1 signal red brown	6018	3001
57	TEMPERED WATER	Yellow Green with 2 grass green bands	6018	6010
58	DM WATER	Yellow Green with 1 aluminum band	6018	9006
59	DM WATER ABOVE 150°F	Yellow Green with 2 jet black bands	6018	9005
60	SOUR WATER	Yellow Green with 2 traffic yellow bands	6018	1023
61	STRIPPED WATER	Yellow Green with 2 Cobalt blue bands	6018	5013
62	ETP TREATED WATER	Yellow Green with 2 oxide red bands	6018	3009
FIRE PROTECTION SYSTEM (ABOVE GROUND)				
63	FIRE WATER FOAM & EXTINGUISHERS	Carmin Red		3002
AIR & OTHER GAS LINES (UNINSULATED)				
64	SERVICE AIR	Sky blue with 1 signal red band	5015	3001
65	INSTRUMENT AIR	Sky blue with 1 jet black band	5015	9005
66	NITROGEN	Lemon Yellow with 1 deep orange band	1012	2011
67	FREON	Yellow green with 1 traffic yellow band	6018	1023
68	CHLORINE	Lemon Yellow with 1 oxide red band	1012	3009
69	SO ₂	Lemon Yellow with 2 white bands	1012	9010
70	H ₂ S	Deep Orange with 2 oxide red bands	2011	3009
71	GAS (Fuel)	Deep Orange with 1 aluminum band	2011	9006
72	GAS (Sour)	Deep Orange with 2 aluminum bands	2011	9006
73	GAS (Sweet)	Deep Orange with 2 signal red band	2011	3001
74	HYDROGEN	Deep Orange with 1 Pale green band	2011	6021

STEAM AND CONDENSATE LINES (UNINSULATED)

75	HP STEAM	White Aluminum with 1 traffic yellow band	9006	1023
76	MP STEAM	White Aluminum with 1 signal red band	9006	3001
77	MLP STEAM	White Aluminum with 1 orange band	9006	2011
78	LP STEAM	White Aluminum with 1 light green band	9006	6021
79	CONDENSATE	Yellow green with 1 white band	6018	9010
80	CONDENSATE ABOVE 150°F	Yellow green with 3 oxide red band	6018	3009
81	BFW	Yellow green with 2 signal red bands	6018	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	Jet Black ground colour with 1 traffic yellow band in centre	9005	1023
83	IFO RETURN	Jet Black ground colour with 1 grass green band in centre	9005	6010
84	HPS	Jet Black ground colour with 1 signal red band in centre	9005	3001
85	BITUMEN	Jet Black ground colour with 2 signal red bands in centre	9005	3001
86	CLO	Jet Black ground colour with 1 brown band in centre	9005	8004
87	VB TAR	Black ground colour with 2 copper brown bands in centre	9005	8004
88	VR AM (BITUMEN / VBU FEED)	Jet Black ground colour with 1 Cobalt blue band in centre	9005	5013
89	VR BH	Black ground colour with 2 Cobalt blue bands in centre	9005	5013
90	VAC. SLOP	Black ground colour with 1 white band in centre	9005	9010
91	SLOP	Black ground colour with 1 deep orange band in centre	9005	2011
92	CRUDE SWEET	Basalt Grey ground colour with 1 signal red band in centre	7012	3001

93	CRUDE SOUR	Basalt Grey ground colour with 1 deep orange band in centre	7012	2011
94	VGO / HCU	Oxide red ground colour with 2 iron grey bands in centre	3009	7011
95	OHCU BOTOM / FCCU FEED	Oxide red ground colour with 2 iron grey bands in centre	3009	7011
UNINSULATED EQUIPMENT, TANKS AND STRUCTURES				
96	HEATER STRUCTURE	Iron grey		7011
97	HEATER CASING	White Aluminum		9006
98	VESSELS & COLUMNS	White Aluminum		9006
99	HYDROGEN BULLETS	Antique Pink		3014
100	LPG VESSELS	Oxide red		3009
101	SO ₂ VESSEL	Lemon Yellow		1012
102	HEAT EXCHANGER	White Aluminum		9006
103	FO TANK AND HOT TANKS	Jet Black		9005
104	ALL OTHER TANKS *Note 2	Pure White		9010
105	CAUSTIC / AMINE / ACID TANKS	Golden yellow		1004
106	SOUR WATER	Sky Blue		
107	OUTER SURFACE IN BOILER HOUSE	Aluminum		9006
108	COMPRESSORS AND BLOWERS	Basalt Grey		7012
109	PUMPS	Pigeon Blue		5014
110	MOTORS & SWITCH GEAR	Pastel Blue		5024
111	HAND RAILING	Signal red		3001
112	STAIRCASE, LADDER AND WALKWAYS	Jet Black		9005
113	LOAD LIFTING EQUIPMENT AND MONORAILS ETC	Clay Brown		8003
114	GENERAL STRUCTURE	Steel blue (equivalent to British Airways Blue as per British Standard)		5011
115	FLUE GAS STACK	Jet Black		9005

PIPES AND FITTINGS OF ALLOY STEEL AND SS MATERIAL IN STORE

115	IBR	Signal red	3001
116	9Cr-1Mo	Pale Green	6021
117	5Cr-0.5Mo	Light Blue	5012
118	2 $\frac{1}{4}$ Cr-1 Mo	Luminous Yellow	1026
119	1 $\frac{1}{4}$ Cr- $\frac{1}{2}$ Mo	Traffic Yellow	1023
120	SS-304	Grey Blue	5008
121	SS-316	Blue Lilac	4005
122	SS-321	Pigeon Blue	5014

SAFETY COLOUR SCHEMES

123	DANGEROUS OBSTRUCTION	Jet Black and Briht Red Orange band	9005	2008
124	DANGEROUS OR EXPOSED PARTS OF MACHINERY	Bright Red Orange	2008	

Note for Table-19:

1. As per latest DGCA guide line for ATF service color coding shall be Leaf Brown with two black bands.
2. Sr. no 104 - "All other tanks" having pure white (RAL 9010) as top coat shall have intermediate coat in colour: Signal white (RAL 9003) or Traffic White (RAL- 9016) to have lighter intermediate coat.

9.2 Ground Color

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 this specified length to identify the particular service. Above colour code is applicable for both unit and offsite pipelines.

9.3 Color band & Identification lettering (except for ATF service)

For ATF service, 2 color bands of 100 mm with 50 mm gap in between them shall be provided.

The following specifications of color bands shall be followed for identifying the piping contents, size and location of bands & letters. The bandwidth and size of letters in legends will depend to some

extent upon the pipe diameter. Either white or black letters are selected to provide maximum contrast to the band color. Bands are spaced 25 mm apart when two bands are employed.

Outside dia of pipe or covering in mm	Width of color band in mm
19-32	200
38-51	200
64-150	300
200-250	600
Over 250	800

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

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

Column and vessel: 150 mm (Height)

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

9.3.1 Color band

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

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

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

9.3.2 Color band specification

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

- Unit Area: Bands at intervals of 6.0 meters.
- Offsite Area: Bands at intervals of 10.0 meters.
- Each pipe segment will have minimum one band indication, irrespective of length.

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

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

- The letters will be in black on pipes painted with light shade colors and white on pipes painted with dark shade colors to give good contrast.
- Only writing of service name shall be done on stainless steel lines. Precautions should be taken while painting by using low chloride content painting to avoid any damage to the stainless-steel pipes. It is preferable to use adhesive plastic tapes to protect stainless steel pipes.

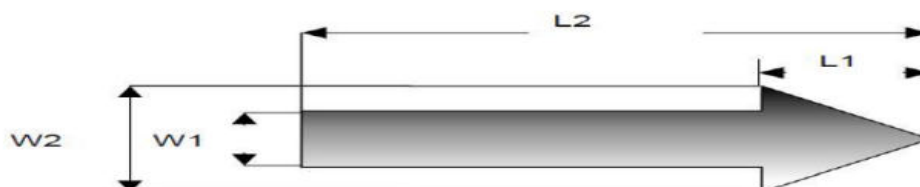
Size of Lettering and Direction Arrow shall be as follows:

Lettering

Pipe diameter	Width x Height- spacing
2" to 6" inclusive	30 x 30mm - 10 mm min.
6" to 50" inclusive	80 x 80mm - 25 mm min.
Greater than 50"	100 x 100mm - 30 mm min.

Direction arrow

Pipe Diameter	W1 (mm)	W2 (mm)	L1 (mm)	L2 (mm)
2" to 6" inclusive	10	30	45	135
6" to 50" inclusive	40	80	90	270
Greater than 50"	50	100	150	450



10.0 QUALITY CONTROL, INSPECTION AND TESTING

- 10.1 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 12.0 & 13.0).
- 10.2 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, in consultation with SMMS, 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, as instructed, performed at his cost at any one of the NABL accredited laboratories under a TPI agency.

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:

- a. Specific Gravity
- b. % solids by weight (% zinc content in case of inorganic or organic zinc primer)
- c. Drying time (touch dry & full curing)
- d. Adhesion test on a test panel prepared at the site (ASTM D 6677).

Test methods for above tests shall be as per relevant ASTM or ISO Standard.

10.3 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

10.3.1 Following tests are to be carried out during surface preparation:

- a. 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:

- Visual inspection - continue degreasing until all visible signs of contamination are removed.
- 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.
- b. **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 m² of blasted surface and a minimum of 3 checks per shift.
- c. **Test for presence of soluble salt** as per method ISO 8502-9. Maximum allowable salt content shall be considered 20 mg/m². Checks shall be done on each component at least once per 200 m² of blasted surface and minimum of 3 checks per shift. In case salt exceeds specified limit,

the contaminated surface shall be cleaned by method as per Annexure-C of ISO 12944-4 (water cleaning). After cleaning, surface shall be retested for salt after drying.

- d. **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 ASTM D 4417 method B (Profile depth gauge micrometer)/ calibrated Digital gauge meter. Spot measurement shall be carried out every 15m² of blasted surface. At each spot three measurements shall be taken over an area of 10 m² and average of measurements to be recorded and reported. If profile is less than specified range, blasting shall continue till greater specified depth profile is achieved.
- e. **Tests for blasting media:** 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.
- 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.
 - Soluble salt contamination if suspected shall be verified by method ASTM D 4940. If present, media to be replaced.
 - Clean blasting equipment, especially pot and hoses, and then replace blasting media and retest.
- f. **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.

10.4 Final inspection of finished coating shall consist of the following:

Coating DFT & WFT check: DFT measurement shall be as per ISO 2808. Type-II electronic gauge shall be used as described in ASTM D7091. DFT gauge calibration, adjustment of gauge coating thickness, frequency and number of coating thickness measurement shall be as per ASTM D7091

and SSPC-PA2. Measured DFT shall have a tolerance as per SSPC-PA-2 level-3 of the dry film thickness, specified in this specification. Once in every layer of coating application, spot checks of WFT shall be carried out during the coating application according to ISO 2808, Method No. 1A- comb gauge. This is to ensure that film thickness is being achieved as per the specification. The frequency of WFT check shall be one per 10 m².

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 m² of coated surface.

Holiday detection check: Holiday testing of non-conductive coatings shall be carried out in accordance with NACE SP0188. For immersion, buried & under insulation 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.

11.0 PAINT MATERIAL GUARANTEE CERTIFICATE

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 and shall submit necessary certificate of the paint material.

12.0 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.

13.0 PRE-QUALIFICATION/ACCEPTANCE CRITERIA FOR PAINT COATING SYSTEM

13.1 Pre-qualification of paint coating manufacturer and their products

Paint manufacturer meeting the following requirements shall be considered by the CONTRACTOR for supply of the paint products.

- a) Manufacturer should have been in continuous business of paint coating formulation and manufacturer for at least past 5 years.
- b) Manufacturer should possess past experience of supplying products to hydrocarbon, petrochemical, fertilizer, chemical processing, offshore or heavy industry in the past 5 years.
- c) Coating manufacturer should have supplied at least 10000 litre of an individual product to hydrocarbon, petrochemical, fertilizer, chemical processing, offshore or heavy industry.
- d) The manufacturer's manufacturing procedure & QA/QC system shall meet ISO 9001 requirements and preferably should possess ISO 14000 certificate.
- e) The Quality control set up should be manned by qualified paint technologists whose biodata should be sent along with quality control organization chart.

The Past Track record of the manufacturers as mentioned above shall be substantiated by providing relevant documents to EIL-SMMS for their review and acceptance. This shall include Work Orders, Purchase orders and ISO 9001 certification covering all the requirements mentioned from bullets a) to e) above.

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.

13.2 Pre-Qualification Testing procedure:

The paint manufacturer engaged by the mechanical contractor shall carry out the tests in NABL accredited government laboratories or in suggested list of laboratories below, 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-20 (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.

Colored photographs of coated test panels should be taken before and after the test and should be enclosed along with test report. Contractor shall furnish these test certificates along with all necessary supporting documents/information to EIL-SMMS for approval/ acceptance. The paint manufacturer will be qualified and approved by EIL-SMMS 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.

List of suggested laboratories:

1. National Test house – Kolkata
2. National Test house-Mumbai

3. HBTU- Kanpur
4. GIRDA (Gujarat Industrial Research & Development Agency)- Vadodara
5. Indian institute of chemical technology – Hyderabad
6. RITES – Kolkata
7. ICT- Mumbai

TABLE-20: PRE-QUALIFICATION TESTING

SYSTEM No.	COATING SYSTEM	REFERENCE CLAUSE (from table-3 to 12)	TOTAL DFT μ (min)
1.	F-9+P6+F6B+F2	6.2	345
2.	F9+F12+F12	6.4	105
3.	F9+F11+F11	6.3	105
4.	F15+F15+F15	11.1.1	240
5.	F16+F16	8.3.1	250
6.	F17	9.2.1	400
7.	F8	3.1	125
8.	F20+F20	9.5.1	1100
9.	F6C+ F6C + F6C	Annexure II	675
10.	F9+F7+F7+F7	10.2.1	365
11.	F15+F6A+F6A	9.9.1	280
12.	F19+F19+F19	9.2.2	375

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	4, 6, 8, 10 11 & 12	1000 hrs.	Shall pass. No cracking, discoloration, blistering, peeling or softening of film shall be observed.
2b.	5% H ₂ SO ₄		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)	4, 6, 8, 10 11 & 12	30 days	No softening, blistering or film damage.
4.	Resistance to DM water using water immersion. (ASTM D870)	9	2000 hrs.	Shall pass. No chalking, cracking, flaking, blistering or peeling.
5.	100% Humidity Test (ASTM D2247)	1 to 12 (except system-2 & 3)	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, 5, & 11 (For system-2, testing to be done after heating the panels at 400°C for 2 hrs.) & (For system-3, testing to be done after heating the panels at 250°C for 2 hrs.)	-	Shall pass
7.	Cathodic Disbondment Test (ASTM G42 @80°C)	4, 5, 10, 6 & 11	-	Diameter of cathodic

				Disbondment < 10 mm with 6 mm diameter artificial holiday.
8.	Assessment of Adhesion and artificial ageing as per ISO 19277	4, 5, 6, 7, 11 & 12	-	Shall Pass

Each coating product to be qualified shall be identified by the Specific gravity of base and curing agent (ISO 2811). The identification shall be carried out on the batch, which is used for the pre-qualification testing.

13.3 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) ~ ASTM D521.

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 in consultation with SMMS. Failing to meet the specified quality requirements may cause rejection of the paint products.

c) Remaining Shelf life shall be at least 50% of the total duration at the time of above application of procured material by contractor / owner. However, it is preferred to have the materials from the fresh stock for better performance of coatings.

14.0 METHOD OF SAMPLING & DISPATCH FOR LABORATORY TESTING

(Pre-Qualification tests (sec. 13.2), Batch testing (sec. 13.3) and Inspection testing (sec. 10.0))

14.1 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.

14.2 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.

14.3 Manufacturers should intimate EIL, details of sample submitted for testing, name of testing agency, date, and contact personnel of the testing agency.

15.0 RCC PAINTING

RCC structures shall be coated with protective coatings as per the requirements laid out in respective drawings/relevant documents.

15.1 Concrete surface preparation and coating application

- a. The proper surface preparation of concrete surface is critical for ensuring strong adhesion of coatings, sealants, overlays, and repair materials. The surface preparation removes contaminants, weak layers (like laitance), and provides a rough texture for mechanical bonding.
- b. The prepared concrete surface should be free of contaminants, laitance, loosely adhering concrete, and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems.
- c. The surface preparation shall remove protrusions such as from sharp edges, fins, and concrete spatter, voids and other defects that are at or near the surface. Concrete damaged by exposure to chemicals shall be removed so that only sound concrete remains. All contamination, form-release agents, efflorescence, laitance and curing compounds shall be removed.
- d. Detergent water cleaning as described in ASTM D4258 shall be used to remove oils and grease from concrete.
- e. The minimum surface preparation shall be as per SSPC-SP-13, Clauses 4.3.1, 4.3.2 & 4.4. The surface preparation method, or combination of methods, should be chosen based on the condition of the concrete and the requirements of the coating system to be applied by the CONTRACTOR. Inspection testing and acceptance criteria as applicable shall be as described in sections 5 & 6 of SSPC-SP-13.
- f. The DFT of the applied coating shall be checked by using ultrasonic DFT gauge in accordance with SSPC-PA-9
- g. All concrete surfaces to be prepared and coated shall be visually inspected for signs of concrete defects, physical damage, chemical damage, contamination, and excess moisture.

- h. All concrete should be cured using the procedures described in ACI 308. Curing requires maintaining of sufficient moisture and temperatures for a minimum time period. The surface preparation performed on insufficiently cured or low-strength concrete may result in excessively coarse surface profile or excess removal of concrete.
- i. Concrete that has been damaged because of physical forces such as impact, abrasion, or corrosion of reinforcement shall be repaired before surface preparation if the damage would affect coating performance. Repairs should be made in accordance with ACI 301, ACI 562, ACI 546.

15.2 RCC coating system

Table 21- Coating system on concrete surface

S. No	Description	Coating system	Remarks
1	RCC super structure surfaces	1 Priming coat of water based 100% Acrylic exterior emulsion anti-carbonation primer with light fast pigments and resistant to fungus and algae growth, alkali and UV degradation @ 50 μ per coat + 3 coats of finish coat with water based 100% acrylic exterior emulsion anti-carbonation paint with light fast pigments and resistant to fungus and algae growth, alkali and UV degradation @ 50 μ per coat = 3 $\times$ 50 = 150 μ	Note 1
2	All external Cooling tower RCC surfaces and structures, which are prone to carbonization as well as algae & fungus attack due to continuous exposure of water & sea water etc.	1 Priming coat of water based 100% Acrylic exterior emulsion primer with light fast pigments and resistant to fungus and algae growth, alkali and UV degradation @ 50 μ per coat + 3 coats of finish coat with water based 100% acrylic exterior emulsion paint with light fast pigments and resistant to fungus and algae growth, alkali and UV degradation @ 50 μ per coat = 3 $\times$ 50 = 150 μ	Note 1
3	Cooling tower internal surfaces including all the inner surfaces but not limited to walls, columns, beams, basins, sumps, channels, all RCC above fills and below fills etc.	3 coats of F-7 @ 125 μ per coat. Total DFT=375 μ	-

Notes for Table 21:

1. Contractor shall propose suitable coating product and submit their necessary datasheet, test certificates and Past Track record for EIL review and approval.
2. No painting shall be done in rainy season.
3. Painting shall be done in given pattern in desired colors preferably bright in shades. Colour Shall be Azure Blue for RCC foundations of pumps & Equipment and Ivory for Piperack. and track. For any other RCC structures, contractors shall propose suitable color code for EIL review and approval.

ANNEXURE-I

SPECIFICATION FOR THERMALLY SPRAYED ALUMINIUM (TSA) COATING

1.0 SCOPE

The following sections outlines the requirement of supply, application and testing of thermally sprayed aluminum coatings (TSAC) for corrosion protection of insulated critical carbon steel, LTCS, LAS equipment like vessels, reactors, columns & equipment within the design temperature range of 200-540°C. Contractor shall establish the criticality in consultation with BPCL/EIL, and finalize the type of under insulation coating required.

2.0 ITEMS TO BE THERMALLY SPRAYED

Vessels, reactors, columns & equipment to be protected by TSAC shall be as per Table 11.0 of this specification. Components thermally sprayed shall not have any uncoated area or shall not be in mechanically connected by flanges etc. to any uncoated bare steel work. Such adjacent areas to TSA coated areas, if not coated by TSA shall have suitable paint coating system as per the standard specification.

3.0 TSAC REQUIREMENTS

3.1 Surface Preparation

All the parts to be sprayed shall be degreased according to SSPC-SP 1. The absence of oil and grease after degreasing shall be tested by method given elsewhere in the specification (Refer Sec. 6.7 of this annexure). Thereafter the surface to be abrasive blasted to white metal finish as per NACE 1/SSPC-SP 5 for marine and immersion service. Using SSPC VIS 1, it is to be visually assessed that the blast cleaned surface meets requirement of SSPC-SP 5. Thereafter clear cellophane tape test as per ISO 8502-3 shall be used to confirm absence of dust on the blasted surface. Finally blasted surface shall be tested for presence of soluble salts as per method ISO 8502-9. Maximum allowable salt content shall be considered 20mg/m² (2 micrograms/cm²). In case salt content exceeds specified limit. The contaminated surface shall be cleaned by method as per Annex C of IS 12944-4 (Water Cleaning). After cleaning the surface shall be retested for salt content after drying. Testing shall be carried out at least on each component, once per 200 m² and a min of 3 times per shift during progress of work.

The blasting media shall be either chilled iron or angular steel grit as per SSPC-AB-3 of mesh size G-16 to G-40. Copper, Nickel slag, Garnet or Aluminum Oxide as abrasives will also be suitable having mesh size in the range of G16 to G24 (10-30 mesh), conforming to SSPC-AB-1. Mesh size shall be required as appropriate to the anchor tooth depth profile requirement and blasting equipment used. The blasted surface should be having angular profile depth not less than 65 microns with sharp angular shape but shall not exceed 85 microns. The profile depth shall be measured according to NACE standard RP 0287 (Replica Tape) or ASTM D 4417 method B (Profile depth gauge).

For manual blasting one profile depth measurement shall be taken every 10-20 m² of blasted surface.

Surface preparation shall be completed in one abrasive blast cleaning operation wherever possible.

If rust bloom (visual appearance of rust) appears on the blast cleaned surface before thermal spraying, the affected area shall be reblasted to achieve specified degree of cleanliness after which only thermal spraying shall commence.

Air blasting pressure at nozzle shall be normally maintained at 100 psi. Air pressure and media size should be reduced and adjusted to preclude damage/distortion to thin gauge materials. Blasting time on work piece should be adjusted to only clean the surface and cut required anchor tooth with minimum loss of metal. Blast angle should be as close to perpendicular as possible but in no case greater than $\pm 30^\circ$ from perpendicular to work surface. Blasting media must be free of debris, excessive fines, and contaminants such as NaCl and sulfur salts (Ref. Sec. 6.0 of this annexure). Blast cleaning shall not be performed when the surfaces to be blasted are wet or less than 3°C above dew point temperature or when the relative humidity in the vicinity of the work is greater than 85%.

3.1.1 Blasting Equipment

The TSAC applicator shall use mechanical (centrifugal wheel) or pressure pot blast cleaning equipment and procedures. Suction blasting equipment shall not be used. Sec 6.6.2 of this annexure shall be used to validate clean and dry air.

3.1.2 Feed Stock

The feed stock shall be in the form of wire. The feed stock shall be 99.5% aluminum of commercial purity grade, its composition shall be in accordance with requirement of BS 1475 or ISO 209-1 type A1 (wrought aluminum and aluminum alloys, wire). Wire shall be supplied in protective wrapping indicating batch number and other details.

3.1.3 Thickness Requirement

The nominal thickness of finished TSAC shall be 250 microns having minimum value of 225 microns at low thickness areas (valleys) and not more than 275 microns at peak areas.

The finished thickness shall be measured using SSPC-PA 2 type 1 fixed probe gauge (Magnetic Gauge).

3.1.4 Coating Bond Strength Requirement

The TSAC coating shall have a minimum individual tensile-bond strength value of 1000 psi for flame sprayed and 1500 psi for arc sprayed coating with an average of 2000 psi for arc

sprayed coatings. Minimum tensile bond strength should be achieved by proper anchor tooth profile of blasted surface, laying down the TSA thickness in multiple passes and carrying out TSA application under controlled environment

3.1.5 Porosity

All thermally sprayed metallic coatings will have porosity. For thermally sprayed aluminum coatings porosity shall not exceed 15% of total surface area for flame sprayed coating and 8% for arc spray coating.

4.0 Thermal Spray Application Procedure

Items in the atmospheric zone to be coated by TSA shall be applied by either Flame spray or Arc spray method only. For coating under insulation, application shall be by arc wire method.

4.1 Equipment Set Up

4.1.1 Thermal spray equipment shall be set up calibrated, operated (1) according to manufacturer instructions/technical manuals and also TSAC applicators refinement thereto and (2) as validated by Procedure Qualification (Sec 7.0 of this annexure).

4.1.2 Spray Parameters

Spray parameters (see 4.1.3 below) and thickness of each crossing pass shall be set and shall be validated with bend test (See 6.5 of this annexure).

4.1.3 Spray Parameters

Spray Parameters	Method of Application	
	Arc wire Spray	Flame Wire Spray
Arc voltage	27 V	-
Air pressure	80 psi	80 psi
Steel surface cleanliness	NACE-1 white metal	NACE-1 white metal / or near white metal
Steel surface profile	60-75 microns	60-75 microns
Arc current	250-280A	-
Coating thickness	225 microns (nominal)	225 microns(Nominal)
Coating adhesion	> 1500 psi (Total coating), see 3.1.4	>1000 psi
Coating porosity	Less than 8%	Less than 15%.
Spray distance (spray Gun work piece)	6-8"	5-7"
Spray Pass width	40mm	20 mm

The above parameters to be validated with a bend test by the contractor before start of work (for details of bend test see Sec 6.5 of this annexure).

4.2 Post Blasting Substrate Condition and Thermal Spraying Period.

4.2.1 The steel surface temperature shall be at least 3°C above dew point of ambient air temperature.

Steel substrate surface temperature shall be recorded by with a contact pyrometer. Thermal spraying should commence within 15 minutes from the time of completion of blasting

4.2.2 Holding Period

Time between the completion of final anchor tooth blasting and completion of thermal spraying of blasted surface should be no more than four hours. If within this period rust bloom appears Sec 4.4.1 of this annexure will apply.

4.3 Pre-Heating

For flame spraying, the initial starting area of 1-2 square feet to be preheated to approx. 120 °C to prevent condensation of moisture in the flame on the substrate. For arc spraying the preheating is not required.

4.4 Thermal Spraying

Spraying should commence only after validation of equipment set up by procedure qualification test and spray parameter validation tests described in Sec 7.0 and 6.5 respectively. Thermal spraying must commence within 15 minutes from the time of completion of blast cleaning

The specified coating thickness shall be applied in several crossing passes. The coating bond strength is greater when the spray passes are kept thin. Laying down an excessively thick spray pass increases the internal stresses in TSAC and decreases the bond strength of total TSAC. The suitable thickness for crossing passes shall be determined by procedure qualification test described in Sec 7.0 of this annexure.

For manual spraying, spraying to be done in perpendicular crossing passes to minimize thin spots in coating. Approx. 75-100 microns of TSAC shall be laid down in each pass.

The surface geometry of the item or area to be sprayed should be inspected before application. The spraying pass and sequence shall be planned according to following.

- Maintain Gun as close to perpendicular as possible and within $\pm 30^\circ$ from perpendicular to the substrate.
- Maintain nominal standoff distance and spray pass width as given below:

Spray method	Standoff (Inches)	Spray pass width (Inches)
Arc Wire	6-8	1 ½ (40mm)
Flame wire	5-7	¾ (20mm)

4.4.1 Rust Bloom (Visual appearance of rust or Discoloration)

If rust bloom appears on the blasted surface before thermal spraying, the affected area shall be re-blasted to achieve the specified level of cleanliness.

If Rust bloom in form of discoloration, or any blistering or a degraded coating appears at any time during application of TSAC, then spraying shall be stopped and acceptable sprayed area shall be marked off. The unsatisfactory areas shall be repaired to the required degree of surface cleanliness and profile.

Blast the edges of the TSAC to provide for 2-3" feathered area overlaps of the new work into existing TSAC.

Then apply TSAC to the newly prepared surfaces and overlap the existing TSAC to the extent of feathered edge so that overlap is a consistent thickness.

4.4.2 Masking

Masking all those parts and surfaces which are not required to be thermally sprayed as instructed by purchaser should be inspected by applicator to ensure that they are properly marked and covered by purchaser.

Complex geometries (flanges, valve manifolds, intersections) shall be masked by applicator to minimize overspray i.e. TSAC applied outside spray parameters (primarily gun to substrate distance and spray angle).

4.4.3 TSAC Finish

The deposited TSAC shall be uniform without blisters, cracks, loose particles, or exposed steel as examined with 10 X magnification.

5.0 SEALER

Sealant shall be applied after satisfactory application of TSAC and completion of all testing and measurements of the finished TSAC as per Sec 6.0 of this annexure. For shop work, sealer shall be applied immediately after thermal spraying and for field work sealer

shall be applied within 8 hours. The sealcoat shall be thin enough to penetrate into the body of TSAC.

The sealant shall be silicone alkyd aluminium paint having DFT not more than 35-40 micron. Typically seal coat shall be applied at a spreading rate resulting in theoretical 38 microns DFT. The seal coat shall be applied in accordance with SSPC-PA 1 and the paint manufacturer instruction for sealing.

6.0 TESTING AND MEASUREMENT SCHEDULE

6.1 Surface Finish

That the blasted cleaned surface meets the required criteria (NACE 1/SSPC-SP 5) shall be visually inspected using SSPC-VIS 1. The clear cellophane-tape test as per ISO 8502-3 shall be used to confirm absence of dust or foreign debris on the cleaned surface. Checks shall be done on each component at least once per 200 m² of blasted surface and minimum of 3 checks per shift.

6.2 Blast Profile Measurement: (In-Process testing during actual production before application of TSA 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 15m² of blasted surface. At each spot three measurements shall be taken over an area of 10 cm² and average of measurements to be recorded and reported.

If profile is <65 microns blasting shall continue till greater than 65 microns depth profile is achieved.

6.3 TSAC Thickness (In-Process Testing For finished coating during regular production)

6.3.1 TSAC finished thickness shall be measured using SSPC-PA 2 type 1 fixed probe gauge.

6.3.2 For flat surfaces, measurements shall be taken along a straight measurement line, one measurement line for every 15 m² of applied TSAC shall be selected along which 5 measurements to be taken at 25 mm interval and average to be reported.

6.3.3 For curved surface or complex geometry, 5 measurements shall be taken at a spot measuring 10 cm² in area. One spot to be taken for every 15 m² of applied TSAC area.

6.3.4 The TSAC thickness in surface changes or contour changes, welds and attachments shall be also measured and reported.

6.3.5 If TSAC is less than specified minimum thickness, apply additional TSAC until specified thickness range is achieved.

6.3.6 All locations and values of TSAC thickness measurements shall be recorded in Job Record (JR).

6.4 Tensile Bond Testing (In-Process testing for finished coating during regular production)

- Tensile Bond strength of the TSAC finish coat shall be determined according to ASTM D 4541 using a self-aligning adhesion tester.
- One measurement shall be made every 50 m². If tensile bond at any individual spot is less than 1000 psi for flame sprayed coating and 1500 psi for arc sprayed coating the degraded TSAC shall completely remove and reapplied.
- The tensile bond portable test instrument to be calibrated according to ASTM C 633

6.5 Bend Tests

Bend test shall be carried out at beginning of each work shift. Bend tests shall also be conducted on sample coupons before start of thermal spraying work to qualify the following as mentioned earlier in this specification.

- To qualify spray parameters and thickness of each crossing pass.

6.5.1 Test Procedure

- a) Five corrosion control steel coupons each of dimension 50 mm x 150 mm x 1.3 mm thk. to be prepared.
- b) Surface shall be prepared by dry abrasive blast cleaning as per this specification.
- c) TSAC shall be applied as per specified thickness range. TSAC should be sprayed in crossing passes laying down approx. 75-100 microns in each pass.
- d) TSAC applied coupons shall be bent 180° around a 13 mm diameter mandrel.
- e) Bend test shall be considered passed if on bend radius there is
 - No cracking or spalling or lifting by a knife blade from the substrate
 - Only minor cracking that cannot be lifted from substrate with a knife blade.
- f) Bend test fails if coating cracks with lifting from substrate.

6.6 Tests for blasting media, blasting air

6.6.1 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.

6.6.2 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.

6.7 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 trichloromethane 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.

7.0 TSAC APPLICATOR QUALIFICATION

Following tests to be carried out as part of procedure qualification test for the applicator.

- Thickness measurement
- Coating bond strength
- Porosity test
- Bend strength

TSAC applicator's surface finishing and application process and equipment set up, calibration and operation shall be qualified by application of TSA on a reference sample which shall be used as a comparator to evaluate the suitability of application process. Only that applicator will be permitted to carry out the work when test specimens coated by the applicator meets the desired requirements as cited below.

The sample shall be made of a steel plate measuring approx. 18"x 18" x ¼" thick. If the actual work is less than ¼" thick then the sample to be made from material of representative thickness.

The surface preparation, TSAC application shall be made with actual field equipment and process/spray parameters and procedures as per the specification. The depth profile of blasted surface, TSAC coating thickness for each cross pass and total thickness range shall be as per specification.

The surface preparation and thermal spraying shall be carried out in representative environmental conditions spraying with makeshift enclosure.

7.1 After application of coating, thickness and tensile bond measurements shall be made in following manner.

- Divide the sample piece into four quadrants.
- Measure thickness along the diagonal line of each quadrant.
- Four each quadrant five in-line thickness measurements at 1" interval shall be done using SSPC-PA 2 type 2 fixed probe gauge. Thus, a total of four "five in line" thickness measurements to be done for the whole sample.
- One tensile bond measurement using ASTM D 4541 type III or IV portable self-aligning test instrument to be done at center of each quadrant. Total of 4 measurements for the sample.
- One porosity evaluation test by Metallographic examination shall be conducted to demonstrate the achievement of porosity within the limits specified. Sample shall be prepared for Metallographic examination as per ASTM E-3.
- The procedure shall be considered qualified if thickness and tensile-bond strength and porosity values meet the specification requirement.

7.2 Bend test: Bend test shall be carried out as detailed at sec. 6.5 of this annexure.

Applicators thermal spray equipment set-up, operation and procedure of application including in-process QC checkpoints adopted during procedure qualification as described above should be always subsequently followed during entire duration of work.

8.0 DOCUMENTATION

The following information shall be provided by TSAC applicator before award of work.

- TSAC application process consisting of equipment capabilities and their technical parameters, feed stock material and source of procurement.
- Detailed application procedure and in-process quality control check points for (a) surface preparation (b) thermal spraying (c) seal coats.
- Type and specification of instruments to be deployed for measurement of blast profile depth, TSAC thickness and tensile bond.
- Paint manufacturer data sheet for the selected sealing coat to be applied.
- Applicator shall submit repair procedure and all relevant documents for restoring the existing TSAC which will be removed for routine maintenance/NDT testing.

9.0 RECORDS

- The TSAC applicator shall maintain job record to record production and QC information. All the results of the tests and quality control checks shall be entered in the record for each component/part thermally sprayed. All the result of tests (thickness, tensile bond, bend tests) and other validation tests (e.g. procedure qualification test, test for surface cleanliness after abrasive blasting, test for cleanliness of abrasives and air) shall also be recorded and duly signed by owner.
- All the information mentioned in Sec 8.0 above should also form part of the Job record.
- Any modification affected after procedure qualification in the procedure, QC, spray parameter, equipment spec to the original information (submitted before award of the work) must also form part of Job record.

10.0 WARRANTY

The TSAC applicator shall warrant the quality of material used by providing the purchaser with a certificate of materials used to include

- Spray feed stock: Alloy type/designation, Lot Number, wire diameter, chemical analysis, name of supplier, manufacturer.

- Sealant: Name of manufacturer, application data sheet.

11.0 SAFETY

The TSAC applicator shall follow all safety procedures required by the purchaser/owner. Owner shall also give compliance requirement to be followed by applicator. The applicator shall follow all appropriate regulatory requirements.

12.0 CODES AND STANDARDS

This specification shall apply in case of conflict between specification and following applicable standards:

AWS C. 2.17	Recommended Practice for Electric arc Spray.
ASTM C 633	Test Method for Adhesive/Cohesive Strength of Flame Sprayed Coatings.
ASTM D 4285	Method for indicating Oil or Water in Compressed Air.
ASTM D 4417	Test Method for Field Measurement of Surface Profile of Blasted Steel.
BS 2569	Specification for Sprayed Metal Coating.
NACE Standard RP 0287	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape.
ASTM D 4541	Test method for Pull-Off Strength of Coating Using Portable Adhesion Testers.
ANSI/AWS C2.18	Guide for the Protection of Steel with Thermal Spray Coatings of Aluminum, Zinc and Their Alloys and Composites.
NACE No. 12/AWS C2.23M/SSPC-CS 23.00	Specification for the application of thermal spray coatings (Metallizing) of aluminum, zinc, and their alloys and composites for the corrosion protection of steel.
SSPC Publication	The inspection of coatings and linings: A Handbook of Basic practice for Inspectors, Owners, and Specifiers.
SSPC-AB 1	Mineral and Slag Abrasives.
SSPC-AB 3	Ferrous Metallic Abrasives.
SSPC-PA 1	Shop, Field, and Maintenance Painting of Steel.
SSPC-PA 2	Measurement of Dry Coating Thickness with Magnetic Gages.
NACE No. 1/SSPC-SP 5	White Metal Blast Cleaning.
NACE No. 2/SSPC-SP 10	Near –White Metal Blast Cleaning.
SSPC-VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.

Annexure-II



25. CRUDE OIL TANKS PAINTINGS

25.1 Scope

This standard exclusively covers the painting of crude oil storage tanks in BORL Refinery including COT, Vadinar. This standard has been derived from existing SOP/09/11, Rev.-1 & AE-S-5430, Rev. 2 (BPCL, MR) and painting practices being followed at BPCL MR. Intent of this standard is to have better protection of Crude tanks against adverse environments.

25.2 Tank operating conditions

Operating temperature: Not above 65 degree Celsius.

Operating pressure: Ambient.

25.3 Surface preparation

The purpose of surface preparation is to create a continuous highly adherent, homogeneous and defect free paint film with an even thickness over the tank surfaces. For new painting, **all the internal & external surfaces shall be blasted to achieve the surface profile as given in Annexure – A.** Light shades and streaks are not allowed. When steel shot is used, it shall be used together with steel grit. The purpose of surface preparation is to create a continuous highly adherent, homogeneous and defect free paint film with an even thickness over the tank surface. Compressed air used shall be free of moisture and oil. Adequate separators and traps shall be provided, installed in the coolest part of the system. The presence of oil and water shall be determined at least two (2) times per eight hours and following every compressor start-up. The air discharge temperature shall not exceed 100 °C. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the materials for liners. Blasting nozzles shall be replaced when the specified minimum blast pressure, surface cleanliness and surface roughness can no longer be achieved. Blasting equipment and the equipment being blasted shall be properly earthed to prevent the occurrence of electrostatic discharges. If possible, vacuum collector shall be installed for collecting the abrasives for recycling. Recycled shot shall be used only after ensuring that it is clean enough to provide the minimum surface preparation mentioned above.

When working in confined spaces, adequate ventilation and intrinsically safe lighting shall be used. As a minimum, ventilation shall ensure sufficient air changes such that the threshold limit value (TLV) of the various coating materials in use shall not be exceeded. Access for coating work should be constructed so as to provide easy and sufficient access for surface preparation, painting and inspection of all surfaces

25.4 Recommended environment conditions for Paint Application

For all cases, paint manufacturer guidelines shall be followed. Following restrictions are given as



recommended practices:

25.4.1 Coating application shall not be permitted in the following conditions.

- 4.1.1 During fog, mist or rain.
- 4.1.2 When the relative humidity is 85 percent or above.
- 4.1.3 When the steel surface temperature and/or ambient temperature is below 10°C (50°F).
- 4.1.4 When the steel surface temperature and/or ambient temperature is above 50°C (120°F).
- 4.1.5 When the steel surface temperature is less than 3°C (5°F) above the dew point.

25.4.2 For all internal painting work, the dehumidification of the surrounding air dew point shall be maintained 5 degree Celsius below the prevailing surface temperature. The relative humidity shall be maintained not more than 45% from preparation to curing of coatings. It is strongly recommended to use Dehumidifiers to maintain the better conditions for painting and effective results.

25.4.3 The measurement of the following shall ensure prior to start of work and shall be done every three hours for the entire duration of the painting work and shall extend till the paint is dried and cured.

- 4.3.1 Relative Humidity (RH).
- 4.3.2 Ambient air temperature.
- 4.3.3 Surface temperature of the object being painted.
- 4.3.4 Air temperature at surrounding of the painting.
- 4.3.5 Air flow

25.4.4 There shall be no welding activity or radiography testing on the shell during and after installation of coating system.

25.4.5 Humidity and dew point readings shall be taken with a sling Psychrometric meter and calculated using psychrometric tables.

25.4.6 Coatings shall not be applied before the surface has been inspected and the preparatory work approved.

25.4.7 All edges shall be ground to a minimum radius of 3.2 mm. Flame cut areas and weld spatter shall have been ground flush. All rough welds shall be ground to remove sharp edges and other such irregularities. The amount of grinding performed shall be judicious and performed only to the extent necessary to prepare the weld surface and surrounding metal surfaces in accordance with the specification. Over grinding, which would result in



decreasing the wall thickness or the integrity of the weld beyond the limitations imposed by good welding practices, applicable welding codes, or tank or vessel ratings, shall be avoided. All weld spatter and arc strikes must be removed. (Refer NACE SP 0178).

25.4.8 Salt water spray areas shall require fresh water blasting or fresh water (Max. Chloride content 50 ppm) mopping to remove the salts deposited on metal surface before application of primer. Mopping can be repeated before application of other coats to remove salts deposited on previous coats, if such deposits are suspected.

25.4.9 Blast cleaned steel surfaces shall not be touched by bare hand.

25.4.10 If the surface being cleaned is adjacent to a coated surface, the blast cleaning shall cut in to the coated surface by at least 50 mm. The edges of the existing coating system shall be feathered. The remainder of the existing coated surface shall be properly protected with shields or screens to prevent any over blast damage.

25.4.11 To prevent dust and abrasive contamination, blast cleaning shall not be carried out adjacent to painting operations or wet (painted) surfaces.

25.5 Mixing and Painting

25.5.1 Mixing & Thinning

All paint spraying equipment, including mixers, shall be thoroughly cleaned before mixing of new materials. All coating materials shall be mixed and thoroughly stirred in accordance with the instructions of the paint Manufacturer. Sufficient agitation to maintain good mixing shall be applied until the product is used. If air is entrapped in the product during mixing/stirring, sufficient time should be allowed for the air bubbles to escape before application.

25.5.2 Application of paint/primer:

5.2.1 Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hrs. the same day or as per the time frame stipulated in the technical data sheet of the paint, whichever is earlier.

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

5.2.3 No coat shall be applied until the preceding coat has dried and cured as



recommended by Paint Manufacturer. Next coat shall be applied within the time stipulated by the paint manufacturer. Before over coating, over-runs, drips and smears shall be removed and any coating damage or imperfection shall be repaired. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or mixing is faulty.

- 5.2.4 No paint shall be force dried under conditions, which will cause cracking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint. No drier shall be added to paint on the job unless specifically called for in the manufacturer's specification for the paint. Paint shall be protected from rain, condensation and contamination until dry.
- 5.2.5 All paints and painting materials shall be stored only in rooms to be arranged by contractor and approved by Engineer-in-charge for the purpose. All necessary precautions shall be taken to prevent fire.
- 5.2.6 Surface preparation and paint application shall be done in presence of Manufacturer's representative. Manufacturer's representative shall have necessary certification from agency like NACE to supervise and ensure the quality of paint applied.
- 5.2.7 All personnel shall be provided with personnel protection, e.g. protective clothing, safety glasses, safety shoes, hard hats, goggles, respirators, earplugs, fresh air-fed hood and any other necessary safety equipment. All safety equipment shall be maintained in a good working condition. Warning signs shall be prominently displayed at all access points to areas where abrasive blasting and painting is in progress.
- 5.2.8 The Contractor shall protect all equipment, structures and any other areas from mechanical damage, environmental damage, blockage or obstruction and damage caused by over blasting, dripping paint, paint splashes and overspray.
- 5.2.9 To minimize the risk of damage, no lifting, transportation, erection or fabrication operations shall be done before the paint has been fully dried and/or cured.
- 5.2.10 Abrasive blast cleaning and coating operations should be carried out during daylight hours. However, grit blasting and coating may be carried out at night providing the lighting and environmental conditions are acceptable. Minimum lighting requirements for abrasive blasting, painting and inspection are 500 lux.



5.2.11 For internal tank coatings and the external coatings of buried or immersed equipment and structures, pinhole testing for electrically non-conductive coatings shall be carried out in accordance with NACE SP0188. The high voltage technique shall be used; nominally set at 5 V/ μ based on DFT, or as agreed with the paint Manufacturer but not exceeding 25 kV in total. For coating thickness < 500 μ DFT, the low voltage wet sponge technique shall be used.

25.5.3 Spray application

Spraying is the required method of application. The painting Contractor shall supply the required range of spray tips, sizes and fan angles for the work being undertaken. The spray pressure shall be uniform and the spray pattern smooth.

25.5.4 Brush application

Brush application may be done for Maintenance operations, in those cases where spray application may affect other plant, equipment, property or personnel in or near the work site. Where the coating product is specified as only being suitable for brush application. Manufacturer shall confirm in writing that paint is suitable for brush application and will be able to meet the guarantee period. Brush application shall be done only with concurrence of Engineer in charge. Coatings applied by brush shall be smooth and even

25.5.5 Roller application

Roller application shall only be allowed for steel floors and for panels and equipment inside climate-controlled areas. Rollers shall be of good quality to ensure uniformity of the applied coating.

25.5.6 Stripe coat

Before spray application of each coat, irregular surfaces such as sharp edges, welds, small brackets, interstices etc. shall be stripe-coated, usually by brush, to ensure the specified film thickness is provided. Stripe coat shall be applicable in all the painting systems.

25.5.7 Repair of coating defects

Damaged areas, defects in the coating system such as over-runs, drips and smears that have to be removed or areas with inadequate dry film coating thickness shall be re-cleaned. The re-cleaning shall carry over on to the sound coating for not less than 50 mm all round, the edges of which shall be feathered.



After the surface cleaning, the specified coating system shall be re-applied. Any additional coats shall blend in with the final coating at adjoining areas. Paint Manufacturers shall be consulted if the existing coating requires abrading before over-coating to obtain good bonding.

25.5.8 Only thinners specified by the paint Manufacturer shall be used

25.6 Paint Procurement

Painting Contractor shall procure paint material from BORL approved manufacturers only.

25.7 Inspection and testing

25.7.1 Refer **section 18** or point no. **25.12** for testing of paint material

25.7.2 Minimum suggested stages of inspection shall be:

- a. Surface Preparation
- b. Primer application
- c. Each coat of paint

25.7.3 All defects noticed during stages of inspection, shall be rectified free of cost by the contractor. All records shall be kept by the contractor.

25.7.4 Wet film thickness measurements shall be made throughout the course of painting in order to ascertain the adequacy and uniformity of thickness. The readings shall be taken at least one every ten (10) square meters.

25.7.5 Dry film thickness shall be taken on each coat after drying and curing of the coat. Dry film thickness (DFT) readings shall be taken using a non-destructive dry film thickness instrument capable of storing the readings. Sufficient readings shall be taken covering each coat prior to application of the following coat to ensure the correct required DFT.

25.7.6 The DFT indicated against each system shall be obtained by applying one or more coat of the paint based on paint properties. The Contractor is responsible to obtain the indicated DFT as per painting system specification.

25.7.7 DFT meter used shall be calibrated before each inspection and shall be witnessed by the Inspector. It is the duty of the Inspector to satisfy him/herself with the performance of the DFT meter.

25.7.8 Criteria for acceptance of painting work shall be in accordance with table – 2.

TABLE - 2

Test	Standard	Frequency	Acceptance criteria
Surface cleanliness	ISO 8501-1	One per ten (10) square meters	Sa 2 ½
Surface Profile	ISO 8503-2	One per ten (10) square meters	As per coating procedure / data sheet
Total Soluble salt contamination 	ISO 8502-9	One per twenty (20) square meters or minimum 5 tests whichever is more.	<5 g/cm ²
Dust	ISO 8502-3	One per ten (10) square meters	Rating 2 or better
Adhesion	ISO 4624	One pretest panel, per shift	5 MPa
Holiday Detection	NACE SP0188	100% of surface	Zero defects
Dry Film Thickness 	SSPC PA-2	As per Annexure - F	Shall not be less than 80 % and more than 120 % of the Specified dry film thickness. (DFT).
Wet Film Thickness	ISO 2802	One per ten (10) square meters	Consistent with providing required DFT

25.8 Painting Contractor's Responsibility

- 25.8.1** Contractor shall mobilize the adequate capacity dehumidification unit at site for all internal painting work, if required. The surrounding air dew point shall be maintained 5 degree Celsius below the prevailing surface temperature. The relative humidity shall be maintained not more than 45% from preparation to curing of coatings.
- 25.8.2** The contractor shall ensure proper functioning of the dehumidification unit, measuring RH and temperature, measuring air flows and maintained 24 hours till coating work is completed in the tank.
- 25.8.3** All paints and consumables for a particular tank painting work shall be sourced from one manufacturer only to have desired paint performance, guarantee and single point responsibility.
- 25.8.4** Painting contractor shall deploy adequate number of NACE CIP Level 2 qualified

coating Inspectors to supervise, monitor, inspect & control entire painting process right from the surface preparation, storage, handling, mixing and application on substrate of the painting/coating and to ensure the compliance of this specification. These qualified painting inspectors will report to and shall get guided by BORL Inspection Dept.

25.8.5 Each contractor shall possess relevant standards and deploy all inspection tool/instrument to carry out the all above inspection and testing as per relevant standard.

25.8.6 Organizing of testing all the painting parameters, supply of all the testing instruments, consumables for testing each parameter as defined in clause 7.10 above, including getting accepted by BORL, shall be the responsibility of painting contractor.

25.8.7 The Inspection test plan which will be mandatory part of the contract shall be prepared by the above qualified coating inspector and get it approved by BORL inspection department. The Contractor's qualified coating inspector and BORL shall sign an inspection report as per approved inspection test plan.

25.8.8 The report shall consist, as a minimum, of the following in addition to the inspection parameters and acceptable criteria:

- 8.8.1 Names of the applicator and the responsible personnel.
- 8.8.2 Dates when work was carried out.
- 8.8.3 Paint testing parameters tested
- 8.8.4 Equipment and techniques used.
- 8.8.5 Type and calibration of instruments used.
- 8.8.6 Weather and ambient conditions.

25.9 Frequency and Guarantee of painting

25.9.1 Frequency of Crude oil tanks Painting system for both internal and external painting shall be once in 10 years.

25.9.2 Painting Contractor shall furnish Guarantee for minimum 10 years for both internal and external painting with shot blasting as per Annexure – B, C, D & E.

25.9.3 BORL reserves the right to invoke the guarantees in case contractor (paint applicator) or contractor fail to repair the paint failed area within reasonable time.

**25.10 Painting system**

25.10.1 The painting system shall be as mentioned in Annexure – A.

25.10.2 No painting is considered for roof legs for new tanks. Roof legs to be hot dip galvanized. Schedule 80 pipes to be used for both roof legs and sleeves. The sufficient clearance shall be ensured between sleeves and roof legs. However, painting shall be as per directions & recommendations of inspection in case of Old roof legs with CS pipes or as applicable.

25.11 SIGN WRITING

All painting work information shall be mentioned (sign writing) with date of completion on Tank shell as per Engineer-in-charge instructions.

25.12 INSPECTION AND TESTING OF PAINTING MATERIAL

25.12.1 All the procured paint material along with batch/test certificates shall be offered for BORL inspection for approval. Remaining Shelf life shall be at least 90% of the total duration at the inspection above.

25.12.2 All paint materials shall be accompanied by Manufacturer Test Certificate. Inspection Engineer at his discretion may test paint formulations, if required.

**ANNEXURE – A**

THIS PAINTING SYSTEM SHALL BE APPLICABLE FOR CRUDE TANKS AT COT VADINAR FOR ALL EXTERNAL PAINTINGS EXPOSED TO ENVIRONMENT AND FOR CRUDE TANKS AT BINA REFINERY FOR TOP SHELL COURSE PAINTING (FREE BOARD) & EXPOSED PORTION OF FLOATING ROOF (APPLICATION - AIRLESS SPRAY)

SR. NO.	SURFACES	SURFACE PREPARATION	SURFACE PROFILE	PRIMER	FINISH COAT	TOTAL DFT, MICRONS
1	Bottom plate under side (soil side)	Blast cleaning with grit and shot to Sa 2.5	Profile of 40-70 microns	1 Coat of F-15@ 100 DFT/Coat	2 Coats of F-15@ 100 DFT/Coat 2x100 = 200	300
2	Top shell internal 100 mm above top of shunt of secondary seal marked at safe filling height during hydro test. (Free Board area)	Blast cleaning with grit and shot to Sa 2.5	40 microns	1 coat of F9 (VS 65%; 85% zinc on dry film minimum) – 1X 70 Microns DFT + 1 coat of P-6 @ 40µ DFT/ coat	1) Low VOC (Volatile Organic Compounds) two component internally flexibilised high build surface tolerant epoxy suitably pigmented coating – 2 X 125 µ - Note 1 2) F2- One (1) coats of aliphatic acrylic polyurethane with minimum 55% vol solids - 2 x 40 microns DFT.(in approved colour only)	400



SR. NO.	SURFACES	SURFACE PREPARATION	SURFACE PROFILE	PRIMER	FINISH COAT	TOTAL DFT, MICRONS
3	a) Shell surface. external b) Vertical band. Gauging	Blast cleaning with grit and shot to Sa 2.5	40 microns	1 coat of F9 (VS 65%; 85% zinc on dry film minimum) – 1X 70 Microns DFT + 1 coat of P-6 @ 40μ DFT/ coat	1) Low VOC (Volatile Organic Compounds) two component internally flexibilised high build surface tolerant epoxy suitably pigmented coating – 2 X 125 μ - Note 1 2) F2- Two (2) coats of aliphatic acrylic polyurethane with minimum 55% vol solids - 2 x 40 microns DFT.(in approved colour only)	440



SR. NO.	SURFACES	SURFACE PREPARATION	SURFACE PROFILE	PRIMER	FINISH COAT	TOTAL DFT, MICRONS
4	Roof deck plates top surface (Floating roof top surface)	Blast cleaning with grit and shot to Sa 2.5	40 microns		1) Two component Amine / Amine adduct cured high solid glass flake epoxy coating (in conformance to ISO 20340) – 2 X 300 micron DFT – Note- 1 2) F2- Aliphatic acrylic modified high solids weather resistant recoatable two pack polyurethane (finish coat) – 2 X 40 micron DFT	680
5	Pontoon inside surface	SSPC-SP10 / SA 2 ½ OR SSPC – SP2/ST2	Not applicable	1 coat of F9 (VS 65%; 85% zinc on dry film minimum) – 1X 70 Microns DFT OR 1 Coat of F-8 @ 100µ DFT/Coat	1) Low VOC (Volatile Organic Compounds) two component internally flexibilised high build surface tolerant epoxy suitably pigmented coating – 2 X 125 µ - Note 1	320 OR 350

**SYSTEM FOR EXTERNAL PAINTING OF CRUDE TANKS AT BORL, BINA REFINERY (EXCEPT FREE BOARD INTERNAL AND FLOATING ROOF TOP SURFACE WHICH SHALL BE AS PER ABOVE TABLE)**

SR. NO.	SURFACES	SURFACE PREPARATION	SURFACE PROFILE	PRIMER	FINISH COAT	TOTAL DFT, MICRONS, MIN
1	External surfaces of bottom plate (soil side) for Crude tanks.	Blast cleaning with grit and shot to SA 2.5	Profile of 40-70 microns	1 Coat of F-15@ 100 DFT/Coat	2 Coats of F-15@ 100 DFT/Coat 2x100 = 200	300
2	External shell, wind girders, rolling and stationary ladders, spiral stairways, hand rails for all environments for crude oil	Blast cleaning with grit and shot to SA 2.5	Profile of 40 microns	1 coat of F-9 @ 65-75 μ + 1coat of P6 @ 40 μ DFT / coat	2 coats of F-6A @ 100 μ DFT /coat + 1 coat of F-2 @ 40 μ DFT/ coat	345

SYSTEM FOR INTERNAL PAINTING OF CRUDE TANKS AT BPCL, BINA REFINERY (EXCEPT FREE BOARD) & AT COT, VADINAR (FOR INTERNAL FREE BOARD SECTION OF CRUDE TANK AT BORL, BINA, REFER ABOVE TABLES)

SR. NO.	SURFACES	SURFACE PREPARATION	SURFACE PROFILE	PRIMER	FINISH COAT	TOTAL DFT, MICRONS, MIN
1	Underside of floating roof, oil side surface of pontoons, support structures and ladders and other CS internals etc, inside of bottom plate, internal surface of bare shell for 1.5 mtr from bottom , for storing Crude Oil and Crude + Water Tank (52-TT-CR-15).	Blast cleaning with grit and shot to SA 2.5	Profile of 40 microns	1 coat of Primer @ 75 μ DFT/ coat (Primer shall be compatible with F-6C & F-6C should be suitable for immersion service of products given) Note-1	2 Coats of F-6C @ 300 μ DFT/ Coat 2X300=600	675



SR. NO.	SURFACES	SURFACE PREPARATION	SURFACE PROFILE	PRIMER	FINISH COAT	TOTAL DFT, MICRONS, MIN
2	Internal surfaces of bare shell above 1.5 mtrs from bottom including underside of cone roof and supporting structures for Crude + Water Tank (52-TT-CR-15).	Blast cleaning with grit and shot to SA 2.5	Profile of 40 microns	1 Coat of F-15 @ 100 µ DFT/Coat	2 Coats of F-15 @ 100µ DFT/ Coat 2X100=200	300
3	Inside surface of pontoon of all floating roofs.	Blast cleaning with grit and shot to SA 2.5		1 Coat of F-8 @ 100µ DFT/Coat	1 Coat of F- 8 @ 100µ DFT/Coat	200

Notes

- 1) Contractor shall submit suitable product datasheet, PTR and test certificate, for EIL review and approval.
- 2) Stripe coat is must for weld area, edges and corners.
- 3) Over zinc silicate, intermediate coat to be applied in mist coat and full coat technique.
- 4) In PU paint of silver shade, total thickness to be built in two coats.
- 5) For PU paint QUVA 340 requirement of 80 % gloss retention after 3000 hrs.
- 6) All sharp edges to be grinded well before painting.
- 7) Pitted area having width greater than 2mm or depth greater than 5 mm to be filled with solvent less polyamine adduct cured epoxy.
- 8) Camouflaging not to be do

Paint Inspection Daily Coating Inspection Report

Project/Client:		Date: / / Su M Tu W Th F Sa		Pg ____ of ____																																																																														
Location:		Project #:		Copy to:																																																																														
Description:		Inspector:		☐ QC Super ☐ Owner ☐ Contr ☐ _____																																																																														
Requirements:				Attachments:																																																																														
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Description of Areas and Work Performed		Hold Point Inspections Performed																																																																																
		☐ 1. Pre Surface Preparation/Condition and Cleanliness ☐ 2. Surface Preparation Monitoring ☐ 3. Post Surface Preparation/Cleanliness and Profile ☐ 4. Pre Application Prep/Surface Cleanliness ☐ 5. Application Monitoring/Wet Film Thickness (WFT) ☐ 6. Post Application/Application Defects ☐ 7. Post Cure/Dry Film Thickness (DFT) ☐ 8. Nonconformance/Corrective Actions Follow-Up ☐ 9. Final Inspection																																																																																
		Approved by: _____																																																																																
Surface Conditions		Ambient Conditions																																																																																
☐ New ☐ Maint ☐ Primer/Paint ☐ Age/Dry/Cure _____ ☐ Steel ☐ Galvanize ☐ Concrete ☐ Other _____ ☐ Hazard _____ ☐ Sample Report # _____ ☐ Degree of contamination: _____ Test: ☐ Cl _____ $\mu\text{g}/\text{cm}^2$ ($\mu\text{s}/\text{cm}$) ☐ Fe _____ ppm ☐ pH _____ ☐ Degree of Corrosion: _____ ☐ Scale ☐ Pitting/Holes ☐ Crevices ☐ Sharp Edges ☐ Weld _____ ☐ Moisture ☐ Oils ☐ Other _____ ☐ Painted Surface Condition: _____ Dry to: ☐ Touch ☐ Handle ☐ Recoat ☐ Dry/Over Spray ☐ Runs/Sags ☐ Pinholes ☐ Holidays ☐ Abrasion ☐ Fall Out ☐ Other _____		Time (Indicate AM or PM) : : : : Dry Bulb Temp° (C/F) : ° : ° : ° : ° Wet Bulb Temp° (C/F) : ° : ° : ° : ° % Relative Humidity : % : % : % : % Surface Temp° (C/F) Min/Max : / ° : / ° : / ° : / ° Dew Point Temp° (C/F) : ° : ° : ° : ° Wind Direction/Speed : : : : Weather Conditions : : : :																																																																																
		Application																																																																																
		Start Time: _____ Finish Time: _____ Est Sq Ft: _____ ☐ Primer ☐ Intermediate ☐ Topcoat ☐ Touch-Up Generic Type: _____ Qty Mixed: _____ Mfr: _____ Mix Ratio: _____ Prod Name: _____ Mix Method: _____ Prod #: _____ Strain/Screen: _____ Color: _____ Material Temp: _____ °F Kit Sz/Cond: _____ Sweat-In Time: _____ Min/Hrs Shelf Life: _____ Pot Life: _____ Min/Hrs																																																																																
Surface Preparation		Batch #s																																																																																
Start Time: _____ Finish Time: _____ Est Sq Ft: _____ ☐ Solvent Clean ☐ Hand Tool ☐ Power Tool ☐ HP Wash PSI _____ ☐ Other _____ ☐ Abrasive Blast ☐ Abrasive Type _____ ☐ Sample ☐ Blast Hose Size _____ ☐ Nozzle Size/PSI _____ ☐ Air Supply CFM _____ ☐ Air Supply Cleanliness ☐ Water/Oil Trap Check ☐ Equipment Condition Check		(A) _____ Reducer #: _____ (B) _____ Qty Added: _____ Pt/Qt/Gal (C) _____ % by Vol: _____ % Specified WFT Avg: _____ Mils Achieved WFT Avg: _____ Mils ☐ Airless/Conv Spray ☐ Brush ☐ Roller ☐ Other _____																																																																																
Surface Cleanliness and Profile Measurement		Dry Film Thickness (DFT) Gage Calibration Record																																																																																
☐ Job Specification ☐ SSPC/NACE SP _____ ☐ SSPC/NACE Spec/Visual Stds ☐ _____ ☐ Profile Check _____ ☐ Disc ☐ Tape ☐ Gage ☐ Specified _____ mils avg/Achieved _____ mils ☐ Surface Effect on DFT Gage/BMR _____ mils		<table border="1"> <thead> <tr> <th>Gage Type/ Model</th> <th>Gage Serial #</th> <th>Plate/Shim Mils/μm</th> <th>Gage Adj +/-</th> <th>Spec Avg DFT</th> <th>DFT Last Coat</th> <th>DFT This Coat</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>				Gage Type/ Model	Gage Serial #	Plate/Shim Mils/ μm	Gage Adj +/-	Spec Avg DFT	DFT Last Coat	DFT This Coat																																																																						
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		Pump Pot: _____ Hose Diameter: _____ Air Check: _____ Ratio/Size: _____ Hose Length: _____ SEP/Trap: _____ GPM/CFM: _____ Spray Gun: _____ Filter: _____ PSI: _____ Tip Size: _____ Agitator: _____ Inspector Signature: _____ Date: _____																																																																																

JOB SPECIFICATION FOR EXTERNAL COATING OF BURIED PIPING, VALVES, FLANGES AND FITTINGS

PROJECT: MPMC AND PMC/EPCM SERVICES FOR ETHYLENE
CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO
BINA PETCHEM & REFINERY EXPANSION PROJECT
(BPREP)

OWNER : M/s BHARAT PETROLEUM CORPORATION LIMITED

MPMC : ENGINEERS INDIA LIMITED

JOB NO : B957

0	04-02-2025	ISSUED FOR JOB SPECIFICATION	JATIN	SAHIL	SRIDHAR
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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2.0 REFERENCE
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ABBREVIATIONS:

API: American Petroleum Institute
DIN: Deutsches Institut für Normung
3LPE: 3 Layer Polyethylene
FJC: Field Joint Coating
HSS: Heat Shrinkable Sleeves

1.0 SCOPE

This specification specifies the minimum technical requirements for pipes externally coated with extruded / sintered 3-layer polyethylene (3LPE) in shop or field and the fittings / flanges / valves / strainer body externally coated with liquid epoxy in the shop or field. These externally coated pipes and fittings are intended for the usage in the buried conditions. The list of items to be coated given in this specification is not exhaustive. This specification is applicable for all items which are in buried condition.

