GENERAL

Project: **EPCM SERVICES FOR POLYPROPLENE PROJECT AT NRL**							EIL Job No: **C050**			
Owner: **M/s NRL**							Site:			
Purchaser:							Unit:		Unit No:	
Item No.:							Service:			
No. Reqd.:		Working:			Standby:		Parallel Operation Required:	☐ Yes	☐ No	
Applicable to	☐ Proposal		☐ Purchase				☐ As Built			
■ Scope option & Information specified by purchaser ☐ Information Reqd. from & option left to vendor. Vendor to cross ☒ the selected option.										
Driver: Working			Standby			Driver Supplied & Mounted By:	☐ Pump Mfr.	☐ Other		

OPERATING CONDITIONS (Refer Process Package)

Liquid Handled						Capacity (m^3/hr): Min/Nor/Rated:	
Pumping Temp. (^{0}C):	Normal			Max.		Discharge Pressure (kg/cm², A):	
Specific Gravity at P.T./15°C:						Suction Pressure: Nor./ Max. (kg/cm², A):	
Vapour Pressure at P.T. (kg/cm², A):						Diff. Pressure (kg/cm²) @ Rated Capacity:	
Viscosity at P.T. (cP/~~cst~~):			Corr./Eros. By:			Diff. Head (m) @ Rated Capacity:	
Solids in suspension	☐ Yes	☐ No	Size:		%	NPSH Available (m):	

MANUFACTURERS SPECIFICATIONS

Pump Manufacturer:							Model No.:		
CONSTRUCTION							**PERFORMANCE**		
Casing Mounting:	☐ Centerline	☐ Foot	☐ Inline				Proposal Curve No.		
Casing Split:	☐ Axial	☐ Radial					Visc. Corr. Factor: C_E	C_Q	C_H
Type:	☐ Single Volute	☐ Double Volute	☐ Diffuser				NPSH Reqd. (Water) (m):	F/L Speed (rpm):	
Casing Connection:	■ Vent	■ Drain	☐ Gauge				No. of stages:	Efficiency (%):	
Nozzles	Size	ANSI Rating	Facing	Position			Rated BKW (0% Tol.):	kW Max.BKW rtd. Imp.:	
Suction							BKW @ MCF (Δ=1.0):	kW Rec. Driver Rating: (kW)	
Discharge							Max.head rtd imp. (m):	Cap@ BEP(m^3/hr):	
Imp. N (mm)	Max:	Rated:	Min:	Type:	**Closed / Semi open**		MCF (m^3/hr): Stable	Thermal	
Brg.: Type/No. Radial:		Thrust:		Lub: **Oil**			M.A.W.P @ 15^{0}C/P.T./Design Temp. (kg/cm², G):		
Cplg. Make/Type:	**Fleximetl w spacer**		Non-spark Guard	■ Yes	☐ No		Hydrostatic Test pressure (kg/cm², G):		
Driver Half cplg. mounted by:	■ Pump Mfr.		☐ Others				Rotation facing coupling end:	☐ CW	☐ CCW
Packing Type:		Size:		No. of rings:			Seal flush/ Quench plan:	Material:	
Mech. Seal:	Make	Model:		API Code:			Ext. seal flush fluid:	LPM: @ Kg/cm²G/ °C	
Base Plate Drain Rim Type:	■ Yes	☐ No	Fdn. Bolts:	■ Yes	☐ No		Seal Barrier fluid:	LPM: @ Kg/cm²G/ °C	
Throat Bush:	■ Yes	☐ No	Matl.:	Bal. Device:	☐ Yes	☐ No	Ext. quench fluid:	LPM: @ Kg/cm²G/ °C	

Materials (API-610 Matl. Class):		**(Rem.4)**	MOC	ASTM Grades
I - Cast Iron (Ductile)	Casing			
B – Bronze	Impeller			
S - Carbon Steel	Inner Case parts			
C - 11-13% Chr. Stl.	Sleeve Packed			
h – Hardened	Sleeve Seal			
f – Faced	Casing ring	ΔH-BHN		
K -SS 304	Impeller ring	50(min)		
L -SS 316	Shaft			
X - AISI 410	Throttle Bush			
Y	Throat Bush			
Z	Balance Drum			

C.W. Plan:	LPM:	@ Kg/cm²G/ °C		
Weight(kg): Pump+Base+Coupling:			Driver:	

AUXILIARY PIPING INTERFACE CONNECTIONS
(All interface conns. shall be terminated with a flanged block valves)

	Size	Rating(ANSI)	Facing
Lantern Ring Inlet/Outlet			
Ext. Seal flush fluid Inlet/Outlet			
Seal Quench fluid Inlet			
Seal pot vent/ drain			
Casing vent/ drain			
C.W Inlet/ Outlet			
Base plate drain (only flanged)			
Casing steam jacket			

☐ Driver suitable for Pump starting with open Disc. Valve condition.

SHOP INSPECTION & TESTS (EACH PUMP)

	Witness	Observe		Witness	Observe
■ Shop Test / Inspection	☐	■	■ NPSH As Reqd. ■ Per Spec. ☐ Mandatory	■	☐
■ Material Certificates	☐	■	■ Dismantle Insp. & Re-assembly after Test (Rem. 6)	■	☐
■ Hydrostatic	☐	■	■ Visual, dimension and skid completeness check	☐	■
■ Performance/Sound Level (Rem. 5)	■	☐	☐ Check for direction of rotation of pump.	☐	☐

Applicable Specification: EIL Standard Specification 6-41-0002, Job Specifications

REMARKS: - 1) Max. allowable casing working pressure shall not be less than _____ kg/cm²g @_____ °C.

2) Down Stream Design Pressure is ____ kg/cm²g. Maximum shut-off, considering max suction pressure, including all tolerances shall not exceed this value.

3) Accessories and Instrumentation shall be as per EIL approved vendors only.

4) MOC shall be as specified in process package.

5) Dismantle Inspection of pump after performance test shall be applicable only in case of abnormality in mechanical behavior (such as excessive noise & vibration, bearing temperature rise, etc.) during performance test.

6) This is typical datasheet. Contractor shall fill the datasheet for each items separately for preparation of enquiry documents and Owner/PMC's approval.

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1	**GENERAL**					
2	Project: **EPCM SERVICES FOR POLYPROPLENE PROJECT AT NRL**			Job no.: **C050**		
3	Owner: **M/s NRL**			Site:		
4	Purchaser:			Unit: Unit no.:		
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 [☒:] 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/cm², a):		
14	☐Vapour Pressure at PT (kg/cm², a):			Min:	Nor:	Rated:
15	☐ Viscosity at PT(Cp/Cst):			☐ Suction Pressure (kg/cm², a):		
16	☐ Corrosion Erosion caused by:			Min:	Nor:	Rated:
17	☐ Presence of Solids:			☐ Differential Pressure (kg/cm²):		
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, JOB SPECIFICATIONS**					
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/cm², g):		
29	☐ Volumetric efficiency (%): [≤ 90%]			☐ Pump Head MAWP (kg/cm², g):		
30	☐ Mechanical Eff. (%):	☐ Overall Eff. (%):		☐ Hydro test Pressure (kg/cm², 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**	**Position**
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						

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61	**SHOP INSPECTION & TESTS (EACH PUMP)**					
62	**Description**	**Required**	**Witnessed**	**Description**	**Required**	**Witnessed**
63	Hydrostatic	■	☐	Material Certificates	■	--
64	Performance Test	■	■	Shop Inspection	■	☐
65	Steady State Accr.	■	■	Dismantle & Insp. after test	■	■
66	Repeatability	■	■	R.V. Set Pressure Function Test	■	■
67	Linearity	■	■	Diaphragm Rupture Detection (Functional)	■	■
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/cm²g):			☐ 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 &		
89	■ Common Base Plate under: Pump, gear box & driver			mounted by Pump Manufacturer		
90	■ Coupling supplied & mounted by Pump Manufacturer:			☐ Back Pressure Valve		
91	Make:			☐ Calibration Pot: ☐ At Suction ☐ At Discharge		
92	☐ Type:			☐ Common to all pump units	☐ Separate	
93	■ Gas Pre-charging Kit (If reqd)			☐ With Level Gauge		
94				■Puls. Dampener (Suct) **(See Rem 3)**	Type:	
95				■Puls. Dampener (Disch) **(See Rem 4)**	Type:	
96				■ Diaphragm Rupture Detection System (PDT->PAH contacts@ DCS)		
97	**REMARKS**					
98	1. Pump casing design pressure shall not be less than _____kg/cm², 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.					
105	7) This is typical datasheet. Contractor shall fill the datasheet for each items separately for preparation of enquiry documents and Owner / PMC's approval.					
106						
107						
108						
109						
110						

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AIR OPERATED DOUBLE DIAPHGRAM (AODD) PUMP (TYPICAL MDS)

1.	**GENERAL**							
2.	Project:	**EPCM SERVICES FOR POLYPROPLENE PROJECT AT NRL**			Job No.: **C050**			
3.	Owner:	**M/s NRL**			Site:			
4.	Purchaser:				Unit :	Unit No.		
5.	Item No.:				Service:			
6.	No. Reqd.:	Working		Standby	Driver: **Pneumatically operated (Rem 5)**			
7.	Applicable to: ☐ Proposal ☐ Purchase ☐ As Built				Allowable Noise Level: **85 dBA**			
8.	**Applicable Specification: MANUFACTURER STANDARD**							
9.	**OPERATING CONDITIONS**							
10.	Liquid Handled :				Capacity (m^3/hr):			
11.	Pumping Temp.(°C):				Discharge Pressure (kg/cm²,A):			
12.	Specific Gravity at P.T.:				Suction Pressure (kg/cm²,A):			
13.	Vapour Pressure at P.T. (kg/cm²,A):				Diff. Pressure (kg/cm²) @ Rated Capacity:			
14.	Viscosity at P.T. (cP):		Corr./Eros. By:		Diff. Head (m) @ Rated Capacity:			
15.	Solids in ☐ Yes ■ No		Size :	%	Actual Suction Lift (m)			
16.	**SITE & UTILITY CONDITIONS (Refer site & utility data attached elsewhere)**							
17.	Motive Fluid: **Plant Air**				Site Temperature (°C): Max.: Min.:			
18.	Supply Pressure (Min./Nor./Max./Mech. Design) (kg/cm²g):				Drum Size (mm): Dia.: Height:			
19.	Temperature (Min./Nor./Max./Mech. Design) (°C):				Drum Capacity (Litres):			
20.	**MANUFACTURERS SPECIFICATIONS**							
21.	Pump Manufacturer:				Model No.:			
22.	**CONSTRUCTION**							
23.	Type of Pump: ■ Air Operated Double Diaphragm Pump (AODD)							
24.	Mounting of Pump: ■ Stand alone Structure Mounted ☐ With Base for placing on Drum Top							
25.	Valves per feed (Suction / Discharge): Type:				**PERFORMANCE**			
26.	Type of Diaphragm: ☐ Single ■ Double				Proposal Curve No.:			
27.					Rated Capacity (m^3/hr) : ***[Max. Free flow]***			
28.	**Nozzles**	**Size**	**Position**	**Rating / Facing (as per ANSI)**	Discharge Pressure (kg/cm²g) [Max.]:			
29.	Liquid Suct.				Efficiency (%): Max. Head (m):			
30.	Liquid Disch.				Rated BKW (kW):			
31.	Air Inlet				NPSHR (m) : Suction Lift (Dry/Wet) (m):			
32.	Air outlet			**Through Muffler**	Plant Air Consumption (Nm³/hr):			
33.	Packing / Seal : **Seal-Less**				Min. Air Pressure / Volume Reqd. (kg/cm²g / Nm3/hr):			
34.	**Materials : (Note 1)**		**MOC**	**ASTM Grades**	M.A.W.P (Liquid side) @ PT/Design Temp.(kg/cm².G):			
35.					M.A.W.P (Air Side) (kg/cm²G):			
36.	S - Carbon Steel	Wetted Parts			Pumpable solids size (mm): Noise Level:			
37.	C -11-13% Chr. Stl.	Non Wetted parts			Weight (kg):			
38.	T - Teflon (PTFE)	Diaphragm			**SCOPE OF SUPPLY**			
39.	L - SS 316	Air Valve			Pump	■ Yes	☐ No	
40.	U - Polypropylene				Stand alone Structure Mounted Arrangement	■ Yes	☐ No	
41.	V - Acetal				Anchor Bolt, Nut & Washers	☐Yes	■ No	
42.	W - Polythene				Drain Valve	■ Yes	☐ No	
43.	X - Zinc Plated				Liquid Suction Hose (of suitable length) with filter	■ Yes	☐ No	
44.	Y - Polyester				Liquid Discharge Hose (of suitable length)	■ Yes	☐ No	
45.	Z - Manfr. Std.				Check Valve (Liquid Discharge side)	■ Yes	☐No	
46.					Shut Off Valve (Liquid Discharge side)	☐ Yes	■ No	
47.	**Note:**				External Relief Valve (Liquid Side)	☐ Yes	■ No	
48.	1. Material of Construction should be suitable for fluid handled.				External Relief Valve (Air Side)	■ Yes	☐ No	
49.					Air inlet hose (*Min. 10 m*)	☐ Yes	■ No	
50.					Bleed type Master Air Valve	■ Yes	☐ No	
51.					Air filter regulator with pressure gauge assembly	■ Yes	☐ No	
52.					Air Dryer (Requiring no electric power)	■ Yes	☐ No	
53.					Air Discharge Muffler	■ Yes	☐ No	
54.					Grounding clips	■ Yes	☐ No	
55.					Flexible connection between pump head & pump lance (Suction side)	■ Yes	☐ No	
56.					Flexible connection between pump head & pump lance (Discharge side)	■ Yes	☐ No	
57.	**SHOP INSPECTION & TESTS (EACH PUMP)**							
58.						Witness	Test Cert	
59.	■ Running Performance With Water (As per Manufacturer Standard)					☐	■	
60.								
61.	**REMARKS:**							
62.	1) The mech. design pressure for the liquid side/air side of pump shall not be less than____ kg/cm2g @ _____ °C.							
63.	Min design temp is _____ °C.							
64.	2) The material of the liquid hoses shall be suitable for the specified service (as recomm. by the vendor).							
65.	3) Vendor to indicate the set point of the external relief valve (air side) included in his scope of supply.							

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66.	4) Pump liquid discharge end and air inlet end shall be flanged to facilitate proper connection to piping.
67.	5) Pump is air driven. The motive fluid and process material must not come in contact with each other during operation of the
68.	equipment.
69.	6) NPSHA at pump centerline is _____ m.
70.	7) Pump vendor to ensure that complete mounting arrangement with pump shall be portable type to facilitate ease of mounting &
71.	operation.
72.	8) Grounding Clips shall be provided by pump vendor.
73.	9) Pump vendor shall categorically confirm that offered pump is suitable for the specified operating condition, even with minimum
74.	Plant air inlet conditions.
75.	5) This is typical datasheet. Contractor shall fill the datasheet for each item separately for preparation of enquiry documents and
76.	Owner/PMC's approval.

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EXPERIENCE RECORD - HORIZONTAL CENTRIFUGAL PUMPS (LCWS)

ITEM :

ITEM NUMBER. :

VENDOR. :

INSTRUCTIONS TO BIDDERS:

1. This proforma duly filled in shall be submitted for each item separately, along with 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 (along with 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:

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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	Number of units supplied					
1.5	Type of driver (Electric Motor / Steam Turbine / Gas Turbine / IC Engine)					
1.6	Driver rated kW / Speed (rpm)					
1.7	Drive (Fixed Speed / Variable Speed / Variable Frequency)					
1.8	Shop where pump is designed, manufactured, packaged, tested & supplied with address.					
2	**OPERATING CONDITIONS**					
2.1	Fluid handled					
2.2	Fluid temperature (Min / Max) °C					
2.3	Capacity (m^3/hr)					
2.4	Maximum Suction pressure (kg/cm², g)					
2.5	Differential Head, Rated (m)					
2.6	Differential Pressure, Rated (kg/cm²)					
2.7	$NPSH_R$ (m)					

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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	Efficiency					
2.9	BKW, Rated					
2.10	Minimum Continuous Stable Flow, (m^3/hr)					
2.11	Rated Speed					
2.12	Speed range for variable speed drive					
2.13	MAWP casing (kg/cm^2,g) @ 15°C @ Pumping Temperature @ Design Temperature					
3	**CONSTRUCTION**					
3.1	No. of stages (single / two)					
3.2	Casing split (Axial / Radial)					
3.3	Impeller diameter - Rated/ Maximum / Minimum (mm)					
3.4	Whether the proposed model and reference models have identical hydraulic design (for impeller / diffuser / volute)					
3.5	Sealing Element (packing / mechanical seal)					
3.6	Type of mechanical seal (Single / Double)					
3.7	Sealing Plan No.					
4	**MATERIAL OF CONSTRUCTION**					
4.1	Casing					
4.2	Impellers					
4.3	Shaft					
5	**OTHER INFORMATION ON INSTALLATIONS**					
5.1	Date of supply of entire unit					

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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.*
5.2	Date of commissioning of entire unit					
5.3	No. of operating hours completed as on the date of issue of material requisition					
5.4	Major Problems encountered					
5.5	Name of plant					
5.6	Purchaser's Name and Address					
	Name (Company / Organization)					
	Name of Contact Person					
	Address					
	Telephone No.					
	Fax No.					
	email-id					

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EXPERIENCE RECORD - CENTRIFUGAL PUMP (HORIZONTAL)

SERVICE :

ITEM NUMBER. :

VENDOR :

INSTRUCTIONS TO BIDDERS:

1. This proforma duly filled in shall be submitted for each item separately, along with 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 (along with his address, telephone no., fax no./email-id etc.) who may be contacted by the Purchaser / his representative, if felt necessary.
5. The equipment manufacturer shall also furnish along with the bid his standard reference list for the offered equipment model manufactured and supplied by him.
6. The equipment manufacturer shall clarify the meaning of each letter / digit used in the model designation below:

Description of Model designation system:

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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					
1.3	Model Number (#)					
1.4	Performance Curve No.					
1.5	Number of units supplied					
1.6	Type of driver (Electric Motor / Steam Turbine / Gas Turbine / IC Engine)					
1.7	Driver rated kW / Speed(rpm)					
1.8	Drive (Fixed Speed / Variable Speed / Variable Frequency)					
1.9	Shop where pump is designed, manufactured, packaged, tested & supplied with address					
2	**OPERATING CONDITIONS**					
2.1	Fluid handled / Specific Gravity					
2.2	Fluid Pumping Temperature (Min / Max) °C					
2.3	Design Temperature (Min / Max) °C					
2.4	Capacity (m^3/hr)					
2.5	Maximum Suction pressure (kg/cm², a)					
2.6	Differential Head, Rated (m)					
2.7	Differential Pressure, Rated (kg/cm²)					
2.8	NPSHR (m)					
2.9	Efficiency					
2.10	BKW, Rated					

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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	Minimum Continuous Stable Flow, (m^3/hr)					
2.12	Rated Speed					
2.13	Speed range for variable speed drive					
2.14	MAWP (kg/cm²G) @ 15 °C @ pumping temperature @ design temperature					
3	**CONSTRUCTION**					
3.1	No. of stages (single / two)					
3.2	Casing split (Axial / Radial)					
3.3	Impeller diameter - Rated/ Maximum / Minimum (mm)					
3.4	Whether the proposed model and reference models have identical hydraulic design (for impeller / diffuser / volute)					
3.5	Sealing Element (packing / mechanical seal)					
3.6	Type of mechanical seal (Single / Double)					
3.7	API Sealing Plan No.					
3.8	API Cooling Plan					
4	**MATERIAL OF CONSTRUCTION**					
4.1	API - 610 Material Code					
4.2	Casing					
4.3	Impellers					
4.4	Shaft					
5	**OTHER INFORMATION ON INSTALLATIONS**					
5.1	Date of supply of entire unit					

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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.
5.2	Date of commissioning of entire unit					
5.3	No. of operating hours completed as on the date of issue of material requisition					
5.4	Major Problems encountered					
5.5	Name of plant					
5.6	Purchaser's Name and Address					
	Name (Company / Organization)					
	Name of Contact Person					
	Address					
	Telephone No.					
	Fax No.					
	email-id					

(#) – Indicate complete model no. including type of offered hydraulics

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EXPERIENCE RECORD - CONTROLLED VOLUME PUMP

SERVICE :

ITEM NUMBER. :

VENDOR. :

INSTRUCTIONS TO BIDDERS:

1. This proforma duly filled in shall be submitted for each item separately, along with 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 (along with his address, telephone no., fax no./email-id etc.) who may be contacted by the Purchaser / his representative, if felt necessary.
5. The equipment manufacturer shall also furnish along with the bid his standard reference list for the offered equipment model manufactured and supplied by him.
6. The equipment manufacturer shall clarify the meaning of each letter / digit used in the model designation below:

Description of Model designation system:

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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	Driver rated kW / Speed(rpm)					
1.6	Shop where pump is designed, manufactured, packaged, tested & supplied with address					
2	**OPERATING CONDITIONS**					
2.1	Fluid handled					
2.2	Fluid temperature (Min / Max) ˚C					
2.3	Capacity (litres/hr)					
2.4	Maximum Suction pressure (kg/cm²,a)					
2.5	Differential Pressure, Rated (kg/cm²)					
2.6	NPSHR (m), excluding acceleration head					
2.7	Overall Efficiency (%)					
2.8	BKW, Rated (kW)					
2.9	Rated Speed (rpm)					
2.10	MAWP cylinder (kg/cm²G) @ 15˚C @ pumping temperature					
3	**CONSTRUCTION**					
3.1	Type of pump (Simplex / Duplex / Triplex etc.)					
3.2	Type of compression element (Plunger / Diaphragm)					
3.3	Type of valves (Single ball / Double ball / others)					

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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.
3.4	Stroke Variation (local manual / remote auto / remote manual)					
3.5	Type of diaphragm (single / double / sandwich)					
3.6	Cylinder bore (mm)					
3.7	Stroke (mm)					
3.8	Speed (Strokes per minute)					
4	**MATERIAL OF CONSTRUCTION**					
4.1	Plunger					
4.2	Diaphragm					
4.3	Cylinder					
5	**OTHER INFORMATION ON INSTALLATIONS**					
5.1	Date of supply of entire unit					
5.2	Date of commissioning of entire unit					
5.3	No. of operating hours completed as on the date of issue of material requisition					
5.4	Major Problems encountered					
5.5	Purchaser's Name and Address					
	Name (Company / Organization)					
	Name of Contact Person					
	Address					
	Telephone No.					
	Fax No.					
	email-id					

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EXPERIENCE RECORD - PACKAGING OF DOSING PACKAGE (SKID MOUNTED)

ITEM (SERVICE) :

ITEM NUMBER :

PACKAGE VENDOR :

INSTRUCTIONS TO BIDDERS:

1. This proforma duly filled in shall be submitted for each item separately, along with the bid.
2. Since the information requested in this proforma will be utilised to assess provenness of offered Package, it is in the interest of the Package manufacturer to pick up those cases out of total list of references which most closely match with the offered Package. The Package 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 package manufacturer shall furnish ASTM equivalents also.
4. For the referred installations, the package manufacturer shall indicate the name of the person (along with his address, telephone no., fax no./email-id etc.) who may be contacted by the Purchaser / his representative, if felt necessary.
5. The package manufacturer shall also furnish along with the bid his standard reference list for the offered Package, manufactured and supplied by him.