This specification does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this specification to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.0 REFERENCES

BS EN ISO 21809-1: External coatings for buried or submerged pipelines –Polyolefin coatings
DIN 30670: Polyethylene coatings on steel pipes and fittings – Requirements and testing
DIN EN 10289: Steel tubes and fittings for onshore and offshore pipelines
BS EN ISO 21809-3: External coatings for buried or submerged pipelines -Field joint coatings

3.0 MATERIALS

3.1 Coating materials shall be suitable for the service conditions and the pipe sizes involved in the project. The 3LPE coating system for pipes shall comprise of a powder epoxy primer, polymeric adhesive and a medium or high-density polyethylene top coat. The coating materials i.e. epoxy powder; adhesive and polyethylene compound shall have proven compatibility. The compatibility of all the three components shall be ensured by manufacturer / applicator.

3.2 Fittings shall be coated with liquid applied epoxy coating material

3.3 Buried field joints of 3LPE pipe shall be coated with heat shrinkable sleeves / Cold applied tapes defined as per clause 4.3 of this specification.

4.0 FUNCTIONAL REQUIREMENTS AND PROPERTIES OF COATING

4.1 3LPE coated pipes

4.1.1 General requirements

The 3LPE coating shall preferably be applied by side extrusion method as per BS EN ISO 21809-1 for piping which are having a design temperature up to 80°C. However, for design temperature up to 70°C, 3LPE coating by sintering method is also acceptable and shall conform to DIN 30670 (Type S) and table-1 of this specification. Total thickness of the coating shall conform to thickness class 'n' as per table-3 of DIN 30670.

Cut back provision for pipes and fittings shall be as follows:

For pipes smaller than DN 600 the length of the cutback shall be no greater than 150 mm, for larger pipes the cutback shall be (150 ± 20) mm. For three-layer coatings, the epoxy resin and adhesive layers at the pipe ends shall be removed to at least 80 mm

from the welding bevel. A not less than 20 mm strip of epoxy resin or epoxy resin and adhesive should extend from the cutback of the polyethylene coating. For coating thicknesses up to 2.2 mm the bevel angle shall be no greater than 45°, for greater coating thicknesses the bevel angle shall be no greater than 30°.

Table-1: Properties of 3 LPE Coatings

PROPERTY	REQUIREMENT	TESTING AS PER DIN 30670	NOTES
Cathodic disbondment (CD test)	23 °C/28 d or 60 °C/2 d max. 7 mm	Annex C	-
Peel strength	70 N/cm (23 °C) 30 N/cm (70 °C)	Annex D	For system testing single values shall be no more than 25 % lower than the required average value.
Continuity (holiday detection)	No discharges	Annex E	25 kV test
Elongation at break (23 °C ± 2 °C)	min. 300 %	Annex F	-
Impact resistance (23 °C ± 2 °C)	≥ 7 J/mm	Annex H	25 kV test No discharges
Low temperature impact resistance	≥ 7 J/mm (-40 °C ± 2 °C)	Annex H	25 kV test No discharges
Indentation resistance	max. 0,2 mm (23 °C) max. 0,4 mm (70 °C)	Annex I	-
Specific electrical coating resistance (23 °C ± 2 °C)	≥ 10 ⁸ Ωm ²	Annex J	-
UV resistance	ΔMFR ± 35 %	Annex K	-
Thermal ageing resistance	ΔMFR ± 35 %	Annex L	-

4.2 Epoxy coated fittings, flanges and valves

Fittings shall be coated with liquid epoxy conforming to DIN EN 10289 (Class C and type 3) and table-2 of this specification. Thickness of the coating shall be minimum 1500 microns. Wherever epoxy coated fittings are to be welded with 3LPE coated pipes or fittings, it is the responsibility of the supplier/coating applicator to ensure a proper cut

back in such a way that the coating is not damaged during welding. Specific written approval of EIL to be obtained in case there is difficulty in complying with this requirement, supplier to submit justification for the same. The joints between two epoxy coated fittings shall be coated with liquid epoxy as per DIN EN 10289, Class C and type 3.

Table-2: Properties of Liquid Epoxy Coatings

PROPERTIES	REQUIREMENTS		TESTING AS PER DIN EN 10289
Hardness Shore "D"	Specified by the manufacturer		Clause 7.3
Appearance and continuity	Uniform colour, smooth appearance and free from defects		Clause 7.4
Cut back	(150 ± 20) mm		Clause 7.5
Holiday detection	Free from holiday		Clause 7.6
Impact resistance	(23 ± 2) °C	(- 5 ± 3) °C	Clause 7.7
	5 J X k X mm (mm of coating thickness)	3 J X k X mm (mm of coating thickness)	
Adhesion test Resistance to removal	(23 ± 2) °C	maximum service temperature ± 2 °C	Clause 7.8
	min. rating 2	Results for information	
Cathodic disbondment	Average	Maximum	Clause 7.10
	<=6 mm	<= 8 mm	
Specific electrical insulation resistance	Minimum Rs after set number of days at constant temperature		Clause 7.11
Indentation resistance	(23 ± 2) °C	maximum service temperature ± 2 °C	Clause 7.13
	max 0.2 mm	<=30 % of initial measured thickness	

4.3 Field joint coating

The joint between 3LPE coated pipe and epoxy coated fitting shall be protected by heat shrinkable sleeves / cold applied tapes conforming to codes 14-B / 19-E respectively as per BS EN ISO 21809-3. The FJC shall meet the requirements as mentioned in table-3 & 4 of this specification.

Note: Liquid epoxy coating conforming to DIN EN 10289, Class C and type 3 can also be applied as field joint coating where there is practical difficulty in applying HSS / Cold applied tapes subject to approval by the OWNER / PMC. A certificate for compatibility of liquid epoxy with 3LPE coated pipes shall be obtained from liquid epoxy coating manufacturer and submitted to OWNER / PMC for approval. Epoxy coating shall comply to the Table-2 of this specification.

Table-3: Properties of Heat Shrinkable sleeves

PROPERTY	TEST TEMP.	UNIT	REQUIREMENTS	TEST METHOD AS PER BS EN ISO 21809-3
Thickness – Sleeve Layers	-	-	>= specified min. value	Annex B
Holiday detection at 5 kV/mm + 5 kV	-	-	No holiday	Annex C
Impact resistance (holiday detection at 5 kV/mm + 5 kV)	23 °C	J/mm	≥7	Annex D
Indentation resistance: Pressure	T _{max}	N/mm ²	10,0	Annex E
Residual thickness		mm	≥0,6	
Amount of penetration		mm	—	
Cathodic disbondment at 28 days	23 °C	mm	≤5,0	Annex G
	T _{max} limited to 95 °C	mm	≤10	
Peel strength at 10 mm/min to pipe surface and to poly- olefin plant coating	23 °C	N/mm	≥5,0	H.1
	T _{max}	N/mm	≥0,30	
Peel strength at 10 mm/min to pipe surface and to poly- olefin plant coating after 100- day hot-water immersion test at T _{max} limited as per Annex I	23 °C	P100/P0	≥0,75	Annex I and Annex H
Lap shear strength at 10 mm/min	23 °C	N/mm ²	≥3,0	Annex J
	T _{max}	N/mm ²	≥0,20	
Elongation at break E100/ E70)	23 °C	—	≥0,75	Annex M
Peel strength to pipe surface (P100/P70)		—	≥0,75	

Table-4: Properties of Cold applied tapes

PROPERTY	TEST TEMPERATURE	UNIT	VALUE	TEST METHOD AS PER BS EN ISO 21809-3
Holiday detection at 10 kV/mm, max. 25 kV	—	—	No holiday	Annex C
Peel strength	23 °C	N/mm	>15	Annex H
	T _{max}	N/mm	>4,0	Annex H
Adhesion to pipe surface and plant coating after 28-day hot-water immersion test at T _{max} limited as per Annex I	23 °C	—	>10 N/mm	Annex I plus Annex H
Cathodic disbondment at 28 days	23 °C	mm	≤7	Annex G
	T _{max}	mm	≤10	Annex G
Impact resistance	23 °C	J/mm	5 × α × β	Annex D
Indentation resistance at a pressure of 10 N/mm ²	T _{max}	mm	≤1,0	Annex E

5.0 INSPECTION AND TESTING

The contractor shall establish and maintain a proven quality assurance system to ensure that supplied pipes & fittings comply in all respects with the requirements of this specification. The minimum inspection and testing to be performed shall be as per relevant clauses of DIN 30670, BS EN ISO 21809-1 & 3 and DIN EN 10289. Prior to starting the coating job, the contractor /supplier/coating applicator shall prepare coating application procedure and ITP based on the above mentioned standards in consultation with OWNER/PMC and submit for their approval. Coating Job shall start only after approval of the same.

6.0 HANDLING, TRANSPORTATION AND STORAGE

- 6.1 The vendor shall load, unload, transport and stockpile the coated pipes, flanges, valves and fittings within the coating plant using approved suitable means and in a manner to avoid damage to the coating.
- 6.2 Coated pipes, flanges, valves and fittings may be handled by means of slings and belts of proper width (minimum 60 mm) made of non- abrasive/non-metallic materials. In this case, pipes, flanges, valves and fittings to be stacked shall be separated row by row to avoid damages by rubbing the coated surface in the process of taking off the slings. Use of round sectional slings is prohibited. Forklifts may be used provided that the arms of the forklift are covered with suitable pads, preferably rubber/PVC/Teflon.
- 6.3 Coated pipes, flanges, valves and fittings at all times shall be stacked completely clear from the ground, at least 300 mm, so that the bottom row of pipes remains free from any stagnant surface water. The pipes and fittings shall be stacked at a slope so that driving rain does not collect inside the pipe. Coated pipes and fittings may be stacked by placing them on ridges of sand free from stones and covered with a plastic film or on wooden supports provided with suitable cover. Flanges and valves shall be provided with covers/wrapping to ensure that there is no water stagnation/accumulation to protect the coating. This cover can be of dry, germ free straw covered with plastic film, otherwise

foam rubber may be used. The supports shall be spaced in such a manner as to avoid permanent bending of the pipes. Stacks shall consist of limited number of layers such that the pressure exercised by the pipe's own weight does not cause damages to the coating. Each pipe section shall be separated by means of spacers suitably spaced for this purpose. Stacks shall be suitably secured against falling down and shall consist of pipe sections having the same diameter and wall thickness. The weld seam of pipes shall be positioned always in a manner so as not to touch the adjacent pipes. The ends of the pipes and fittings during handling and stacking shall always be protected with bevel protectors.

6.4 The trucks used for transportation shall be equipped with adequate pipe supports having as many round hollow beds as there are pipes to be placed on the bottom of the lorry bed. Total width of the supports shall be at least 5% of the pipe length and min. 2 no. support shall be provided. These supports shall be lined with a rubber protection and shall be spaced in a manner as to support equal load from the pipes. The rubber protection must be free from all nails and staples where pipes are in contact. The second layer and all following layers shall be separated from the other with adequate number of separating layers of protective material such as straw in plastic covers or mineral wool strips or equivalent, to avoid direct touch between the coated pipes.

All stanchions of Lorries used for transportation shall be covered by non-abrasive material like rubber belts or equivalent. Care shall be exercised to properly cover the top of the stanchions and other positions such as reinforcement of the truck body, rivets, etc. to prevent damage to the coated surface. Slings or non-metallic straps shall be used for securing loads during transportation. They shall be suitably padded at the contact points with the pipe.

6.5 In case of any marine transportation of coated pipes, flanges, valves and fittings involved, the same shall be carried out in compliance with API RP 5LW.

7.0 MARKING

Vendor shall place marking on the outside surface of the coating at one end of the coated pipe and marking shall be as per the requirements of DIN 30670, BS EN ISO 21809-1 & 3 and DIN EN 10289.

VENDOR DATA REQUIREMENTS FOR PROTECTIVE COATINGS-B957-420-80-44-PG- T-7410

0	18-FEB-2025	ISSUED FOR BIDS	JATIN	SAHIL	SS
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

VENDOR DATA REQUIREMENTS

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

COATING SYSTEMS

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Schedule of Vendor Documents		✓		✓	
2.	Painting Scheme / Schedule/specifications (Including particulars of surface conditions, surface preparation and coating system etc. and inspection).		✓		✓	
3.	Paint manufacturer's Credentials/PTR (Past Track record)			✓	✓	
4.	Paint Pre-qualification Certificates as per the specifications.		✓		✓	
5.	Paint datasheets and Material safety Datasheets (MSDS)		✓		✓	

Notes :

- "TICK" denotes applicability.
- Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
- All post order documents shall be submitted / approved through EIL eDMS portal.
- Final documentation shall be submitted in hard copy (Six prints) and soft (two CDs/DVDs) in addition to submission through EIL eDMS.
- Refer - 6-78-0001: Specification for quality management system from Bidders.
- Refer - 6-78-0002: Specification for documentation requirements from Contractors.
- Refer - 6-78-0003: Specification for documentation requirement from Suppliers.
- All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
- Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
- "@" indicates submission of documents to Inspection Agency.
- Bill of Material shall form part of the respective drawing.



JOB SPECIFICATION FOR CATHODIC PROTECTION SYSTEM

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)

UNIT : STEAM GENERATION PACKAGE

OWNER : BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

PMC : ENGINEERS INDIA LIMITED (EIL)

JOB NO. : B957

0	18/02/2025	ISSUED FOR TENDER	A K DAS	SD	NSB
Rev No.	Date	Purpose	Prep. By	Checked by	Approved by

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Annexure-1

- 1) Standard Specification for Cathodic Protection System for Tank bottom Plate, 6-45-0030, Rev.0
- 2) Standard Specification for Cathodic Protection System for Underground Vessels, 6-45-0032, Rev.0
- 3) Specification for installation, pre-commissioning, testing and commissioning of cathodic protection system for tanks, 6-45-0051, Rev 0
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1.0 SCOPE OF WORK

1.1 SCOPE OF WORK FOR CATHODIC PROTECTION SYSTEM (CP SYSTEM)

The work to be performed by the EIL/ OWNER approved CP contractor shall comprise of design, detailed engineering, supply, installation, testing and commissioning of Impressed Current Cathodic Protection (CP) System for soil/ sand side corrosion prevention of Underground Vessels, Tank bottom plate and UG piping (without having heat insulating material) within the scope of this project.

This document is not intended to be all-inclusive and the use of the guidelines set forth here do not relieve the CONTRACTOR of his responsibility of providing adequate CP System, which shall be proved performing to the entire satisfaction of the OWNER/ EIL.

The successful EPC contractor shall furnish all necessary details with supporting documents of proposed CP contractor (List of orders executed with copies of work orders/ technical details of work executed, completion certificate of CP contractor during detail engineering stage).

The contractor needs to supply all materials, consumables in his scope of supply from EIL/ Owner approved vendor list. The items which are not listed, the same shall be considered based on proven track record (PTR) basis for application of minimum one year period and five years for critical items such as MMO wire anode (filled with factory coke breeze and connecting lead cable), Surge diverter, SSPC (solid state polarization cell) / DC Decoupler and Reference electrode with satisfactory performance record (Refer technical specification of items). The contractor shall provide all construction tools, tackles, equipment and personnel necessary for the work and prepare detailed engineering package including construction drawings before starting of the work. After commissioning of the system commissioning report along with as built drawings including soft copies in latest version of AutoCAD and operating manuals to be prepared.

The Contractor needs to keep vigilance and take all precautionary measures to prevent fire hazards during execution of job.

1.2 SCOPE OF WORK FOR CATHODIC PROTECTION SYSTEM INSTALLATION

1.2.1 Item wise works envisaged under this Contract will comprise of the following:

Preparation and submission of Detail Engineering package as per Design basis and job specifications enclosed in this document. The detail engineering package shall include, as a minimum, design calculations, Bill of quantities, layout drawings of all materials/ equipments of CP System, Connection schemes and wiring diagrams, Installation procedures, name of equipment suppliers, shop/ field testing & inspection plan for equipment, necessary technical information/ datasheets, fabrication/ construction drawings, testing and commissioning procedures and formats, Quality control/ Quality assurance documents etc. & obtain approval from OWNER/ EIL before execution of work. CONTRACTOR needs to obtain approval on all layout drawings of cathodic protection materials/ equipment at site from OWNER/ EIL before starting the installation work.

1.2.2 Carry out Soil Resistivity test, detailed engineering, Supply all materials, equipment and perform all erection and installation work as per approved detail-engineering package. Provision of all service connection to T/R units shall be in CONTRACTOR's scope of work.

- 1.2.3 Shop testing of all major contractor supplied CP equipment (T/R, Anode, Cables, Junction Boxes, and RTU etc.) and submission to EIL of Test results/ certificates for approval before delivery of equipment.
- 1.2.4 Field-testing of individual components of CP System as per approved detail engineering package. Final commissioning of installed system as per approved procedure and submission to EIL of results thereof.
- 1.2.5 Liaison with other agencies, seek and obtain all permission related and obligatory to his part of the work.
- 1.2.6 Preparation and submission of 1 set of soft copy and 6 sets of hard copies to client and one set each soft and hard copy to EIL for records for all as built CP System package comprising of operation and maintenance manual for equipment, as-built drawings, Material specifications and Pre-commissioning/ Commissioning results.
- 1.2.7 After Commissioning of the CP System, if it is found that structure to electrolyte potential achieved at some location is in the range which is below acceptable limit as per code, then a supplementary CP System need to be installed to bring the potential level at such locations within acceptable limit as mentioned vide section 2.0 for "Design Basis/ Philosophy for CP System".
- 1.2.8 CONTRACTOR shall give performance guarantee for CP System for applicable equipments/ UG piping as per design basis and job specifications and operation guarantee of the material and equipment supplied by him as well as guarantee against defective workmanship for installation work carried out by him.

1.3 INSTRUCTION TO BIDDERS

1.3.1 Site Particulars

It shall be the bidder's responsibility to have a thorough understanding of the reference documents, site conditions and specification included therein. The intending bidders shall be deemed to have visited the site and have studied the conditions before submitting the Bids. Non-familiarity with the site conditions will not be considered a reason either for extra claims or for not carrying out the work in strict conformity with the drawings and specifications.

- 1.3.2 Every item of work and supply by CONTRACTOR shall be subject to Engineer-In-Charge scrutiny, supervision and approval. Any work carried out or supplies affected without such approval shall stand automatically rejected and his claim for compensation for such unauthorized work shall be null and void.

1.4 SPECIFIC REQUIREMENTS FOR CP SYSTEM WORKS

1.4.1 General

Clauses given under specific requirements for CP System works shall be read in conjunction with General conditions of contract and in case of any conflict, the provisions of specific requirements

for CP System works will override the provision of general conditions of contract.

1.4.2 EIL/ OWNER shall have the right to inspect the following:

- Workshop & production facilities available with CONTRACTOR or its tie up agency.
- Fabrication/ testing of material/ equipment to be supplied by CONTRACTOR or its tie up agency for CP system.

1.4.3 It shall be Bidder's responsibility to arrange access for EIL/ OWNER Personnel for such visits. All costs related with travel, boarding, lodging for EIL/ OWNER personnel for such visits (if any) shall be borne by EIL/ OWNER.

1.4.4 Materials

1.4.4.1 Material Supplied By Owner

No material for CP System shall be supplied by owner.

1.4.4.2 Material Supplied by Contractor

The Contractor shall procure, supply all materials, equipment and consumables required for the work in his scope. Technical specifications of major items are given in section 3.0 for "Job specification for CP System", of this document. Supply of all balance materials, consumables not covered in section 3.0 for "Job specification for CP System", but required for completion of work as per this specification shall be entirely Contractor's responsibility. The rates quoted for the execution of the Contract shall be inclusive of all Contractor supplied material and equipment.

1.4.5 Warranty

Contractor needs to provide design guarantee for the system as per codes and standards & the protection criteria mentioned in the section Design basis/ Philosophy of this document also shall replace/ repair or reinstall free of cost any material/ equipment supplied or installed by him in case it fails to operate due to defective material or workmanship as per requirements of this specification within 12 (Twelve) months from the date of issue of completion certificate and acceptance of the CP System by Owner. Contractor shall replace at his own cost if any item found defective or missed before handing over the system to owner.

Comprehensive Annual Maintenance (AMC) for CP System for 1 year is in CP Contractor's scope after Guarantee/ Warrantee period is over.

1.4.6 Construction Aids, Equipment, Tools and Tackles

Contractor shall be solely responsible for making available for executing the work, all requisite construction equipment, special Aids, tools, tackles and testing equipment and appliances, all instruments including automatic Programmable current interrupters required for commissioning and interference testing of the system. Such construction equipment shall be in first class operating condition. Any discrepancies pointed out by Owner/ EIL shall be immediately got rectified, repaired

or the equipment replaced all together by Contractor. Owner/ EIL shall not in any way be responsible for providing any such equipment, machinery tools and tackles etc. The Owner/ EIL reserves the right to re-arrange such deployment depending upon the progress and priority of work in various sections at no extra cost to Owner.

1.4.7 Transportation, Packing and Handling

Contractor shall be responsible for transportation of all equipment/ materials required for CP system work and unload the same at allotted area at site.

1.4.7.1 To protect all the material during period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and storage in open during monsoon including delays in transit. Bidder shall be responsible for any damage to equipment/ material due to above reasons.

1.4.7.2 Bidder to refer Section 2.0 for "Design Basis/ Philosophy for CP System", Section 3.0 for "Specification for CP System material & equipment", Section 4.0 for "Mandatory Spares for Cathodic Protection System",

2.0 DESIGN BASIS/ PHILOSOPHY FOR CP SYSTEM

ABBREVIATION

AJB	:	Anode Junction Box
CP	:	Cathodic Protection
CPTR	:	Cathodic Protection Transformer Rectifier
CJB	:	Cathode Junction Box
MJB	:	Monitoring junction Box
MMO	:	Mixed Metallic Oxide
PCP	:	Permanent Cathodic Protection
CMS	:	Central monitoring system
RTU	:	Remote Terminal Unit
PLC	:	Programmable logic controller
DW	:	Deep well
GL	:	Ground Level

1.0 Codes and Standards

The entire work shall be performed as per the following codes/ standards.

NACE : SP-0169, SP-0285, SP-0177, SP-0286

OISD : OISD 150

DIN EN 50162 VDE 015: Protection against corrosion by stray current from direct current (DC) systems.

BS EN 12954 : Cathodic protection of buried or immersed metallic structures

IEC/ NEC/ IS : Relevant codes

IS/ IEC: 60079 : Electrical Apparatus for Explosive Gas Atmosphere

IS/ IEC: 60529 : Classification of Degree of Protection Provided by Enclosures

Indian electricity act and rules framed there under.

Fire insurance regulations.

Regulations laid by Chief Electrical Inspector of State.

Regulations laid by Chief Inspector of Explosives.

Regulation laid by Factory Inspector of State.

Wherever the requirements in this specification are in conflict with any of the above standards, the requirements of this specification shall be binding.

2.0 Design basis:

Impressed Current Cathodic Protection (CP) System to be provided for Carbon Steel material for soil side corrosion prevention of underground raw water line, cooling water line, Tank bottom plate (without installation of fire brick materials) resting on soil/ sand pad, underground vessels inside the pit and their connecting lines as applicable for the tender. Anodes to be considered for impressed current CP System shall be Mixed Metal Oxide (MMO) tubular and close distributed long line mixed metal oxide (MMO) wire anode piggyback connected with anode lead cable, factory pre-packed with coke breeze with factory connected tail cables as per structure design and site condition.

No Insulating joints shall be installed to isolate any incidental structures from CP System within the Battery limit. Hence the structures intended to be cathodically protected shall be in electrical continuity with many foreign structures within the plant complex such as RCC pavements, RCC foundations, earthing grids, other U/G structures, which are not intended to be protected. The CP current requirement therefore shall be governed by following factors:

- Surface area and coating quality of structures to be protected.
- Surface area and surface condition of nearby foreign structures including earth grid.
- Relative position of anode between foreign structure and structure intended to be protected.

To take care of such situation CP System shall be designed & installed in two stages by providing one preliminary design and another supplementary design for Impressed Current CP System as follows:

Preliminary design:

A preliminary design shall be made as per required scheme which shall be approved by Owner/ consultant. The quantities required for T/R units, Power Distribution Boards, anode beds of various configurations, Junction boxes (AJB, CJB, MJB, etc.), Cables of various sizes, Thermit weld connections, and any other materials as required shall be calculated by CP CONTRACTOR. The locations of T/R units, Distribution Boards, anode beds of various configurations, Junction boxes (AJB, CJB, MJB, etc.), Cables of various sizes, Thermit weld connections, shall be marked by CONTRACTOR in appropriate layout drawings and shall be submitted along with Detail engineering package to OWNER/ EIL for approval. The T/R Units, PDB, and MJB shall be installed at one location under a common sun/ rain shed in non-classified area near the equipments. Cathodic protection Transformer Rectifier unit (CPTR Unit) shall be oil cooled, outdoor type. The power supply for the T/R Unit/ PDB shall be drawn from the identified cubical of the electrical substation nearest to the equipments.

Supplementary design:

After energising CP System as per preliminary design, the unprotected/ under protected and over protected areas shall be identified and a supplementary design is to be made to bring all structures intended to be protected within acceptable potential limits.

The following criteria shall be followed to determine the protection levels:

- Maximum allowable equipment to soil potential with respect to Cu/ CuSO₄ ref. Cell: -1.10V (Instant OFF) for impressed current system.
- Minimum allowable equipment to soil potential with respect to Cu/ CuSO₄ ref. Cell: -0.850 V (Instant OFF) or -100mV polarization shift .
- Discretion to use any of the criteria shall solely rest with Owner/ Owner's Representative.
- Interference Criteria: +50mV positive shift.
- Design life of Anode = 25 years (minimum) for impressed current CP system.
- a) While deciding number of modular type 75V/75A, 50V/50A, 25V/25A , 50V/75A, 50V/25A, 25A/12 V capacity T/R units, considerations must be given to see no T/R unit is loaded more than 75% of its rated output voltage & current capacity throughout design life while feeding load to a single or group of anode beds.
- b) For continuous wire anode the anode current capacity shall be considered as 30mA/m for design purpose and tubular anode 6A rated current output to be considered.
- c) Identification and mitigation of interference between structures to be protected as well as between the structures to be protected and foreign structures need to be carried out by the contractor as per the requirements of the codes mentioned in this document.
- d) Earthing of all T/R Units, PDB and Junction Boxes need to be done by connecting the same with plant earthing grids, wherever plant earthing grids are not available nearby, a separate earth pit approved by OWNER/ EIL may be considered by contractor.
- e) To avoid cable damage in the long run, all cables are to be laid at the cable trays wherever possible; underground cable laying through PVC/ HDPE conduit should be considered only when no cable trays are available nearby. All CP System cables need to be laid at power cable trays,

all multi core- monitoring cables may be laid in either electrical or instrumentation cable trays whichever is available.

- f) The type of coating and operating temperature of each Equipment should be taken into consideration for all detail-engineering calculations.
- g) Wherever specific guidelines are not furnished for cathode structure current density, a current density shall be considered for coated piping: 3.0 mA/m² and for bare cathode/incidental structures: 25 mA/m².
- h) If operating temperature of Equipment exceeds 25 deg C, protective current density shall be corrected @ 0.5mA/m²/deg. C up to 60 deg.C.
- i) Connection of drainage cables and measurement cables to the structure shall be done by Thermit welding method.
- j) Sand resistivity need to be considered for the structure CP System design as minimum 200 ohm- m or as measured at site whichever is higher.
- k) The structure shall have suitable paint for the soil side corrosion protection
- l) Reference cell shall be supplied along with required length of lead cable connected at manufacturer's factory as far as possible.

2.1 Design Scheme for Cathodic Protection (CP) System:

Free ends of each string anode shall be terminated to AJB through loop connection on sand cushions. Outdoor type, Transformer-Rectifier unit (T/R Unit) shall be installed to energise the anode strings through anode junction boxes (AJB). Rating of T/R unit shall be 75V/75A, 50V/50A, 25V/25A, 50V/75A, 50V/25A, 25A/12 V based on design calculations. T/R Unit shall have one or two outgoing positive header cables, which shall be terminated to post/ structure mounted AJB to be installed at suitable location near the structures. T/R Unit shall have one out going negative header cable, which shall be terminated, to a cathode junction box cum test station (CJB). CJB cum test station (CJB) shall be located at suitable location near the structures for the drainage connection and potential measurement. Two drainage cables and two measurement cables from each structure shall be terminated to its CJB. Power supply for the T/R Unit shall be drawn from the nearest S/S. OWNER shall provide one 63A/ 250A, 415V, TP circuit breaker/ Switch Fuse unit at the nearest S/S. CONTRACTOR need to lay one 3-phase, 4-wire (Required cable size) power supply cable from this circuit breaker/ Switch Fuse unit outlet to one outdoor type PDB near the T/R Unit location for distribution of power to the T/R Unit. The reference cell cables and the measurement cables from each structures shall be routed through the respective cathode junction box cum test station (CJB) to a single Monitoring Junction Box (MJB), which shall be located near the T/R Units and have the provision of measurement of structure to soil potential.

Also for monitoring of structure to soil potentials at the T/R unit, monitoring cables consisting of reference cell and measurement cables shall be laid between MJB and T/R unit for connection of at least three reference cells to T/R Unit panel. Rotary Selector shall be used at the TR Unit for measurement of potential for each reference cell. The T/R Units, PDB, MJB and RTU shall be installed at one location under a common sun/ rain shed in non-classified area near the Electrical S/S or near the process unit/ offsite area to be decided jointly at the detailed engineering stage by EIL / OWNER.

Common Computerized central monitoring of all T/R units and the permanent reference cells of CP System shall be provided with the help of microprocessor based CP System remote terminal unit (RTU) for subject unit area. The central monitoring unit shall be located at Central Electrical substation.

2.1.1 Tank Bottom Plate:

The anode strings shall be laid in the sand cushion of the tank foundation, extending straight from one end to other end or making each single loop in the same end of the tank rim. Alternatively, concentric anode ring configuration factory predesigned may be considered for diameter 60 meter and above. Following guide lines shall be considered irrespective of anode length worked out from the current density calculation for installation of String Anode for coated tank bottom plates for uniform current distribution:

- Average depth of String anode from bottom plate to be protected shall be minimum 1m.
- Spacing between consecutive anode strings shall be maximum 1.5m.
- Minimum 5 nos reference cell to be provided for each tank.

2 Nos. of anode lead cables from each string loop shall be terminated to AJB. Each alternate loops of string shall be in same direction for easy access of AJB's. However tail cables of each alternate loop of anode string shall be terminated into different AJB. Dedicated TRU with suitable rating to be considered for each tank.

In case tank is mounted on RCC pile foundation, one insulating HDPE film is to be laid on the pile cap before sand filling of the cap to ensure minimum CP system current is diverted to the pile cap.

Contractor need to lay one layer of insulating HDPE film of thickness 1.2mm on the concrete surface of the RCC cap before sand filling on the pile cap. The contractor shall decide the Roll size of the HDPE film. While laying, overlap of 5mm is to be made between consecutive longitudinal HDPE strips. Also, the overlaps need to be sealed using blowlamp or plastic welding method.

During operation of the tank, the bottom plate is subject to flexure and settlement due to loading/ unloading of the contents of tank. Therefore, if required suitable shielding arrangement to be provided on string anode system to ensure that it does not touch the bottom plate.

Three HDPE perforated pipes shall be provided under the tank at 300 mm distance from tank base. All the pipes shall be installed at 1200 apart from each other. The HDPE pipe shall be covered with geotextile cloth and shall be of 75mm diameter, slotted of 50 mm (2 inch) in length 0.15 mm width, 4 kg/cm² pressure rating, sealed at one end.

2.1.2 U/G vessels:

RCC pit shall be provided for the U/G vessel, Anodes string employed for C.P. System of U/g vessels shall be located within the RCC pit. Specific installation requirements of String Anode shall be as follows:

- Anode strings shall be installed in the sand cushion surrounding the vessel at a distance of 500 mm from the vessel.
- Separation distance between consecutive String anode loop shall be uniform.
- Length of each longer side of the loop string anode shall be same as the length of the vessel + 0.6m.
- Minimum 4 No. of strings should be considered for each vessel

Free ends of each anode string should be connected to AJB located at each end of the vessel. Thus 2 No. of anode lead cables from each anode string shall be terminated to AJB.

2.1.3 Plant UG Piping :

Anode Beds to be employed for C.P. System of U/G piping shall be Close distributed MMO Titanium tubular anode pre-packed with coke breeze should be considered as anode for impressed current CP System except for very congested area where MMO Titanium wire anode pre-packed with coke breeze at anode manufacturer's factory shall be installed for underground raw water, cooling water including UG Vessels connecting line piping as per site condition. The length of anode wire shall be same as length of U/G pipe for single run of pipe. In case of parallel run of pipes and higher dia pipes, the no.of continuous anode strings to be considered depending on factors such as diameter of pipes, congestion of the area etc. Each continuous anode string shall be of 300m (max.) length and shall be fed at both ends from a single T/R Unit using same or different anode junction box. Wire anode shall be laid laterally along the pipe axis at a distance 2D or 500mm from the pipe.

For monitoring the performance of the CP System, Permanent Cu/CuSO₄ reference or silver / silver chloride reference (as per site condition) cells shall be installed at a distance of 300mm from the UG Piping for monitoring of CP System. Minimum 5 no. of reference cells to be installed for piping at equidistant locations for each TR Unit. Test coupons to be provided to measure the off potential in the critical / congested area. Also, soil access pots shall be provided for measurements for potentials at each test post in paved areas. Test posts shall be provided at an average spacing of 150 m distance.

2.2 Detailed Engineering Works to be performed by Contractor for CP System:

Following detailed engineering works are to be performed by contractor based on scheme given vide item no. 2.1 and design basis given vide item no. 2.0 of this document for CP System:

- List of materials/ equipments to be procured from Indian market/ foreign market.
- Item wise list of vendors with their reference lists for supply of materials/ equipment.
- Calculation and Preparation of Bill of Quantities for all CP system materials and equipment required.

Bill of quantity along with detailed calculations and preparation of specifications, installation work procedures & fabrication/ construction drawings for following items:

- CP System power distribution board (PDB): Total quantity and connection scheme showing group of T/R units to be connected with each CP System PDB and connection details between

owner's switch board and each CP System PDB.

- T/R unit: Total quantity, detailed circuit diagrams and their installation drawings.
- AJB/ CJB/ MJB: Total quantity and connection Scheme showing how group of anodes, anode beds and structure/ equipment are to be connected with each AJB/ CJB/ MJB. Also, fabrication drawing & schematic drawing for internal terminal arrangements and installation drawings for a typical AJB/ CJB/ MJB.
- Anodes: Total nos. of Anode strings and anode string to anode lead cable joint details for entire CP System and their layout arrangement drawings showing no. of anode strings in each structure/ equipment. Construction drawings and work procedures for anode to cable jointing and also for installation of anode strings.

Design calculations showing:

- Cables: Total quantity of cables and their layout drawing for each CP Station as well as for entire CP System for +ve header cables, -ve header cables, anode lead cables, earthing cables, drainage cables, power supply cables and multi-core monitoring cables.
- Cable to structure/ equipment joint: Total quantity of joints and details of a typical joint.

T/R unit wise CP System layout drawing showing how each T/R unit is connected with group of anode strings for UG Vessel/ Tank bottom plate/ UG piping through AJB/ CJB/ MJB.

- Test points: All reference cells and anode strings should be marked in a single layout drawing.
- Overall CP System layout drawing including all test points, anodes, anode beds, AJB, CJB, MJB, cable routes on a plot plan. All CP System materials/ equipment shall be marked properly for easy identification on all appropriate drawings as well as on site.
- Preparation of testing & commissioning procedure for CP System.
- Preparation of construction drawings with soft copies before starting of installation/ procurement work, Preparation of Soft & hard copies of as built drawings after completion of CP System work, shall also be furnished.
- Quantified list of the major construction equipment, tools, tackles etc. including Diesel engine pump set for dewatering at cable/ pipe trench the BIDDER proposes to use for execution of the work.
- Details & list of vehicles proposed to be used by the CONTRACTOR during the entire construction & commissioning period for transportation of material, equipments, as well as movement of personnel within the plant area.
- Bar chart giving details how BIDDER plans to execute the work within the specified time schedule.

- Quality Assurance Plans/ Procedure

The CONTRACTOR shall establish document and maintain an effective Quality Assurance system as outlined in recognized codes etc. and Quality Assurance Plans included in Specifications etc. to ensure that the work is performed in a planned, systematic manner to the best quality standards and properly documented to provide confidence that materials supplied and/ or work executed and services performed by him conform to the applicable specifications and all the requirements of contract document and work executed by him shall perform satisfactorily over the entire period of its life.

The Quality Assurance Systems Plans/ Procedures of the CONTRACTOR shall generally cover the following aspects/ details, which shall be furnished by BIDDER along with, his detail- engineering package.

- i) A Quality Assurance Organogram with curriculum vitae of key personnel responsible for the Quality Assurance at site.
- ii) Complete details pertaining to the responsibility authority and accountability of the Quality Assurance Organization of the CONTRACTOR at site.
- iii) Equipments, material, Erection, Installation, Testing and commissioning control plans for quality testing/ inspection etc.
- iv) Quality Control of processes such as Thermit welding, anode to cable jointing etc.
- v) Control Procedures/ Plans for calibration and safe up-keep of instruments, gauges and similar testing equipments etc.
- vi) Quality audit & Maintenance/ records/ procedures etc.
- vii) Other relevant details.

Quality Assurance System Plans/ Procedures of the CONTRACTOR shall be furnished in the form of a QA manual. BIDDER shall be required to provide explanation pertaining to the details furnished by him in accordance with provisions contained in this clause and any further details, as sought for by OWNER/ EIL. In addition, all the Quality Assurance Programs/ Plans as per specifications enclosed with the Contract shall be fully complied with by the Contractor.

- Precautionary measures to be taken to prevent fire hazard during Thermit welding and Pin Brazing of structure/ equipment for the purpose of cable to structure/ equipment joint as well as during installation, operation & maintenance of CP System.
- All other information as required in individual job specifications shall be furnished by CONTRACTOR in his detail-engineering package.

3.0 SPECIFICATION FOR CP SYSTEM EQUIPMENT AND MATERIALS

CONTENTS

SECTION	DESCRIPTION
3.1	SPECIFICATION FOR NATURAL OIL COOLED TRANSFORMER/ RECTIFIER UNIT
3.2	CP SYSTEM POWER DISTRIBUTION BOARD (PDB)
3.3	MIXED METAL OXIDE COATED TITANIUM TUBULAR ANODE
3.4	PERMANENT REFERENCE CELL
3.5	SPECIFICATION FOR MIXED METAL OXIDE TITANIUM WIRE ANODE FOR CP SYSTEM
3.6	ANODE, CATHODE & MONITORING JUNCTION BOXES
3.7	CABLES
3.8	CALCINED PETROLEUM COKE BREEZE
3.9	THERMIT WELDING
3.10	MATERIALS/ EQUIPMENT FOR OPERATION AND MAINTENANCE
3.11	SPECIFICATION FOR PAINTING CORROSION PROTECTION FOR JUNCTION BOXES, PDB, CABLE MARKERS AND JUNCTION BOXES SUPPORT STRUCTURES
3.12	SPECIFICATION FOR CENTRAL MONITORING SYSTEM
3.13	SPECIFICATION FOR SOIL RESISTIVITY TEST

3.1 SPECIFICATION FOR OIL COOLED TRANSFORMER/ RECTIFIER UNIT

SPECIFICATIONS AND TESTING OF OIL COOLED TRANSFORMER RECTIFIER UNITS

The specifications and testing procedure of transformer units are given as follows:

3.1 TRANSFORMER RECTIFIER UNITS (T/R UNITS)

The transformer rectifier units shall be a standard product of a manufacturer regularly engaged in production of cathodic protection power supplies. The units shall be supplied in accordance with the following specifications and data sheets.

3.1.1 CODES AND STANDARDS

In general the T/R Unit covered by this specification shall unless otherwise specified, be in line with the requirements of any of the latest applicable standard of:

- a) Indian Standards Institution (ISI)
- b) International Electrotechnical commission (IEC)
- c) American Standards Institution (ANSI)
- d) British Standards Institution (BS)

Wherever the requirements in this specification are in conflict with any of the above standards, the requirements under this specification shall be binding.

3.1.2 TRANSFORMER

The main transformer will be the isolation type having separate primary and secondary windings. An electrostatic shield, composed of heavy copper foil, shall be placed between the two windings and grounded to the rectifier cabinet, for this purpose a visible lead should be brought out from the copper foil which shall be connected to any of the mounting stud of the transformer core. Transformer winding wire insulation, winding interlayer insulation, core to winding insulation shall be class F type. The transformer core and winding will be dipped in thermosetting varnish and baked. Transformer varnish will meet the standards for 155 degree C operation. The transformer winding shall withstand 2,000 volt (RMS at 50 hertz) applied for one minute between the windings and between each winding and the transformer core. Maximum temperature of transformer oil will not exceed 85 Deg.C and air temperature inside the upper cabinet will not exceed 85 Deg.C at full load current at ambient temperature of up to 45 deg.C. Transformer full load efficiency will not be less than 95%. The auto transformer shall be similar to main transformer except it will have single winding and tapping for manual mode of control.

3.1.3 RECTIFYING ELEMENTS

The power rectification shall be done by Silicon diodes mounted on heat sinks of sufficient size to prevent the diode case temperature from exceeding 100°C at ambient temperature as per data sheet. The peak inverse voltage rating and current ratings of the diodes shall be as per data sheet. The diodes shall be connected in Bridge circuitry for full wave rectification. Each diode in the bridge circuit shall be protected by a HRC fuse.

3.1.4 A.C. INPUT

The transformer rectifier units shall be designed to operate on 240 volts ($\pm 10\%$) AC single phase, 50 Hz power supply. Inrush current limiting reactor of suitable rating to be provided at input line of the main transformer to avoid possibility of abnormal tripping of MCB while closing circuit using MCB.

3.1.5 D.C OUTPUT

The transformer rectifier shall be designed to operate continuously at 100% rated output current and 100% rated output voltage at input supply voltage 240v ($\pm 10\%$) without exceeding specified hot spot temperature limit and without damaging any components.

3.1.6 D.C OUTPUT ADJUSTMENTS

The DC output control shall be available in any of the following modes, with the help of a selector switch.

3.1.6.1 MANUAL MODE

Output voltage at 23 equal steps up to 100% rated voltage shall be available by means of coarse and fine tap changing switches for rated input supply voltage and 100% rated output current. Tapping for output voltage control shall be taken from a separate auto transformer. The controlled output voltage of the auto transformer shall be fed to main transformer input. The output of the main transformer shall be rectified for DC load supply.

3.1.6.2 AUTO MODE

Unit shall have CONSTANT OUTPUT CURRENT/ VOLTAGE CONTROL (AVCC MODE) in AUTO MODE as per Data Sheet.

CONSTANT CURRENT AND VOLTAGE CONTROL (AVCC MODE)

It will be possible to operate the T/R unit in either Constant Voltage Mode or Constant Current Mode.

Constant Voltage control feature shall be achieved by automatically adjusting T/R unit output voltage between 0 to 100% rated voltage through close loop control using T/R unit output voltage as feedback taken from the voltage divider inside the T/R unit so that T/R unit output voltage of any value between 0 to 100% rated voltage does not vary more than $\pm 0.5V$ of set value when there is a change in input supply voltage of $\pm 10\%$ or change in load resistance over a specified range decided by the ratio of output voltage & current rating of the T/R Unit

3.1.7 DC OUTPUT RIPPLE

The filter circuit shall be designed in such a manner that ripple factor does not exceed 5% RMS at rated load both in Auto and manual mode.

3.1.8 INPUT OVERLOAD PROTECTION

Protection from overloads on the input will be provided by Miniature circuit breakers of suitable rating on the input side. The trip point will be unaffected by ambient temperature. The trip handles of individual poles of circuit breaker will be mechanically linked so that all lines are opened when an overload occurs. In addition to above MCB, HRC fuse of suitable rating should be connected before MCB so that AC input current is limited to max. 10% excess rated input current as per data sheet.

3.1.9 OUTPUT OVERLOAD PROTECTION

Protection from overload on the output in auto mode for T/R unit having either constant current control or constant pipe to soil potential control will be provided by another close loop SCR control circuitry giving automatic constant current control same as mentioned vide 3.1.6.2(i) except that it will act as back up control to main auto mode control. Separate PCB shall be used for main auto mode control and the backup control. The current limit for backup control is to be set by two limit switches marked "coarse" and "fine". The limits of the two switches shall be algebraically additive and shall give equal 30 steps up to 110% rated current. One scale calibrated in Ampere shall be provided with each limit switches so that current limit can be set by operator at any desired value in 30 equal steps. In any circumstances even in case of short circuit the T/R unit output current should not exceed the current limit set by the backup control.

In addition to above electronic current limiting feature HRC fuse of suitable ratings to be used at positive and negative terminals as well as one double pole MCB of suitable rating to be connected after HRC fuse at the output to disconnect T/R unit quickly in case of over loads in the output circuit or for ease of isolating T/R Unit from the circuit when it is desired to keep the T/R Unit in standby mode.

3.1.10 VOLTAGE SURGE PROTECTION

Each silicon controlled rectifier (SCR) and Diodes shall be protected from voltage surges by means of R-C/MOV circuitry. This R-C circuitry/MOV will be rated as recommended by the manufacturer of the SCR/

Diodes so that they will conduct heavily before the peak inverse voltage ratings of the SCR/ Diodes are reached. In addition, lightning arrestors and zener Barrier type or MOV type surge Diverters shall be provided in the AC input and DC output circuit of the Transformer rectifier as per data sheet.

3.1.11 COOLING

The transformer/ rectifier will be Natural oil cooled (ONAN) completely enclosed IP55 construction. The temperature of the oil measured at the top layer shall not be more than 85 °C and maximum air temperature of the upper cabinet should not be more than 85°C for ambient temperature of up to 45 °C.

3.1.12 INPUT AND OUTPUT TERMINALS

DC terminals made of tinned plated copper shall be located convenient to the cable entrance. The terminals shall be suitable for cable sizes as per data sheet. Three negative and three positive output terminals shall be provided.

AC terminals shall be insulated to withstand 2000 volts 50Hz to the enclosure, shall be shielded to prevent accidental contact and shall be sized to take cable sizes as per data sheet.

3.1.13 METERS

The transformer rectifier units shall be equipped with separate continuous reading voltmeter and ammeter for the DC output and the A.C. input voltage, current and Structure to electrolyte Potential measurement meter with selector switch for selection of different Structure to electrolyte Potential measurement meter. All meters shall be electronic digital type with LED display arrangement and should be able to indicate the current and voltage ranges as per data sheet up to a resolution of one decimal place for DC Ammeter & Voltmeter and 2 decimal places for PSP meter. Digit size should be 12.5mm (minimum). All meters shall be rectangular in shape and accurate to within 2% at full load at ambient temp. as per data sheet. They shall be temperature compensated to vary no more than 1% per 10% temperature changes.

All AC&DC voltmeters shall be provided with separate fuse and toggle switch whereas all Ammeters shall be provided with only toggle switch.

3.1.14 ANNUNCIATION

Each transformer rectifier shall be supplied with a continuous signal light which will go out at loss of AC input. In addition to this each T/R unit should give annunciation for Auto and manual mode of operation by continuous signal light. T/R unit should also indicate the failure of each fuse in bridge rectifier and two DC output fuses by an independent LED for each.

3.1.15 ENCLOSURES

"The enclosure of T/R unit shall be plinth mounted type having two compartments. Lower compartment shall contain main transformer, Auto-transformer, DC choke and the compartment should be filled with Transformer oil to IEC 296. The upper compartment shall contain the SCRs, Diodes, indicating meters, Protective devices, Electronic control circuits/ control cords etc. and shall be provided with a plexi glass viewing window. Both the compartments shall be completely enclosed type having IP55 construction.

The enclosure shall have a frame work made of minimum 50mm x 50mm x 3mm angle iron, the upper cabinet body shall be made of minimum 12SWG(2.5mm) W.T. sheet steel, lower cabinet shall be 10 SWG(3.0mm) W.T sheet steel. Size of enclosure shall be minimum 1500(H) x 700(W) x 550mm (D) or higher size than this. Necessary fins for the cooling purpose shall be provided at lower compartment. A detachable sun/ rain shade to be provided of suitable size.

The transformer rectifier shall be provided with the following accessories.

- Steel channel under the base for plinth mounting.
- Lifting lugs of size suitable for lifting complete transformer rectifier unit when full of oil
- Sunshade/ rain shade.
- Oil filling hole with screw cap and drain plug.
- An oil sight gauge comprising a flat toughened glass window through which the oil is viewed. The viewing window shall have a white background.
- Silica gel breather suitable for 10KVA transformer to be located inside the upper cabinet of T/R unit.
- A removable dial type thermometer graduated in degrees Celsius with a red mark on the scale at the maximum oil temperature.
- Thermometer pocket
- Locatable control cabinet with viewing window to IP-55 as a minimum.

Accessibility shall be provided by hinged and removable front and back shutters. A plexi glass viewing window shall be provided at the front shutter to allow the meters to be read without opening the front shutter. One drawing pocket shall be made at inner side of the front shutter. One holder for 5W LED lamp connection shall be provided at a strategic point inside the cabinet to facilitate proper illumination during operation and maintenance. The enclosure shall be supplied with an engraved warning level with the words "DANGER". Two junction boxes shall be provided at both sides of the upper compartment, one of them A.C. cable entries and other for D.C. cable entries. Gland plate should be provided against each junction box for fixing single compression cable glands for A.C DC control/monitoring cables. One 240V, 5A Socket shall be provided at a strategic point inside the cabinet to facilitate connection of soldering iron during maintenance. After fabrication the entire enclosure shall be sand blasted to SA 2 1/2 surface to surface or chemically treated with Industry Standard 7 Tank treatment process. An inorganic zinc primer shall then be sprayed to a total thickness of 3 mils. The finish coat shall be a dark grey shade of polyamide cured epoxy in three coats to achieve total thickness of 10 mils. Alternatively Powder coating of total thickness 100-125 Microns is also acceptable.

3.1.16 ENCLOSURE EARTHING

All normally dead metallic parts shall be electrically continuous, earthing terminals shall be suitable for 35mm square cable connection, one earthing terminal shall be made for earthing connection to power supply earthing and two earthing terminals shall be made for earthing connection to the local earthing pits.

The earth connection points shall be protected against corrosion. It shall not be necessary to scrape the paint away in order to make an effective earth connection. Provision shall also be made adjacent to each gland plate for cable gland earthing connection.

3.1.16.1 Cable Terminations

- i) Cable glanding and terminating facilities and terminals shall be suitable for the specified cable type and conductor size. Consideration and provision shall be taken by the manufacturer on the equipment design for the use of cables with aluminium conductors. Cable glands & cable lugs shall be in the scope of supply for CP system installation contractor.
- ii) Terminal blocks shall be arranged and positioned to afford easy access for carrying out external cable termination, testing, inspection and maintenance. There shall be ample clear space allowed between the terminal block and the gland plate for the spreading and termination of external conductors.
- iii) All terminal blocks shall be shrouded or provided with transparent covers. Pinch screw type terminals are not acceptable.
- iv) Three positive and three negative post type DC output terminals shall be provided for the T/R Unit. Each post shall be fitted with double nuts and washers.
- v) Terminals for different voltages shall be separated by partitions.
- vi) A terminal box or chamber with undrilled gland plate or entry panel of sufficient dimensions to terminate the specified incoming and outgoing cables shall be provided. Direction of cable entry shall be from below.
- vii) Termination of single core cables shall be through a suitable gland plate and provision made for bonding and earthing any armour and/ or concentric ground conductors.
- viii) Cable terminal arrangements for power and control cables may be integrated provided that a barrier separates the two.
- ix) Auxiliary wiring shall have copper conductors of the manufacturer's standard sizing (subject to Buyer's approval).
- x) Suitable terminals for three nos. ref. cell cables, one no. measurement cables and a selector switch for permanent ref. cell to be provided for T/R unit panel for connection to PSP meter. Wiring shall be crimped using self-insulated compression type terminal blocks which shall be suitably identified. Conductors shall be fitted with sleeve ferrules bearing the same identification as the terminal to which they are connected. Minimum conductor size shall be 1.0mm² (current density shall not be more than 3A/mm² for copper conductor). However, Electronic wiring can be done with 0.5 mm² conductor.

3.1.17 NAME PLATE

A permanently stamped stainless steel metal plate shall be attached to outside of the case with the following information.

- a. Manufacturer's name

- b. AC input voltage and current rating
- c. AC frequency
- d. Phase
- e. Output DC Volts and Amps. rating
- f. Weight in Kg of T/R unit
- g. Model number
- h. Serial number
- i. Year of Manufacture

3.1.18 SPECIFICATION OF 75V, 50A T/R UNIT

- A. AC input voltage : 240 Volts $\pm 10\%$ 50 Hz single phase
- B. AC input Current : 30A (Max.)
- C. DC power output : 3.75 KW (Max.)
- D. KVA rating of transformer : 7.5KVA
- E. DC output voltage : 75V
- F. DC output current : 50A
- G. Current rating
 - Diodes: 100A(Max. Average forward current)
 - SCR : 85A(Average on state current), 133A (RMS on state current)
- H. Full load efficiency
 - Transformer alone : More than 95%
 - Transformer Rectifier Assembly : More than 75%
- I. Full load power factor : 0.8 lagging
- J. Insulation level : 2KV
- K. Peak Inverse Voltage
 - Diodes/SCR's : 1500V(PIV)
- L. Filtering circuit : L.C.filter
- M. Ripple and Hum at rated output : Not more than 5% RMS
- N. Surge Diverters
 - i) For diodes/SCR's : R-C circuitry of rating as advised by manufacturer of SCR/ Diodes or MOV
 - ii) For input of T/R unit : 2 nos. Zener Diodes of voltage rating 300V RMS, spark over voltage 1000V(Peak), RIR Type A6 FMR 100 BB or equivalent MOV type surge diverters.
 - iii) For output of T/R : 2 nos. Zener Diodes of voltage unit rating 300V RMS, Spark over voltage 800V(Peak), RIR Type A6 FMR 80 or equivalent MOV type surge diverters.
- O. Lightening arrestor: 2 nos. each at the input and output of the T/R unit of voltage rating 500V RMS, Max. 1.2/50 micro Seconds impulse spark over voltage 2.5KV(Peak), Max. discharge residual voltage at 5KA, 8/20 micro second impulse current wave 2.5KV @1.5KA, Max. impulse current discharge capacity 4/10 micro second impulse current wave 10KA(Peak), LAMCO PL01 L.T-2.8 or equivalent make.

P. Protection : MCB suitable for motor load having thermal over load and magnetic short circuit Protection for input current in addition to separate HRC fuse protection for each Diode, HRC fuse

at out put and input terminals, glass cartridge fuse, in the live line of all lamps, auxiliary power lines to control circuit and voltmeter circuits.

Q. Construction : Plinth mounted outdoor type.

R. Cooling : Oil cooled

S. Meters/ Instruments: As per Sec.3.1.13.

1No.DC voltmeter 0-200V,
1No.DC Ammeter 0-60A
1No.AC voltmeter 0-300V
1No. AC Ammeter 0-30A
1No.Corrosionvoltmeter,0-19.99V,10Mohm input resistance.

Other accessories:

- a) Silica Gel Breather
- b) Dial type thermometer 8 Dial 2 1/2" graduate in degree celsius with one red mark on the scale at the maximum oil temperature.
- c) Thermometer Pocket
- d) Oil filling screw cap and drain plug.
- e) An oil sight gauge comprising a flat long head glass window with white back-ground through which oil is viewed.
- f) Sun shade/rain shade.

T. Enclosure: Per sec. 3.1.15

U. Cable Entry: Through single compression Aluminium gland of following sizes of cables. Gland plates are to be provided at the junction boxes located at both side of upper compartment:
+ve and -ve header : 95mm²/ 50mm² 1-core, 4nos.
Power supply cable : 25mm² , 3-core, 1 No.
Monitoring cable : 6mm², 1-core, 3 nos
(Monitoring cable to be used in case permanent ref.cell is used for monitoring pipe/ structure to soil potential)

V. Enclosure painting : As per sec. 3.1.15

W. Fabrication, Schematic: Supplier to furnish for EIL approval schematic wiring diagram and fabrication drawing prior to fabrication of T/R units.

X. Spare parts & Additional features : Supply as per Sec.3.1.18.

Y. Ambient temp. : 45 deg.C

Z. Type of control required in Auto mode: Constant current control and constant voltage control (AVCC MODE)

3.1.19 DATA SHEET OF 50V, 25A T/R UNIT

A.	AC input voltage single phase	:	240volts $\pm$ 10%50HZ B.
B.	AC input current	:	10A (max.)
C.	DC power output	:	1.25KW (max.)
D.	KVA rating of transformer	:	2.5 KVA
E.	DC output voltage	:	50V
F.	DC output current	:	25A
G.	Current rating SCR:50A (Average on state current), 75A(RMS on state current)		

Rest same as 3.1.18 except in item(s) where meter rating shall be as under

- 1 No. DC voltmeter 0-60V,
- 1 No. DC Ammeter 0-30A
- 1 No. AC voltmeter 0-300V
- 1 No. AC Ammeter 0-10A
- 1 No. Corrosion voltmeter, 0-19.99V, 10 Mohm input resistance.

3.1.20 Testing of T/R units

All T/R units shall be tested by contractor and inspected by EIL/Owner before despatch, testing shall be conducted in accordance with codes and standards enclosed in this document, as per routine tests done by manufacturer and additional tests as mentioned below:

3.1.20.1 Efficiency test of Transformer Rectifier Assembly at 25%, 50%, 75% and 100% rated output current both in Auto and manual mode of operation.

3.1.20.2 No load output voltage test in Manual mode for each voltage setting using coarse and fine tap switches at rated input voltage of 240V AC.

3.1.20.3 Output voltage and current test in Manual mode for each voltage setting using coarse and fine tap switches for the following conditions.

- i) Input voltage 240V AC, load resistance 1.5 ohm for 50A T/R & 2.0 ohm for 25A T/R
- ii) Input voltage 264V AC, load resistance 1.5 ohm for 50A T/R & 2.0 ohm for 25A T/R
- iii) Input voltage 216V AC, load resistance 1.5 ohm for 50A T/R & 2.0 ohm for 25A T/R.

3.1.20.4 Output voltage test at rated output current setting in Auto mode for the following conditions.

- i) Input voltage 240V AC, load resistance: 1.5 ohm for 50A T/R & 2.0 ohm for 25A T/R
- ii) Input voltage 264V AC, load resistance: 1.5 ohm for 50A T/R & 2.0 ohm for 25A T/R
- iii) Input voltage 264V AC, load resistance 0 ohm (short circuit across +ve and -ve terminal of T/R unit). Set back up control 50A & 25A for 50 A & 25A T/R unit respectively.
- iv) Input voltage 216V AC, load resistance: 1.50 ohm for 50A T/R & 2.0 ohm for 25A T/R

Output current and voltage shall be recorded for each of above conditions (i) to (iv).

3.1.20.5 Heat run test for max. Temp rise to be conducted for main transformer, Autotransformer, filter choke, Diodes and SCR's, at 50A output current for 50A T/R Unit & 25A current for 25A T/R

unit for 24 hours continuous operation. Number of T/R units to be considered for Heat run tests and actual duration for which test to be conducted up to 24 hours (max.) shall be decided by EIL and owner. Thermocouple instrument shall be used for measurement of temperature. The sensors shall be clamped at different locations inside the closed T/R unit cubical and the cable of the sensors shall be connected to temperature indicator through a selector switch outside the T/R unit cubical during heat run test.

3.1.20.6 Insulation resistance test using 500V megger for Auto transformer and Main transformer between primary and secondary, primary and earth, secondary and earth.

3.1.20.7 Dielectric strength test using 2KV for 1 min. duration for Auto transformer, main transformer between Primary and secondary, primary and earth, secondary and earth.

3.1.20.8 Polarity test in Auto and manual mode of operation of T/R unit.

3.1.20.9 Calibration test for all Ammeters and volt meters.

3.1.20.10 Auto mode over load protection test:

Set back up control at 50 Amp. and increase current from zero to max. Possible using main Auto control for T/R Unit having constant current control. In case of Auto PSP control T/R unit ref. feed back signal to be varied from min. to max. set potential of T/R unit using battery & rheostat in place of ref. half cell signal, current during the test should not exceed more than 50A in both cases.

3.1.20.10.1 Constant Current Test

i) D.C Current Regulation against variation in AC Input

Put the unit in constant current mode and set the output current at 50 A by the help of current setting potentiometer and observe the variation in, if any, of output current with variation of AC input voltage at the steps keeping the output load constant: 216V, 240 V, 264 V.

ii) D.C Current Regulation against variation in Load Voltage

Keeping the AC input voltage at 240 V constant, set the output D.C current at 50 A and observe for any variation of DC current with variation of output load voltage at three different values ensuring that at each output load voltage, taking care voltage limit set value is not exceeded.

Repeat the above at 50A and finally at 25A set output current.

3.1.20.11 Constant voltage test for control circuitry. Supply voltage of T/R unit to be applied 240V 216V and 264V.

For each input supply voltage the reference voltage, +ve DC and -ve DC voltages of Auto mode control circuit to be checked whether they are constant.

3.1.20.11.1 D.C Voltage Regulation against variation in Load Current

Keeping the AC input Voltage at 240 V constant, set the output D.C voltage at 75 V and observe for any variation of D.C Voltage with variation of output load current at three different values ensuring that each output load current, current limit set value is not exceeded .

Repeat the above at 24 V and finally at 12 V set output Voltage.

3.1.20.12 Ripple factor test

T/R unit shall be operated at full load both in Auto and Manual mode. In each case ripple voltage to be checked on a cathode ray oscilloscope (CRO). Peak to Peak ripple wave from shall be limited within 10.5 volt in CRO screen for 7.5 volt TR unit & 7.0 volt for 50 volt TR unit.

3.1.20.13 Annunciation check:

Annunciation check to be done for power on, manual mode operation and auto mode operation.

3.1.20.14 Auto mode constant PSP operation test:

Connect one battery with variable rheostat in place of reference cell feedback signal and conduct the following test:

i) Make both T/R unit set potential & feedback signal from battery 1.0V, Switch on T/R unit & note T/R output current. Increase feedback signal from 1.0V to 1.5V and again bring back to 1.0V. Note change in the T/R output current.

ii) Conduct similar test as item (i) above with decrease of feedback signal from 1.0V to 0.5V and again back to 1.0V. Note change in the T/R output current.

of choke at 50A T/R unit output current =

3.1.20.15 Test certificate/ documents in 6 copies are to be furnished by vendor before despatch of T/R unit to site. The test certificate shall contain results for the tests from 3.1.20.1 to 3.1.20.14 given above in addition the following observations:

- Sl. No. of T/R unit
- D.C. output rating of T/R unit
- External dimensions of T/R unit
- Weight of T/R unit
- Thickness of M.S .sheet steel used for T/R unit enclosure.
- Painting details of enclosure.
- Visual inspection details of T/R unit stating:

a) All components of T/R unit are as per specification

b) All items are labeled properly for identification purpose.

- c) Number used in ferrules of cable leads are matching with schematic/ wiring diagram of T/R unit furnished.

3.1.22 DRAWINGS/ DOCUMENTS

Following drawings/ documents shall be furnished by vendor within 15 days from award of contract for approval of the same by EIL/ OWNER before starting of fabrication. Approved drawings after incorporation of comments (if any from EIL/ OWNER shall be furnished in 6 copies alongwith reproducible during the delivery of T/R units:

3.1.22.1 Fabrication drawings and data sheet of T/R unit giving dimensions, rating, weight, including installation/ foundation arrangement details.

3.1.22.2 Front view and typical sections of T/R unit panel with arrangement of equipment, control, protection and metering.

3.1.22.3 Data sheet of all accessories and circuit element of T/R unit including ratings.

3.1.22.4 Schematic and wiring diagram of T/R unit circuitry giving Auto/ Manual Mode of control including circuit details of all control cards.

3.1.23 INSTRUCTION BOOK

3.1.23.1 The instruction book in 10 copies shall be presented in such manner as to enable it to be used by personnel who are unfamiliar with the operation and maintenance of the T/R unit. The instruction book to be furnished along with supply of T/R unit.

3.1.23.2 CONTENTS

The instruction book shall contain

- A description of the T/R unit.
- Instruction for the installation, testing commissioning and safe operation and maintenance.

The information shall be presented as follows:

1. Index of contents
2. General description giving brief description of the T/R and its use.

Detailed description of T/R unit

This description shall include the technical characteristics, physical and mechanical limitations, and item wise the components, accessories and spare parts.

4. Description of the operation of the T/R unit. This description shall be clear, concise and in

a logical sequence, using schematic diagram, wiring diagram and fabrication drawing.

5. Procedures for testing and adjusting the T/R unit:

The complete procedure for testing and adjusting the T/R unit during plant operation, periodic maintenance and overhaul shall be covered.

6. Maintenance Instructions:

This section shall be divided into two parts:

a) Preventive maintenance which shall indicate the periodic inspection required the inspection procedure and cleaning procedures.

b) Break down maintenance which shall include instruction for trouble shooting of the electrical circuits. The procedure for the removal and replacement of all parts listed as spares shall be given.

7. Spare parts

The instruction books shall give all the necessary details so as to procure all the spare parts from the manufacture or from open market.

8. Each instruction book shall be accompanied with one set of final approved Drawing/ documents as listed vide item 3.1.21.

- COVERING OF THE INSTRUCTION BOOKS: The instruction book shall be presented in a stiff covered binder with the following information printed on the cover:

- the client's name
- the location of the installation
- the name of the installation
- the title of the instruction book.

3.1.24 Following additional features are to be provided with T/R Unit

i) T/R UNIT INTERRUPTION

The T/R units shall have programmable current interruption facility according to a schedule defined by the user through the Central Monitoring and Control System. Interruption ON / OFF cycle should be programmable in the time ratio selectable from 0 to 9999 seconds in increments of 1 second. The interruption device shall be solid state type without any mechanical moving parts and shall have arrangement for bypass.

The interrupter clock of TR Unit should accept external time synchronization signal from the

central monitoring system having GPS synchronized current interrupter for measurement and recording of interrupted OFF potential recording in synchronization with other T/R units.

ii) ANNUNCIATION FOR FUSE FAIL

T/R unit should be provided with Electronic Fuse fail Indicator. The Fuse fail indicator should sense signals from each Fuse in series with diode in the rectifier circuit as well as each fuse in DC

output circuit and on its failure, it should identify the fuse failed with the help of an independent LED for each fuse for local visual alarm.

iii) MANDATORY SPARE PARTS

Mandatory spare parts as mentioned at Section 4.0 in this document need to be supplied for the T/R Units.

IV) T/R UNIT REMOTE MONITORING

T/R Units should be provided with transducers for providing 4-20 mA output signals or direct signals as required for remote monitoring unit (RMU) interface for remote monitoring of T/R Unit output voltage and current. Alternatively, if this feature is built into the RTU, then separate transducers are not required in the T/R unit.

Necessary terminals are to be provided at suitable locations of the T/R unit panel for easy termination of onward wiring by others for remote monitoring purpose.

Each T/R Unit shall accept set point signals for DC Voltage and DC Current from Remote Monitoring & Controlling Panel and accordingly shall control its output from 0 to 100%.

3.2 SPECIFICATION FOR CP SYSTEM POWER DISTRIBUTION BOARD (PDB)

3.2 Power Distribution Board (PDB):

The Power distribution board (PDB) shall be plinth mounted outdoor type and shall be installed at non-classified locations near a single or group of T/R Unit under a sun/ rain shed. The enclosure of shall be IP-55 as per relevant IEC/ NEC/ IS codes.

The Power distribution board (PDB) shall be composed of one no.3 phase, 4-wire 250A/ 63A, incoming MCCB and 12/3 no. 1 phase, 63A outgoing MCB for input power supply to TR Unit as well as 6No.6A outgoing MCB for central monitoring system power supply. The incoming switch shall be 3-pole and outgoing switches shall be 2-pole. 4 Nos. of 25x 5mm tinned copper bus bar shall be used which should be taped by PVC tape of red, yellow and blue colours for identification of the three phases and black colour for neutral. Wiring inside PDB shall be done using 50mm², 1-core, copper conductor, PVC insulated, unarmored cable between TPN switch neutral and neutral bus whereas rest of the wiring shall be done by 25mm², 1-core, copper conductor, PVC insulated unarmored cable. All single core cables shall be used red, yellow and blue coloured for phase connections and black coloured for neutral connection. All cables terminations shall be through Tinned copper cable lugs of matching cable size. All cable entries to the PDB panel shall be through Aluminium single compression glands. One gland for 300mm² / 50mm², 3-phase, 4-core incoming cable connection shall be provided at left side bottom of the panel, 12/3/6 glands to be provided at right side bottom of the panel for outgoing cable connections for 63A PDB. The outgoing cables shall be 25mm², 1-phase, 3-core Aluminum conductor cables for TRU power input and 16mm², 1-phase, 3-core Aluminum conductor cables for central monitoring system power supply. Size of the PDB Panel enclosure shall be adequate to accommodate all components easily and shall be made of 12 SWG sheet steel. Two nos. hinged front shutters shall be provided. The shutters shall be screwed to the panel enclosure structure at the centre in addition it shall have lockable handles. Painting details of inside and outside surfaces of the PDB panel shall be as follows: After fabrications the entire enclosure shall be sand blasted to a SA2½ surface. An inorganic zinc primer shall then be sprayed to a total thickness of 3 mils. The finish coat shall be of polyamide cured epoxy in three coats to achieve total thickness of 15 mils. The finish coat shall be a dark grey or yellow shade as per choice of EIL/ OWNER.

3.3 SPECIFICATION FOR MIXED METAL OXIDE COATED TITANIUM TUBULAR ANODE FOR CP SYSTEM

3.3.1.0 Scope

3.3.1.1 Anodes

Mixed Metal oxide coated Titanium tube anodes shall be dimensionally stable and will be supplied with anode lead cable connected to it.

3.3.1.2 ANODE DATA SHEET

Sl.No.	Description	Details
1.	Anode Type	Dimensionally stable Anode (DSA)
2.	Anode Shape & Dimension	Hollow Tubular 750mm long x 25.4mm OD, W.T: 1 mm $\pm$ 0.1 mm
3.	Anode weight	0.210 kg $\pm$ 5%
4.	Anode Material	Titanium seamless tube of Grade 1, ASTM B 861, overlayed with mixed oxide of noble metals.
5.	Anode design life	30 years
6.	Anode consumption rate (Kg/A-yr) at 100 A/m ² Current density	2 mg/A-yr.
7.	Metal Oxide coating thickness weight (gm/M ²)	6 gms/m ² (at 100 A/m ² for 30 years design life)
8.	Optimum Recommended anode current density (A/m ²)	
	i) With Carbonaceous backfill in soil	100A/M ²
	ii) Without backfill in soil	Vendor to furnish
	iii) Fresh water	Vendor to furnish
9.	Rated current output	6 Amps
10.	Anode Centralizer for 8" NB casing pipe	1 Nos. per anode. Vendor to furnish details.
11.	Mechanical & Physical Properties:	
	i) Electrical Resistivity (ohm Cm) of Metal Oxide	10 ⁻⁵ Ohm Cm
	ii) Contact resistance of anode to cable	0.9 milli ohms (max.)
	iii) Pull out strength	200 kg(min) or breaking strength of cable
	iv) Anode fabrication	Vendor to furnish details
	v) Anode to cable connection details	Vendor to furnish details
	vi) Anode to cable joint insulation details	Vendor to furnish details
12.	Dead Weight for Anode	Each anode to be supplied with a dead weight. Details of the same to be furnished by vendor

Note: All information to be furnished by vendor as per data sheet shall be furnished with his offer.

3.3.1.3 Anode Lead Cable

Anode lead cables to be connected between each anode and AJB shall be 7 strands, 10mm² stranded copper conductor, single core, unarmored, with a double insulation system. The primary insulation shall be 0.04/0.1 inch thick cross-linked polyvinylidene fluoride (PVDF) 1100 Volt grade. The secondary insulation shall be 0.065 inch thick high molecular weight polyethylene (HMWPE) sheathing jacket over the primary insulation. For anode lead cable, manufacturer should have minimum 7 years of manufacturing experience and having proven track record of minimum 5 years of successful performance. The minimum 5 years of performance certificate of this item for any hydro carbon industry /pipelines needs to be furnished by the contractor. The proposed make/model of these items being supplied by contractor shall be subject to acceptance as per sole discretion of EIL/Owner.

Anode to Lead cable jointing and insulation shall be done by using straight through jointing kit which is to be provided by anode manufacturer. Anode to Lead cable jointing and insulation shall be done at manufacturer's work shop.

3.3.1.3.1 Anode to Cable connection

Anode lead cable conductor shall be crimped with tubular anode at the center of anode or at the ends and shall be sealed to prevent ingress of water at the joint. Fabrication details of the joint including sealing arrangement and test procedure of the joint shall be furnished by vendor for EIL's approval before making the joints.

3.4 SPECIFICATIONS FOR PERMANENT REFERENCE CELL

3.4 SPECIFICATIONS FOR PERMANENT REFERENCE HALF CELL

3.4.1 For monitoring of soil side potential:

- a. Type of ref. half cell : Cu/ CuSO₄ type.
- b. Body : Impact resistance
- d. Each reference shall be supplied in cotton bag of chemical backfill (as per manufacturer recommendation) and complete with 25 M (minimum) cable as per specification. Contractor to measure the actual length of measurement cable required at site during detailed engineering stage and cut the required length from cable drum so as to avoid cable-to-cable joint. Alternatively, moisture proof joints may be carried out at site by trained joiner with holiday testing with manufacturer reference cell cable.
- e. Location of half cell : 150 mm from structure
- f. Design life : 25 years
- g. Stability : ± 10 mv with 3 Micro- A load.
- h. Make : Shall be suitable for 15-40 deg.C temperature application in sand.
- i. Measurement Cable: 4-6mm², stranded Cu conductor, Single core, screened/ armoured, PVC insulated and sheathed, 1100 V grade.

Reference Cell Cable: 4-6mm², stranded Cu conductor, Single core, screened/ armoured, PVC insulated and sheathed, 1100 V grade.

Contractor shall get the electrodes approved before placement of order. For Reference cell, manufacturer should have minimum 7 years of manufacturing experience and having proven track record of minimum 5 years of successful performance. The minimum 5 years of performance certificate of this item for any hydro carbon industry /pipelines need to be furnished by the contractor. The proposed make/model of these items being supplied by contractor shall be subject to acceptance as per sole discretion of EIL/Owner.

Necessary test certificates from manufacturer giving calibration test, results, date of manufacture shall be furnished during delivery. Any delivery effected without prior approval of owner will be at suppliers risk & cost.

3.5 SPECIFICATION FOR MIXED METAL OXIDE TITANIUM WIRE ANODE FOR CP SYSTEM

3.5.1.0 MIXED METAL OXIDE TITANIUM WIRE ANODE

Factory coke backfilled fabric jacketed Mixed Metal Oxide coated Titanium wire anodes shall be a standard product of the manufacturer regularly engaged in the production of such anodes for use in impressed current Cathodic Protection system. The make / model of MMO wire anode being proposed by CP System contractor shall be subject to acceptance as per sole discretion of EIL / OWNER. The anode manufacturer should have minimum 7 years of manufacturing experience for the similar type pre-packed with coke-breeze MMO Ti Wire anodes and also proven track record for minimum five years of successful performance of such anode for UG Vessels/ Tank bottom plate/ Plant piping protection for any hydrocarbon plant need to be furnished by the CP System contractor.

3.5.1.1 Anodes

Mixed Metal oxide anodes shall be dimensionally stable. Each wire anode shall be supplied with anode lead cable piggy back connected to it i.e there will be connection between the Primary anode and the internal header cable at every 3m (max) distance. The connection shall be multi- step and water proof.

Anode Data Sheet:

a.	Anode Type	Dimensionally stable Anode (DSA)
b.	MMO Anode Shape & Dimension	Wire anode 1.5 mm $\pm$ 0.10mm*
c.	MMO Anode weight	Vendor to Specify
d.	MMO Anode Material	Commercially pure solid Titanium wire, grade 1/2, ASTM B 863, over laid with mixed oxide of noble metals suitable for soil application
e.	Anode design life	30 years
f.	i) Anode consumption rate (Kg/A-yr.) at 100 A/M2 C. density. ii) Overall OD of anode string with calcined petroleum coke breeze and its fabric jacket enclosure	i) 2 mg/A-yr. ii) 35mm (min.)
g.	Metal Oxide coating thickness weight (gm/M2)	6gms/m ² (min.) / MMO coating on titanium suitable for current output and design life.
h.	Optimum Recommended anode current density (A/M2) i) With Carbonaceous backfill in soil ii) Without backfill in soil iii) Fresh water	i) 100A/m ² ii) Vendor to furnish iii) Vendor to furnish

i)	Minimum rated current output in soil/ sand	50mA/m
j)	Mechanical & Physical Properties	
	i) Electrical Resistivity (ohm Cm) of Metal Oxide	10 ⁻⁵ Ohm Cm
k)	Contact resistance of anode to cable	0.9 milli ohms (max.)
l)	Anode fabrication	Vendor to furnish details
m)	Anode to cable connection details	100% water proof. Vendor to furnish
n)	Anode to cable joint insulation details	Vendor to furnish
o)	Allowable attenuation of potential along anode	1% for dry sand of resistivity 20,000 ohm-cm 10% for wet sand of resistivity 500 ohm-cm.
p)	Spacing between consecutive anode to cable joints	3 meters
q)	Coke breeze backfill	Vendor to furnish (as per manufacturer standard)
	Carbon content	99% min
	Coke Resistivity	< 1 ohm
	Bulk density of coke breeze	1180 kg/ m ³ min
r)	FABRIC	The anode wire with surrounding coke breeze should be held together by an Integrated woven, acid resistant and porous jacket assembly.
s)	Chloride resistance	The fabric should pass the 6 month acid immersion test

- Following Insulation specification to be followed for supply of anode internal header and anode lead cable. Laboratory testing to be done in national/ international reputed laboratory at anode manufacturing country.

Insulation Type	Insulation Specifications**
Polyvinylidene Fluoride (PVDF) Irradiation Cross-Linked	Tensile Break Strength 4500 PSI min. Break Elongation 50% min. Flexural Strength 8600 PSI min. Resistivity 2 x 10 ¹⁴ ohm-cm min. Dielectric Constant 8.0 min. at 100 Hz
Ethylene Chlorotrifluoroethylene (ECTFE)	Tensile Break Strength 6500 PSI min. Break Elongation 100% min. Resistivity 1 x 10 ¹⁵ ohm-cm min. Dielectric Constant 2.5 min. at 1 Mhz
High Density High Molecular Weight Polyethylene (HMWPE)	Color Black Density (minimum) 0.941 gram s per cm ³ ASTM D1248, Type 3, Class C, Category 5, or IEC 60502-1 Temperature Rating 90°C.

** Standard Test Method ASTM D638 shall be used to determine the tensile strength, flexural strength and break elongation. For the resistivity and dielectric constant tests, Standard Test Methods ASTM D257 and ASTM D150 shall be utilized.

Note: All information is required to be furnished by vendor as per data sheet and shall be furnished with his detail engineering package.

3.5.1.3 ANODE HEADER AND LEAD CABLE

Anode internal header cable and anode lead cable in between each anode string and AJB shall be insulated, 7 strands, 8 AWG/ 10mm² stranded copper conductor, single core, unarmoured, with a double insulation system. The primary insulation shall be 0.04/0.1 inch inch **± 0.005 inch** thick cross-linked polyvinylidene fluoride (PVDF) 1100 Volt grade. The secondary insulation shall be 0.065 inch inch **± 0.005 inch** thick high molecular weight polyethylene (HMWPE) sheathing jacket over the primary insulation.

Jointing of anode lead cable with internal anode header cable and its insulation shall be done by using standard jointing kit which is to be provided by anode manufacturer. However, preference will be given for direct termination of the anode header cable to AJB without any joint in between with internal anode header cable and anode lead cable. Anode lead cable to anode header cable jointing, shall be done at site by a trained cable joiner in case of unavoidable site/ project situation.

3.6.1.3.1 Anode to Cable connection

Vendor should submit procedure and sealing arrangement drawing of the joint and get the Anode lead cable to anode internal piggyback cable joint approved by EIL/ OWNER.

3.5.1.4 QA/ QC for Anodes

Following tests are to be conducted by anode manufacturer. Anodes with cables shall be delivered to site only after EIL/ Owner's approval of the test results, which are to be furnished by anode manufacturer. Detailed procedure for conducting the following tests shall be furnished by manufacturer for EIL/ Owner's approval before commencing tests. All the tests should be conducted in presence of EIL/ OWNER/ TPI (as applicable).

3.5.1.4.1 Visual Inspection Test –

The anode assembly shall be visually inspected for proper compaction of coke breeze and centralization of MMO wire and cable .

3.5.1.4.2 Dimensional check

- Dimensional check of MMO wire anode and OD of complete anode assembly
- Dimensional Check of Anode internal piggyback cable
- Thickness of primary cable insulation
- Thickness of secondary cable insulation

3.5.1.4.3 MMO Wire Anode (Type Test)

- MMO coating loading/ thickness by XRF or SEM method
- Accelerated Life Test NACE TM0108 (latest version)

3.5.1.4.4 Coke Breeze (Type Test)

- Coke Breeze Resistivity as per ASTM G57-06
- Weight of coke breeze per meter of anode

3.5.1.4.5 Anode Fabric (Type Test)

- Acid Immersion Test for 6months (5N HCl Solution)

3.5.1.4.6 Anode Lead cables (Routine tests)

Routine & type test certificates of cable manufacturer to be furnished for anode lead cable as per IEC std. Cable length and identification tag to be verified by measurement.

3.5.1.4.7 Anode to Cable joint test (Routine tests)

Sample anode lead cable to internal anode header cable joint shall be tested for its electrical contact resistance & its value in ohms shall be recorded.

3.5.1.4.8 a) Prototype Test

First anode string / loop shall be subjected to destructive test to determine pull out strength of cable to anode joint as well as effectiveness of the joint insulation and coke breeze backfilling to be performed at manufacturer's factory or at site (as applicable).

b) Type Test Frequency: - The type test frequency shall be 3 years or in case of any change in the material whichever is stringent

3.5.1.4.9 Test Reports

After conducting each test, reports showing test results should be submitted to EIL/ Owner for approval. Anode/ cable identification No./ batch No. shall be mentioned in test results against each test result. Any delivery made to site before getting EIL/Owner's approval of test reports shall be at manufacturer risk & cost.

3.5.1.4.10 Anode Fabrication

Manufacturers/ supplier shall furnish detailed dimensioned fabrication drawing of anode as well as details of cable connection and its insulation sealing to EIL/ Owner for approval.

Vendor (Anode Manufacturer/ supplier) shall furnish following information for approval before commencement of Anode to cable joint.

- Procedure for making the entire anode to cable joint.
- Procedure for accelerated ageing test of the string anode or test results.

3.6 JOB SPECIFICATION FOR ANODE, CATHODE & MONITORING JUNCTION BOXES FOR CP SYSTEM

3.6.1 Specifications for Anode & Cathode Junction Boxes

3.6.1.1 Anode Junction Boxes and Cathode Junction Box cum test station shall be suitable for Classified Area applications

An anode lead junction box (AJB) will be provided to feed T/R Unit output current to anode strings. These junction boxes will have provision for independent current measurement of each anode output. This will be accomplished by means of individual shunts for each anode circuit.

Drainage cable, reference cell cables and measurement cables from each structure/ equipment shall terminate in its respective cathode junction box cum test station. All the above-mentioned reference cell cables and measurement cables from each CJB shall be terminated into a single Monitoring junction box (MJB). Each CJB shall be connected to the negative terminal of the each T/R unit through loop in loop out arrangement for return of drainage current from structure/ equipment to the T/R unit.

The enclosure of CJB shall be structure/ wall mounted type. Shutter should be provided with closed cell neoprene sealing gaskets. The terminal board shall be of 10mm WT Phenolic laminated sheet on which all terminals and shunts are to be mounted. The terminals shall be made of cadmium plated steel or stainless steel stud nut and washers of M-10 size for termination of anode and cathode lead cables and M-4 size for termination of reference cell and measurement cables. All cable entries shall be through Aluminium double comprehension glands. The external bolt, nuts and clamps to be used for mounting the junction box with back plate/structures shall be MS electro-galvanised or Cadmium plated.

For classified areas, Junction box enclosure shall be of type "Exd" protection Zone 2/Group IIA/IIB application, Temp. Class: T-6, as per IS 5571,5572,2148 & 8289 and relevant IEC/NEC/IS standards. The cable glands shall be FLP double compression type made of Aluminium. Enclosure need to be certified by CMRI. The shutter of the junction box shall be screwed to the body of junction box by using MS electro galvanised/ Cadmium plated nut, bolt and washers. The enclosure of the junction box shall be made of cast aluminium. One earthing terminal shall be provided for earthing the junction box.

3.6.1.2 Monitoring Junction Boxes for non Classified Areas:

Monitoring junction boxes (MJB) will be installed near the T/R Unit and shall be required for monitoring potentials of multiple structure/ equipment . The enclosure for the MJB shall be of IP-55 construction made of 12SWG (2.67) W.T. sheet steel.

The enclosure shall be structure/wall mounted type having removable hinged front shutter with one handle and flush type locking arrangement. Shutter should be provided with closed cell neoprene sealing gaskets. The terminal board shall be of 8mm thick Phenolic laminated sheet on which all terminals shall be made of stainless steel stud, nut and double spring washers of M-4 size for reference cell/ measurement cables. The terminal arrangement shall be such that bottom row is utilised for termination of measurement cables from each structure/ equipment and upper rows one each is allotted for the reference cell cable termination from each structure/ equipment , hence total number of rows shall be one more than the total number of structure/ equipment. All cable entries shall be through Aluminum double compression glands. The external bolt, nuts and clamps to be used for mounting the junction box with back plate/ structures shall be MS electro-galvanised or Cadmium, plated. Shutter should be provided with closed cell neoprene sealing gaskets.

3.6.1.3 Proper fitting of cables at cable glands

It is essential that all cables should fit tight at cable glands. For this purpose vendor need to make openings for glands at junction box or cast/ procure cable glands as per cable samples to be procured for CP System.

3.6.1.4 Painting

Enclosures of all non classified type anode and Cathode junction boxes shall be surface finished with paint as per guidelines outlined in Section 3.11.

3.6.1.5 Inspection & Testing

Fabrication drawing showing internal terminal arrangement of each type of junction box to be submitted by vendor to OWNER/ PMC to obtain approval for a Prototype construction. After inspection and approval of prototype the mass production shall be started. Calibration test for shunts for each junction box to be inspected by OWNER/ PMC before dispatch.

3.7 SPECIFICATION FOR CABLES FOR CP SYSTEM

3.7.1.0 SCOPE

3.7.1.1 CODES AND STANDARDS

In general the cables covered by this specification shall unless otherwise specified be in the line with the requirements of any of the latest applicable standard of IS, IEC, BS and Relevant NEC/ JIS/ JEC standards. Wherever the requirements in this specification are in conflict with any of the above standard, the requirements under this specification shall be binding.

3.7.1.2 ANODE LEAD CABLE

Anode lead cables shall be 7 strands, 10mm² stranded copper conductor, single core, unarmoured, with a double insulation system. The primary insulation shall be 0.04/0.1 inch thick cross-linked polyvinylidene fluoride (PVDF) 1100 Volt grade. The secondary insulation shall be 0.065 inch thick high molecular weight polyethylene (HMWPE) sheathing jacket over the primary insulation.

Insulation Type	Insulation Specifications**	
Polyvinylidene Fluoride (PVDF) Irradiation Cross-Linked	Tensile Break Strength	4500 PSI min.
	Break Elongation	50% min.
	Flexural Strength	8600 PSI min.
	Resistivity	2 x 10 ¹⁴ ohm-cm min.
	Dielectric Constant	8.0 min. at 100 Hz
Ethylene Chlorotrifluoroethylene (ECTFE)	Tensile Break Strength	6500 PSI min.
	Break Elongation	100% min.
	Resistivity	1 x 10 ¹⁵ ohm-cm min.
	Dielectric Constant	2.5 min. at 1 Mhz
High Density High Molecular Weight Polyethylene (HMWPE)	Color	Black
	Density (minimum)	0.941 gram s per cm ³
	ASTM D1248, Type 3, Class C, Category 5, or IEC 60502-1	
	Temperature Rating	90°C.

** Standard Test Method ASTM D638 shall be used to determine the tensile strength, flexural strength and break elongation. For the resistivity and dielectric constant tests, Standard Test Methods ASTM D257 and ASTM D 150 shall be utilized.

3.7.1.3 +VE, -VE HEADER CABLE

+ve header and -ve header cables shall be 95mm², stranded Aluminium conductor, single core, Aluminium wire armoured, PVC insulated and PVC sheathed 1100V grade cable.

3.7.1.4 DRAINAGE CABLE

Drainage cables shall be 50mm², stranded Copper conductor, single core, Aluminium wire armoured, PVC insulated and sheathed 1100V grade cable.

3.7.1.5 POWER SUPPLY CABLE (Between PDB & T/R Unit)

Power supply cable between Power source or CP System DB and T/R unit shall be 25mm², stranded Aluminium conductor, 3-core, Aluminium wire armoured, PVC insulated and sheathed 1100V grade cable.

3.7.1.6 POWER SUPPLY CABLE (between Power Source & PDB).

Power supply cable between Power source & CP System DB shall be 300mm² /50mm², stranded Aluminium conductor, 4-core, Aluminium wire armoured, PVC insulated & sheathed 1100 V grade cable.

3.7.1.7 EARTHING CABLE

Earthing cable shall be 35mm² , stranded Aluminium conductor, 1-core unarmoured, PVC insulated and sheathed 1100V grade cable.

3.7.1.8 REFERENCE CELL / MEASUREMENT CABLE BETWEEN REFERENCE CELL / UG VESSEL/ TANK TO CJB CUM TEST STATION

Instrumentation cable, 4mm², 1-core, stranded copper conductor, PE/PVC insulated and PVC sheathed, screened and armoured cable, PE/PVC insulation of each core shall be Numbered or colour coded for easy identification of each core.

3.7.1.9 REFERENCE CELL / MEASUREMENT CABLE BETWEEN CJB TO MJB & MJB TO TRU

Instrumentation cable, 2.5mm², 10-core, stranded copper conductor, PE/PVC insulated and PVC sheathed, screened and armoured cable, PE/PVC insulation of each core shall be Numbered or colour coded for easy identification of each core.

3.7.1.10 REFERENCE CELL / MEASUREMENT CABLE BETWEEN MJB & RTU

Instrumentation cable, 2.5mm², 20-core, stranded copper conductor, PE/PVC insulated and PVC sheathed, screened and armoured cable, PE/PVC insulation of each core shall be Numbered or colour coded for easy identification of each core.

3.7.1.11 REFERENCE CELL / MEASUREMENT CABLE BETWEEN TRU & RTU

Instrumentation cable, 2.5mm², 24-core, stranded copper conductor, PE/PVC insulated and PVC sheathed, screened and armoured cable, PE/PVC insulation of each core shall be Numbered or colour coded for easy identification of each core.

3.7.1.13 POWER SUPPLY CABLE BETWEEN PDB TO RTU FOR CENTRAL MONITORING

Power supply cable between PDB to RTU for central monitoring shall be 16mm², stranded Aluminum conductor, 3-core, Aluminium wire armoured, PVC insulated and sheathed 1100V grade cable.

3.7.1.14 CABLE DRUMS

All cables to be supplied in wooden drums. Cable lengths in each cable drum shall be 600m (min.) wherever cable lengths are more than 600m.

3.7.1.15 INSPECTION

All cables along with manufacturer's test certificate as per IS standards shall be inspected by OWNER/EIL at the vendor's shop before dispatch. Minimum 15 days advance notice to be furnished by vendor for this purpose. In case of any doubt OWNER/EIL may insist vendor to conduct the tests as per IS standards in presence of OWNER/ EIL at vendor's work shop or some third party reputed laboratory approved by OWNER/ EIL at no extra cost.

3.7.1.16 CABLE IDENTIFICATION

For easy identification of cable, the over sheath of the cable should have yellow colour and "CP SYSTEM CABLES" should be printed using black colour at one meter interval throughout the length of the cable.

3.8 JOB SPECIFICATION FOR CALCINED PETROLEUM COKE BREEZE FOR CP SYSTEM

3.8 SPECIFICATION FOR CALCINED PETROLEUM COKE BREEZE

Calcined Petroleum Coke Breeze shall conform to the following specifications as per latest NACE- SP 0572 std .

A	Chemical Composition:	
	Moisture (on Dry Basis)	< 0.1 (% by mass)
	Fixed Carbon	Minimum 99.0 (% by mass)
B	Bulk density	900 Kg/m ³ to 1200 Kg/m ³
C	Real density	2.03 gm/cc
D	Particle Size	1.00mm (max.), dust free
E	Resistivity	0.1 ohm-cm. at 150 psi.

3.8.1 Test Certificates

Test Certificate shall be furnished for the following:

1. Make of coke breeze
2. Batch no.
3. Chemical composition
4. Bulk density and Real density
5. Particle size analysis
6. Resistivity (ohm-Cm.) at 150 psi compaction

Any delivery effected without prior approval of test certificate by EIL/ Owner will be at suppliers risk & cost.

Above mentioned specification for coke breeze shall be considered for MMO tubular anodes incase required for supplementary design, the coke breeze to be considered for MMO wire anode may be of make as per the anode manufacturer's choice meeting the requirements of the specifications mentioned above.

3.9 JOB SPECIFICATION FOR THERMIT WELDING FOR CP SYSTEM

3.9.1 Thermit Weld Connection:

All cable-to-pipe connections shall be made utilizing the exothermic weld process. All thermit weld connections shall be encapsulated with thermit weld cap and flood coating of coal tar enamel. Each thermit weld connection will basically require the following:

- Thermit weld mold vertical/ horizontal
- Thermit weld metal
- Thermit weld cap Steel disc.
- Copper sleeve
- Flint Igniter
- Mold Cleaner
- Mold Packing
- Coal tar enamel/ two part epoxy resin for encapsulation of the joint.

3.10 MATERIALS/ EQUIPMENT FOR OPERATION AND MAINTENANCE OF CP SYSTEM

3.10 Materials/ Equipment for Operation and Maintenance of CP System:

Following materials/ equipment shall be supplied by the CP System Contractor for operation and maintenance of CP system.

S.No.	Quantity	Description
1.0	1 No.	Digital Multimeter having minimum input resistance 10 Mohm, complete with leads and leather case.
2.0	10 Nos.	Reference electrodes: Portable Copper/ Copper sulphate type having PVC SCH 40 body with transparent window and threaded ceramic porous plug suitable for 15-40 deg.C temperature application in sand.
3.0	1 No.	DC Clipon ammeter in milliamp. / micro amp. range current measurement.

**3.11 SPECIFICATION FOR PAINTING CORROSION PROTECTION FOR JUNCTION
BOXES, PDB, CABLE MARKERS AND JUNCTION BOXES
SUPPORT STRUCTURES**

3.11.1.0 Corrosion Protection for Junction boxes, PDB, Cable markers and junction Boxes support structures

All junction Boxes in Non-classified area, PDB and their support structures, MS channels for T/R mounting if any, cable marker Posts shall be galvanized & painted in following manner.

i) Surface preparation

Grit/shot Blasted to SA2 1/2 as per Swedish standard SIS 055900

ii) Galvanizing

Hot dip or spray galvanized to achieve a minimum zinc thickness of 150µm.

iii) Primer Application

Etch Primer with 10 µ DFT based on Polyvinyl Butyral resin + 1 coat of epoxy zinc phosphate primer @40 µ DFT/coat

iv) Paint Application

1 Coat of 2 Pack high build epoxy with Polyamide hardener cure @100 µ DFT/coat followed by 1 Top coat of Acrylic Polyurethane finish paint @40 µ DFT/coat.

Primer & Paint application procedure shall be standard airless spray and as per paint manufacturer's procedure. Name of Paint manufacturer and product should be approved by EIL prior to application. Colour of top coat shall be yellow or grey as per choice of EIL/ OWNER.

3.11.1.1 MS covers for shallow vertical Beds shall be painted with 2 coats of synthetic enamel paint of Asian Paint/Berger or equivalent make. Colour of paint shall be yellow.

3.12 CENTRAL MONITORING SYSTEM

CENTRAL MONITORING & CONTROL SYSTEM (RMC)

3.12.1 Common Computerized Central Monitoring and Control is required for the CP System for each TR unit/ items to be protected inside the Unit. For this purpose, the T/R unit & permanent reference cells should be connected to Remote Terminal Unit (RTU) consisting of microprocessor based CPS controller with alpha- numeric LCD display, memory, real time clock, keypad, battery backup and communication ports or equivalent PLC-SCADA system.

- RTU/ PLC system shall be capable to process minimum 8 analogue input signals (including one each for TR Unit output current & voltage), 4 digital input signals, 2 analogue output signals and 1no. digital output signal for monitoring performance of each TR Unit which shall be considered for structure/ equipment protection
- In addition to this some digital and analog (input) signal should also be kept as 20 % spare capacity.
- Single or multiple RTU/ PLC system may be provided for monitoring and control of all TR unit output and monitoring of potential for structures.

Thus considering few spares minimum analogue inputs, digital inputs, digital outputs and analogue outputs to be processed by each RTU/ PLC system is to be designed by vendor for review / approval by EIL/ OWNER. The system should also have inbuilt mechanisms to reduce / nullify induced AC interference voltages.

The RTU/ PLC Unit shall also be provided with 1 No. digital output for switching operation for TR Unit. This output shall be used to turn the rectifier OFF and ON for depolarised and instant "OFF" readings. The rectifier shall have in-built facility to accept these signals and interrupt its output supply. The digital input/ output channels shall be optically isolated. The RTU/ PLC should include a GPS based time synchronization unit for measurement of true OFF potential readings.

Further, RTU/ PLC shall be provided with 1 or 2 analogue output that can be used for controlling the various modes of the TR unit for remote control.

The RTU/ PLC should be capable of generating alarms when the parameter limits are violated and it should communicate the alarm data in real time and should not wait for the monitoring software query. The field RTU/ PLC units will have capability to control & monitor the T/R unit Voltage/ Current/ PSP & Current interruption by means of commands from the Central Monitoring Panel(CMP). The operator will be in a position to set all the parameters of T/R unit like DC Voltage, DC current, T/R unit current interruption timings/ schedules from the Central Monitoring Panel (CMP).

All CP System parameters shall be monitored and controlled from central control room using suitable software. The communication link between the RTU /PLC and Central monitoring and Control station should be cost effective GSM based wireless technology or RS485 fiberoptic/ Copper communication, whichever is decided by EIL/ OWNER as the communication network. CP System Sub-contractor should design, procure and install the requisite communication system and the cables required for this purpose.

Central monitoring and Control station computer to be provided by the CP System sub- contractor shall consist of standalone computer suitable for CP monitoring application with following minimum specifications:

- ┐ Intel Core 2, I-7 (seven) processor
- ┐ Genuine Windows latest operating system with License
- ┐ 8 GB RAM
- ┐ 500 GB HDD
- ┐ 24in Flat Panel LCD Color Monitor
- ┐ DVD Rom
- ┐ Intel Integrated 100/ 1000 Ethernet Network Card
- ┐ 1 Serial, 4 USB Ports
- ┐ MS SQL Server Latest
- ┐ A3 Laser jet printer (HP make)
- ┐ Inbuilt UPS system which can operate up to 30 minutes on full load in case of power failure
- ┐ Other standard accessories

CP System sub-contractor shall also provide necessary Software for Remote Monitoring & Control as well as for printing of CP reports. The software should be compatible to Windows format and MS SQL Server or Oracle database (10g) with proper License should be used.

3.12.2 Remote Monitoring & Controlling Central Control System

The software and hardware for the proposed SCADA system shall have a proven track record of minimum three years of successful operation in the field of CP monitoring.

The Remote Monitoring & Control Panel (RMCP) shall have a Data Acquisition and Control Hardware operating in Real Time on PC having minimum specification mentioned in item 3.12.1

A Front End Communication Module (FEC) is also required that will be responsible for managing the entire communication traffic between the RMCP and RTU/ PLC.

The T/R Unit Output DC Voltage, DC Current, Reference Electrode Voltages, Alarms are to be extended to RMCP Panel through RTU/PLC units by any of the cost effective communication network such as GSM based wireless technology/ RS485/ fibreoptic/ copper communication whichever is decided by EIL/ OWNER as the communication network for data downloading and remote monitoring & control from master control room.

Each T/R Unit shall accept set point signals for DC Voltage and DC Current from Remote Monitoring & Controlling Panel and accordingly shall control its output from 0 to 100%.

┐ REMOTE MONITORING SYSTEM - SOFTWARE:

The Remote Monitoring and Control System shall monitor and control various process parameters of Cathodic protection system. The Monitoring software shall be user friendly, Windows compatible, and should allow easy data transfer to other windows based applications or custom applications having ODBC compliant database. The Software shall have built-in graphic package to display graphical representation of the process on-screen with embedded buttons for switching ON/ OFF TR units. Data security should be ensured through three different types of Access Levels namely Expert, Supervisory and Operator. It should have provisions to accommodate future need of addition of new TRs for equipments & piping as may be required from time to time.

If required by client, The software shall be compatible for interfacing of the available CP System monitoring data on LAN at 10 No. additional nodes for management information system for access and reporting for the management. The monitoring software should be capable of generating notification & visual alarm, as and when signals go outside programmed set points and during RTU/PLC failure and TR Unit input power failure. It should generate customized reports as decided by EIL/ OWNER. The software shall allow configuration of emails of OWNERS employees who are responsible for maintenance.

7 Remote Terminal Unit – specifications:

Sl No	Parameter	Specifications
1	Model	As per manufacturer
2	Local display & Local Keypad	The RTU shall consist of a 3 x 6 matrix membrane keypad and a 16 x 2 LCD Display with back-lighting for entering local settings and viewing TR parameters locally. Following Local settings can be done using the Key Pad & Display :  Setting Date/ Time  Setting Periodic Logging Interval  Setting of Scaling factor for DC shunt rating  Setting levels for various Alarm notifications  Setting Field ID.
		The LCD will normally display 7 TR Voltage 7 TR Current 7 Reference Potential 7 AC supply Voltage 7 The RTU/ PLC should be able to be remotely configured for most of the above parameters from the central station.

3	Programmable Periodic Interval	The Periodic Logging & Broadcast interval is programmable from 1 reading per 5 Minutes to 1 reading in 24 hours.
4	CPU	Microprocessor based latest generation design. Built-in Real Time Clock (+/- 1 minute accuracy over one month) Watch dog timer which provides a reset signal to the CPU if not toggled due to any hardware or software failure to ensure fail safe operation.
5	Local Memory	The RTU/ PLC will have sufficient local NVRAM memory to store the monitored data locally. Logged Data shall also be stored in the internal non-volatile Memory of RTU. About 30,000 total Data readings should be able to be stored without downloading. The locally stored data should be retained for upto 10 years without external power to RTU/PLC. It will be possible to download the locally stored RTU data on a field Laptop reader through the local communication port in the RTU/ PLC whenever desired.
6	Analog Inputs for each TR Unit- (8 T/R Unit parameters viz ▮ DC Voltage ▮ DC Current ▮ Ref. Cell Potential (5 No.) ▮ AC supply Voltage + spare)	Fully differential Inputs, 12bit /16-bit resolution Should nullify the effect of AC interferences. High accuracy, High Impedance, with high common mode rejection ratio CMRR. CH-1: 0 – 100V DC (For DC Output Voltage) CH-2: 0 - 100mV DC (For DC Output Current through T/R shunt) CH-3 to 7: -5.0V to +5.0 V DC (For 5 No. Reference potential) CH-8: 0 - 300V AC (For AC supply Voltage Monitoring)

7	Digital Inputs or software for Alarm generation. As required by design	24/12 VDC operated. shall also continuously scan and check for Alarm conditions listed below Following Alarms will be generated using Digital Inputs : • Diode/Output Fuse Fail • Unit Working in Remote Mode • Unit working in Local Mode Following Additional alarms will be generated by Software : • Input AC Supply Fail • Under Protection for Each Ref Electrode • Over Protection for Each Ref Electrode • Reference Fail for Each Ref Electrode The set parameters for the above alarm conditions can be programmed remotely through the central PC
8	Analog Control Outputs for T/R unit control As required by design	4-20mA / 0-5VDC / 0-10 VDC with isolation of 2500Vrms. Resolution – 12 Bit
9	Digital Output – 1 No. For T/R unit Current Interruption	SSR outputs relay 2500 V RMS optical Isolation. Contact rating 2A@ 240 V AC/ 1A @200 V DC On / off delay times 3 msec.
10	Communication	Through RS485 over Copper/ Fibre Optics network for broadcasting data to the Central Station at the programmed periodic interval. E-mail message facility for abnormal condition notification.
11	GPS Interface	Each RTU/ PLC will have built-in GPS module to synchronise the RTC to GPS time. This will ensure uniform real time for all the RTU/ PLCs.
12	Power Supply	230V $\pm$ 20%AC, 50 Hz └ 20V to 70V DC └ 12 VDC (Any one type as required by design)
13	Battery Backup	Battery Back-up for up to 2 Hrs of un-interrupted operation including E-mail transmission, in the event of failure of AC supply.
14	Communication Ports	As required by design

15	Protection	Short Circuit Protection Surge Protection using MOV. Over Voltage protection EMI / EMC protection
16	Mounting	Preferably inside TR Unit if not possible then Wall / Pole mounting
17	Operating Temperature range	0 to 55 deg C
18	Humidity	95% condensing
19	Time Stamping	The RTU/ PLC shall have precise, accurate Real Time Clock (RTC) for exact time stamping of data.
20	Enclosure	The RTU/ PLC shall be housed in a compact & sturdy non corroding enclosure suitable for installation inside the shed common for all TR units. ABS / M.S. With IP 55 degree of protection Mounting : Either mounting inside each TR unit or common for all TR unit located under a single shed with Plinth mounting arrangement. Cable Entry : From Bottom
21	Data Download Port	The RTU/ PLC Unit shall have USB port through which the logged data can be downloaded onto the laptop.
22	Centralised Monitoring	The RTU/ PLC shall have built-in fibre optic modem to communicate with the central station Through RS485 over Fibre Optics Communication network. The RTU / PLC shall send the TR Data with exact time stamp directly to the Master Computer at central station at the programmed Periodic Interval. At the central end a PC shall be installed with a fibre optic Front End Communication (FEC) module and centralized monitoring software. The RTU shall also send alarm information with exact time stamp to the central station Periodic Interval. The PC software shall accept the data received from the RTU/ PLC, display it in graphical and analytical formats and store it in database like MS SQL to generate Reports and Graphs. It shall also possible to remotely program the Field RTU/ PLC Unit through the Central PC for configuration details like Setting Date/Time, Setting/ changing Periodic Interval . PC software should be able to monitor and receive data from up to 50 field RTU/ PLC at a time.
23	Compliance	Relevant BIS/ IEC EMI/ EMC standards

3.12.3 Reports

The software should generate reports, which can be viewed as well as printed as listed below:

- i) A monthly report showing readings from every system. The reports shall highlight readings outside limits and systems, which did not call.
- ii) A single page report yearly report for each remote monitoring. This shall be used to show the monthly readings for each site.
- iii) Alarm Reports: This particular report shall give all information about the alarms, which occurred in any abnormal conditions.
- iv) Report information shall be compatible with standard spread sheet programs.
- v) All above reports of different type should be available in graphical presentation, on screen and printer.
- vi) Scaling and calibration of analogue channel can be done by use of supplier Editor Software.

3.12.4 DATA BASE SECURITY

Database shall be in the form of SQL Server. The version of SQL shall be latest with proven track. Following security features shall be provided in the server software:

- ┐ Roles
- ┐ Fixed Server Roles
- ┐ Fixed Database Roles
- ┐ User-Defined Roles
- ┐ Application Roles
- ┐ Granting and Denying Permissions to Users and Roles

Over and above the above features, the software supplied by the vendor shall broadly have following essential features to access the database as applicable.

- ┐ Group Creation
- ┐ User Creation
- ┐ User Group Allocation
- ┐ Enable - Disable Account Status
- ┐ Audit Trail
- ┐ Access Level Based on the operation
- ┐ Roles and Reasons
- ┐ Password Masking

3.12.5 DESIGN REVIEW:

CP System sub-contractor should prepare detailed engineering package for central monitoring and control system along with schematic drawings and equipment/ materials list including make/ model

of the same and get the same approved by EIL/ OWNER before procurement/execution.

3.12.6 INSPECTION

The prototype inspection along with simulation tests shall be done at specialist agency's office / workshop by EIL/ OWNER before the dispatch of the equipment and materials at site. For this purpose CP System sub-contractor should furnish notice to EIL/ OWNER minimum 15 days before the date of inspection.

3.13 SPECIFICATION FOR SOIL RESISTIVITY TEST

3.13.1 SCOPE

The scope of this standard is to conduct the following tests within a plant complex:

- Soil/sand resistivity up to 10m depth to be measured using Wenner's 4-pin method in offsite/ unit areas/ Vessel pit.

3.13.2 OBJECTIVE

The objective of the tests given by Para 1.0 is to assess the corrosiveness of the soil/ sand & to decide suitable locations for anode beds for CP System for prevention of external corrosion of structure/ equipment within a plant complex.

3.13.3 SOIL RESISTIVITY TEST

In general soil resistivity tests covered by this specification shall unless otherwise specified, be in line with the requirements of BS CP 1021. Wherever the requirements in this specification are in conflict with the above standard, the requirements under this specification shall be binding.

3.13.3.1 SOIL RESISTIVITY TEST BY WENNER 4-PIN METHOD

Soil resistivity by Wenner 4-Pin method to be conducted at 4 anode bed locations as per instructions of EIL, at each location soil resistivity readings to be taken for 2m, 4m, 6m & 10m depth for distributed anode beds.

$$\rho = 2\pi AR$$

Where,	ρ	=	Soil resistivity in ohm-cm
	A	=	Inter electrode spacing in cm
	R	=	Resistance observed from soil resistivity meter in ohm.

While inserting electrodes in soil for taking soil resistivity care should be taken to make good contact of electrodes with the soil, for this purpose limited watering may be required at the electrode penetration points wherever soil is dry or less compact. The depth of penetration of electrodes should not exceed 1/10th of the electrode spacing.

3.13.3.2 CALIBRATION OF SOIL RESISTIVITY METER

Soil resistivity meter should be calibrated at a reputed laboratory before use. The calibration certificate must be furnished to ENGINEER-IN-CHARGE for approval of the meter before use of the same for soil resistivity test at site.

3.13.4.0 REPORT PREPARATION

All soil resistivity readings shall be typed and presented in a tabular form giving co-ordinates and other location reference of each test locations & depth of each reading. The soil resistivity is to be expressed in ohm-cm.

Six copies each of soil resistivity report to be furnished to OWNER/ EIL for record.

4.0 MANDATORY SPARES FOR CATHODIC PROTECTION SYSTEM

4.0 The Bidder shall supply the following spares for each T/R unit:

-	D.C. Voltmeter	Nos.	1
-	D.C. Ameter	Nos.	1
-	A.C. Voltmeter	Nos.	1
-	A.C. Ammeter	Nos.	1
-	Diodes	Nos.	2
-	SCR's	Nos.	2
-	D.C. Fuses for output side	Nos.	5
-	HRC fuse for Diodes	Nos.	5
-	A.C. fuses for input side	Nos.	5
-	D.C. Lightning arrestor	Nos.	2
-	A.C. Circuit breaker(MCB)	Nos.	2
-	Electronic Control Cards each type	Nos.	2
-	Filter circuit capacitor	Nos.	2
-	Signal light assembly for annunciation	Nos.	2
-	R.C. Surge Diverter	Nos.	2
-	Control transformer	Nos.	2
-	Coarse voltage control switch	Nos.	2
-	Coarse current control switch	Nos.	2
-	Fine voltage control switch	Nos.	2
-	Fine current control switch	Nos.	2
-	Auto Manual Mode selector switch	Nos.	2
-	Toggle switches	Nos.	2
-	Assorted Glass cartridge fuses	set.	15

Annexure-1

VENDOR DATA REQUIREMENTS FOR CP SYSTEM FOR STEAM GENERATION PACKAGE

A	18-FEB-2025	ISSUED FOR TENDER (T-7401)	AKDas	-SD-	-NSB-
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

VENDOR DATA REQUIREMENTS

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

CATHODIC PROTECTION SYSTEM FOR PIPING

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Schedule of Vendor Documents		✓			
2.	Soil/Sand resistivity report			✓	✓	
3.	CP material Data Sheets MMO Wire/Tubular anode		✓		✓	
4.	CP material Data Sheets CPTR unit		✓		✓	
5.	CP material Data Sheets Remote Monitoring Unit for CP		✓		✓	
6.	CP material Data Sheets Reference cell, Surge Diverter and Polarisation Cell, CP cables, Sacrificial Anode and Test Lead Point stations		✓		✓	
7.	CP material Data Sheets CP Junction boxes (Anode Junction Box(AJB), Cathode Junction Box(CJB) and Monitoring Junction Box(MJB))		✓		✓	
8.	CP material Data Sheets CP Central monitoring system		✓		✓	
9.	CP material Vendor list		✓		✓	
10.	Inspection & Test Plan (ITP) -For review by Inspection Dept. (Refer Note-*)			✓	✓	
11.	CP Design Document		✓		✓	
12.	CP Drawings : MMO anode dimensional GA drawing			✓	✓	
13.	CP Drawings : Anode Bed/Arrangement GA drawings (Clearly showing the clear distance between Bullet surface to anode, clear distance between Mound wall surface to anode, inter anode spacing and reference cell positions etc.)		✓		✓	
14.	CP Drawings: CP Plat plan showing CP equipment (AJB, TLP, CJB) along the piping route			✓	✓	
15.	CP Drawings : AJB/CJB/MJB GA drawing			✓	✓	
16.	CP Drawings : CPTR Unit GA drawing			✓	✓	

**VENDOR DATA REQUIREMENTS
FOR
CP SYSTEM FOR STEAM GENERATION
PACKAGE**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
17.	CP Drawings : RMCP Unit GA drawing			✓	✓	
18.	CP Drawings : CPTR Unit installation layout			✓	✓	
19.	CP Drawings: Overall CP system layout drawings indicating CPTR, RMCP, AJB, CJB, MJB Central Monitoring system location and tank location		✓			
20.	CP Equipment Installation Procedures/QAPs			✓	✓	
21.	CP Commissioning procedure/QAPs			✓	✓	
22.	CP Commissioning reports			✓	✓	
23.	CP Material Test reports			✓	✓	
24.	List of Commissioning Spares			✓	✓	
25.	List of Mandatory Spares		✓		✓	
26.	Data Books/ Manuals : Operating/ Maintenance Manual/ CP Material Manufacturer catalogues				✓	
27.	Equipment storage procedure at site				✓	

CATHODIC PROTECTION SYSTEM FOR TANKS

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Schedule of Vendor Documents		✓			
2.	Soil/Sand resistivity report			✓	✓	
3.	CP material Data Sheets MMO Wire/Tubular anode		✓		✓	
4.	CP material Data Sheets CPTR unit		✓		✓	
5.	CP material Data Sheets Remote Monitoring Unit for CP		✓		✓	
6.	CP material Data Sheets Reference cell, Surge Diverter and Polarisation Cell, CP cables		✓		✓	
7.	CP material Data Sheets CP Junction boxes (Anode Junction Box(AJB), Cathode Junction Box(CJB) and Monitoring Junction Box(MJB))		✓		✓	
8.	CP material Data Sheets CP Central monitoring system		✓		✓	
9.	CP material Vendor list		✓		✓	

**VENDOR DATA REQUIREMENTS
FOR
CP SYSTEM FOR STEAM GENERATION
PACKAGE**

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
10.	Inspection & Test Plan (ITP) -For review by Inspection Dept. (Refer Note-*)			✓	✓	
11.	CP Design Document		✓		✓	
12.	CP Drawings : MMO anode dimensional GA drawing			✓	✓	
13.	CP Drawings : Anode Bed/Arrangement GA drawings (Clearly showing the clear distance between Bullet surface to anode, clear distance between Mound wall surface to anode, inter anode spacing and reference cell positions etc.)		✓		✓	
14.	CP Drawings : AJB/CJB/MJB GA drawing			✓	✓	
15.	CP Drawings : CPTR Unit GA drawing			✓	✓	
16.	CP Drawings : RMCP Unit GA drawing			✓	✓	
17.	CP Drawings : CPTR Unit installation layout			✓	✓	
18.	CP Drawings: Overall CP system layout drawings indicating CPTR, RMCP, AJB, CJB, MJB Central Monitoring system location and tank location		✓			
19.	CP Equipment Installation Procedures/QAPs			✓	✓	
20.	CP Commissioning procedure/QAPs			✓	✓	
21.	CP Commissioning reports			✓	✓	
22.	CP Material Test reports			✓	✓	
23.	List of Commissioning Spares			✓	✓	
24.	List of Mandatory Spares		✓		✓	
25.	Data Books/ Manuals : Operating/ Maintenance Manual/ CP Material Manufacturer catalogues				✓	
26.	Equipment storage procedure at site				✓	

CATHODIC PROTECTION SYSTEM FOR VESSELS

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Schedule of Vendor Documents		✓			
2.	Soil/Sand resistivity report			✓	✓	

**VENDOR DATA REQUIREMENTS
FOR
CP SYSTEM FOR STEAM GENERATION
PACKAGE**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
3.	CP material Data Sheets MMO Wire/Tubular anode		✓		✓	
4.	CP material Data Sheets CPTR unit		✓		✓	
5.	CP material Data Sheets Remote Monitoring Unit for CP		✓		✓	
6.	CP material Data Sheets Reference cell, Surge Diverter and Polarisation Cell, CP cables		✓		✓	
7.	CP material Data Sheets CP Junction boxes (Anode Junction Box(AJB), Cathode Junction Box(CJB) and Monitoring Junction Box(MJB))		✓		✓	
8.	CP material Data Sheets CP Central monitoring system		✓		✓	
9.	CP material Vendor list		✓		✓	
10.	Inspection & Test Plan (ITP) -For review by Inspection Dept. (Refer Note-*)			✓	✓	
11.	CP Design Document		✓		✓	
12.	CP Drawings : MMO anode dimensional GA drawing			✓	✓	
13.	CP Drawings : Anode Bed/Arrangement GA drawings (Clearly showing the clear distance between Bullet surface to anode, clear distance between Mound wall surface to anode, inter anode spacing and reference cell positions etc.)		✓		✓	
14.	CP Drawings : AJB/CJB/MJB GA drawing			✓	✓	
15.	CP Drawings : CPTR Unit GA drawing			✓	✓	
16.	CP Drawings : RMCP Unit GA drawing			✓	✓	
17.	CP Drawings : CPTR Unit installation layout			✓	✓	
18.	CP Drawings : Overall CP system layout drawings indicating CPTR, RMCP, AJB, CJB, MJB Central Monitoring system location and Vessel location			✓	✓	
19.	CP Equipment Installation Procedures/QAPs			✓	✓	
20.	CP Commissioning procedure/QAPs			✓	✓	
21.	CP Commissioning reports			✓	✓	
22.	CP Material Test reports			✓	✓	
23.	List of Commissioning Spares			✓	✓	

**VENDOR DATA REQUIREMENTS
FOR
CP SYSTEM FOR STEAM GENERATION
PACKAGE**

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
24.	List of Mandatory Spares		✓		✓	
25.	Data Books/ Manuals : Operating/ Maintenance Manual/ CP Material Manufacturer catalogues				✓	
26.	Equipment storage procedure at site				✓	

Notes :

1. "TICK" denotes applicability.
2. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
3. All post order documents shall be submitted / approved through EIL eDMS portal.
4. Final documentation shall be submitted in hard copy (Six prints) and soft (two CDs/DVDs) in addition to submission through EIL eDMS.
5. Refer - 6-78-0001: Specification for quality management system from Bidders.
6. Refer - 6-78-0002: Specification for documentation requirements from Contractors.
7. Refer - 6-78-0003: Specification for documentation requirement from Suppliers.
8. All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
9. Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
10. "@" indicates submission of documents to Inspection Agency.
11. Bill of Material shall form part of the respective drawing.
12. Also refer other department's VDR :-
13. Electrical
14. Instrumentation
15. '*' indicates the following:
 - a. Equipments whose ITP is attached with Contract -ITP for respective equipment shall be followed. Therefore, no ITP is to be furnished for review for those equipments.
 - b. Equipments whose ITP is not attached with Contract-Manufacturer's ITP shall be submitted by Packager/ Vendor/Contractor to respective Regional Procurement Office (RPO) near to manufacturer's works for approval by EIL Inspection.
16. All technical details and documents furnished with bids shall be treated as data for engineering. These shall however be subject to Purchasers review after order placement and bidder shall comply to MR/Tender requirements without any cost & time implication to EIL/Owner.
17. '*' indicates the following:
 - a. Equipments whose ITP is attached with Contract -ITP for respective equipment shall be followed. Therefore, no ITP is to be furnished for review for those equipments.
 - b. Equipments whose ITP is not attached with Contract-Manufacturer's ITP shall be submitted by Packager/ Vendor/Contractor to respective Regional Procurement Office (RPO) near to manufacturer's works for approval by EIL Inspection.
18. All technical details and documents furnished with bids shall be treated as data for engineering. These shall however be subject to Purchasers review after order placement and bidder shall comply to MR/Tender

requirements without any cost & time implication to EIL/Owner.

19. '*' indicates the following:

- a. Equipments whose ITP is attached with Contract -ITP for respective equipment shall be followed. Therefore, no ITP is to be furnished for review for those equipments.
- b. Equipments whose ITP is not attached with Contract-Manufacturer's ITP shall be submitted by Packager/ Vendor/Contractor to respective Regional Procurement Office (RPO) near to manufacturer's works for approval by EIL Inspection.

20. All technical details and documents furnished with bids shall be treated as data for engineering. These shall however be subject to Purchasers review after order placement and bidder shall comply to MR/Tender requirements without any cost & time implication to EIL/Owner.