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S 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.	**GENERAL**					
1.1	Order / Reference number in the General Reference list					
1.2	Skid Size & Weight (L x W x H, m & Tons)					
1.3	Fluid / Chemical handled					
1.4	Capacity of Dosing Vessels / Tanks (m3)					
1.5	Material of Construction of Dosing Vessels / Tanks					
1.6	Capacity of Metering Pump in the dosing system (LPH)					
1.7	Type of Metering Pump in the dosing system					
1.8	Type of capacity control for metering pump					
2	**PACKAGER**					
2.1	Name of Packager					
2.2	Package engineered by					
2.3	Shop where the entire dosing skid is packaged					
2.4	Location of the above-mentioned facilities with complete address/fax.no. /Telephone no./email-id and name of the contact person					
3	**OTHER INFORMATION ON INSTALLATIONS**					
3.1	Date of supply of entire unit					
3.2	Date of commissioning of entire unit					
3.3	No. of operating hours completed as on the date of issue					

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S 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.***
3.4	Major Problems encountered					
3.5	Name of plant					
3.6	Purchaser's Name and Address					
	Name (Company / Organization)					
	Name of Contact Person					
	Address					
	Telephone No.					
	Fax No.					
	email-id					

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PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	**CLIENT**	NUMALIGARH REFINERY LIMITED
UNIT	Recirculating Cooling water System	**JOB NO.** C050	**UNIT NO.** 1U68

ITEM NO.		1U68-CT-4371A/B/C
SERVICE		COOLING WATER SYSTEM
TYPE		MECHANICAL (INDUCED) DRAFT(NOTE-13,24)
TOTAL CAPACITY	M3/HR	8000
NO OF CELLS		3 (TWO OPERATING + ONE STANDBY) (NOTE-2)
CAPACITY OF EACH CELL	M3/HR	4000
TEMPERATURE		
COOLING WATER IN	Deg C	45
COLING WATER OUT	Deg C	33
HEAT LOAD	MMKCAL/HR	96 (NOTE-14)
DESIGN WET BULB TEMPERATURE	Deg C	27 (NOTE-27)
DESIGN DRY BULB TEMPERATURE	Deg C	35
TEMPERATURE APPROACH	Deg C	4
TEMPERATURE RANGE	Deg C	12
WIND VELOCITY		
NORMAL	KM/HR	0-36
MAXIMUM	KM/HR	140
COOLING WATER,P&ID		Note-1

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0	12-JUN-2025	Issued For Engineering	MAHENDRA	SUBHOSREE	SUBHOSREE
A	29-APR-2025	Issued For Comments	MAHENDRA	SUBHOSREE	SUBHOSREE

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PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	CLIENT	NUMALIGARH REFINERY LIMITED		
UNIT	Recirculating Cooling water System	JOB NO.	C050	UNIT NO.	1U68

NOTES:

1	DETAILS OF COOLING WATER SYSTEM SHALL BE SHOWN IN THE P&ID IN TERMS OF EIL P&ID NUMBERING C050-79-41-1U68-1111 SHEET 1 OF 2 TO SHEET TO 2 OF 2 TO 1112. THE P&ID NUMBERING OF THE SAME IN TERMS OF NRL NUMBERING PHILOSOPHY SHALL BE EL-1U68A-PR-PID-4301 TO 4303.	0
2	EACH CELL TO HAVE PROVISION TO ISOLATE COMPLETELY FOR MAINTENANCE.	
3	VENDOR TO PROVIDE VIBRATION TRANSMITTER FOR TRIP ALARM AND RUNNING STATUS INDICATION IN CONTROL ROOM FOR EACH COOLING TOWER FAN. FAN MOTOR TO TRIP AUTOMATICALLY ON SENSING VIBRATION ABOVE LIMIT.	
4	PROVIDE 10 (TEN) MINUTES HOLD UP BETWEEN MINIMUM AND NORMAL WATER LEVEL IN THE COOLING TOWER BASIN INCLUDING CHANNEL BASED ON DESIGN CIRCULATION RATE.	
5	VENDOR TO PROVIDE OIL SKIMMING ARRANGEMENT WITH OVERFLOW TO OWS.	
6	PROVIDE REMOVABLE 1/2 (2 NOS.) & 10 MESH (2 NOS.) SCREENS OF SS316L AT THE INTERSECTION OF COOLING TOWER SUMP AND CHANNEL.	
7	SUMP TOP SHOULD BE COVERED. PROVIDE 2 -3 DRAIN PITS IN SUMP CHANNEL AND ACCESS OPENING FOR CLEANING AND MAINTENANCE. NUMBER & SIZE TO BE CONFIRMED DURING DETAIL ENGINEERING.	
8	COOLING WATER RETURN DISTRIBUTION DECK SHOULD BE COVERED.HOT WATER DISTRIBUTION INSIDE COOLING TOWER BY PIPE NETWORK AND NOZZLE AS PER VENDOR DESIGN.	0
9	FLUSHING CONNECTION TO BE PROVIDED FROM CW RETURN LINE TO BASIN OF CELLS AS SHOWN IN P&ID.	
10	START/STOP PUSH BUTTONS FOR COOLING TOWER FANS TO BE PROVIDED AT FAN LEVEL. IN ADDITION, STOP PUSH UTTONS SHALL BE PROVIDED AT GRADE LEVEL.	
11	COOLING TOWER CELLS TO BE PROVIDED WITH HIGH EFFICIENCY DRIFT ELIMINATION. COMPLETE DRIFT ELIMINATION IS DESIRED TO AVOID CORROSION PROBLEM IN THE VICINITY OF THE COOLING TOWER, AND TO CONSERVE WATER IN THE PLANT. IN ADDITION, COOLING TOWER SHALL BE DESIGNED IN SUCH A WAY THAT THERE WILL BE NO SPLASH/DRIFT LOSS DUE TO WIND AT MAX. SPEED. MAXIMUM ALLOWABLE DRIFT LOSS IS 0.001 % OF RECIRCULATING COOLING WATER CIRCULATION RATE.	
12	VENDOR TO PROVIDE HYDROCARBON DETECTORS SUITABLE FOR WORKING IN MOIST CONDITIONS AT THE TOP OF EACH CELL OF THE COOLING TOWER. ALARM FROM THE SAME TO BE TAKEN TO CONTROL ROOM.	
13	TOWER SHALL BE COUNTER FLOW TYPE WITH FLAME PROOF MOTORS - AREA CLASSIFICATION ZONE-2.	
14	HEAT LOAD SPECIFIED IS SENSIBLE HEAT LOAD ONLY.	
15	COOLING WATER RETURN PRESSURE AVAILABLE AT COOLING TOWER BATTERY LIMIT AT GRADE IS 2.2 KG/CM2 G.	
16	THE FAN ASSEMBLY SHALL BE STATICALLY BALANCED AND THE FAN HUB SHALL BE DYNAMICALLY BALANCED.	
17	CHLORINE DIOXIDE DOSING SHOULD BE PROVIDED IN COOLING TOWER SUMP AND TO BE LOCATED CLOSE TO BOTTOM. IT SHOULD RUN FOR APPROXIMATELY 80% OF SUMP LENGTH FOR UNIFORM DISTRIBUTION.	
18	VENDOR TO GUARANTEE THE HEAT LOAD, DRIFT LOSS AND POWER CONSUMPTION AT DESIGN CAPACITY OF COOLING TOWER AS A MINIMUM.	
19	VENDOR TO INDICATE UTILITY CONSUMPTION.	
20	MDMT IS TO BE CONSIDERED AS 5 DEG C.	
21	FACILITY TO REMOVE ACCUMULATED SILT FROM THE COOLING TOWER SUMP SHALL BE PROVIDED.	
22	VENDOR TO PROVIDE FIELD MOUNTED LOCAL PANEL FOR COOLING TOWER FAN MOTOR. THE MOTOR SHALL BE WEATHER PROOF.	
23	COOLING TOWER BASIN SHALL BE ELEVATED TO HAVE FLOODED SUCTION FOR PUMPS. ALL PUMPS SHALL BE LOCATED ABOVE HIGH PAVEMENT POINT	
24	COOLING TOWER SHOULD BE STATE OF THE ART WITH HIGH EFFICIENCY.	
25	ADEQUATE SLOPE AND DRAINING FACILITY WILL BE PROVIDED IN COOLING TOWER CELLS	
26	THE COOLING TOWER AND COOLING TOWER FAN SHALL BE OF FRP(FIBRE GLASS REINFORCED PLASTIC) CONSTRUCTION.	
27	THE RE-CIRCULATING COOLING WATER SYSTEM SHOULD BE DESIGNED FOR WET BULB TEMPERATURE OF 29 °C & APPROACH TEMPERATURE OF 4°C.	
28	THE COOLING TOWER PDS NUMBERING (C050-1U68-79-41-DS-1901) IN TERMS OF NRL NUMBERING PHILOSOPHY SHALL BE EL-1U68-PR-DAT-4301.	0

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0	12-JUN-2025	Issued For Engineering	MAHENDRA	SUBHOSREE	SUBHOSREE
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PUMP

PROCESS DATA SHEET

Document No. C050-1U68-79-41-DS-1601

Rev. No. 0

PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	**CLIENT**	NUMALIGARH REFINERY LIMITED
UNIT	Recirculating Cooling water System	**JOB NO.** C050	**UNIT NO.** 1U68

ITEM NO.			1U68-PA-4301 A/B/C	
DESIGN CASE			--	
SERVICE			COOLING WATER RECIRCULATION PUMPS	
PARALLEL OPERATION			YES	
OPERATION			CONTINUOUS	
OPERATING			2	
STAND BY			1	
TYPE OF PUMP			CENTRIFUGAL (HORIZONTAL)	
PROPERTIES OF LIQUID				
LIQUID HANDLED			COOLING WATER	
PUMPING TEMPERATURE		deg C	AMBIENT	
VISCOSITY AT PUMPING TEMPERATURE		CP	0.75	
VAPOUR PRESSURE AT PUMPING TEMPERATURE		KG/CM2 A	0.06	0
LIQUID DENSITY AT PUMPING TEMPERATURE		KG/M3	995	
PRESENCE OF CORROSIVE / TOXIC COMPONENTS			NO	
SOLIDS IN SUSPENSION			NO	
POUR POINT (FOR CONGEALING SERVICE)		deg C	NOT APPLICABLE	
OPERATING CONDITIONS FOR ONE PUMP				
FLOW RATE	NORMAL	M3/HR		
	MAXIMUM	M3/HR	4000 (NOTE-3)	
	MINIMUM	M3/HR		
SUCTION PRESSURE		KG/CM2 G	(-)0.1	
DISCHARGE PRESSURE		KG/CM2 G	5.3 (NOTE-8)	
DIFFERENTIAL PRESSURE		KG/CM2	5.4	
DIFFERENTIAL HEAD		m	54.3	
NPSH AVAILABLE		m	9.0 (NOTE-9,10)	
CAPACITY CONTROL FOR VOLUMETRIC PUMPS				
METHOD OF CONTROL				
TYPE OF CONTROL				
CONTROL RANGE				
PRECISION AT MINIMUM RATE				
MECHANICAL DATA				
DESIGN PRESSURE		KG/CM2 G	8 (NOTE-6)	
MAXIMUM SUCTION PRESSURE		KG/CM2 G	0.26 (NOTE-10)	0
DESIGN TEMPERATURE		deg C	65	
MATERIAL OF CONSTRUCTION				
	CASING		KCS	0
	IMPELLER / PISTON / PLUNGER		12% Cr Steel	0
LINE RATING				
	SUCTION		150	
	DISCHARGE		150	
SEAL TYPE			NON-API MECHANICAL SEAL	
DRIVER TYPE			ELECTRIC MOTOR (NOTE-1,2,4,5)	
STEAM TURBINE DATA				
INLET PRESSURE	(MIN./NOR./MAX./DES.)	KG/CM2 G		
INLET TEMPERATURE	(MIN./NOR./MAX./DES.)	deg C		
EXHAUST PRESSURE	(MIN./NOR./MAX./DES.)	KG/CM2 G		
LINE RATING				
	INLET			
	OUTLET			
SAFETY VALVE REQUIRED ON STEAM TURBINE EXHAUST			NO	
MOTOR DATA				
VARIABLE SPEED MOTOR REQUIRED			NO	
AUTO START/STOP OF PUMP REQUIRED			YES	
REACCELERATION REQUIRED			YES	
PUMP CONNECTED TO EMERGENCY POWER/STEAM SUPPLY			NO	

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
0	08-JUL-2025	Issued For Engineering	SUBHOSREE	SUBHOSREE	SUBHOSREE
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PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	**CLIENT**	NUMALIGARH REFINERY LIMITED		
UNIT	Recirculating Cooling water System	**JOB NO.**	C050	**UNIT NO.**	1U68

NOTES:

1	ALL ELECTRIC MOTOR DRIVEN PUMPS.	
2	MOTORS OF THESE PUMPS SHALL BE SPECIFIED FOR END OF CURVE OPERATION.	
3	SYSTEM RESISTANCE CURVE IS ENCLOSED.	
4	TRIPPING OF ANY OPERATING PUMP SHOULD NOT CAUSE ANY CASCADING EFFECT TO TRIP OTHER OPERATING PUMPS.	
5	AUTOMATIC RE-ACCELERATION AND AUTO-START FACILITY SHALL BE PROVIDED FOR CW PUMP MOTORS.	
6	PUMP VENDOR TO ENSURE THAT PUMP SHUT-OFF PRESSURE DOES NOT EXCEED THE COOLING WATER DESIGN PRESSURE INDICATED.	
7	REFER P&ID NO: C050-79-41-1U68-1111.	
8	THE DISCHARGE PRESSURE OF PUMPS HAS BEEN FIXED BASED ON CW RETURN PRESSURE OF 2.2 KG/CM2G REQUIRED AT THE BATTERY LIMIT OF COOLING TOWER GRADE LEVEL.	
9	NPSH REPORTED AT PUMP CENTER LINE AND IS BASED ON PUMP CENTER LINE ELEVATION OF 2.2 METER ABOVE PUMP GRADE LEVEL (HIGH PAVEMENT POINT).	
10	FOLLOWING ELEVATIONS HAVE BEEN CONSIDERED FOR HPP (HIGH PAVEMENT POINT), FGL (FINISHED GRADE LEVEL), MINIMUM WATER LEVEL AND OVERFLOW LEVEL FOR ESTIMATING NPSH AND DESIGN PRESSURE. 1. HPP: 100.0 2. FGL: 99.7 3. MINIMUM WATER LEVEL: 102.7 4. OVERFLOW LEVEL: 104.78	0
11	THE PDS NUMBERING(C050-1U68-79-41-DS-1601) IN TERMS OF NRL NUMBERING PHILOSOPHY SHALL BE EL-1U68-PR-DAT-4301.	0

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A	01-MAY-2025	Issued For Comments	MAHENDRA	SUBHOSREE	SUBHOSREE

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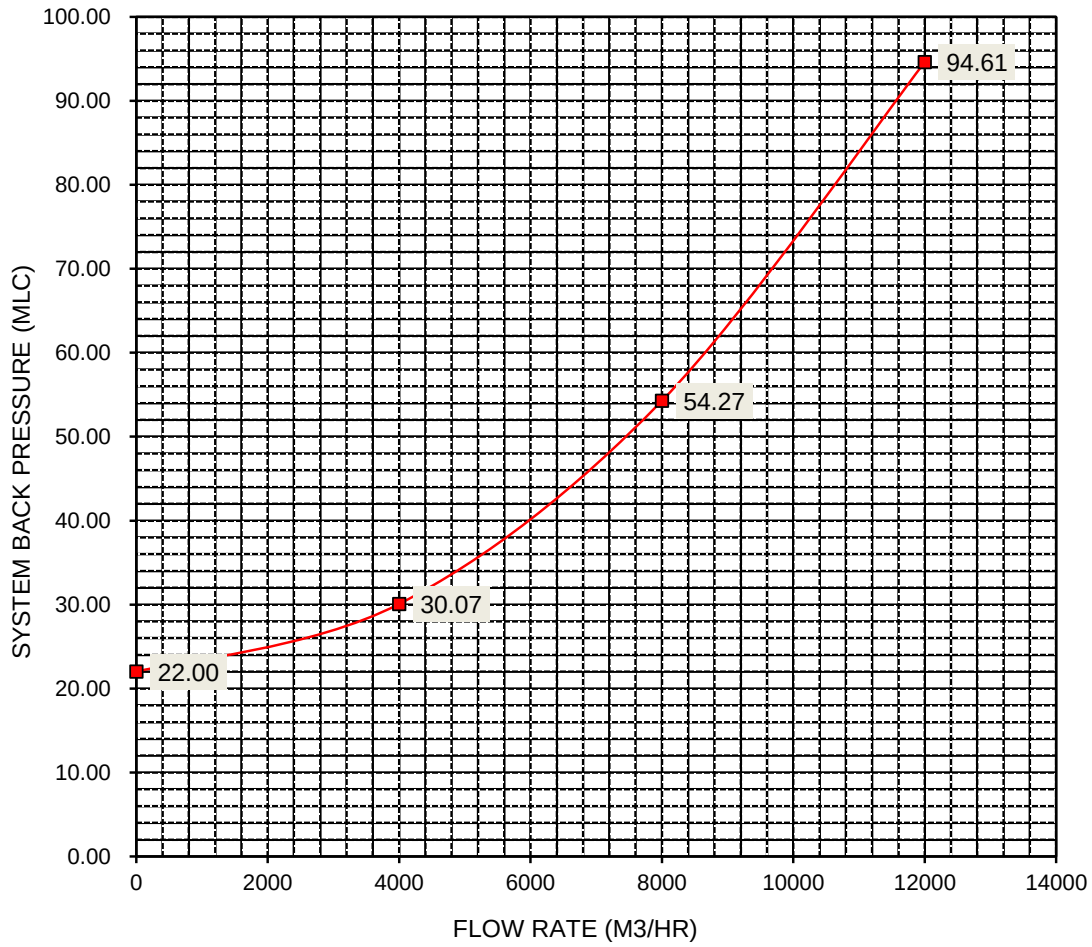
PROJECT	NUMALIGARH REFINERY EXPANSION PROJECT(NREP)	CLIENT	NUMALIGARH REFINERY LIMITED
UNIT	RECIRCULATING COOLING WATER SYSTEM	JOB NO.	CO50
UNIT NO.	1U68		
ITEM NO.	1U68-PA-4301A/B/C	SERVICE	COOLING WATER RECIRCULATION PUMP

SYSTEM RESISTANCE CURVE
RECIRCULATING PROCESS COOLING WATER SYSTEM



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0	8/7/2025	ISSUED FOR ENGINEERING	MPS	SC	SC
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PUMP

PROCESS DATA SHEET

Document No. C050-1U68-79-41-DS-1602

Rev. No. 0

PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	**CLIENT**	NUMALIGARH REFINERY LIMITED
UNIT	Recirculating Cooling water System	**JOB NO.** C050	**UNIT NO.** 1U68

ITEM NO.			1U68-PA-8601 A/B	
DESIGN CASE			--	
SERVICE			H2SO4 UNLOADING/ TRANSFER PUMP FOR CT	
PARALLEL OPERATION			NO	
OPERATION			INTERMITTENT	
OPERATING			1	
STAND BY			1	
TYPE OF PUMP			CENTRIFUGAL	
PROPERTIES OF LIQUID				
LIQUID HANDLED			98% SULPHURIC ACID	
PUMPING TEMPERATURE		deg C	AMBIENT	
VISCOSITY AT PUMPING TEMPERATURE		CP	16.6 (NOTE-2)	
VAPOUR PRESSURE AT PUMPING TEMPERATURE		KG/CM2 A	NEGLIGIBLE	
LIQUID DENSITY AT PUMPING TEMPERATURE		KG/M3	1840	
PRESENCE OF CORROSIVE / TOXIC COMPONENTS			YES (SULPHURIC ACID)	
SOLIDS IN SUSPENSION			NIL	
POUR POINT (FOR CONGEALING SERVICE)		deg C	NOT APPLICABLE	
OPERATING CONDITIONS FOR ONE PUMP				
FLOW RATE	NORMAL	M3/HR		
	MAXIMUM	M3/HR	5	
	MINIMUM	M3/HR		
SUCTION PRESSURE		KG/CM2 G	(-)0.133	
DISCHARGE PRESSURE		KG/CM2 G	2.6	
DIFFERENTIAL PRESSURE		KG/CM2	2.7	
DIFFERENTIAL HEAD		m	14.7 (NOTE-3)	
NPSH AVAILABLE		m	4.6	
CAPACITY CONTROL FOR VOLUMETRIC PUMPS				
METHOD OF CONTROL				
TYPE OF CONTROL				
CONTROL RANGE				
PRECISION AT MINIMUM RATE				
MECHANICAL DATA				
DESIGN PRESSURE		KG/CM2 G	4.8 (NOTE-1,5)	
MAXIMUM SUCTION PRESSURE		KG/CM2 G	BY VENDOR	
DESIGN TEMPERATURE		deg C	65 (NOTE-6)	
MATERIAL OF CONSTRUCTION				
	CASING		ASTM A743 TYPE CN7M	0
	IMPELLER / PISTON / PLUNGER		ASTM A743 TYPE CN7M	0
LINE RATING				
	SUCTION		150 #	
	DISCHARGE		150 #	
SEAL TYPE			MECHANICAL (SINGLE SEAL)	
DRIVER TYPE			ELECTRIC MOTOR	
STEAM TURBINE DATA				
INLET PRESSURE	(MIN./NOR./MAX./DES.)	KG/CM2 G		
INLET TEMPERATURE	(MIN./NOR./MAX./DES.)	deg C		
EXHAUST PRESSURE	(MIN./NOR./MAX./DES.)	KG/CM2 G		
LINE RATING				
	INLET			
	OUTLET			
SAFETY VALVE REQUIRED ON STEAM TURBINE EXHAUST			--	
MOTOR DATA				
VARIABLE SPEED MOTOR REQUIRED			NO	
AUTO START/STOP OF PUMP REQUIRED			NO	
REACCELERATION REQUIRED			NO	
PUMP CONNECTED TO EMERGENCY POWER/STEAM SUPPLY			NO	

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0	19-AUG-2025	Issued For Engineering	MAHENDRA	SUBHOSREE	SUBHOSREE
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PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	**CLIENT**	NUMALIGARH REFINERY LIMITED		
UNIT	Recirculating Cooling water System	**JOB NO.**	C050	**UNIT NO.**	1U68

NOTES:

1	DESIGN PRESSURE TO BE CONFIRMED BY VENDOR.	0
2	VISCOSITY CORRECTION FACTOR TO BE CONSIDERED FOR SIZING THE PUMP MOTOR.	
3	PUMP HEAD TO BE VERIFIED DURING ENGG.	
4	PUMP IS IN INTERMITTENT SERVICE AND IS USED FOR UNLOADING H2SO4 TANKERS AS WELL AS TRANSFERING SULPHURIC ACID TO DOSING DRUM.	
5	PUMP VENDOR TO ENSURE THAT THE PUMP SHUT-OFF PRESSURE DOES NOT EXCEED THE DESIGN PRESSURE	
6	LOW AMBIENT TEMPERATURE =5 DEG C.	
7	REFER P&ID NO. C050-79-41-1U68-1111 SHEET 2 OF 2.	
8	DRAINS AND SPILLS FROM THIS PUMP TO BE ADEQUATELY TAKEN CARE OF IN LIME PIT.	
9	THE PDS NUMBERING (C050-1U68-79-41-DS-1602) IN TERMS OF NRL NUMBERING PHILOSOPHY SHALL BE EL-1U68A-PR-DAT-8601.	

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PUMP

PROCESS DATA SHEET

Document No. C050-1U68-79-41-DS-1603

Rev. No. 0

PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	**CLIENT**	NUMALIGARH REFINERY LIMITED
UNIT	Recirculating Cooling water System	**JOB NO.** C050	**UNIT NO.** 1U68

ITEM NO.			1U68-PA-8602 A/B	
DESIGN CASE			--	
SERVICE			H2SO4 DOSING PUMP FOR CT	
PARALLEL OPERATION			NO	
OPERATION			CONTINUOUS	
OPERATING			1	
STAND BY			1	
TYPE OF PUMP			DOUBLE DIAPHRAGM	
PROPERTIES OF LIQUID				
LIQUID HANDLED			98% SULPHURIC ACID	
PUMPING TEMPERATURE		deg C	AMBIENT	
VISCOSITY AT PUMPING TEMPERATURE		CP	16.6 (NOTE-6)	
VAPOUR PRESSURE AT PUMPING TEMPERATURE		KG/CM2 A	NEGLIGIBLE	
LIQUID DENSITY AT PUMPING TEMPERATURE		KG/M3	1840	
PRESENCE OF CORROSIVE / TOXIC COMPONENTS			YES (SULPHURIC ACID)	
SOLIDS IN SUSPENSION			NIL	
POUR POINT (FOR CONGEALING SERVICE)		deg C	NOT APPLICABLE	
OPERATING CONDITIONS FOR ONE PUMP				
FLOW RATE	NORMAL	LPH	18	
	MAXIMUM	LPH	20	
	MINIMUM	LPH		
SUCTION PRESSURE		KG/CM2 G	(-)0.133	
DISCHARGE PRESSURE		KG/CM2 G	2.1	
DIFFERENTIAL PRESSURE		KG/CM2	2.2	
DIFFERENTIAL HEAD		m	11.8 (NOTE-5)	
NPSH AVAILABLE		m	4.7 (NOTE-2)	
CAPACITY CONTROL FOR VOLUMETRIC PUMPS				
METHOD OF CONTROL			MANUAL	
TYPE OF CONTROL			STROKE ADJUSTMENT	
CONTROL RANGE			10%-100%	
PRECISION AT MINIMUM RATE				
MECHANICAL DATA				
DESIGN PRESSURE		KG/CM2 G	4.1 (NOTE-1)	
MAXIMUM SUCTION PRESSURE		KG/CM2 G	BY VENDOR (NOTE-1)	
DESIGN TEMPERATURE		deg C	65 (NOTE-7)	
MATERIAL OF CONSTRUCTION				
	CASING		ALLOY 20	0
	IMPELLER / PISTON / PLUNGER		DIAPHRAGM: PTFE	0
LINE RATING				
	SUCTION		150 #	
	DISCHARGE		150 #	
SEAL TYPE				
DRIVER TYPE			ELECTRIC MOTOR	
STEAM TURBINE DATA				
INLET PRESSURE	(MIN./NOR./MAX./DES.)	KG/CM2 G		
INLET TEMPERATURE	(MIN./NOR./MAX./DES.)	deg C		
EXHAUST PRESSURE	(MIN./NOR./MAX./DES.)	KG/CM2 G		
LINE RATING				
	INLET			
	OUTLET			
SAFETY VALVE REQUIRED ON STEAM TURBINE EXHAUST			--	
MOTOR DATA				
VARIABLE SPEED MOTOR REQUIRED			NO	
AUTO START/STOP OF PUMP REQUIRED			NO	
REACCELERATION REQUIRED			NO	
PUMP CONNECTED TO EMERGENCY POWER/STEAM SUPPLY			NO	

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PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	**CLIENT**	NUMALIGARH REFINERY LIMITED		
UNIT	Recirculating Cooling water System	**JOB NO.**	C050	**UNIT NO.**	1U68

NOTES:

1	PACKAGE VENDOR TO SPECIFY THE MAXIMUM SUCTION PRESSURE & DESIGN PRESSURE OF THE PUMP ACCORDINGLY.	0
2	NPSH SPECIFIED IS WITHOUT CONSIDERING EFFECT OF ACCELERATION HEAD. IT SHALL BE CONFIRMED DURING DETAIL ENGG.	
3	PRESSURE TRANSMITTER FOR DETECTING DIAPHRAGM FAILURE IS IN PUMP VENDOR SCOPE.	
4	RELIEF VALVE AT PUMP DISCHARGE IS IN PUMP VENDORS SCOPE. RELIEF VALVE DISCHARGE TO BE CONNECTED TO SUCTION SIDE OF PUMP.	
5	PUMP HEAD TO BE CONFIRMED DURING ENGG.	
6	VISCOSITY CORRECTION FACTOR TO BE CONSIDERED FOR SIZING THE PUMP MOTOR.	
7	LOW AMBIENT TEMPERATURE = 5 DEG C.	
8	REFER P&ID NO. C050-79-41-1U68-1111 Sheet 2of 2	
9	DRAINS AND SPILLS FROM THIS PUMP TO BE ADEQUATELY TAKEN CARE OF IN LIME PIT.	
10	THE PDS NUMBERING (C050-1U68-79-41-DS-1603) IN TERMS OF NRL NUMBERING PHILOSOPHY SHALL BE EL-1U68A-PR-DAT-8602.	