VENDOR LIST (CATHODIC PROTECTION SYSTEM)

A). EIL PDD APPROVED VENDORS FOR SACRIFICIAL ANODES (13EA)

SL. NO.	VENDOR NAME	Remarks/Material
1	M/s CONTROL PLUS OIL AND GAS SOLUTIONS PVT. LTD., AHMEDABAD	Magnesium and Zinc
2	M/s VIJAY CORROSION TECHNOLOGY, AHMEDABAD	Magnesium, Zinc and Aluminium
3	M/s SHAKTI ANODES PRIVATE LIMITED, AHMEDABAD	Magnesium and Zinc
4	M/s CATHODIC CONTROL COMPANY PVT. LTD., BENGALURU	Magnesium and Zinc
5	M/s ELECTRO PROTECTION SERVICES INDIA PVT. LTD., KARAIKUDI	Magnesium, Zinc and Aluminium
6	M/s EMIRATES TECHNO CASTING LLC, AJMAN	Magnesium, Zinc and Aluminium
7	M/s SCIENTIFIC METAL ENGINEERS (P) LTD., KARAIKUDI	Magnesium and Zinc

B). EIL PDD APPROVED VENDORS FOR TUBULAR ANODES (13EA)

SL. NO.	VENDOR NAME	Remarks/Material
1	M/s DE NORA INDIA LTD., GOA	Mixed Metal Oxide Coated Titanium Anode

C). EIL PDD APPROVED VENDORS FOR TRANSFORMER RECTIFIER UNIT (CPTRU) (13KE)

SL. NO.	VENDOR NAME
1	M/s BIN SARI SPECIALIZED TECHNOLOGIES, DUBAI
2	M/s KRISTON SYSTEMS, MUMBAI
3	M/s CATHODIC CONTROL COMPANY PVT. LTD., BENGALURU
4	M/s RECTIFIERS AND CONTROL ELECTRONICS TECHNOLOGIES PVT. LTD., BHIWANDI

D). EIL PDD APPROVED VENDORS FOR CATHODIC PROTECTION POWER SUPPLY MODULE (13KF):

SL. NO.	VENDOR NAME
1	M/s KRISTON SYSTEM, MUMBAI

E). EIL PDD APPROVED VENDORS FOR JUNCTION BOXES (CLASSIFIED TYPE) (13MA)

SL. NO.	VENDOR NAME
1	M/s FCG POWER INDUSTRIES PVT. LTD., VAPI
2	M/s PHOENIX MECANO INDIA PVT. LTD., PUNE
3	M/s BALIGA LIGHTING EQUIPMENTS (P) LIMITED, CHENNAI
4	M/s FLEXPPO ELECTRICALS PVT. LTD., NAVSARI
5	M/s FLAMEPROOF EQUIPMENT PVT. LTD., MUMBAI
6	M/s FCG FLAME PROOF CONTROL GEARS. P. LTD., VAPI
7	M/s PEPPERL & FUCHS MANUFACTURING (INDIA) PVT. LTD., KANCHEEPURAM
8	M/s KAYSONS TECHNO EQUIPMENTS PVT. LTD., GUJARAT
9	M/s R STAHL PVT LTD, KANCHEEPURAM
10	M/s SUDHIR SWITCHGEARS PVT.LTD., THANE

NOTES:

1. Contractor may procure material from any of OWNER's approved vendors. However current validity and range of approval as per enlistment letter, workload, stability and solvency need to be verified by the Contractor before placement of order.
2. For components other than the above, contractor shall submit past track record for the proposed sub-vendors and obtain written approval from Owner / EIL before placing order.
3. Wherever vendor has application specific makes, same shall be clearly brought out in the offer.
4. Contractor can offer equipment of makes other than specified in the bid, during order execution as per the tender requirement. The alternate make of equipment will be evaluated post order, based on satisfactory track record & test certificate to be furnished by the contractor. In case the alternate makes are not found acceptable, equipment shall be strictly as per above vendor list.
5. For "MMO wire anode", "SSPC/DC-Decoupler", "Surge Diverter/Spark Gap Arrester", "Reference Cell", "Computerized Test Station Unit (CTSUS)" and "Anode Lead Cable", manufacturer should have minimum 7 years of manufacturing experience and having proven track record of minimum 5 years of successful performance for these items. The minimum 5 years of performance certificate of these items in Cathodic protection system for any hydro carbon industry /pipelines need to be furnished by the contractor. The make/model of these items being supplied by contractor shall be subject to acceptance as per sole discretion of EIL/Owner.
6. The items which are not listed and not mentioned in NOTE-5, the same shall be considered based on proven track record (PTR) basis for application of minimum one year period. The minimum 1 year of performance certificate of these items in Cathodic protection system for any hydro carbon industry /pipelines need to be furnished by the contractor. The make/model of these items being supplied by contractor shall be subject to acceptance as per sole discretion of EIL/Owner.

ENGINEERING DESIGN BASIS PIPING

JOB NO: B857
PROJECT: EPCM Services for Site Enabling for Bina Petrochemical
and Refinery Expansion Project
CLIENT: BPCL - BINA REFINERY

EIL SIGNATURE:

Akash Gupta
(AKASH GUPTA)

CLIENT SIGNATURE:

Manish Kumar
Pandey

Digitally signed by
Manish Kumar Pandey
Date: 2024.07.05
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0	03/Jul/2024	Issued For Engineering	SHASHI KANT SAHU	MANMOHAN KALER	RAJ KUMAR GROVER
A	08/Feb/2024	Issued For Comments	SHASHI KANT SAHU	MANMOHAN KALER	RAJ KUMAR GROVER
Rev. No.	Date	Purpose	Prepared by	Reviewed by	Approved by

Legend: ***Bold italic*** text denotes change with respect to previous revision.

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1.0 SCOPE

The Design Basis briefly covers the basic requirements for the design of Piping systems for Refineries, Petrochemicals, Onshore Piping & Gas Processing facilities covered by ASME B31.3. These shall be adhered to by Engineering / EPCC Contractor(s) or his subcontractor(s) during the course of engineering, procurement & construction

2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

2.1 ABBREVIATIONS

Code	Description
EDB	Engineering Design Basis
EPCC	Engineering, Procurement, Construction & Commissioning
ISBL	Inside Battery Limit
LSTK	Lumpsum Turnkey
OISD	Oil Industry Safety Directorate
OSBL	Outside Battery Limit
HAZ	Heat Affected Zone
BHN	Brinell Hardness Number
PNGRB	Petroleum and Natural Gas Regulatory Board

2.2 CODES & STANDARDS / PUBLICATIONS

The following codes & standards in their latest edition including latest addenda as on the date of first issue of this design basis shall be followed.

S.No.	Description	Standards / Codes	Edition	Remarks
1	International Codes/Standards		Latest	
1.1	Process Piping	ASME B31.3	Latest	
1.2	Pipe Flanges and Flanged Fittings	ASME B16.5	Latest	
1.3	Welding and Brazing Qual.	ASME BPV Sec. IX	Latest	
1.4	Non Destructive Examination	ASME BPV Sec.V	Latest	
1.5	Welding rods, electrodes & filler materials	ASME BPV Sec.II Pt.C	Latest	
1.6	Indian Boiler Regulations	IBR	Latest	
1.7	PNGRB Regulations	-	Latest	
1.8	Expansion Joints Manufacturers' Association	EJMA Standards	Latest	
1.9	Layouts for Oil and Gas Installations	OISD-118	Latest	

S.No.	Description	Standards / Codes	Edition	Remarks
1.10	Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments Resistant Metallic Materials for Oilfield Equipment	NACE MR 0103	Latest	
1.11	Materials for use in H ₂ S containing Environments in Oil & Gas Production	NACE MR0175/ISO15156	Latest	
1.12	Sizing, Selection & Installation of Pressure Relieving Devices in Refineries	API RP 520	Latest	
1.13	Centrifugal Pumps for Petroleum, Heavy Duty Chemical and Gas Industry Service	API Std. 610	Latest	
1.14	Steam Turbines for Mechanical Drive Service	ANSI/NEMA SM 23	Latest	
1.15	Centrifugal Compressors for Petroleum, Chemical and Gas Industry Service	API STD. 617	Latest	
1.16	Air Cooled Heat Exchanger	API Std. 661	Latest	
1.17	Fired Heater	API STD. 560	Latest	
1.18	Evaluation of Pipeline and Pressure Vessel Steel for Resistance to Hydrogen Induced Cracking	NACE MR-0284	Latest	
1.19	Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking in H ₂ S Environments	NACE TM-0177	Latest	
2	EIL Standards		Latest	
2.1	Standard Spec. For Steam Tracing	6-44-0007	Latest	
2.2	Standard Spec. For Steam Jacketing	6-44-0078	Latest	
2.3	Standard specification for application of torque and hydraulic bolt tension for flange joints	6-76-0002	Latest	
2.4	Welding Specification for fabrication of Piping	6-77-0001	Latest	
2.5	Material requirements for carbon steel components used in sour service for petroleum refinery environments	6-79-0013	Latest	

S.No.	Description	Standards / Codes	Edition	Remarks
2.6	Standard specification for surface preparation and protective coating (new construction)	6-79-0020	Latest	
2.7	Standard Spec for Hot Insulation	6-79-0026	Latest	
2.8	Standard Spec for Cold Insulation	6-79-0027	Latest	
2.9	Standard specification for positive material identification (PMI) at construction sites	6-82-0002	Latest	
2.10	Clearances	7-44-0501	Latest	
2.11	Accessibility for valves and Instruments	7-44-0502	Latest	
2.12	Table of Basic Span	7-44-0506	Latest	
2.13	Maximum Spacing of Guides for Vertical and Horizontal Pipes	7-44-0507	Latest	

3.0 GENERAL / DESIGN CONSIDERATIONS

3.1 EQUIPMENT LAYOUT

3.1.1 BASIS OF EQUIPMENT LAYOUT

Equipment Layout shall be developed based on the following data.

S.No.	Project Philosophy
1	P&IDs
2	Overall Plot Plan
3	Wind direction
4	Equipment Data Sheets
5	Indicative Equipment Layout from Process Licensor/EIL Process
6	Process Package
7	OISD Std. 118 / PNGRB Regulations

3.1.2 DEVELOPMENT OF EQUIPMENT LAYOUT

The following aspects shall be considered during development of equipment layout.

S.No.	Project Philosophy
1	Process Requirement i.e. proper interconnection between equipment as per P&IDs to achieve the intended process parameters.
2	Economy of Piping material Minimize the quantity of costly piping.
3	Erection & Construction requirement-Erection scheme and schedule of all equipment must be considered during equipment layout to have smooth erection mainly in case of tall columns, heavy equipment like thick walled reactors, space for laying tall column, approach road for cranes / derrick for lifting the column or reactors and requirement of special foundation / pile etc.
4	Safety Requirements - As a minimum, 'OISD Std. 118 / PNGRB Regulations' shall be followed. Safety shower location shall be marked in equipment layout.

S.No.	Project Philosophy
5	Operation and Maintenance Requirement like Overhead and side clearances for exchangers and pumps, Provision of exchangers tube bundle pulling area, Horizontal & overhead clearances for easy movement of working personnel, Crane approaches for air coolers/fired heaters/exchangers. Provision of catalyst loading/unloading facilities, Provision of monorail/mobile crane for maintenance of pumps, Provision of hydro extractor/monorail for maintenance of exchangers and Provision of EOT/HOT crane for compressors, Provision of Analyzer shelter.
6	Similar equipment grouping - All columns, exchangers, pumps etc. should be grouped together for convenience of maintenance and safety wherever feasible.
7	The technological structures should be inter-connected for easy movement of operational personnel.
8	U/G piping corridors for main headers and U/G trenches (as applicable) should be marked in equipment layout.
9	All areas requiring crane access for erection or specific maintenance purpose e.g. catalyst loading etc., hard stand for construction, tube bundle pulling area and drop-out/laydown areas shall be marked on the equipment layout.

3.1.3 PIPE RACK

S.No.	Type	Description
1	Pipe Rack Configurations	Preferably Straight. However, L/T/U/H/Z can be used based on area available
2	Preferred Pipe rack width depending on project requirements	Single Bay : 6M/8M/10M/12M Double bay : 14M/16M/18M/20M/24M
3	Maximum Tiers	Generally 4 or as per requirement
4	Portal Spacing	8M(standard). All other spacing as per job requirements. Intermediate structural member shall be provided in pipe rack for supporting pipes as per requirement
5	Clearance beneath Pipe Rack - Units	4.75M Vertical X 3M Horizontal; First Tier at 6M Min. (For Main and Branch Pipe rack)
6	Road Clearance	7M : Main Road 5M : Secondary Road / Fire Tender access
7	Pipe Rack Clearance - Offsites	2.2M (Refer clause 3.1.3 S. No. 6)
8	Space for Future Expansion - Units	As per Clause 5.0 S.No. 3.
9	Space for Future Expansion - Offsites	As per Clause 5.0 S.No. 3.
10	Water lines on Pipe Rack	As per Clause 5.0 S.No. 4.
11	Minimum Sleeper Height	As per Clause 5.0 S.No. 5.
12	Interconnecting platforms	Interconnecting platforms shall be provided between pipe rack & technological structures.

3.1.4 TOWERS AND VERTICAL VESSELS

S.No.	Type	Description

S.No.	Type	Description
1	Location	Towers and vertical vessels in a row with a common centerline with OD minimum 4M away from Pipe Rack. Chemical Dosing vessels near dosing point to the extent possible, especially for ammonia and corrosion inhibitors and grouped together with escape routes
2	Minimum Clearance	Minimum 3M. Minimum 100mm horizontal gap between platforms of adjacent tower. Minimum 900mm clear aisle between plinths. Clearance shall allow full opening of Manhole.
3	Interconnecting platforms	To be provided at suitable levels where possible allowing for differential expansion.
4	Davit provision for heavy items (relief valves, blinds, etc)	On side of vessel away from pipe rack with clear drop out area at grade Clear access shall be provided at grade on the access side for lowering external & internal fittings, PSVs, Control valves etc from elevated equipment(columns, towers etc) by providing pipe davits.

3.1.5 REBOILER

S.No.	Type	Description
1	Location	Reboilers shall be located next to the tower they serve except fired heater type. Clearance for rodding to be provided for vertical reboilers. Vertical thermo siphon types to be supported by tower (except large vertical types which may require independent structure) and located away from pipe rack. Pressure drop calculations to be done before finalizing.
2	Elevation	As per P&ID.

3.1.6 HORIZONTAL VESSELS

S.No.	Type	Description
1	Location	Perpendicular to Pipe Rack and Min. 4M away from it.
2	Minimum Clearance	Minimum 2M Minimum 900mm clear aisle.

3.1.7 PUMPS

S.No.	Type	Description
1	Location	As per Clause 5.0 S.No. 7. Wherever possible, centerline of discharge shall be kept on common straight line.
2	Minimum Clearance	Minimum 900mm clear aisle between pumps Gap between each pump foundation and foundation of technical structure should be sufficient after piping, for access.
3	Maintenance	
3.1		As per Clause 5.0 S.No. 8.

S.No.	Type	Description
3.2		Sufficient space to be available for maintenance below pipe rack. Clear access of 4.0M vertically and 3M horizontally shall be provided centrally under main pipe ways for small mobile equipment to service pumps/motors, wherever these are installed under pipe ways with prior specific approval. Pumps outside rack shall be approachable by mobile equipments etc. from under the pipe rack.

3.1.8 EXCHANGERS

S.No.	Type	Description
1	Location	Floating head 4M from pipe rack
2	Minimum Clearance	Minimum 2M. Minimum 900mm clear aisle. Heat Exchanger train should be suitably spaced such that shell/ tube inlet/ outlet piping do not foul with floating Head Covers.
3	Maintenance	
3.1	Maintenance of shell and tube type exchangers	Shell and tube type exchangers may have a removable shell cover with flanged head. Tube pulling or rod cleaning area must be allowed at the channel end.
3.2	Maintenance with Hydroextractor	Tube bundle pulling area shall be minimum the tube bundle length + 4M from the channel head for hydroextractor frame (1.5M on platform and rest clear in front of tech. structure subject to a minimum of 10M for crane movement) and sufficient height shall be maintained in the tech. structure so that bundles must be accessible for pulling using hydroextractor.
3.3	Maintenance with monorail and chain pulley block	Tube bundle pulling area shall be minimum the tube bundle length + 1.5M from the channel head on the platform and 4M clear in front of Tech structure for vehicular movement. Suitable capacity monorail shall be provided to cater component handling requirement at front end channel side & at rear end dome side.
3.4	Maintenance of vertical exchangers	In case of vertical exchanger suitable platform shall be provided below the top flange of channel or bonnet. For vertical exchanger, davit shall be provided for cover removal (as part of exchanger), if required, for maintenance.
3.5	Maintenance of high pressure exchangers	For high pressure exchangers, shell pulling on rails shall be provided, as required.
3.6	Means of tube bundle removal	As per Clause 5.0 S.No. 9.

3.1.9 AIR COOLERS

S.No.	Type	Description
1	Location	As per Clause 5.0 S.No. 6.

S.No.	Type	Description
2	Flooring	For air coolers located on technological structure/rack, blind floor shall be provided if any part of pumps /equipment handling hydrocarbons are placed below them. In other cases, flooring with grating shall be provided.
3	Supporting Structure	The width of the structure from where Air cooler assembly is supported shall be about 2.0m more than the Air cooler tube bundle length so that proper supporting of inlet/outlet piping manifolds can be done from the main members of pipe rack/technological structure to transfer piping load to main structural members
4	Maintenance	Davit shall be provided for lowering the motor, gear boxes etc. along with mobile trolley with retractable jacking arrangement of suitable load carrying capacity. Crane access shall be provided.

3.1.10 FIRED HEATERS

S.No.	Type	Description
1	Location	
1.1		Fired heaters are located upwind or sidewind of process units to blow any combustible leaks away from the open flame. They are located minimum 90M away from hydrocarbon tanks and 30M away from control room. Distances for equipments handling hydrocarbon from the fired heaters shall be as per OISD norms / PNGRB Regulations. Vessels / reactors directly connected to fired heaters are exception.
1.2		Fired heaters shall be arranged with centerline of the stacks on a common line in case of circular fired heaters and wherever a common stack is furnished to cater more than one fired heater the stacks shall be located at the end or side, which is away from the unit. In case of individual box fired heater, the edge of the fired heater on the rack side shall be matched. F.D. fans shall be located at one corner of fired heater area away from equipments handling hydrocarbons.
1.3		It shall be ensured that there are no working platforms within an elevation of 6M below the tip of stack and within a 25M radius of stack. However, the stack height is governed by the clearances from statutory authorities like Director General of Civil Aviation and Pollution Control Board.
1.4		Air Pre Heaters should be located in such a way that the modules can be removed by crane.
2	Maintenance	
2.1		Vertical tube fired heaters must have access to permit a crane to remove and replace tubing.
2.2		Horizontal tube fired heaters must have horizontal free space equal to tube length plus crane parking space for tube pulling / maintenance / cleaning.
2.3		In case of bottom floor fired heaters, there shall be adequate headroom clearance underneath the fired heater for removal of burners.

S.No.	Type	Description
2.4		In case of wall fired heaters min. 2M wide platform with escape route at each end is necessary.
3	Drainage	
3.1		Pits and trenches are not permitted under fired heater or any fired equipment. All the OWS/CRWS/SS drain points within 15M of Fired heater area shall be taken through closed pipe sewers.

3.1.11 COMPRESSORS AND THEIR PRIME MOVERS

S.No.	Type	Description
1	Location	
1.1		Compressors shall be located to keep suction lines as short as possible.
1.2		The gas compressors shall be located downwind side of fired heater so that leaks are not blown towards fired heater.
1.3		In general compressors are to be located under shed if required as per Clause 5.0 Point 18.1. When compressors are located under shed, sides to be kept fully open for the low shed or partially closed from top for high shed to avoid accumulation of heavier gases in the shed, however, in case of hydrogen compressors located under the sheds provision for top venting from compressor sheds shall be provided.
1.4		In case of a turbine driven compressor, if exhaust steam is condensed, turbine and compressor need to be located at an elevated level and condenser to be located below turbine.
1.5		A major consideration in centrifugal compressor location is the lube and seal oil console. It must be accessible from a road, must be lower than the compressor to allow gravity drain of oil to the consoles oil tank.
1.6		Intercoolers & Knockout pots may be kept within/outside the Compressor house shed, but, shall be kept near compressor house.
1.7		Compressor manufacturer may be consulted for recommended layout. Licensor's requirement, if any, shall also be taken into consideration.
2	Maintenance	
2.1		For compressors E.O.T/H.O.T as per clause 5.0 S.No. 18.2 to handle heaviest removable piece shall be provided for each compressor house.
2.2		Maintenance bay for compressors shall be provided. Maintenance bay shall be accessible from road to facilitate unloading & loading on to truck etc.
2.3		For removal of bundles of exchangers located within building monorail arrangement shall be provided.
2.4		Compressor manufacturer may be consulted additional requirement for maintenance. Licensor's requirement, if any, shall also be taken into consideration.

3.1.12 ACCESSIBILITY

S.No.	Type	Description
1	Crane access	
1.1		Equipment, Structures shall be arrange to permit crane access to service air coolers, compressors in the open area & exchangers
1.2		A clear space for tube bundle removal shall be provided.
2	Pumps Maintenance	As per Clause 3.1.7
3	Access to lowering piping components	Clear access shall be provided at grade on the access side for lowering external & internal fittings, PSVs, Control valves etc. from elevated equipment (Column, Tower etc.) by providing pipe Davits.

3.1.13 LAYOUT AND ACCESS REQUIREMENTS FOR PLATFORM

S.No.	Type	Description
1	Platform requirement	
1.1		Air coolers shall have platforms with interconnected walk ways provided to service valves, fan motors and instruments.
1.2		Fired heaters located adjacent to one another shall have inter connecting platforms at various elevations.
1.3		Inter connecting platforms between adjacent towers shall be provided wherever feasible, taking into consideration expansion of towers.
1.4		Platforms shall be provided for columns/vertical vessels as per Clause 5.0 S.No. 35.
1.5		All round Platform shall be provided for maintenance of Filters, wherever feasible.
2	Access to Platforms - ladders and stairs	
2.1		Two means of access (i.e. two ladders or one ladder and one stair case) shall be provided for any elevated platform, which serves three or more vessels and for battery limit valves operating platform.
2.2		Platforms, ladders & stairways shall be consistent with access & safety requirements.
2.3		Stairway for tanks to be provided on upstream of predominant wind direction.
2.4		Dual access (i.e. one staircase and one ladder) shall be provided at large elevated structure if any part of platform has more than 22.65M (75 ft) of travel. Maximum distance to escape ladder/staircase shall not be more than 22.65M from any point on the platform. Additional ladders to ensure this shall be provided as required.
2.5		Air coolers platforms shall have Dual access (i.e. one staircase and one ladder).
2.6		Platforms shall be provided with stair access in the case of platforms provided for normal monitoring (once a day or more) or where samples are taken, where vessels or equipment items have operator attention such as compressors, heaters, boilers etc and main pipe rack at battery limits.

S.No.	Type	Description
2.7		Ladder access shall be provided in the case of platforms for items that require occasional operating access including valves, spectacle blind and motor operated valves, heater stack sampling points and Man-ways above grade on equipment.
3	Ladder Design	
3.1		Wherever practicable, ladder shall be so arranged that users face equipment or platform rather than facing open space. Ladder shall preferably have side entry to platform.
3.2		Landings shall be staggered. No ladder shall be more than 6M in one flight.

3.1.14 CLEARANCES

S.No.	Project Philosophy
1	Clearance requirements shall be as per 7-44-0501

3.1.15 ELEVATOR

S.No.	Project Philosophy
1	Requirements shall as per Clause 5.0 Point 17

3.2 UNIT PIPING

3.2.1 BASIS OF UNIT PIPING

S.No.	Project Philosophy
1	Piping & Instrument Diagrams
2	Equipment layout
3	Equipment Data sheet & Setting plan
4	Line list
5	Instrument Data sheet
6	Structural 3D model & building drawings
7	Topography of the plant
8	Piping material specification
9	Overall Plot Plan
10	Proper access to all operating points including valves and for all orifice -tapping points, instruments in particular (refer 7-44-0502).
11	Proper access to interrelated operating points for specific purpose and for maintenance

3.2.2 PIPE WAYS/RACK PIPING

S.No.	Project Philosophy
1	Racks shall be designed to give the piping shortest possible run and to provide clear head rooms over main walkways, secondary walkways and platforms.
2	Predominantly process lines are to be kept at lower tier and utility & hot process lines on upper tier. Generally, hot lines and cold lines shall be kept apart in different groups on a tier.

S.No.	Project Philosophy
3	Generally the top tier is to be kept for Electrical cable trays (if not provided in underground trench) and Instrument cable ducts/trays. Cable tray laying to take care of necessary clearances for the fire proofing of structure.
4	Generally the bigger size lines shall be kept nearer to the rack column.
5	Minimum spacing between adjacent lines shall be decided based on O.D. of bigger size flange (minimum rating 300# to be considered), O.D. of the smaller pipe, individual insulation thickness and additional 25 mm clearance. Even if flange is not appearing the min. spacing shall be based on above basis only.
6	Actual line spacing, especially at 'L' bend and loop locations, shall take care of thermal expansion / thermal contraction / non-expansion of adjacent line. Non-expansion / thermal contraction may stop the free expansion of the adjacent line at 'L' bend location.
7	Anchors on the racks are to be provided on the anchor bay if the concept of anchor bay is adopted. Otherwise anchors shall be distributed over two to three consecutive bays.
8	Anchors shall be provided within unit on all hot lines leaving the unit.
9	Process lines crossing units (within units or from unit to main pipeway) are normally provided with a block valve, spectacle blind and drain valve. Block valves are to be grouped and locations of block valves in vertical run of pipe are preferred. If the block valves have to be located in an overhead pipe-way, staircase access to a platform above the lines shall be provided.
10	Branches from main headers shall be preferably from top.

3.2.3 COLUMN / VESSEL PIPING & CONTROL VALVES

S.No.	Project Philosophy
1	Piping from column shall drop or rise immediately upon leaving the nozzle and run parallel and close as practicable to vessel. Reboiler outlet piping shall be as short as possible with minimum bends.
2	Piping shall be grouped as far as possible for the ease of supports and shall run on the rack side of the column.
3	Manholes shall be kept on the road side and shall be approachable from the platform.
4	Piping shall be supported from cleats welded on the Vessel. Small bore lines may also be supported from operating platform where taking support from cleat is not feasible.
5	Proper guides at recommended intervals shall be provided for long vertical lines.
6	Access platforms/ladders shall to be provided along the column for valves and instruments as per Clause 5.0 S.No.35. Minimum clear width of platform shall be 750mm.
7	For ease of operation and maintenance, column and vessels which are grouped together, should preferably have their platforms at the same elevation and should be interconnected by walkways where feasible. However each column / vessel shall have an independent access also.
8	Column / vessel platforms should be designed in such a way so that all the nozzles should be approachable from platforms.
9	Piping at columns/vessel nozzles shall be arranged so that blanks can be easily installed for hydrotesting.
10	Unless specifically indicated in P&IDs control valves shall preferably be kept at grade or on technological platforms.
11	Piping intended for vacuum services shall be routed as short as possible with minimum bends and flanged joints.

S.No.	Project Philosophy
12	Piping support cleats for safety valves shall be independent and meant for safety valves only. These cleats shall be designed considering impact loading during popping off.
13	Utility Connection nozzles shall be from side/top.

3.2.4 EXCHANGER PIPING

S.No.	Project Philosophy
1	Exchanger piping shall not run in the way of built in or mobile handling facilities.
2	Wrench clearance shall be provided at exchanger flanges.
3	Piping shall be arranged so that they do not hinder removal of shell end and channel cover and withdrawal of tube bundle.

3.2.5 FIRED HEATER PIPING

S.No.	Project Philosophy
1	Arrange piping to permit burner removal by providing break-up flanges in the piping
2	Burner valves shall be located close to the peepholes/sight doors for operation so that adjustment can be made while observing the flame from working level as per Clause 5.0 S.No. 46.
3	Piping to burners shall be arranged so that there are no pockets & shall distribute equal and sufficient quantity of oil/gas to all burners.
4	Block valves for emergency, snuffing steam valve shall be located at the recommended distance from the heater, preferably on the upwind side of the heater.
5	Piping from various passes of heater outlet nozzles should preferably be symmetrical. Transfer line from heater to column shall be as short as possible, without pockets, free draining and with minimum bends.
6	No piping shall be routed in the tube withdrawal area. If unavoidable, break up flanges shall be provided in the piping for removal.
7	Only flexible metallic SS (SS316/SS304) hoses shall be used for burner piping, if required.
8	Sufficient space (greater than the tube length) to be considered in front of the convection sections of fired heaters in case of any tube replacement.

3.2.6 PUMP PIPING

S.No.	Project Philosophy
1	Pump drives shall have clear access.
2	Pump suction piping shall be as short as possible and shall be arranged to avoid vapour pockets.
3	Reducers immediately connected to the pump suction shall be eccentric type with flat side up to avoid the accumulation of gas pocket.
4	For pump suction, elbows shall not be directly connected to the suction flange. A straight piece minimum 5 times the nozzle size unless otherwise recommended by Pump Manufacturer shall be provided at the suction nozzle.
5	Pump discharge check valve if installed in vertical lines shall be fitted with a drain connection as close as possible downstream of the valve.
6	All small bore piping connected to pump (drain to OWS & CBD, seat and gland leak drain) shall have break up flanges for removal of pumps.
7	Piping shall be so arranged that the forces and moments imposed on the pump nozzle do not exceed the manufacturer recommended values / Double the allowable values of API 610.

S.No.	Project Philosophy
8	Pump discharge piping should be routed away from the motor side. For Top suction and top discharge pumps, straight run at pump discharge nozzle shall be provided as per Pump manufacturer's recommendation.
9	Pump cooling water connection shall be taken from the top of circulating cooling water header.

3.2.7 COMPRESSOR PIPING

S.No.	Project Philosophy
1	Suction lines shall be as short as possible
2	Suction piping shall have adequate flanged joints for ease of erection and maintenance.
3	Where the line between knockout drum and the compressor cannot be routed without pocket, low point drain shall be provided to remove accumulation of liquid. The system should be approved by Process.
4	A minimum straight length of suction pipe shall be provided as per manufacturer's recommendation.
5	Lube oil cooler space shall be provided in a way so as to facilitate tube bundle removal.
6	All operating valves on main suction and discharge piping shall be lined on one side as far as possible.
7	Piping shall be designed so that forces and moments imposed on the compressor do not exceed the manufacturer's recommendation.
8	Low points in the discharge line from an air compressor shall be avoided because it is possible for lube oil to be trapped and subsequently ignited. If low points are unavoidable, they shall be provided with drains.
9	In case of reciprocating compressor, piping shall be suitably supported to avoid vibrations due to pulsating flow. Unless requirements of no pockets are specified by the licensor, all the piping shall run at 500mm above grade level so that proper supports can be provided to minimize vibrations. Digital Acoustic Pulsation & Mechanical Vibration study as per applicable requirements of API 618 shall be carried out for complete compressor piping including suction / discharge piping as per P&IDs and the study recommendations if any, shall be implemented.
10	Reciprocating compressor piping shall be provided independent supports (preferably RCC) from grade and shall not be supported from compressor shed / platform structure.
11	The small bore branches shall be checked for requirement of braced supports
12	Seal gas skid shall be placed below the compressor platform level so as to avoid entry of entrapped liquid in to dry gas seal unless otherwise recommended by Vendor.
13	All the inlet & outlet piping of the compressor and drive shall be routed from one side, to the extent possible so as to enable free space for maintenance.
14	For reciprocating compressor, normal operating valves, strainers, and check valve piping loops shall be in a separate tier to the extent possible to avoid congestion in the compressor platform.

3.2.8 RELIEF SYSTEM /BLOW DOWN SYSTEM PIPING

S.No.	Project Philosophy
1	Wherever the inlet line size is higher than the safety valve inlet size, reducer shall be installed adjacent to inlet of safety valve.

S.No.	Project Philosophy
2	Relief valve discharging steam, air or other non flammable vapour or gas directly to atmosphere shall be equipped with weep-hole / drain to prevent accumulation of liquid at valve outlet.
3	Liquid-phase blowdown piping connected to a gravity flow closed system shall be self draining to the blowdown system.
4	Liquid-vapour phase relief valves shall discharge into the flare header at an angle 45 degrees in the direction of header flow, to minimize the effect of kinetic energy and to avoid accumulation of liquid.
5	Pockets in the flare header and blowdown system shall be prohibited.
6	Relief valve discharge piping shall be taken to safe location as per following: 3M above top platform of column or structure, within 8M radius for steam and 15M for hydrocarbon/ toxic discharge or as per P&ID, whichever is more stringent. 25M Horizontally away from fired heater for hydrocarbon. 50M Horizontally away from fired heater, if more than one hydrocarbon relief system of different set pressures is discharging into one common riser of vent stack.
7	Inlet and outlet piping of pressure relief valve shall be adequately supported to take care of the thrust induced by the relief valve during popping.
8	Reaction forces including both momentum & static pressure effects due to safety valve popping shall be ascertained in the connected piping according to API RP520 for systems discharging to atmosphere. The effect of these forces on the piping supports and the anchors of the piping system shall be calculated to ascertain that the allowable limits at these locations are not exceeded. The supporting structure also shall be adequately designed so that when subjected to these reaction forces the supporting elements connected to piping as well as the basic supporting structure i.e. platform members etc. are capable of withstanding them.

3.2.9 BOILER REGULATION REQUIREMENTS

S.No.	Project Philosophy
1	All statutory requirements as per Indian Boiler Regulations (IBR) shall be met for IBR piping.
2	All materials used on lines falling under IBR must be accompanied with IBR Inspection Certificate in original. Alternatively, photocopy of the original certificate duly countersigned and attested by local boiler inspector is acceptable. Leading inspection authority viz. Lloyds, EIL, CEIL etc are authorised inspection authorities for IBR outside India, whereas, for Indian supply only IBR is the inspection authority.
3	IBR documents for lines falling under IBR must be approved by IBR authority of State in which the system is being installed.
4	All welders used for fabrication of IBR system must possess IBR welding qualification certificate.
5	IBR system shall be designed to comply with IBR regulations as well as ASME B31.3. Design calculations for the same must be approved by IBR authority.
6	IBR approval is obtained with requisite fees payable to Indian Boiler Board of the State concerned.
7	The discretion of IBR authority of state is final and binding for the above cases.

3.2.10 STEAM HEADER AND SUPPLY LINES

S.No.	Project Philosophy
1	Steam header shall be located generally on the upper tier and at one end of the rack adjacent to columns.
2	Branch lines from horizontal steam header, except condensate collection points, shall be connected to the top of the pipe header.

S.No.	Project Philosophy
3	Isolation valves (if provided) on the branch line shall preferably be provided on the horizontal run and outside the pipe rack.
4	All branch lines should be drainable.
5	Drip legs & compact steam trap assemblies with integral glandless piston valve and in-built strainer shall be provided at all low points and dead ends of steam header. Steam trap assemblies may be used for 900# and above. Drip legs at low points shall be closer to downstream riser.
6	All turbines on automatic control for startup shall be provided with a steam trap in the steam inlet line.
7	All traps shall be provided with strainers if integral strainers are not provided.
8	Expansion loops are to be provided to take care of the expansions within units.
9	Wherever condensate is to be drained, proper condensate draining facility shall be provided.
10	Steam trap connection in upstream of OSBL isolation valve shall be provided to avoid accumulation of condensate during unit is under shutdown.

3.2.11 STEAM TRACING

S.No.	Project Philosophy
1	Shall be as per 6-44-0007. Material of tracer shall be as per Clause 5.0 S.No. 28.
2	Steam Manifolds shall be located preferably at upper levels in pipe-rack, accessible from a platform whereas Condensate Manifolds shall be located on grade. Manifolds shall be installed in vertical position.

3.2.12 STEAM JACKETING

S.No.	Project Philosophy
1	Shall be as per 6-44-0078. For jacketed lines using high pressure steam, actual calculations for core jacket and feeder pipe shall be performed before finalization.

3.2.13 UTILITY STATIONS

S.No.	Project Philosophy
1	Requisite number of utility stations shall be provided throughout the unit to cater to the utility requirement. Number of utility stations shall be such that all equipments shall be approachable from at least one utility station. The approach of utility station shall be considered 15M all around the station location.
2	Utility stations shall have three connections [one for LP steam (SL), one for Plant Air (AP) and one for Service Water (WS)] each of 1"NB unless otherwise specified in P&ID. A single common hose shall be procured for Plant air and Service water connections. Air and water lines shall have quick type hose connection and steam line shall have flanged type hose connection and shall be directed downward. All connections shall have globe valve for isolation purpose. Inert gas hose, when required, shall have built in non return valve and quick connection coupling at piping end.
3	The Utility stations shall generally be located adjacent to pipe-rack column. The utility stations shall also be provided on elevated structures like technological structure, operating platforms of vertical equipments etc. Operating platforms having manholes must be accessible from utility station.

3.2.14 ADDITIONAL REQUIREMENTS

S.No.	Type	Description
1	Safety Shower / Eye Wash	As per Clause 5.0 S.No. 16
2	Fire Fighting	Refer Engineering Design Basis of Fire Protection System (EWS)
3	Cryogenic Piping	For Liquid/Two phase Cryogenic service, stem of the valve shall be at least 45° above horizontal. For Vapour Cryogenic service, stem of the valve shall be at horizontal or above.

3.3 OFFSITE & YARD PIPING

S.No.	Type	Description
1	General philosophy	In general, offsites piping (except tankages area), electrical cable and instrumentation cable shall be laid as per Clause 5.0 Point 10, 13 and 14. The movement area along sleepers shall be approachable from the road at a distance of every 500 meters.
2	Road Crossings	Pipes at road crossing shall be as per Clause 5.0 Point 12. Culverts / overhead pipe bridges shall be adequately designed to take care of future requirements
3	Layout	
3.1		Clearances between lines shall be minimum 'C' as given below. $C = (D_o + D_f) / 2 + 25 \text{ mm} + \text{Insulation thickness(es)}$ Where, D_o - outside diameter of smaller pipe (mm) D_f - outside diameter of flange(min 300#) of bigger pipe (mm) However this 'C' spacing between the offsite piping on the rack/sleeper can be suitably increased so that the lines should not touch each other after insulation/lateral expansion.
3.2		Adequate clearance shall be provided for every long & high temperature lines to avoid clashing at the bends. Actual line spacing, especially at 'L' bend and loop locations, shall take care of thermal expansion / thermal contraction / non-expansion of adjacent line. Non-expansion / thermal contraction may stop the free expansion of the adjacent line at 'L' bend location.
3.3		Expansion loops for all lines shall generally be kept at the same location.
3.4		Vents shall be provided on all high points & drains shall be provided at all low points. Drain valves at sleeper piping shall be kept outside the sleeperway if the same is not accessible and valves shall be put in horizontal only. At all such places where piping is extended to make drain valves accessible - 2 nos. of stiffeners, irrespective of pipe rating, shall be provided at 90° to each other from the main pipe to impart adequate stiffness to the branch connection. The stiffeners shall be made of 6mm thick flats of material equivalent to the pipe material.

S.No.	Type	Description
3.5		Spacing of guides on each line on a pipe bay shall not exceed the value given in 7-44-0507.

3.4 TANK FARM PIPING

S.No.	Type	Description
1	Layout	
1.1		The number of pipelines in the tank dyke shall be kept minimum and shall be routed in the shortest practicable way to main pipe track outside the tank dyke, with adequate allowance for expansion. Within one tank dyke the piping connected to that tank shall only be routed.
1.2		Manifolds shall be located outside the tank dyke & by the side of the roads, easily accessible by the walkway.
1.3		Special consideration shall be given as regards to spacing of nozzles while installing special item like hammer blind, MOV etc.
1.4		Pipe crossing the dyke wall shall pass through a sleeve suitably sealed. Coating & wrapping for pipe sleeves & pipes crossing dyke walls, shall be as requirements of 6-79-0020
2	Settlement	If exceptionally high settlement is expected, it shall be taken care during stress analysis as per Clause 5.0 Point 27.

3.5 FLARE PIPING

S.No.	Type	Description
1	Layout	Flare header shall be sloped towards flare knock-out drum. Expansion loop shall be provided in horizontal plane as per requirement to accommodate thermal expansion. The desired slope shall be ensured throughout including flat loop. Flare header shall be supported on shoe of height ranging from 100mm to 400mm.
2	Stress Analysis and supporting	Proper thermal analysis temperature shall be established including the possibility of temperature gradient along the line before providing expansion loops. Efforts shall be made to minimize the number of loops. Flare line between knock out drum and water seal drum shall be designed for pressure fluctuations and adequately supported to avoid vibrations.

3.6 UNDERGROUND PIPING SYSTEM

S.No.	Type	Description
1	Design and Layout	As per Engineering Design Basis - Structural(UG-Civil)

3.7 FLEXIBILITY ANALYSIS AND SUPPORTING

3.7.1 PIPE SUPPORTING CRITERIA & GENERAL GUIDELINES

Piping system shall be properly supported taking into account the following:

S.No.	Project Philosophy
1	Sustained Loads including weight of Piping (Bare pipe, service fluid, valves, flanges etc), Weight of Insulation (if any), - Weight of snow (if any), Weight of online equipments (if any), Weight of instruments (if any). Thermal loads due to operating/design/steam out/decking or any other possible abnormal condition. Occasional Loads such as Wind/Seismic loads(as and when required). Pressure relief loads due to safety valve operation, Dynamic loads due to pulsating flow/two phase with slug flow, Pressure-Thrust loads in case of expansion joints, Differential settlement for tanks.
2	The design of piping systems shall take into account the different conditions expected during operation, start-up, shut-down, cold branch in case of standby pump, tracing, etc. Hydrocarbon lines shall be designed for steam-out conditions, if so specified in Process document. System where combination of different operating conditions are envisaged, such system shall be analysed for all possible combinations e.g. ejector system etc.

3.7.2 BASIC SPANS, GUIDES SPACING

S.No.	Project Philosophy
1	Pipe supporting shall preferably follow the basic span as given in 7-44-0506 except for flare line in offsite on trestles in which case the basic span shall be restricted to max. 18.0 metres. For sizes not covered in 7-44-0506, basic span shall be established based on project requirement. For piping on rack or sleeper, as a minimum, providing resting support on every grid of pipe rack/sleeper is mandatory.
2	Guides shall be provided on straight run of pipes at intervals as specified in 7-44-0507, unless specifically becomes non-viable due to flexibility problems.

3.7.3 SUPPORTING

S.No.	Project Philosophy
1	Guides, anchors, special supports like spring supports and sway braces shall be provided based upon detailed analysis of piping system to restrict the forces on nozzles of critical equipments like pumps, compressors, turbines, exchangers, Air coolers etc.
2	Permanent arrangement for supporting shall be provided for lines which do not need any supporting otherwise but require supporting during maintenance.
3	In the heaters where steam air decking provision is there, the main lines and decking lines should be supported in such a way that either of the lines should not be in the hanging position when not in operation.
4	Piping passing through the technology structure or passing near the concrete column etc. should have adequate space to avoid restriction of line movement during thermal expansion. The gap should take care the thermal expansion along with insulation thickness.
5	Pipe support design shall be such that deflection in piping systems due to sustained loads shall not exceed 15mm, between two adjacent supports.

S.No.	Project Philosophy
6	The use of expansion joints shall be considered only when space or pressure drop limitation does not permit pipe bends. Expansion joint of axial type shall generally be avoided.
7	All pipes supports shall be so designed that there is no undue tension on equipment flanges. Forces and moments due to weight, thermal loads and other imposed loads on the equipment nozzle must not exceed the allowed loads for the equipment. In case the same is exceeded, categorical written confirmation of acceptance of the higher loads shall be obtained from the equipment supplier.

3.7.4 CORROSION PAD REQUIREMENT

S.No.	Project Philosophy
1	As per Clause 5.0 S.No. 49.

3.7.5 TRUNNION SUPPORTS

S.No.	Project Philosophy
1	As far as possible long trunnion types of supports (more than 0.5 mtr.) are to be avoided. In case long trunnion support is unavoidable in straight length of pipe, trunnion height to be preferably restricted to 0.5m and balance height to be made up by providing extended structure.

3.7.6 SUPPORTING FOR SMALL BORE LINES

S.No.	Project Philosophy
1	Adequate care shall be taken for small bore (1.5" and below) branch from piping. As a rule, all small bore branches, e.g. vents, drain, pressure tapplings, temperature tapplings, sample connections etc. from lines in 600# & above classes, lines having two phase flow, lines having Pulsating flow such as discharge of reciprocating compressors & reciprocating pumps, shall be provided with 2 number stiffeners at 90° to each other from the main pipe to impart adequate stiffness to the branch connection. The stiffeners shall be made of 6mm thick flats of material equivalent to the pipe material. Further, irrespective of line rating, the stiffeners shall be provided for all orifice taps, all small bore tapplings from PSV/TSV inlet / outlet lines and all small bore tapplings from Control Valve manifolds.

3.7.7 SUPPORTING OF COLD INSULATED LINES

S.No.	Project Philosophy
1	High density PUF blocks shall be considered for cold piping supports. Wooden blocks may be used for load taking supports on vertical lines or as anchor supports.

3.7.8 ANALYSIS TEMPERATURE

S.No.	Project Philosophy

S.No.	Project Philosophy
1	All lines shall be analysed at analysis temperature. In the absence of analysis temperature, lines shall be analysed at operating temperature if difference between operating & design temperatures is less than or equal to 30 deg.C, otherwise it shall be analysed at design temperature. However, analysis of flare line & calculation of thermal growth of tall equipments shall be done as per Process input. All hydrocarbon lines shall be analysed at Steam out temperature. Steam out temperature shall be taken as per the line list. In case of non-availability of line-list, it shall be taken as 30 deg.C less than the saturation temperature of type of steam.

3.7.9 LINES REQUIRING MANDATORY FORMAL ANALYSIS

S.No.	Project Philosophy
1	All process lines to and from fired heaters and steam generators
2	All process lines to and from centrifugal compressor and blower
3	All lines to and from turbines
4	All pump lines (6" & above and analysis temp > 120 °C or less than -60 °C) & air cooler lines.
5	Reboiler piping, Flare header/sub headers, Jacketed lines, Non metallic Piping
6	All other lines as below: 6" to 8" with analysis temp above 300 °C or less than -100 °C 10" to 14" with analysis temp above 150 °C or less than -80 °C 16" & above with analysis temp above 100 °C or less than -80 °C
7	Lines requiring Dynamic/Seismic/Wind analysis or composite stress analysis (Piping along with Structure and Equipment)
8	Lines requiring Flange leakage check, i.e. 26" & above except air & water lines (upto 600 rating) 4" & above for hydrogen lines (900 rating and above) 8" & above, other lines (900 rating and above) For dissimilar material flanged joints in lines requiring formal stress analysis
9	All other critical lines (connecting to sensitive equipments). Such as Platefin exchangers, Cold boxes (sizes 6" and above and analysis temp. > 120 °C or less than -60 °C)
10	For lines involving pulsating flow such as those connected to reciprocating pumps & compressors, in addition to thermal analysis, digital study for acoustic & mechanical vibration shall be done along with equipments, by approved vendor / Agency.
11	Dynamic analysis shall be performed as per Clause 5.0 S.No. 43. The fundamental frequency of the piping system shall be well above the imposed frequencies, if any, to avoid resonance. The minimum acceptable frequency for transfer lines shall be 7 Hz and for remaining lines with slug flow, it shall be 6 Hz.
12	Seismic Analysis shall be performed as per Engineering Technology Development Department Seismic analysis Design Basis.
13	Wind Analysis shall be performed as per Engineering Technology Development Department Wind analysis Design Basis.
14	The requirement of Composite Stress Analysis shall be decided in consultation with Engineering Technology Development Department on a case-to-case basis, for critical and important systems only, like FCC R-R Section, CCR Cyclemax Reactor System, etc. where the relative stiffness of structure and/or equipment may affect the response.

3.7.10 ADDITIONAL REQUIREMENTS

S.No.	Type	Description
1	Software	As per Clause 5.0 S.No. 34.

3.8 MATERIALS

S.No.	Type	Description
1	Basic Material of Construction	Basic material selection of particular line depending on its service, temperature and corrosivity shall be as spelt out in process package. Detailed material specification shall follow the requirements stated herewith, except wherever specified as per Licensor's requirement.

3.8.1 PIPE

3.8.1.1 THICKNESS

S.No.	Project Philosophy
1	Calculation of pipe thickness and branch reinforcement shall be based on requirements of ASME B31.3 / IBR as applicable. Proper corrosion allowance and mill tolerance shall be considered while selecting nominal thickness.
2	For carbon steel and low alloy steel pipes minimum pipe thickness shall be as follows: 'S160' up to 0.75"NB(except steam tracing), 'XS' up to 0.75"NB(for steam tracing), 'XS' for 1" to 2"NB, 'STD' for above 2NB, 12 mm for above 48" NB.
3	For stainless pipes minimum pipe thickness shall be as follows: '80S' up to 0.75"NB, '40S' for 1"NB to 2"NB, '10S' for above 2"NB
4	The philosophy of minimum thickness / schedule is applicable for both seamless and welded pipes but is not applicable to category -D classes and firewater service specification where IS pipes are being used.
5	All pipes (seamless & welded) shall have uniform negative wall thickness tolerance of 12.5% for wall thickness calculations purpose.
6	For thicknesses exceeding minimum thickness/schedule criteria, schedule XS shall be selected for CS & AS classes (for 2" & above). Intermediate schedules between STD & XS shall be ignored. Similarly for SS classes (2" & above) S10, S20, S30 & 40S may be selected beyond minimum thickness/schedule criteria.
7	Maximum 10% of corrosion allowance may be reduced in special cases, to optimize the pipe schedules.
8	For Cat-D classes, for aboveground applications, 'D/t' ratio shall be taken as 120(max.). For other than Cat-D services, 'D/t' ratio shall be generally restricted to 100 (except for Flare, Cooling water, Vacuum, O/H Vapour and Transfer lines. For these lines minimum thickness specified in clause 3.8.1.1(2) shall be followed). 'D' is nominal dia. and 't' is nominal thickness. In cases where 'D/t' ratio is more than 100, branch reinforcement calculation shall take consideration of B31J.

S.No.	Project Philosophy
9	Pipe wall thickness shall be calculated at Class condition except as defined in Clause 3.8.1.2

3.8.1.2 BASIS FOR WALL THICKNESS CALCULATION

In general, the pressure-temperature combination to calculate wall thickness shall be as given. Deviation to this clause can be permitted with specific permission from HOD-Piping and Client.

Material For Groups

Group A1

- (1) C.S. (A106 GR.B, API-5L GR.B, A672)
- (2) LTCS (A333 GR.6, A671)

Group A2

- (1) Low Alloys
- (2) 1.25% Cr-0.5% Mo
- (3) 2.25% Cr-1.0% Mo
- (4) 5%Cr-0.5% Mo
- (5) 9%Cr-1.0% Mo
- (6) 9%Cr-1.0% Mo-V

Group B

- (1) SS(A312 TP304, 304L, 304H, 316, 316L, 316H, 321, 321H, 347, 347H)
- (2) SS(A358 TP304, 304L, 304H, 316, 316L, 316H, 321, 321H, 347, 347H)

Group C

- (1) Higher Alloys

S.No.	GROUP	CLASS	SIZE	DESIGN CONDITION
1	A1/A2	150	upto 24"	Class condition
2	A1/A2	150	above 24"	Line condition (Note-1,4)
3	A1/A2	300	upto 14"	Class condition
4	A1/A2	300	above 14"	Line condition (Note-1,4)
5	A1/A2	600	upto 8"	Class condition
6	A1/A2	600	above 8"	Line condition (Note-2,4)
7	A1/A2	900	upto 8"	Class condition
8	A1/A2	900	above 8"	Line condition (Note-2,4)
9	A1/A2	1500, 2500	upto 4"	Class condition
10	A1/A2	1500, 2500	above 4"	Line condition (Note-4)
11	B	150	up to 24"	Class condition
12	B	150	above 24"	Line condition (Note-3,4)
13	B	300	upto 14"	Class condition
14	B	300	above 14"	Line condition (Note-3,4)
15	B	600	upto 6"	Class condition
16	B	600	above 6"	Line condition (Note-3,4)
17	B	900, 1500	upto 4"	Class condition
18	B	900, 1500	above 4"	Line condition (Note-4)
19	B	2500	upto 2"	Class condition
20	B	2500	above 2"	Line condition (Note-4)
21	C	150	upto 6"	Class condition
22	C	150	above 6"	Line condition (Note-4)
23	C	300 to 2500	all sizes	Line condition (Note-4)

NOTES:

1. Only If the thickness / schedule as per class condition exceeds 16.0mm for Group A1 and XS for Group A2, the thickness shall be calculated based on actual design service conditions subject to a minimum of 80% class rating upto 20mm thickness. Above 20 mm thickness, it should be based on actual/design service conditions subject to minimum 20mm.
2. Only If the thickness / schedule as per class condition exceeds 18.0mm for Group A1 and XS for Group A2, the thickness shall be calculated based on actual design service conditions subject to a minimum of 80% class rating upto 20mm thickness. Above 20 mm thickness, it should be based on actual/design service conditions subject to minimum 20mm.
3. Only If the thickness / schedule as per class condition exceeds 40S The thickness shall be calculated based on actual design service conditions subject to a minimum of 80% class rating upto 20mm thickness. Above 20 mm thickness, it should be based on actual/design service conditions subject to minimum 20mm.
4. "Line Condition" is defined as the maximum line condition for the entire job considering all lines for which thickness is to be calculated on line conditions.
5. For Cladded and Refractory lined Pipes, above notes 1 to 3 are not applicable.

3.8.1.3 PIPE SIZE

S.No.	Project Philosophy
1	Pipe sizes shall normally be 0.5", 0.75", 1.0", 1.5", 2.0", 3", 4", 6", 8", 10", 12", 14", 16", 18", 20", 24", 26", 30", 32", 36", 40", 42", 44", 48", 52", 54", 56" (Not recommended for water service since flanges are not covered in AWWA), 60", 64", 72", 76", 78", 80"

3.8.1.4 TYPE

S.No.	MATERIAL	SIZE	TYPE
1	CS, LTCS, AS	Upto 14"	Seamless
2	CS, LTCS, AS	16" and Above	E.F.S.W.
3	SS	Upto 8"	Seamless
4	SS	10" and Above	E.F.S.W.

3.8.2 FITTINGS

S.No.	Type	Description
1	Material	
2	Type	Type of Fittings shall be equivalent to pipe type.
3	Thickness / Rating	Thickness of fittings at ends to match pipe thickness for BW fittings SW fittings shall be 3000#, 6000# or 9000# depending on the pipe thicknesses S80, S160 and above S160 respectively.
4	Branch Connections	
4.1	Upto 600#	1.5" NB and below : Half Couplings/Tees 2" and above : Tees/Pipe to Pipe with or without reinforcement

S.No.	Type	Description
4.2	900# and above	Equal tee/unequal tee shall be used for all sizes. In case of non availability of unequal tees, o-lets may be used. Usage of sweepo-let shall be avoided due to poor availability globally.
5	Mitres	Mitres may be used in Category 'D' service above 14"NB. However, use of elbows is preferred up to 48" size. For other than Category 'D' fluid in 150# and 300# Class mitres can be permitted for sizes above 48". Mitres to be designed as per ASME B31.3. However, use of mitres shall be minimum.
6	Unions	Union shall not to be used in lines other than Cat-D water lines.

3.8.3 FLANGES

S.No.	Type	Description
1	Type	
1.1	For 150 class rating	Upto 1.5" : SW RF (with Non-metallic Gasket), WN RF (with metallic/Spiral Wound gasket) 2" and above : WN RF for CS (other than Cat.D),AS&SS SO RF for Cat.D service & Fire Water service up to 24" and SO FF for Cat.D service 26" and above
1.2	For 300,600 class rating	Upto 1.5" : SW RF 2" and above : WN RF
1.3	For 900 class rating and above	All sizes : WN RTJ
2	Hydraulic Bolt Tensioning	Shall be performed to the extent and as defined in 6-76-0002

3.8.4 GASKETS

S.No.	RATING	MATERIAL/SERVICE	TEMPERATURE	TYPE	GASKET OR STRIP MATL+FILLER MATL/RTJ GASKET MATL
1	150	CS & SS(utilities & except steam)	up to 371 Deg.C	PLAIN	BS 7531 Gr. X
2	150	CS & LTCS (Process and steam)	up to 371 Deg.C	Spiral wnd	SS316+Grafoil+I ring
3	150	AS (all services)	up to 371 Deg.C	Spiral wnd	SS316+Grafoil+I ring
4	300 & 600	CS	up to 427 Deg.C	Spiral wnd	SS316+Grafoil+I ring
5	300 & 600	AS	All	Spiral wnd	SS316+Grafoil+I ring

S.No.	RATING	MATERIAL/SERVICE	TEMPERATURE	TYPE	GASKET OR STRIP MATL+ FILLER MATL/RTJ GASKET MATL
6	150, 300, 600	SS (other than utilities)	All	Spiral wnd	SS316+Grafoil+I ring (where trim material is SS304/316) SS316L+Grafoil+I ring (where trim material is SS304L/316L)
7	300(*), 600(*), 900, 1500, 2500	CS	All	Octagonal RTJ	Soft Iron
8	300(*), 600(*), 900, 1500, 2500	AS	All	Octagonal RTJ	5Cr-Alloy steel
9	300(*), 600(*), 900, 1500, 2500	SS	All	Octagonal RTJ	SS

(*) Only if RTJ is specially mentioned in PMS.

3.8.5 VALVES

S.No.	Type	Description
1	SW Valves	Upto 1.5 inch, for 150#, 300#, 600# (except ball & plug valves).
2	Flanged Valves	Above 1.5 inch for 150#, 300#, 600#. Ball & Plug valves shall be flanged for all sizes.
3	BW Valves	900# and above

3.8.6 STRAINERS

S.No.	Type	Description
1	Y-Strainers	As per Clause 5.0 S.No. 42.1.
2	T-Strainers	As per Clause 5.0 S.No. 42.2.

3.8.7 TRAPS

S.No.	Type	Description
1	Main line drains up to 600# Rating / Steam Supply Manifold	Pre-fabricated Compact Steam Trapping assemblies with thermodynamic Steam traps
2	Main line drain for 900# and above	Thermodynamic/Bimetallic Steam traps with conventional fabricated Steam Trap Assembly.

S.No.	Type	Description
3	Traps in Steam Tracing Lines	As per Clause 5.0 Point 28
4	Process Traps	As per Process Data Sheets

3.8.8 NDE REQUIREMENTS (IF NOT SPECIFIED IN PMS)

S.No.	Type	Description
1	General	Extent of NDE in all cases shall depend on severity of application. In case of any conflict in NDE specifications, more stringent NDE shall apply.
2	No radiography	Category 'D' service as per B31.3
3	5% Radiography of Butt welds and DP/MP testing of Fillet welds	150#, 300#, 600# Normal Hydrocarbon service, CS & SS & LTCS
4	10% Radiography of Butt welds and DP/MP testing of Fillet welds	150#, 300#, 600# in IBR, Firewater
5	20% Radiography of Butt welds and DP/MP testing of Fillet welds	150#, 300#, 600# up to 3% Cr AS - General Services. 150#, 300#, 600# NACE (Note-1), Caustic - CS & SS. 150#, 300# Hydrogen & Oxygen- CS & SS.
6	100% Radiography of Butt welds and DP/MP testing of Fillet welds	All ratings for Cryo, 5%Cr and above AS, High temp. applications (>500 deg.C), severe cyclic Piping. 900# and above for all services . 600# and above for hydrogen & oxygen in CS & SS NACE (Note-1), Oxygen, Hydrogen, Caustic for all ratings for up to 3% Cr AS.

Notes:

1. Additional 100% Wet-fluorescent MP testing shall also be done for all CS/AS NACE classes.
2. In place of Radiography, Ultrasonic Testing is also acceptable wherever allowed as per Welding specification and subject to prior approval of Owner.

In case of any conflict amongst the radiography requirements above or any other specifications, the more stringent requirement shall be followed.

3.9 THERMAL INSULATION OF PIPING, EQUIPMENT & VESSELS

S.No.	Type	Description
1	Hot Insulation	As per 6-79-0026
2	Cold Insulation	As per 6-79-0027

3.10 PAINTING

S.No.	Type	Description
1	Shop and Field Painting	As per Clause 5.0 S.No. 23.
2	Colour Coding requirements	As per Clause 5.0 S.No. 24.
3	Environment	As per Clause 5.0 S.No. 21.

3.11 WELDING

S.No.	Type	Description
1	Applicable Codes & Stds.	Process Piping - B31.3 (all requirements) Indian Boiler Regulations (all requirements) ASME BPV Sec. IX(Welding and Brazing Qual.) ASME BPV Sec.V (Non Destructive Examination) ASME BPV Sec.II Pt.C (Welding rods, electrodes & filler materials)
2	Welding Specification	As per 6-77-0001

3.12 MISCELLANEOUS

S.No.	Type	Description
1	Positive Material Identification	Positive material identification (PMI) test at construction site shall be done as per 'Standard Specification for positive material identification PMI at construction site, 6-82-0002'.

4.0 SPECIFIC DESIGN REQUIREMENTS

4.1 HYDROGEN SERVICE REQUIREMENTS

4.1.1 PIPES, FITTINGS AND FLANGES

S.No.	Project Philosophy
1	All carbon steel pipes, fittings and flanges having wall thickness 9.53 mm and above shall be normalised. Cold drawn pipes and fittings shall be normalised after the final cold draw pass for all thicknesses. In addition, fittings made from forgings shall have Carbon - 0.35% max. and Silicon - 0.35% max. The normalising heat treatment shall be a separate heating operation and not a part of the hot forming operation.
2	All alloy steel (Cr-Mo) pipes, forgings and fittings 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 psi.
3	For carbon steel pipes, fittings and flanges, hardness of weld and HAZ shall be 200 BHN (max.). For alloy steel, hardness of weld and HAZ shall be 225 BHN (max.).
4	For all Carbon steel and Alloy steel pipes, fittings and flanges 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). If welding is used in manufacture, impact testing of Heat Affected Zone(HAZ) & weld metal shall also be carried out.

4.1.2 VALVES

4.1.2.1 GENERAL

S.No.	Project Philosophy
1	All valve castings shall be of radiographic quality. 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-7 of ASME SEC-VIII, DIV.1, regardless of casting quality factor. 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

4.1.2.2 HELIUM LEAK TEST

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 :

S.No.	PRESSURE CLASS	NOMINAL SIZE	TEST DURATION(in Minutes)
1	Upto 300	Upto 2"	3
2	Upto 300	3" to 6"	6
3	Upto 300	8" to 16"	9
4	Upto 300	18" to 24"	9
5	600	Upto 2"	6
6	600	3" to 6"	9
7	600	8" to 16"	9
8	600	18" to 24"	12
9	800 & 900	Upto 2"	9
10	800 & 900	3" to 6"	12
11	800 & 900	8" to 16"	12
12	800 & 900	18" to 24"	15
13	1500	Upto 2"	12
14	1500	3" to 6"	15
15	1500	8" to 16"	15
16	1500	18" to 24"	18
17	2500	Upto 2"	12
18	2500	3" to 6"	18
19	2500	8" to 16"	18
20	2500	18" to 24"	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.

4.1.2.3 CS & AS VALVES

S.No.	Project Philosophy
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. 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 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. Carbon steel shall be normalized and alloy steels shall be normalized & tempered. 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. 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 [minimum value 15 ft-lb] at 30 F). For radiography and acceptance criteria of Valve castings, refer Paragraph 2 of Clause 4.1.2.4(1)

4.1.2.4 SS VALVES

S.No.	Project Philosophy
1	Casting and test bar shall be heat treated together. Valve casting shall be in solution heat treated and pickled condition. 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. 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 E165 Procedure B-2, Interpretation as per Appendix-8 of ASME-VIII Div.1.

4.2 TECHNICAL REQUIREMENTS FOR PIPING MATERIAL

This is applicable over and above the requirements specified in Clause 3.8.

4.2.1 GENERAL

S.No.	Type	Description
1	Ends : Unless otherwise specified, the ends shall be to the given standard	SW/SCRD : ASME B16.11 BW : ASME B16.25 FLANGED : ASME B16.5 and ASME B16.47 SERIES 'B' THREADING : ASME/ANSI B1.20.1 (NPT, Taper threads) up to 1.5" and IS-554 for 2" to 6"
2	Face Finish shall be to MSS-SP-6/ASME B46.1 / ASME B16.5 / B16.47. The interpretation shall be as given	Stock Finish : 250-1000 μ in AARH Serrated Finish /Smooth Finish/125 AARH : 125-250 μ in AARH Extra Smooth Finish/63 AARH : 32-63 μ in AARH
3	Austenitic Stainless Steel requirements	
3.1		All items/parts shall be supplied in solution annealed condition
3.2		For all Austenitic Stainless steels, Intergranular Corrosion (IGC) Test shall be conducted as per following : ASTM A262 Practice 'B' with acceptance criteria of 60 mils/year (max.) for casting. OR 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. For IGC test, two sets shall be drawn from each solution annealing lot; one set corresponding to highest carbon content and other set corresponding to the highest rating/thickness.
3.3		For all items of stabilised SS grades (SS321, SS347), stabilizing heat treatment shall also be done. It shall be carried out subsequent to normal solution annealing. Soaking temperature and holding time shall be 900 °C and 4hrs respectively
4	Threaded joints	Upto 204 deg.C, threaded joints shall be made with 1" width PTFE joining tape. Above 204 deg.C, threaded joints shall be seal welded with a full strength fillet weld. All threaded joints, irrespective of pressure and temperature, for critical services including toxic fluid, hydrogen etc shall be seal welded with a full strength fillet weld.
5	Piping used in fire fighting system	Piping used in fire fighting shall be marked as such.

4.2.2 PIPES

Unless specifically exempted, welded pipes shall be acceptable only with longitudinal weld made employing automatic welding, however, ERW Pipes are not acceptable.

S.No.	Project Philosophy
1	Spiral Weld pipes shall be acceptable only for Category D and Fire Water services.

S.No.	Project Philosophy
2	Unless mentioned otherwise in the material code, double seam 180 deg. apart is allowed for sizes 36" and larger only.
3	Galvanised Pipes shall be only Hot Dip galv. to ASTM A53.

4.2.3 FITTINGS

S.No.	Project Philosophy
1	All fittings shall be seamless in construction unless otherwise specified.
2	For reducing BW fittings having different wall thickness at each end, the greater one shall be employed and the ends shall be matched to suit respective thickness.
3	All welded fittings shall have maximum negative tolerance equivalent to pipe selected.
4	All welded fittings shall be double welded. Inside weld projection shall not exceed 1.6mm, and the welds shall be ground smooth at least 25mm from the ends.
5	For fittings made out of welded pipe, the pipe itself shall be of double welded type, manufactured with the addition of filler material and made employing automatic welding only.
6	All welded fittings shall be normalized for CS, normalized & tempered for AS; and 100% radiographed by X-ray for all welds made by fitting manufacturer as well as for welds on the parent material.
7	Bevel ends of all BW fittings shall undergo 100% MP/DP test.
8	Those used in fire fighting facilities shall be marked.

4.2.4 FLANGES

S.No.	Project Philosophy
1	Bore of weld neck flange shall correspond to the inside diameter of pipe for specified schedule/thickness. Ends shall be beveled to suit the specified schedule / thickness.
2	For RTJ flanges, only octagonal section ring joint flanges shall be used.
3	Minimum Hardness of groove of RTJ flanges of given materials, blinds and spacers shall be as given : Carbon Steel : 140BHN 1% Cr to 5%, 9% Cr : 150BHN Type 304, 316, 321, 347 : 160BHN Type 304L, 316L : 140BHN
4	For RTJ flanges, blinds & spacers, the hardness of the groove shall be specified on the test report.

4.2.5 VALVES

4.2.5.1 GENERAL

S.No.	Type	Description
1		Valves of Class 900 & above shall be pressure-seal type. Threaded and seal welded or welded bonnet may be employed upto sizes 1.5".
2		All flanged valves (except forged) shall have flanges integral with the valve body. Weld-on flanges shall be made by full penetration joints and 100% radiographed.
3		Forgings are acceptable in place of Castings but not vice-versa.

S.No.	Type	Description														
4		Cast Iron valve use shall be as per Clause 5.0 S. No. 41														
5		Valve under LTCS (Low temperature Carbon Steel temperature below -29° C to -45° C) and cryogenic service (below -45° C) shall meet the requirements of BS 6364/ BS EN ISO 28921-1 and shall be procured from pre-qualified vendor. Pre-qualification test as per BS 6364/ BS EN ISO 28921-2 is mandatory regardless of intended service.														
6		For Vacuum service, One valve per metallurgy, per rating, per size shall be helium vacuum tested as per ASME Sec.V, Subsection A, Article 10 (Hood method) Appendix IX.														
7		Face-to-Face/End-to-End dimension shall be as per ANSI B16.10. In case the same is not covered under B16.10, the dimension shall be as per BS 2080/Manufacturer' s Std.														
8	By pass arrangement															
8.1	A globe type valve shall be provided as bypass for the given sizes of gate valves. Size of bypass valve shall be 0.5" for main valve up to 4", 0.75" for main valve of 6" and 8" size and 1" for main valves 10" and above.	<table><tr><td colspan="2">Class Rating Size of valve requiring bypass</td></tr><tr><td>150</td><td>26" and above</td></tr><tr><td>300</td><td>16" and above</td></tr><tr><td>600</td><td>6" and above</td></tr><tr><td>900</td><td>4" and above</td></tr><tr><td>1500</td><td>4" and above</td></tr><tr><td>2500</td><td>3" and above</td></tr></table>	Class Rating Size of valve requiring bypass		150	26" and above	300	16" and above	600	6" and above	900	4" and above	1500	4" and above	2500	3" and above
Class Rating Size of valve requiring bypass																
150	26" and above															
300	16" and above															
600	6" and above															
900	4" and above															
1500	4" and above															
2500	3" and above															
8.2		Bypass piping, fittings and valves shall be of compatible material and design. 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. NDT of bypass valve shall be in line with main valve.														
9	Radiography of castings	All casting shall be of radiographic quality. This requirement to be ensured by sample radiography before proceeding with the actual production. Radiography procedure, areas of casting to be radiographed, and the acceptance criteria shall be as per ASME B16.34. Percentage of radiography shall be as given below.														
9.1	Hydrogen/Hydrogen bearing hydrocarbons, oxygen, NACE service, stress relieved classes	Class 150 : 50% up to 24" and 100% for 26" & above Class 300 : 50% up to 16" and 100% for 18" and above														
9.2	LT/Cryo services	Class 150 : 20% up to 24" and 100% for 26" & above Class 300 : 20% up to 16" and 100% for 18" and above														
9.3	Stabilized grades of SS	100% radiography irrespective of size or rating														

S.No.	Type	Description
9.4	All services other than those mentioned at Clause 4.2.5.1 S.Nos. 9.1, 9.2, 9.3 above, Category D services, Fire water	Class 150 CS : 5% up to 24" and 100% for 26" and above Class 150 AS & SS : 10% up to 24" and 100% for 26" & above Class 300 : 10% up to 16" and 100% for 18" and above
9.5	All services	Class 600 & above : 100% radiography for all sizes
9.6	Category 'D' , Fire water	NIL
10	Ball/Plug /Butterfly valve requirements	
10.1		Each valve shall be supplied with a lever / wrench except for gear operated / motor operated valves
10.2		Soft-seated ball, plug & butterfly valves shall be supplied with antistatic devices.
10.3		The ball of ball valve shall not protrude outside the end flanges of valve.
10.4	Ball valves shall be of floating ball / trunnion mounted type as given:	150# : Up to 8"-Floating ball; 10" & above- Trunnion mounted 300# : Up to 4"- Floating ball; 6" & above- Trunnion mounted 600# and above : Up to 1.5"- Floating ball; 2" & above- Trunnion mounted
10.5		Use of soft seated ball/plug/butterfly valves shall be suitably selected based on temperatures handled.
10.6		Butterfly valves shall be suitable for throttling application.
10.7		For all services other than Category-D butterfly valve shall be triple offset, high performance type.
10.8		Quarter-turn valves shall have "open" position indicators with limit stops.
10.9		Fire safe valves shall be used for all Hydrocarbon services.

S.No.	Type	Description
11	Fugitive Emission Requirements	Except for Valves in Cat-D and Water service, all valves with stem packing shall comply with the fugitive emission requirements detailed below as a pre-qualification. Gate valves as per API-600 and all Gate/Globe valves as per API-602 shall comply with fugitive emission requirements of API 624. Gate valves of Class rating 900 & above, Gate valves of size 26" & above and Globe valves of size 2" & above or valves where API-624 is not applicable due to non-graphite stem packing material, shall comply with Fugitive emission requirement of ISO-15848-1. Quarter turn valves shall comply with Fugitive emission requirement of API 641. Quarter turn valves where API-641 is not applicable due to non-graphite stem packing material, shall comply with Fugitive emission requirement of ISO-15848-1.
12		Valves (excluding all type of control valves) and NRVs should not have any threaded drain plugs.

4.2.5.2 VALVE OPERATION REQUIREMENT

Manual mode of operation shall also be provided for all MOVs. Requirement of Gear operator for manual mode of operation shall be defined below.

Gear operation shall be provided as given. For sizes lower than these ranges, hand wheel / lever / wrench shall be provided. For pressure balance plug valves manufacturer's recommendation shall be acceptable. 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 hand wheel periphery. However, failing to meet the above requirements, vendor shall offer gear operation.

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.

Group Valve Type

- A Gate Valve, Globe Valve & Diaphragm Valve
- B Ball Valve / Plug Valve (Other than pressure balance plug valves)
- C Butterfly Valve

S.No.	VALVE GROUP	CLASS	SIZE REQUIRING GEAR-OPERATOR
1	A	150 Class	12" and larger
2	A	300 Class	12" and larger
3	A	600 Class	10" and larger

S.No.	VALVE GROUP	CLASS	SIZE REQUIRING GEAR-OPERATOR
4	A	900 Class	6" and larger
5	A	1500 Class	3" and larger
6	A	2500 Class	3" and larger
7	B	150 Class	6" and larger
8	B	300 Class	6" and larger
9	B	600 Class	4" and larger
10	B	900 Class	3" and larger
11	B	1500 Class	3" and larger
12	C	150, 300 Class	6" and larger

4.2.6 STRAINERS

S.No.	Project Philosophy
1	Allowable pressure drop when specified shall be certified by vendor along with the offer. If asked specifically, vendor shall furnish pressure drop calculations.
2	All 2" & higher sized Y type strainers shall be provided with 0.75" threaded tap and solid threaded plug as drain connection on the blind flange. For less than 2", this shall be 0.5" size. For hydrocarbon and Steam services welding joints shall be used instead of threading in valves & plug of the drain assembly.
3	Bottom flange of Y-type strainer shall not have tapped hole. Full length standard size studs shall be used for joining blind flange.
4	For fabricated strainers, all BW joints shall be fully radiographed and fillet welds shall be 100% DP/MP.
5	All the strainers shall be hydrostatically tested at the lower of twice the design pressure and 1.5 times the class rating as per ASME B16.5 at ambient temperature.

4.2.7 TRAPS

S.No.	Project Philosophy
1	Vendor shall furnish the performance curve indicating the capacity in mass/hour at various differential pressures across the trap.
2	Parts subject to wear and tear shall be suitably hardened.
3	Traps shall function in horizontal as well as in vertical installation.
4	Traps shall have integral strainers.
5	All traps shall be hydrostatically tested to twice the design pressure. Air traps shall be tested at 1.5 times the design pressure.

4.2.8 HOSES

S.No.	Project Philosophy
1	Manufacturer shall guarantee suitability of hoses for the service and working conditions specified in the requisition, even if the material is not specified in the Material Requisition for any particular service.
2	All hoses shall be clearly marked with service and working pressure at both ends.
3	Hoses shall be resistant to ageing, abrasion and suitable for outdoor installations.
4	Complete Hose assembly shall be tested at two times the design pressure.
5	Rubber Steam hoses shall be subject to steam resistance test.

4.2.9 EXPANSION JOINTS

S.No.	Project Philosophy

S.No.	Project Philosophy
1	The applicable codes are ASME B31.3 and EJMA (Expansion Joint Manufacturer's Association).
2	Bellows shall be formed from solution annealed sheet conforming to the latest ASTM Spec.
3	Any longitudinal weld shall be 100% radiographed. The finished longitudinal weld must be of the same thickness and same surface finish as the parent material. Circumferential welds are not permitted.
4	Bellows are to be hydraulically or expansion (punched) formed. Rolled formed bellows are not acceptable. Noticeable punch or die marks resulting from expansion operation are not acceptable.
5	No repairs of any kind are allowed on the bellows after forming. Deep scratches and dents are not acceptable.
6	The out of roundness shall be limited to $\pm 3\text{mm}$. This is the max. deviation between the max. & min. diameter.
7	The actual circumference of the welding end shall be maintained to $\pm 3\text{mm}$ of the theoretical circumference.
8	Apart from the usual requirements, the vendor shall also furnish Design calculations to justify stiffness and fatigue life, Axial, lateral stiffness, angular stiffness, effective pressure thrust area, Installation/maintenance manual and Moments & forces due to stiffness & pressure thrust due to expansion joint.

4.2.10 SUPPORTS AND SPRING ASSEMBLIES

S.No.	Project Philosophy
1	The Material, Design, Manufacture and Fabrication shall be generally as per MSS-SP-58/ MSS-SP-89 and/or BS 3974.
2	Testing of springs shall be as per BS1726

4.2.11 GASKETS

S.No.	Project Philosophy
1	Asbestos shall not be used for gaskets and fillers.
2	Full face gaskets shall have bolt holes punched out
3	Non-metallic ring gaskets as per ASME B16.21 shall match flanges to ASME B16.5 upto 24", and ASME B16.47 or AWWA for sizes > 24" unless otherwise specified.
4	Spiral wound gaskets as per ASME B16.20 shall match flanges to ASME B16.5 upto 24", and ASME B16.47 series 'B' for sizes > 24" unless otherwise specified.
5	Inner ring shall be provided for the following: a) As per code (B 16.20) requirement. b) For sizes 26" & above in all classes. c) For vacuum, cryo and hydrogen service. d) For SS321, SS347 and H-grade SS classes. e) For classes where temperature is higher than 427 °C. f) For 900# rating and above classes. (If PMS specifies spiral wound gasket)
6	In case of RTJ gaskets, only octagonal section ring gaskets shall be used & shall have proper marking stamped. Material certificate shall be available for the gasket. Hardness of RTJ gaskets shall be 20 BHN(min) less than the corresponding flange groove hardness.

4.2.12 STUDS, BOLTS, NUTS

S.No.	Project Philosophy

S.No.	Project Philosophy
1	All bolting shall be as per ASME B18.2.1 for Studs, M/C Bolts and Jack screws, and ASME B18.2.2 for nuts.
2	Threads shall be unified (UNC for $\leq 1"$ dia and 8UN for $> 1"$ dia) as per ANSI B1.1 with class 2A fit for Studs, M/C Bolts and class 2B fit for nuts.
3	Stud bolts shall be threaded full length with two heavy hex nuts. Length tolerance shall be in accordance with the requirement of ASME B16.5
4	The nuts shall be double chamfered, semi-finished, heavy hexagonal type and shall be made by the hot forged process.
5	All the stud/ bolt should have metallurgical certificates in case of alloy/ SS metallurgy with identified colour marking at the stud ends/ bolt side face.
6	Heads of jack screws and M/C bolts shall be heavy hexagonal type. Jack screw end shall be rounded.
7	Wherever bolt tensioning is specified stud bolt length shall be longer by minimum one diameter to suit bolt tensioner. Excess threads shall be protected by a threaded nut.

4.2.13 SPECIAL SERVICE REQUIREMENTS

S.No.	Type	Description
1	IBR	IBR stands for Indian Boiler Regulation. For steam services, it is statutory obligation to meet IBR requirements. For items under IBR material composition restrictions, test reports, painting, etc. shall be as per IBR's stipulations.
2	NACE & Sour Service	For items under this category EIL Standard Specification 'Material requirements for Carbon steel components used in sour service in Petroleum Refinery Environments, 6-79-0013' shall be followed, unless otherwise specified by Licensor.
3	CRYO & Fire-Safe	For items to be used under LTCS (low temperature Carbon Steel -29°C to -45°C) and cryogenic conditions, temp below -45°C and those required to be fire-safe, special designs and tests would be applicable. Pre-qualification criteria needs to be compiled before execution of job.
4	Impact Tests	Welded Pipes and Fittings used below ASME Temp. -29 °C shall be impact tested as per requirement of ASME B31.3.

4.2.14 INSPECTION AND TESTING

S.No.	Project Philosophy
1	All items and their parts shall be subjected to all mandatory as well as supplementary (wherever specified) tests and checks called for in the respective codes/standards/data sheets.
2	The examining personnel shall have the requisite qualification and experience.
3	Client and its authorized representative reserve the right to vet and suggest changes in vendor's procedures.
4	Vendor's works and facilities shall be accessible to the Client/Representative at all reasonable times.
5	Test reports for all mandatory as well as supplementary tests wherever specified shall be furnished.

S.No.	Project Philosophy
6	Positive material identification test at vendor's works shall be done as per 'Standard specification for positive material identification PMI at vendor's works, 6-81-0001'.
7	All RF pads to be pressure tested thru tell-tale holes.

4.2.15 MARKING

S.No.	Project Philosophy
1	All items shall be marked (stamped/etched) in accordance with the applicable code/standard/specification. In addition, the item code, if available, shall also be marked.
2	For ease of identification, the colour of painted strip (wherever required) shall be as per the applicable standard.
3	Paint or ink for marking shall not contain any harmful metal or metal salts which can cause corrosive attack either ordinarily or in service. Special items/smaller items shall have attached corrosion resistant tag providing salient features.

4.2.16 DISPATCH

S.No.	Project Philosophy
1	All items shall be dry, clean and free from moisture, dirt and loose foreign material of all kinds.
2	All items shall be protected from rust, corrosion, and mechanical damage during transportation, shipment and storage.
3	Rust preventive on machined surfaces to be welded shall not be harmful to welding and shall be easily removable with a petroleum solvent.
4	Ends shall be suitably protected, and the protectors shall be securely and tightly attached.
5	Each variety and size of item shall be supplied in separate packaging marked with the purchase order no., item code (if available), and the salient specifications.
6	Carbon steel, LTCS and low alloy steel valves shall be painted with one coat of inorganic zinc silicate primer.

5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

S.No.	Description	Selected Option
1	Equipment spacing (ISBL)	Generally OISD norms / PNGRB Regulations / Licensor requirements
2	Minimum pipe rack width (Main Pipe Rack)	As per equipment layout
3	Spare capacity on Rack / Sleeper Except for revamp units	10% of clear rack/ Sleeper width for Units and Offsites
4	Cooling water lines	On rack upto 36" Underground above 36"
4.1	FW lines (in Units)	As per Engineering Design Basis for Fire Protection system (EWS)
5	Minimum height of sleeper	300mm (with pavement/ gravel below pipe-way) or 500mm without pavement
6	Air cooler location	On Pipe rack / Tech structure top
7	Location of pumps:	

S.No.	Description	Selected Option
7.1	In Units	Pump discharge 1m outside rack with motor towards rack
7.2	In Offsites	Open area (no shed)
8	Requirements of monorail on pumps:	
8.1	Under pipe rack / shed	In Motor rating 75KW and above for all pumps
8.2	Open area	None
9	Means for Exchanger bundle removal:	
9.1	In Open area at grade and on Tech Structures top floor open to sky	None
9.2	On Tech Structures except top floor open to sky	Hydroextractor
10	Offsites Piping (On sleepers / Pipe Rack)	Generally Pipe Rack, however, sleepers may be considered in localized areas
11	Battery limit valves' operation:	
11.1	OSBL Piping on sleepers	Operable from ground / platform at grade level
11.2	OSBL Piping on Piperack : Valves at grade level / Valves at piperack level	Valves at grade level, Operable from ground/platform at grade level
11.2.1	Valves at grade level	Operable from ground / platform at grade level
11.2.2	Valves at Piperack level	Operable from platform
12	Pipe way road crossing	Culvert / Overhead pipe bridges, as applicable
13	Electrical cable routing underground / above ground	As per Electrical Design Basis
14	Instrument cable routing underground / above ground	As per Instrumentation Design Basis
15	Any requirement of statutory approval.	IBR regulations for projects in India
16	Safety shower / eye wash	As per P & ID, Equipment Layout
17	Requirement of elevators	As per Specific requirement of Client/Licensors
18	Compressor house for ISBL & OSBL:	
18.1	Location	As per SME(Equipment Division) Engineering design basis
18.2	Maintenance requirement	As per SME(Equipment Division) Engineering design basis
19	Instrument Air Drier Shed	None
20	Insulation material: Hot Cold Safety Electrical heat tracing	Material selection and thickness as per agreed Process Design Basis
21	Type of environment for selection of painting system	Environment as per 6-79-0020.
22	Method of surface preparation: Mechanical tools Power tool cleaning Blast cleaning	Blast cleaning (Grit blasting) No sand blasting is permitted
23	Corrosion protection below insulation:	
23.1	CS Pipe (upto 125 DEG C operating temperature)	As per EIL Painting spec 6-79-0020

S.No.	Description	Selected Option
23.2	SS Pipe: Cold Insulated Hot insulated	As per EIL Painting spec 6-79-0020
24	Specific colour coding requirements	As per EIL Painting Spec 6-79-0020
25	Usage of IS grade material	Limited to Cat-D services as per ASME B31.3 & Fire water service
26	Usage of asbestos sheet gasket	Not permitted
27	Provision for high settlement in tank farm: Usage of dresser coupling in tank farms Flexibility of piping	Flexibility of piping
28	Steam tracing	Tracer material shall be 0.5" Seamless CS Pipe unless otherwise specified in the Process Design Basis. Supply Lead lines from Steam supply manifold to traced lines and return lead lines from traced lines to Condensate return manifold shall be Pre-insulated SS304 tubing. Bought out Standard modules of Steam distribution & Condensate Recovery with 'integral glandless piston valves' for Steam Station and 'integral glandless piston valves and trap valve station' for Condensate recovery. Condensate Return station shall have Balanced pressure thermostatic steam traps.
29	Bulk Material Supplier	EIL approved vendor list
30	Engineering Drawing mode	Electronic - ISBL/OSBL
31	Specific software package for engineering drawings:	E3D for Units and Offsites. AutoCAD for revamp jobs.
32	Material Control System	EIL in-house software package (for Jobs for which detail engineering is done by EIL) & LSTK Vendor's software for Packages
33	Item Coding system	EIL practice(for Jobs for which detail engineering is done by EIL) & LSTK Vendor's coding for Packages
34	Stress analysis package	CAESAR-II
35	Access to nozzles of columns	Platform for 'manholes, nozzles with valves, spectacle blinds and instruments' (However, ladder access may be provided for Instrument connections)
36	Staircase / Ladders for tall columns	Ladder
37	Provision of breakup flanges for removal of tube bundles of heat exchangers	Nil / To be established during 3D model review.
38	Height of pipe support pedestals	150 mm
39	Mandatory Bulk Material Escalation	EIL Standard (for Jobs for which detail engineering is done by EIL) & LSTK Vendor's standard for Packages
40	Cathodic Protection of Tankage and U/G Piping	As per Client requirement.

S.No.	Description	Selected Option
41	Cast iron valves	None, except in drinking water service for sizes 2" and above and in Butterfly valves in cooling water service where Ductile Iron Castings are acceptable in place of Carbon steel castings
42	Strainers:	
42.1	Y Type	Upto 1.5" irrespective of service 2" & above in steam service
42.2	T type	2" & above in services other than steam
43	Dynamic stress analysis	Required for: Two phase flow lines with slug/plug flow Transfer lines
44	Piping isolation valve for instruments/ Stand Pipes	As per P&ID/ Process Design Basis
45	Disposal of nonrecoverable condensate in units & offsites: Through U/G header to storm water sewer Soak Pit	As per Process Design Basis
46	Sequence of burner piping near peep-doors	Valves to be operable while viewing from peepholes
47	Sea Water Piping	CS with Corrosion Allowance 3.0mm upto 2" size and Cement Lined CS for 3" & above
48	Spiral Weld pipes	IS pipes for Category D services & Fire Water service.
49	Corrosion Pad/Protection Shield:	
49.1	Corrosion Pad on bare pipe (except galvanized) directly resting on Pipe rack/ sleeper/ structure	For 2" NB and above.
49.2	Protection Shield for Shoe type support on insulated/bare Piping	For 10" NB & above for CS Piping For 2" NB and above for AS/SS Piping
49.3	Protection Shield with Trunnion/Lug/Dummy etc. type support on insulated/bare Piping	Protection shield for 2" NB and above piping.
50	Special requirements for Hydrogen service	As per Clause 4.1
51	Ultrasonic examination in place of radiography is acceptable	As per Clause 3.8.8, Note 2
52	Percentage of Conventional Radiography/ Digital Radiography /Close Proximity Radiography / Ultrasonic examination	As per client requirement

SCOPE OF WORK AND SUPPLY (PIPING) STEAM GENERATION SYSTEM TENDER NO. – B957-420-80-44-PG-T-7410

PROJECT : BINA PETROCHEMICAL AND REFINERY
EXPANSION PROJECT, BEPREP

UNIT : OFFSITES

OWNER : BPCL (India) LTD.

LOCATION : BPREP, BINA, INDIA

JOB NO. : B957

A	28/01/2025	ISSUED FOR TENDER	UC	CC	RKG
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

1.0 GENERAL

The Scope of work and supply given herein describes the minimum requirements and guidelines to the Contractor for the complete piping engineering, supply and procurement of materials and supervision of fabrication, erection, testing, pre-commissioning and commissioning for **Steam generation system package of BINA Petrochemical & Refinery Expansion Project (BPREP), BPCL(India) Ltd.**

- a. The Contractor's battery limit (B/L) for aboveground piping shall be as per scope marked P&IDs and Scope Drawing for Piping B/L for Steam Generation System Package (B957-420-16-43-SK-7410) attached with the tender. Tie-in points at battery limit shall generally be butt welded, unless otherwise agreed by Owner / EIL on case-to-case basis. Platform shall be detailed for operation of Battery limit valves or where otherwise required as per accessibility requirements. Lower tiers of the pipe rack shall be used by Steam Generation System Contractor for routing the piping and top tier shall be used for instrument/Electrical cable duct. In case of any conflict the decision of Owner/ EIL shall be final and binding and is to be implemented without any cost and schedule implication.
- b. Contractor shall do the Piping Layout, design, detailed engineering and associated work in accordance with requirements of the Engineering Design Basis (B857-999-16-43-EDB-1001), Standard Specifications, Job specifications, Engineering Standards, Drawings, Codes, approved P&IDs and Data Sheets in providing final details for Steam Generation System as covered under this tender. The requirements contained in the specifications, drawings etc. enclosed with the tender are minimum which Contractor has to follow. However, they can be improved upon at no extra cost to the Owner.
- c. The Contractor's scope of work shall also include generation of Smart 3D model, using version 13.01.00.2661 , preparation of drawings and documents, supply & procurement of all materials, positive material identification, flexibility analysis, supporting, maintenance provisions etc, preparation of drawings and documents, supply & procurement of all materials, positive material identification, flexibility analysis, Dynamic analysis, Vibration analysis, Wind analysis, supporting, maintenance provisions as required and passivation of all grades of SS including stabilized grades (where specified) in shop.
- d. In addition to the above, piping scope within the battery limit for Steam Generation System as per the process package, the Contractor's scope shall also include detailing of steam tracing and electric tracing (if applicable) of piping as per the approved P&ID's, line schedule and specifications. Contractor's scope also includes obtaining all statutory approvals and clearance like IBR, OISD, CCE, TAC, PCB etc.
- e. Contractor shall provide details of all skids in the Steam Generation System with respect to Location and spacing and obtain approval from Owner/EIL regarding placement of the same in the Steam Generation System area before proceeding on Detailed Engineering of piping connecting skids.
- f. Contractor shall supervise fabrication, erection, and testing, pre-commissioning and commissioning activities for piping under purview of Steam Generation System.

2.0 Detailed engineering scope of work by Contractor (Above-Ground)

Following minimum drawings and documents shall be prepared by the Contractor and submitted to Owner/ EIL for Approval/review/information for execution of piping works.

All documents and drawings shall be submitted as per agreed schedule and no bunching of documents shall be accepted.

- a. **PIPING MATERIAL SPECIFICATION** based on PMS (B957-420-6-44-0005-7410) is to be followed. Contractor shall update the Piping Material Specification enclosed with the tender package and submit it in the same format, for review to EIL.

The updated Piping Material Specification shall give all the necessary details as given in the enclosed Piping Material Specifications keeping the format same. These details shall be given for piping components like pipes, flanges, fittings, valves, studs/nuts, gaskets, strainers, steam trap, etc. and shall include but not limited to the following:

Size range, Temp. /Pressure range

Dimensional and material standard, material description

Schedules, ends, ratings, facing, finish

Branch tables, vent drain details, pressure, temperature connection details

Standard and specific notes

Complete above information for Pipes, flanges, fittings, valves, studs/nuts, gaskets, strainers, traps etc.

All calculations for pipe thickness, reinforcement pad etc. are to be submitted along with the updated Piping Material Specification for all sizes and all classes as per the criteria given in Engineering design basis (B857-999-16-43-EDB-1001).

Pipe wall thickness shall be calculated for all combinations of pressure / temperature and highest thickness shall be selected. For lines where thickness is to be calculated for actual line pressure / temperature conditions (design), thickness shall be selected at that combination of pressure/temperature which results in maximum calculated thickness. This pressure-temperature combination shall be decided considering pressure-temperature conditions for all sizes of lines for which thickness are to be calculated for actual design conditions. However, in such cases the thickness shall not be less than required by Engineering Design Basis (Piping) clause no. 3.8.1.2. While submitting thickness calculations, these aspects shall be demonstrated by Contractor with documents. Pipe thickness, reinforcement calculations shall be as per ASME B31.3. Thickness and reinforcement calculations for lines under IBR shall meet IBR requirements. Thickness given in the PMS (B957-420-6-44-0005-7410) are minimum and cannot be lowered. Any upward revision in the thickness as a result of pipe wall thickness calculation carried out by the contractor shall be accommodated by the contractor without any cost and time implication.

Mitres and reducers fabricated from pipe may be used if specified in particular pipe class. Mitres require higher thickness than corresponding pipe / elbow to hold the same pressure (refer ASME B 31.3).

For lines under vacuum, Contractor shall perform thickness calculations in accordance with ASME Sec VIII Div I and submit the same for review to Owner/EIL along with external stiffener required. Thickness for steam and condensate lines, if any, shall be checked for full vacuum conditions as per process requirement.

Updated PMS shall reflect all the Piping Classes covered in the P&IDs developed by the Contractor or any class not covered in PMS attached with the Bid documents. All additions in the PMS shall be consistent with the given parameters and specifications and in no case inferior to the items already covered therein. Necessary changes shall be carried out by the Contractor in all relevant documents from consistency point of view.

While submitting updated PMS, Contractor shall clearly highlight the changes/additions w.r.t. PMS attached with the Bid documents. A list of changes/additions shall be prepared which shall be approved by Owner/EIL.

- b. VALVE MATERIAL SPECIFICATION (VMS)** to the extent available for Steam Generation System shall be provided to successful Bidder. However, Contractor shall prepare VMS for all types/sizes of valves not covered in the EIL/Owner VMS but required for the Steam Generation System based on Piping Material Specification (B957-420-6-44-0005-7410), Engineering Design Basis (B857-999-16-43-EDB-1001), approved P&IDs & process package requirements. The valve material specification shall give all the details as mentioned below:

Type of Valves i.e. Gate, Globe etc.

Size range, Special service condition if any i.e. service, pressure, temp. etc.

Design Standard, material description for body and trims, bonnet gasket, bolting, hand wheel etc.

Description of special features/requirement, end connection details i.e. pipe schedules for welding ends, ratings for flanged ends and SW ends.

Type of operation/requirement of By- pass

Test standards and type of test and test pressures.

Standard and specific notes to cover special requirement/duty.

The Contractor shall combine the VMS furnished by EIL/Owner and developed by them. The combined Valve material specifications shall be submitted to EIL / Owner.

The following Fugitive emission requirement for valves shall be complied by Contractor for all valves:

- a) All Gate valves as per API-600 and all Gate/ Globe valves as per API-602 shall comply to fugitive emission requirements of API 624 as per clause 5.9.7 of API 600 and 5.9.4 of API 602.
- b) For hydrocarbon service, Gate valves of size 26" & above, Globe valves of size 2" & above, all size of Ball valves, all size of Plug valves and all size of Butterfly valves shall comply with Fugitive emission requirement of ISO-15848-1 with Tightness Class-C.

c. EQUIPMENT LAYOUT:

Equipment Layout shall be developed by Contractor meeting all requirements of P&IDs, other documents of Process package, Piping Design Basis and specifications and standards attached with Steam Generation System. The final Approved Equipment Layout drawing during detail engineering shall form the basis of the piping work. Contractor to ensure and confirm that Steam Generation System along with all associated skids and facilities shall be accommodated in the area provided for Steam Generation System.

Contractor shall ensure that all the aspects of erection, maintenance, operation, safety, fire escape route etc. are taken care of while finalizing the equipment layout.

The space requirements for individual packages shall be firmed up with the approval of Equipment Layout.

Contractor shall update the Equipment Layout as per comments (without any extra cost to OWNER) and updated equipment layout shall be sent to OWNER/EIL for records.

- d. PIPING GENERAL ARRANGEMENT DRAWINGS** & view drawing from different directions indicating piping for aboveground piping. Supporting steel and operating platforms required shall be clearly marked in GADs.

All Elevations shall be given with respect to EL 100.000, which corresponds to relevant HPP (Highest Point of Pavement). Dimensioning shall be done with equipment centerlines or main structural columns as reference grids. GADs shall be printed in 1:33 1/3 scale for unit piping

e. 3D Model guidelines:

- (i) Bidder shall prepare complete Piping, Equipment & other Engineering Discipline Modeling (3-D model). The 3-D model shall be done as per Smart 3D version 13.01.00.2661 and as per Specification for 3D Modeling by Package Contractors (Document No. B957-000-16-43-SP-0001). Higher or lower version shall not be accepted from Bidder. Before starting 3-D modeling, Bidder shall consult EIL for project database creation for 3-D modeling. Complete 3D model along with all native files and design database, catalogues etc. shall be submitted to EIL / Owner in electronic form at 30%, 60%, 90% & 100% of model completion for review/ records on or before mutually agreed dates. Bidder shall incorporate Owner's/ EIL's comments on model without any time and cost implication.

Complete internal Piping i.e., all piping within battery limit of Flare Package Vendor's scope, above ground piping, big bore and small bore, except tubing, for all piping materials shall be modeled. Details shall include all pipes, valves, flanges, fittings, reducers, spectacle blinds, drains, temperature/pressure connections, sample points, drip legs etc. All piping special items like expansion bellows, slide valves, and special valves with purge points, Steam traps, strainers etc. with near exact geometry. Steam supply and condensate recovery stations up to the first isolation valves in tracer lines. Complete vessel trims with level instruments, equipment/instrument vents/drains utility connections, pressure gauges etc. with exact geometry. All pipe supports along with concrete pedestals to be modeled in complete details and all spring hangers, roller supports, Rotational stops, Anchors, Structural steel members used for the pipe supports to be modeled in complete details.

All Skid mounted Equipments and Packaged units/modular units to be modeled with exact geometry including but not limited to : manholes with davits, pipe davits on top platforms, nozzles, stiffener rings, bellows, break flanges, platforms, ladders, handrails, lifting lugs etc., for all the equipments in the skid like, vessels, columns, reactor, receivers, pumps with motors, compressors with details of volume bottles, cylinders etc., blowers, centrifugal compressors, air coolers with motors and fans, filters, blow down drums, tanks, all equipments within packages and heat exchangers etc. Equipments supports: skirts, support legs/lugs, saddles to be modeled along with the equipments.

All in- line instruments like control valves, safety valves, rota-meters, orifice plate etc. shall be modeled with near exact geometry.

Maintenance areas around equipments, davit swing areas, swing elbows sweep areas, bundle removal areas, drop out areas to be modeled as soft envelopes and should be used for clash detections.

Contractor shall submit 3D model along with Design database in hard drive at 30%, 60% and 90% progress stage for review. Complete 3D model along with Design database shall also be delivered at completion of the job.

All isometrics, piping GADs shall be extracted from 3D model.

Bidder shall generate material take off of piping materials and submit for records to Owner/PMC

- f. **PIPING ISOMETRICS** for All Lines to be submitted for record by EIL including small bore lines, system isometrics for steam and Boiler feed water, condensate system falling in the purview of IBR, if any, with Support Marking and Bill of Material.

Isometric shall be drawn on A3 size sheets. System Isometrics, if required by IBR authorities shall be prepared on A0/A1 size. BOM and all support requirements shall be shown on the Isometric by using symbols and designations in accordance with Piping Support Standard. All vessel mounted instruments, items i.e. trims shall be detailed in isometrics.

g. **STRESS ANALYSIS**

Contractor shall carry out the flexibility analysis of the piping systems using CAESAR II , as per criteria specified in Piping Engineering Design Basis (B857-999-16-43-EDB-1001) pertaining to piping in Contractor scope, provide supports and satisfy flexibility requirements of piping in its scope. The drawings pertaining to any portion of the purchaser's piping required for carrying out the analysis shall be made available to the vendor during detail engineering at a mutually agreeable date. Vendor shall furnish all flexibility reports to the purchaser for review.

All lines shall be anchored by the contractor at or near the contractor's battery limit in case the actual loading exceeds the values of allowable loadings on account of Owner's piping, actual values shall be furnished to vendor. Vendor shall also furnish anchor loads for all the anchor points.

Piping arrangement shall provide for flexibility of lines to take care of the thermal expansion, contraction and equipment settlement.

Expansion computation and stress analysis shall be made on the basis of a base temperature and shall cover (+ve or -ve) design temperature(s) as shown in line schedule as well as start-up, shutdown and variable operating conditions. Analysis shall be done considering the actual fluid densities in the line.

(i) Flexibility analysis shall meet the requirements of Code ASME B-31.3 (latest edition). Analysis shall consider stress intensification factors as per ASME B-31.3. Analysis shall be done considering the actual fluid densities in the line.

(ii) All Hydrocarbon lines shall be subject to steam out conditions and shall be designed and analyzed at temperature as per clause 3.7.8 of Engineering Design Basis (B857-999-16-43-EDB-1001). Lines having negative design temperature shall be analyzed for both conditions separately (if applicable).

(iii) Flexibility Analysis of lines shall be carried out using simplified methods or a comprehensive computer program. Comprehensive computer analysis shall be carried out for lines as per Clauses 3.7.9 of Piping Design Basis for lines connected to equipments like vessels, towers, columns, pumps, exchangers, cold-box, filters, furnaces, compressors or other strain-sensitive equipments. The result of the analysis must satisfy the allowable loading on nozzles of such equipments.

Piping shall be adequately supported for weight of piping, water full, attached unsupported components, wind, seismic, dynamic loads, insulation and any other applicable forces. Care should be taken that these supports are adequate to prevent excessive stress, loads or moments in either the piping or terminal nozzles of the equipment to which it is connected. Adequacy of supporting of lines having heavy valves shall be checked. The supports shall be indicated in the piping isometrics. Adequacy check of the supports for imposed loads shall also be carried out. Adequacy of nozzles shall be checked to bear hydrotest loads, otherwise suitable precaution to be taken at nozzle points.

For design of supports, due consideration shall be given for all load cases including hydrotest. Load generated due to wind and seismic effects shall be considered for design of supports. Pressure thrust shall be considered for all lines.

Seismic analysis shall be done as per Seismic analysis Design Basis for piping. List of lines where seismic analysis is required shall be supplied by the Contractor for review by OWNER / EIL. The reports shall be submitted for review/approval for the lines selected by OWNER / EIL out of the list given by the Contractor. The reports shall include following:

Dynamic analysis boundary conditions,
Natural frequencies,
Mode shape plots and model displacements,
Mass participation factor,
Stress considering earthquake load,

Wind analysis shall be done as per Wind analysis Design Basis for piping. List of lines where wind analysis is required shall be submitted by the Contractor for review by OWNER / EIL. The reports shall be submitted for review for the lines selected by OWNER / EIL out of the list given by the Contractor. The reports shall necessarily include following load cases for support reactions, pipe stresses and displacements:

Sustained + Wind
Sustained + Thermal + Wind.

Safety valve manifolds and piping downstream of control valves shall be adequately supported to avoid vibrations.

Flange joints shall be checked for leakage for Equivalent pressure at flange joints due to combined effect of imposed forces and bending moments and internal pressure. This check shall also be performed for all lines irrespective of rating when Equivalent pressure exceeds pressure as per pressure-temp. Rating and for any other line as may be decided by OWNER / EIL at a later date. Separate pipe support standard shall be developed by the Contractor for high pressure piping and shall be submitted for OWNER / EIL review. Flange leakage checks shall be performed for the above lines as per ASME Section VIII Div. 1 or Div. 2.

For all critical lines, Contractor shall prepare a detailed list of the flanges, size wise giving details of the type/rating of flange, size and material of fasteners, gasket type and material, Bolt tension/torque provided. This list shall be handed over by the Contractor to OWNER as part of document transfer.

All reports shall be submitted along with stress reports. Stress Index shall allocate a Stress System number to each system along with Design Temperature/Pressure, Insulation thickness, fluid state etc.

Computer analysis, shall be done using 'CAESER-II' software. Flexibility Analysis reports shall be submitted for OWNER / EIL's review only for the lines which shall be identified by the OWNER / EIL in the stress index, rest shall be submitted only for information. However, OWNER / EIL may ask the Contractor to submit the flexibility reports of lines for review in addition to the lines covered in stress index if deemed necessary during the detail engineering of the project. These additions shall not have any impact on the project schedule, cost and also on the schedule of submission of other related documents. For composite analysis any one of the finite element packages such as ANSYS, NISA, NASTRAN or equivalent may be used. All reports shall be submitted along with stress reports. CONTRACTOR shall specify any one of the packages to be used for composite analysis.

The reports shall comprise of the following:

- Basic input data and calculated conditions i.e. list of load case considered.
- Layout isometric with node no. marked and supports configuration including gaps/limit stops
- Calculated member forces and stresses for different load cases
- Forces, moments and displacement reports
- Spring Hangers, sway braces, design parameters
- Additional requirements (reinforcement pad etc.)
- Flange leakage checks if applicable.
- WRC 107/WRC 297 checks (if required).
- Allowable Stress Range.
- Expansion Bellow parameters, if applicable.
- Calculation of PSV Loads, if applicable.
- Design calculations for adequacy of supporting elements
- Loads at interface B/L with other Contractors.
- Analysis of segments of other Contractor or Package vendor lines upto the nearest anchor.
- Basis of allowable forces and moments and wherever applicable vendor given allowable loads/moments.

- Allowable equipment load check

DYNAMIC ANALYSIS

Dynamic analysis shall be performed by the CONTRACTOR for all two-phase Slug or plug flow lines (under operating or start up or turn down conditions) in the plant in order to ensure that such lines are provided with proper supports and there shall be no vibrations in the line during normal operation as well as during start up or any upset conditions. The fundamental frequency of the piping system shall be well above the imposed frequencies, if any, to avoid resonance. The minimum acceptable frequency shall be as per Piping Design Basis. A List of all such lines shall be prepared by the Contractor and shall be submitted during the kick off meeting for review by OWNER / EIL. Contractor shall decide the flow regime (slug or plug) based on Process Package.

Actual densities shall be considered while carrying out static analysis. Dynamic analysis shall be performed at operating temperature given in the line list. Line shall be safe in design condition with guides, etc. as provided in dynamic analysis. Modal displacement output shall be submitted. Boundary condition and other parameter used in dynamic analysis shall also be part of dynamic analysis report.

SLUG FLOW ANALYSIS

Contractor shall submit a list of lines for which Slug Flow analysis is also required in addition to dynamic analysis. Contractor shall submit this list along with list of lines for stress analysis for review by PMC Process. Contractor shall analyze the above lines for slug flow effect and modify the supporting accordingly.

RELIEF VALVE ANALYSIS

Stress and Flange leak check analysis for relief valve piping shall be performed as per Engineering Design Basis. A List of all such lines shall be prepared by the Contractor and shall be submitted to OWNER/EIL. Stress Analysis Reports and Flange Leakage Check Reports shall also be submitted for review by OWNER/EIL.

ANALOG ANALYSIS

For pulsating lines connected to reciprocating compressors/pumps, list of lines and reports to be submitted. Reports shall include both acoustical and mechanical studies.

EXPANSION BELLOWS

All the expansion bellows should be brought with the shipping rods in as shipped condition to avoid any damage in the bellow elements. The shipping rods should be removed after installation or prior to commissioning and bellows should be adjusted for cold or hot condition. Care should also be taken to avoid any restriction in the movement of the expansion bellow during operation. A list of all expansion bellows area wise should be handled over to the OWNER. Bellows shall be procured only from Licensor's recommended vendors.

ALLOWABLE LOADS ON PRESSURE VESSELS NOZZLES

Localized stresses at nozzle to shell shall be calculated by WRC 107 and WRC 297, If required, else by FEM analysis and these computed stress values shall be limited in accordance with ASME section VIII, for all Pressure Vessels.

FINAL DOCUMENTATION

Final flexibility analysis reports of piping along with input file, units file and configuration file shall be submitted to OWNER / EIL in Six sets in hard copy and in soft copies in Hard Drive for records. Mismatch between drawings, supports and flexibility analysis shall not be permitted.

h. PIPING SUPPORTS

All piping shall be adequately supported, guided or anchored so as to prevent undue vibration, deflection/expansion or loads on connected equipment and piping and leakage at joints.

Piping at valves and equipments such as heat exchangers and pumps, requiring periodic maintenance, shall be supported in such a way so that the valves and Equipments can be removed with a minimum necessity of installing temporary pipe supports.

The first solid support for pump suction and discharge lines shall be adjustable type to facilitate pump alignment. Pedestal for pipe supports for outdoor installation shall be 150mm above HPP.

Pipe support pedestal drawing shall be submitted for information and the type of pedestal including load capacity shall be marked on Isometrics. Piping support standard with load bearing capacity, shall be submitted for information prior to submitting the Isometrics. Special pipe supports not covered in the pipe support standard are also to be submitted along with the respective isometrics.

As far as possible long trunion types of supports (more than 0.5 mtr.) are to be avoided. In case long trunion support is unavoidable in straight length of pipe, trunion height to be preferably restricted to 0.5m and balance height to be made up by providing extended structure.

Corrosion pad on bare pipe shall be provided for the sizes and lines as mentioned in the Piping Design Basis (B857-999-16-43-EDB-1001).

For insulated lines on pipe rack, shoe support shall be provided. Shoe height shall be based on insulation thickness. Minimum shoe height shall be 100mm and minimum shoe length shall be 300mm and shall be suitably increased to suit thermal movement of line.

All the supports in a piping system shall be checked for their correctness and adequacy after complete installation by the designer.

The pump piping from vessels in technological building/columns may require cantilever supports to be taken from the pipe rack or from the technological building to maintain the basic spans.

T-supports from pavement shall be minimized. Anchor fasteners for T supports shall not be used.

Spring supports shall have Teflon pad on top slide plate of spring for temperature upto 200°C and graphite pad or roller bearing for higher temperatures. Spring supports shall be unlocked and cold set prior to commissioning of system by the CONTRACTOR as per instructions of spring manufacturer.

Separate Pipe Support Standard with Load bearing Capacity, for High Pressure Piping shall be developed by the Contractor. For lines on pipe rack/sleeper, as a minimum, providing resting support on every grid of pipe rack/sleeper is mandatory.

Safety valve piping shall not be supported from the equipment platforms. Cleats shall be provided in the equipments for these lines. Supporting of vibration prone lines from platform or weak structure members shall be avoided. If required, sufficient bracing shall be provided.

Contractor shall furnish a list of spring-supports and expansion joints, area-wise giving complete specifications.

SPECIAL REQUIREMENT FOR SMALL BORE PIPING

Refer Clause 3.7.6 of Engineering Design Basis B857-999-16-43-EDB-1001.

- i. **ENGINEERING DATA/SKETCHES** for other miscellaneous items.
- j. **IBR PACKAGE** as per the requirements of IBR authorities and obtaining their clearances and approvals.
- k. **QUALITY PLAN** for piping activities under Contractor's scope.

I. TIE-IN POINTS / BATTERY LIMITS FOR ABOVE GROUND PIPING

Tie-in Points/Battery Limit drawings developed by Contractor shall indicate exact location and scope of unit piping for all incoming and outgoing lines as per P&ID. Contractor shall make a separate drawing along with all interface detail in tabulated form in the drawing.

All lines at B/L shall be terminated at Pipe Rack level, matching with the offsite piping elevation, with an isolation valves/spectacle blind/matching flange etc. as per P&ID. Battery Limit Valves shall be located at grade level. Access platforms shall be provided at battery limit to access all valves, spec. blinds, instruments etc. and the platforms shall have staircase access at both the ends.

The scope of supply and works of Contractor shall be up to the unit/offsite B/L interface as per attached Scope Drawing for Piping B/L in Steam Generation System drawing no. B957-420-16-43-SK-7410. B/L shown in the scope drawing is tentative, exact location, sequence and elevation of the tie-in points shall be finalized during detail engineering

Contractor shall Hydro-test each line in his scope & having connectivity with others up to B/L interface.

Any insulation/painting already done by other contractor but damaged due to above testing, etc. shall be redone by bidder without any time/cost implication.

Contractor shall provide suitable access to other contractor to enable them to execute Hydro-testing of their piping systems up to the battery limit flange

All incoming and outgoing lines shall be anchored at B/L by Contractor. Location and detail of loads due to thermal expansion shall be forwarded to Other Contractor to design the piping accordingly and shall co-ordinate through Owner / EIL.

Contractor shall provide, if required, suitable access to other OSBL Contractor to enable them to execute Hydro-testing of their piping system.

Contractor to prepare Battery Limit interface drawing including battery limit valve arrangement as per attached Scope Drawing for Piping B/L in Steam Generation System drawing no. B957-420-16-43-SK-7410 and submit for Owner/EIL approval.

m. STEAM PIPING

Steam piping under the purview of IBR shall meet the requirement of Indian Boiler Regulation (IBR). Isometrics with Bill of Material, pipe wall thickness calculations, computation of pipe length, spec and size wise and other documentation as required for approval from IBR authorities shall be prepared by Contractor.

IBR approval shall be taken by Contractor prior to start of any fabrication at site. Contractor shall meet the concerned IBR authorities, discuss with them and finalize the documents, drawings and their formats required for approval of complete IBR package.

The As-Built drawings for Steam Piping shall also require IBR approval which shall be duly obtained by Contractor.

n. FABRICATION, ERECTION, TESTING, FLUSHING & CHEMICAL CLEANING

Fabrication and Erection of Piping shall be executed as per EIL specification 6-44-0012.

Fabrication of all stub-in branch connections shall meet the requirement of the relevant codes. Reinforcement pad to be provided only after carrying out visual and additional checks specified for the branch weld. All the reinforcement pad telltale holes should be taped properly & provided with grub screws. Gas-cut holes are not acceptable.

Inspection, Flushing and Testing of Piping Systems shall be performed in accordance with EIL specification 6-44-0013.

Hydro-test pressure shall be calculated by the Contractor based on ASME B31.3, however for lines coming under IBR the hydro test pressure shall be calculated based on requirements of IBR.

Contractor shall calculate hydro test pressure as per ASME B31.3, and incorporate in line list along with test medium. For IBR lines, if any, hydro test pressure shall be calculated as per IBR as well as ASME B31.3 and maximum pressure out of both shall be considered. Updated line list shall be submitted to Owner/EIL.

Procedure and criteria for passivation of all grades of SS, where specified, shall be submitted for Owner's/ EIL approval.

All the components of alloy steel, stainless steel and other higher metallurgy equipment system should be positively identified as per 6-81-0001 at supplier's shops. The properly identified material should be given a distinct color by supplier before dispatch to avoid any mixing with other material. Third party inspector should also certify this.

- o. INSULATION:** For Hot Insulation, Standard specification 6-79-0026 to be followed. final job specification shall be provided to successful bidder after award of contract for compliance.

3.0 Scope of supply by Contractor:

- a. Contractor shall Supply & Procure all piping materials including hook-up material, springs and bellows required within Contractor's B/L along with all material test certificates including IBR inspection certificates, if applicable.
- b. Prepare Bill of Materials including material summary on the basis of P&ID's, GADs, Isometrics including fabrication allowance, pre-commissioning and commissioning spares, Prepare Material Requisitions etc. Place purchase orders for all piping items as per approved Vendor List of Owner/EIL. Furnish Final Vendor drawings for piping items e.g. Bellows, Special tagged items etc. Arrange 3rd party inspection of materials by approved inspecting agencies as per requirements, transport and receive materials at site and store with proper identification tag.
- c. Contractor shall supply the piping in prefabricated spool pieces.
- d. All pipe spools and loose items shall be easily identifiable with respect to Isometric to ensure ease of erection.
- e. All the Piping items/components of Alloy Steel, Stainless Steel and other higher-grade materials procured under Bulk materials shall be positively identified as per 6-81-0001 and checked on three tier basis; first at supplier's shop, second at Contractor's stores and third, after erection at site. The properly identified material shall be given a distinctive color by supplier before dispatch to avoid mixing with any material and to be certified by the Third-Party Inspector.
- f. Procure, Supply Electric tracing and steam tracing material (if applicable).
- g. Supply of all support materials, pipe supports including spring supports.
- h. Supply of any necessary blind or additional valving not identified in P&ID's to isolate lines to facilitate phased commissioning & start up.
- i. Supply of all painting and insulation materials including accessories for complete painting and insulation of the lines.
- j. CONTRACTOR shall arrange suitable numbers of PMI equipment at site to enable OWNER / EIL to verify the bulk piping material supplied.
- k. The above list of activities is not exhaustive and therefore not limited to the above. The scope of supply includes all such activities like supply of all materials and components as required, for successful commissioning of the plant as per the requirements of the P&IDs, line lists, Piping Design Basis and Engineering specifications etc. enclosed in the Steam Generation System so as to result in a total trouble free operable and maintainable plant.

4.0 Scope of Construction by Contractor

- a. Provide WPS/PQR for OWNER / EIL's review and maintain records for welder qualification and welder testing.
- b. CONTRACTOR shall execute all activities for receipt of materials at WORKSITE including offloading, checking, warehousing, proper storage and protection and material control facilities, including storage and retrieval of associated certification documentation. CONTRACTOR shall also operate a separate quarantine stores/compound for storage of materials which arrive without suitable documentation. Security of the material and stores issue/report arrangement on round the clock basis is in the scope of CONTRACTOR.
- c. The CONTRACTOR's scope of work shall include supporting, fabrication, laying, erection, painting, insulation, steam / electrical tracing, jacketed piping (if applicable), chemical cleaning, passivation of all grades of SS, testing, flushing and pre-commissioning including steam flushing, complete in all respects, of all piping in accordance with the final Process Package, required for successful erection, commissioning, operation and maintenance of the plant.
- d. Execute piping fabrication including prefabrication, preheating, welding, NDT including radiography, site fabrication, Post weld heat treatment, lifting, laying and erection including bolt tensioning, bolt torquing, supporting, water/steam flushing, air drying, disposal of fluids, preservation of piping and miscellaneous items following hydrotest, nitrogen purging, testing, cleaning, painting, insulation, chemical cleaning, cardboard blasting etc. as per specifications.
- e. Installation of all valves and other miscellaneous in line / on line items.
- f. Installation & testing of tracing system (if applicable)
- g. Fabrication and installation of pipe supports, guides, anchors, spring supports, expansion joints, sway braces etc. as required including construction of RCC pipe support pedestals independent of floor pavements.
- h. Execute all mechanical jobs identified during OWNER/EIL check list, technical audits, pre-commissioning and commissioning.
- i. Set up field engineering Cell and execute field engineering, which becomes necessary to resolve problems arising during prefabrication, shop fabrication, field fabrication or erection at site & based on sub vendor data. Necessary field design change drawings shall be prepared by CONTRACTOR and submitted for review/information and shall be reflected in the As Built Drawings/Documents/3D model. CONTRACTOR shall arrange Checker for checking the P&ID, GAD and isometrics for correct transformation of data from one document to another document.
- j. Obtain clearances and approvals from all applicable statutory/Government agencies e.g. IBR, PCB, OISD, PESO, TAC etc.
- k. Development and agreement with OWNER / EIL of a system base for Mechanical Completion and handover of sections of the work. CONTRACTOR shall adopt OWNER / EIL's requirements regarding sequence of system completion and handover.

- l. Installation of any necessary blind or additional valving not identified on CONTRACTOR P & ID's to isolate lines to facilitate phased commissioning and start-up.
- m. CONTRACTOR shall comply with the requirements of Mechanical Completion as described in relevant Section of the Steam Generation System.
- n. Testing of welds/flanged joints not subjected to hydro testing.
- o. CONTRACTOR shall fully familiarize himself with the site conditions, approach roads, location of fabrication yards, transportations from the fabrication yard to the unit.
- p. To the maximum possible extent, CONTRACTOR shall prefabricate the piping spools in Fabrication yard with Minimum possible weld joints to be executed at site.
- q. The above list of activities is not exhaustive and therefore not limited to the above. The scope of construction includes all such activities as required for successful commissioning of the plant as per the requirements of the P&IDs, line lists, Engineering Design Basis (Piping) and engineering specifications etc. enclosed in the Steam Generation System so as to result in a total trouble free operable and maintainable plant.

5.0 OEM Piping: OEM piping shall be as per OEM standards; however same shall comply with ASME B 31.3 & IBR.

6.0 Piping Specifications / Standards / Drawing / Enclosures:

Sl. No.	Description	Doc. No.	Rev. No.
1	Engineering Design Basis – Piping	B857-999-16-43-EDB-1001	0
2	Piping Material Specification (Note-1)	B957-420-6-44-0005-7410	A
3	Valve Material Specification (Note-2)	B957-6-44-0006-7410	A
4	Specification for 3D Modeling by Package Contractor (Note-2)	B957-000-16-43-SP-0001	B
5	Scope Drawing for Piping B/L in Steam Generation System	B957-420-16-43-SK-7410	A
6	Technical Compliance Format (Piping) for Steam Generation System	B957-420-16-43-TCL-7410	A
7	Vendor Data Requirement for Steam Generation System	B957-420-16-43-VDR-7410	A
8	Site specific seismic spectra	B957-000-16-54-DB-0001	1
9	Design Basis for wind load on piping	B957-000-16-54-DB-0002	0
10	Job Specification For Non-Destructive Examination Requirements of Piping	B957-6-44-0016	C

11	Seismic design requirements for piping	B957-000-16-54-DB-0003	0
12	Specification for Surface Preparation and Protective Coating System (Note-3)	B957-000-06-42-PLS-01	0
13	Job Specification for External Coating of Buried Piping & Fittings (Note-3)	B957-000-06-42-PLS-04	0
14.	Welding Specification Charts (Note-3)	B957-999-06-41-WSC-0001	0
15	Standard specification for steam tracing	6-44-0007	6
16	Standard Specification of Fabrication and Installation of Piping	6-44-0012	5
17	Standard Specification for Inspection, Flushing and Testing of Piping Systems	6-44-0013	6
18	Technical notes for pipes.	6-44-0051	8
19	Technical notes for valves.	6-44-0052	9
20	Technical notes for flanges, spectacle blinds and drip rings.	6-44-0053	8
21	Technical notes for butt welded, socket welded and screwed fittings.	6-44-0054	8
22	Technical notes for gaskets.	6-44-0056	7
23	Technical notes for bolts and nuts.	6-44-0057	7
24	Technical notes for hoses & hose couplings	6-44-0064	3
25	Technical notes for steam and air traps	6-44-0066	4
26	Technical notes for strainers	6-44-0067	3
27	Technical notes for sample coolers	6-44-0068	3
28	Technical notes for sight flow indicators (sight glasses)	6-44-0069	3
29	Technical notes for spring support assemblies	6-44-0070	3
30	Standard Specification for Application Of Torque And Hydraulic Bolt Tension For Flange Joints	6-76-0002	3
31	Welding Specification for Fabrication of Piping	6-77-0001	5
32	Specification for Quality Management System Requirements from Bidders	6-78-0001	2

33	Specification for documentation requirements from contractors	6-78-0002	2
34	Specification for documentation requirements from suppliers	6-78-0003	2
35	Standard specification for Hot insulation of Vessels, Piping and Equipments	6-79-0026	0
36	Standard Specification for Positive Material Identification (PMI) At Supplier's Work	6-81-0001	4
37	Standard Specification for Positive Material Identification (PMI) at Construction Sites	6-82-0002	5
38	Standard specification for color coding of Piping material	6-82-0003	4
39	Stub-in Standard	7-44-0032	5
40	Details Of Mitered Elbows	7-44-0033	6
41	Standard For Spacers and Blinds > 26" (150#, 300#, & 600# FF)	7-44-0162	5
42	Standard for Spacers and Blinds >26" (for AWWA flanges)	7-44-0164	2
43	Dimensions For Handle Projection for Spacers and Blinds, ½"-24" NB (150#,300#, & 600# FF)	7-44-0166	5
44	Temporary strainer RF (all ratings), FF 125# -300#.	7-44-0300	6
45	T-strainer type- 1 2" - 4" (150CL RF, 300CL RF & RTJ, 600CL RF & RTJ).	7-44-0303	7
46	T strainer type-1 6" - 24"(150# RF, 300# RF and RTJ, 600# RF and RTJ).	7-44-0304	7
47	Standard for orientation of CBD/OWS points for package	7-44-0326	1
48	Vents & Drains (On Lines 1.5" And Below)	7-44-0350	6
49	Vents & Drains (On Lines 2.0" And Above)	7-44-0351	6
50	Orientation Of Orifice Tap	7-44-0352	6
51	Well Installation	7-44-0353	6
52	Pressure Tappings	7-44-0354	6
53	Utility Hose Station	7-44-0401	5
54	Drip Leg for Steam Lines	7-44-0403	6
55	Tolerances for fabrication	7-44-0486	6

56	Clearances	7-44-0501	4
57	Accessibility for Valves and Instruments	7-44-0502	4
58	Valve accessibility and clearance	7-44-0503	4

NOTE-1: These documents are preliminary and only for reference. Final document shall be given to successful bidder after award of job for compliance.

NOTE-2: These document and any other relevant purchase documents shall be given to the Bidder after award of contract for compliance.

NOTE-3: Attached elsewhere in the package.

JOB SPECIFICATION FOR 3D MODELING BY PACKAGE VENDOR (PIPING)

PROJECT: BINA PETROCHEMICAL AND REFINERY EXPANSION
PROJECT (BPREP)

CLIENT: M/s BHARAT PETROLEUM CORPORATION LIMITED
(BPCL)

UNIT: ETHYLENE CRACKER AND ASSOCIATED UNITS

JOB NO: B957

B	29-10-2024	ISSUED FOR BIDS	ABA	PK	SNH
A	11-09-2024	ISSUED FOR BIDS	ABA	PK	SNH
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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1.0 GENERAL

The specifications given herein describe the minimum requirements and guidelines to VENDOR which forms the Scope of Work of 3D modeling of **ECU AND ASSOCIATED UNIT& OFFSITE FACILITIES, BREP, BINA.**

2.0 SOFTWARE

Intergraph Smart 3D HEXAGON software shall be used for 3D modeling. The version which shall be used for this software shall be SMART 3D version 2019 (12. 01.00.0983) and use ORACLE database version 12C R2/ SQL standard edition 2016. If required by EIL/Owner, version may be upgraded to Smart 3D 13.1 with Oracle 19C/ SQL standard edition 2019 at no extra cost and time implication. The selection of the database shall be intimated to the successful bidder.