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STORAGE TANK

PROCESS DATA SHEET

Document No. C050-1U68-79-41-DS-1701

Rev. No. 0

PROJECT	EPCM Services for setting up Polypropylene Unit at NRL		**CLIENT**	NUMALIGARH REFINERY LIMITED	
UNIT	Recirculating Cooling water System		**JOB NO.**	C050	**UNIT NO.** 1U68

ITEM NO		1U68-TK-8632		
SERVICE		H2SO4 STORAGE TANK FOR CT		
TYPE		CONE ROOF		
FLUID HANDLED		98% SULPHURIC ACID		
PROCESS DATA				
NOMINAL CAPACITY	M3	21		0
LIQUID STORED	M3	16(PUMPABLE VOLUME=13 M3)		0
STORAGE TEMPERATURE	deg C		AMB	
STORAGE PRESSURE				
POSITIVE PRESSURE	KG/CM2 G		ATM	
VACUUM PRESSURE	KG/CM2 G		NIL	
FLUID PROPERTIES @ OPERATING P & T				
LIQUID DENSITY	KG/M3	1840		
VISCOSITY	CP	31		
FLASH POINT	deg C	-		
POUR POINT	deg C	-		
BLANKETING REQUIRED		NO		
IF YES,BLANKETING GAS				
MECHANICAL DATA				
DIAMETER	MM	2800		
HEIGHT	MM	3450		0
DESIGN PRESSURE				
POSITIVE PRESSURE	KG/CM2 G		FULL OF LIQUID + 150 mmWC	
VACUUM PRESSURE	MMWC		50	
DESIGN TEMPERATURE	deg C	65	(NOTE-3)	
AMBIENT TEMPERATURE				
DESIGN MINIMUM	deg C	5	(NOTE-3)	
DESIGN MAXIMUM	deg C	45		
COIL REQUIRED		NO		
IF YES,PURPOSE OF COIL				
COIL DESIGN PRESSURE	BARG			
COIL DESIGN TEMPERATURE	deg C			
COIL NOMINAL SIZE	INCH			
COIL AREA	M2			
FLUID CIRCULATED IN COIL				
COIL MATERIAL OF CONSTRUCTION				
INSULATION REQUIRED		NO		
IF YES,TYPE OF INSULATION				
INSULATION THICKNESS	MM			
BREATHER VALVE REQUIRED		NO		
VENT WITH/WITHOUT FLAME ARRESTOR		WITHOUT FLAME ARRESTOR		
SUCTION EXCHANGER REQUIRED		NO		
GAUGING AND SAMPLING HATCH		YES		
MIXER REQUIRED		NO		
IF YES, MIXER DS NO				
CODE REQUIREMENT				
MATERIAL OF CONSTRUCTION		MATERIAL	CORROSION ALLOWANCE, MM	
SHELL BOTTOM COURSE		KCS	6.0	0
SHELL OTHER COURSE		KCS	6.0	0
BOTTOM		KCS	6.0	0
ROOF		KCS	6.0	0
ROOF WHERE VAPOR CAN ACCUMULATE	NO			
INNER TANK	NO			
OUTER TANK	NO			
SUSPENDED DECK				
ANY OTHER				
CATHODIC PROTECTION AT TANK BOTTOM		YES		
PIPING SPEC FOR NOZZLES				

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PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	CLIENT	NUMALIGARH REFINERY LIMITED
UNIT	Recirculating Cooling water System	JOB NO. C050	UNIT NO. 1U68

NOZZLE DETAILS

MARK	NUMBER	SIZE, IN	RATING	SERVICE	Rev
LT1	1	8	300#	LEVEL INDICATOR (NON CONTACT RADAR T	0
LT2	1	8	300#	LEVEL INDICATOR (NON CONTACT RADAR T	0
F	1	2		TANK INLET	
B	1	3		TANK OUTLET	
D	1	2		DRAIN	0
V	1	2		VENT (NOTE-2)	0
UC	1	2		UTILITY CONNECTION	
M	2	24		MANWAY(NOTE-6)	
O	1	3		OVERFLOW	

NOTES:

1. VENT NOZZLE SHALL BE FITTED WITH SILICA GEL BREATHER. REFER DATA-SHEET NO. C050-79-41-1U68-1111 Sheet 2of 2 .
2. TO BE CONFIRMED BY SILICA GEL BREATHER VENDOR.
3. MDMT = 5 DEG C.
4. ALL DRAINS, OVERFLOWS AND SPILLS TO BE PROPERLY TAKEN CARE OF IN A LIME PIT.
5. NO., SIZE AND LOCATION OF INSTRUMENT NOZZLES TO BE FIRMED UP DURING DETAIL ENGINERING.
6. LOCATIONS OF MANHOLES TO BE FIRMED UP DURING DETAIL ENGINEERING.
7. NOZZLES F & B (BOTH NECK AND FLANGE) SHALL BE OF SS316L (A1N PIPING SPEC). ALL OTHER NOZZLES SHALL BE OF A8A SPEC.
8. TANK WILL BE PROVIDED WITH A PATHWAY AND PLATFORMS FOR THE OPERATORS TO ACCESS MANHOLES, INSTRUMENTS, VALVES, ETC. ON THE TANK ROOF. THIS PATHWAY AND PLATFORMS SHALL BE INDEPENDENTLY SUPPORTED FROM GRADE SO THAT THEIR INTEGRITY IS NOT AFFECTED BY INTERNAL CORROSION OF THE TANK ROOF. THE PATHWAY AND PLATFORMS WILL BE ARRANGED IN SUCH A MANNER THAT THE OPERATOR DOES NOT HAVE TO WALK / PLACE FOOT ON THE TANK ROOF FOR PERFORMING ALL HIS ROUTINE OPERATIONAL AND MANITENANCE ACTIVITIES. THIS IS A SAFETY REQUIREMENT TO AVOID THE OPERATORS FALLING INSIDE A TANK FULL OF SULPHURIC ACID DUE TO THINNING OF ITS ROOF BY CORROSION.
9. THE PDS NUMBERING (C050-1U68-79-41-DS-1701) IN TERMS OF NRL NUMBERING PHILOSOPHY SHALL BE EL-1U68A-PR-DAT-8604.

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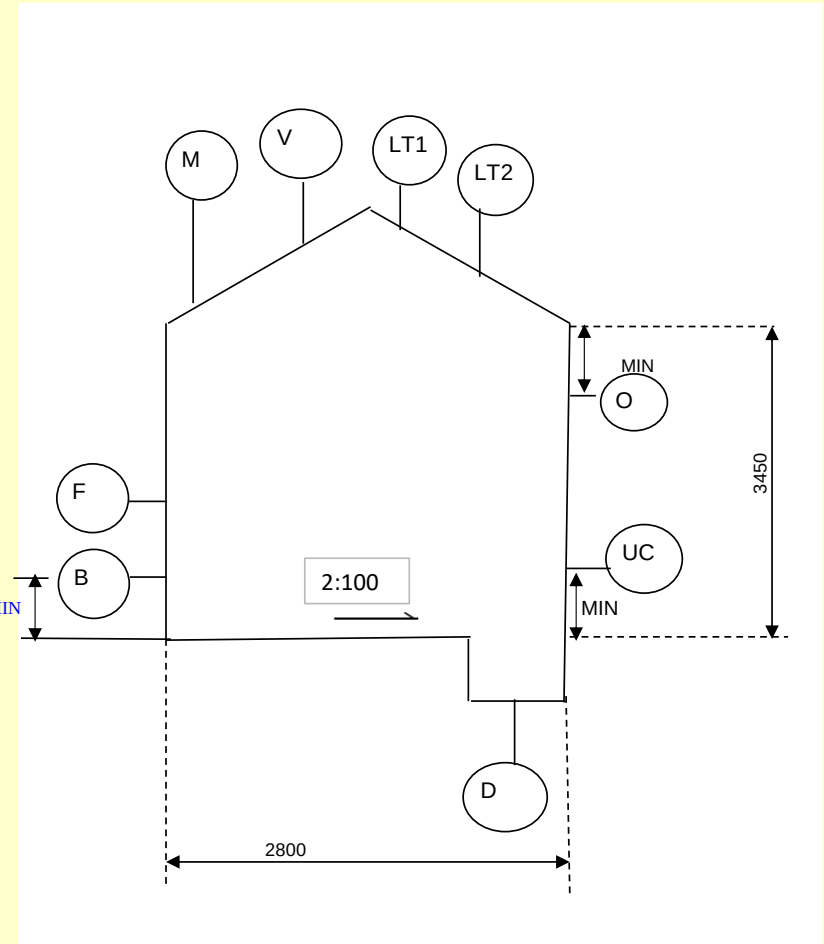
PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	CLIENT	NUMALIGARH REFINERY LIMITED
UNIT	Recirculating Cooling water System	JOB NO. C050	UNIT NO. 1U68
ITEM NO.	1U68-TK-8632	SERVICE	H2SO4 STORAGE TANK

SKETCH OF STORAGE TANK



ALL DIMENSIONS ARE IN MM

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HORIZONTAL VESSEL

PROCESS DATA SHEET

Document No. C050-1U68-79-41-DS-1201
Rev. No. 0

PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	**CLIENT**	NUMALIGARH REFINERY LIMITE
UNIT	Recirculating Cooling water System	**JOB NO.** C050	**UNIT NO.** 1U68

ITEM NO.		1U68-VV-8631	
SERVICE		H2SO4 DOSING DRUM FOR CT	
PROCESS DATA			
FLUID HANDLED		98% SULPHURIC ACID	
OPERATING PRESSURE	KG/CM2 G	ATM	
OPERATING TEMPERATURE	deg C	AMB.	
DESIGN PRESSURE	KG/CM2 G	3.5	
DOES VESSEL REQUIRE FULL VACUUM DESIGN		YES	
DESIGN TEMPERATURE	deg C	65 (NOTE-6)	
MECHANICAL DATA			
MATERIAL OF CONSTRUCTION			
SHELL		KCS	0
LINER			
CORROSION ALLOWANCE			
SHELL	MM	6.0	0
LINER THICKNESS	MM		
INSULATION REQUIRED		NO	
IF YES. TYPE		N.A.	
INSULATION THICKNESS	MM	N.A.	
IS INLET BAFFLE DEFLECTOR REQUIRED		NO	
VESSEL SUBJECTED TO STEAM OUT CONDITIONS		NO	
IF YES, STEAM TEMPERATURE	deg C		
STEAM PRESSURE	BARG		
VORTEX BREAKER REQUIRED		NO	
IF YES, TYPE			
DEMISTER REQUIRED		NO	
IF YES, REF DATASHEET NUMBER			
IS DESIGN FOR NACE CODE REQUIRED		NO	
IS DESIGN FOR IBR CODE REQUIRED		NO	

Mark	Number	Size, IN	Rating	Mark Service	Rev
F	1	2	300#	FEED (NOTE-3, 8)	
B	1	2	300#	BOTTOM OUTLET (NOTE-8)	
D	1	2	300#	DRAIN	
V	1	2	150#	VENT (NOTE-1)	
UC	1	2	300#	UTILITY CONNECTION	
LTI	1	4	300#	LEVEL INSTRUMENT (RADAR TYPE, NOTE-4)	0
MH	1 (NOTE-5)	24	150#	MANHOLE	0
O	1	2	300#	OVERFLOW	
VI	1	4	150#	VENTILATION NOZZLE	
LT2	1	4	300#	LEVEL INDICATOR (RDAR TYPE, NOTE-4)	0

NOTES:

1	VENT NOZZLES SHALL BE FITTED WITH SILICA GEL BREATHER. REFER DATA SHEET NO. C050-1U68-79-41-DS-1904.	
2	FLUID DENSITY IS 1840 KG/M3.	
3	FEED NOZZLE TO BE LOCATED AT DOSING DRUM CENTRE AND IS TO BE PROVIDED WITH DIP PIPE OF SAME DIAMETER.	
4	NO./ SIZE/ LOCATION OF INSTRUMENT NOZZLES TO BE FINALISED DURING DETAIL ENGG.	
5	NUMBER OF MANHOLES TO BE CONFIRMED DURING DETAIL ENGG.	
6	MDMT = 5 DEG C.	
7	REFER P&ID C050-79-41-1U68-1111 Sheet 2of 2.	
8	NOZZLES F & B (BOTH NECK AND FLANGE) SHALL BE OF SS316L (A1N PIPING SPEC). ALL OTHER NOZZLES SHALL BE OF A8A SPEC.	
9	THE PDS NUMBERING (C050-1U68-79-41-DS-1201) IN TERMS OF NRL NUMBERING PHILOSOPHY SHALL BE EL-1U68A-PR-DAT-8603.	0

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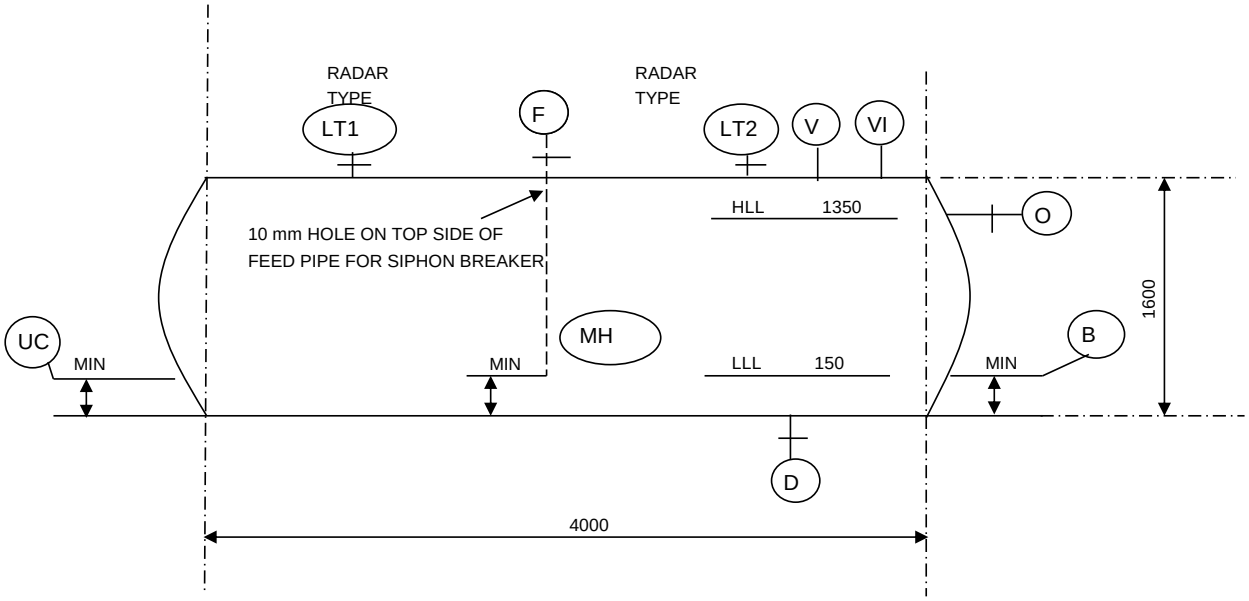
PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	CLIENT	NUMALIGARH REFINERY LIMITED
UNIT	Recirculating Cooling water System	JOB NO. C050	UNIT NO. 1U68
ITEM NO.	1U68-VV-8631	SERVICE	H2SO4 DOSING DRUM

SKETCH OF HORIZONTAL VESSEL



DIAMETER IS INTERNAL DIAMETER
ALL DIMENSIONS ARE IN MM
LENGTH IS FROM TANGENT LINES

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0	19-08-25	ISSUED FOR ENGINEERING	MPS	SC	SC
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SIDE STREAM FILTER

PROCESS DATA SHEET

Document No. C050-1U68-79-41-DS-1902

Rev. No. 0

PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	CLIENT	NUMALIGARH REFINERY LIMITED
UNIT	Recirculating Cooling water System	JOB NO.	C050 UNIT NO. 1U68
ITEM NO.	1U68-ZGN-4271 A/B	SERVICE	SIDE STREAM FILTER FOR CT

TYPE		PRESSURE SAND FILTER (VERTICAL DUAL MEDIA FILTER)	0
MOTIVE WATER CONDITION			
FLOW RATE			
NORMAL	M3/HR		
DESIGN	M3/HR	80 (FOR EACH FILTER)	
OPERATING PRESSURE	KG/CM2 G	1.8(NOTE-4,8)	
OPERATING TEMPERATURE	DEG C	45	
SUSPENDED SOLIDS AT INLET	mg/l	60	
SUSPENDE SOLIDA AT OUTLET	mg/l	10 (MAX.)	
ALLOWABLE PRESSURE DROP	KG/CM2 G	0.5 (VENDOR TO CONFIRM)	
MECHANICAL DATA			
DESIGN PRESSURE	KG/CM2 G	8	
DESIGN TEMPERATURE	DEG C	65 (NOTE-6)	
MATERIAL OF CONSTRUCION		CS(BOILER QUALITY EPOXY PAINTED)	0
CORROSION ALLOWANCE	MM	3.0	0
PIPING SPECIFICATIONS			
INLET PIPE	SIZE/RATING	6" / 300#	
OULET PIPE	SIZE/RATING	6" / 300#	
FOR CW SYSTEM DETAILS,REFER P&ID NO.		C050-79-41-1U68-1111 Sheet 2of 2	

NOTES

1 MOTIVE WATER WILL BE USED FOR BACKWASH.

2 VENDOR TO PROVIDE FOLLOWING INSTRUMENTS WITH THE FILTER.
- DPT ACROSS SAND FILETR
- PRESSURE GAUGE ON SAND FILTER.
- PSV ON SAND FILTER
- SELF ACTUATING PCV ON SCOURING AIR HEADER.
- FE/FT AT INLET OF FILTER.

3 PLANT AIR IS AVAILABLE AT FOLLOWING CONDITIONS AT PACKAGE B/L ;
PRESSURE, KG/CM2G : 4.0/5.0/6.0/10.5 (MIN/ NOR/ MAX/ MECH DESIGN)
TEMPERATURE,DEG C: AMB/65 (NOR/MECH DESIGN)

4 NORMALLY BACKWASH SHALL BE DONE FROM THE CW RETURN LINE. IN CASE PRESSURE IS INADEQUATE FOR BACK WASH PURPOSE, VENDOR SHALL TAKE TAPPING FROM THE COOLING WATER PUMP DISCHARGE LINE FOR THIS PURPOSE.

5 BOTH THE FILTERS ARE OPERATING SIMULTANEOUSLY.

6 MDMT = 5 DEG C.

7 LIQUID DENSITY AT OPERATING CONDITION IS 994 KG/M3.

8 PRESSURE AT THE UPSTREAM OF FLOW INSTRUMENT OF EACH FILTER INLET LINE.

9 INTERNAL COATING SHALL BE AS PER APPLICABLE SPECIFICATION.

10 THE SIDE STREAM FILTER PDS NUMBERING (C050-1U68-79-41-DS-1902) IN TERMS OF NRL NUMBERING PHILOSOPHY SHALL BE EL-1U68A-PR-DAT-4201. 0

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SILICA GEL BREATHER

PROCESS DATA SHEET

Document No. C050-1U68-79-41-DS-1904
Rev. No. 0

PROJECT EPCM Services for setting up Polypropylene Unit at NRL **CLIENT** NUMALIGARH REFINERY LIMITED

UNIT Recirculating Cooling water System **JOB NO.** C050 **UNIT NO.** 1U68

ITEM NO.		1U68-ZM-5772	
SERVICE		H2SO4 DOSING DRUM SILICA GEL BREATHER FOR CT	
TYPE		INDICATING TYPE (SILICA GEL SHOULD CHANGE COLOUR ON ABSORPTION)	
NO. OF ITEMS		ONE	
LOCATION		VENT LINE OF SULPHURIC ACID DOSING DRUM (1U68-VV-8631)	
QUATITY OF SILICA GEL	KG	94 (NOTE-2)	
DIMENTION OF VESSEL			
DIAMETER	MM	550	
HEIGHT	MM	550	
MECHANICAL DATA			
DESIGN PRESSURE	KG/CM2 G	3.5	
DESIGN TEMPERATURE	DEG C	65 (NOTE-4)	
MATERIAL OF CONSTRUCTION		KCS	0
CORROSION ALLOWANCE	MM	3.0	0
ALLOWABLE PRESSURE DROP	MMWC		
NOZZLE DETAILS		**SIZE, INCHES**	**RATING**
INLET LINE		2"	150# 0
OUTLET LINE		2"	150# 0
SLIGHT GLASS		COVERING ENTIRE HEIGHT OF BREATHER	

NOTES

1. DESSICANT SHALL BE SUPPORTED ON TWO LAYERS OF WIREMESH PUT OVER THE SUPPORT PLATE.
2. SILICA GEL QUANTITY IS BASED ON THE ASSUMPTION THAT IT IS CHANGED AFTER EVERY 30 DAYS, HOWEVER THE SAME SHALL BE CONFIRMED BY THE CONTRACTOR.
3. BREATHER SHALL BE PROVIDED WITH BUILT IN SIGHT GLASS COVERING THE ENTIRE HEIGHT OF BREATHER.
4. MDMT = 5 DEG C.
5. NOZZLES PIPING SPECIFICATION IS A8A. SIZE TO BE CONFIRMED BY VENDOR BASED ON ALLOWABLE PRESSURE DROP.
6. REFER P&ID NO. C050-79-41-1U68-1111 Sheet 2 of 2.
7. THE PDS NUMBERING(C050-1U68-79-41-DS-1904) IN TERMS OF NRL NUMBERING PHILOSOPHY SHALL BE EL-1U68A-PR-DAT-5702.

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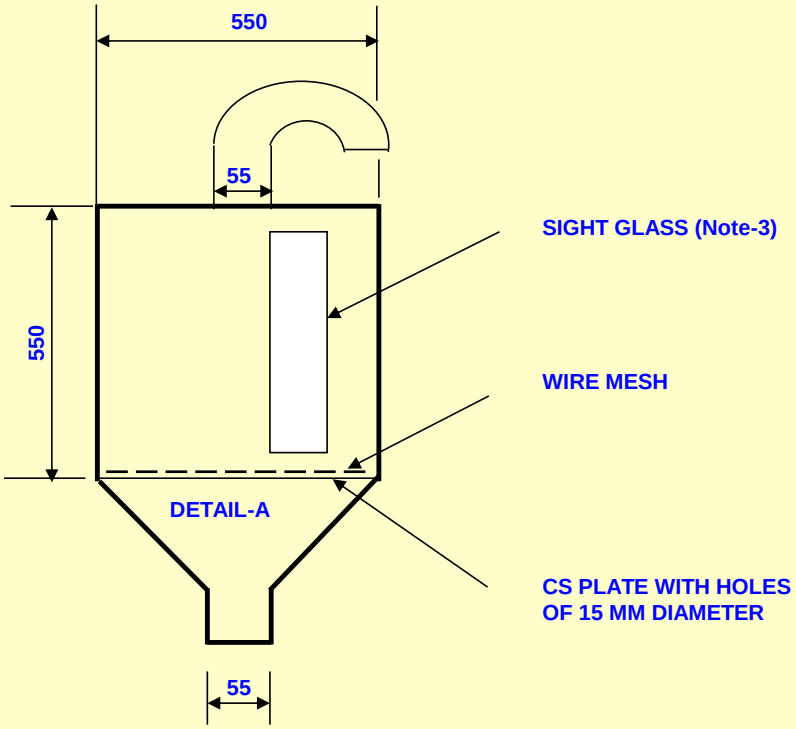
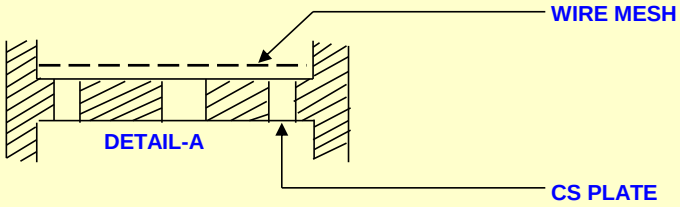
PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	CLIENT	NUMALIGARH REFINERY LIMITED
PLANT	Recirculating Cooling water System	JOB NO. C050	UNIT NO. 1U68
ITEM NO.	1U68-ZM-5772	SERVICE	H2SO4 DOSING DRUM SILICA GEL BREATHER FOR CT(NOTE-1)





ALL DIMENSIONS IN MM

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PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	**CLIENT**	NUMALIGARH REFINERY LIMITED
UNIT	Recirculating Cooling water System	**JOB NO.** C050	**UNIT NO.** 1U68

ITEM NO.		1U68-ZM-5771		
SERVICE		H2SO4 TANK SILICA GEL BREATHER FOR CT		
TYPE		INDICATING TYPE (SILICA GEL SHOULD CHANGE COLOUR ON ABSORPTION)		
NO. OF ITEMS		ONE		
LOCATION		VENT LINE OF SULPHURIC ACID STORAGE TANK (202-TT-1001)		
QUATITY OF SILICA GEL	KG	280 (NOTE-2)		
DIMENTION OF VESSEL				
DIAMETER	MM	800		
HEIGHT	MM	800		
MECHANICAL DATA				
DESIGN PRESSURE	KG/CM2 G	3.5		
DESIGN TEMPERATURE	DEG C	65 (NOTE-4)		
MATERIAL OF CONSTRUCTION		KCS		0
CORROSION ALLOWANCE	MM	3.0		0
ALLOWABLE PRESSURE DROP	MMWC			
NOZZLE DETAILS		**SIZE, INCHES**	**RATING**	
INLET LINE		2"	150#	0
OUTLET LINE		2"	150#	0
SLIGHT GLASS		COVERING ENTIRE HEIGHT OF BREATHER		

NOTES

1. DESSICANT SHALL BE SUPPORTED ON TWO LAYERS OF WIRE MESH PUT OVER THE SUPPORT PLATE.
2. SILICA GEL QUANTITY IS BASED ON THE ASSUMPTION THAT IT IS CHANGED AFTER EVERY 30 DAYS, HOWEVER THE SAME SHALL BE CONFIRMED BY COOLING TOWER VENDOR.
3. NOZZLES PIPING SPECIFICATION IS A8A. SIZE TO BE CONFIRMED BY VENDOR BASED ON ALLOWABLE PRESSURE DROP.
4. MDMT = 5 DEG C.
5. REFER P&ID NO. C050-79-41-1U68-1111 Sheet 2 of 2.
6. BREATHER SHALL BE PROVIDED WITH BUILT IN SIGHT GLASS COVERING THE ENTIRE HEIGHT OF BREATHER.
7. THE PDS NUMBERING(C050-1U68-79-41-DS-1903) IN TERMS OF NRL NUMBERING PHILOSOPHY SHALL BE EL-1U68A-PR-DAT-5702.

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
0	19-AUG-2025	Issued For Engineering	MAHENDRA	SUBHOSREE	SUBHOSREE
A	08-JUL-2025	Issued For Comments	MAHENDRA	SUBHOSREE	SUBHOSREE

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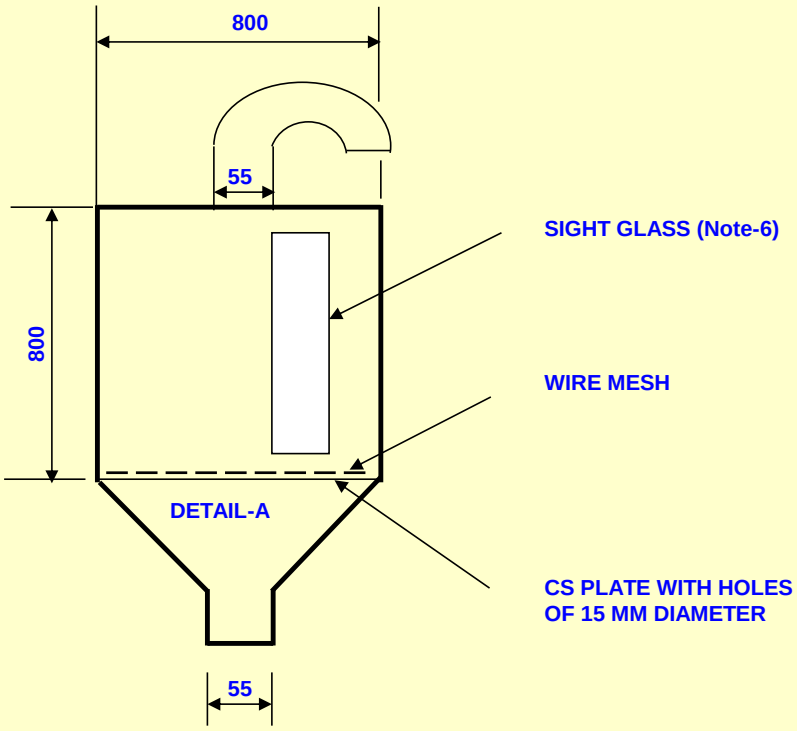
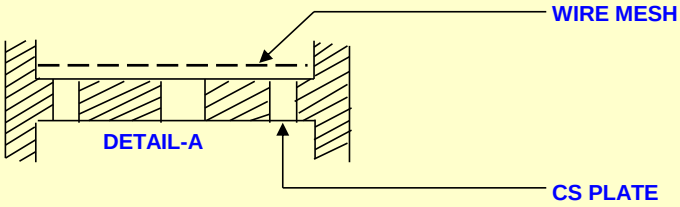
PROJECT	EPCM Services for setting up Polypropylene Unit at NRL	CLIENT	NUMALIGARH REFINERY LIMITED
PLANT	Recirculating Cooling water System	JOB NO. C050	UNIT NO. 1U68
ITEM NO.	1U68-ZM-5771	SERVICE	H2SO4 STORAGE TANK (NOTE-1)





ALL DIMENSIONS IN MM

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
0	19-08-25	ISSUED FOR ENGINEERING	MPS	SC	SC
A	08-07-2025	ISSUED FOR COMMENTS	MPS	SC	SC

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S.No	Tag No.	Service	Make	Type of Cooling (Air/ Water)	Water Qunatity (m^3/hr)	For Motors			
						Type of Enclosure	Air Quantity (Start up) Nm^3/hr	Duration of Purging (Start up) in minutes	Air Quantity (Continuous) Nm^3/hr

Vendor shall fill the details of all motors & VFDs, which are included in the scope of this MR and submit with the offer

A	02.04.2025	ISSUED WITH MR/ TENDER	MS	AKG	VK
Rev. No.	**Date**	**Purpose**	**Prepared**	**Checked**	**Approved**

Page 2654 of 5436 : C050-TENDER DOC-C050-1U68-81-45-PB-T-8010 : Rev. A

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ELCTRICAL BLOCK DIAGRAM
COOLING TOWER PACKAGE

BY CLIENT

BY COOLING TOWER PACKAGE CONTRACTOR

FROM CLIENT'S 6.6KV SWGR IN SS	FROM CLIENT'S PCC IN SUBSTATION	FROM CLIENT'S MCC IN SUBSTATION	FROM CLIENT'S MCC IN SUBSTATION	FROM CLIENT'S ASB IN SUBSTATION	FROM CLIENT'S ASB IN SUBSTATION	FROM CLIENT'S LDB IN SUBSTATION	FROM CLIENT'S ELDB IN SUBSTATION	FROM CLIENT'S DCDB IN SUBSTATION
*	*	*	*	*	*	*	*	*
			LOC : COOLING TOWER PACKAGE 415V POWER PANEL		LOC : COOLING TOWER PACKAGE 415V POWER PANEL	LOC : COOLING TOWER PACKAGE 415V LTG. PANEL NORMAL LTG.	LOC : COOLING TOWER PACKAGE 415V LTG. PANEL EMERG. LTG.	LOC : COOLING TOWER PACKAGE 220V DCJB CRITICAL LTG.
			#		#	#	#	#
FEEDING TO MOTORS (>160KW) OF THE PCKG.	FEEDING TO MOTORS (≤160KW &>55KW) & OTHER LOADS OF THE PCKG.	FEEDING TO MOTORS (<55KW) & OTHER LOADS OF THE PCKG.	FEEDING TO MOTORS REQUIRING SINGLE PHASE POWER	FEEDING TO WELDING RECEPTACLE	TO SINGLE PHASE POWER SOCKETS	TO SINGLE PHASE LIGHTING CIRCUITS	TO SINGLE PHASE LIGHTING CIRCUITS	TO DC LIGHTING CIRCUITS

NOTES : –

1. (*) SUPPLY & LAYING, TERMINATION OF 6.6kV POWER, LV POWER & CONTROL CABLES FROM OWNER'S SWITCHBOARD / SYSTEM UPTO CONTRACTORS EQUIPMENTS SHALL BE BY OWNER. CABLE TRAYS / TRENCHES FROM OWNER'S SWITCHBOARD / SYSTEM UPTO PACKAGE BATTERY LIMIT SHALL BE MADE AVAILABLE BY OWNER. CABLE TRAYS / TRENCHES INSIDE PACKAGE BATTERY LIMIT SHALL BE IN THE SCOPE OF CONTRACTOR

2. (#) SUPPLY, LAYING, TERMINATION OF CABLES INCLUDING CABLE TRAYS / TRENCHES INSIDE PACKAGE BATTERY LIMIT SHALL BE IN THE SCOPE OF PACKAGE CONTRACTOR.

3. REFER DOCUMENT C050–1U68–16–50–SOW–8010 FOR DETAILS.

ENGINEERS INDIA LIMITED NEW DELHI	PROJECT - PP UNIT PROJECT CLIENT - NRL PLANT - NUMALIGARH	A	11.08.2025	ISSUED WITH TENDER	MS	AKG	VK
		REV.	DATE	REVISION	PREPARED BY	CHECKED BY	APPROVED BY

ELECTRICAL BLOCK DIAGRAM
COOLING TOWER PACKAGE
PP UNIT PROJECT, NRL-NUMALIGARH

DRAWING NO.	REV.
C050-1U68-16-50-SK-8010	A

1–1641–0503 REV.0 A3–420x297

Project	EPCM Services for setting up Polypropylene Unit at NRL		**Client**	NRL - REFINERY	
Unit	DESIGN BASIS	**Location**	**Job No.**	C050	**Unit No.** 999

PURCHASER'S DATA

A.	**Site Conditions**		
1.	Maximum Ambient Temperature	°C	38
2.	Minimum Ambient Temperature	°C	5
3.	Design Ambient Temperature	°C	40
4.	Relative Humidity	%	90
5.	Altitude	mm	less then 1000
6.	Environment		Corrosive
B.	**Technical particulars**		
1.	Motor Tag no.:		
2.	Driven Equipment name:		
3.	Voltage:	kV	
4.	Phase:		Three
5.	Frequency:	Hz	
6.	Fault level:	kA	40
7.	Fault Duration:	sec.	0.25
8.	System Earthing:		Resistance Earthing
9.	Duty:		Continuous
10.	Method of starting:		D.O.L
11.	Cable size:	mm²	
12.	Cable type:		Al. Cond. XLPE insulated
13.	Temperature rise:	°C	
14.	Cooling:		TEFC/CACA/TETV
15.	Insulation class:		F
16.	Temperature rise Limited to insulation class		B
17.	Hazardous area classification:		As per area classification
18.	Dust classification		NA
19.	Gas group:		As per area classification
20.	Dust Group		NA
21.	Type of explosion protection:		As per MR/ Tender
22.	Prestart purging for Ex(n) motor		Not Required
23.	Type of ingress protection:		IP 55
24.	Reacceleration::		Required
25.	Diff. protection CTs:		As per specification
26.	CT specs.:		
27.	Color shade:		RAL-7031
28.	Thermisters:		Not Required
29.	RTD:		Refer Note-3
30.	BTD:		Refer Note-3
31.	RTD/BTD monitoring device:		Refer elsewhere
32.	Applicable specification:		EIL spec. 6-51-0031

DRIVEN EQUIPMENT MANUFACTURER's DATA

1.	Suggested motor rating:	kW	

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
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Project	EPCM Services for setting up Polypropylene Unit at NRL			**Client**	NRL - REFINERY
Unit	DESIGN BASIS	**Location**		**Job No.** C050	**Unit No.** 999

2.	Manufacturer:		
3.	Type of driver mounting:		
4.	Driven equipment:		
5.	Shaft kW:	kW	
6.	kW at maximum load:	kW	
7.	Speed:	RPM	
8.	Rotation of eqpt. from coupling end:		
9.	Coupling type:		
10.	Torque required starting	mkg	
11.	Torque required Maximum	mkg	
12.	GD2 of eqpt including flywheel	kgm²	
	excluding flywheel:	kgm²	
13.	Maximum thrust:	kg	
14.	Pulsation rate:		
15.	Starting condition:		

MOTOR MANUFACTURER's DATA

1.	Rating:	kW	
2.	Manufacturer:		
3.	Frame designation:		
4.	No. of poles:		
5.	Full load speed:	RPM	
6.	Mounting:		
7.	Full load torque (FLT):	mkg	
8.	Starting torque:	% of FLT	
9.	Break down or pull out torque	% of FLT	
10.	Full load current (FLC):	A	
11.	Starting current at 100%	% of FLC	
12.	Rotation viewed from coupling end:		
13.	Starting time at 80%/100% voltage:	sec.	
14.	Locked rotor withstand time (cold/hot) at,		
	80% voltage	sec.	
	100% voltage:	sec.	
15.	Time (Te) for Increased Safety Motor at 100% Voltage		
16.	Efficiency at 75%/100% Load:	%	
17.	Power factor at 75%/100% Loa		
18.	Heating/Cooling Time Const. (min.)	min	
19.	Space heater - voltage & power:		
20.	Moment of inertia, GD2:	kgm²	
21.	DE/NDE bearing type & no.:		
22.	Type of lubrication:		
23.	Type of main terminal box:		
24.	Type of neutral terminal b		
25.	No. of Terminals		
26.	Weight of motor:	kg	

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Project	EPCM Services for setting up Polypropylene Unit at NRL			**Client**	NRL - REFINERY
Unit	DESIGN BASIS	**Location**		**Job No.**	C050

Unit No. 999

27.	Thermisters, quantity	no.	
	make: type:		
28.	RTD, quantity:	no.	
	make: type:		
29.	BTD, quantity	no.	
	make: type:		
30.	Shaft voltage:	V	
31.	Critical speed, 1st/2nd st	RPM	
32.	Pressurization panel:		
	make: type:		
33.	Canopy:		
34.	Fan rotation Design		

Eil Notes

1 Canopy shall be provided for all outdoor motors.
2 Starting time calculations shall be based on operating conditions specified on Material Requisition e.g. open valve condition/closed valve condition, at no load/full load, as applicable.
3 RTDs and BTDs are applicable for motors as per EIL Specification 6-51-0031.

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
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Project	EPCM Services for setting up Polypropylene Unit at NRL		**Client**	NRL - REFINERY	
Unit	DESIGN BASIS	**Location**	**Job No.**	C050	**Unit No.** 999

PURCHASER'S DATA

A.	**Site Conditions**		
1.	Maximum Ambient Temperature	°C	38
2.	Minimum Ambient Temperature	°C	5
3.	Design Ambient Temperature	°C	40
4.	Relative Humidity	%	90
5.	Altitude	mm	less then 1000
6.	Environment:		Corrosive
B.	**Technical particulars**		
1.	Motor Tag no.:		
2.	Driven Equipment name:		
3.	Voltage:	V	415 +/- 10 %
4.	Phase:		Three
5.	Frequency:	Hz	50 +/- 3 %
6.	Fault level:	kA	65
7.	Method of starting:		D.O.L
8.	Winding Connection:		Delta
9.	No of Terminals:		6
10.	Cable size:	mm²	
11.	Cable type:		Cu/Al
12.	Temperature rise:	°C	
13.	Cooling:		TEFC
14.	Insulation class:		F
15.	Temperature rise Limited to insulation class		B
16.	Hazardous area classification:		As per area classification
17.	Dust classification		NA
18.	Gas group:		As per area classification
19.	Dust Group		NA
20.	Type of explosion protection:		As per MR/ Tender
21.	Prestart purging for Ex(n) motor		Not Required
22.	Type of ingress protection:		IP 55
23.	Color shade:		RAL-7031
24.	Thermisters:		Not Required
25.	RTD:		Not Required
26.	BTD:		Not Required
27.	RTD/BTD monitoring device:		Not Required
28.	Applicable specification:		6-51-0064
29.	Efficiency:		IE3 for Hazardous Area and IE4 for Safe Area

DRIVEN EQUIPMENT MANUFACTURER's DATA

1.	Suggested motor rating:	kW	
2.	Manufacturer:		
3.	BkW at Full load:	kW	
4.	kW:at end of Curve	kW	

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
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Project EPCM Services for setting up Polypropylene Unit at NRL **Client** NRL - REFINERY

Unit DESIGN BASIS **Location** **Job No.** C050 **Unit No.** 999

5.	Speed:	RPM	
6.	Rotation of eqpt. from coupling end:		
7.	Driven equipment:		
8.	Coupling type:		
9.	Torque required starting	mkg	
	Torque required Maximum	mkg	
10.	GD2 of eqpt including flywheel	kgm²	
	excluding flywheel:	kgm²	
11.	thrust Up:	kg	
	thrust Down:	kg	
12.	Starting condition:		

MOTOR MANUFACTURER's DATA

1.	Rating:	kW	
2.	Manufacturer:		
3.	No. of poles:		
4.	Frame designation:		
5.	Full load speed:	RPM	
6.	Mounting:		
7.	Full load torque (FLT):	mkg	
8.	Starting torque:	% of FLT	
9.	Break down or pull out torque:	% of FLT	
10.	Full load current (FLC):	A	
11.	Starting current at 100% voltage:	% of FLC	
12.	Rotation viewed from coupling end:		
13.	Starting time at 75% voltage:	sec.	
	100% voltage:	sec.	
14.	Locked rotor withstand time (cold/hot) at,		
	75% voltage	sec.	
	100% voltage:	sec.	
15.	Time (Te) for Increased Safety Motor at 100% Voltag	sec.	
16.	Heating/Cooling Time Const. (min.)	min	
17.	Space heater - voltage & power:		
18.	Efficiency at 75% Load:	%	
	100% Load: voltage:	%	
19.	Power factor at 75%/ Load:		
	100% Load:		
	starting		
20.	Moment of inertia, GD2:	kgm²	
21.	NDE bearing type & no		
22.	DE bearing type & no.:		
23.	Type of lubrication:		
24.	Weight of motor:	kg	

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
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Project EPCM Services for setting up Polypropylene Unit at NRL **Client** NRL - REFINERY

Unit DESIGN BASIS **Location** **Job No.** C050 **Unit No.** 999

25.	Thermisters, quantity	no.	
	make: type:		
26.	RTD, quantity:	no.	
	make: type:		
27.	BTD, quantity	no.	
	make: type:		
28.	Shaft voltage:	V	
29.	Critical speed, 1st/2nd stage:	RPM	
30.	Canopy:		

Notes

1 Canopy shall be provided for all outdoor motors.
2 Starting time calculations shall be based on operating conditions specified on Material Requisition e.g. open valve condition/closed valve condition, at no load/full load, as applicable.
3 Space heater shall be provided for motors rated 30 kW and above.

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
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Project EPCM Services for setting up Polypropylene Unit at NRL **Client** NRL - REFINERY

Unit DESIGN BASIS **Location** **Job No.** C050 **Unit No.** 999

PURCHASER'S DATA

A.	**Site Conditions**		
1.	Maximum Ambient Temperature	°C	38
2.	Minimum Ambient Temperature	°C	5
3.	Design Ambient Temperature	°C	40
4.	Relative Humidity	%	90
5.	Altitude Above MSL	mm	less then 1000
6.	Environment		Corrosive
B.	**Technical particulars**		
1.	System Voltage		
	Nominal		415 V
	Highest		500 V
	Voltage grade		650/1100V
2.	Frequency	Hz	
3.	Conductor material		
	HV Power cable		NA
	MV Power cable		Copper & Aluminium (Refer Note 1)
	MV control cable		NA
4.	Installation under DGMS jurisdiction (See Note)		No
5.	Applicable spec.		6-51-0051 Rev 9
6.	Insulation		XLPE
7.	PVC compound type		ST-2
8.	Type of conductor		As per 6-51-0051
9.	Conductor class		AS PER IS
10.	Types of cable		Flame retardant low smoke / Fire survival
11.	Armour		
	Type		AS PER IS 1554
	Size of armour		As per Table -3 of IS 1554
12.	Type of drum		Steel

MANUFACTURER'S DATA

A.	**Technical particulars**		
1.	Name of manufacturer		
2.	MR/PR item no.		
3.	Cable type/ code		
4.	Conductor material		
5	Conductor semiconducting screen (HV cables)		
	Material		
	Thickness	mm	
6.	Insulation		
	Type of compound		
	Thickness	mm	
7.	Insulation semiconducting screen (HV cables)		
	Material		

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
A	03-JUL-2025	ISSUED WITH MR	MANISH SINGHAL	ANIL KUMAR GARHWAL	VIJAY KUMAR

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Project EPCM Services for setting up Polypropylene Unit at NRL **Client** NRL - REFINERY

Unit DESIGN BASIS **Location** **Job No.** C050 **Unit No.** 999

	Thickness	mm	
8.	Copper tape		
	Thickness	mm	
9.	Inner sheath		
	Type of compound		
	Thickness	mm	
10.	Nominal dia under armour	mm	
11.	Calculated dia under armour	mm	
12.	Armour		
	Material		
	Type		
	Size		
13.	Nominal dia under outersheath	mm	
14.	Calculated dia under outersheath	mm	
15.	Outersheath		
	Type of compound		
	Thickness	mm	
16.	Nominal outer dia of cable	mm	
17.	Tolerance on outer dia	%	
18.	Weight of cable per km	kg	
19.	Maximum drum length	mtr.	
20.	Maximum DC resistance of conductor at 20 °C		
21.	AC resistance at 90 °C		
22.	Reactance of cable at 50 Hz		
23.	Capacitance of cable		
24.	Zero sequence impedance of cable		
25.	Capacitive charging current per km		

Notes

1 Cables upto and including 16 sq.mm shall be of copper conductor.

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
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इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

COMMUNICATION & FIRE ALARM CABLES DATA SHEET

Document No. C050-999-16-50-DS-0221
Rev. No. A

Project EPCM Services for setting up Polypropylene Unit at NRL **Client** NRL - REFINERY

Unit DESIGN BASIS **Location** **Job No.** C050 **Unit No.** 999

PURCHASER'S DATA

A.	**Site Conditions**		
1.	Maximum Ambient Temperature	°C	38
2.	Minimum Ambient Temperature	°C	5
3.	Design Ambient Temperature	°C	40
4.	Relative Humidity	%	90
5.	Altitude Above MSL	m	less then 1000
6.	Environment		Corrosive
B.	**Technical particulars**		
1.	Cable Type/Code		CONTROL PAIRED CABLES
2.	Embossing Details		Sequential marking/ mtr
3.	Details of Color Coding		As per ITD spec
4.	Details of Pairing		As per cl. 4.4 (6-51-0052)
5.	Standard Drum Length		Refer Note-3

MANUFACTURER'S DATA

A.	**Twisted Pair Unshielded Cables**		
1.	Name of Manufacturer		
2.	Material Specifications		
	Conductor dia.	mm	
	Insulation Thickness	mm	
	Inner Sheath Thickness	mm	
	Outer Sheath Thickness	mm	
3.	Performance Data		
	Rated Voltage	V	
	Max. Resistance at 20°C	ohms	
	Max. Core-Core Capacitance	nF	
	Max. Inductance	mH	
	Nominal Impedance	ohms	
4.	Technical Particulars		
	Approx. overall diameter	mm	
	Approx. dia. over armour	mm	
	Approx. dia. under armour	mm	
	Armour Galvanised Steel wire thickness		
	Minimum outer sheath thickness	mm	
B.	**Twisted Pair Shielded Cables**		
1.	Name of Manufacturer		
2.	Material Specifications		
	Conductor dia.	mm	
	Insulation Thickness	mm	
	Inner Sheath Thickness	mm	
	Outer Sheath Thickness	mm	
3.	Performance Data		
	Rated Voltage	V	
	Max. Resistance at 20°C	ohms	
	Max. Core-Core Capacitance	nF	

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Project EPCM Services for setting up Polypropylene Unit at NRL **Client** NRL - REFINERY

Unit DESIGN BASIS **Location** **Job No.** C050 **Unit No.** 999

	Max. Core-Screen Capacitance	nF	
	Maximum Inductance	mH	
	Nominal Impedance	ohms	
4.	Shielding Data		
	Material of Shielding		
	Minimum Thickness	mm	
	Coverage and Overlap		
5.	Drain Wire for Overall Sheath		
	Drain Wire Material		
	Area of Cross Section	mm sq	
	No. of Strands		
	Diameter	mm	
6.	Technical Particulars		
	Conductor Size	mm sq	
	Approx. overall diameter	mm	
	Approx. dia. over armour	mm	
	Approx. dia. under armour	mm	
	Armour Galvanised Steel wire thickness		
	Minimum outer sheath thickness	mm	

Eil Notes

1 Applicable specification 6-51-0052.
2 Outer sheath of cable shall be FRLS.
3 As per Cl. No.-7.3 & 7.4 of specification 6-51-0052.