Intergraph Smart P&ID shall be used for P&ID modelling.

3.0 SCOPE AND EXTENT OF MODELING

The objective of this 3D modeling is to deliver to OWNER i.e. M/s BPCL a complete 3D model which shall be utilized for all future maintenance, operation, revamping and any debottlenecking of the plant. The 3D Design Reviews through dynamic walk-through shall assist Owner's operation and maintenance personnel in reviewing the project prior to construction and suggest modifications for efficient operation & maintenance of the plant. It shall also be used for frequent review of design by OWNER/EIL.

All plant items listed below shall be modeled for completeness of 3D model and for extraction of deliverables from model.

Scope of modeling is as under:

3.1 Piping

- a) Overall system co-ordination.
- b) All equipments are to be modeled with exact geometry including but not limited to : manholes with davits, pipe davits on top platforms, nozzles, stiffener rings, bellows, break-up flanges, lifting lugs, piping clips etc., for all the equipments in the plant like, vessels, columns, reactors, receivers, pumps with motors, air coolers with motors and fans, filters, blow down drums, heat exchangers, filters, dryers, coldbox, vaporizers, air purifiers, etc.
- c) Maintenance areas around equipments, davit swing areas, swing elbows, sweep areas bundle removal areas, drop out areas to be modeled as soft envelopes and should be used for clash detections.
- d) Equipments supports: skirts, support legs/lugs, saddles etc.
- e) Above ground (AG) piping, big bore and small bore shall be modeled. This shall include all pipes, valves, flanges, fittings, reducers, spectacle blinds, drains, temperature/pressure connections, sample points, drip legs, jacketed pipes etc.
- f) All in-line instruments like control valves, safety valves, rotameters, orifice plate, flow meter etc.
- g) All piping special items like expansion bellows, slide valves, special valves with purge/bleed points, Steam traps, strainers etc.
- h) Complete vessel trims with level gauges, level switches, level transmitters, equipment/instrument vents/drains, utility connections, temperature / pressure gauges etc.
- i) Insulation type, Insulation thickness operating/design pressure/temperature etc.

- j) Manhole vents piping to atmosphere etc.
- k) Steam supply and condensate recovery stations up to the first valves in tracer lines.
- l) All pipe supports with complete details.
- m) Integration of all packages like Compressor, Blower, Heater, Refrigeration, Pre Purification unit, Air separation unit, etc. If package modeling is not done by Vendor, the same shall also be undertaken.
- n) Tagging of all Line nos., Instruments nos., special items, and Equipment nos. shall be as marked in the P&IDs.
- o) All Equipments, special Piping items, inline instrument items, trims etc. shall be modeled with exact geometry, to the extent possible.
- p) Preliminary modeling of Hot Air duct, Cold air duct, ID/FD Fan, Suction Stack and APH of Heater to be modeled by Piping, However, same shall be replaced by actual Model received from the Heater vendor.
- q) Incorporation of Site changes during fabrication and erection with 3D Model in order to deliver a complete as built model.

3.2 Underground Facilities(if applicable)

- a) Complete underground facilities including but not limited to Underground (UG) Piping, Equipment break-up flanges, funnels, equipment & their pits, manholes, catch pits, trenches etc. to be modeled .
- b) Complete Fire water network (UG Piping in unit area & Offsite).
- c) Envelopes to be modeled on top of manholes and catch pits and shall be used for interference detection.
- d) Overall Plot plan, unit approaches from main roads, main roads outside the units, all approach roads around units ,paving, Site grading, Earth Dyke, Earth Pond, reservoirs boundary wall, gates, fencing shall be modeled. Hard stands, fabrication space for tall columns, crane access, Pipe sleepers, Instrument Road Crossing, Electrical Road crossing (IRC/ERC) and Box culvert shall also be modeled.
- e) Indicative modeling of Tankages (including dyke) /Spheres/Bullets/Flare shall be modeled by General civil for Plot Plan extraction purpose.

3.3 Structural

The scope of modeling for structural shall include but not limited to the following:

- a) Main steel/secondary steel equipment support beams, bracing, columns , stiffener plates, platforms, platform openings, ladders, pipe racks, stair cases, walkways , wind shield supports, claddings, supporting structure for air coolers with operating platforms and staircase, monorails, EOT support , entire technological structure, compressor sheds etc. shall be modeled in exact geometry.
- b) Moment connections, stiffener plates, gusset plates etc. with tentative sizes shall be modelled at initial stage of modelling (before 30% model stage).
- c) Handrails, gratings to be modeled in approximate geometry.
- d) Skid supports, platforms, ladders & Equipment supports inside skids are to be modeled in exact geometry. No welds to be modeled.
- e) Equipment and structure foundations, Technological Buildings, Equipment supporting structure, flue gas stack and any other concrete structure to be modeled in exact geometry with exact locations of all insert plates.
- f) Foundation and structure for platforms, gratings, hand rails etc. for packaged item and skid mounted items are also included.
- g) Structural modeling of Hot Air duct, Cold air duct, ID/FD Fan, Suction Stack and APH of Heater, Compressors foundation with details, blowers, HRSG units and Flue Gas units (FGD/FGC) shall be modeled as per project guidelines/requirements.
- h) Structural steel members used for the pipe supports to be modeled in complete

details based on piping input.

- i) For applicable Buildings, Control Rooms, Doors, Ceiling and Floors, compressor house asbestos sheeting etc.
- j) Modeling of buildings shall include all doors, windows, trenches, walls, openings in walls etc., and shall be imported from Architecture Model.
- k) Prelim modeling of Hot Air duct, Cold air duct, ID/FD Fan, Suction Stack and APH of Heater to be modeled by Piping, However, same shall be replaced by actual Model received from the Heater vendor.
- l) Structural supports (continuous) for:
 1. Instrumentation cable ducts on main pipe rack (MPR),
 2. Duct interconnection of MPR and all technical structures, fired heaters, compressors, major package skids and all columns / vessels of heights 50m and above;

Structural shall provide these supports even if branch pipe rack is not available. The structural supports shall be at main duct elevation as far as possible. Structural shall ensure modelling of the above supports before 60% model review.

3.2 Instrumentation

- a) Instrument cable Duct (Instrument ducts are of minimum 400mm width).
- b) Following instrument entities shall be modeled:
 - Analyzer Shelter / House, Analyzer Racks/ Cabinets located in the field to be modeled near exact geometry
 - Control Room with piping & cable entry points
 - Local Control Panels

Inside details of control Room/ Shelter/ Racks/Cabinets/ Local Control Room are excluded from the scope of modeling.
- c) Prefabricated Assemblies (Hook-ups)
- d) Gas detectors
- e) Closed Circuit Television (CCTV)
- f) Instrument Stanchions
- g) Instrument Air lines from the Air Header to the consumer
- h) Instrument Junction Boxes
- i) Input to General Civil / Structures for Instrument Cable Trench (Concrete/Buried), Sleeves and Culvert.

3.3 Electrical

The modeling for electrical facilities shall include the following:

- a) Electrical Cable Trays of size 100mm & above.
- b) Local Control Stations in the field for motor/other equipments.
- c) Lighting & power panels.
- d) Light fixtures, Control gear boxes, plugs, sockets, welding receptacle, lighting masts, lighting poles in the field.
- e) Earth strips, earth electrodes and earth plates in the field.
- f) Plant communication system equipment including field call stations, paging loudspeakers and telephones in the field.
- g) FA system equipment including break glass units in the field.
- h) Sleeves for cables in the field.

3.4 Others / Miscellaneous Models

- Packaged units /modular units are to be treated like the main units and all the requirements of modeling shall be followed for such units by the vendor.
- Skid mounted Equipments to be modeled with exact geometry.
- Skid to be tagged as main equipment.
- All sub-equipments of all skids to have skid tag as a prefix.
- All sub-equipments to be modeled with exact geometry.
- Extent of internal Piping of the skid with all inline and online instruments to be modeled.

4.0 PROJECT SETUP & DATA MANAGEMENT

4.1 Project Database Setup

Piping department shall carry out the project creation activity. Major steps involved are:

- 3D modelling shall be done in Smart 3D version 2019 (12. 01.00.0983) and use ORACLE database version 12C R2/ SQL standard edition 2016. . If required by EIL/Owner, version may be upgraded to Smart 3D 13.1 with Oracle 19C/ SQL standard edition 2019 at no extra cost and time implication. Lower version shall not be accepted from Vendor.The selection of the database shall be intimated to the successful bidder.
- No foreign database for catalogues or any reference purpose shall be used in project. Any such database shall be included in project and renumbered accordingly.

4.2 Creation of Areas / Model Files and Design Databases

This activity shall be carried out in discussion with EIL in order to maintain the uniformity in areas for various departments shall help in organizing data properly and facilitate generation of deliverables, reports and interference management.

4.3 Project Database & Naming Convention

Standard project naming convention for 3D Modeling will be provided to successful bidder.

4.4 Project-Co-ordinates Projects co-ordinates shall be global and tie-in points co-ordinates provided by EIL shall be referred for modelling.

4.5 Project-Nomenclature

Standard project nomenclature convention for 3D Modelling shall be followed as under:

Separate models to be generated for each discipline

<u>Discipline</u>	<u>Model Identifier</u>
- Piping above ground	- PIP
- Piping under-ground	- GCIV
- Equipment	- EQP
- HVAC	- HVAC
- Structural	- STR
- Architectural	- ARCH
- Electrical	- ELCT
- Instrumentation	- INST

Within each discipline, models to be generated based on the Zone Division developed by piping. The Naming conventions for model Database in SMART 3D shall be as follows:

<u>XXXX</u>	<u>ZONE</u>	<u>XX</u>
Model Identifier as given above	Levels	Zone Number

- Above ground and underground piping shall always be in different models.

4.6 Database Hierarchy in SMART 3D

Piping

a) PIPE NAME:

Line No. Label (As given in P & ID)	- Dash	XX Zone/Area No

Line No label shall include the information of line size, unit, line no , subline no(if any), spec , insulation(if any) in sequence.

b) Branch Name: PIPE NAME/B1,B2 and so on.

b) TAG NOS:

For all Inline Instruments, Special items as component Name in PDS, Same tag numbering philosophy to be followed in SMART 3D.

<u>XXX</u> UNIT . No.	<u>-</u> DASH	<u>XXX</u> INST. TYPE i.e. PSV, FV, PV	<u>XXXX</u> INST. NO./ SPECIAL ITEM NO.	<u>- X</u> 1,2,3. Only if same no. is getting repeated

d) Structure:

All Structures shall be individually modeled in Zones, including all associated with Electrical / Instrumentation Supports, Saddle Supports, Pipe Supports etc.

Naming	
/XXX/TSXX	Tech Structure
/XXX/MPRXX	Container for Main Pipe Rack
/XX-CC-XXX/STR	Container for Structural Foundation and Platforms
/XX-CC-XXX/FDN	Foundation for the Equipment
/XX-VV-XXX/STR	Container for Saddle Support for Vessel, all Associated Platforms etc.

4.7 Line information required in Smart 3D model:

The following attributes must be keyed in while modelling:

- Line operating/design, temperature/pressure in deg.C and Kg/cm2g respectively.
- Insulation type i.e. IH/IC/IJ/IC etc
- Contractor Code;

Line number label should be as per the P&ID with the following attributes:

- Line size + Fluid code + unit no. + line sequence no.+ sub-line no. + Piping material specification + Insulation Type + Model Zone number.
- Pre-requisite attributes viz., PMS, Insulation and Model Zone (for hierarchy) to be ensured before creating Pipe as per Line List and Zone-Division.

5.0 INTERFERENCE MANAGEMENT

Before release of AFC drawings, all entities will be checked for clashing, reports will be Generated and clashes if any will be resolved. Also interface tie-in point with EIL shall be matched(coordinates/rating/size) and thoroughly checked before issuing the AFC GA drawing.

6.0 DESIGN REVIEW

Review by OWNER / EIL shall be done at 30%, 60%, 90% and 100% progress stages.

Model review report will be prepared listing all action points with comments and recommendations. Modifications / changes if suggested by OWNER / EIL/ Licensor shall be mutually agreed. The same will be issued as MOM after the review.

Model review comment-Action close out report will be issued by Vendor once all the actions are taken incorporating model review comments.

Minimum 2 week prior to each stage wise model review, vendor to submit complete 3D model back up to Client/EIL.

During job progress contractor/vendor to submit complete 3D model back up with in 3days as and when demanded by Client/EIL.

The review schedule for 3D Model shall be as follows:

FIRST MODEL REVIEW (30% REVIEW):

The objective of the 30% model review is to consolidate the Equipment, Piping and platform layouts focusing mainly on the constructability, maintenance and safety (HSE) aspects. Consequently this review includes a safety review, constructability review and Basic Design review.

The model content must consist of the following items:

- Location and orientation of all equipment with nozzles.
- All 8" and above lines with associated instruments.
- All Buildings (as a block), Shelters (with main frames).
- All package Units (as a block).
- Major maintenance areas (bundle pulling, dropping areas, mobile crane aprons etc).
- Main Pipe rack main pipe support structures and sleepers.
- Electrical Cable Tray/Trenches & Instrumentation items that impact plot plan.
- Main platforms, ladders and stairs.
- Roads and plot limits.
- Location of all critical instruments.
- Escape routes.
- Main fires fighting equipments.
- Plant Boundary.
- Main headers of underground piping (other than fire water) and majority of Of branch connection and funnel points. All underground networks shall be Completed within two months of the completion of 30% model review.
- Underground trenches
- Major operator walkways and stairways.
- Earthworks final surface levels
- Site and drainage contours
- Reserve envelopes for major cable ways.
- Reserve envelopes for volumes for: maintenance areas, equipment removal, tower dropouts, lay-down areas, radiation for flares, hazardous area classification.
- HVAC equipment and major ducting.

SECOND MODEL REVIEW (60% REVIEW):

This review is the design review intended to confirm the entire plant layout. The main focus will be on operability, accessibility, process design review and maintenance of the facilities. All action items of 30% model review shall be resolved before 60% model review.

The model content must consist of the following items:

- All 2" and above lines and associated instruments
- All large bore piping and associated instruments
- All buildings and shelters with detailing as applicable
- All Equipment with trims such as stand pipes / level gauges/transmitters etc.
- All package units (as a block with limited details if required).
- All structures & supports
- All platforms, ladders, stairs
- All fire fighting systems (including hydrant, monitors)
- All Underground Systems
- Branch cable tray/trench routing & support
- Main earth strips, earth electrodes and earth plates
- Instrumentation duct routings and support
- CCTV, Fire and Gas Detectors, Part of Instrument Junction Boxes.
- All major electrical, instrument and communication equipment modeled.
- Concrete foundations, tankage bunds and retaining walls.
- Permanent cranes and hoisting beams.
- Platforms for valve operation, instrument access and maintenance access.
- Final dimensions of tabletops, structures and steel constructions.
- All HVAC ducting.
- Eye bath and safety shower locations.
- Local operation panels.
- Firefighting systems.
- Instrumentation connections.

THIRD & FINAL MODEL REVIEW (90% review):

The third & final model review is intended to confirm the results of the other outstanding details of the 60% model review. The design and model must be substantially complete clash free and ready for final review.

- All small bore piping and associated instruments
- Offline instruments
- Utility stations
- Instrumentation facilities including local operation panels
- Instrument Duct & Electrical branch cable tray routing & supports
- Instrument Prefabricated Hookups
- All safety systems (eye-washer, safety showers, escape routes).
- Instrument Air line distribution
- Instrument Junction Boxes, Instrument Stanchions
- All Cable Trenches /Trays
- All lighting fixtures, lighting & power panels, junction boxes, Control gear boxes.
- All earth strips, earth electrodes and earth plates
- All fire alarm equipments
- All PA system equipments
- All local control stations for motors
- All available package vendor models.

6.1 Milestones for Model Review

Model review shall be done accordingly to the Milestones as referred above. Vendor shall notify the date and venue of the various 3D Model reviews to OWNER / PMC. Vendor shall furnish the review model CD and other documents at least 2 weeks prior to schedule model review.

6.2 Documents Required before 3D Model Review

Vendor shall furnish the following documents to OWNER / PMC.

- Compliance statement on milestones as defined.
- Compliance statement on tag points of previous model reviews.
- List of items not modeled(if any).

7.0 **SYSTEM BACKUP**

System backups shall be taken at regularly. At least one backup must be taken every week.

8.0 **DOCUMENTATION**

All 3D model native files along with Databases, catalogues,back-up files along with share content and bulk files etc. shall be submitted at the each stage of model review and final submission of model accompanied with all drawings shall be done at the end of Project.

पाइपिंग के अध्वंसात्मक परीक्षण की आवश्यकताओं हेतु मानक विनिर्देश

JOB SPECIFICATION FOR NON DESTRUCTIVE EXAMINATION REQUIREMENTS OF PIPING

C	01.01.25	REVISED & ISSUED AS JOB SPECIFICATION	SRG	PK	SNH
B	24.12.24	REVISED & ISSUED AS JOB SPECIFICATION	SRG	PK	SNH
A	19.11.24	ISSUED AS JOB SPECIFICATION	SRG	PK	SNH
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

Abbreviations:

DP/LP :	Dye/Liquid Penetrant
MP :	Magnetic Particle
CS :	Carbon Steel
AS :	Alloy Steel
SS :	Stainless Steel
ASTM :	American Society for Testing & Materials
ASME :	American Society of Mechanical Engineers
IBR :	Indian Boiler Regulations
PMS :	Piping Material Specification

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1.0 GENERAL

1.1 Scope

This specification covers the general requirements for non destructive examination of shop & field fabricated piping.

1.2 Related Codes & Engineering Standards

Referred codes / standards are as follows. Latest editions of the Codes/Standards referred to shall be followed.

- a) ASME Boiler & Pressure Vessel Codes, Section V & VIII (Div.1) including addenda.
- b) ASME B31.3
- c) ASME B16.5
- d) ASME B16.34
- e) Job Piping Material Specification, B957-6-44-0005
- f) Welding Specification Charts for Piping Classes, B957-999-06-41-WSC-0001
- g) Standard Specification for Fabrication & Erection of Piping 6-44-0012
- h) ASTM E10
- i) Welding Specification for Fabrication of Piping, 6-77-0001 & B957-999-06-41-WSP-0001
- j) Design Guide for Radiography Requirements, 8-77-0010
- k) Indian Boiler Regulations (IBR)

2.0 VISUAL EXAMINATION

2.1 Weld shall be visually inspected wherever accessible in accordance with the following requirements:

a)	Internal misalignment	1.5 mm or less
b)	Cracks or lack of fusion	not permitted
c)	Incomplete penetration	Depth shall not exceed the lesser of 0.8mm or 0.2 times thickness of thinner component joined by butt-weld. The total length of such imperfections shall not exceed 38 mm in any 150 mm of weld length.
d)	Surface porosity and exposed slag inclusions (For nom. wall thickness 4.7 mm and less)	not permitted

e)	Concave root surface (Suck up)	For single sided welded joints, concavity of the root surface shall not reduce the total thickness of joint, including reinforcement, to less than the thickness of the thinner of the components being joined.										
f)	Weld ripples irregularities	2.5 mm or less.										
g)	Lack of uniformity in bead width	2.5 mm or less.										
h)	Lack of uniformity of leg length	2.5 mm or less.										
i)	Unevenness of bead	2.0 mm or less.										
j)	Weld undercutting	0.8 mm or 1/4 thickness of thinner components joined by butt weld, whichever is less. (shall be smooth finished)										
k)	Overlap	1.5 mm or less										
l)	Bead deflection	2.5 mm or less										
m)	External weld reinforcement and internal weld protrusion (when backing rings are not used) shall be fused with and shall merge smoothly into the component surfaces. The height of the lesser projection of external weld reinforcement or internal weld protrusion from the adjacent base material surface shall not exceed the following limits: <table border="0"> <tr> <td>Wall thickness of thinner component joined by butt weld (mm)</td> <td>Weld reinforcement or internal weld protrusion (mm) max</td> </tr> <tr> <td>6.4 and under</td> <td>1.6</td> </tr> <tr> <td>Over 6.4 -12.7</td> <td>3.2</td> </tr> <tr> <td>Over 12.7 -25.4</td> <td>4.0</td> </tr> <tr> <td>Over 25.4</td> <td>4.8</td> </tr> </table>		Wall thickness of thinner component joined by butt weld (mm)	Weld reinforcement or internal weld protrusion (mm) max	6.4 and under	1.6	Over 6.4 -12.7	3.2	Over 12.7 -25.4	4.0	Over 25.4	4.8
Wall thickness of thinner component joined by butt weld (mm)	Weld reinforcement or internal weld protrusion (mm) max											
6.4 and under	1.6											
Over 6.4 -12.7	3.2											
Over 12.7 -25.4	4.0											
Over 25.4	4.8											
n)	Throat thickness of fillet welds: Nominal thickness of the thinner component x 0.7 or more.											
o)	Flattening Flattening of a bend, as measured by difference between the nominal outside diameter and minimum or maximum diameter at any cross section shall not exceed 5 % of the nominal outside diameter of pipe.											
p)	Reduction of wall thickness Reduction of wall thickness of a bend, as measured by difference between the nominal thickness and minimum thickness shall not exceed 10 % of the nominal wall thickness of pipe.											

- 2.2** Welds having any of imperfections which exceed the limitations specified in various clauses of 2.1 shall be repaired by welding, grinding or overlaying etc. Number of times of repair welding for the same weld, however shall conform to applicable notes to Table 1- Note 6(b)b.5.

3.0 NON DESTRUCTIVE EXAMINATION

- 3.1** The type and extent of weld examination shall be in accordance with Table-1. All visual and supplementary methods of girth weld examination shall be in accordance with ASME B31.3 & the requirements of this standard specification.

- 3.2** Welds between dissimilar materials shall be examined by method & to the extent required for the material having the more stringent examination.

4. TABLE-1 (with applicable notes)

TABLE 1 : CLASS, TYPE & EXTENT OF WELD EXAMINATION

INSPECTION CLASS: I

INSPN. CLASS	SERVICE	MATERIAL (NOTE 3)	P.NO.	TEMP. DEG.C	PRESS. CLASS B16.5/ B16.34	APPLICABLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED								
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTACH-MENT WELD	FAB. BRANCH WELD (NOTE 1)	FAB. WELDS OF MITRES / REDUC.				
1	2	3	4	5	6	7	8	9	10	11	12	13				
I	CATEGORY 'D' FLUID SERVICE	CARBON STEEL	1	0 TO 186	150# UPTO 10.55 KG/CM ²	A3A, A39A, J2A, A4Y, A5Y, A91A, A95A, A96A	a) VISUAL	100%	100%	100%	100%	100%				
		AUSTENIC S.S.	8	- 29 TO 186		A3K										
		HDPE	---	- 20 TO 50		A1Z, A4Z, A5Z					b) LP (NOTE 4, 6, 9)	---	---	---	5%	10%
		CUPRO NICKEL	34	- 29 TO 60												

REMARKS FOR ABOVE TABLE :

1. LP TEST NOT APPLICABLE TO NON-METALLIC CLASSES.
2. MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)
INSPECTION CLASS: II

INSPN. CLASS	SERVICE	MATERIAL (NOTE 3)	P. NO.	TEM P. DEG. C	PRESS. CLASS B16.5/ B16.34	APPLICABLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED				
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTACH- MENT WELD	FAB. BRANCH WELD (NOTE 1)	FAB. WELDS OF MITRES/ REDUC.
1	2	3	4	5	6	7	8	9	10	11	12	13
	a) ALL SERVICES COVERED UNDER INSPECTION CLASS-I, BUT, EXCEEDING CATAGORY 'D' PR./TEMP LIMITATIONS.	CARBON STEEL	1	- 29 TO 427	150# TO 600#	A1A,B1A, D1A, A6A, B6A, A7A, A8A, A9A, B9A, D9A, A11A, A13A, B13A, A15A, A20A, A32A, B32A, B28A, A71A, A83A	a) VISUAL b) RADIOGRAPHY (NOTE 5, 6, 14, 15) c) MP / LP (NOTE 4, 6, 10, 11, 16) d) HARDNESS	100%	100%	100%	100%	100%
	b) ALL SERVICES OTHER THAN THOSE COVERED UNDER INSPECTION CLASS-I BUT NON-TOXIC, NOT SUBJECTED TO SEVERE CYCLIC CONDITIONS.							5%	---	---	---	20%
	c) TOXIC, NON-LETHAL & FLAMMABLE.	LTCS		-45 TO 204		A4A, B4A, D4A, A41A, A42A, B41A, B42A, D42A, A40A, D40A		---	5%	---	5%	20%
	d) FLAMMABLE / NON FLAMMABLE & TOXIC / NON-TOXIC; NOT SUBJECT TO SEVERE CYCLIC CONDITIONS							NOTE 7	NOTE 7	NOTE-7	NOTE-7	NOTE-7
		AUSTENITIC STAINLESS STEEL		8		-29 TO 500		A1K, B1K,D1K, A6K, B6K, A11K, A1M,B1M,B3M, A1N,B1N, B6N, A21K, A23K, A24K, A28K, A28M, D21K, D23M, A71K, A92K				

REMARKS FOR ABOVE TABLE :

- EXTENT OF HARDNESS TEST FOR A11A IS 100%.
- MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.
- NOTE- 7 FOR HARDNESS IS NOT VALID FOR P. NO. 8.

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)

INSPECTION CLASS: III

INSPN. CLASS	SERVICE	MATERIAL (NOTE 3)	P. NO.	TEMP. DEG.C	PRESS. CLASS B16.5/ B16.34	APPLICABLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED				
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTACH- MENT WELD	FAB. BRANCH WELDS (NOTE 1)	FAB. WELDS OF MITRES / REDUC.)
1	2	3	4	5	6	7	8	9	10	11	12	13
III	FIRE WATER AND IBR SERVICES.	CARBON STEEL (FIRE WATER)	1	- 29 TO 427	150# TO 600#	A33A, A33Y, A94A, A97A, J95A	a) VISUAL	100%	100%	100%	100%	100%
		A2A, B2A, D2A				b) RADIOGRAPHY (NOTE 5, 6, 14, 15)	10%	---	---	---	50%	
						c) LP / MP (NOTE 4,6,11)	---	10%	---	10%	---	
						d) HARDNESS	NOTE 7	NOTE 7	NOTE 7	NOTE 7	NOTE 7	

REMARKS FOR ABOVE TABLE :

- FOR IBR SERVICE A2A, B2A & D2A NOTE- 8 IS ALSO APPLICABLE.
- MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.
- FOR A33A & A33Y FIRE WATER SERVICE, NOTE-12 IS ALSO APPLICABLE.

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)

INSPECTION CLASS: III (CONTD.)

INSPN. CLASS	SERVICE	MATERIAL (NOTE 3)	P. NO.	TEMP. DEG.C	PRESS. CLASS B16.5/ B16.34	APPLICABLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED				
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTACH- MENT WELD	FAB. BRANCH WELDS (NOTE 1)	FAB. WELDS OF MITRES / REDUC.)
1	2	3	4	5	6	7	8	9	10	11	12	13
III (CONTD.)	ALL GENERAL SERVICES EXCEPT THOSE SUBJECT TO SEVERE CYCLIC CONDITIONS.	C - 0.5 Mo STEEL.	3	ABOVE -29	150# TO 600#		a) VISUAL	100%	100%	100%	100%	100%
		0.5 Cr - 0.5 Mo STEEL					b) RADIOGRAPHY (NOTE 5, 6, 14, 15)	20%	---	---	---	50%
		C - 0.5 Mo STEEL (IBR)					c) LP / MP (NOTE 4,6,11)	---	20%	20%	20%	---
							d) HARDNESS	NOTE 7	NOTE 7	NOTE 7	NOTE 7	NOTE 7

REMARKS FOR ABOVE TABLE :

1. MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)

INSPECTION CLASS: III (CONTD.)

INSPN. CLASS	SERVICE	MATERIAL (NOTE 3)	P. NO.	TEMP. DEG.C	PRESS. CLASS B16.5/ B16.34	APPLICABLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED				
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTACH -MENT WELD	FAB. BRANCH WELDS (NOTE 1)	FAB. WELDS OF MITRES. REDUC.)
1	2	3	4	5	6	7	8	9	10	11	12	13
III (CONTD)	ALL GENERAL SERVICES EXCEPT THOSE SUBJECT TO SEVERE CYCLIC CONDITIONS.	1 TO 3 Cr Mo. STEEL.	4,5A	ABOVE -29	150# TO 600#	B1D, D1D B1E, B4D	a) VISUAL	100%	100%	100%	100%	100%
		1 - 3 Cr Mo STEEL (IBR)					4,5A	D2D, B20D	b) RADIOGRAPHY (NOTE 5, 6, 14, 15)	20%	---	---
			c) LP / MP (NOTE 4, 6, 11)			---			100%	100%	100%	---
			d) HARDNESS			NOTE 7			NOTE 7	NOTE 7	NOTE 7	NOTE 7

REMARKS FOR ABOVE TABLE :

- FOR IBR SERVICE B20D & D2D NOTE- 8 IS ALSO APPLICABLE.
- MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)

INSPECTION CLASS: III (CONTD.)

INSPN. CLASS	SERVICE	MATERIAL (NOTE 3)	P. NO.	TEMP. DEG.C	PRESS. CLASS B16.5/ B16.34	APPLICABLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED				
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTACH- MENT WELD	FAB. BRANCH WELDS (NOTE 1)	FAB. WELDS OF MITRES / REDUC.)
1	2	3	4	5	6	7	8	9	10	11	12	13
III (CONTD)	ALL GENERAL SERVICES EXCEPT THOSE SUBJECT TO SEVERE CYCLIC CONDITIONS.	3.5 Ni STEEL	9B	- 80 TO 120	150# TO 600#		a) VISUAL	100%	100%	100%	100%	100%
							b) RADIOGRAPHY (NOTE 5, 6, 14, 15)	20%	---	---	---	50%
							c) LP / MP (NOTE 4,6,10,11)	---	10%	---	10%	---
							d) HARDNESS	NOTE 7	NOTE 7	NOTE 7	NOTE 7	NOTE 7

REMARKS FOR ABOVE TABLE:

- NOTE- 7 FOR HARDNESS IS NOT VALID FOR P. NO. 9B.
- MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)

INSPECTION CLASS: III (CONTD.)

INSPN. CLASS	SERVICE	MATERIAL (NOTE 3)	P. NO.	TEMP. DEG.C	PRESS. CLASS B16.5/ B16.34	APPLICABLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED				
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTACH-MENT WELD	FAB. BRANCH WELDS (NOTE 1)	FAB. WELDS OF MITRES / REDUC.)
1	2	3	4	5	6	7	8	9	10	11	12	13
III (CONTD)	ALL GENERAL SERVICES EXCEPT THOSE SUBJECT TO SEVERE CYCLIC CONDITIONS	ALUMINIUM & ALUMINIUM BASE ALLOY	21 TO 25	ALL	150#		a) VISUAL	100%	100%	100%	100%	100%
		COPPER & COPPER BASE ALLOY	31				b) RADIOGRAPHY (NOTE 5,6, 14, 15)	20%	---	---	---	50%
		ALUMINIUM BRONZE	35				c) LP / MP (NOTE 4,6,10,11)	---	20%	---	20%	---
		OTHER NON FERROUS ALLOYS	---									

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)

INSPECTION CLASS: III (CONTD.)

INSPN. CLASS	SERVICE	MATERIAL (NOTE 3)	P. NO.	TEMP. DEG.C	PRESS. CLASS B16.5/ B16.34	APPLICABLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED				
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTACH- MENT WELD	FAB. BRANCH WELDS (NOTE 1)	FAB. WELDS OF MITRES / REDUC.)
1	2	3	4	5	6	7	8	9	10	11	12	13
III (CONTD)	SPECIAL SERVICES (CAUSTIC)	CARBON STEEL	1	ALL	150# TO 600#	A19A, B19A, D19A, A69A, A99A	a) VISUAL	100%	100%	100%	100%	100%
							b) RADIOGRAPHY (NOTE 5,6)	20%	---	---	---	50%
	SPECIAL SERVICES (O, H)	CARBON STEEL			150# TO 300#	B5A, B55A	c) LP / MP (NOTE 4,6,10,11)	10%	20%	10%	20%	---
	SPECIAL SERVICES (CAUSTIC)	AUSTENITIC STAINLESS STEEL	8		150# TO 600#	-	d) HARDNESS	NOTE 7	NOTE 7	NOTE 7	NOTE 7	NOTE 7

REMARKS FOR ABOVE TABLE :

- EXTENT OF HARDNESS TEST FOR CLASSES B5A, B55A, A19A, B19A & D19A IS 100%.
- MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)

INSPECTION CLASS: III (CONTD.)

INSPN. CLASS	SERVICE	MATERIAL (NOTE 3)	P. NO.	TEMP. DEG.C	PRESS. CLASS B16.5/ B16.34	APPLICABLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED				
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTACH- MENT WELD	FAB. BRANCH WELDS (NOTE 1)	FAB. WELDS OF MITRES / REDUC.)
1	2	3	4	5	6	7	8	9	10	11	12	13
III (CONTD)	SPECIAL SERVICES (NACE)	CARBON STEEL	1	ALL	150# TO 600#	A16A, B16A, D16A, A61A, A62A	a) VISUAL	100%	100%	100%	100%	100%
							b) RADIOGRAPHY (NOTE 5,6)	20%	---	---	---	50%
							c) LP / MP (NOTE 4,6,10,11, 18)	100%	100%	10%	100%	100%
		AUSTENITIC STAINLESS STEEL	8		150# TO 600#	A60K, A60N, B60K, B60N	d) HARDNESS	NOTE 7	NOTE 7	NOTE 7	NOTE 7	NOTE 7

REMARKS FOR ABOVE TABLE :

- EXTENT OF HARDNESS TEST FOR CLASSES A16A, A61A, A62A, B16A & D16A IS 100%.
- MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)

INSPECTION CLASS: IV

INSPN. CLASS	SERVICE	MATERIAL (NOTE 3)	P. NO.	TEMP. DEG.C	PRESS. CLASS B16.5/ B16.34	APPLICABLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED				
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTACH- MENT WELD	FAB. BRANCH WELDS (NOTE 1)	FAB. WELDS OF MITRES / REDUC.)
1	2	3	4	5	6	7	8	9	10	11	12	13
IV	ALL SERVICES OTHER THAN SPECIAL SERVICES (O,H)	CARBON STEEL	1	ALL	ABOVE 600#	E1A, F1A, E9A, F9A, E19A, F19A	a) VISUAL	100%	100%	100%	100%	100%
		LTCS				E40A	b) RADIOGRAPHY (NOTE 5, 6, 14, 15)	100%	---	---	---	100%
		CARBON STEEL (IBR)				E2A, F2A	c) LP / MP (NOTE 4,6,10,11)	---	100%	10%	100%	---
		CARBON STEEL (IBR) ASME SEC-I				F22A	d) HARDNESS	NOTE 7	NOTE 7	NOTE 7	NOTE 7	NOTE 7

REMARKS FOR ABOVE TABLE :

- FOR IBR SERVICE E2A, F2A & F22A NOTE- 8 IS ALSO APPLICABLE.
- EXTENT OF HARDNESS TEST FOR CLASSES E19A, F19A IS 100% .
- MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)

INSPECTION CLASS: IV (CONTD.)

INSPN. CLASS	SERVICE	MATERIAL (NOTE 3)	P. NO.	TEMP. DEG.C	PRESS. CLASS B16.5/ B16.34	APPLICABLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED				
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTACH- MENT WELD	FAB. BRANCH WELDS (NOTE 1)	FAB. WELDS OF MITRES / REDUC.)
1	2	3	4	5	6	7	8	9	10	11	12	13
IV (CONTD)	ALL GENERAL SERVICES.	C - 0.5 Mo STEEL	3	ALL	ABOVE 600#	--	a) VISUAL	100%	100%	100%	100%	100%
		5 Cr - 9 Cr Mo STEEL	5B		150# TO 600#	A4F, A4G, B3F, B4F, B4G, D23F	b) RADIOGRAPHY (NOTE 5, 6, 14, 15)	100%	---	---	---	100%
		13 Cr (TYPE- 410 SS)	6		ALL	--	c) LP / MP (NOTE 4,6,10,11)	100%	100%	100%	100%	100%
		KILLED CARBON STEEL & LTCS	1	UPTO - 45	ABOVE 600#	--	d) HARDNESS	NOTE 7	NOTE 7	NOTE 7	NOTE 7	NOTE 7
		1 TO 3 Cr, 9Cr-1Mo-V STEEL (IBR)	4,5A, 15E	ALL		F2D, F2G, G2D, G2G						
		1 TO 3 Cr, 9Cr-1Mo-V STEEL (IBR) ASME SEC-I	4,5A, 15E	ALL		F22D, G22D, G22G						

REMARKS FOR ABOVE TABLE :

- FOR IBR SERVICE F2D, F2G, F22D, G2D, G22D, G2G & G22G NOTE- 8 IS ALSO APPLICABLE..
- MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.
- FOR F2G, G22G & G2G, ALL WELDS FOR WHICH RADIOGRAPHY HAS BEEN DONE, SHALL ALSO BE SUBJECTED TO 100% LP/MP EXAMINATION.

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)
INSPECTION CLASS: IV (CONTD.)

INSPN. CLASS	SERVICE	MATERIAL (NOTE 3)	P. NO.	TEMP. DEG.C	PRESS. CLASS B16.5/ B16.34	APPLICABLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED										
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTACH-MENT WELD	FAB. BRANCH WELDS (NOTE 1)	FAB. WELDS OF MITRES / REDUC.)						
1	2	3	4	5	6	7	8	9	10	11	12	13						
IV (CONTD)	SPECIAL SERVICES (O, H), BENZENE ETC.	CARBON STEEL	1	ALL	ABOVE 300#	D5A, E5A, F5A, F25A, D55A, D52A, A87A												
	SPECIAL SERVICES (TEAL, HYDROGEN-ECU)				ALL	A43A, A44A, A45A A46A, B43A,B44A, B45A, B46A, A21A, B21A, B52A												
	SERVICES SUBJECT TO SEVERE CYCLIC CONDITIONS					A24A, B24A, B27A, D28A												
	SERVICES SUBJECT TO SEVERE CYCLIC CONDITIONS	0.5 TO 9 CR Mo STEEL	3, 4, 5A, 5B	ALL	ALL	--							a) VISUAL	100%	100%	100%	100%	100%
	SPECIAL SERVICES (NACE, O, H, CAUSTIC)					B5D, D5D, D5E, E5E, D52D							b) RADIOGRAPHY (NOTE 5, 6, 14, 15)	100%	---	---	---	100%
	SERVICES SUBJECT TO SEVERE CYCLIC CONDITIONS	13 CR STEEL (TYPE 410SS)	6			--							c) LP / MP (NOTE 4,6,10,11, 18)	10%	100%	10%/ 100% REMARKS -4	100%	---
	SERVICES SUBJECT TO SEVERE CYCLIC CONDITIONS.	3.5 NI STEEL	9B			--							d) HARDNESS	NOTE 7	NOTE 7	NOTE 7	NOTE 7	NOTE 7
	SPECIAL SERVICES (NACE, O, H, CAUSTIC)					--												
	SPECIAL SERVICES (NACE, O, H, CAUSTIC)	NI ALLOYS	41, 42, 43			A99P												
			45			--												
	ALL SERVICES																	

REMARKS FOR ABOVE TABLE:

- NOTE-7 FOR HARDNESS IS NOT VALID FOR P.NO.9B.
- EXTENT OF HARDNESS TEST FOR CLASS D5A, E5A F25A, D55A, D52A, AND F5A IS 100%.
- MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.
- ATTACHMENT WELDS SHALL BE 100% LP/MP TESTED FOR ALLOY STEEL CLASS.

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)
INSPECTION CLASS: IV (CONTD.)

INSPN. CLASS	SERVICE	MATERIAL (NOTE 3)	P. NO.	TEMP. DEG.C	PRESS. CLASS B16.5/ B16.34	APPLICABLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED					
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTACH- MENT WELD	FAB. BRANCH WELDS (NOTE 1)	FAB. WELDS OF MITRES REDUC.)	
1	2	3	4	5	6	7	8	9	10	11	12	13	
IV (CONTD)	SERVICES SUBJECT TO SEVERE CYCLIC CONDITIONS.	AUSTENITIC STAINLESS STEEL	8	ALL	ALL	D42K, B46K,	a) VISUAL b) RADIOGRAPHY (NOTE 5, 6, 14, 15) c) LP (NOTE 4, 6, 10, 11, 16) d) HARDNESS	100%	100%	100%	100%	100%	
	LOW TEMP. SERVICE			BELOW - 45	150# 300# & 600#	A2K, B2K, D2K, A42K, B42K, D54K, A41K, D41K							
				ABOVE 600#	E41K								
	GENERAL SERVICES			ALL	ABOVE 600#	F92K							
	HIGH TEMP. SERVICES			> 500	ALL	B4K, B5K							
	SPECIAL SERVICES (O,H,) ETC.			ALL	ALL	B5M, A44K, A45K, B44K, B45K, F55K							
	SPECIAL SERVICES (TEAL)			ALL	ALL	A20K, B20K, D20K							

REMARKS FOR ABOVE TABLE :

- MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.

Applicable Notes to Table-1

1. Branch welds shall consist of the welds between the pipe & reinforcing element (if any), nozzles & reinforcing element and the pipe & nozzle under the reinforcing element. Reinforcing element to be interpreted as pads, saddles, weldolets, sockolets etc.
2. Seal welds of threaded joints shall be given the same examination as socket welds.
3. Unless specifically stated, all materials shall be for "Non-IBR" service.
4. Magnetic Particle & the Liquid Penetrant method of examination shall be in accordance with Section V of the ASME Boiler and Pressure Vessel Code, Article VII and VI respectively. The entire area of the accessible finished weld surface shall be examined. Selected root runs, subject to a maximum of 10%, before finished weld, may also be examined, at the discretion of the engineer-in-charge.
 - a) Wherever MP / LP testing is specified, either MP or LP test may be used. But wherever only MP test is specified, LP method of examination may be used only if MP examination is impracticable in the field as concurred by EIL site-in charge.
 - b) "Random 5%" of Liquid Penetrant / Magnetic Particle test shall mean testing, by applicable test, one weld for each twenty welds or less made by the same welding procedure. "Random 10%" shall mean testing, by applicable test, one weld for each ten welds or less made by the same welding procedure. Similarly "Random 20%" shall mean testing, by applicable test, one weld for each five welds or less made by the same welding procedure. The welds to be examined in each designated lot shall include the work product of each welder or welding operator whose welds are part of the lot.
 - c) When Liquid Penetrant examination is specified, the surface shall be free of peened discontinuities.
 - d) Inspection shall be performed in the welds excluding those for which Radiography has been done.
 - e) Girth weld, branch weld, attachment weld & socket weld of 3-1/2% Ni steel shall be Liquid Penetrant tested only when welded with austenitic material where MP test has been specified.
5. Radiography (Note-14,15):
 - a) "Random 5%, 10% or 20% Radiography" shall mean examining not less than one from each 20 welds or less in case of "Random 5% Radiography", not less than one from each 10 welds or less in case of "Random 10% Radiography", not less than one from each five welds or less in case of "Random 20% Radiography" made by the same welding procedure. The welds to be examined in each designated lot shall include the work product of each welder or welding operator whose welds are part of the lot. Irrespective of percentage, no. of welds to be radiographed shall be minimum 1. However first two welds made by each welder shall also be radiographed in case of "Random Radiography". Welds selected for examination shall not include flange welds and shall be radiographed for their entire length. However, where it is impossible or impracticable to examine the entire weld length of field welds for either random or 100% Radiography, and if the same impossibility is agreeable to EIL site-in- charge, then a single 120 deg. exposure of the weld length may be given a Magnetic Particle test or Liquid Penetrant test.

However in such cases for ferro-magnetic materials, only MP test shall be acceptable for classes higher than 600#.

- b) In-process examination shall not be substituted for any required radiographic examination.
 - c) Number of radiographs per one circumferential weld shall be as per ASME Sec.V Articles 2 and 22.
6. When radiography or other non destructive inspection is specified, acceptance criteria for repairs or defects shall be as follows:
- a) In case of 100% examination, any unacceptable weld shall be repaired and reinspected.
 - b) If required random examination reveals a defect requiring repair, then:
 - b.1 Two additional examinations of same type shall be made of the same kind of item (if welded joint, then by the same welding procedure and same welder or welding operator).
 - b.2 If the group of items examined as required by b.1 above is acceptable, the items requiring repair shall be repaired or replaced and reexamined as required and all items represented by this additional examination shall be accepted.
 - b.3 If any of the items examined as required by b.1 above reveals a defect requiring repair, two further comparable items shall be examined for each defective item found by examination.
 - b.4 If all the items examined as required by b.3 are acceptable, the items requiring repair shall be repaired or replaced and reexamined as required, and all items represented by this further examination shall be accepted.
 - b.5 Number of times repair welding could be done for the same weld before acceptance shall be as follows:

Material	No. of times repair welding is allowed
C.S. upto 300 #	3 or less
C.S. above 300 #	2 or less
Killed steel	2 or less
Low alloy steel	2 or less
Austenitic S.S.	2 or less
3.5 Ni steel	2 or less
Al & Al base alloy	2 or less
Cu & Cu base alloy	2 or less
Others	2 or less

- b.6 Welds not found acceptable for allowed number of times of repair as per b.5 above shall be replaced and reexamined.
- b.7 If any of the items examined as required by b.4 above reveals a defect requiring repair, all items represented by these examinations shall be either:
- repaired or replaced and reexamined as required.
 - fully examined and repaired or replaced as necessary, and reexamined as necessary.

7. Hardness Test:

- a) Hardness test shall be in accordance with ASTM specification E10. Hardness tests of the heat affected zone shall be made at a point as near as practicable to the edge of the weld. One test per weld shall be performed.
- b) Hardness test where specifically called out in Table-1 of this specification or in PMS, shall be carried out irrespective of thickness and to the extent (%age) as mentioned therein.
- c) All welds which are given heat treatment shall be hardness tested. Hardness test shall be performed after final heat treatment.
- d) A minimum of 10% of welds, hot bends, and hot formed components in each furnace heat treated batch and 100% of those which are locally heat treated shall be hardness tested.
- e) Hardness test requirement not covered in this specification shall be as per Engineering Specifications.
- f) The hardness limit applies to the weld and heat affected zone. Following hardness values shall be maintained unless otherwise mentioned in Job specification :

Base Metal Group	Hardness (BHN/RC)
CS	200 BHN Max.
Cr Upto 2%	225BHN max.
Cr 2.25%-10%	241BHN max.
18/8 SS (NACE)	RC22 max.
9CR-1MO-V	190 BHN (min.)-250 BHN (max.)

- g) In case hardness values are mentioned in both Welding Specification Charts for Piping Classes, (B957-999-06-41-WSC-0001) & table given in Note-7(f), the lower of the two values shall be applicable.

8. For IBR service lines, following IBR requirements shall apply in addition to the notes 4, 5, 6, 7, 12 and Table 1. In case of conflict between above notes and these requirements, the more stringent ones shall apply. IBR piping shall be erected of IBR inspector approved material and

construction procedure. Erected piping shall be hydrotested, inspected and approved by IBR inspector.

a) Piping over 102 mm (4") bore:

10% of welds made by each welder on a pipeline with a minimum of two welds per welder, selected at random, shall be subjected to Radiography.

b) Piping 102 mm (4") bore and under, but not less than 38 mm (1-1/2") bore:

Two percent of welds made by each welder on a pipeline with a minimum of one weld per welder, selected at random, shall be subjected to Radiography or may be cut for visual examination and tests.

c) Piping less than 38 mm (1.5") bore:

Special tests are not normally required but 2% of welds by each welder on a pipe line may be cut out from the pipeline for the visual examination and bend tests.

d) Retests:

If any test specimen is unsatisfactory, two further weld specimens for retests shall be selected from the production welds and subjected to tests. In the event of failure of any retest specimens, the production welds carried out by this welder subsequent to the previous test shall be given special consideration.

9. For fabricated fittings LP test shall be done on the final pass of welding only, in addition to visual examination.
10. For mitres and fabricated reducers, LP / MP test shall be done on root pass in addition to Radiography applicable to circumferential joint of respective piping class.
11. For branch connections, LP/MP test shall be done on root pass and final pass.
12. 10% of the butt weld joints shall be radiographed, however, 50% of these butt weld joints shall be field weld joints.
13. For lined specs, testing (MP/LP/Radiography etc.) shall be performed before lining.
14. Digital/Close Proximity Radiography are also acceptable along with Conventional Radiography with prior approval of Owner/Engineer-in-charge. The same shall be performed in accordance with Welding Specification for Fabrication of Piping.
15. In place of Radiography, Automated Ultrasonic Testing (AUT) as per Welding specification for Fabrication of Piping is also acceptable subject to prior approval of Owner/Engineer-in-charge.
16. LP test is to be performed for Austenitic stainless steel, regardless of MP test specified.
17. For all fluid services, surfaces where attachment welds have been removed shall be visually examined and shall show no evidence of cracking, lack of fusion, or surface porosity.

Where temporary attachments are made on P-No. 4, P-No. 5A, P-No. 5B, and P-No. 15E materials, the surfaces shall also be examined by the MP/ LP methods.

18. All joints including butt weld joints for A16A, A61A, A62A, B16A and D16A and any other NACE classes shall be wet fluorescent magnetic particle tested. Percentage of wet fluorescent

magnetic particle testing of butt weld joints shall be 100% and this testing shall be in addition to radiography.

VENDOR DATA REQUIREMENTS FOR STEAM GENERATION SYSTEM

A	13-FEB-2025	ISSUED FOR TENDER	UC	CC	DG
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

VENDOR DATA REQUIREMENTS

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

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Document Control Index		✓		✓	Extent of Review / Records shall be finalized during DCI review.
2.	Drawings - Equipment Layout	✓	✓		✓	Plans and Elevations.
3.	Updated PMS & VMS based on EIL PMS/VMS		✓		✓	With change list
4.	Battery Limit Interface with valving arrangement		✓		✓	
5.	30% Stage 3D model review		✓		✓	
6.	60% Stage 3D model review		✓		✓	Reviewed 3D Models with Tag points resolution for 30% model reviews shall be provided for records.
7.	90% Stage 3D model review		✓		✓	Reviewed 3D Models with Tag points resolution for 60% model reviews shall be provided for records.
8.	IBR Package			✓	✓	
9.	Index of Lines for Flexibility Analysis indicating type of analysis required (i.e. Static, Dynamic, Wind, Seismic, etc.)		✓		✓	Contractor shall classify lines under review and records category
10.	Flexibility Analysis Reports with Caesar File, Stress isometrics marked with computer nodal points and support type, attaching all relevant P&IDs, line list, equipment drawings, vendor drawings / data. Reports for all types of analysis i.e. Static, Dynamic, seismic, wind analysis, Flange leakage, Relief valves etc.			✓	✓	Only for critical systems identified in flexibility analysis line index
11.	Piping Isometrics & GADs			✓	✓	
12.	As Built 3D-Model with complete editable data base				✓	
13.	As built isometrics & GADs				✓	
14.	Vendor Drawings (as specified)				✓	Vendor drawings for following items: 1. Expansion Bellow 2. Special Valves (except Gate / Globe / Check) 3. Any other special items
15.	Piping support standard/Special pipe supports			✓	✓	
16.	As Built IBR Package				✓	
17.	As Built Job specific sketches/ drawings				✓	
18.	As built Equipment Layout				✓	

Notes :

1. "TICK" denotes applicability.
2. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
3. All post order documents shall be submitted / approved through EIL eDMS portal.
4. Refer - 6-78-0001: Specification for quality management system from Bidders.
5. Refer - 6-78-0002: Specification for documentation requirements from Contractors.
6. All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
7. Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
8. Bill of Material shall form part of the respective drawing.
9. Final documentation shall be submitted in hard copy (Six prints) and soft copies in Hard drive in addition to submission through EIL eDMS.
10. OWNER / EIL reserves the right to change the category of documents from review to records & vice-versa at any stage
11. OWNER/EIL may add any other Drawing/Document in this list based on the project requirements at any stage.

TECHNICAL COMPLIANCE FORMAT (PIPING) STEAM GENERATION SYSTEM TENDER NO. – B957-420-80-44-PG-T-7410

PROJECT : BINA PETROCHEMICAL AND REFINERY
EXPANSION PROJECT, BEPREP

UNIT : OFFSITES

OWNER : BPCL (India) LTD.

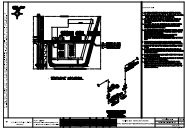
LOCATION : BPREP, BINA, INDIA

JOB NO. : B957

A	29-01-2025	ISSUED FOR BIDS	UC	CC	DG
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

S. NO	COMPLIANCE STATEMENT / QUERY	BIDDER'S CONFIRMATION / ANSWER
1.	Bidder is informed that the detailed offer for piping i.e. any drawings, documents, data sheets, is not required at the stage of bidding and shall not be reviewed or taken cognizance of at this stage. Accordingly, the bidder shall furnish only the following documents along with the bid: a) This Technical Compliance with categorical confirmation against each of the clauses b) Deviation, if any, against the scope of work & supply, Piping design basis, PMS & other applicable specifications and Codes shall be duly consolidated at one place only. (Under Exceptions / Déviations List). In case no deviations are furnished, it shall be construed that Bidder's proposal is in total compliance to Bid document requirements.	
2.	Any deviations/deletions/corrections made elsewhere in the body of the bid document, will not be taken cognizance of and all such deviations shall be deemed to have been withdrawn by the bidder. Bidder to confirm Compliance.	
3.	Confirm that Erection & Commissioning Spares as required for Piping have been included by the bidder in his proposal.	
4.	a) Bidder to read and understand Piping Material Specifications & details of Valves given by EIL and confirm compliance. b) Bidder to confirm that the requirement of updation of piping material specification and preparation of valve material specification described have been understood. c) Bidder to read and understand the specifications attached with the bid document under relevant sections as well as described in the bid document. Bidder to confirm compliance. d) Bidder to confirm compliance to Piping design basis (B857-999-16-43-EDB-1001)	
5.	All piping materials shall be procured from OWNER/EIL approved vendor list for piping items. Specific OWNER / EIL approval shall be obtained in advance for vendors proposed by Bidder for items for which no vendor list is available. Bidder to confirm compliance.	
6.	Bidder to confirm that the scope and requirements of 3-D modeling as described in the bid document is properly understood. Bidder to confirm compliance.	
7.	Bidder to confirm that specifications in PMS and Piping Design Basis for purchase of piping items is properly understood. This shall be the basis for bidder's detailed specification for procurement. Bidder to confirm compliance.	

S. NO	COMPLIANCE STATEMENT / QUERY	BIDDER'S CONFIRMATION / ANSWER
8.	Bidder undertakes to furnish schedule of submission of drawings and documents and schedule of inputs required for review during kick-off meeting. Delay in review of these drawings / documents due to non-adherence to the agreed schedule or not following sequential submission as specified in the bid document shall be the contractor's responsibility. Bidder to confirm compliance.	
9.	Bidder to note that the battery limit for above ground piping facility shall be as per Scope Drawing for Piping B/L in Steam Generation System (Document No. (B957-420-16-43-SK-7410, Scope of Work & Supply (Document No. B957-420-16-43-SOW-7410) and P&IDs. Bidder to confirm compliance.	



PIPING MATERIAL SPECIFICATION

Spec Name : B957-420-6-44-0005-7410

Spec Desc. : LSTK-PMS

Client : BPCL

Project : MPMC & EPCM-1 FOR BPREP

Location : BINA, MADHYA PRADESH

Job No. : B957

Dept/Sec. : 16/43

D	31-01-2025	ISSUED FOR TENDER	SV/SRG	PK	SNH
C	03-12-2024	ISSUED FOR COMMENTS	SV/SRG	PK	SNH
B	22-08-2024	ISSUED FOR COMMENTS	ABA	PK	SNH
A	13-08-2024	ISSUED FOR COMMENTS	ABA	PK	SNH

Rev.no	Date	Purpose	Prepared by	Checked by	Approved by

Abbreviations :

PMS : Piping Material Specifications

M : Matching (Schedule/ Thickness)

IBR : Indian Boiler Regulations

NACE : National Association of Corrosion Engineers

HDPE : High Density Poly Ethylene

NDT : Non Destructive Testing

PE : Plain End

BE : Bevel End

PBE : Plain Both Ends

ASTM : American Society for Testing & Materials

API : American Petroleum Institute

ASME : American Society of Mechanical Engineers

SW : Socket Weld

BW : Butt Weld

BHN : Brinell Hardness Number

MP Test: Magnetic Particle Test

CONTENTS

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2	Annexure-I, Job Piping Material Specification General Notes, (B957-6-44-0005-A1) REV.D	21

Client :	BPCL	Dept./Sect :	16/43
Project :	MPMC & EPCM-1 FOR BPREP		
Location	BINA, MADHYA PRADESH		

PIPING MATERIAL SPECIFICATION INDEX

Sl. No.	Piping Class	Rating	C.A.	Spl. Reqt.	Basic Material	Service	Remarks
1	A1A	150	1.50		CARBON STEEL	NON CORROSIVE/ FLAMMABLE / NON FLAMMABLE/ NON LETHAL -PROCESS & HYDROCARBONS; FUEL GAS, HYDROCARBON FLARE ; LUBE OIL BEFORE FILTER; AMMONIA, STEAM & CONDENSATE (NON IBR); UTILITIES- INST AIR (BEYOND A3A IN OFFSITES DISTRIBUTION), OWS (PRESSURIZED), PLANT AIR, NITROGEN, CARBONDIOXIDE, ; WATER - BEYOND A3A, DECOKING AIR, MINERAL OIL, PROCESS AIR, REGENERATION NITROGEN.	ECU (A1B & H1A), PPU (LGP04, LGP06, LGP07, LPU32 & LPU86) & UNIVATION SWING (1C2, 1C13 & 1C15)
2	A1K	150	0.00		SS 304	PURE NON CORROSIVE OR MILD CORROSIVE HYDROCARBONS FLAMMABLE/NON FLAMMABLE & NON LETHAL HYDROCARBONS, LUBE OIL (AFTER FILTERS), CHEMICALS ETC., NITROGEN, INSTRUMENT AIR, DRINKING WATER (BEYOND CAT-'D' WITHIN UNITS & OFFSITE PACKAGES)	ECU (H3A), PPU (LES76) & UNIVATION SWING (6C1)
3	A2A	150	1.50	IBR SERVICE	CARBON STEEL	STEAM (IBR), BOILER FEED WATER (IBR) & CONDENSATE (IBR)	ECU (A1A) & PPU (LPU02)
4	A3A	150	1.50		CARBON STEEL	NON CORROSIVE UTILITIES (ABOVE GROUND) CATEGORY "D" FLUID - COOLING WATER, INSTRUMENT AIR (2" & ABOVE-IN OFFSITES DISTRIBUTION), PLANT AIR, INERT GAS, CARBON DI OXIDE (DRY), NITROGEN, CONDENSATE & BOILER FEED SUCTION (NON IBR), CRWS/ SS/ VENT (A/G). THIS CLASS DOES NOT COVER UNDERGROUND PIPING AND THE FIRE WATER SERVICE.	ECU (H1A), PPU (LPU32 & LPU86) & UNIVATION SWING (1C13)
5	B1A	300	1.50		CARBON STEEL	NON CORROSIVE PROCESS - FLAMMABLE / NON FLAMMABLE, NON LETHAL - HYDROCARBONS, AROMATICS, AMMONIA, SWEET GAS, FLUSHING OIL AND OTHER UTILITIES -MP CONDENSATE, INSTRUMENT AIR (OFFSITES), PLANT AIR, NITROGEN, AMMONIA GAS, NITROGEN-HIGH TEMPERATURE ETC. ABOVE CLASS 'A1A'.	ECU (B1B), PPU (LGP18 & LGP26) & UNIVATION SWING (1C2, 1E3 & 1E21)
6	F2A	1500	1.50	IBR SERVICE	CARBON STEEL	STEAM AND BOILER FEED WATER (IBR), CONDENSATE (IBR)	ECU (F1A)

Client :	BPCL	Dept./Sect :	16/43
Project :	MPMC & EPCM-1 FOR BPREP		
Location	BINA, MADHYA PRADESH		

PIPING MATERIAL SPECIFICATION INDEX

Sl. No.	Piping Class	Rating	C.A.	Spl. Reqt.	Basic Material	Service	Remarks
7	F2G	1500	1.50	IBR SERVICE	9CR-1MO-V	VERY HIGH PRESSURE STEAM (IBR)	

- Notes :**
1. For PMS General notes refer Annexure -I of this document
 2. For PMS Extracts refer Annexure -II of this document

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A1A

PIPE CLASS : **A1A**
RATING : 150
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 1.50 MM
SPECIAL REQUIREMENT :

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP.	-29	38	93	149	204	260	316	343	371
PRESS	20.03	20.03	18.28	16.17	14.06	11.95	9.84	8.78	7.73

SERVICE

NON CORROSIVE/ FLAMMABLE / NON FLAMMABLE/ NON LETHAL -PROCESS & HYDROCARBONS; FUEL GAS, HYDROCARBON FLARE ; LUBE OIL BEFORE FILTER; AMMONIA, STEAM & CONDENSATE (NON IBR); UTILITIES- INST AIR(BEYOND A3A IN OFFSITES DISTRIBUTION), OWS (PRESSURIZED), PLANT AIR, NITROGEN, CARBONDIOXIDE, ; WATER - BEYOND A3A, DECOKING AIR, MINERAL OIL, PROCESS AIR, REGENERATION NITROGEN.