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A	03-JUL-2025	ISSUED WITH MR	MANISH SINGHAL	ANIL KUMAR GARHWAL	VIJAY KUMAR

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Project EPCM Services for setting up Polypropylene Unit at NRL **Client** NRL - REFINERY

Unit DESIGN BASIS **Location** **Job No.** C050 **Unit No.** 999

PURCHASER'S DATA

A.	**Site Conditions**		
1.	Maximum Ambient Temperature	°C	38
2.	Minimum Ambient Temperature	°C	5
3.	Design Ambient Temperature	°C	40
4.	Relative Humidity	%	90
5.	Altitude Above MSL	m	less then 1000
6.	Environment		Corrosive
B.	**Operating Conditions**		
1.	Voltage	V	Refer job Spec.
2.	Frequency	Hz	50 +/- 3 %
3.	No of phases		Three
4.	System fault level	kA	50kA for 1 sec
5.	System earthing		Solidly Earthed
6.	Auxiliary supply		
	AC	V	Refer Job Spec +/- 10 % SPN
	DC	V	Refer Job Spec +/- 10 % DC
7.	Power supply for spring charging motor	V	Not Applicable AC
C.	**Electrical Data**		
1.	Short circuit withstand capacity for 1 sec.	KA	50
2.	Busbar current rating inside panel at specified ambient		As per job spec
3.	Busbars		Heat shrunk PVC sleeved
4.	System breaking capacity	kA	50
5.	System making capacity	kA(peak)	As per CBIP
6.	Circuit breaker		
	Type		Not Applicable
	Duty cycle		NA
	Rating		Not Applicable
7.	Incoming power entry		Cable
8.	Cable entry (I/C & O/G)		Top/ Bottom
9.	Bus duct entry		NA
10.	Cable gland/lugs		Included
11.	Painting/paint shade		RAL-7032
12.	Feeder arrangement & Execution		Single Front, Fixed type
13.	Minimum motor starter module size		240 mm
14.	Minimum switchfuse module size		Not Applicable
15.	Floor fixing		Base frame for Floor Mounting or Structure/Column Mounting
16.	Seperate bolted removablegland plate		Reqd.(Gland Plate Drilled at side)
17.	Minimum MCCB module		Vendor standard

MANUFACTURER'S DATA

A.	**Switchboards**	
1.	Tag no.:	
2.	Make	
3.	Type designation	

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Project EPCM Services for setting up Polypropylene Unit at NRL **Client** NRL - REFINERY

Unit DESIGN BASIS **Location** **Job No.** C050 **Unit No.** 999

4.	Degree of protection	
5.	CB panel	
	Overall weight	
	Incomer	
	Outgoing	
	Overall dimensions	
	Length*Depth*Height	
6.	Overall dimensions of MCC/ contactor controlled feeder panel	
	Length*Depth*Height	
7.	Overall dimensions of each PCC	
	Length*Depth*Height	
8.	Overall dimensions of each PMCC/ EPMCC	
	Length*Depth*Height	
9.	Overall dimensions of each MCC	
	Length*Depth*Height	
10.	Overall dimensions of each ASB	
	Length*Depth*Height	
11.	Overall dimensions of each LDB	
	Length*Depth*Height	
12.	Largest shipping section:	
	Max. overall weight	
	Length*Depth*Height	
13.	Recommended clearances for SWBD	
	Front*Rear*Above	
14.	Shock loading on foundation	
15.	Max. size/no. of cables that can be terminated	
	with rear extension	
	without rear extension	
16.	Size of rear extension panel	
17.	Clearance in air	
	Phase to Phase	
	Phase to Earth	
18.	Main horizontal bus bar	
	Bus bar current rating at	
	design ambient temp.	
	Main bus bar size	
	Main bus bar material	
	Main bus bar location	
19	Vertical bus bars	
	Bus bar current rating at	
	design ambient temp.	
	Bus bar size	
	Bus bar material	
	Bus bar location	
20.	Insulating material	

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Project EPCM Services for setting up Polypropylene Unit at NRL **Client** NRL - REFINERY

Unit DESIGN BASIS **Location** **Job No.** C050 **Unit No.** 999

21.	Earth bus bar size	
	Material	
22.	1min power freq voltage	
23.	Short circuit	
	1 second	
	Peak dynamic	
24.	Whether adaptor panel required	
	between PCC/MCC panel	
	If Yes, furnish dimensions	
B.	**Circuit breaker**	
1.	Type designation	
2.	Make	
3.	Mounting	
4.	No. of poles/phases	
5.	Current rating (in air)	
6.	Current rating (inside panel	
	at design temperature)	
7.	Short time rating (1 sec)	
8.	Sym breaking capacity	
	% DC component	
9.	Peak making capacity	
10.	Power frequency withstand	
11.	Impulse withstand voltage	
12.	Duty cycle	
13.	Total opening time	
14.	Total closing time	
15.	Power requirement	
	Opening	
	Closing	
	Spring charge motor	
16.	Time for spring charging	
17.	Breaker is trip free	
18.	Closing mechanism	
19.	Provision of manual spring charging	
20.	Tripping mechanism	
21.	Mechanical trip PB provided	
22.	Mechanical ON/OFF indicator provided	
23.	Operation counter provided	
24.	Time taken for spring charging	
25.	No. of auxiliary contacts	
26.	Derating required for capacitor switching	
C.	**Contractor**	
1.	Type designation	
2.	Make	
3.	Rated Voltage	
4.	Rated current	

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Project EPCM Services for setting up Polypropylene Unit at NRL **Client** NRL - REFINERY

Unit DESIGN BASIS **Location** **Job No.** C050 **Unit No.** 999

	AC-3 Duty	
	AC-4 Duty	
5.	Thermal rating	
6.	Making capacity	
7.	Breaking capacity	
8.	Switching frequency	
9.	Life	
	Electrical	
	Mechanical	
10.	Coil consumption	
	Pick up	
	Hold on	
11.	Closing time	
12.	Opening time	
13.	No of aux. contacts	
14	Maximum permitted back up fuse rating	
D.	**Switch**	
1.	Rated voltage	
2.	Rated current	
3.	AC 23 rating	
4.	Rated making capacity	
5.	Rated breaking capacity	
6.	Rated short circuit withstand current with	
	max. permissible rated fuses	
7.	Mechanical life	
8.	Maximum permitted back up fuse rating	
E.	**Thermal Overload Relay**	
1.	Make	
2.	Type	
3.	Setting range	
4.	Single phasing preventor	
5.	Type of operation	
6.	Maximum permitted back up fuse rating	
F.	**Fuses**	
1.	Make	
2.	Type	
3.	Current rating	
G.	**Electronic Motor protection relay**	
1.	Make	
2.	Type	
3.	Setting range	
4.	Single phasing preventor	
5.	Type of operation	
6.	Maximum permitted back up fuse rating	
7.	Earth fault protection available	
H.	**MCCB/MCB**	
1.	Make	

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Project EPCM Services for setting up Polypropylene Unit at NRL **Client** NRL - REFINERY

Unit DESIGN BASIS **Location** **Job No.** C050 **Unit No.** 999

2.	Type	
3.	Rated voltage	
4.	Rated current	
5.	Rated frequency	
6.	No. of poles	
7.	Derating factor for operation under site conditions	
8.	Rated 10 sec short time rating	
9.	Rated breaking capacity at service voltag	
10.	No. of operations at full fault	
11.	No. of operations at partial fault	
12.	No. of guaranteed mech. operations	
13.	1 min dry p.f with stand voltage	
14.	Shunt trip feature (for MCCB only)	
15.	Operating voltage range for MCCB shunt trip	

Eil Notes

1 The switchboard shall be of proven design and shall have been successfully type tested. Type test certificates for an exactly identical design of offered switchboard shall be furnished by bidders. These test reports shall be not more than 5 yeas old, as on the final bid opening date. In case these type tests have not been conducted during the last 5 years, bidder shall conduct these type tests on the offered design of switchboard before dispatch without any extra cost and delivery impact.

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LIGHTING FIXTURE SCHEDULE

PROJECT : EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL

CLIENT : M/s NRL, NUMALIGARH

PMC : ENGINEERS INDIA LIMITED

JOB NO : C050

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INDOOR LED LIGHT FIXTURES

S. No.	Light Fixture - Description	Makes & Catalogue Nos.
1.	**LED IND-1**: Surface mounted / Pendant Type LED Tube Lights for Office or Commercial Buildings – completely integral with in-built linear SMD LEDs/ electronic drivers / length of 1200 mm (4 Feet) for a minimum rating of 20 Watts.	• Bajaj : BLRB 18W LED XE • Crompton : LSDL –20- CDL ; • Philips : TMC501 With TLED 1X18W/4FT Master LED Tube • Pyrotech: PC-14-D-L-WXOA/18W Or Equivalent Models.
2.	**LED IND-2**: Surface mounted / Pendant Type Integral LED Tube Lights for Industrial Warehouses /Workshops / Sub-Stations – completely integral with in-built linear SMD LEDs / electronic drivers / length of 1200 mm (4 Feet) for a minimum rating of 36 Watts. An alternative solution for conventional 2x28 W/2x36 W fluorescent Battens.	• Philips : TMC 501 With TLED 2X18W/4FT Master LED Tube • Crompton : LDL -36 – CDL; • Bajaj : BLRB 218W LED XE • Pyrotech: PC-14-D-L-WXOA/36W Or Equivalent Models
3.	**LED IND-3**: Surface mounted / Pendant Type Integral LED Tube Lights for industrial outdoor /weatherproof applications & IP-65 Ingress Protection – completely integral with in-built linear SMD LEDs / electronic drivers / length of 1200 mm (4 Feet) for a minimum rating of 36 Watts.	• Bajaj : Linea Excel {BIPC 40W LED XE}; • Crompton : Shield {IPFC1LT8/16 & 2X LGT8-20-865-2; • Philips : Endura LED Waterproof – 42 Watts; WT550 C LED 40S CW PSU S1 PC; Or Equivalent Models.
4.	**LED IND-4**: Surface mounted / Pendant Type Integral LED Tube Lights for Industrial Warehouses /Workshops / Sub-Stations – completely integral with in-built linear SMD LEDs / electronic drivers / length of 1200 mm (4 Feet) for a minimum rating of 36 Watts. An alternative solution for conventional 2x28W / 2x36W fluorescent Battens.(Suitable for Mounting on Metsec Channel with white enameled reflector)	• Crompton: Master LED tube 1200mm-18W 869 T8 • Bajaj: BLRB 218W LED XE Or Equivalent Models.
5.	**LED-1:** Recess mounted, compact / slim panel / tile light in square shape – suitable for mounting in 2 Feet X 2 Feet Grid type False Ceiling with minimum 35 Watts rating & White Color – with built-in driver & all mounting accessories.	• Bajaj : ""Armstorme" {BZRSQL 36W WH GZi}; • Crompton : LCTLRNI-36-FO-CDL • Philips : RC 420B LED 35S PSU W60L60 • Pyrotech: PB-12-D-L-WXOA/36W Or Equivalent Models.

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S. No.	Light Fixture - Description	Makes & Catalogue Nos.
6.	**LED-2:** Recess mounted, compact / slim panel / tile light in square shape – suitable for mounting in 2 Feet X 2 Feet Grid type False Ceiling White Color – with built-in driver & all mounting accessories.	• Crompton: LCTLRN-50-FO-CDL • Bajaj: BZRSQL 43W LED GZi WH Or Equivalent Models.
7.	**LED-3:** Recess mounted, compact / flat, round or square shaped LED down-lighter in white finish – suitable for mounting in gypsum / Armstrong type false ceiling – with minimum 18 Watts rating & White Color – with built-in driver and all mounting accessories.	• Bajaj : SLEEK Round / Square {BGSLO Sleek 18W WH RD / SQ}; • Crompton : QUARTZ Round / Square {LCDE or LSDE-18W-CDL/NW }; • Philips : Green LEDi {DN 195B LED 20S – 6500PSU WHS1}; • Pyrotech: PB-12-D-L-WXOA/18W Or Equivalent Models.
8.	**LED-4:** Recess Mounted Adjustable / Swivel LED spot-light / COB Light with tilting (Gimbal) feature and a minimum rating of 20 Watts & golden yellow / white color light – with white round / square frame, built-in driver, suitable for mounting on gypsum false-ceiling & all mounting accessories.	• Philips : ECO Accent Recessed Adjustable {RS271B LED 20/850 PSU-E WB WH}; • Bajaj : KLASS Series COB {BRDCSL 16 W WW}; • Crompton : AQUA COB LED {LR-RAD-20- CDL/NDL-24/50D}; Or Equivalent Models.
9.	**LED-5:** Surface Mounted – Ceiling Tile LED Fixture of dimensions 2 Feet X 2 Feet – suitable for direct ceiling mounting - with minimum 35 Watts rating & White Color – with built-in driver & all mounting accessories.	• Crompton : ORION-I – LCTLSN-36-CDL • Bajaj : BZSSQL 36W LED • Philips : CIRRUS – SM365C LED33-6500 PSU-OD WH • Pyrotech: PB-12-D-L-WXOA/36W Or Equivalent Models.
10.	**LED-6 :** Surface mounted round or square shaped LED down-lighter in white finish – suitable for direct ceiling mounting – with minimum 18 Watts rating & White Color – with built-in driver and all mounting accessories.	• Crompton : Pearl II – Round / Square {LCDSPLN- R-18-CDL / LCDSPLN-S-18-CDL}; • Bajaj : Sleek – Round / Square– BGSLO Sleek Surface 18 W WH RD / BGSLO Sleek Surface 18W WH SQ}; • Philips : Cirrus Mini {SM5 18C LED 16S 6500PSU OD WH} • Pyrotech: PB-13-D-L-WXOA/18W Or Equivalent Models.
11.	**LED-7:** Surface mounted round or square shaped LED Dome -lights – suitable for direct wall mounting – with minimum 18 Watts rating & White Color – with built-in driver and all mounting accessories.	• Philips : CoreLine Wall-Mounted {WL120V LED12S / 840 PSR WH}; • Bajaj : Sleek – Round / Square– BGSLO Sleek Surface 18 W WH RD / BGSLO Sleek Surface 18W WH SQ};

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S. No.	Light Fixture - Description	Makes & Catalogue Nos.
		• Crompton : Orbit {LCDSPLN-R-18-CDL}; Or Equivalent Models.
12.	**LED-8:** Rechargeable Lantern type LED Fixtures of minimum 4 Watts rating - with inbuilt sealed rechargeable Battery / Cell suitable for operation at 240 Volts AC and with a minimum battery back-up time of 2 hours.	• Philips – Ujjwal Plus LED Lantern; • Bajaj LED Glow 648 LR Rechargeable Lantern; • Crompton - CG-LL30 LED Rechargeable Lantern; Or Equivalent Models.
13.	**LED-RSD-10:** LED Fixture suitable for 110V DC complete with 18W LED Lamp, driver, including other materials as applicable for installation (Recess mounted)	• Pyrotech (PB-13-P-L-WXOA/18W) Or Equivalent Models.
14.	**LED-SFD-12:** LED Fixture suitable for 110V DC complete with 18W LED Lamp, driver, including other materials as applicable for installation (Surface mounted)	• Pyrotech (PB-13-P-L-WXOB/18W) Or Equivalent Models.
15.	**LED-LB-1:** Indoor Industrial Low Bay LED Luminaries - with high pressure die-cast aluminum housing, mirror / lens optics (heat- resistant) for symmetric light distribution and high system efficacy for a rating of 80 Watts up to 100 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories.	• Bajaj : Duranto Highbay Luminaire 100 Watts{BGHB 100W LED GV}; • Crompton : SURROUND -II LHB11-70-CDL/60 - 70Watts; • Philips : GreenPerform Highbay G2 – 80 Watts{BY689P LED 90/NW PSU S-NB}; • Pyrotech: PD-17-D-L-WXOA/90W Or Equivalent Models.
16.	**LED-HB-1:** Indoor Industrial Medium Bay LED Luminaries - with high pressure die-cast aluminum housing, mirror / lens optics (heat- resistant) for symmetric light distribution and high system efficacy for a rating of 120 Watts up to 150 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories.	• Bajaj : Duranto Highbay Luminaire 150 Watts{BGHB 150W LED}; • Crompton : : SURROND-II {LHB11-110-CDL/60 -110 Watts}; • Philips : GreenPerform Highbay G2 – 130 Watts{BY688P LED 140/NW PSR S-NB}; • Pyrotech: PD-17-D-L-WXOA/150W Or Equivalent Models.

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S. No.	Light Fixture - Description	Makes & Catalogue Nos.
17.	**LED-HB-2:** Indoor Industrial High Bay LED Luminaries - with high pressure die-cast aluminum housing, mirror / lens optics (heat- resistant) for symmetric light distribution and high system efficacy for a rating above 180 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories.	• Bajaj : Duranto Highbay Luminaire 200 Watts{BGHB 200W LED}; • Crompton : Crompton : LHB11-180-CDL/60- 180Watts; • Philips : Green Perform Highbay G2 – 200 Watts{BY687P LED200/NW PSR S-WB L3000}; • Pyrotech: PD-17-D-L-WXOA/180W Or Equivalent Models.
OUTDOOR LED LIGHT FIXTURES		
18.	**LED-BK-1:** Outdoor Surface Mounted Bulkhead LED Lights – with die-cast aluminum housing / toughened glass lens and minimum IP -65 ingress protection of minimum 10 watts rating – complete with integral type electronic drivers & all mounting accessories.	• Bajaj : Wee Plus {BIBWP 10 W LED} Crompton : Sunrise LED Bulkhead {LBH-10- CDL}; • Philips : Vista Glow WT140W LED7S CW PSU S1 PC; • Pyrotech: PP-11-D-L-WXOA/10W Or Equivalent Models.
19.	**LED-BK-2:** Outdoor Surface Mounted Bulkhead LED Lights – with die-cast aluminum housing / toughened glass lens and minimum IP -65 ingress protection of minimum 30 watts rating – complete with integral type electronic drivers & all mounting accessories.	• Pyrotech: PP-11-D-L-WXOA/30W Or Equivalent Models.
19A.	**LED-BK-3:** Outdoor type well glass light fixture with LED lamp, LED driver, reflectors, mounting hardwares, clamps and brackets etc. and minimum IP-65 ingress protection. This lighting shall be suitable for operation on 240V AC supplies and platform type light poles. Light Output i.e. LUMENS of fixture 6000 to 6500 LM and min. 100 LM/Watt.	Equivalent models
20.	**LED-ST-4 :** LED Street Light Fixtures with Leaf / Sleek Type design & SMD or COB Type LEDs for high system efficacy & rating of 80 Watts to 100 Watts – having powder coated Pressure Die-Cast Aluminum Body & toughened glass visor fitted in a frame & completely integral – with all mounting accessories. The fixture enclosure shall have minimum IP 65 ingress protection.	• Bajaj : EDGE Streetlight – 90 Watts {BRLEP 90W LED}; • Crompton : NEXUS STAR - 90 Watts {LSTP-90-CDL}; • Philips : Green Line V2 BRP410 LED 092 CW HE NR FG S2 PSU GR; • Pyrotech: PP-11-D-L-WXOA/10W Or Equivalent Models.
21.	**LED-ST-10 :** LED Street Light Fixtures with Leaf / Sleek Type design & SMD or COB Type LEDs for high	• Crompton: LSTP120 CDL • Bajaj:- BRTFG 120W LED

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S. No.	Light Fixture - Description	Makes & Catalogue Nos.
	system efficacy & rating of 120 Watts having powder coated Pressure Die-Cast Aluminum Body & toughened glass visor fitted in a frame & completely integral – with all mounting accessories. The fixture enclosure shall have minimum IP 65 ingress protection.	Or Equivalent Models.
22.	**LED-ST-11 :** LED Street Light Fixtures with Leaf / Sleek Type design & SMD or COB Type LEDs for high system efficacy & rating of 120 Watts to 150 Watts – having powder coated Pressure Die-Cast Aluminum Body & toughened glass visor fitted in a frame & completely integral – with all mounting accessories. The fixture enclosure shall have minimum IP 65 ingress protection.	• Bajaj : Edge Streetlight – 150 Watts {BRTFG 135W LED}; • Crompton : 135 Watts {LSTP-135-CDL};; • Philips : Greenline Extra BRP322 LED 122 CW HE MR PC S3 XT; • Pyrotech: PE-11-D-L-WXOA/150W Or Equivalent Models.
23.	**LED-FD-1:** LED Flood-Light Fixtures with COB or SMD Type LEDs and high system efficacy for a rating of 80 Watts up to 110 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories – suitable for outdoor installation & having a minimum IP 65 ingress protection. The Flood-Light fixtures shall have powder-coated pressure die-cast & Aluminum Body & toughened glass front cover.	• Philips : Uniflood 2 Series Flood Light - 110Watts {BVP122 LED110 CW FLNB FG XTFC}; • Crompton : OMEGA LED Flood Light – 110 Watts{LFLN11-110-CDL/60}; • Bajaj : Force Flood Light – 100 Watts {BJFL 100W LED I}; • Pyrotech: PD-17-D-L-WXOA/110W Or Equivalent Models.
24.	**LED-FD-2:** LED Flood-Light Fixtures with COB or SMD Type LEDs and high system efficacy for a rating of 150 Watts up to 200 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories – suitable for outdoor installation & having a minimum IP 65 ingress protection. The Flood-Light fixtures shall have powder-coated pressure die-cast & Aluminum Body & toughened glass front cover.	• Philips : Tempo Series LED Flood Lights – 172Watts { BVP410 LED 172 CW HE NB FG S3 XT}; • Crompton : 200 Watts LED Flood Lights {LFLN11-200-CDL/60};; • Bajaj : Turbo Flood Light – 200 Watts {BJFL 200W LED I}; • Pyrotech: PD-17-D-L-WXOA/200W Or Equivalent Models.
25.	**LED-FD-3:** LED Flood-Light Fixtures with COB or SMD Type LEDs and high system efficacy for a rating of 250 Watts & above – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories – suitable for outdoor installation & having a minimum IP 65 ingress protection. The Flood-Light fixtures shall have powder-coated pressure die-cast & Aluminum Body & toughened glass front cover.	• Philips : Tempo Series LED Flood Lights – 252Watts {BVP410 LED 252 CW HE AK55 FG S3XTFC}; • Crompton : MAGPIE – 250 Watts LED Flood Lights{LFLPI-250-CDL/60}; • Bajaj : Turbo Flood Light – 350 Watts {BJFL 350W LED I}; • Pyrotech: PD-17-D-L-WXOA/250W Or Equivalent Models.

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S. No.	Light Fixture - Description	Makes & Catalogue Nos.
26.	**LED-FD-9:** LED Flood-Light Fixtures with COB or SMD Type LEDs and high system efficacy for a rating of 400 Watt & above – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories – suitable for outdoor installation & having a minimum IP 65 ingress protection. The Flood-Light fixtures shall have powder-coated pressure die-cast & Aluminum Body & toughened glass front cover.	• Crompton: MAGPIE+ LFLPI-400-CDL/60 • Bajaj: BJFL 400W LED IP66 • Philips: Tango G3 BVP383 LED450/CW 400W 220-240V SWB IN; • Pyrotech: PD-17-D-L-WXOA/500W Or Equivalent Models
27.	**LED-BL-1:** Integral decorative LED Bollard Luminaries with opal acrylic diffusers of minimum 8 Watts rating & suitable for landscape lighting with IP-65 Ingress Protection and anti-corrosive powder-coated die-cast aluminum housing – complete with all mounting accessories (anchor bolts / base-plates)	• Bajaj : Tetris LED Bollard {BGBOS 600 9W LED}; • Crompton : Maya-III COB LED Bollard {LBLA3-10- CDL}; • Philips : City Cube Series LED Bollard - 8.5 Watts{BCP400 LED04 U CW PSU GR S1}; • Pyrotech: PD-15-D-L-WXOA Or Equivalent Models.
28.	**LED-PT-1** LED Post Top Lantern type fixture. Lumen Output shall be equivalent to that of 80W HPMV	• Bajaj BLTSP 25W NW LED (Globe) Or Equivalent Models.

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OUTDOOR TYPE FIXTURES
FLAMEPROOF LIGHTING FIXTURE (ZONE-1 AND 2)

S.NO.	FIXTURE NO.	DESCRIPTION	WATTAGE
1.	LED-FLP-1 IIA/IIB	Flameproof well glass/linear LED lighting fixture suitable for use in zone-1/2 & gas group IIA/IIB classified areas complete with LED lamp, LED driver, reflectors, mounting hardwares, clamps & brackets etc. This Lighting fixtures shall be suitable for operation on 240V AC supplies. **(Light Output i.e. LUMENS of fixture 4000 to 4500 LM and min. 100 LM/Watt.)**	Up to 45 W
2.	LED-FLP-1 IIC	Flameproof well glass/linear LED lighting fixture suitable for use in zone-1/2 & gas group IIC classified areas complete with LED lamp, LED driver, reflectors, mounting hardwares, clamps & brackets etc. This Lighting fixtures shall be suitable for operation on 240V AC supplies. **(Light Output i.e. LUMENS of fixture 4000 to 4500 LM and min. 100 LM/Watt.)**	Up to 45 W
3.	LED-FLP-2 IIA/IIB	Flameproof and weatherproof LED cluster based aviation obstruction light suitable for use in zone-1/2 & gas group IIA/IIB classified areas complete with LEDs (Twin type) with LED Lamp, driver, including other materials as applicable for installation.	Up to 60W (Medium Intensity)
4.	LED-FLP-2 IIC	Flameproof and weatherproof LED cluster based aviation obstruction light suitable for use in zone-1/2 & gas group IIC classified areas complete with LEDs (Twin type) with LED Lamp, driver, including other materials as applicable for Installation.	Up to 60W (Medium Intensity)
5.	LED-FLP-3 IIA/IIB	Flameproof & WP Well glass lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in IIA/IIB classified areas. **(Light Output i.e. LUMENS of fixture 4000 to 4500 LM and min. 100 LM/Watt.)**	Up to 45 W
6.	LED-FLP-3 IIC	Flameproof & WP Well glass lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in IIC classified areas. **(Light Output i.e. LUMENS of fixture 4000 to 4500 LM and min. 100 LM/Watt.)**	Up to 45 W
7.	LED-ExnR-4	Weatherproof well glass non sparking restricted breathing type lighting fixture for use in zone-1/2 & gas group IIA/IIB classified areas but with LED lamp, LED driver, reflectors, mounting hardwares, clamps & brackets etc. **(Light Output i.e. LUMENS of fixture 6000 to 6500 LM and min. 100 LM/Watt.)**	Upto 65 W

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S.NO.	FIXTURE NO.	DESCRIPTION	WATTAGE
8.	LED-FLP-4 IIA/IIB	Flameproof & WP Well glass lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIA/IIB Classified areas. **(Light Output i.e. LUMENS of fixture 6000 to 6500 LM and min. 100 LM/Watt.)**	Upto 65 W
9.	LED-FLP-4 IIC	Flameproof & WP Well glass lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIC Classified areas. **(Light Output i.e. LUMENS of fixture 6000 to 6500 LM and min. 100 LM/Watt.)**	Upto 65 W
10.	LED-ExnR-5	Weatherproof well glass non sparking restricted breathing type lighting fixture for use in zone-1/2 with LED lamp with LED driver, reflectors, mounting hardwares, clamps & brackets etc.. **(Light Output i.e. LUMENS of fixture 13500 to 14000 LM and min. 100 LM/Watt.)**	Upto 140 W
11.	LED-FLP-5 IIA/IIB	Flameproof & WP Well glass lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIA/IIB Classified areas. **(Light Output i.e. LUMENS of fixture 13500 to 14000 LM and min. 100 LM/Watt.)**	Up to 140 W
12.	LED-FLP-5 IIC	Flameproof & WP Well glass lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIC, Classified areas. **(Light Output i.e. LUMENS of fixture 13500 to 14000 LM and min. 100 LM/Watt.)**	Up to 140 W
13.	LED-ExnR-6	Weatherproof well glass non sparking restricted breathing type lighting fixture for use in zone-1/2 with LED lamp with LED driver, reflectors, mounting hardwares, clamps & brackets etc.. **(Light Output i.e. LUMENS of fixture 22500 to 23000 LM and min. 100 LM/Watt.)**	Up to 230 W
14.	LED-FLP-6 IIA/IIB	Flameproof and weatherproof flood Lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIA/IIB, Classified areas. **(Light Output i.e. LUMENS of fixture 22500 to 23000 LM and min. 100 LM/Watt.)**	Up to 230 W

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S.NO.	FIXTURE NO.	DESCRIPTION	WATTAGE
15.	LED-FLP-6 IIC	Flameproof and weatherproof flood Lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIC, Classified areas. **(Light Output i.e. LUMENS of fixture 22500 to 23000 LM and min. 100 LM/Watt.)**	Up to 230 W
16.	LED-ExnR-7	Weatherproof flood light non sparking restricted breathing type lighting fixture for use in zone-1/2 & with LED lamp with LED driver, reflectors, mounting hardwares, clamps & brackets etc.. **(Light Output i.e. LUMENS of fixture 13500 to 14000 LM and min. 100 LM/Watt.)**	Up to 140 W
17.	LED-FLP-7 IIA/IIB	Flameproof and weatherproof flood Lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIA/IIB, Classified areas. **(Light Output i.e. LUMENS of fixture 13500 to 14000 LM and min. 100 LM/Watt.)**	Up to 140 W
18.	LED-FLP-7 IIC	Flameproof and weatherproof flood Lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIC, Classified areas. **(Light Output i.e. LUMENS of fixture 13500 to 14000 LM and min. 100 LM/Watt.)**	Up to 140 W
19.	LED-FLP-8 IIA/IIB	Flameproof well glass/linear LED lighting fixture suitable for use in zone-1/2 & gas group IIA/IIB classified areas complete with LED lamp, LED driver, reflectors, mounting hardwares, clamps & brackets etc. This Lighting fixture shall be suitable for operation on 240V AC supplies. **(Light Output i.e. LUMENS of fixture 6000 to 6500 LM and min. 100 LM/Watt.)**	Up to 65 W
20.	LED-FLP-8 IIC	Flameproof well glass/linear LED lighting fixture suitable for use in zone-1/2 & gas group IIC classified areas complete with LED lamp, LED driver, reflectors, mounting hardwares, clamps & brackets etc. This Lighting fixture shall be suitable for operation on 240V AC supplies. **(Light Output i.e. LUMENS of fixture 6000 to 6500 LM and min. 100 LM/Watt.)**	Up to 65 W
21.	LED-FLP-9 IIA/IIB	Flameproof well glass/linear LED lighting fixture suitable for use in zone-1/2 & gas group IIA/IIB classified areas complete with LED lamp, LED driver, reflectors, mounting hardwares, clamps & brackets etc. This Lighting fixture shall be suitable for operation on 240V AC supplies. **(Light Output i.e. LUMENS of fixture 10000 to 10500 LM and min. 100 LM/Watt.)**	Up to 100 W

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S.NO.	FIXTURE NO.	DESCRIPTION	WATTAGE
22.	LED-FLP-9 IIC	Flameproof well glass/linear LED lighting fixture suitable for use in zone-1/2 & gas group IIC classified areas complete with LED lamp, LED driver, reflectors, mounting hardwares, clamps & brackets etc. This Lighting fixture shall be suitable for operation on 240V AC supplies. **(Light Output i.e. LUMENS of fixture 10000 to 10500 LM and min. 100 LM/Watt.)**	Up to 100 W
23.	LED-FLP-FD3 IIA/IIB	Flameproof and weatherproof flood Lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIA/IIB, Classified areas. **(Light Output i.e. LUMENS of fixture 15000 to 15500 LM and min. 100 LM/Watt.)**	Up to 150 W
24.	LED-FLP-FD3 IIC	Flameproof and weatherproof flood Lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIC, Classified areas. **(Light Output i.e. LUMENS of fixture 15000 to 15500 LM and min. 100 LM/Watt.)**	Up to 150 W
25.	LED-FLP-10 IIA/IIB	Flameproof and weatherproof type twin tube lighting fixture with LED lamp, driver including other materials as applicable for installation for use in zone-1/2 & gas group IIA/IIB, Classified areas. **(Light Output i.e. LUMENS of fixture 3600LM for each tube and min. 100 LM/Watt.)**	Up to 2 X 36 W
26.	LED-FLP-10 IIC	Flameproof and weatherproof type twin tube lighting fixture with LED lamp, driver including other materials as applicable for installation for use in zone-1/2 & gas group IIC, Classified areas. **(Light Output i.e. LUMENS of fixture 3600LM for each tube and min. 100 LM/Watt.)**	Up to 2 X 36 W

Notes:

1. All fixtures shall be latest energy efficient type.
2. All fixtures shall be complete with lamps.
3. Make of fixtures shall be embossed on the body of the lighting fixtures.
4. Make of fixtures shall be embossed on the body.
5. All LED fixtures shall be high power factor (Min. 0.95) type.

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6. LED lamps shall be provided with highly translucent diffusers with advance optical system with high internal reflectivity material of excellent and smooth output for glare free light and no visibility of LED to eyes.
7. All lighting fixtures shall be supplied complete with associated LED lamp and driver.
8. All LED fixtures including driver shall be provided with 5 years warranty.
9. Fixture life time (L70) shall be > 50000 hrs. at ambient temp of 45 deg
10. All above Luminaries with controllers & drivers must be suitable for a working voltage range of 150 to 270 Volts, 50 Hz, AC.
11. In case any of the above referred models / makes are discontinued, prior approval from the engineer-in- charge has to be taken for supplying any alternate makes / models.
12. Manufacturers should ensure that all LED panels are sourced from reputed LED manufacturers.
13. The LED light fixtures should be tested for luminous lux level as per IES-LM-79. Type test certificates shall be furnished in compliance to same. Type test certificates for LM-79 for all fixtures shall be from a NABL (National Accreditation Board for Testing and Calibration Laboratories) accredited Lab or UL Laboratory.
14. The LED's used in the lighting fixtures should be tested for the service life as per IES-LM-80. Type test certificates shall be furnished in compliance to same.
15. The LED Driver shall comply with the requirement of IEC 61347-2-13.

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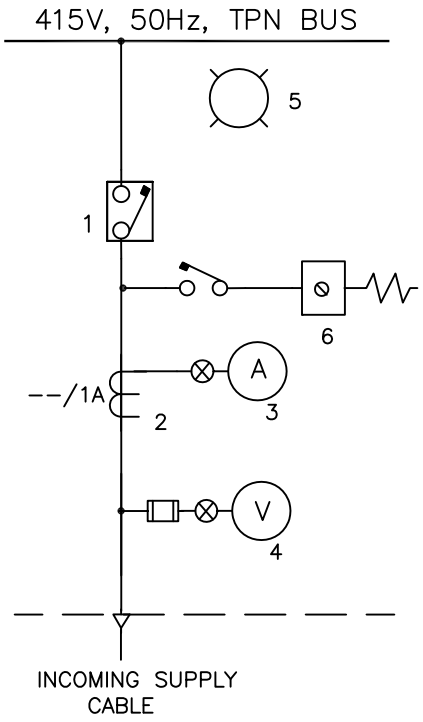
PROJECT: PP UNIT CLIENT: M/s NRL	REV	DATE	PURPOSE	BY	CHKD	APPRV
	A	01.07.2025	ISSUED WITH MR / TENDER	MS	AKG	VK



EQUIPMENT DATA FOR INCOMER

ITEM NO.	NEMA NO.	QTY.	DESCRIPTION
1	–	1	MCCB WITH SC/OL/EF RELEASE & SHUNT TRIP
2	–	3	METERING CT, CL-1
3	–	1	AMMETER WITH 4WAY SELECTOR SWITCH.
4	–	1	VOLTMETER WITH 4WAY SELECTOR SWITCH & FUSE
5	–	3	R Y B INDICATING LAMPS – LED TYPE
6	–	1	PANEL SPACE HEATER WITH MCB AND THERMOSTAT

NOTES

1. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN RESPECTIVE JOB SPECIFICATION/STANDARD SPECIFICATION SHALL BE IN CONTRACTOR'S SCOPE.
2. MCCB SHALL BE SUITABLE FOR THE SYSTEM FAULT LEVEL 65 kA (1 SEC.)

ENGINEERS INDIA LIMITED NEW DELHI	POWER DISTRIBUTION BOARD DATA SHEET PDB INCOMER	DATA SHEET	REV
		C050-999-16-50-DS-0071 SHEET 01	A

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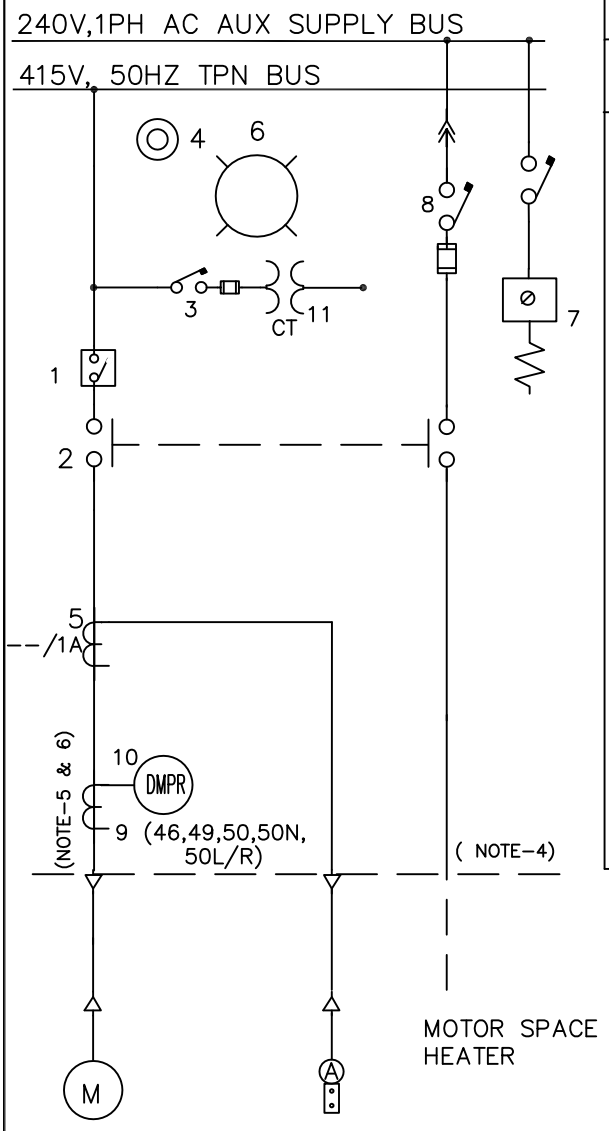
PROJECT: PP UNIT CLIENT: M/s NRL	REV	DATE	PURPOSE	BY	CHKD	APPRV
	A	01.07.2025	ISSUED WITH MR / TENDER	MS	AKG	VK



EQUIPMENT DATA

ITEM NO.	NEMA NO.	QTY.	DESCRIPTION
1	–	1	MCCB WITH SC/OL/EF RELEASE & SHUNT TRIP
2	–	4	AIR BREAK CONTRACTOR, DUTY-AC3 WITH 2NO + 2NC AUXILIARY CONTACTS
3	–	1	CONTROL SUPPLY ISOLATION MCB 2 POLE
4	–	1	STOP PUSH BUTTON
5	–	1	METERING CURRENT TRANSFORMER, CL-1.0
6	–	AS REQ.	INDICATING LAMPS – LED TYPE
7	–	1	PANEL SPACE HEATER WITH MCB AND THERMOSTAT
8	–	1	2P MCB FOR MOTOR SPACE HEATER
9	–	AS	CURRENT TRANSFORMER
10	DMPR	1	DIGITAL MOTOR PROTECTION RELAY
11	–	1	415V/240V CONTROL TRANSFORMER
12	–	AS REQ	AUX. CONTRACTORS WITH MIN. 2NO +2NC CONTACTS

NOTES:

1. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN RESPECTIVE JOB SPECIFICATION/STANDARD SPECIFICATION SHALL BE IN VENDOR'S SCOPE.
2. COMPONENT RATING SHALL BE AS PER DATA SHEET.
3. NO. OF CONTROL TERMINALS PROVIDED SHALL INCLUDE 20% SPARE TERMINALS SUBJECT TO A MINIMUM 24 TERMINALS.
4. MOTOR SPACE HEATER CKT. TO BE PROVIDED FOR MOTORS RATED 30kW AND ABOVE.
5. MOTOR PROTECTION RELAY SHALL BE SUITABLE FOR 240V AC CONTROL SUPPLY.
6. AREVA RELAYS ARE INDICATED FOR TYPE REFERENCE ONLY.
7. FIELD AMMETER & CT FOR FIELD AMMETER SHALL BE PROVIDED FOR ALL MOTORS RATED ABOVE 3.7 kW.

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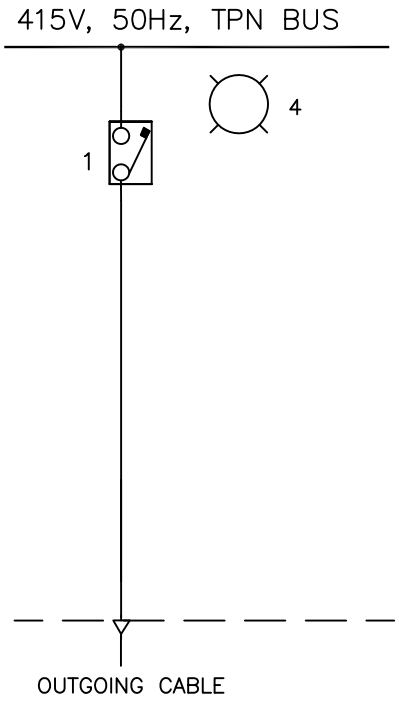
PROJECT: PP UNIT CLIENT: M/s NRL	REV	DATE	PURPOSE	BY	CHKD	APPRV
	A	01.07.2025	ISSUED WITH MR / TENDER	MS	AKG	VK



EQUIPMENT DATA FOR INCOMER			
ITEM NO.	NEMA NO.	QTY.	DESCRIPTION
1	–	1	MCCB WITH SC/OL/EF RELEASE & SHUNT TRIP
2	–	3	R, Y, B INDICATING LAMPS – LED TYPE

NOTES

1. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN RESPECTIVE JOB SPECIFICATION/STANDARD SPECIFICATION SHALL BE IN CONTRACTOR'S SCOPE.
2. MCCB SHALL BE SUITABLE FOR THE SYSTEM FAULT LEVEL 65 kA (1 SEC.)

ENGINEERS INDIA LIMITED NEW DELHI	POWER DISTRIBUTION BOARD DATA SHEET FOR OUTGOING FEEDER MCCB FEEDER (<=100A)	DATA SHEET	REV
		C050-999-16-50-DS-0071 SHEET 03	A

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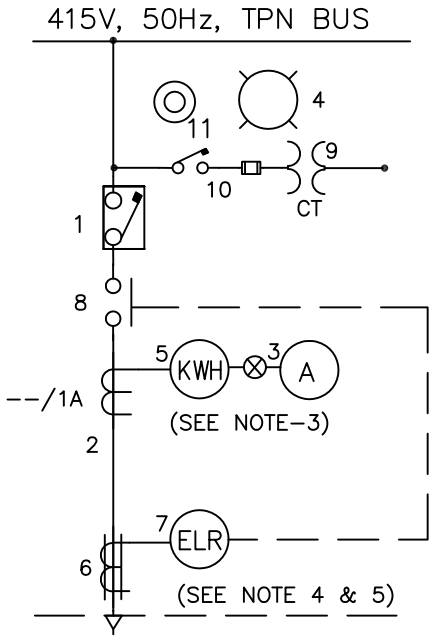
PROJECT: PP UNIT CLIENT: M/s NRL	REV	DATE	PURPOSE	BY	CHKD	APPRV
	A	01.07.2025	ISSUED WITH MR / TENDER	MS	AKG	VK



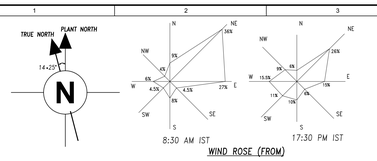
EQUIPMENT DATA

ITEM NO.	NEMA NO.	QTY.	DESCRIPTION
1	–	1	MCCB WITH SC/OL/EF RELEASE & SHUNT TRIP
2	–	3	METERING CURRENT TRANSFORMER, CL-1.0
3	–	1	AMMETER WITH 4WAY SELECTOR SWITCH
4	–	AS REQ.	INDICATING LAMPS – LED TYPE
5	–	1	KWH METER WITH ACCURACY CLASS 1.0
6	–	1	CORE BALANCE CURRENT TRANSFORMER
7	–	1	EARTH LEAKAGE RELAY 'AREVA' TYPE CTUM-15 SETTING RANGE (1-16%) WITH BUILT IN TIMER
8	–	4	AIR BREAK CONTRACTOR, WITH 2NO + 2NC AUXILIARY CONTACTS
9	–	1	415V/240V CONTROL TRANSFORMER
10	–	1	CONTROL SUPPLY ISOLATION MCB 2 POLE
11	–	1	EMERGENCY STOP PUSH BUTTON
12	–	AS REQ	AUX. CONTRACTORS WITH MIN. 2NO +2NC CONTACTS

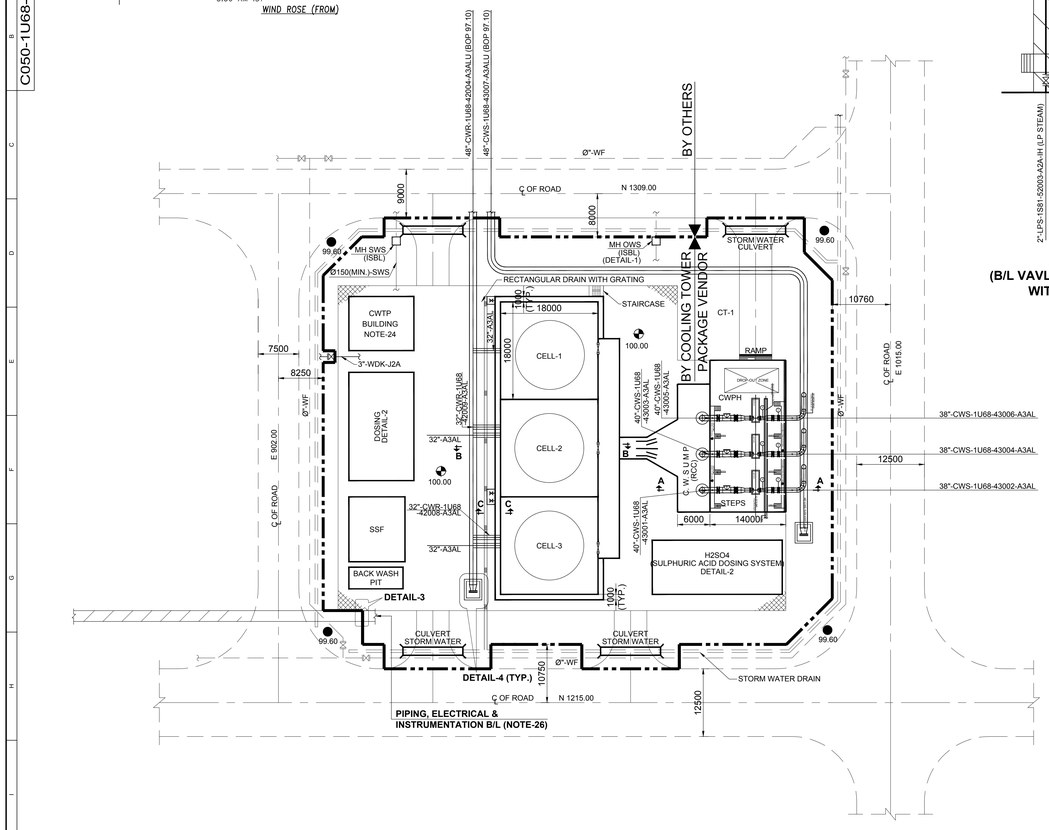
NOTES:

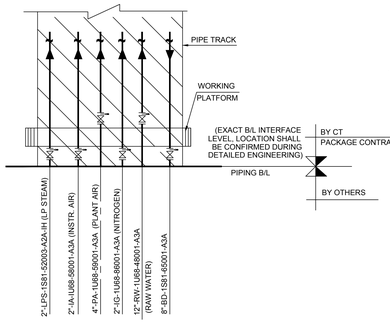
1. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN RESPECTIVE JOB SPECIFICATION/STANDARD SPECIFICATION SHALL BE IN VENDOR'S SCOPE.
2. COMPONENT RATING SHALL BE AS PER DATA SHEET.
3. CT, AMMETER AND KWH METER SHALL BE PROVIDED FOR FEEDERS RATED 250A & ABOVE.
4. CBCT AND ELR SHALL BE PROVIDED FOR ALL FEEDERS.
5. EARTH LEAKAGE RELAY SHALL BE SUITABLE FOR 240V AC CONTROL SUPPLY AND SHALL BE HAND RESET TYPE.
6. AREVA RELAYS ARE INDICATED FOR TYPE REFERENCE ONLY.
7. MCCB SHALL BE SUITABLE FOR THE SYSTEM FAULT LEVEL 65KA (1SEC.)