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A1A

NOTES

- 5 FOR PERMANENT 'T' TYPE BW STRAINERS,REFER EIL/STD 7-44-0303 & 7-44-0304; AND FOR TEMPORARY STRAINERS,REFER EIL/STD 7-44-0300; FOR SPACER AND BLIND REFER EIL/STD 7-44-0162.
- 7 FOR RESTRICTION ON USE OF BALL,PLUG & BUTTERFLY VALVES,REFER GENERAL NOTES.
- 36 THIS IS A PRESSURE BALANCED PLUG VALVES WHICH SHALL BE USED ONLY IF SPECIFIED IN P&ID.
- 92 GATE VALVES OF SIZE 26" AND ABOVE SHALL BE IN ACCORDANCE WITH B-16.34 AND FLANGE ENDS SHALL BE IN ACCORDANCE WITH ASME B16.47 SERIES B.
- 151 NDT REQUIREMENTS AS PER JOB SPECIFICATION B957-6-44-0016
- 954 VALVE TO BE USED FOR VENT AND DRAIN PURPOSE ONLY, IF MENTIONED IN PROCESS DESIGN PACKAGE OR P&ID.
- 961 FOR LICENSOR SPECIFICATION LGP04 IN PPU, FOR SIZE RANGE 0.75" TO 1.5": STR-361 & FOR 2" TO 8"-STR-351 IS TO BE FOLLOWED FOR STRAINERS. SEE LPPF-8 INCLUDED IN THE SUPPLEMENT TO PROCESS PARTS, VOLUME 2, SECTION IX-2 FOR STRAINER SPECIFICATIONS.
- 962 FOR LICENSOR SPECIFICATIONS LGP06 & LGP07 IN PPU, FOR SIZE RANGE 0.75" TO 1.5": STR-366 & FOR 2" TO 12"-STR-351 IS TO BE FOLLOWED FOR STRAINERS. SEE LPPF-8 INCLUDED IN THE SUPPLEMENT TO PROCESS PARTS, VOLUME 2, SECTION IX-2 FOR STRAINER SPECIFICATIONS.
- 967 FOR PPU UNIT-THIS SPECIFICATION IS RATED FOR NON-CRITICAL VACUUM CONDITIONS. BUT VALVES ARE NOT VACUUM PREPARED OR SUITABLE BY DESIGN FOR CRITICAL VACUUM AND MAY ALLOW LEAKAGE INTO THE SYSTEM.
- 968 FOR PPU UNIT, LINE CONDITIONS SHALL BE CHECKED FOR VACUUM. IF VACUUM CONDITIONS ARE APPLICABLE, STIFFENER RINGS, IF NEEDED, SHALL BE PROVIDED AS PER ASME SEC. VIII, DIV. 1.
- 969 FOR PPU UNIT, LINE CONDITIONS SHALL BE CHECKED FOR VACUUM. IF VACUUM CONDITIONS ARE APPLICABLE, VALVE TO BE TESTED FOR VACUUM AS PER ASME V, SUBSECTION-A, ARTICLE 10 (HOOD METHOD) APPENDIX IX TO CHECK SUITABILITY FOR VACUUM SERVICE.
- 992 FOR LICENSOR SPECIFICATIONS 1C2 IN UNIVATION, FOR SIZE RANGE 0.5" TO 0.75": STR-361, FOR 1" TO 1.5"-STR-366 & FOR 2" TO 12" : STR-351 IS TO BE FOLLOWED FOR STRAINERS. REFER PPF-8 FOR STRAINER SPECIFICATIONS.
- 993 FOR LICENSOR SPECIFICATIONS 1C13 IN UNIVATION, FOR SIZE RANGE 0.5" TO 0.75": STR-361, FOR 1" TO 1.5"-STR-366 & FOR 2" TO 12" : STR-351 IS TO BE FOLLOWED FOR STRAINERS. REFER PPF-8 FOR STRAINER SPECIFICATIONS.
- 994 FOR LICENSOR SPECIFICATIONS 1C15 IN UNIVATION, FOR SIZE RANGE 0.5" TO 1.5": STR-366 & FOR 2" TO 10" : STR-354 (20 MESH) IS TO BE FOLLOWED FOR STRAINERS. REFER PPF-8 FOR STRAINER SPECIFICATIONS.
- 997 PMS FOR LLDPE/HDPE SWING UNIT SHALL BE READ IN CONJUNCTION WITH LICENSOR PMS

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A1A

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER EILSTD 7-44-0350, DF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD. 7-44-0351, D4	
VENTS	ON LINES <= 1.5"	REFER EIL STD. 7-44-0350, VF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD 7-44-0351, V4	
TEMP.CONN	1.5"	FLANGED. REFER EIL STD 7-44-0353	
PRESS.CONN	0.75"	SW NIPPLE WITH VALVE TO SPEC AS PER EIL STD 7-44-0354	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A1A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	1.00	1.50	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	2.00	2.00	XS	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z0	
PIP	PIPE	3.00	14.00	STD	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z0	
PIP	PIPE	16.00	36.00	STD	B-36.10	ASTM A 672 GR.B60 CL.12	BE, E.FS.W	PI2A813Z0	
PIP	PIPE	40.00	48.00	XS	B-36.10	ASTM A 672 GR.B60 CL.12	BE, E.FS.W	PI2A813Z0	
NIP	NIPPLE	0.50	0.75	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
NIP	NIPPLE	1.00	1.50	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
Flange Group									
FLG/300	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 105	300, RF/125AARH	FSC0147Z0	
FLG	FLNG.WN	0.50	24.00	M	B-16.5	ASTM A 105	150, RF/125AARH	FWC0127Z0	
FLG	FLNG.WN	26.00	48.00	M	B-16.47-B	ASTM A 105	150, RF/125AARH	FWB0127Z0	
FLG/300	FLNG.WN	26.00	48.00	M	B-16.47-B	ASTM A 105	300, RF/125AARH	FWB0147Z0	
FLG/300	FLNG.WN	2.00	24.00	M	B-16.5	ASTM A 105	300, RF/125AARH	FWC0147Z0	
FLB	FLNG.BLIND	0.50	24.00		B-16.5	ASTM A 105	150, RF/125AARH	FBC0127Z0	
FLB	FLNG.BLIND	26.00	48.00		B-16.47-B	ASTM A 105	150, RF/125AARH	FBB0127Z0	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FGK0121Z0	
FEF	SPCR&BLND	10.00	24.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FCK0121Z0	
FEF	SPCR&BLND	26.00	48.00		ASME B16.47B/EIL/STD	ASTM A 516 GR.70	150, FF/125AARH	FCU6321Z0	
Fitting Group									
ELB90	ELBOW.90	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WA602D3Z0	
ELB90	ELBOW.90	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WA602D2Z0	
ELB90	ELBOW.90	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WAG684Z10	
ELB90	ELBOW.90	16.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z10	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A1A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
ELB45	ELBOW.45	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WB602D3Z0	
ELB45	ELBOW.45	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WB602D2Z0	
ELB45	ELBOW.45	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WBG684Z10	
ELB45	ELBOW.45	16.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WBG754Z10	
TEQ	T.EQUAL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WE602D3Z0	
TEQ	T.EQUAL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WE602D2Z0	
TEQ	T.EQUAL	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ0	
TEQ	T.EQUAL	16.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW	WEG754ZZ0	
TRED	T.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WR602D3Z0	
TRED	T.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WR602D2Z0	
TRED	T.RED	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ0	
TRED	T.RED	16.00	48.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WRG754ZZ0	
REDC	REDUC.CONC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ0	
REDC	REDUC.CONC	16.00	48.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WUG754ZZ0	
REDE	REDUC.ECC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ0	
REDE	REDUC.ECC	16.00	48.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WVG754ZZ0	
SWGC	SWAGE.CONC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WNH026ZZ0	
SWGE	SWAGE.ECC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WPH026ZZ0	
CAP	CAP	2.00	48.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CPLF	CPLNG.FULL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WJ602D3Z0	
CPLF	CPLNG.FULL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WJ602D2Z0	
CPLH	CPLNG.HALF	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WK602D3Z0	
CPLH	CPLNG.HALF	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WK602D2Z0	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A1A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
CPLL	CPLNG.LH	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WL602D3Z0	
CPLL	CPLNG.LH	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WL602D2Z0	
CPLR	CPLNG.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WM602D3Z0	
CPLR	CPLNG.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WM602D2Z0	
Valves Group									
GAV	VLV.GATE	0.25	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED,ST EM-13%CR.STEEL	SW, 800, 3000, B-16.11, SHT NO.-51001	51001ZZZ0	
GAV	VLV.GATE	2.00	42.00		API 600/ ISO 10434	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -51301	51301ZZZ0	92
GLV	VLV.GLOBE	0.25	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED,ST EM-13%CR STEEL	SW, 800, 3000, B-16.11, SHT NO.-52001	52001ZZZ0	
GLV	VLV.GLOBE	2.00	16.00		BS-1873	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -52301	52301ZZZ0	
CHV	VLV.CHECK	0.25	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO.-53001	53001ZZZ0	
CHV	VLV.CHECK	2.00	24.00		BS 1868	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -53301	53301ZZZ0	
BLV	VLV.BALL	0.50	16.00		BS EN ISO 17292	BODY-ASTM A 105 / A 216GR.WCB, TRIM-BODY SEAT-RPTFE	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -54301	54301ZZZ0	
PLV	VLV.PLUG	0.50	24.00		BS-5353	BODY-ASTM A 105 / A 216GR.WCB, TRIM-PLUG-HARDE NED	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -55301	55301ZZZ0	
PLV/1	VLV.PLUG	0.50	36.00		BS-5353	BODY-ASTM A 105 / A 216GR.WCB, TRIM-PLUG-HARDE NED	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -55315	55315ZZZ0	36
BFV	VLV.BTRFLY	3.00	24.00		BS EN 593	BODY-ASTM A 216 GR.WCB, TRIM-13% CR.STEEL	WAFI, 150, B-16.5, WAF/125AARH, SHT NO.-56301	56301ZZZ0	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A1A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Valves Group									
BFV	VLV.BTRFLY	26.00	48.00		BS EN 593	BODY-ASTM A 216 GR.WCB, TRIM-13% CR.STEEL	FLGD, 150, B-16.47 B, RF/125AARH, SHT NO. -56315	56315ZZZ0	
Bolt Group									
BOS	BOLT.STUD	0.50	48.00		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 150	GK66272Z0	
GAS	GASKET	26.00	48.00		B-16.20-ANSI B16.47B	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 150	GK56272Z0	
GAS/300	GASKET	26.00	48.00		B-16.20-ANSI B16.47B	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 300	GK56274Z0	
GAS/300	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 300	GK66274Z0	
Trap/Strainer Group									
TRP	TRAP.STEAM	0.50	1.50		MNF'STD	B:A105;T:13%CR;S:SS 304	FLGD, THRM DNMC, 150,RF/125AARH	TR3065530	
TSR	STRNR.TEMP	1.50	24.00		EIL'STD	B:A516GR.70;INT:SS3 04	CONETYPE, 150,FF/125AARH	ST16831Z0	
PSR	STRNR.PERM	0.50	1.50		MNF'STD	B:A105;INT:SS304	SW, Y-TYPE, 800	SP303D510	
PSR	STRNR.PERM	2.00	14.00	M	EIL'STD	B:A234GR.WPB;INT:S S304	BW, T-TYPE	SP13344Z0	
PSR	STRNR.PERM	16.00	24.00	M	EIL'STD	B:A234GR.WPBW;IN T:SS304	BW, T-TYPE	SP13644Z0	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A1K

PIPE CLASS : **A1K**
 RATING : 150
 BASE MATERIAL : SS 304
 CORROSION ALLOWANCE : 0.00 MM
 SPECIAL REQUIREMENT :

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP.	-29	38	93	149	204	260	316	343	371
PRESS	19.33	19.33	16.17	14.41	13.35	11.95	9.84	8.78	7.73

SERVICE

PURE NON CORROSIVE OR MILD CORROSIVE HYDROCARBONS
 FLAMMABLE/NON FLAMMABLE & NON LETHAL HYDROCARBONS, LUBE OIL (AFTER FILTERS), CHEMICALS
 ETC., NITROGEN, INSTRUMENT AIR, DRINKING WATER(BEYOND CAT-'D' WITHIN UNITS & OFFSITE PACKAGES)

NOTES

- 5 FOR PERMANENT 'T' TYPE BW STRAINERS,REFER EIL'STD 7-44-0303 & 7-44-0304; AND FOR TEMPORARY STRAINERS,REFER EIL'STD 7-44-0300; FOR SPACER AND BLIND REFER EIL'STD 7-44-0162.
- 7 FOR RESTRICTION ON USE OF BALL,PLUG & BUTTERFLY VALVES,REFER GENERAL NOTES.
- 151 NDT REQUIREMENTS AS PER JOB SPECIFICATION B957-6-44-0016
- 996 FOR LICENSOR SPECIFICATIONS 6C1 IN UNIVATION, FOR SIZE RANGE 0.5" TO 0.75": STR-415 & FOR 1" TO 10": STR-406 IS TO BE FOLLOWED FOR STRAINERS. REFER PPF-8 FOR STRAINER SPECIFICATIONS.
- 997 PMS FOR LLDPE/HDPE SWING UNIT SHALL BE READ IN CONJUNCTION WITH LICENSOR PMS

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER EILSTD 7-44-0350, DF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD. 7-44-0351, D4	
VENTS	ON LINES <= 1.5"	REFER EIL STD. 7-44-0350, VF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD 7-44-0351, V4	
TEMP.CONN	1.5"	FLANGED. REFER EIL STD 7-44-0353	
PRESS.CONN	0.75"	SW NIPPLE WITH VALVE TO SPEC AS PER EIL STD 7-44-0354	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A1K

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	80S	B-36.19	ASTM A 312 TP304	PE, SEAMLESS	PI33577Z0	
PIP	PIPE	1.00	1.50	40S	B-36.19	ASTM A 312 TP304	PE, SEAMLESS	PI33577Z0	
PIP	PIPE	2.00	2.00	40S	B-36.19	ASTM A 312 TP304	BE, SEAMLESS	PI33517Z0	
PIP	PIPE	3.00	8.00	10S	B-36.19	ASTM A 312 TP304	BE, SEAMLESS	PI33517Z0	
PIP	PIPE	10.00	24.00	10S	B-36.19	ASTM A 358 TP304 CL.1	BE, E.FS.W	PI35513Z0	
NIP	NIPPLE	0.50	0.75	M	B-36.19	ASTM A 312 TP304	PBE, SEAMLESS	PN33567Z0	
NIP	NIPPLE	1.00	1.50	M	B-36.19	ASTM A 312 TP304	PBE, SEAMLESS	PN33567Z0	
Flange Group									
FLG/300	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 182 GR.F304	300, RF/125AARH	FSC4147Z0	
FLG	FLNG.WN	0.50	24.00	M	B-16.5	ASTM A 182 GR.F304	150, RF/125AARH	FWC4127Z0	
FLG/300	FLNG.WN	2.00	24.00	M	B-16.5	ASTM A 182 GR.F304	300, RF/125AARH	FWC4147Z0	
FLB	FLNG.BLIND	0.50	24.00		B-16.5	ASTM A 182 GR.F304	150, RF/125AARH	FBC4127Z0	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A 182 GR.F304	150, FF/125AARH	FGK4121Z0	
FEF	SPCR&BLND	10.00	24.00		ASME-B16.48	ASTM A 182 GR.F304	150, FF/125AARH	FCK4121Z0	
Fitting Group									
ELB90	ELBOW.90	0.50	1.50		B-16.11	ASTM A 182 GR.F304	SW, 3000	WA642D2Z0	
ELB90	ELBOW.90	2.00	8.00	M	B-16.9	ASTM A 403 GR.WP304-S	BW, 1.5D	WAG874Z10	
ELB90	ELBOW.90	10.00	24.00	M	B-16.9	ASTM A 403 GR.WP304-WX	BW, 1.5D	WAG894Z10	
ELB45	ELBOW.45	0.50	1.50		B-16.11	ASTM A 182 GR.F304	SW, 3000	WB642D2Z0	
ELB45	ELBOW.45	2.00	8.00	M	B-16.9	ASTM A 403 GR.WP304-S	BW, 1.5D	WBG874Z10	
ELB45	ELBOW.45	10.00	24.00	M	B-16.9	ASTM A 403 GR.WP304-WX	BW, 1.5D	WBG894Z10	
TEQ	T.EQUAL	0.50	1.50		B-16.11	ASTM A 182 GR.F304	SW, 3000	WE642D2Z0	
TEQ	T.EQUAL	2.00	8.00	M	B-16.9	ASTM A 403 GR.WP304-S	BW	WEG874ZZ0	
TEQ	T.EQUAL	10.00	24.00	M	B-16.9	ASTM A 403 GR.WP304-WX	BW	WEG894ZZ0	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A1K

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
TRED	T.RED	0.50	1.50		B-16.11	ASTM A 182 GR.F304	SW, 3000	WR642D2Z0	
TRED	T.RED	2.00	8.00	M, M	B-16.9	ASTM A 403 GR.WP304-S	BW	WRG874ZZ0	
TRED	T.RED	10.00	24.00	M, M	B-16.9	ASTM A 403 GR.WP304-WX	BW	WRG894ZZ0	
REDC	REDUC.CONC	2.00	8.00	M, M	B-16.9	ASTM A 403 GR.WP304-S	BW	WUG874ZZ0	
REDC	REDUC.CONC	10.00	24.00	M, M	B-16.9	ASTM A 403 GR.WP304-WX	BW	WUG894ZZ0	
REDE	REDUC.ECC	2.00	8.00	M, M	B-16.9	ASTM A 403 GR.WP304-S	BW	WVG874ZZ0	
REDE	REDUC.ECC	10.00	24.00	M, M	B-16.9	ASTM A 403 GR.WP304-WX	BW	WVG894ZZ0	
SWGC	SWAGE.CONC	0.50	3.00	M, M	BS-3799	ASTM A 182 GR.F304	PBE	WNH426ZZ0	
SWGE	SWAGE.ECC	0.50	3.00	M, M	BS-3799	ASTM A 182 GR.F304	PBE	WPH426ZZ0	
CAP	CAP	2.00	24.00	M	B-16.9	ASTM A 403 GR.WP304-S	BW	WFG874ZZ0	
CPLF	CPLNG.FULL	0.50	1.50		B-16.11	ASTM A 182 GR.F304	SW, 3000	WJ642D2Z0	
CPLH	CPLNG.HALF	0.50	1.50		B-16.11	ASTM A 182 GR.F304	SW, 3000	WK642D2Z0	
CPLL	CPLNG.LH	0.50	1.50		B-16.11	ASTM A 182 GR.F304	SW, 3000	WL642D2Z0	
CPLR	CPLNG.RED	0.50	1.50		B-16.11	ASTM A 182 GR.F304	SW, 3000	WM642D2Z0	
Valves Group									
GAV	VLV.GATE	0.50	1.50		API 602/ ISO 15761	BODY-ASTM A 182 GR.F316, TRIM-STELLITED,ST EM-SS 316	SW, 800, 3000, B-16.11, SHT NO.-51061	51061ZZZ0	
GAV	VLV.GATE	2.00	24.00		API 600/ ISO 10434	BODY-ASTM A 351 GR.CF8M, TRIM-SS 316	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -51361	51361ZZZ0	
GLV	VLV.GLOBE	0.50	1.50		API 602/ ISO 15761	BODY-ASTM A 182 GR.F316, TRIM-STELLITED,ST EM-SS 316	SW, 800, 3000, B-16.11, SHT NO.-52061	52061ZZZ0	
GLV	VLV.GLOBE	2.00	16.00		BS-1873	BODY-ASTM A 351 GR.CF8M, TRIM-SS 316	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -52361	52361ZZZ0	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A1K

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Valves Group									
CHV	VLV.CHECK	0.50	1.50		API 602/ ISO 15761	BODY-ASTM A 182 GR.F316, TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO.-53061	53061ZZZ0	
CHV	VLV.CHECK	2.00	24.00		BS-1868	BODY-ASTM A 351 GR.CF8M, TRIM-SS 316	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -53361	53361ZZZ0	
BLV	VLV.BALL	0.50	16.00		BS EN ISO 17292	BODY-ASTM A 351 GR.CF8M / ASTM A 182 GR.F316,	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -54361	54361ZZZ0	
Bolt Group									
BOS	BOLT.STUD	0.50	24.00		B-18.2	BOLT:A193 GR.B7(HDG), NUT:A194 GR.2H(HDG)		BS43927Z0	
Gasket Group									
GAS	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 150	GK66272Z0	
GAS/300	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 300	GK66274Z0	
Trap/Strainer Group									
TSR	STRNR.TEMP	1.50	24.00		EIL/STD	B:A240TP304;INT:SS304	CONETYPE , 150,FF/125AARH	ST14131Z0	
PSR	STRNR.PERM	0.50	1.50		MNF/STD	B:A182GR.F304;INT:S S304	SW, Y-TYPE, 800	SP307D510	
PSR	STRNR.PERM	2.00	8.00	M	EIL/STD	B:A403GR.WP304-S;I NT:SS304	BW, T-TYPE	SP15344Z0	
PSR	STRNR.PERM	10.00	24.00	M	EIL/STD	B:A403GR.WP304-WX ;INT:SS304	BW, T-TYPE	SP15444Z0	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A2A

PIPE CLASS : **A2A**
 RATING : 150
 BASE MATERIAL : CARBON STEEL
 CORROSION ALLOWANCE : 1.50 MM
 SPECIAL REQUIREMENT : IBR SERVICE

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP.	0	38	93	149	204	260	280	300	371
PRESS	20.03	20.03	18.28	16.17	14.06	11.95	11.19	10.44	7.73

SERVICE

STEAM (IBR), BOILER FEED WATER (IBR) & CONDENSATE (IBR)

NOTES

- 5 FOR PERMANENT 'T' TYPE BW STRAINERS,REFER EIL/STD 7-44-0303 & 7-44-0304; AND FOR TEMPORARY STRAINERS,REFER EIL/STD 7-44-0300; FOR SPACER AND BLIND REFER EIL/STD 7-44-0162.
- 7 FOR RESTRICTION ON USE OF BALL,PLUG & BUTTERFLY VALVES,REFER GENERAL NOTES.
- 8 ALL PIPES,FITTINGS,VALVES,FLANGES,TRAPS AND STRAINERS SHALL BE TESTED AND TEST CERTIFICATE IN FORM III A FOR PIPE AND FORM III C FOR OTHERS SHALL BE REQD. DULY COUNTERSIGNED BY IBR AUTHORITY OR ITS APPROVED REPRESENTATIVE.
- 9 CARBON CONTENT SHALL NOT EXCEED 0.25% FOR ALL PIPES,FITTINGS FLANGES ETC. THAT MAY REQUIRE WELDING. MOREOVER,FOR FLANGES THE SULPHUR AND PHOSPHOROUS SHALL ALSO BE LIMITED TO 0.05% EACH.
- 92 GATE VALVES OF SIZE 26" AND ABOVE SHALL BE IN ACCORDANCE WITH B-16.34 AND FLANGE ENDS SHALL BE IN ACCORDANCE WITH ASME B16.47 SERIES B.
- 151 NDT REQUIREMENTS AS PER JOB SPECIFICATION B957-6-44-0016

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER EILSTD 7-44-0350, DF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD. 7-44-0351, D4	
VENTS	ON LINES <= 1.5"	REFER EIL STD. 7-44-0350, VF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD 7-44-0351, V4	
TEMP.CONN	1.5"	FLANGED. REFER EIL STD 7-44-0353	
PRESS.CONN	0.75"	SW NIPPLE WITH VALVE TO SPEC AS PER EIL STD 7-44-0354	

BRANCH PIPE (SIZE IN INCHES)

<u>CODE</u>	<u>DESCRIPTION</u>				
F	SADDLE FUSED JT	T	TEES	J	THREAOLET
H	H.COUPLING	W	WELDOLETS	N	NIPPOLET
P	PIPE TO PIPE	I	INSTRUMENT TEE	U	UNLISTED B31.3 COMP
R	REINFORCED	X	REFER NOTES		
S	SOCKOLETS	L	SWEEPOLET		

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A2A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z1	
PIP	PIPE	1.00	1.50	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z1	
PIP	PIPE	2.00	2.00	XS	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	
PIP	PIPE	3.00	14.00	STD	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	
PIP	PIPE	16.00	36.00	STD	B-36.10	ASTM A 672 GR.B60 CL.12	BE, E.FS.W	PI2A813Z1	
PIP	PIPE	38.00	48.00	XS	B-36.10	ASTM A 672 GR.B60 CL.12	BE, E.FS.W	PI2A813Z1	
NIP	NIPPLE	0.50	0.75	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z1	
NIP	NIPPLE	1.00	1.50	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z1	
Flange Group									
FLG/300	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 105	300, RF/125AARH	FSC0147Z1	
FLG	FLNG.WN	0.50	1.50	M	B-16.5	ASTM A 105	150, RF/125AARH	FWC0127Z1	
FLG	FLNG.WN	2.00	24.00	M	B-16.5	ASTM A 105	150, RF/125AARH	FWC0127Z1	
FLG	FLNG.WN	26.00	48.00	M	B-16.47-B	ASTM A 105	150, RF/125AARH	FWB0127Z1	
FLG/300	FLNG.WN	26.00	48.00	M	B-16.47-B	ASTM A 105	300, RF/125AARH	FWB0147Z1	
FLG/300	FLNG.WN	2.00	24.00	M	B-16.5	ASTM A 105	300, RF/125AARH	FWC0147Z1	
FLB	FLNG.BLIND	0.50	24.00		B-16.5	ASTM A 105	150, RF/125AARH	FBC0127Z1	
FLB	FLNG.BLIND	26.00	48.00		B-16.47-B	ASTM A 105	150, RF/125AARH	FBF0127Z1	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FGK0121Z1	
FEF	SPCR&BLND	10.00	24.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FCK0121Z1	
FEF	SPCR&BLND	26.00	48.00		ASME B16.47B/EIL/ST D	ASTM A 516 GR.70	150, FF/125AARH	FCU6321Z1	
Fitting Group									
ELB90	ELBOW.90	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WA602D3Z1	
ELB90	ELBOW.90	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WA602D2Z1	
ELB90	ELBOW.90	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WAG684Z11	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A2A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
ELB90	ELBOW.90	16.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z11	
ELB45	ELBOW.45	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WB602D3Z1	
ELB45	ELBOW.45	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WB602D2Z1	
ELB45	ELBOW.45	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WBG684Z11	
ELB45	ELBOW.45	16.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WBG754Z11	
TEQ	T.EQUAL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WE602D3Z1	
TEQ	T.EQUAL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WE602D2Z1	
TEQ	T.EQUAL	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ1	
TEQ	T.EQUAL	16.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW	WEG754ZZ1	
TRED	T.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WR602D3Z1	
TRED	T.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WR602D2Z1	
TRED	T.RED	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ1	
TRED	T.RED	16.00	48.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WRG754ZZ1	
REDC	REDUC.CONC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ1	
REDC	REDUC.CONC	16.00	48.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WUG754ZZ1	
REDE	REDUC.ECC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ1	
REDE	REDUC.ECC	16.00	48.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WVG754ZZ1	
SWGC	SWAGE.CONC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WNH026ZZ1	
SWGE	SWAGE.ECC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WPH026ZZ1	
CAP	CAP	2.00	48.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ1	
CPLF	CPLNG.FULL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WJ602D3Z1	
CPLF	CPLNG.FULL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WJ602D2Z1	
CPLH	CPLNG.HALF	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WK602D3Z1	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A2A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
CPLH	CPLNG.HALF	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WK602D2Z1	
CPLL	CPLNG.LH	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WL602D3Z1	
CPLL	CPLNG.LH	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WL602D2Z1	
CPLR	CPLNG.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WM602D3Z1	
CPLR	CPLNG.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WM602D2Z1	
Valves Group									
GAV	VLV.GATE	0.50	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED,ST EM-13%CR STEEL	SW, 800, 3000, B-16.11, SHT NO.-51002	51002ZZZ1	
GAV	VLV.GATE	2.00	36.00		API 600/ ISO 10434	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -51302	51302ZZZ1	92
GLV	VLV.GLOBE	0.50	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED,ST EM-13%CR.STEEL	SW, 800, 3000, B-16.11, SHT NO.-52002	52002ZZZ1	
GLV	VLV.GLOBE	2.00	16.00		BS-1873	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -52302	52302ZZZ1	
CHV	VLV.CHECK	0.50	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO.-53002	53002ZZZ1	
CHV	VLV.CHECK	2.00	24.00		BS-1868	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -53302	53302ZZZ1	
BLV	VLV.BALL	0.50	1.50		BS EN ISO 17292	BODY-ASTM A 105 / A 216GR.WCB, TRIM-BODY SEAT-PEEK	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -54302	54302ZZZ1	
G3V	VLV.PISTON	0.50	1.00		MNF'STD	BODY-ASTM A 105, TRIM-13% CR.STEEL	SW, 800, 3000, B-16.11, SHT NO.-64002	64002ZZZ1	
Bolt Group									
BOS	BOLT.STUD	0.50	48.00		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 150	GK66272Z0	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A2A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Gasket Group									
GAS	GASKET	26.00	48.00		B-16.20-ANSI B16.47B	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 150	GK56272Z0	
GAS/300	GASKET	26.00	48.00		B-16.20-ANSI B16.47B	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 300	GK56274Z0	
GAS/300	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 300	GK66274Z0	
Trap/Strainer Group									
TRP	TRAP.STEAM	0.50	1.50		MNF'STD	B:A105;T:13%CR;S:SS 304	FLGD, THRMDNMC , 150,RF/125AARH	TR3065531	
TSR	STRNR.TEMP	1.50	24.00		EIL'STD	B:A516GR.70;INT:SS3 04	CONETYPE , 150,FF/125AARH	ST16831Z1	
PSR	STRNR.PERM	0.50	1.50		MNF'STD	B:A105;INT:SS304	SW, Y-TYPE, 800	SP303D511	
PSR	STRNR.PERM	2.00	24.00		MNF'STD	B:A216GR.WCB;INT:S S304	FLGD, Y-TYPE , 150,RF/125AARH	SP3805531	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A3A

PIPE CLASS : **A3A**
 RATING : 150
 BASE MATERIAL : CARBON STEEL
 CORROSION ALLOWANCE : 1.50 MM
 SPECIAL REQUIREMENT :

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP.	0	38	50	65	100	150	186
PRESS	10.55	10.55	10.55	10.55	10.55	10.55	10.55

SERVICE

NON CORROSIVE UTILITIES (ABOVE GROUND) CATEGORY "D" FLUID - COOLING WATER, INSTRUMENT AIR(2" & ABOVE-IN OFFISTES DISTRIBUTION), PLANT AIR, INERT GAS, CARBON DI OXIDE (DRY), NITROGEN, CONDENSATE & BOILER FEED SUCTION (NON IBR), CRWS/ SS/ VENT (A/G). THIS CLASS DOES NOT COVER UNDERGROUND PIPING AND THE FIRE WATER SERVICE.

NOTES

- 4 USAGE OF UNIONS TO BE RESTRICTED TO WATER SERVICES ONLY.
- 6 FOR FABRICATED REDUCERS,REFER EIL/STD 7-44-0485 & 7-44-0487. FOR MITRES, REFER EIL/STD 7-44-0033.
- 31 USE BUTTERFLY VALVES INSTEAD OF GATE VALVES FROM 10" ONWARDS IN WATER SERVICE AND UPTO 70 DEG C. DESIGN PRESSURE FOR BUTTERFLY VALVES IS LIMITED UPTO 10 BAR.
- 32 CORROSION ALLOWANCE HAS BEEN ADJUSTED TO SELECT OPTIMUM SCH. REFER GENERAL NOTES TO PMS.
- 65 FORGINGS ARE ACCEPTABLE IN LIEU OF PLATE MATERIAL FOR BLIND FLANGES AND SPACER & BLINDS.
- 76 FOR PERMANENT BW STRAINERS,REFER EIL/STD 7-44-0303 & 7-44-0304; AND FOR TEMPORARY STRAINERS,REFER EIL/STD 7-44-0300.
- 77 FOR SIZES > 24", SPACER & BLIND SHALL BE AS PER EIL/STD 7-44-0164.
- 86 BUTTERFLY VALVES FOR THE SPEC ARE PN10 RATED WITH A MAXIMUM PRESSURE OF 10.2 KG/CM2G.
- 99 BLIND FLANGES AND SPACER & BLINDS SPECIFIED TO MANUFACTURER'S STANDARD SHALL BE DESIGNED FOR 70 DEG.C AND 7.0 KG/CM2G TO SUIT 150#, FF, 125AARH, AWWA C207 CL.D FLANGES.
- 151 NDT REQUIREMENTS AS PER JOB SPECIFICATION B957-6-44-0016
- 155 GASKET SHALL CONFIRM TO ALL THE TESTING REQUIREMENTS OF BS 7531 AND THICKNESS TOLERANCES SHALL BE AS PER TOLERANCES FOR 2 MM THICKNESS SPECIFIED IN BS 7531 .
- 993 FOR LICENSOR SPECIFICATIONS 1C13 IN UNIVATION, FOR SIZE RANGE 0.5" TO 0.75": STR-361, FOR 1" TO 1.5"-STR-366 & FOR 2" TO 12" : STR-351 IS TO BE FOLLOWED FOR STRAINERS. REFER PPF-8 FOR STRAINER SPECIFICATIONS.
- 997 PMS FOR LLDPE/HDPE SWING UNIT SHALL BE READ IN CONJUNCTION WITH LICENSOR PMS

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A3A

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING 3000 LBS.	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER EILSTD 7-44-350, DF3	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER EIL STD. 7-44-351, D4	
VENTS	ON LINES <= 1.5"	REFER EIL STD. 7-44-350, VC1	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER EIL STD 7-44-351, V1	
TEMP.CONN	1.5"	FLANGED. REFER EIL STD 7-44-353	
PRESS.CONN	0.75"	SW, SH HVY NIPPLE WITH GATE VALVE TO SPEC AS PER EIL STD 7-44-354	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A3A

[illegible]**RUN PIPE (SIZE IN INCHES)**

<u>CODE</u>	<u>DESCRIPTION</u>				
F	SADDLE FUSED JT	T	TEES	J	THREAOLET
H	H.COUPLING	W	WELDOLETS	N	NIPPOLET
P	PIPE TO PIPE	I	INSTRUMENT TEE	U	UNLISTED B31.3 COMP
R	REINFORCED	X	REFER NOTES		
S	SOCKOLETS	L	SWEEPOLET		

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A3A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	1.00	1.50	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	2.00	2.00	XS	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z0	
PIP	PIPE	3.00	14.00	STD	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z0	
PIP	PIPE	16.00	22.00	6.0	IS-3589	IS-3589 GR.410	BE, SAW	PI7E316Z0	
PIP	PIPE	24.00	30.00	8.0	IS-3589	IS-3589 GR.410	BE, SAW	PI7E316Z0	
PIP	PIPE	32.00	38.00	10.0	IS-3589	IS-3589 GR.410	BE, SAW	PI7E316Z0	
PIP	PIPE	40.00	42.00	12.0	IS-3589	IS-3589 GR.410	BE, SAW	PI7E316Z0	
PIP	PIPE	48.00	48.00	14.0	IS-3589	IS-3589 GR.410	BE, SAW	PI7E316Z0	
PIP	PIPE	60.00	60.00	14.0	IS-3589	IS-3589 GR.410	BE, SAW	PI7E316Z0	
NIP	NIPPLE	0.50	0.75	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
NIP	NIPPLE	1.00	1.50	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
Flange Group									
FLG	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 105	150, RF/125AARH	FSC0127Z0	
FLG	FLNG.SO	2.00	24.00		B-16.5	ASTM A 105	150, RF/125AARH	FNC0127Z0	
FLG	FLNG.SO	26.00	42.00		AWWA-C207 CL.D	ASTM A 516 GR.70	150, FF/125AARH	FN46321Z0	
FLG	FLNG.SO	48.00	48.00		AWWA-C207 CL.D	ASTM A 516 GR.70	150, FF/125AARH	FN46321Z0	
FLG	FLNG.SO	60.00	60.00		AWWA-C207 CL.D	ASTM A 516 GR.70	150, FF/125AARH	FN46321Z0	
FLB	FLNG.BLIND	0.50	24.00		B-16.5	ASTM A 105	150, RF/125AARH	FBC0127Z0	
FLB	FLNG.BLIND	26.00	42.00		AWWA-C207 CL.D	ASTM A 516 GR.70	150, FF/125AARH	FB46321Z0	
FLB	FLNG.BLIND	48.00	48.00		AWWA-C207 CL.D	ASTM A 516 GR.70	150, FF/125AARH	FB46321Z0	
FLB	FLNG.BLIND	60.00	60.00		AWWA-C207 CL.D	ASTM A 516 GR.70	150, FF/125AARH	FB46321Z0	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FGK0121Z0	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A3A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Flange Group									
FEF	SPCR&BLND	10.00	24.00		ASME-B16.48	ASTM A 105	150, FF/125AARH	FCK0121Z0	
FEF	SPCR&BLND	26.00	42.00		AWWA C207D/EIL'ST D	ASTM A 516 GR.70	150, FF/125AARH	FCT6321Z0	
FEF	SPCR&BLND	48.00	48.00		AWWA C207D/EIL'ST D	ASTM A 516 GR.70	150, FF/125AARH	FCT6321Z0	
FEF	SPCR&BLND	60.00	60.00		AWWA C207D/EIL'ST D	ASTM A 516 GR.70	150, FF/125AARH	FCT6321Z0	
Fitting Group									
ELB90	ELBOW.90	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WA602D3Z0	
ELB90	ELBOW.90	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WA602D2Z0	
ELB90	ELBOW.90	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WAG684Z10	
ELB90	ELBOW.90	16.00	42.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z10	
ELB90	ELBOW.90	48.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z10	
ELB45	ELBOW.45	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WB602D3Z0	
ELB45	ELBOW.45	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WB602D2Z0	
ELB45	ELBOW.45	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WBG684Z10	
ELB45	ELBOW.45	48.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WBG754Z10	
MIT90	MITRE.90	60.00	60.00	M	EIL'STD	IS-3589 GR.410	BW, 1.5D	WDKF241Z0	
MIT45	MITRE.45	60.00	60.00	M	EIL'STD	IS-3589 GR.410	BW, 1.5D	WGKF241Z0	
TEQ	T.EQUAL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WE602D3Z0	
TEQ	T.EQUAL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WE602D2Z0	
TEQ	T.EQUAL	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ0	
TEQ	T.EQUAL	16.00	48.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW	WEG754ZZ0	
TRED	T.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WR602D3Z0	
TRED	T.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WR602D2Z0	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A3A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
TRED	T.RED	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ0	
TRED	T.RED	16.00	48.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WRG754ZZ0	
REDC	REDUC.CONC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ0	
REDC	REDUC.CONC	16.00	48.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WUG754ZZ0	
REDC	REDUC.CONC	50.00	60.00	M, M	EIL/STD	IS-3589 GR.410	BW	WUKF24ZZ0	
REDE	REDUC.ECC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ0	
REDE	REDUC.ECC	50.00	60.00	M, M	EIL/STD	IS-3589 GR.410	BW	WVKF24ZZ0	
SWGC	SWAGE.CONC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WNH026ZZ0	
SWGE	SWAGE.ECC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WPH026ZZ0	
CAP	CAP	0.50	1.50		B-16.11	ASTM A 105	SCRF, 3000	WF60282Z0	
CAP	CAP	2.00	48.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CAP	CAP	60.00	60.00	CALC	ASME-VIII	ASTM A 285 GR.C	BW	WF3J54ZZ0	
CPLF	CPLNG.FULL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WJ602D3Z0	
CPLF	CPLNG.FULL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WJ602D2Z0	
CPLH	CPLNG.HALF	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WK602D3Z0	
CPLH	CPLNG.HALF	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WK602D2Z0	
CPLL	CPLNG.LH	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WL602D3Z0	
CPLL	CPLNG.LH	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WL602D2Z0	
CPLR	CPLNG.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WM602D3Z0	
CPLR	CPLNG.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WM602D2Z0	
UNN	UNION	0.50	1.50		BS-3799	ASTM A 105	SW, 3000	WQH02D2Z0	4
Valves Group									
GAV	VLV.GATE	0.25	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED,ST EM-13%CR.STEEL	SW, 800, 3000, B-16.11, SHT NO.-51001	51001ZZZ0	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A3A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Valves Group									
GAV	VLV.GATE	2.00	24.00		API 600/ ISO 10434	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -51321	51321ZZZ0	
GLV	VLV.GLOBE	0.25	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED,ST EM-13%CR STEEL	SW, 800, 3000, B-16.11, SHT NO.-52001	52001ZZZ0	
GLV	VLV.GLOBE	2.00	16.00		BS-1873	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -52321	52321ZZZ0	
CHV	VLV.CHECK	0.25	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO.-53001	53001ZZZ0	
CHV	VLV.CHECK	2.00	24.00		BS 1868	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -53321	53321ZZZ0	
CHV	VLV.CHECK	26.00	48.00		API-594	BODY-ASTM A 105 / A 216GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 150, AWWAC207, FF/125AARH, SHT NO. -53316	53316ZZZ0	
BLV	VLV.BALL	0.50	16.00		BS EN ISO 17292	BODY-ASTM A 105 / A 216GR.WCB, TRIM-BODY SEAT-RPTFE	FLGD, 150, B-16.5, RF/125AARH, SHT NO. -54321	54321ZZZ0	
BFV	VLV.BTRFLY	3.00	24.00		BS EN 593	BODY-ASTM A 216 GR.WCB, TRIM-13% CR.STEEL	WAF, 150, B-16.5, WAF/125AARH, SHT NO.-56321	56321ZZZ0	
BFV	VLV.BTRFLY	26.00	48.00		BS EN 593	BODY-ASTM A 216 GR.WCB, TRIM-13% CR.STEEL	FLGD, 150, AWWAC207, FF/125AARH, SHT NO. -56316	56316ZZZ0	
Bolt Group									
BOS	BOLT.STUD	0.50	60.00		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	24.00		B-16.21-ANSI B16.5	NONASBESTOS BS7531 GR X	RING, 150, 2 MM	GKBAX52Z0	
GAS	GASKET	26.00	60.00		AWWA-C207 CL.D	NONASBESTOS BS7531 GR X	RING, 150, 3 MM	GK2AX52Z0	155
Trap/Strainer Group									
TRP	TRAP.STEAM	0.50	1.50		MNF*STD	B:A105;T:13%CR;S:SS 304	FLGD, THRMDNMC , 150,RF/125AARH	TR3065530	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : A3A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Trap/Strainer Group									
TSR	STRNR.TEMP	1.50	24.00		EIL'STD	B:A285GR.C;INT:SS304	CONETYPE , 150,FF/125AARH	ST14431Z0	
PSR	STRNR.PERM	0.50	1.50		MNF'STD	B:A105;INT:SS304	SW, Y-TYPE, 800	SP303D510	
PSR	STRNR.PERM	2.00	6.00	M	EIL'STD	B:A234GR.WPB;INT:S304	BW, T-TYPE	SP13344Z0	
PSR	STRNR.PERM	8.00	24.00	M	EIL'STD	B:A234GR.WPBW;INT:SS304	BW, T-TYPE	SP13644Z0	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : B1A

PIPE CLASS : **B1A**
 RATING : 300
 BASE MATERIAL : CARBON STEEL
 CORROSION ALLOWANCE : 1.50 MM
 SPECIAL REQUIREMENT :

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP.	-29	38	93	149	204	260	316	343	371
PRESS	52.02	52.02	47.8	46.05	44.64	42.53	40.07	38.66	37.26

SERVICE

NON CORROSIVE PROCESS - FLAMMABLE / NON FLAMMABLE, NON LETHAL - HYDROCARBONS, AROMATICS, AMMONIA, SWEET GAS, FLUSHING OIL AND OTHER UTILITIES -MP CONDENSATE, INSTRUMENT AIR(OFFSITES), PLANT AIR, NITROGEN, AMMONIA GAS, NITROGEN-HIGH TEMPERATURE ETC. ABOVE CLASS 'A1A'.

NOTES

- 3 USE PIPE OF CLASS 22 INSTEAD OF CLASS 12 IF PIPE THICKNESS EXCEEDS 25.00 MM.
- 5 FOR PERMANENT 'T' TYPE BW STRAINERS,REFER EIL'STD 7-44-0303 & 7-44-0304; AND FOR TEMPORARY STRAINERS,REFER EIL'STD 7-44-0300; FOR SPACER AND BLIND REFER EIL'STD 7-44-0162.
- 7 FOR RESTRICTION ON USE OF BALL,PLUG & BUTTERFLY VALVES,REFER GENERAL NOTES.
- 26 SEPARATE PMS CLASS SHALL BE SELECTED FOR PIPES WITH THICKNESS > 12.7MM WHERE IMPACT TESTING IS REQUIRED BASED ON DESIGN CONDITIONS AS PER ASME B31.3
- 32 CORROSION ALLOWANCE HAS BEEN ADJUSTED TO SELECT OPTIMUM SCH. REFER GENERAL NOTES TO PMS.
- 151 NDT REQUIREMENTS AS PER JOB SPECIFICATION B957-6-44-0016
- 963 FOR LICENSOR SPECIFICATIONS LGP18 & LGP26 IN PPU, FOR SIZE RANGE 0.75" TO 1.5": STR-366 & FOR 2" TO 10"-STR-354 IS TO BE FOLLOWED FOR STRAINERS. SEE LPPF-8 INCLUDED IN THE SUPPLEMENT TO PROCESS PARTS, VOLUME 2, SECTION IX-2 FOR STRAINER SPECIFICATIONS.
- 992 FOR LICENSOR SPECIFICATIONS 1C2 IN UNIVATION, FOR SIZE RANGE 0.5" TO 0.75": STR-361, FOR 1" TO 1.5"-STR-366 & FOR 2" TO 12" : STR-351 IS TO BE FOLLOWED FOR STRAINERS. REFER PPF-8 FOR STRAINER SPECIFICATIONS.
- 995 FOR LICENSOR SPECIFICATIONS 1E3 & 1E21 IN UNIVATION, FOR SIZE RANGE 0.5" TO 1.5": STR-366 & FOR 2" TO 10" : STR-354 IS TO BE FOLLOWED FOR STRAINERS. REFER PPF-8 FOR STRAINER SPECIFICATIONS.
- 997 PMS FOR LLDPE/HDPE SWING UNIT SHALL BE READ IN CONJUNCTION WITH LICENSOR PMS

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : B1A

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER EILSTD 7-44-0350, DF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD. 7-44-0351, D4	
VENTS	ON LINES <= 1.5"	REFER EIL STD. 7-44-0350, VF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER EIL STD 7-44-0351, V4	
TEMP.CONN	1.5"	FLANGED. REFER EIL STD 7-44-0353	
PRESS.CONN	0.75"	SW NIPPLE WITH VALVE TO SPEC AS PER EIL STD 7-44-0354	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : B1A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	1.00	1.50	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	2.00	2.00	XS	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z0	
PIP	PIPE	3.00	14.00	STD	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z0	
PIP	PIPE	16.00	20.00	XS	B-36.10	ASTM A 672 GR.B60 CL.12	BE, E.FS.W	PI2A813Z0	
PIP	PIPE	24.00	24.00	S30	B-36.10	ASTM A 672 GR.B60 CL.12	BE, E.FS.W	PI2A813Z0	32
NIP	NIPPLE	0.50	0.75	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
NIP	NIPPLE	1.00	1.50	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
Flange Group									
FLG	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 105	300, RF/125AARH	FSC0147Z0	
FLG	FLNG.WN	2.00	24.00	M	B-16.5	ASTM A 105	300, RF/125AARH	FWC0147Z0	
FLB	FLNG.BLIND	0.50	24.00		B-16.5	ASTM A 105	300, RF/125AARH	FBC0147Z0	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A 105	300, FF/125AARH	FGK0141Z0	
FEF	SPCR&BLND	10.00	24.00		ASME-B16.48	ASTM A 105	300, FF/125AARH	FCK0141Z0	
Fitting Group									
ELB90	ELBOW.90	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WA602D3Z0	
ELB90	ELBOW.90	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WA602D2Z0	
ELB90	ELBOW.90	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WAG684Z10	
ELB90	ELBOW.90	16.00	24.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z10	
ELB45	ELBOW.45	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WB602D3Z0	
ELB45	ELBOW.45	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WB602D2Z0	
ELB45	ELBOW.45	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WBG684Z10	
ELB45	ELBOW.45	16.00	24.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WBG754Z10	
TEQ	T.EQUAL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WE602D3Z0	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : B1A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
TEQ	T.EQUAL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WE602D2Z0	
TEQ	T.EQUAL	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ0	
TEQ	T.EQUAL	16.00	24.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW	WEG754ZZ0	
TRED	T.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WR602D3Z0	
TRED	T.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WR602D2Z0	
TRED	T.RED	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ0	
TRED	T.RED	16.00	24.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WRG754ZZ0	
REDC	REDUC.CONC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ0	
REDC	REDUC.CONC	16.00	24.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WUG754ZZ0	
REDE	REDUC.ECC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ0	
REDE	REDUC.ECC	16.00	24.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WVG754ZZ0	
SWGC	SWAGE.CONC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WNH026ZZ0	
SWGE	SWAGE.ECC	0.50	3.00	M, M	BS-3799	ASTM A 105	PBE	WPH026ZZ0	
CAP	CAP	2.00	24.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CPLF	CPLNG.FULL	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WJ602D3Z0	
CPLF	CPLNG.FULL	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WJ602D2Z0	
CPLH	CPLNG.HALF	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WK602D3Z0	
CPLH	CPLNG.HALF	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WK602D2Z0	
CPLL	CPLNG.LH	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WL602D3Z0	
CPLL	CPLNG.LH	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WL602D2Z0	
CPLR	CPLNG.RED	0.50	0.75		B-16.11	ASTM A 105	SW, 6000	WM602D3Z0	
CPLR	CPLNG.RED	1.00	1.50		B-16.11	ASTM A 105	SW, 3000	WM602D2Z0	
Valves Group									

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : B1A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Valves Group									
GAV	VLV.GATE	0.25	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED,ST EM-13%CR.STEEL	SW, 800, 3000, B-16.11, SHT NO.-51001	51001ZZZ0	
GAV	VLV.GATE	2.00	24.00		API 600/ ISO 10434	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 300, B-16.5, RF/125AARH, SHT NO. -51401	51401ZZZ0	
GLV	VLV.GLOBE	0.25	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED,ST EM-13%CR STEEL	SW, 800, 3000, B-16.11, SHT NO.-52001	52001ZZZ0	
GLV	VLV.GLOBE	2.00	12.00		BS-1873	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 300, B-16.5, RF/125AARH, SHT NO. -52401	52401ZZZ0	
CHV	VLV.CHECK	0.25	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO.-53001	53001ZZZ0	
CHV	VLV.CHECK	2.00	24.00		BS-1868	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 300, B-16.5, RF/125AARH, SHT NO. -53401	53401ZZZ0	
BLV	VLV.BALL	0.50	16.00		BS EN ISO 17292	BODY-ASTM A 105 / A 216GR.WCB, TRIM-BODY SEAT-RPTFE	FLGD, 300, B-16.5, RF/125AARH, SHT NO. -54401	54401ZZZ0	
PLV	VLV.PLUG	0.50	24.00		BS-5353	BODY-ASTM A 105 / A 216GR.WCB, TRIM-PLUG-HARDE NED	FLGD, 300, B-16.5, RF/125AARH, SHT NO. -55401	55401ZZZ0	
Bolt Group									
BOS	BOLT.STUD	0.50	24.00		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SP.WND SS316+GRAFIL+ I RING	SPIRAL, 300	GK66274Z0	
Trap/Strainer Group									
TRP	TRAP.STEAM	0.50	1.50		MNF'STD	B:A105;T:13%CR;S:SS 304	FLGD, THRMDNMC , 300,RF/125AARH	TR30655B0	
TSR	STRNR.TEMP	1.50	24.00		EIL'STD	B:A516GR.70;INT:SS3 04	CONETYPE , 300,FF/125AARH	ST16839Z0	
PSR	STRNR.PERM	0.50	1.50		MNF'STD	B:A105;INT:SS304	SW, Y-TYPE, 800	SP303D510	
PSR	STRNR.PERM	2.00	14.00	M	EIL'STD	B:A234GR.WPB;INT:S S304	BW, T-TYPE	SP13344Z0	

Client : BPCL						Dept./Sect : 16/43			
Project : MPMC & EPCM-1 FOR BPREP									
Location : BINA, MADHYA PRADESH						Piping Class : B1A			
Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Trap/Strainer Group									
PSR	STRNR.PERM	16.00	24.00	M	EIL/STD	B:A234GR.WPBW;IN T:SS304	BW, T-TYPE	SP13644Z0	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : F2A

PIPE CLASS : **F2A**
RATING : 1500
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 1.50 MM
SPECIAL REQUIREMENT : IBR SERVICE

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP.	0	38	93	149	204	260	316	343	371	399	427
PRESS	260.49	260.49	238.66	229.88	222.85	211.95	199.65	192.97	186.64	178.21	144.46

SERVICE

STEAM AND BOILER FEED WATER (IBR), CONDENSATE (IBR)

NOTES

- 3 USE PIPE OF CLASS 22 INSTEAD OF CLASS 12 IF PIPE THICKNESS EXCEEDS 25.00 MM.
- 8 ALL PIPES,FITTINGS,VALVES,FLANGES,TRAPS AND STRAINERS SHALL BE TESTED AND TEST CERTIFICATE IN FORM III A FOR PIPE AND FORM III C FOR OTHERS SHALL BE REQD. DULY COUNTERSIGNED BY IBR AUTHORITY OR ITS APPROVED REPRESENTATIVE.
- 9 CARBON CONTENT SHALL NOT EXCEED 0.25% FOR ALL PIPES,FITTINGS FLANGES ETC. THAT MAY REQUIRE WELDING. MOREOVER,FOR FLANGES THE SULPHUR AND PHOSPHOROUS SHALL ALSO BE LIMITED TO 0.05% EACH.
- 26 SEPARATE PMS CLASS SHALL BE SELECTED FOR PIPES WITH THICKNESS > 12.7MM WHERE IMPACT TESTING IS REQUIRED BASED ON DESIGN CONDITIONS AS PER ASME B31.3
- 90 INST. CONNECTIONS LIKE ORIFICE TAPS ETC SHALL BE PROVIDED WITH DOUBLE ISOLATION VALVES.
- 131 PIPE WALL THICKNESS IS CALCULATED BASED ON ACTUAL LINE DESIGN CONDITION [150 DEG. C & 214 KG/ CM2 G].
- 145 Y-TYPE GLOBE VALVE.
- 151 NDT REQUIREMENTS AS PER JOB SPECIFICATION B957-6-44-0016

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : F2A

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	ALL	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	AS PER P&ID OR 0.75".TEE, NIPPLE, SINGLE VLV(AS PER P&ID OR LINE ISOLATION VLV), BLIND FLG ASSEMBLY	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75".WELDOLET,NIPPLE,SINGLE VLV(AS PER P&ID OR LINE ISOLATION VLV), BLIND FLG ASMBLY	
VENTS	ON LINES <= 1.5"	AS PER P&ID OR 0.75".TEE, NIPPLE, SINGLE VLV(AS PER P&ID OR LINE ISOLATION VLV), BLIND FLG ASSEMBLY	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75".WELDOLET,NIPPLE,SINGLE VLV(AS PER P&ID OR LINE ISOLATION VLV), BLIND FLG ASMBLY	
TEMP.CONN	2.0"	FLANGED. REFER EIL STD 7-44-0353	
PRESS.CONN	0.75"	TEE/WELDOLET & NIPPLE WITH DOUBLE VALVES (AS PER P&ID OR SIMILAR TO LINE ISOLATION VALVES)	

BRANCH PIPE (SIZE IN INCHES)

<u>CODE</u>	<u>DESCRIPTION</u>				
F	SADDLE FUSED JT	T	TEES	J	THREAOLET
H	H.COUPLING	W	WELDOLETS	N	NIPPOLET
P	PIPE TO PIPE	I	INSTRUMENT TEE	U	UNLISTED B31.3 COMP
R	REINFORCED	X	REFER NOTES		
S	SOCKOLETS	L	SWEEPOLET		

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : F2A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	4.00	S160	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	26
PIP	PIPE	6.00	6.00	S160	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	131
PIP	PIPE	8.00	8.00	S140	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	131
PIP	PIPE	10.00	10.00	XXS	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	131
PIP	PIPE	12.00	14.00	S140	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	131
PIP	PIPE	16.00	16.00	38.0	B-36.10	ASTM A 672 GR.B60 CL.22	BE, E.FS.W	PI2A913Z1	3,131
PIP	PIPE	18.00	18.00	42.0	B-36.10	ASTM A 672 GR.B60 CL.22	BE, E.FS.W	PI2A913Z1	3,131
NIP	NIPPLE	0.50	1.50	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z1	
Flange Group									
FLG	FLNG.WN	0.50	24.00	M	B-16.5	ASTM A 105	1500, RTJ/63AARH	FWC0189Z1	
FLB	FLNG.BLIND	0.50	24.00		B-16.5	ASTM A 105	1500, RTJ/63AARH	FBC0189Z1	
FEF	FLNG.FIG.8	0.50	4.00		ASME-B16.48	ASTM A 105	1500, RTJ/63AARH	FGK0189Z1	
FEF	SPCR&BLND	6.00	24.00		ASME-B16.48	ASTM A 105	1500, RTJ/63AARH	FCK0189Z1	
Fitting Group									
ELB90	ELBOW.90	0.50	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WAG684Z11	
ELB90	ELBOW.90	16.00	24.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WAG754Z11	
ELB45	ELBOW.45	0.50	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW, 1.5D	WBG684Z11	
ELB45	ELBOW.45	16.00	24.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW, 1.5D	WBG754Z11	
TEQ	T.EQUAL	0.50	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ1	
TEQ	T.EQUAL	16.00	24.00	M	B-16.9	ASTM A 234 GR.WPB-W	BW	WEG754ZZ1	
TRED	T.RED	0.50	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ1	
TRED	T.RED	16.00	24.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WRG754ZZ1	
REDC	REDUC.CONC	0.50	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ1	
REDC	REDUC.CONC	16.00	24.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WUG754ZZ1	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : F2A

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
REDE	REDUC.ECC	0.50	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ1	
REDE	REDUC.ECC	16.00	24.00	M, M	B-16.9	ASTM A 234 GR.WPB-W	BW	WVG754ZZ1	
CAP	CAP	0.50	24.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ1	
Olet Group									
WLT	WELDOLET	0.50	20.00	M, M	MSS-SP97	ASTM A 105	BW	YWS024ZZ1	
Valves Group									
GAV	VLV.GATE	0.50	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED,ST EM-13%CR STEEL	BW, 1500, B-16.25, SHT NO.-51102	51102ZZZ1	
GAV	VLV.GATE	2.00	4.00		ANSI-B-16.34	BODY-ASTM A 105 / A 216GR.WCB, TRIM-STELLITED,ST EM-13%CR STEEL	BW, 1500, B-16.25, SHT NO.-51702	51702ZZZ1	
GLV	VLV.GLOBE	0.50	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED,ST EM-13%CR.STEEL	BW, 1500, B-16.25, SHT NO.-52102	52102ZZZ1	145
GLV	VLV.GLOBE	2.00	4.00		ANSI-B-16.34	BODY-ASTM A 105 / A 216GR.WCB, TRIM-STELLITED,ST EM-13%CR.STEEL	BW, 1500, B-16.25, SHT NO.-52702	52702ZZZ1	145
CHV	VLV.CHECK	0.50	1.50		API 602/ ISO 15761	BODY-ASTM A 105, TRIM-STELLITED	BW, 1500, B-16.25, SHT NO.-53102	53102ZZZ1	
CHV	VLV.CHECK	2.00	4.00		ANSI-B-16.34	BODY-ASTM A 105 / A 216GR.WCB, TRIM-STELLITED	BW, 1500, B-16.25, SHT NO.-53702	53702ZZZ1	
Bolt Group									
BOS	BOLT.STUD	0.50	24.00		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	24.00		B-16.20-ANSI B16.5	SOFT IRON	OCT-RING, 1500	GK67238Z0	
Trap/Strainer Group									
PSR	STRNR.PERM	0.50	1.50	M	MNF'STD	B:A105;INT:SS304	BW, Y-TYPE	SP30345Z1	
PSR	STRNR.PERM	2.00	24.00	M	MNF'STD	B:A216GR.WCB;INT:S S304	BW, Y-TYPE	SP38045Z1	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : F2G

PIPE CLASS : **F2G**
RATING : 1500
BASE MATERIAL : 9CR-1MO-V
CORROSION ALLOWANCE : 1.50 MM
SPECIAL REQUIREMENT : IBR SERVICE

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP.	0	38	93	149	204	260	316	343	371	399	427
PRESS	263.65	263.65	263.65	255.91	248.18	233.77	212.67	206.7	199.67	187.01	178.57
	454	482	510	538	540						
	171.19	157.83	135.69	127.95	127.84						

SERVICE

VERY HIGH PRESSURE STEAM (IBR)

NOTES

- 1 NDT REQUIREMENTS AS PER EIL STANDARD SPECIFICATION 6-44-0016.
- 8 ALL PIPES, FITTINGS, VALVES, FLANGES, TRAPS AND STRAINERS SHALL BE TESTED AND TEST CERTIFICATE IN FORM III A FOR PIPE AND FORM III C FOR OTHERS SHALL BE REQD. DULY COUNTERSIGNED BY IBR AUTHORITY OR ITS APPROVED REPRESENTATIVE.
- 14 RADIOGRAPHY SHALL BE PERFORMED AFTER HEAT TREATMENT.
- 30 ALL COMPONENTS SHALL HAVE A MINIMUM HARDNESS OF 190-250 BHN. MINIMUM HARDNESS OF ALL WELDS, INCLUDING FIELD WELDS AFTER HEAT TREATMENT SHALL BE 190-250 BHN.
- 32 CORROSION ALLOWANCE HAS BEEN ADJUSTED TO SELECT OPTIMUM SCH. REFER GENERAL NOTES TO PMS.
- 85 ALL WELDED FITTINGS SHALL BE NORMALIZED AND TEMPERED.
- 154 THICKNESS CALCULATION IS BASED ON DESIGN CONDITION 118 KG/CM² AT 540 DEG.C

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : F2G

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	ALL	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	AS PER P&ID OR 0.75".TEE, NIPPLE, SINGLE VLV(AS PER P&ID OR LINE ISOLATION VLV), BLIND FLG ASSEMBLY	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75".WELDOLET,NIPPLE,SINGLE VLV(AS PER P&ID OR LINE ISOLATION VLV), BLIND FLG ASMBLY	
VENTS	ON LINES <= 1.5"	AS PER P&ID OR 0.75".TEE, NIPPLE, SINGLE VLV(AS PER P&ID OR LINE ISOLATION VLV), BLIND FLG ASSEMBLY	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75".WELDOLET,NIPPLE,SINGLE VLV(AS PER P&ID OR LINE ISOLATION VLV), BLIND FLG ASMBLY	
TEMP.CONN	2.0"	FLANGED. REFER EIL STD 7-44-0353	
PRESS.CONN	0.75"	TEE/WELDOLET & NIPPLE WITH DOUBLE VALVES (AS PER P&ID OR SIMILAR TO LINE ISOLATION VALVES)	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : F2G

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	S160	B-36.10	ASTM A 335 GR.P91	BE, SEAMLESS	PI2K517Z1	
PIP	PIPE	1.00	1.00	XS	B-36.10	ASTM A 335 GR.P91	BE, SEAMLESS	PI2K517Z1	
PIP	PIPE	1.50	1.50	XS	B-36.10	ASTM A 335 GR.P91	BE, SEAMLESS	PI2K517Z1	32
PIP	PIPE	2.00	3.00	S160	B-36.10	ASTM A 335 GR.P91	BE, SEAMLESS	PI2K517Z1	
PIP	PIPE	4.00	4.00	S120	B-36.10	ASTM A 335 GR.P91	BE, SEAMLESS	PI2K517Z1	
PIP	PIPE	6.00	6.00	XS	B-36.10	ASTM A 335 GR.P91	BE, SEAMLESS	PI2K517Z1	154
PIP	PIPE	8.00	8.00	XS	B-36.10	ASTM A 335 GR.P91	BE, SEAMLESS	PI2K517Z1	32,154
PIP	PIPE	10.00	14.00	S100	B-36.10	ASTM A 335 GR.P91	BE, SEAMLESS	PI2K517Z1	154
PIP	PIPE	16.00	24.00	S100	B-36.10	ASTM A 691 GR.P91 CL.42	BE, E.FS.W	PI2L813Z1	154
NIP	NIPPLE	0.50	1.50	M	B-36.10	ASTM A 335 GR.P91	PBE, SEAMLESS	PN2K567Z1	
Flange Group									
FLG	FLNG.WN	0.50	24.00	M	B-16.5	ASTM A 182 GR.F91	1500, RTJ/63AARH	FWCB789Z1	
FLB	FLNG.BLIND	0.50	24.00		B-16.5	ASTM A 182 GR.F91	1500, RTJ/63AARH	FBCB789Z1	
FEF	FLNG.FIG.8	0.50	4.00		ASME-B16.48	ASTM A 182 GR.F91	1500, RTJ/63AARH	FGKB789Z1	
FEF	SPCR&BLND	6.00	24.00		ASME-B16.48	ASTM A 182 GR.F91	1500, RTJ/63AARH	FCKB789Z1	
Fitting Group									
ELB90	ELBOW.90	0.50	14.00	M	B-16.9	ASTM A234GR.WP91	BW, 1.5D	WAGQ34Z11	
ELB90	ELBOW.90	16.00	24.00	M	B-16.9	ASTM A234GR.WP91-W	BW, 1.5D	WAGU54Z11	
ELB45	ELBOW.45	0.50	14.00	M	B-16.9	ASTM A234GR.WP91	BW, 1.5D	WBGQ34Z11	
ELB45	ELBOW.45	16.00	24.00	M	B-16.9	ASTM A234GR.WP91-W	BW, 1.5D	WBGU54Z11	
TEQ	T.EQUAL	0.50	14.00	M	B-16.9	ASTM A234GR.WP91	BW	WEGQ34ZZ1	
TEQ	T.EQUAL	16.00	24.00	M	B-16.9	ASTM A234GR.WP91-W	BW	WEGU54ZZ1	
TRED	T.RED	0.50	14.00	M, M	B-16.9	ASTM A234GR.WP91	BW	WRGQ34ZZ1	
TRED	T.RED	16.00	24.00	M, M	B-16.9	ASTM A234GR.WP91-W	BW	WRGU54ZZ1	

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : F2G

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
REDC	REDUC.CONC	0.50	14.00	M, M	B-16.9	ASTM A234GR.WP91	BW	WUGQ34ZZ1	
REDC	REDUC.CONC	16.00	24.00	M, M	B-16.9	ASTM A234GR.WP91-W	BW	WUGU54ZZ1	
REDE	REDUC.ECC	0.50	14.00	M, M	B-16.9	ASTM A234GR.WP91	BW	WVGQ34ZZ1	
REDE	REDUC.ECC	16.00	24.00	M, M	B-16.9	ASTM A234GR.WP91-W	BW	WVGU54ZZ1	
CAP	CAP	0.50	24.00	M	B-16.9	ASTM A234GR.WP91	BW	WFGQ34ZZ1	
Olet Group									
WLT	WELDOLET	0.50	24.00	M, M	MSS-SP97	ASTM A 182 GR.F91	BW	YWSQ24ZZ1	
Valves Group									
GAV	VLV.GATE	0.50	1.50		API 602/ ISO 15761	BODY-ASTM A182 GR.F91, TRIM-STELLITED,ST EM-13%CR STEEL	BW, 1500, B-16.25, SHT NO.-51140	51140ZZZ1	
GAV	VLV.GATE	2.00	8.00		ANSI-B-16.34	BODY-ASTM A 217 GR.C12A, TRIM-STELLITED,ST EM-13% CR.STEEL	BW, 1500, B-16.25, SHT NO.-51740	51740ZZZ1	
GLV	VLV.GLOBE	0.50	1.50		API 602/ ISO 15761	BODY-ASTM A182 GR.F91, TRIM-STELLITED,ST EM-13%CR STEEL	BW, 1500, B-16.25, SHT NO.-52140	52140ZZZ1	
GLV	VLV.GLOBE	2.00	8.00		ANSI-B-16.34	BODY-ASTM A 217 GR.C12A, TRIM-STELLITED,ST EM-13% CR.STEEL	BW, 1500, B-16.25, SHT NO.-52740	52740ZZZ1	
CHV	VLV.CHECK	0.50	1.50		API 602/ ISO 15761	BODY-ASTM A 182 GR.F91, TRIM-STELLITED	BW, 1500, B-16.25, SHT NO.-53140	53140ZZZ1	
CHV	VLV.CHECK	2.00	8.00		ANSI-B-16.34	BODY-ASTM A 217 GR.C12A, TRIM-STELLITED	BW, 1500, B-16.25, SHT NO.-53740	53740ZZZ1	
Bolt Group									
BOS	BOLT.STUD	0.50	24.00		B-18.2	BOLT:A193 GR.B16, NUT:A194 GR.7		BS40134Z0	
Gasket Group									
GAS	GASKET	0.50	24.00		B-16.20-ANSI B16.5	5%CR 0.5%Mo	OCT-RING, 1500	GK67338Z0	
Trap/Strainer Group									

Client : BPCL	Dept./Sect : 16/43
Project : MPMC & EPCM-1 FOR BPREP	
Location : BINA, MADHYA PRADESH	Piping Class : F2G

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Trap/Strainer Group									
TRP	TRAP.STEAM	0.50	1.50		MNF'STD	B:A182GR.F91;INT:SS 304	BW, THRMDNMC	TR3F545Z1	
PSR	STRNR.PERM	0.50	1.50	M	MNF'STD	B:A182GR.F91;INT:SS 304	BW, Y-TYPE	SP3F545Z1	

ENGINEERING DESIGN BASIS (STRUCTURAL)

JOB NO. : B857
PROJECT : BINA PETROCHEMICAL AND REFINERY EXPANSION PROJECT
(BPREP) – BINA, MADHYA PRADESH
OWNER : M/S. BPCL



[Signature]

EIL SIGNATURE



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OWNER SIGNATURE

1	08.11.2024	Revised & Re- issued for Engineering	SS <i>SS</i>	<i>SP</i> SP	<i>AS</i> AS
0	12.06.2024	Issued for Engineering	SD	VKG	AS
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1.0 SCOPE

This document specifies the design criteria and loads that shall be taken into account for the civil-structural design of all industrial plant and non-plant structures and buildings pertaining to the project.