C050-1U68-81-45-04801

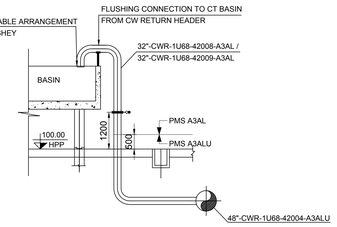


WIND ROSE (FROM)

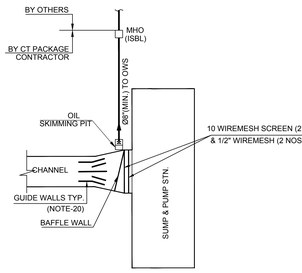




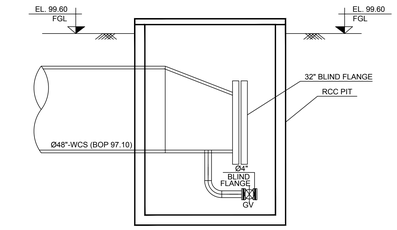
DETAIL-3
(B/L VAVLE ARRANGEMENT WITH PLATFORM)



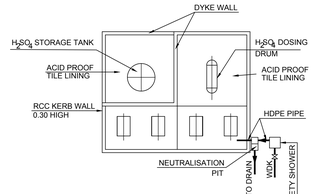
TYPICAL DETAIL OF FLUSHING CONNECTION



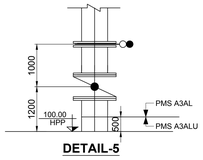
DETAIL-1



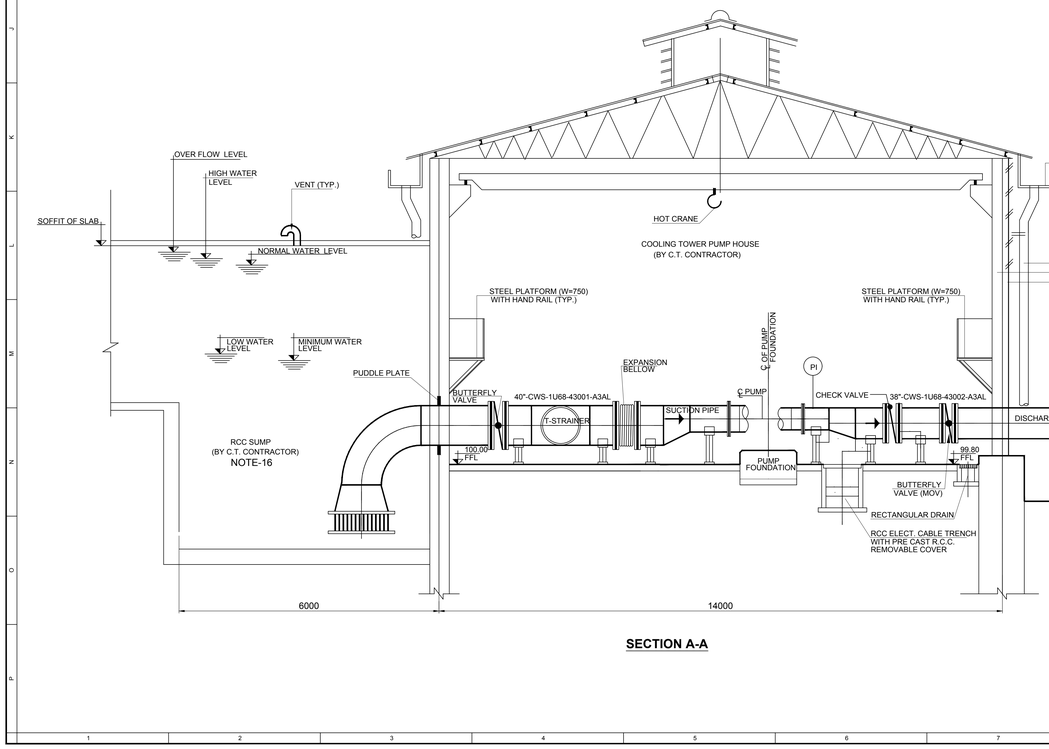
DETAIL-'4'



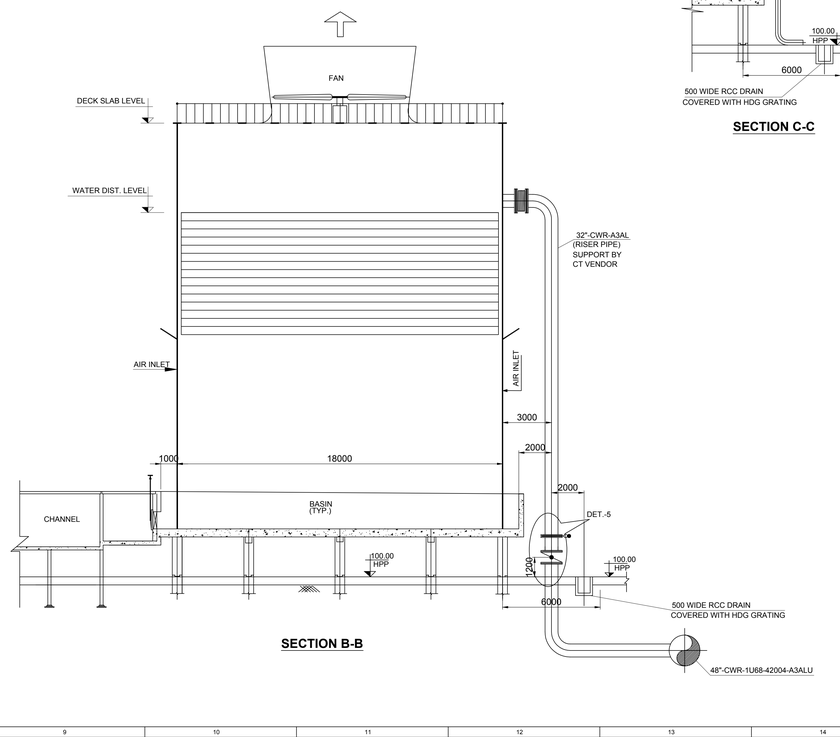
DETAIL-2
(SULPHURIC ACID DOSING SYSTEM)



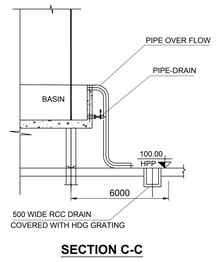
DETAIL-5



SECTION A-A



SECTION B-B



SECTION C-C

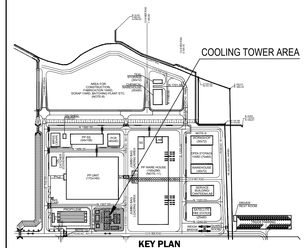
REF. DWG. NO.	REFERENCE DRAWING TITLE
C050-000-81-45-00001	OVERALL PLOT PLAN

NOTES :-

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED. HIGHEST PAVEMENT POINT (H.P.P.) SHALL BE RL. 100.00 & FINISHED GROUND LEVEL SHALL BE RL. 99.60.
2. GRADED SITE SHALL BE HANDED OVER TO CONTRACTOR WITH AVERAGE FGL OF 99.60 M.
3. ALL FACILITIES SHOWN WITHIN SCOPE LIMIT ARE INDICATIVE OF BIDDER'S SCOPE OF WORK. LAYOUT OF ALL FACILITIES WITHIN SCOPE LIMIT SHALL BE FIRMED BY CT CONTRACTOR DURING DETAIL ENGINEERING. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH BID SCOPE OF WORK, P&IDS, DATA SHEETS, DRAWINGS AND SPECIFICATIONS. ENTIRE WORK SHALL BE CARRIED OUT AS PER BID DOCUMENT, THOUGH NOT NECESSARILY SHOWN IN THIS DRAWING. NO DEVIATION SHALL BE ACCEPTABLE.
4. PIPING MATERIAL CLASS FOR COOLING WATER LINES SHALL BE A3ALU FOR U/G LINES AND A3AL FOR A/G LINES. ALL U/G COOLING WATER PIPES ARE PRE COATED 3LPE PIPES AS PER PMS. AND SAME SHALL BE EXTENDED MINIMUM 500mm ABOVE FINISHED PAVED LEVEL/ FINISHED GROUND LEVEL WHEREVER EXTENDING FROM U/G TO A/G.
5. LOCATIONS OF BATTERY LIMIT PIPING, ELEVATION OF PIPES ETC. SHOWN IN THE DRAWING ARE TENTATIVE. THE EXACT LOCATION AND ELEVATIONS SHALL BE FINALISED DURING DETAIL ENGINEERING WHICH MAY VARY FROM THE PRESENT LOCATION. CT PACKAGE CONTRACTOR TO FOLLOW THE FINAL BATTERY LIMIT CONDITIONS, WITHOUT ANY TIME AND COST IMPLICATION.
6. SEQUENCE OF PIPE AS SHOWN IN DETAIL-3 IS INDICATIVE ONLY. ACTUAL SEQUENCE SHALL BE DECIDED DURING DETAILED ENGINEERING. ALL ISOLATION VALVES, SPECTACLE BLINDS, DRAIN VALVE, INSTRUMENTS ETC. SHALL BE PROVIDED BY CONTRACTOR AS PER P&ID NO. C050-79-41-1U68-1111/1112/1113.
7. IN CASE OF ANY DISCREPANCY IN LINE SIZE GIVEN IN THIS DRAWING & P&ID, THE P&ID SHALL GOVERN.
8. HIGH POINT VENT AND LOW POINT DRAIN COMING IN CONTRACTOR SCOPE SHALL BE PROVIDED BY CONTRACTOR.
9. ALL VALVES, INSTRUMENT CONNECTIONS ETC. INSIDE PACKAGE LIMIT SHALL BE ACCESSIBLE AND IF REQUIRED PLATFORM TO BE PROVIDED FOR OPERATIONS. THE SAME SHALL BE ENGINEERED AND SHOWN BY PACKAGE CONTRACTOR.
10. THE DIMENSIONS OF COOLING TOWER CELL SHOWN ARE MAXIMUM WHICH CAN BE ACCOMMODATED IN THE AVAILABLE SPACE. THE CT PACKAGE CONTRACTOR SHALL DESIGN THE COOLING TOWER CELL SIZE ACCORDINGLY. OTHER DIMENSION & DETAILS AS SHOWN IN DRAWING ARE MINIMUM, WHICH SHALL BE FINALIZED DURING DETAIL ENGG. AS PER CODES, STD., DESIGN, GOOD ENGG. PRACTICES AND OPERATIONAL REQUIREMENT.
11. A MINIMUM CLEAR COVER OF 1000mm SHALL BE ENSURED OVER ALL U/G COOLING WATER LINES. EXACT LEVELS OF COOLING WATER HEADERS SHALL BE CONFIRMED DURING DETAILED ENGINEERING.
12. ENTIRE AREA WITHIN PACKAGE LIMIT SHALL BE RCC PAVED AS PER EIL STANDARD, INCLUDING BELOW CT BASIN AND COLD WATER CHANNEL AS PER PAVEMENT LIMIT MARKED IN THIS DRAWING. TYPE-III PAVEMENT (RCC) SHALL BE PROVIDED BELOW COOLING TOWER BASIN AND CHANNEL. TYPE-I RCC PAVEMENT SHALL BE PROVIDED FOR VEHICULAR MOVEMENT AREA. REST OF THE AREA SHALL BE PROVIDED WITH TYPE-II PAVEMENT.
13. COOLING WATER RETURN RISER PIPE TO EACH CELL SHALL BE PROVIDED BY CT CONTRACTOR & SAME SHALL BE ADEQUATELY SUPPORTED BY CT CONTRACTOR.
14. PERIPHERAL RCC-STORM WATER DRAIN AROUND THE RCC PAVEMENT SHALL BE PROVIDED WITH HDG GRATING AND SHALL BE SUITABLY CONNECTED TO OSBL STORM WATER DRAIN.
15. BIDDER SHALL PROVIDE CABLE TRENCH/CABLE TRAY CONNECTIVITY WITHIN PACKAGE LIMIT FOR PURCHASER'S MAIN CABLES FROM DCS/PLC TO BIDDER'S JB/LCP. THE CO-ORDINATE AND TIE-IN POINT AT PACKAGE BATTERY LIMIT SHALL BE FINALIZED DURING DETAIL ENGINEERING.
16. WATER LEVELS SHALL BE FINALIZED BY CT CONTRACTOR DURING DETAIL ENGINEERING. NORMAL WATER LEVEL SHALL BE DECIDED BASED ON 10 MINUTES HOLD-UP CAPACITY BETWEEN MINIMUM AND NORMAL WATER LEVEL IN COOLING TOWER BASIN INCLUDING CHANNEL AND EXCLUDING SUMP. OTHER WATER LEVEL LIKE LOW WATER LEVEL, HIGH WATER LEVEL AND OVER FLOW LEVEL SHALL BE AS PER PROCESS P & ID REQUIREMENT.
17. ACID / ALKALI HANDLING AREA SHALL BE PROVIDED WITH ACID/ALKALI RESISTANT TILE LINING AND SUITABLE KERB WALL ALL AROUND. DYKE WALL SHALL BE PROVIDED AROUND H_2SO_4 STORAGE TANK. DYKE WALL SHALL BE DESIGNED FOR FULL CONTAINMENT.
18. MONORAIL ALONG WITH THE CHAIN PULLEY BLOCK FOR HANDLING CHEMICALS SHALL BE PROVIDED BY THE CONTRACTOR.
19. BASIN OF EACH CELL SHALL BE PROVIDED WITH OVERFLOW PIPE AND DRAIN PIPE ALONG WITH VALVES.
20. GUIDE WALL ARRANGEMENT SHOWN IN COLD WATER CHANNEL IS PRELIMINARY. RECOMMENDATIONS OF CFD ANALYSIS FOR BASIN/ CHANNEL/ SUMP/ BELL MOUTH ETC. SHALL BE INCORPORATED BY CT CONTRACTOR WITHOUT ANY TIME & COST IMPLICATION.
21. CT CONTRACTOR'S SLOPE INCLUDE U/G PIT FOR SS FILTER BACKWASH COLLECTION ALONG WITH BACKWASH PIT PUMPS AS SHOWN IN P&ID C050-79-41-1U68-1113.
22. CT CONTRACTOR SHALL ROUTE THE DISCHARGE PIPING FROM THE PIT UPTO PIPING B/L.
23. APPROACH ROADS UP TO COOLING TOWER PACKAGE B/L, FROM MAIN ROADS SHALL BE IN THE SCOPE OF OTHERS. LOCATION OF THE SAME SHALL BE FIRMED UP DURING DETAIL ENGINEERING AFTER AWARD OF JOB.
24. THE CLO2 DOSING PACKAGE AND ITS PLC WILL BE LOCATED INSIDE CWTP BUILDING.
25. ALL TRENCHES WITHIN THE PACKAGE SHALL BE OF RCC CONSTRUCTION.
26. THE CO-ORDINATE AND TIE-IN POINT AT PACKAGE BATTERY LIMIT SHALL BE FINALIZED DURING DETAIL ENGINEERING.
27. VARIOUS INSTRUMENTS INCLUDING THEIR UG PITS ON COOLING WATER SUPPLY AND RETURN HEADERS ARE NOT SHOWN. THE SAME SHALL BE PROVIDED AS PER PROCESS P&ID REQUIREMENT.

LEGEND:

	COOLING TOWER (CT) PACKAGE CONTRACTOR SCOPE B/L
	FACILITIES BY CT PACKAGE CONTRACTOR
	FACILITIES BY OTHERS
FGL	FINISHED GROUND LEVEL
HPP	HIGHEST PAVEMENT POINT
RTL	ROAD TOP LEVEL
	STORM WATER DRAIN WITH GRATING
	GATE VALVE
Ø"-WF	FIRE WATER LINE
	RCC PAVEMENT
U/G	UNDER GROUND
A/G	ABOVE GROUND
MH	MANHOLE
SWS	SANITARY WASTE SEWER
OWS	OILY WATER SEWER
WDK	POTABLE WATER
B/L	BATTERY LIMIT
PMS	PIPING MATERIAL SPECIFICATION



KEY PLAN

REV.	DATE	DESCRIPTION	BY	CHKD	APPD	PEM
B	02.09.2025	ISSUED FOR BIDS	RAJU	VMF	GYAS	
A	19.08.2025	ISSUED FOR COMMENTS	RAJU	VMF	GYAS	

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

NRL NUMALIGARH REFINERY LIMITED

EPCM SERVICES (Part-A) FOR 360 KTPA PPU AT NRL	एनआरएल में 360 केटीपीए पीपीयू के लिए ईपीसीएम सेवाएं (भाग-ए)
SCOPE DRAWING GENERAL CIVIL WORKS PPU COOLING TOWER	स्कोप ड्राइंग जनरल सिविल कार्य पीपीयू कूलिंग टॉवर

SCALE	JOB NO.	UNIT	DIVN.	DEPT.	DWG. NO.	REV.
1:400	C050	1U68	81	45	04801	B

3-1641-0500 REV.5 / 06.12.2024 A0-1189 x 841

प्रस्तुत आलेख एवं इसमें निहित डिज़ाइन, अभिकल्पना इंजीनियर्स इंडिया लिमिटेड की संपत्ति है। वे बस उधार दिए गए हैं और दूसरा मुद्रित किया जाएगा, न नकल की जाएगी, न उधार दिए जाएंगे, न प्रदर्शित किए जाएंगे और न ही सार्वजनिक और निजी प्रयोग के अलावा इसका इस्तेमाल कोई अन्य प्रयोग किसी अन्य तरीके से होगा।

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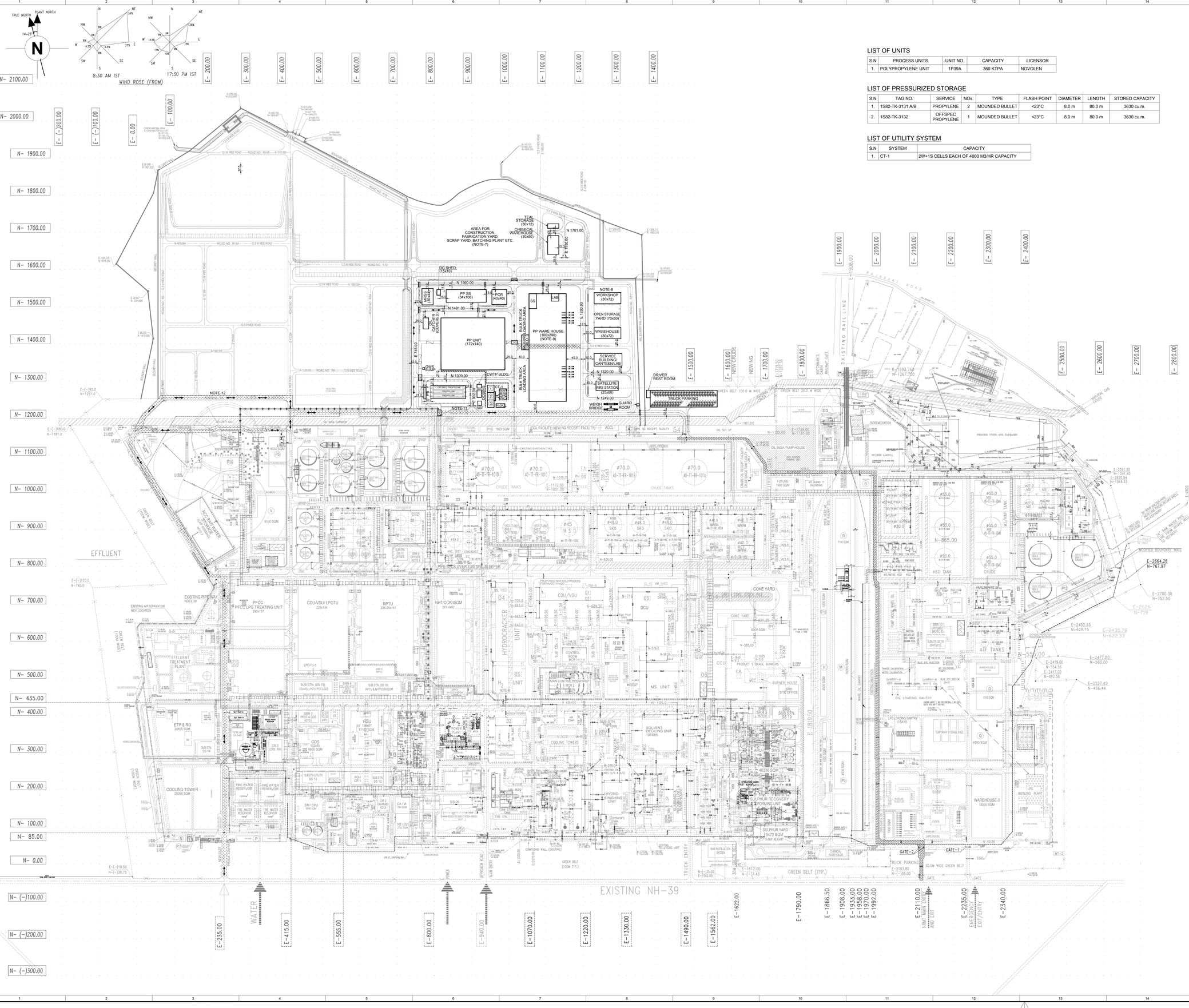
C050-000-81-45-00001



LIST OF UNITS

S.N	PROCESS UNITS	UNIT NO.	CAPACITY	LICENSOR
1.	POLYPROPYLENE UNIT	1P39A	360 KTPA	NOVOLEN

LIST OF PRESSURIZED STORAGE

S.N	TAG NO.	SERVICE	NOs.	TYPE	FLASH POINT	DIAMETER	LENGTH	STORED CAPACITY
1.	1S82-TK-3131 A/B	PROPYLENE	2	MOUNDED BULLET	<23°C	8.0 m	80.0 m	3630 cu.m.
2.	1S82-TK-3132	OFFSPEC PROPYLENE	1	MOUNDED BULLET	<23°C	8.0 m	80.0 m	3630 cu.m.

LIST OF UTILITY SYSTEM

S.N	SYSTEM	CAPACITY
1.	CT-1	2W+1S CELLS EACH OF 4000 M3/HR CAPACITY

REF. DWG. NO.	REFERENCE DRAWING TITLE
TP-IZZZA-PI-PPL-0001	OVERALL PLOT PLAN
TP-IZZZA-PI-PPL-0002	OVERALL PLOT PLAN - RAJABARI

NOTES :-

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ROAD WIDTH SHOWN ON DRAWING IS INCLUSIVE OF BERM.
3. FOR NRL REFINERY RL 100.0 CORRESPONDS TO BM LEVEL 90.4M. ELEVATION FOR POLYPROPYLENE PLANT AT RAJABARI PLOT SHALL BE FINALIZED AFTER RECEIPT OF SURVEY DATA.
4. WIDENING REQUIREMENT OF PRODUCT MOVEMENT ROAD SHOWN SHALL BE FIRMED UP AFTER RECEIPT OF AS-BUILT SURVEY DATA.
5. ODC ROUTE MARKED IS PRELIMINARY.
6. GREEN BELT FOR PPU PROJECT TO BE PROVIDED IN REMAINING RAJABARI PLOT BY NRL.
7. CLIENT TO CONFIRM THE LOCATION OF SCRAP YARD AND BATCHING PLANT.
8. SPACE FOR PMC SITE OFFICE SHALL BE ALLOCATED IN WAREHOUSE / WORKSHOP.
9. PP WAREHOUSE IS UNDER EPCM PART-B (OPTIONAL).
10. ALTERNATE ROAD FOR ODC MOVEMENT POST COMMISSIONING OF NREP FLARE.
11. LOCATION OF BATTERY LIMIT BETWEEN NREP AND PPU PROJECT TO BE FINALIZED BY PIPING.
12. ALL DIMENSIONS SHOWN FROM MOUNDED BULLETS ARE FROM INNER EDGE OF RETAINING WALL.

HOLD:

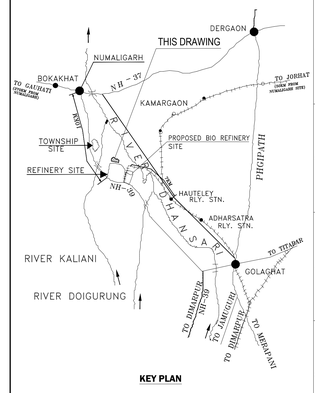
1. FLARE TRESTLE ROUTE

LEGEND:

- PROPOSED ROAD
- EXISTING ROAD
- PROPOSED PIPE RACK
- PROPOSED SLEEPER
- UG COOLING WATER CORRIDOR
- PIPE WAY BRIDGE
- EXISTING ROAD TO BE DISMANTLED
- PRODUCT MOVEMENT ROUTE (NOTE-5)
- EXISTING ROAD TO BE USED FOR ODC MOVEMENT ROUTE (NOTE-6)
- ODC MOVEMENT ROUTE
- FENCING
- BARRIER GATE
- FLARE TRESTLE
- PCR — PPU CONTROL ROOM
- FACILITIES IN EPCM PART-A
- FACILITIES IN EPCM PART-B/C OPTIONAL

AREA CHART FOR PPU PROJECT

ITEM	AREA (IN ACRE)
TOTAL PLANT AREA FOR PPU PROJECT	63.85
TOTAL GREEN AREA REQUIRED FOR PPU PROJECT (33%)	35.12



KEY PLAN

CLIENT DOCUMENT NUMBER:
EL-1ZZZA-CV-PPL-0001-00

REV.	DATE	DESCRIPTION	BY	CHKD	APPD	PEM
0	13/08/2025	ISSUED FOR ENGINEERING	RAJU	UMP/KN	SKN	
F	08/08/2025	UPDATED AS PER CLIENT'S REQUIREMENT & REISSUED FOR PPRC APPROVAL	RAJU	UMP/KN	SKN	
E	03/07/2025	CLIENT'S COMMENTS INCORPORATED & REISSUED FOR INTERNAL COMMENTS	RAJU	UMP/KN	SKN	
D	09/06/2025	ISSUED FOR PPRC APPROVAL	RAJU	UMP/KN	SKN	
C	22/05/2025	REVISED & REISSUED FOR CLIENT'S COMMENTS	RAJU	UMP/KN	SKN	
B	08/05/2025	ISSUED FOR CLIENT'S COMMENTS	RAJU	UMP/KN	SKN	
A	24/04/2025	ISSUED FOR INTERNAL COMMENTS	RAJU	UMP/KN	SKN	

इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

NRL NUMALIGARH REFINERY LIMITED

EPCM SERVICES (Part-A) FOR 360 KTPA PPU AT NRL

एनआरएल में 360 केटीपीए पीपीयू के लिए ईपीसीएम सेवाएं (भाग-ए)

OVERALL PLOT PLAN

समग्र प्लॉट योजना

SCALE	JOB NO.	UNIT	DIVN.	DEPT.	DWG. NO.	REV.
1:3333	C050	000	81	45	00001	0

3-1641-0500 REV.5 / 06.12.2024 A0-1189 x 841

ये और उपकरणों ने यह स्पष्ट समझौता किया है कि ये सब प्रपत्र दिए गए हैं और उपकरण ये केवल इसी उद्देश्य के लिए ऋण पर दिए गए हैं, न तो इन्हें पूरा या पूरा किया जाएगा, न तो इन्हें किसी अन्य व्यक्ति को दिया जाएगा, न ही इन्हें किसी अन्य उद्देश्य के लिए प्रयोग किया जाएगा।
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1U68-CT-4371 A/B/C COOLING TOWER TOTAL FLOW CAPACITY : 4000 M3/HR

(2W+1S CELLS) NOTE-23

1U68-LM-9381 CHLORINE DIOXIDE DOSING SYSTEM

1U68-CT-4371

1U68-PA-4301A / B/ C COOLING WATER RECIRCULATION PUMPS

RATED FLOW : 4000 M^3/HR
RATED DIFFEREENTIAL HEAD : 54.3 M
(2W+1S) NOTE-C,24,55

GENERAL NOTES :

A. FOR GENERAL NOTES, DETAILS AND SYMBOLS REFER LEGNED P&ID'S.
B. ALL INSTRUMENT TAGS TO BE PREFIXED BY UNIT NO. 1U68.
C. FOR DETAILS OF PUMP VENT/DRAIN AND SAMPLE CONNECTION, REFER LEGNED P&ID'S.
D. ALL INSTRUMENT DRAINS FROM SULPHURIC ACID SYSTEM SHOULD GO TO LIME PIT.
E. ITEMS SHOWN UNDER CONTRACTOR SCOPE ARE INDICATIVE ONLY.
F. DETAILS FOR PACKAGE UNITS ARE PRELIMINARY & CONTRACTOR TO DEVELOP FURTHER.
G.PIPING FIRST ROOT ISOLATION VALVE SHALL BE PROVIDED FOR PG, PT, DPT, FT(DP TYPE) ETC.