2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

2.1 ABBREVIATIONS

Code	Description
EDB	Engineering design basis
FBEC	Fusion bonded epoxy coating
FFL	Finished floor level
FGL	Finished grade level
FOS	Factor of safety
HPP	High point of pavement
MOC	Material of construction
NA	Not applicable
PCC	Plain cement concrete
RCC	Reinforced cement concrete
SBC	Safe bearing capacity
TMT	Thermo-mechanically treated
UOM	Unit of measurement

2.2 CODES & STANDARDS /PUBLICATIONS

S. No.	Description	Standards/Codes
1	Specification for Ordinary Portland Cement	IS 269
2	Specification for Coarse and Fine Aggregates from Natural Sources for Concrete	IS 383
3	Specification for Expanded Metal Steel Sheets for General Purposes	IS 412
4	Mild Steel and Medium Tensile Steel Bars and Hard-Drawn Steel Wire for Concrete Reinforcement	IS 432
5	Specification for Portland Slag Cement	IS 455
6	Code of Practice for Plain & Reinforced Concrete	IS 456
7	Specification for Test Sieves: Part-I Wire Cloth Test Sieves	IS 460
8	Methods of Test for Strength of Concrete	IS 516
9	General Construction in Steel - Code of Practice	IS 800
10	Code of Practice for Use of Cold Formed Light Gauge Steel Structural Members in General Building Construction.	IS 801
11	Code of Practice for Use of Structural Steel in Overhead Transmission Line Towers	IS 802
12	Code of Practice for Design, Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Storage	IS 803
13	Code of Practice for Use of Steel Tubes in General Building Construction	IS 806
14	Hot Rolled Steel Beam, Column, Channel and Angle Sections – Dimensions and Properties	IS 808

S. No.	Description	Standards/Codes
15	Cold Formed Light Gauge Structural Steel Sections	IS 811
16	Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel	IS 816
17	Code of Practice for Design Loads	IS 875
18	Code of Practice for Design of Structural Timber in Building	IS 883
19	Steel Tubes for Structural Purposes – Specification	IS 1161
20	Bitumen-Mastic for Flooring – Specification	IS 1195
21	Steel Tubes, Tubular and Other Wrought Steel Fittings	IS 1239
22	Specification for Bitumen Felts for Water Proofing and Damp-Proofing	IS 1322
23	Hexagon Head Bolts, Screws and Nuts of Product Grade 'C' – Part-1: Hexagon Head Bolts	IS 1363
24	Technical Supply Conditions for Threaded Steel Fasteners	IS 1367
25	Specification for Portland Pozzolana Cement	IS 1489
26	Specification for Hard-Drawn Steel Wire Fabric for Concrete Reinforcement	IS 1566
27	Code of Practice for Construction of Stone Masonry	IS 1597
28	High Strength Deformed Steel Bars and Wires for Concrete Reinforcement – Specification	IS 1786
29	Preformed Fillers for Expansion Joint in Concrete Pavement and Structures (non extruding and	IS 1838
30	Criteria for Earthquake Resistant Design of Structures	IS 1893
31	Code of Practice for Design & Construction of Foundations in Soil – General Requirements	IS 1904
32	Code of Practice for Structural Use of Un-reinforced Masonry	IS 1905
33	Specification for Plain Washers	IS 2016
34	Hot Rolled Low, Medium and High Tensile Structural Steel	IS 2062
35	Specification for Sand for Masonry Mortars	IS 2116
36	Specification for Concrete Masonry Units	IS 2185
37	Code of Practice for Brickworks	IS 2212
38	Steel Wire Ropes for General Engineering Purposes – Specification	IS 2266
39	Recommended Practice for Hot Dipped Galvanizing of Iron and Steel	IS 2629

S. No.	Description	Standards/Codes
40	Methods for Testing Uniformity of Coating of Zinc Coated Articles	IS 2633
41	Integral Waterproofing Compounds for Cement Mortar and Concrete – Specification	IS 2645
42	Code of Practice for Design and Construction of Pile Foundations	IS 2911
43	Code of Practice for Design & Construction of Raft Foundations	IS 2950
44	Code of Practice for Design & Construction of Machine Foundations	IS 2974
45	Code of Practice for Concrete Structures for Storage of Liquids	IS 3370
46	Steel Chequered Plates – Specification	IS 3502
47	Specification for Structural Timber in Building	IS 3629
48	Specification for High Strength Structural Bolts	IS 3757
49	High Strength Bolts in Steel Structures – Code of Practice	IS 4000
50	Code of Practice for Design and Construction of Foundation for Transmission Line Towers and Poles	IS 4091
51	Code of Practice for Earthquake Resistant Design and Construction of Buildings	IS 4326
52	Hollow Steel Sections for Structural Use	IS 4923
53	Criteria for Blast Resistant Design of Structures for Explosions Above Ground	IS 4991
54	Criteria for Design of Reinforced Concrete Bins	IS 4995
55	Criteria for Design of RCC Chimneys	IS 4998
56	Determination of Dynamic Properties of Soil	IS 5249
57	Code of Practice for Determination of Bearing Capacity of Shallow Foundations	IS 6403
58	Code of Practice for Anti-termite Measures in Buildings	IS 6313
59	Specification for High Alumina Cement for Structural Use	IS 6452
60	Code of Practice for Design & Construction of Steel Chimney	IS 6533
61	Method for Determination of Mass of Zinc Coating on Zinc Coated Iron and Steel Articles	IS 6745
62	Code of Practice for Calculation of Settlements of Foundations	IS 8009
63	Concrete Admixtures – Specification	IS 9103
64	Criteria for Design of Steel Bins for Storage of Bulk Materials	IS 9178

S. No.	Description	Standards/Codes
65	Code of Practice for Design and Construction of Shallow Foundations on Rocks	IS 12070
66	Provision of Water-Stops at transverse Contraction Joints in Masonry and Concrete	IS 12200
67	Specification for Sulphate Resisting Portland Cement	IS 12330
68	Pulverised Fuel Ash Lime Bricks – Specifications	IS 12894
69	Fusion Bonded Epoxy Coated Reinforcing Bars	IS 13620
70	Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces	IS 13920
71	Safety of Control Room for Hydrocarbon Industry	OISD-STD-163
72	Fire Proofing of Steel Supporting Structures in Oil & Gas Industry	OISD-STD-164
73	Fire Protection System for Electrical Installations	OISD-STD-173
74	Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese steel	IS 814
75	Chlorpyrifos Emulsifiable Concentrates	IS 8944
76	Imidacloprid Suspension Concentrate (SC) – Specification	IS 16131
77	Pesticide – Bifenthrin, Technical – Specification	IS 15936
78	Recommendations for Metal Arc Welding of Carbon and Carbon Manganese Steel	IS 9595
79	Two Parts Polysulphide-based Sealants	IS 12118
80	Welded Tanks for Oil Storage	API 650
81	Code of Practice for Road Bridges	IRC:6
82	Code of Practice for Construction of Autoclaved Cellular Concrete Block Masonry	IS 6041
83	Standard Specification for Thin-bed Mortar for Autoclaved Aerated Concrete (AAC) Masonry	ASTM C 1660

Note: The above list is suggestive and not exhaustive. Apart from these basic codes any other related codes shall also be followed wherever required. Where Indian codes are not available, any other suitable international codes shall be referred. All codes & standards shall be latest revision with all amendments issued thereto.

3.0 GENERAL /DESIGN CONSIDERATIONS

3.1 MATERIAL OF CONSTRUCTION

S. No.	Name of Structure	Material of Construction	Level up to	Fire Proofing up to	Remarks
1.0	Technological Structures				
1.1	Supporting Process equipment's, with/ without air coolers	RCC	2.5m above HPP	NA	For MOC, Refer Note-a
1.2	Supporting process equipment's with air coolers	Steel	Above RCC Portion up to top	Air cooler Supporting level.	For MOC, Refer Note-a
1.3	Supporting process equipment's without air coolers	Steel	Above RCC Portion up to top	As per OISD- STD-164 or min. 9.1m above HPP, whichever is Higher.	
2.0	Pipe Rack				
2.1	Inside process unit (without air cooler)	RCC (Precast/ Cast-in-situ)	First tier level above HPP	NA	
		Steel	Above RCC Portion up to top	As per OISD- STD-164 or min. 9.1m above HPP, whichever is higher.	
2.2	Inside process unit (with air cooler)	RCC (Precast/ Cast-in-situ)	First tier level above HPP	NA	For MOC, refer Note-a
		Steel	Above RCC Portion	Air cooler supporting level.	For MOC, refer Note-a
2.3	Offsite area	Steel	Top	NA	
3.0	All Shed type structures e.g. compressor house, pump house etc.	Steel	Top	NA	Ref. Note-b
4.0	All plant & non-plant buildings, including blast-resistant buildings	RCC (Precast/ Cast-in-situ)	Top	NA	Ref. Note-c
5.0	All enabling buildings e.g. Warehouse, cement go down etc.	RCC (Precast/ Cast-in-situ)/Steel	Top	NA	Ref. Note-d
6.0	Cable trenches	RCC (Precast/ Cast-in-situ) / Bricks	NA	NA	

Notes:

- a) Blind floor below air cooler shall be in RCC over metal decking (left-in/ sacrificial shuttering).

Slope shall be provided on blind floor slab. Kerb wall with drainage arrangement shall be provided on blind floor slab to avoid pool fire.

- b) Roofing & side cladding shall be as per Architecture Design Basis.
- c) Buildings shall have RCC floors & masonry infill walls; however, blast-resistant buildings shall have RCC walls & precast buildings shall have RCC precast / AAC block wall panels. Material of construction of masonry shall be as per Architecture Design Basis.
- d) Material of construction for buildings shall be as per Architecture Design Basis.
- e) Electro-forged galvanized grating shall be used for flooring at all operating floors, unless RCC floor is required from operations considerations (e.g. blind floor below air coolers supported on technological structure & pipe rack, plant & non-plant buildings).
- f) Electro-forged galvanized grating shall be provided for walkway along crane girder
- g) In case of chequered plate is essentially required at specific locations, Electro-forged galvanized grating shall be provided under chequered plates for safety reasons.
- h) Air cooler Structure shall be fire-proofed as per requirement of OISD-STD-164.
- i) Fire-proofing material for steel structures wherever required, shall be as follows:
 - i) Concrete for structures, supporting transfer line & two-phase flow line above 6" diameter.
 - ii) Vermiculite for all other structures, however fire-proofing up to minimum 1.8m from HPP shall be in concrete. Epoxy intumescent fire proofing material shall be used near critical equipment like Compressors, Reactors and Air fin cooler floors.

3.2 LOADS

3.2.1 DEAD LOADS

The weight of all permanent construction, including foundation, walls, floors, roofs, partitions, fire-proofing, stairways and fixed service and other equipments including all fixtures, platforms, ladders and attached piping but excluding their content. If piping weight is not indicated separately or included in the weight of the equipment, the same shall be taken as 10% of the empty weight of the equipment. Component of soil backfill weight over foundation slab shall be considered as foundation dead load.

The dead load of panels in sub-station & control room shall be considered as 12.0 kN/Sq.m or actual panel load whichever is higher for panel area only. The dead load of false ceiling & false flooring shall be considered as 0.75kN/Sq.m, wherever applicable.

In absence of actual panel area/load, for foundation and column design, panel load shall be considered as 7.0 KN/ Sq.m distributed uniformly on entire switchgear hall (including panel area).

The unit weight of materials in general, should be in accordance with IS 875 Part 1.

3.2.2 IMPOSED LOADS

Following may be considered under Imposed Loads:

3.2.2.1 LIVE LOADS

Live loads shall, in general, be as per IS 875 Part-2. However, the following minimum live loads shall be considered in the design of structures to account for maintenance and erection as well:

S. No.	Title/ Description	Value	UOM	Remarks
1.0	Process Building/ Technological Structure (open/closed)			
1.1	Operating area	5.0	kN/sqm	
1.2	Maintenance area	7.5	kN/sqm	
2.0	Compressor House/ TG house			
2.1	Operating area	7.5	kN/sqm	
2.2	Maintenance area	7.5	kN/sqm	(or as specified by machine vendor)
3.0	Platforms			
3.1	Service platform around/ on Vessel/ Tower	3.0	kN/sqm	
3.2	Isolated platform (for valve operation)	3.0	kN/sqm	
3.3	Access way	3.0	kN/sqm	
3.4	Cross over	2.0	kN/sqm	
4.0	Sub-station/Control Room floors			
4.1	Panel floor- Operating	5.0	kN/sqm	Refer note- b / d
4.2	Panel floor- Maintenance	10.0	kN/sqm	Refer note- c / d
4.3	Unknown partition (Definition as per Cl. 3.1.2 of IS 875 Part-2)	1.0	kN/sqm	
5.0	Office building			
5.1	Office area	3.0	kN/sqm	
5.2	Lobby	5.0	kN/sqm	
5.3	Exit way	5.0	kN/sqm	
5.4	Unknown partition (Definition as per Cl. 3.1.2 of IS 875 Part-2)	1.0	kN/sqm	
6.0	Laboratory			
6.1	Upper floors	4.0	kN/sqm	
7.0	Cooling tower			
7.1	Operating platform/ Hot water basin cover slab	3.0	kN/sqm	
8.0	Staircase			
8.1	Process building/ Technological structure	5.0	kN/sqm	
8.2	Office	5.0	kN/sqm	
8.3	Sub-station/ Control room	5.0	kN/sqm	
8.4	Laboratory	3.0	kN/sqm	
8.5	Service platforms	2.5	kN/sqm	
9.0	Walkway			
9.1	Gantry girder	3.0	kN/sqm	
10.0	RCC UG sump			
10.1	Sump top slab	3.0	kN/sqm	

Note:

- Live load on various types of roofs shall be as per requirements given in IS 875 Part-2.
- Live load shall be on entire panel floor excluding panel area. Load shall be combined with wind and seismic loads.
- Live load shall be on entire panel floor excluding panel area. Load shall not be combined with wind and seismic loads.
- In absence of actual panel area, for foundation and column design, live loads shall be considered as 3.0 KN/sqm for operating case and 6.0 KN/sqm for maintenance case, distributed uniformly on entire switchgear hall (including panel area).

3.2.2.2 HYDRO-TEST LOAD

All equipment foundations & supporting structures shall be designed for Hydro-test loads. Hydro-test shall be considered for one equipment at a time. Further, under hydro-test condition the wind force shall be taken as 25% of normal wind loading. Seismic forces shall not be considered while hydro-testing.

3.2.2.3 OPERATING LOAD OF EQUIPMENT

Operating loads shall include the maximum designed equipment inventory in the operating cycle of the plant. For silos, the contents shall be considered as operating loads.

3.2.2.4 BUNDLE PULL

S. No.	Project Philosophy
1.0	Bundle pull for different types of Exchangers shall be taken as under unless otherwise specified in the equipment data sheet:
1.1	For Fixed type, no bundle pull is considered.
1.2	For Kettle type, bundle pull to be considered as 0.3 times the bundle weight.
1.3	For all other types, bundle pull to be considered as 0.86 times the bundle weight or 30 N/mm of diameter, whichever is greater.
2.0	Total Bundle Pull shall be considered on fixed pedestal alone.

3.2.2.5 PIPING LOAD

Piping loads shall be considered as follows:

- Actual load as given by piping department, for structures other than pipe racks.
- For Piperack, refer Clause No 4.5.1

3.2.2.6 IMPACT & VIBRATORY LOADS

Structures subjected to impact or vibratory loads shall be designed as per the provisions of IS 875 Part-5 & IS 2974.

3.2.2.7 MAINTENANCE LOADS

These are temporary loads (i.e. monorail etc.) and are not to be combined with wind loads/ Seismic loads.

3.2.3 WIND LOAD

Wind loads shall generally be as per IS 875 Part-3 except for switch yard structures & Transmission towers for which IS 802 shall be applicable.

S. No.	Title/ Description	Value	UOM	Remarks
1.0	Basic wind Speed, V_b	39	m/sec	
2.0	k_1 (Probability factor, risk coefficient)			
2.1	For permanent structures	1.00	-NA-	
2.2	For temporary structures	0.76	-NA-	Based on V_b
2.3	For boundary wall/ barricading	0.76	-NA-	
3.0	k_2 (Terrain roughness & height factor)		-NA-	
3.1	For category	2	-NA-	
4.0	k_3 (Topography factor)	1.00	-NA-	
5.0	K_4 (Importance factor for the cyclonic region)		-NA-	Industrial Structures
		-	-NA-	All other Structures
6.0	Mean probable design life for computation of wind forces shall be considered as follows:			
6.1	All structures (units & offsite)	50	Years	
6.2	temporary sheds, structures such as those used during construction operations (for example, formwork and false work), structures during construction stages and boundary walls	5	Years	

Note: To account for surface area of piping, platforms and other attachments fixed to the equipment the surface area of the equipment (vessel / column) exposed to wind shall be increased by 20% or as specified in the mechanical datasheet of the equipment.

3.2.4 SEISMIC LOAD

Seismic forces shall be based on IS 1893 (Part- 1 & 4) & site specific recommendations & response spectra document as issued for the project.

3.2.5 BLAST FORCES

S. No.	Project Philosophy
1.0	Structures subjected to blast forces generated due to accidental blasts from hydrocarbon ignitions shall be designed corresponding to Blast Pressure as recommended in Rapid Risk Analysis (RRA) report, subjected to minimum static incident overpressure of 3psi (20.7KN/sq.m). In absence of RRA report, minimum static incident overpressure shall be considered as 3psi (20.7KN/sq.m) as specified in OISD-STD-163.

S. No.	Project Philosophy
2.0	Following load configurations with respect to design of wall panel, roof slab and frame members shall be considered: a. Front wall loading: Each wall shall be designed as front wall to withstand load due to peak reflected overpressure. b. Roof slabs & beams shall sustain peak incident overpressure. c. Main frame shall sustain peak reflected overpressure on any one wall and incident overpressure on roof & side walls.
3.0	Static Analysis Load Combination for Blast Load: a) for Flexural / Axial Design 1.0 (Dead Load + Live Load + Blast Load) b) for shear Design 1.2 (Dead Load + Live Load + Blast Load)

3.2.6 OTHER LOADS

S. No.	Project Philosophy
1.0	Apart from the specified live loads, any other equipment load or possible overloading during construction / erection / hydro-test of equipment or piping / maintenance shall also be considered in the design.
2.0	Design of all structures shall also consider any other relevant and consequential load / stress imparted to the structure.
3.0	All liquid retaining / storage structures shall be designed assuming liquid up to the full height of wall irrespective of provision of any over flow arrangement.
4.0	Pressure relief valves or similar pressure relieving devices for relieving ground water pressure shall not be made in underground water retaining/ storage RCC structures.
5.0	Hot water basin in cooling tower shall be designed for the weight of water upto top of parapet wall.
6.0	All buildings / structures shall be designed to resist the worst combination of the above loads (in accordance with IS 875 Part-5, other than seismic loads). However, wind/ seismic loads shall not be considered in combination together or with loads during maintenance.
7.0	Box culverts are designed for class A & class AA loading as per IRC-6.

3.3 FLOORING DETAILS FOR BUILDINGS & SHEDS

S. No.	Description	Flooring Type I	Flooring Type II	Flooring Type III
1.0	Sub Grade			
1.1	Earth-fill base Compacted to 95% dry density.	To be provided	To be provided	To be provided
1.2	Compacted layer of sand over Thoroughly compacted Earth fill (mm)	200 mm thick	200 mm thick	150 mm thick
2.0	Structural Grade Slab			

S. No.	Description	Flooring Type I	Flooring Type II	Flooring Type III
2.1	Lean concrete 1:5:10 over sand layer(mm)	50 mm thick	50 mm thick	50 mm thick
2.2	Structural non suspended slab in M20 Grade concrete (Reinforced with 8 mm dia. Bars @ 200c/c both ways) over lean concrete	150 mm thick slab with reinforcement placed centrally.	150 mm thick slab with reinforcement placed in two layers (at top & bottom).	100 mm thick slab without reinforcement.

Note:

- Flooring details as given above shall be adopted for the non-suspended ground floor slabs for buildings & sheds only as categorized for various flooring types.
- Flooring Type I shall be considered for Control Rooms, Satellite Rack Rooms, Sub- Stations, Pump Houses, Utility Compressor Houses, Parking Areas, Stores, Porches.
- Flooring Type II shall be considered for Ware Houses, Workshops, Cement Go-downs, Fire Stations, Process Compressor Houses.
- Flooring Type III shall be considered for Administration, Laboratory, Canteen, Time Office, Gate House, Training Centre, Guest House, Residential buildings.
- Floor finish for all the above three types of flooring shall be as per Engineering Design Basis (Architecture).
- Reinforcement steel shall be as per clause 4.2.3 of this document.
- In case Job specific flooring detail is provided elsewhere in the SOW/ Tender/ Package input then more Stringent detail amongst above detail and job specific detail shall be followed. Stringent shall be followed for all individual item i.e. thickness of concrete, reinforcement detail etc.
- Expansion gap if provided in the building shall be provided in flooring also.
- Outdoor pavements shall be as per Engineering Design Basis–General Civil. However, 20 mm gap to be provided between floor slab and equipment foundation / column and shall be sealed using joint sealing compound.
- All contraction/ construction/ expansion joints of building floor shall be filled with liquid polysulphide sealant as per IS 12118.

4.0 SPECIFIC DESIGN CONSIDERATIONS

4.1 FOUNDATION DESIGN

4.1.1 MINIMUM REQUIREMENTS

S. No.	Project Philosophy
1.0	Minimum depth of foundation for all structures/ buildings shall be as per Geotechnical Recommendations.

S. No.	Project Philosophy
2.0	Factors of safety against overturning and sliding shall be as per clause 4.1.2 of this document.
3.0	For stability checks the weight of soil as overburden (soil backfill weight over foundation slab) shall be as per clause 4.1.2 of this document.
4.0	The design ground water level shall be as per the Geotechnical Recommendations and the hydrostatic pressure shall be adequately accounted for in design.
5.0	Allowable Net Safe Bearing Capacity (SBC) of soil for isolated/ raft/ pile/ tank Foundations shall be based on the settlement criteria for dead plus imposed load conditions, as follows:
5.1	For isolated foundations in Unit areas, Utility areas and foundations of Plant buildings, settlement shall be considered as 25mm.
5.2	For isolated foundations of non-plant buildings, settlement shall be considered as 40mm.
5.3	For Raft foundations, settlement shall be considered as 40mm.
5.4	Cone roof/ Dome roof Storage Tanks resting on sand pad foundation, permissible settlement shall be as per API-650.
5.5	Floating roof Storage Tanks resting on sand pad foundation, permissible settlement shall be as per API-650.
6.0	Pile capacities (compression, shear and uplift/tension) shall be as per Geotechnical Recommendations.
7.0	For transient loadings, e.g., wind/seismic, SBC (safe bearing capacity) shall be considered based on shear criteria instead of settlement criteria.
8.0	Permissible increase in SBC/Pile capacities (for compression, shear and uplift/tension) shall be as per the Geotechnical Recommendations.
8.1	Under blast (due to hydrocarbon explosion) load combinations the SBC of soil shall not exceed 2.0 times allowable static bearing pressure of soil.
8.2	Under blast (due to hydrocarbon explosion) load combinations Pile capacity shall not exceed 2.0 times the permissible capacity under compression, tension and shear modes.
9.0	Foundation for vibrating equipment shall be kept independent of building floors/ Foundations and other adjacent foundations.
10.0	Foundation for tanks upto 10m diameter shall be of RCC ring wall type. Foundation for tanks above 10m diameter shall also be of RCC ring wall type if required from anchorage or counter weight considerations or as per geotechnical recommendations.
11.0	Foundation for acid/ alkali storage tanks shall have acid/ alkali resistant lining & under tank drainage arrangement.

4.1.2 FACTORS OF SAFETY IN FOUNDATION DESIGN

S. No.	Type of Structure	FOS OT-W/S (EL)(i)	FOS OT-N-W/S (EL)(ii)	FOS OT-W/S (OL) (iii)	FOS OT-N-W/S (OL) (iv)	FOS SL-W/S(v)	FOS SL-N-W/S (vi)
1.0	All Structures, Equipment's in Units & Offsite	1.5	1.5	1.5	2.0	1.5	1.5
2.0	Overhead tank	1.5	-	2.0	-	1.5	-
3.0	Flood Light Mast	1.5	-	1.5	-	1.5	-
4.0	Retaining Wall	-	-	1.5	2.0	1.5	1.5

S. No.	Type of Structure	FOS OT-W/S (EL)(i)	FOS OT-N-W/S (EL)(ii)	FOS OT-W/S (OL) (iii)	FOS OT-N-W/S (OL) (iv)	FOS SL-W/S(v)	FOS SL-N-W/S (vi)
5.0	Flare supporting structure	1.5	-	1.5	-	1.5	-
6.0	Blast-resistant structure	-	-	1.5	2.0 or 1.2*	1.5	1.5 or 1.2*
7.0	Transmission Tower / Switch Yard Structure	1.5	2.0	1.5	2.0	1.5	1.75

Legend:

- (i) OT-W/S(EL) –FOS against Overturning with Wind/Seismic in Erection condition.
- (ii) OT-N-W/S(EL) - FOS against Overturning without Wind/Seismic in Erection condition.
- (iii) OT-W/S (OL) - FOS against Overturning with Wind/Seismic in operating condition.
- (iv) OT-N-W/S(OL) –FOS against Overturning without Wind/ Seismic in operating condition.
- (v) SL-W/S- FOS against Sliding with Wind/Seismic.
- (vi) SL-N-W/S- FOS against Sliding without Wind/Seismic.

Note:

- a) *-with blast pressure.
- b) Minimum factor of safety against uplift & overturning for liquid retaining structures, shall be as per IS 3370 (Part 1) (in case of sumps, lining weight shall not be included). For all other structures minimum factor of safety against uplift shall be 1.2.

In the design of foundations, the upward pressure of water, where applicable, should be taken as the full hydrostatic pressure applied over the whole area. The hydrostatic head shall be measured from the underside of construction. The beneficial load of backfill can be included only in circumstances where it will never be removed.

- c) Percentage weight of overburden shall be taken as 100% & to be considered on projected plan area of footing.

4.1.3 ANTI-TERMITE TREATMENT

All buildings coming in units, offsite and utility shall be provided with anti-termite treatment as per IS 6313 and IS 8944.

4.1.4 MINIMUM COVER TO FOUNDATION BOLT/POCKET

S. No.	Project Philosophy
1.0	Minimum distance from the center line of foundation bolt/ anchor bolt to edge of pedestal shall be the maximum of the following:
1.1	Clear distance from the edge of the base plate/base frame to the outer edge of the pedestal shall be minimum 50 mm.
1.2	Clear distance from the face of pocket to the outer edge of the pedestal shall be 100 mm.
1.3	Clear distance from the edge of the sleeve or anchor plate to the edge of pedestal shall be 100mm
2.0	The tension capacities of anchor bolts shall be worked out based on the bolt to bolt spacing and the distance between anchor bolt to the edge of concrete. If required, additional reinforcement around anchor bolts shall be provided in the concrete pedestal.

4.1.5 HEIGHT OF PEDESTAL

S. No.	Project Philosophy
1.0	The minimum projection of pedestals supporting any steel structure/column bases shall be 300 mm/ 150 mm above the high point of pavement/ finished grade/ finished floor level whichever is higher, for outdoor and indoor located pedestals respectively.
2.0	Off-site pipe rack/ pipe bridge/ pipe support pedestals shall be of minimum 500mm Height above FGL.
3.0	The maximum projection of pedestals for staircase/ladder shall be 200mm.

4.1.6 GROUTING & MINIMUM GROUT THICKNESS

S. No.	Project Philosophy
1.0	The thickness of grout shall be as follows:
1.1	Minimum 50mm for process columns(equipment) unless otherwise required in equipment datasheet.
1.2	Minimum 30mm & maximum 50mm for all other foundations/structures, unless otherwise required in equipment/ vendor data sheet
2.0	All anchor bolt sleeves/pockets and spaces under column bases, shoe plates etc. Shall be grouted with free flow, non-shrink (pre-mix type) grout with 28-day minimum cube crushing strength of 40N/sq mm.
3.0	Ordinary cement sand (1:2) grout shall only be used under the base plates of cross-overs, short pipe supports (not exceeding 1.5 m height) and small operating platforms (not exceeding 2.0m height) not supporting any equipment.
4.0	Grouting requirement for machines and equipment's are not covered here. The same shall be governed by vendor's requirement.

4.2 RCC STRUCTURES & FOUNDATIONS

4.2.1 GENERAL/ DESIGN METHODS

S. No.	Project Philosophy
1.0	All buildings, structures, foundations, machine/ equipment foundations, liquid retaining/ storage structures, trenches, pits etc. shall be of RCC and designed based on the following IS Codes in general and other relevant IS Codes applicable: IS 456, IS 875, IS 1893, IS 1904, IS 2911, IS 2950, IS 2974, IS 3370, IS 4091, IS 4326, IS 4991, IS 4995, IS 4998, IS 5249, IS 6403, IS 8009, IS 13920.
2.0	Only limit state method as per IS 456 shall be followed in the design unless otherwise specified elsewhere in this document for special structures.
3.0	All structures shall be of frame type construction. Ductile detailing requirement (if any) shall be as per IS 13920 for RCC Structure & IS 800 Section 12 for Steel Structure.
4.0	Where the specified design depth of ground water table so warrants all underground pits, tunnels, basements etc. (excluding appurtenances of stormwater/ effluent collection system, cable trench, pipe trench) shall be of leak-proof RCC construction using approved make of water-proofing compounds.

S. No.	Project Philosophy
5.0	All liquid retaining/storage RCC structures shall be leak-proof and designed as un-Cracked section (or with limited crack width in limit state design) as per IS 3370. However, the parts of such structures not coming in direct contact with liquid shall be designed according to IS 456 except ribs of beams of suspended floor slabs, counterforts of walls (located on the side remote from the liquid) and roof which shall be designed as un-cracked section (or with limited crack width in limit state design) as per IS 3370. No increase in permissible stresses in concrete and reinforcement shall be made under wind or seismic conditions for such structures. Pipe entering/ exit shall be provided with puddle flange for RCC water retaining structure.
6.0	The walls and base slabs of liquid retaining/storage structures shall be provided with reinforcement on both faces for thickness greater than or equal to 150mm. In All liquid retaining structures, PVC water bars (minimum size 230mm wide x 5mm thick) shall be provided at each construction joint (horizontal and vertical).
7.0	Water basin and other primary framing members of Cooling towers or similar liquid retaining structures which remain constantly in contact with water (stored/sprayed) shall be designed as un-cracked sections (or with limited crack width in limit state design) as per IS 3370.
8.0	Ground improvement below & around foundation & back-filling shall be as per Geotechnical recommendation.
9.0	Corrosion resistant protective coating around footing shall be as per Geotechnical recommendation.

4.2.2 CONCRETE

S. No.	Project Philosophy
1.0	The minimum grade of reinforced cement concrete to be used for super-structure & sub-structure (in case otherwise specified in Geotechnical Recommendation, higher grade shall be followed for sub-structure) shall be M25 (design mix) as per IS 456 based on Moderate exposure condition. However, for liquid retaining structures the minimum grade of reinforced cement concrete shall be as per IS 3370.
1.1	From durability considerations the minimum cement content and maximum water-cement ratio shall be 300 Kg/Cu.m and 0.50 for M25 (design mix). However, the maximum cement content shall not exceed 450 kg/m ³ . For liquid retaining structures the minimum cement content and maximum water-cement ratio shall be as per IS 3370.
2.0	Generally, the use of one of the following type of cements shall be considered:
2.1	Ordinary Portland Cement (OPC) conforming to IS 269.
2.2	Portland Pozzolana Cement (PPC, fly ash based) conforming to IS 1489 Part 1.
2.3	Portland Pozzolana Cement (PPC, calcined based) conforming to IS 1489 Part 2.
2.4	Portland Slag Cement (PSC) conforming to IS 455.
2.5	Sulphate Resistant Portland Cement (SRC) conforming to IS 12330 shall be used (if required as per soil recommendation for respective site).
3.0	Minimum cement content for concrete in foundation shall be as per Geotechnical Recommendations document.
4.0	75mm thick lean concrete of grade 1:5:10 shall be provided under all RCC foundations (except under base slab of liquid retaining structures). The lean concrete shall extend 50mm beyond the foundation edges on all sides.
5.0	100mm thick lean concrete of grade M15 (nominal mix) shall be provided under Base slab of liquid retaining structures. The lean concrete shall extend 75mm beyond the foundation edges on all sides.
6.0	Plain Cement Concrete (PCC) mud mat of grade M20 (nominal mix) of minimum 150 mm thickness shall be provided under all masonry wall foundations.

S. No.	Project Philosophy
6.1	From durability considerations the minimum cement content and maximum water-cement ratio shall be 240 Kg/Cu.m and 0.60 respectively. However, the maximum cement content shall not exceed 450 kg/m ³ .
7.0	Plain cement concrete of grade M20 (nominal mix) of minimum 40mm thickness Shall be provided as dampproof course at plinth level of all masonry walls. Integral water-proofing compound conforming to IS 2645 shall be mixed with concrete (as per manufacturer's specifications) and coated with bitumen emulsion.
8.0	Crystalline water-proofing compound of approved make as per CPWD specification shall be mixed with concrete for all liquid retaining/leak-proof structures.
9.0	Self-compacting concrete shall be provided as per EIL Specification for concrete works wherever required as directed by Engineer-in-charge.
10.0	Water based solvent free white pigmented curing compound as per manufacturer's specification and satisfying National or International standards for all concrete surfaces wherever required as directed by Engineer-in-charge.

4.2.3 REINFORCEMENT BARS

S. No.	Project Philosophy
1.0	High Strength deformed steel bars (TMT) of Grade Fe500D shall be used as reinforcement for all structures.
2.0	18-gauge black soft annealed SWG wire shall be used for binding of reinforcement bars.
3.0	Corrosion protection of reinforcement bars:
3.1	Bi-polar concrete penetrating Corrosion inhibiting admixture in concrete
4.0	Minimum and maximum bar spacing for foundations, slabs, stirrups for beams, Ties for columns, pedestals, walls etc. should be 100mm and 300mm respectively. However, for main reinforcement in blast resistant wall and roof slab, maximum bar spacing shall be 150mm. Bar spacing should be provided in multiples of 25mm.
5.0	Minimum bar diameter shall be as follows:
5.1	Piles: Main Bars: 12 mm
5.2	Piles: Tie Bars: 8 mm
5.3	Major & Minor Foundations: 12 mm
5.4	Block Foundations: Main Bars & Tie Bars: 12 mm
5.5	Pedestals, Columns: Main Bars: 12 mm
5.6	Pedestals, Columns: Tie Bars: 8 mm
5.7	Beams: Main Bars: 12 mm
5.8	Beams: Anchor Bars: 10 mm
5.9	Beams: Stirrups: 8mm
5.10	Slabs & Walls: Main Bars: 10 mm
5.11	Slabs & Walls: Distribution Bars: 8mm
5.12	Minor Elements (e.g. chajja, parapet, lintel, etc.): 8 mm
5.13	Slabs & Walls (blast-resistant buildings): 12 mm

4.2.4 MINIMUM COVER TO MAIN REINFORCEMENT

Clear cover shall be considered overlinks/ stirrups/ ties. Unless otherwise specified in Geotechnical Recommendations, minimum clear cover to RCC elements shall be provided as follows:

S. No.	Title/ Description	Value	UOM
1.0	Foundation slab, base slab, pedestal, plinth beam	50	mm

S. No.	Title/ Description	Value	UOM
2.0	Pile Cap		
2.1	Bottom face	100	mm
2.2	Top& sides	50	mm
3.0	Retaining Wall, Basement and Pit Wall:		
3.1	Face in contact with earth	50	mm
3.2	Free face	30	mm
4.0	Column	50	mm
5.0	Tie beam, Floor beam, Roof Beam	40	mm
6.0	Floor slab, Roof slab, Canopy, Lintel	30	mm
7.0	Liquid retaining structure		
7.1	Face in contact with liquid	30	mm
7.2	Face away from liquid but in Contact with earth	50	mm
7.3	Free face	30	mm

4.2.5 MINIMUM THICKNESS OF STRUCTURAL CONCRETE ELEMENT

The following minimum thickness shall be followed:

S. No.	Title/ Description	Value	UOM
1.0	Footings (all types, with or without beams)	300	mm
1.1	Tapered Footings (all types, with or without beams)	150 (at edge) 300 (average)	mm
2.0	Pile Cap	500	mm
3.0	Liquid retaining/ Leak-proof structure/ Basement/ Underground Pit:		
3.1	Base slab	300	mm
3.2	Walls	150	mm
4.0	Floor/ Roof Slab, Walkway, Canopy slab	150	mm
5.0	Cable/Pipe Trench/Launder Walls & Base Slab	125	mm
6.0	Parapet	125	mm
7.0	Louver/Fin	125	mm
8.0	Louver (in contact with liquid)	125	mm
9.0	Precast Trench Cover/ Precast Floor Slab	125	mm
10.0	Blast Resistant Structure		
10.1	Blast Resistant Wall	250	mm
10.2	Blast Resistant Roof	As per OISD 163	

4.3 STEEL STRUCTURES

4.3.1 GENERAL/ DESIGN METHODS

S. No.	Project Philosophy
1.0	Design, fabrication and erection of the above work shall be carried out in accordance with the following IS Codes as applicable to the specific structures, viz. IS 800, IS 801, IS 802, IS 806, IS 814, IS 816, IS 875, IS 1893, IS 6533, IS 9178, IS 9595, etc. Basic consideration of structural framework shall primarily be stability, ease of fabrication/ erection and overall economy satisfying relevant Indian Standard Codes of Practice. Simple and fully rigid design as per IS 800 shall be used. Where fully rigid joints are adopted, they shall generally be confined to the major axis of the column member.
2.0	All Structural Steel elements continuously exposed to temperatures above 215 DEG C shall be designed for reduced stress as per Clause 16.4(Fig24) of IS 800.
3.0	Crane gantry girders shall generally be of welded construction and of single span lengths.
4.0	Steel staircases for main approaches to operating platforms shall have channels provided as stringers with minimum clear width of 750 mm and slope of approximately 41degree. The vertical height between successive landings shall not be less than 2.6m or exceed 4.0m. Treads shall be minimum 230mm wide made of electro-forged galvanized grating (with suitable nosing) spaced equally so as to restrict the rise to maximum 200 mm.
5.0	Hand rails 1000mm high (from top of grating/top of chequered plate/FFL), shall be provided to all walkways, platforms, staircases. Toeplate (100mmx6mm) shall be provided for all horizontal handrailing (except for handrailing in inclined portion of staircases & platforms around circular vessels). Handrail shall be as per EIL Standard No. 7-68-0060.
6.0	Electro-forged Hot-dipped galvanized MS Gratings shall be as per EIL Standard Specification No. 7-68-0697.
7.0	Welded connections shall be adopted during shop fabrication, except where only bolted connections are required (viz. removable members, galvanized electrical Switchyard structures and transmission towers). Field/site connections shall be bolted.
8.0	Structural connections shall have minimum two bolts of 16mm diameter, unless otherwise limited by the size of members.
9.0	Minimum two nuts shall be used for all anchor bolts except for crossovers, platforms on grade & T- supports.

4.3.2 GRADE OF STEEL

S. No.	Project Philosophy
1.0	Structural steel shall be of Grade E350 Quality BR/B0 conforming to IS 2062. Anchor bolts shall be of Grade E250 Quality BR/B0 conforming to IS 2062. Minimum grade of steel for insert plate, chequered plate, cover plate for fire proofing, grating & steel structure in platforms taken from equipment shall be of Grade E250 Quality BR/B0 conforming to IS 2062.
2.0	Tubular/ hollow steel shall be of Grade Yst355.
3.0	Properties of steel sections shall be as follows:
3.1	Hot Rolled Steel Beam, Column, Channel and Angle Sections - Dimensions and Properties as per IS 808
3.2	Circular Hollow Sections (CHS) as per IS 1161
3.3	Square Hollow Sections (SHS)/ Rectangular Hollow Sections (RHS) as per IS 4923

4.0	Connection Bolts shall be High Strength Structural Steel (Hot Dip Galvanized) Bolts of Property Class 8.8 conforming to IS 3757 & IS 4000. Hexagonal Nuts shall conform to IS 6623. Washers shall conform to IS 6649.

4.3.3 LIMITING PERMISSIBLE STRESSES

S. No.	Project Philosophy
1.0	Permissible stresses in structural members shall be as follows:
1.1	Hot rolled sections (excluding transmission towers and switchyard structures) as specified in IS 800
1.2	Cold formed light gauge sections as specified in IS 801
1.3	Transmission towers & switchyard structures as specified in IS 802
1.4	Tubular structures as specified in IS 806
2.0	Permissible stresses in bolts shall be as follows:
2.1	Hot rolled sections (excluding transmission towers and switchyard structures) as specified in IS 800
2.2	Cold formed light gauge sections as specified in IS 801
2.3	Transmission towers & switchyard structures as specified in IS 802
3.0	Permissible stresses in welds shall be as follows:
3.1	Cold formed light gauge sections as specified in IS 801
3.2	Metal Arc Welding as specified in IS 816

4.3.4 LIMITING DEFLECTION

4.3.4.1 LIMITING VERTICAL DEFLECTION

The limiting permissible vertical deflection for structural steel members such as gantry girder for electric overhead crane, manually operated crane, purlin supporting any type of roofing material under dead + live load or dead + wind load conditions shall be as specified in IS 800, however for girder/beam for supporting dynamic equipment/hoist, the same shall be Span/450.

Note: Limiting permissible vertical deflection for grating/ chequered plate shall be Span/200 or 6mm whichever is minimum.

4.3.4.2 LIMITING HORIZONTAL DEFLECTION

The limiting permissible horizontal deflection for structural steel members shall be as specified below, where 'H' represents the height:

S. No.	Title/ Description	Value	UOM
1.0	Multi storeyed steel structure/ Building	as per IS 800	Same as 'H'
2.0	Flare stack supporting structure	H/200	Same as 'H'

4.3.5 MINIMUM THICKNESS

The minimum thickness of various structural components (hot rolled sections) shall be as given:

S. No.	Title / Description	Value	UOM	Remarks
1.0	Trusses, purlins, side girts & bracings	6	mm	
2.0	Columns, beams	7	mm	

S. No.	Title / Description	Value	UOM	Remarks
3.0	Gussets in trusses & girders			
3.1	upto and including 12m span	8	mm	
3.2	above 12m span	10	mm	
4.0	Stiffeners	8	mm	
5.0	Base plates	10	mm	
6.0	Chequered plate	6	mm	(plain thickness)
7.0	Grating	3	mm	
8.0	Hollow RHS & SHS section upto 80mm depth	4	mm	
9.0	Hollow RHS & SHS section above 80mm depth	6	mm	
10.0	Plate thickness for primary framing members of PEB	8	mm	
11.0	Plate thickness for cold formed secondary members of PEB	2.5	mm	GI coated

Notes:

- For transmission towers & switchyard structures the minimum thickness of various structural components shall be as per IS 802.
- The minimum thickness for rolled beams and channels shall be mean flange thickness regardless of the web thickness.
- The minimum thickness of structural components (except gratings & chequered plates) which are directly exposed to weather and in accessible for repainting shall be 8mm.
- The minimum thickness of tubes shall be as specified in IS 806.
- Structural members exposed to marked corrosive action shall be increased in thickness or otherwise suitably protected against corrosion.
- Chequered plates shall be avoided on structures exposed to atmosphere.

4.3.6 ELECTRICAL SWITCHYARD STRUCTURE & TRANSMISSION TOWER

S. No.	Project Philosophy
1.0	All electrical switchyard structure and transmission tower shall be of structural steel with bolted connections and designed as per of IS 802
2.0	Structural steel members including bolts, nuts and washers shall be hot dip galvanized in accordance with relevant IS Codes. The Zinc coating on tower members shall not be less than 900g/sqm of the surface area

4.3.7 FLARE STACK

S. No.	Project Philosophy
1.0	Structural steel members including bolts, nuts and washers shall be hot dip galvanized in accordance with relevant IS Codes. The Zinc coating on tower members shall not be less than 900g/sqm of the surface area

4.3.8 PROTECTIVE COATING

Protective Coating (including surface preparation, shop primer, field primer & finish coat) to Concrete, Structural Steel, Ladders, Spiral Stairways, Grating & Hand Rails shall be as per the Project Specification.

4.4 MASONRY WORKS

4.4.1 GENERAL

S. No.	Project Philosophy
1.0	All masonry works shall be designed in accordance with IS 1077, IS 1905, IS 1597, IS 2185, IS 4326, IS 12894 and other relevant IS Codes as applicable.
2.0	Clay Brick masonry shall be of Class 5.0 as per IS 1077 / AAC Block masonry shall be of Grade 1 (with minimum compressive strength as 5 N/mm ²) as per IS 2185 (Part-3).
3.0	AAC concrete blocks shall not be used in foundations and for masonry below damp-proof course.
4.0	All external masonry wall shall be of minimum 200 mm thickness for AAC block masonry / 230 mm thickness for other than AAC block masonry, except for fire walls.

4.4.2 CEMENT MORTAR

All masonry work except AAC block shall be constructed in cements and mortar 1:4 for load bearing walls and 1:6 cements and mortar for non-load bearing walls except half brick partition walls which shall be constructed in 1:4 cements and mortar with two numbers of 6mm diameter MS bars provided at every fourth course properly anchored with cross walls or pillars.

All AAC block masonry walls shall be constructed with premixed thin-bed mortar as per ASTM C1660 with prior approval of Engineer-in-Charge. Construction of AAC block masonry including bond beam etc. shall be as per IS 6041 or as directed by Engineer-in-Charge.

4.4.3 FIREWALLS

All fire walls shall be of minimum 300 mm thickness for AAC block masonry / 345 mm thickness for other than AAC block masonry as per OISD-STD-173.

4.5 SPECIFIC APPLICATIONS

4.5.1 PIPE RACK

Pipe rack shall be designed as per pipe loading from piping department.

4.5.2 RCC & STEEL CHIMNEYS

RCC and Steel chimneys shall be designed as per the requirements of EIL Standard Specification No. 6-68-0053, IS 4998 and IS 6533.

4.5.3 MACHINE FOUNDATIONS

Machine foundations shall satisfy the requirements of IS 2974 and any other parameter as specified by the machine manufacturer.

4.5.4 BARRICADING

Foundation and superstructure shall be designed as per Safety/ Client requirements of location & height, keeping in view the mean probable design life of structure.

4.5.5 TANK FOUNDATIONS

Storage tanks shall be supported either on ring wall type pile/ open foundations or sand pads in accordance with the Geotech recommendations.

SCOPE OF WORK & SUPPLY (STRUCTURAL)

STEAM GENERATION PACKAGE

TENDER NO. – B957-420-80-44-PG-T-7410

**PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER
UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM &
REFINERY EXPANSION PROJECT (BPREP)**

OWNER : M/s BHARAT PETROLEUM COOPERATION LIMITED

EPCM : ENGINEERS INDIA LIMITED

JOB NO : B957

0	06.02.2025	ISSUED FOR BIDS	IF	PU	SP
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by



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1. SCOPE OF WORK

The scope of Civil and Structural works under this package shall include design, detailing, supply and construction of all relevant civil and structural works required for successful completion of works for **STEAM GENERATION PACKAGE** for **BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT (BPREP)** of **M/s BHARAT PETROLEUM CORPORATION LIMITED (BPCL)** as per specifications enclosed with the Bid document.

Contractor shall visit the site to ascertain actual site conditions to quantify/ assess the job himself before quoting for the package. No extra claim at a later date shall be entertained due to non-familiarization of site.

Major Civil and Structural works involved shall include but not limited to the following:

- I. Design, Detailing, Supply and Construction of foundations and superstructure for all types of structures & equipment for package (Scope battery limits shall be as per functional discipline i.e. EWS/ General civil / Architectural/ Piping/ Mechanical/ Electrical/ Instrumentation scope) such as:
 - Substation & SRR Building
 - Pipe Rack
 - Boiler structure/shed
 - Any other equipment supporting structure
 - Foundations for boiler, stack, pumps, turbine drive, exchangers, tanks, fans, KOD, skids, any other equipment etc.
 - Supporting structure for electrical cable tray, instrumentation ducts etc.
 - Pipe supports, operating/maintenance platforms, walkways, crossovers, monorail etc.
 - U/G vessel pit, Sumps etc.
 - RCC trenches
 - Modification of existing building/structure if any
 - Any other structures not listed but required to complete the work.
- II. Sand filling below floor and at all locations wherever required.
- III. Fabrication & placing/ erection of miscellaneous steel items like Anchor Bolts, Metal Insert Plates, Chequered Plates, Pipe Sleeves, Hand Railing, etc. as per EIL Specifications/as directed by Engineer-in-charge at any location wherever required.
- IV. Designing and constructing any barricading arrangement required in or around unit/ worksite due to safety reasons at any stage prior to the commissioning of the Plant, and dismantling & removal of the same by the contractor from the site of work after completion of the project.
- V. Design and construction of all foundations shall be in line with geotechnical recommendations (including recommendations for concrete/brick works in sub structure if any) attached elsewhere in the bid package.
- VI. Soil treatment for foundations, wherever required.

- VII. Preparation of bar bending schedule for all RCC works before construction is taken up.
- VIII. Supplying and mixing of approved brand of bipolar concrete penetrating corrosion inhibiting admixture in concrete in superstructure and substructure as per manufacturer's recommendation & EIL specification for protection of reinforcement against corrosion.
- IX. Anti-termite treatment for buildings.
- X. Water proofing and damp proofing wherever specified/ directed by Engineer-in-charge.
- XI. Preparation of fabrication drawings for all structural steel works.
- XII. Providing puddle flange for pipes wherever pipe is crossing RCC wall.
- XIII. Grouting of all equipment & structural steel.
- XIV. Painting of structural steel including shop primer & protective coating for RCC shall be as per relevant painting specification attached elsewhere in the bid package.
- XV. Providing hot dip galvanized electro-forged MS grating & handrails.
- XVI. Providing one side machined sliding plates, embedded in the grout over sliding support, under horizontal equipment.
- XVII. Clearing and removal of debris includes clearing the site of all unserviceable material from the site after completion of work and disposal of the same at a designated area as directed by Owner/ Owner's representative/ Resident Construction Manager.
- XVIII. Obtaining statutory approval from local authorities such as Municipal Corporation, Development authorities, Inspector of Factories and any other concerned authorities, before starting the work at site.
- XIX. Contractor to provide necessary assistance in documentation for statutory approvals taken by client.
- XX. 3-D modeling of all structures including foundations.
- XXI. Documentation of "AS BUILT" drawings/ details for all works in native file format (AutoCAD etc.) (whether designed by CONTRACTOR or Owner/ Owner's representative).
- XXII. All the calculations & STAAD files shall be provided in Native software format (*.xls, *.std etc.). All supporting native files shall be attached as attachment to PDF design report before submission.
- XXIII. Any other civil and structural works required/ directed by Owner/ Owner's representative/ Resident Construction Manager for the satisfactory and successful completion of the Project.

2. SPECIFIC REQUIREMENTS

Apart from the conditions mentioned in the Engineering and Seismic design basis B857-999-81-41-EDB-1001 & B857-000-16-54-DB-0001, 6-68-0021 & 6-68-0022; the following shall be strictly adhered to

- a. Contractor shall make necessary arrangement for placing the anchor bolts in position before concreting. Whenever there are more than four foundation bolts, these shall be fixed by using template.
- b. Package contractor to ensure isolation of structures/ equipment with difference of temperature for free expansion while providing interconnecting platform and for connection to stair structures.
- c. Expansion joint shall be provided in concrete structure as per engineering design basis. Filler material with liquid polysulphide sealant compound shall be provided as per EIL standard 7-68-0065.
- d. Contractor shall ensure lateral stability by providing box/ built-up sections for columns wherever it is not feasible to provide vertical bracing in either direction.
- e. All designs, detailing & construction shall strictly conform to enclosed standards, specifications & drawings.
- f. Sequence of construction is to be shown on the AFC drawings by indicating construction joints wherever required.
- g. During the execution of the work, the contractor, at his own cost, shall keep structures, materials and equipment adequately braced by guys, struts or otherwise approved means which shall be supplied and installed by the Contractor as required till such time the installation work is satisfactorily completed. The provided guys, shoring, bracing, strutting, planking supports etc. shall not interfere with the work of other agencies and shall not damage or cause distortion to other works executed by him or other agencies.
- h. Contractor has to take of all safety measures as per Refinery fire and safety standard.
- i. The contractor shall ensure proper co-ordination / co-operation with other agencies, while working in the Construction area, without affecting others work front areas.
- j. During execution of work, all existing facilities (Temporary /Permanent) shall be protected from any damage. In case of any damage / dismantling (if required) is required to be carried out for carrying out contractor's work. The same shall be restored to original condition to the satisfaction of Owner/ Engineer In-charge without additional time and cost implication.
- k. Fabrication of structure steel shall be done in contractor's fabrication shop outside plant boundary, on its own cost.
- l. Contractor shall make his own arrangements for casting of Pre-cast elements, outside the plant boundary, on its own cost.

- m. Contractor shall consider requirement of borrowed earth from outside the plant boundary for backfilling and similarly disposal of unserviceable surplus earth and debris outside the plant boundary. Contractor shall obtain relevant statutory approval from all statutory authorities, local authorities (like municipal etc.) and including payment of charges/royalty/ octroi for the same. Contractor shall keep client indemnified of any liability and/or complaint from local authorities/municipal bodies etc. However serviceable surplus earth & rock shall be disposed within plant boundary (including Bina dispatch terminal) limit at designated location as per directions of Engineer-in-charge.
- n. Modularization of structure, equipment & piping, including electrical & instrumentation support shall be preferred to the extent possible. Successful bidder to present modularization philosophy during the kick-off meeting.
- o. Use of precast concrete shall be preferred in structures & buildings to the extent possible. Successful bidder to present the precast concrete philosophy during the kick-off meeting.
- p. Contractor shall consider recycling of construction & demolition wastes to the extent possible (except in RCC structures) and to present the recycling philosophy during the kick-off meeting. The construction & demolition waste can be recycled subject to confirmation of material test report as per relevant BIS code for the intended purpose.
- q. Use of products having less embodied carbon (i.e. low carbon footprint) is preferred, subject to meeting other requirements mentioned elsewhere in the tender documents.
- r. All works shall be done to the entire satisfaction of the Owner/Engineer-in-Charge. Any work not carried out in accordance with the instructions shall be dismantled and made good without any extra cost and time implication to the owner.
- s. **Verification of foundation loading data for all equipment/ structures/ stacks etc., which form part of the comprehensive packages supplied by the respective vendors, shall be entirely the responsibility of Package contractor. Package contractor shall ensure that wind/ seismic loadings are strictly in line with the basic wind pressures/ seismic loads enclosed with this package.**
- t. The Net Safe Bearing Capacity of Soil (for both shear & settlement criteria)

considered for the design of foundation shall be mentioned in drawings for all structures and equipment.

3. SCOPE OF SUPPLY OF MATERIALS

All materials (consumable / non-consumable) required for execution of Civil - Structural works under this contract shall be in the scope of CONTRACTOR.

4. VENDOR DATA REQUIREMENT

Vendor to submit & get the documents approved as per VDR requirement provided elsewhere in the bid document.

Submission of typical review category documents shall be taken up prior to corresponding

information category documents. Owner/owner's representative comments on typical review category documents shall be duly taken care in information category documents as well before issuing them for construction.

The contractor shall furnish the quantities of RCC & different grades of structural steel in the respective AFC drawings.

5. ADDENDUM TO STRUCTURAL SPECIFICATIONS

SL No.	Specification	Clause / Item	Title of Document
1.	6-68-0022	Clause 4.1.3	"The damp proof course shall be laid in two layers of equal thickness and each layer given two coats of hot bitumen on top (grade VG-10 conforming to IS 73) at the rate of 1.7 kg/m ² . Dry sharp sand shall be sprinkled evenly over the top layer of bitumen before hardening." shall be read as "40mm thick DAMP PROOF COURSE with plain cement concrete of grade M20 (nominal mix) with 10mm & down size graded crushed stone aggregates shall be provided as damp-proof course at plinth level of all masonry walls. Integral water proofing compound (confirming to IS: 2645) as per manufacturer's specifications shall be mixed with concrete. Two coats of hot bitumen (Grade VG10 conforming to IS:73) @ 1.7 Kg/sq.m for each coat on top surface shall be provided as per specifications including cleaning, watering the top surface of walls, centring, shuttering, placing, tamping, curing, sprinkling an even layer of dry sharp sand over the hot bitumen before hardening as specified and directed."