NOTES:

1. SAFETY SHOWER, EYE WASH AND DRINKING WATER TO BE PROVIDED IN ACID, FORMULATION HANDLING, CLO2 GENERATION SYSTEM AREA AND BIOCIDE DOSING FACILITIES/AREA. DRINKING WATER TO BE PROVIDED TO SAFETY SHOWER AND EYE WASH FACILITIES.
2. LOCATE PH CELL CLOSE TO HEADER ANY PRESSURE REDUCING DEVICE FOR PH CELL IF REQUIRED TO BE PROVIDED ALONG WITH ITS SAFETY DEVICE.
3. THIS DIMENSION TO BE FINALISED BY CONTRACTOR. PUMP SHOULD OPERATE BELOW MINIMUM WATER LEVEL ALSO.
4. PROVIDE OIL SKIMMING ARRANGEMENT WITH OVERFLOW TO OWS AT CONVENIENT STAGNANT POINT.
5. PROVIDE CORROSION PROBE (CP) AND CORROSION COUPON (CC) TESTING ASSEMBLY IN THE RETURN HEADER NEAR THE COOLING TOWER. CORROSION RACKS SHALL BE DUAL PURPOSE TYPE SUITABLE FOR CORROSION COUPONS AND LPR PROBES, CORROSION TRANSMITTER.
6. PROVIDE ACID PROOF TILES IN SULPHURIC ACID STORAGE TANK AND ACID HANDLING AREA. WASHOUT FROM THESE AREAS TO FLOW TO NEUTRALISATION PIT. PIT SHOULD HAVE LIME COMPARTMENT AND OVERFLOW COMPARTMENT LEADING TO STORM SEWER. NEUTRALISATION PIT CAN BE COMMON ONLINE PH ANALYZER SHALL BE PROVIDED IN COMMON NEUTRALIZATION PIT BEFORE DISCHARGE TO STORM SEWER.
7. GAS DETECTOR (HC) AND HYDROGEN (H2) DETECTORS ARE TO BE PROVIDED AT THE MOUTH OF THE RETURN CW DISTRIBUTOR.
8. COOLING TOWER FAN SHOULD HAVE MOTORS SUITABLE FOR AREA CLASSIFICATION ZONE-2. TYPE OF MOTOR TO BE AS PER ELECTRICAL SPECIFICATIONS. COOLING TOWER FANS TO HAVE FRP BLADES AND HIGH-HIGH VIBRATION TRIP.
9. DUAL PLATE TYPE CHECK VALVE.
10. DEAD ENDS OF CW HEADER TO BE PROVIDED WITH 4" LINE WITH ISOLATION VALVES AT THE LOWEST POINT OF THE BLIND. SEE 'DETAIL-C ON SHEET-2.
11. PROVIDE A MINIMUM OF 2-3 DRAINN PITS OF THE SUMP CHANNEL TO FACILITATE DRAINING AND CLEANING.
12. TYPICAL ARRANGEMENT FOR CT FAN. ALSO PROVIDE START/STOP BUTTON AT FAN LEVEL AND STOP SWITCH AT GRADE LEVEL ALSO FOR FAN MOTORS. TAG NOS. OF THESE INSTRUMENTS ARE 4371A 01 TO 4371C 01 CORRESPONDING TO 1ST TO 3RD CELL OF COOLING TOWER.
13. FLUSHING CONNECTION FROM COOLING WATER RETURN LINE TO BASIN SHOULD BE PROVIDED SLIGHTLY ABOVE THE BASIN AND TO BE LOCATED AT FARTHEST END OF THE RETURN HEADER. THIS IS TO BE BLIND AFTER FLUSHING.
14. PROVIDE 1/2" AND 10 MESH SCREEN IN SERIES AT THE INTERSECTION OF SUMP AND CHANNEL.
15. DISTRIBUTOR FOR SULPHURIC ACID TO BE PROVIDED NEAR MAKE-UP WATER POINT.
16. PROVIDE EXPANSION BELOWS IN PUMP SUCTION LINES FOR PREVENTING VIBRATIONS.
17. IF ANY PIT IS ENVISAGED FOR CW SUPPLY AND RETURN LINE INSTRUMETATION, IT SHALL BE PROVIDED WITH PORTABLE DEWATERING PUMP ARRANGEMENT ALONG WITH SHED.
18. FOR OVERALL INSPECTION OF SUMP IN COOLING WATER SYSTEM, PROVIDE ADEQUATE ROOF OPENING.
19. ALL MOVS TO BE PROVIDED WITH OPEN/CLOSE INDICATION. REFER DETAIL-B ON SHEET 2 OF 2.THE VALVES SHALL HAVE PROVISION FOR HAND OPERATION.
20. DELETED.
21. ACID LINE ENDS 300 MM ABOVE OVERFLOW LEVEL AND 300 MM AWAY FROM WALL.
22. DISTANCE BETWEEN FORMULATION DOSING/POLYMERIC DISPERSANT DOSING/BIOCIDE DOSING AND H2SO4 DOSING SHOULD BE MAXIMUM.
23. THIS P&ID IS SCHEMATIC ONLY. SCOPE OF CT PACKAGE SHALL NOT BE LIMITED TO THIS P&ID.
24. PUMP DRAINS TO BE ROUTED TO OWS.
25. TO BE SIZE/CONFIRMED BY PACKAGE VENDOR MINIMUM SIZE TO BE PROVIDED SHALL BE 8" FOR DRAIN AND 12" FOR OVERFLOW.
26. LINE TO BE SIZED BY CT VENDOR.
27. BACKWASH WATER SHALL BE PUMPED TO CTBD LINE FOR FURTHER ROUTING TO RO DM PLANT. HYDRULICS TO BE CARRIED OUT BY CT CONTRACTOR. CT CONRCTOR TO WORKOUT THE BACKWASH PIT PUMP DISCHARGE PRESSURE ACCORDINGLY.
28. PRESSURE TRANSMITTER FOR DIAPHRAGM FAILURE ALARM IN DCS ARE IN PUMP VENDOR SCOPE.
29. THESE PUMPS SHALL BE LOCATED IN SHED.
30. CLO2 DIFFUSER SHOULD BE PROVIDED IN COOLING TOWER SUMP AND TO BE LOCATED CLOSE TO THE BOTTOMS. IT SHOULD RUN FOR APPROX 80% OF THE SUMP LENGTH. MOC FOR CLO2 DIFFUSERS SHALL BE UPVC/CPVC.
31. COOLING TOWER FANS SHALL BE PROVIDED WITH VIBRATION TRANSMITTER (INSTEAD OF VIBRATION SWITCH) WHICH SHALL BE CONNECTED TO ESD SYSTEM AND DO CONTACT FROM ESD TO MCC SHALL BE USED FOR TRIPPING OF AFC FANS.
32. INTERLOCK DESCRIPTION :

INTERLOCK NO.	ACTUATED BY	ACTION
1U68-I-43001	PT/PALL-430004 A/B/C	START STANDBY PUMP
1U68-I-43002 TO 43004	VT-430001 A/B/C (2OO3)	TRIP THE RESPECTIVE FAN
1U68-I-43005 TO 43007	MOV-430001 TO 430003	RESPECTIVE PUMP SHALL START ONLY IF MOV IN DISCHARGE LINE IS OPEN AS PER STATUS INDICATION AVAILABLE

33. LINE SIZE TO BE CONFIRMED BY VENDOR.
34. LINE SIZE TO BE CONFIRMED DURING DETAIL ENGINEERING BASED ON VENDOR INFORMATION.
35. MINIMUM SIZE OF NOZZLES ON VESSEL SHALL BE 2".
36. DELETED.
37. ALL INSTRUMENTS INSIDE PACKAGE BATTERY LIMIT SHALL BE BY PACKAGE VEDNOR. THIS IS AN ADDITION TO ALL INSTRUMENTS WHEREVER THE SAME IS SPECIFICALLY INDICATED AS BY VENDOR.
38. INTERNAL DISTRIBUTION IS BY CONTRACTOR.
39. BASIN OF EACH CELL SHOULD HAVE PROVISION TO ISOLATE FOR MAINTENANCE.
40. DELETED.
41. PIPING ARRANGEMENT ARE INDICATED FOR SINGLE PASS SIDE STREAM FILTER. CONTRACTOR TO UPDATE THE SAME FOR TWO PASS SYSTEM.
42. ALL MOV'S TO BE KEPT OPEN.
43. PRESSURE/TEMPERATURE INSTRUMENTS AND ANALYSER SHOWN SHALL BE LOCATED CLOSE TO COMMON SUPPLY HEADER.
44. LINE SIZE TO BE CONFIRMED BY CONTRACTOR.
45. GEAR OPERATED VALVE.
46. NORMALLY ALL SIDE STREAM FILTERS SHALL OPERATE AT A TIME.
47. PROVIDE COROSSION COUPON (IU68-CC-420001)IN RETURN HEADER NEAR THE CT. CORROSION RACKS SHALL BE DUAL PURPOSE TYPE SUITABLE FOR CORROSION COUPONS AND LPR PROBES.
48. SEPARATE TAPPINGS TO BE TAKEN FOR PT-4300 04 A/B/C.
49.VENT TO BE ROUTED TO SAFE LOCATION OUTSIDE CHLORINATOR ROOM.
50.CLO2 DETECTORS TO BE PROVIDED AND CONNECTED TO VENDOR PLC.
51.THE PIPING SPECIFICATION 'XXXX' CORRESPONDS TO PIPING MOC AND TO BE CONFIREMED BY VENDOR.
52. CLOSING TIME FOR THE CHECK VALVE SHALL BE AS PER THE TRANSIENT ANALYSIS.
53. DELETED.
54. THE LINE SHALL BE DIRECTLY ROUTED TO CW SUMP.
55. CT PUMP SUPPLY IS IN THE SCOPE OF CT VENDOR
56. DELETED.
57. EXTENTED STEAM TO BE CONSIDERED FOR ALL VALVES IN PIT.
58. ALL PIPPING WITHIN B/L IS IN THE SCOPE OF CT VENDOR.

59. TYICAL RISER DETAIL:-

60. ALL FIELD TRANSMITTERS SHALL BE 4-20 MA (HART) TYPE.
61. WHERE L/R SELECTOR SWITCH IS SHOWN FOR PUMP, LOCAL START & LOCAL STOP TO BE PROVIDED IN LCS IN FIELD.
62. MANUAL SAMPLING OF CW CAN BE DONE FROM ANY OF THE ANALYZER DRAINS TO SS.

NRL DOCUMENT NO. EL-1U68A-PR-PID-4301.00

No.	DATE	REVISIONS	DRN	BY	CHKD	APPD.
1	19.01.26	REVISED AS MARKED	RS	MPS	SC	MS
0	19.08.25	ISSUED FOR ENGINEERING	RS	MPS	SC	MS
B	07.08.25	RE-ISSUED INCORPORATING ENGINEERING COMMENTS	RS	MPS	SC	MS
A	18.07.25	ISSUED FOR COMMENTS	RS	MPS	SC	MS

ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

NUMALIGARH REFINERY LIMITED
EPCM SERVICES (PART-A) FOR 360 KTPA PPU AT NRL

पाइपिंग एण्ड इंस्ट्रूमेन्टेशन डायाग्राम
PIPING AND INSTRUMENTATION DIAGRAM

RECIRCULATING COOLING WATER SYSTEM

(SHEET 01 OF 02)

अनुमाप SCALE	कार्य संख्या JOB NO.	विभाग DEPT.	अनुभाग SECTN.	इकाई UNIT	आरेख संख्या DWG. No.	संशो REV.
~	C050	79	41	1U68	1111	1

EIL-0241-502-REV-0-A

DISTRIBUTION CODE

1U68-ZM-5771
H2S04 STORAGE TANK SILICA GEL BREATHER

1U68-VV-8631
H2SO4 DOSING DRUM

1U68-ZM-5772
H2S04 DOSING SILICA GEL BREATHER

1U68-PA-8602A / B
H2SO4 DOSING PUMP
NOTE-29

1U68-ZGN-4271A / B
SIDE STREAM FILTERS
NOTE-46

CW RETURN
1U68A-PID-4301.00 12418

48"-CWR-1U68-42004-A3ALU

48"-CWR-1S81-42001-A3ALU
CWR HEADER
1S81-PID-4301.00 12442

8.0
PSV 4271A 01

(H)-SV-1U68-64002-A3A

(H)-PA-1U68-59003-A3A

6"-CWR-1U68-42013-A3AL

2"-A3AL
NOTE-44

1U68-ZGN-4271A
NOTE-35

8"-CWR-1U68-42011-A3AL

FE-4200 01

NOTE-17

NOTE-C

SC TYPE-C 4200 03

HC

NOTE-26.62

CONDUCTIVITY

TAH

AAH SS

6"-CWR-1U68-42012-A3AL

8"x6"

FE-4200 02

FE-4200 04

IN VIEW

BACK WASH PIT

SC TYPE-C 4200 02

6"-CWR-1U68-42018-A3AL

(H)-SV-1U68-64001-A3A

(H)-PA-1U68-59002-A3A

6"-CWR-1U68-42014-A3AL

6"-CWR-1U68-42016-A3AL

4"-PA-1U68-59001-A3A

INST. AIR
12443 1S81-PID-9701.00

2"-IA-1S82-58002-A3A

2"-IA-1U68-58001-A3A

FE-5800 01

NITROGEN
12444 1S81-PID-9701.00

2"-IG-1S81-82006-A3A

2"-IG-1U68-82001-A3A

FE-8600 01

1U68A-PID-4301.00 12419

8"-CWR-1U68-42017-A3AL

1U68-ZGN-4271B
NOTE-35

2"-A3AL
NOTE-44

6"-CWR-1U68-42015-A3AL

6"-CWR-1U68-42019-A3AL

FE-4200 03

PLANT AIR
12446 1S81-PID-9701.00

4"-PA-1S81-59002-A3A

NOTE-38

4"-PA-1U68-59001-A3A

FE-5900 01

NOTE-34

2"-PA-1U68-59002-A3A

LP STEAM
12440 1S81-PID-9701.00

2"-LPS-1S81-52003-A2A-IH

2"-LPS-1U68-52001-A2A-IH

FE-5200 01

HOUSE STATION (TYP) NEAR H2S04 NEUTRALIZATION PIT

1U68-ZM-5772

LOCATE AT GRADE IN VIEW OF LI/1105/1106

2"-AC-1U68-86006-A1N

TO SAFE LOCATION

PROVIDE ACCESSIBILITY

LOCAL HOOTER

LOOP POWER (LOCAL) INDICATOR AT GRADE

RADAR TYPE

2"(H)-SV-1U68-64003-A9A

500MM ABOVE THE VESSEL TOP TANGENT LINE

AC
1U68A-PID-4301.00 12441

TO C.T

1-1/2"-AC-1U68-86008-A1N-

1"-SV-1U68-64011-A1N-

CT VENDOR SCOPE

OTHERS

1-1/2"-AC-1U68-86009-A1N

1-1/2"-AC-1U68-86013-A1N

1-1/2"x2"

1U68-VV-8631
NOTE-1,6

2"-A8A

UC

2"-AC-1U68-86016-A1N

2"-AC-1U68-86014-A1N

250MM

MIN.

MIN FOR PIPING

THE BOTTOM OF LOOP SHALL BE BELOW BOTTOM T.L OF VESSEL

1"-AC-1U68-86015-A1N

LIME PIT

1-1/2"-AC-1U68-86007-A1N

1U68-PA-8602A / B
NOTE-28,29

NOTE-6

LIME PIT SIZE TO TAKE CARE OF NEUTRALIZATION OF PUMP CAPACITY

1U68-ZM-5771

TO SAFE LOCATION

PROVIDE ACCESSIBILITY

LOOP POWER (LOCAL) INDICATOR AT GRADE

NC RADAR TYPE

2"(H)-SV-1U68-64004-A9A

LOCAL HOOTER

2"-AC-1U68-86004-A1N

2"-AC-1U68-86003-A1N

3"-AC-1U68-86002-A1N

3"-AC-1U68-86005-A1N

1U68-TK-8632

1"-SV-1U68-86012-A1N

3"-AC-1U68-86012-A1N

300MM

(2 NO. UNLOADING POINTS)

3"-AC-1U68-86001-A1N

H2SO4 UNLOADING FROM TANKER FREE DRAINING TOWARDS PUMP

PROVIDE RAW WATER HOSE AND EYE WASH NEAR UNLOADING BAY.

1U68-PA-8601A / B

2"-A8A

2"-AC-1U68-86010-A1N

1"-AC-1U68-86011-A1N

1U68-PA-8601A / B
H2SO4 UNLOADING/TRANSFER PUMPS

LIME PIT SIZE TO TAKE CARE OF NEUTRALIZATION OF PUMP CAPACITY

1U68-TK-8632
H2SO4 STORAGE TANK

TYP. DETAIL-B
NOTE-19

DETAIL-C
NOTE-10,29

GENERAL NOTES :

A. FOR GENERAL NOTES, DETAILS AND SYMBOLS REFER LEGEND P&IDS.
B. ALL INSTRUMENT TAGS TO BE PREFIXED BY UNIT NO. 1U68.
C. FOR DETAILS OF PUMP VENT/DRAIN AND SAMPLE CONNECTION REFER LEGEND P&IDS.
D. ALL INSTRUMENT DRAINS FROM SULPHURIC ACID SYSTEM SHOULD GO TO LIME PIT.
E. ITEMS SHOWN UNDER CONTRACTOR SCOPE ARE INDICATIVE ONLY.
F. DETAILS FOR PACKAGE UNITS ARE PRELIMINARY & CONTRACTOR TO DEVELOP FURTHER.
G.PIPING FIRST ROOT ISOLATION VALVE SHALL BE PROVIDED FOR PG,PT,DPT,FT(DP TYPE)ETC.

NOTES:

1. REFER NOTE ON P&ID C050-79-41-202-1111 SHEET 1 OF 2.

NRL DOCUMENT NO.
EL-1U68A-PR-PID-4302.00

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1	19.01.26	REVISED AS MARKED	RS	MPS	SC	MS
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B	07.08.25	RE-ISSUED INCORPORATING ENGINEERING COMMENTS	RS	MPS	SC	MS
A	18.07.25	ISSUED FOR COMMENTS	RS	MPS	SC	MS

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम)
ENGINEERS INDIA LIMITED
(A Govt. of India Undertaking)

NUMALIGARH REFINERY LIMITED
EPCM SERVICES (PART-A) FOR 360 KTPA PPU AT NRL

पाइपिंग एण्ड इंस्ट्रूमेन्टेशन डायाग्राम
PIPING AND INSTRUMENTATION DIAGRAM

RECIRCULATING COOLING WATER SYSTEM

(SHEET 02 OF 02)

SCALE	JOB NO.	DEPT.	SECTN.	UNIT	DWG. No.	REV.
	C050	79	41	1U68	1111	1

EIL-0241-502-REV-0-A

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1U68-ZM-9382
CT FORMULATION DOSING PACKAGE
(NOTE-1,5,15,18)

1U68-ZM-9383
POLYMERIC DISPERSANT DOSING PACKAGE
(NOTE-1,15,18)

1U68-ZM-9384
BIOCIDE DOSING PACKAGE
(NOTE-1,4,15,18)

SERVICE WATER
12436 | 1U68A-PID-4301.00
2"-RW-1U68-48002-A10A
NOTE-16

PLANT AIR
12437 | 1U68A-PID-4302.00
2"-PA-1U68-59004-A3A
NOTE-16

INST. AIR
12434 | 1U68A-PID-4302.00
2"-IA-1U68-58002-A3A
NOTE-16

HOSE STATION (TYP.)

HOSE STATION (TYP.)

2"-PA-1U68-59005-A3A
NOTE-9

TO ATM AT SAFE LOCATION

1U68-AG-9371

2"-SV-1U68-64005-A6K
(SS304L)

LT-9371 01 TO BE READABLE FROM GLOBE VALVE

2"-RW-1U68-48003-A10A
(SS304L)

DRUM PUMP

NOTE-10

LI 9371 01

LT 9371 01

1U68-VV-9332

2"-SV-1U68-64010-A6K
(SS304L)

NOTE-9

2" UC

NOTE-6

PIPE (SS304L)

1U68-ZM-9382
(NOTE-1,5,15)

NOTE-2

LG 9382 01

CALIBRATION CYLINDER

2"-OC-1U68-93021-A6K

2"-OC-1U68-93020-A6K

NOTE-3

2"-OC-1U68-93025-A6K

VALVE TO BE PROVIDED ADJACENT WITH CALIBRATION CYLINDER IN VIEW

NOTE-7

2"-PA-1U68-59007-A6K
(SS304L)

2"-OC-1U68-93017-A6K

NOTE-3

2"-PA-1U68-59006-A3A

NOTE-9

2"-RW-1U68-48004-A10A

TO ATM AT SAFE LOCATION

1U68-AG-9372

2"-SV-1U68-64008-A6K
(SS304L)

LT-9333 01 TO BE READABLE FROM GLOBE VALVE

2"-RW-1U68-48005-A10A
(SS304L)

DRUM PUMP

NOTE-10

LI 9333 01

LT 9333 01

1U68-VV-9333

2"-SV-1U68-64009-A6K
(SS304L)

NOTE-9

2" A6K

UC

NOTE-6

PIPE (SS304L)

1U68-ZM-9383

NOTE-2

LG 9383 01

CALIBRATION CYLINDER

2"-OC-1U68-93027-A6K

2"-OC-1U68-93026-A6K

NOTE-3

2"-OC-1U68-93028-A6K

VALVE TO BE PROVIDED ADJACENT WITH CALIBRATION CYLINDER IN VIEW

NOTE-7

2"-OC-1U68-93016-A6K
(SS304L)

2"-OC-1U68-93005-A6K

NOTE-3
(NOTE-1,5,15)

TO ATM AT SAFE LOCATION

1U68-AG-9373

2"-SV-1U68-64007-A6K
(SS304L)

LT-9334 01 TO BE READABLE FROM GLOBE VALVE

(SS304L)

DRUM PUMP

NOTE-10

LI 9334 01

LT 9334 01

1U68-ZM-9384
(NOTE-1,4,15)

1U68-VV-9334

2"-SV-1U68-64006-A6K
(SS304L)

NOTE-9

2" UC

NOTE-6

PIPE (SS304L)

NOTE-2

LG 9384 01

CALIBRATION CYLINDER

2"-OC-1U68-93024-A6K

2"-OC-1U68-93023-A6K

NOTE-3

1"-OC-1U68-93022-A6K-

VALVE TO BE PROVIDED ADJACENT WITH CALIBRATION CYLINDER IN VIEW

NOTE-7

SPILLBACK

(SS304L)

FO 9300 01

1"-OC-1U68-93019-A6K

1"-OC-1U68-93015-A6K-

FORMULATION
1U68A-PID-4301.00 | 12432
TO CT SUMP

1"-OC-1U68-93006-A6K

1"-OC-1U68-93008-A6K

1"-OC-1U68-93009-A6K-

PULSATION DAMPENER

1"-OC-1U68-93007-A6K

PULSATION DAMPENER

3.5 PSV 9301A 01

3.5 PSV 9301B 01

PI 9300 03

PI 9300 04

1"-OC-1U68-93010-A6K

1U68-PA-9301A

1U68-PA-9301B

M

EYLS 9301A 01 RUN

EYLS 9301B 01 RUN

EYLF 9301A 01 FAULT

EYLF 9301B 01 FAULT

1U68-PA-9301A/ B
FORMULATION DOSING PUMPS (NOTE-17)

POLY. DISPERSANT
1U68A-PID-4301.00 | 12435
TO CT SUMP

1"-OC-1U68-93001-A6K

1"-OC-1U68-93018-A6K

1"-OC-1U68-93004-A6K

1"-OC-1U68-93002-A6K

1"-OC-1U68-93003-A6K

PULSATION DAMPENER

3.5 PSV 9302A 01

3.5 PSV 9302B 01

PI 9300 01

PI 9300 02

1U68-PA-9302A

1U68-PA-9302B

M

EYLS 9302A 01 RUN

EYLS 9302B 01 RUN

EYLF 9302A 01 FAULT

EYLF 9302B 01 FAULT

1U68-PA-9302A/ B
POLY. DISPERSANT DOSING PUMPS (NOTE-17)

2"-OC-1U68-93011-A6K

PULSATION DAMPENER

2"-OC-1U68-93012-A6K

1-1/2"-OC-1U68-93013-A6K

PULSATION DAMPENER

1-1/2"-OC-1U68-93014-A6K

3.5 PSV 9303A 01

3.5 PSV 9303B 01

PI 9300 06

PI 9300 05

1U68-PA-9303A

1U68-PA-9303B

M

EYLS 9303A 01 RUN

EYLS 9303B 01 RUN

EYLF 9303A 01 FAULT

EYLF 9303B 01 FAULT

1U68-PA-9303A / B
BIOCIDE DOSING PUMPS (NOTE-17)

BIOCIDE
12433 | 1U68A-PID-4301.00
TO CT SUMP

CT VENDOR SCOPE BY OTHERS

GENERAL NOTES :

A. FOR GENERAL NOTES, DETAILS AND SYMBOLS REFER LEGEND P&ID'S
B. ALL INSTRUMENT TAGS TO BE PREFIXED BY UNIT NO. 1U68.
C. FOR DETAILS OF PUMP VENT/DRAIN AND SAMPLE CONNECTION, REFER LEGEND P&ID'S
D. ALL INSTRUMENT DRAINS FROM SULPHURIC ACID SYSTEM SHOULD GO TO LIME PIT.
E. ITEMS SHOWN UNDER CONTRACTOR SCOPE ARE INDICATIVE ONLY.
F. DETAILS FOR PACKAGE UNITS ARE PRELIMINARY & CONTRACTOR TO DEVELOP FURTHER.
G. PIPING FIRST ROOT ISOLATION VALVE SHALL BE PROVIDED FOR PG, PT, DPT, FT(DPT TYPE) ETC.

NOTES:-

1. SAFETY SHOWER, EYE WASH AND DRINKING WATER TO BE PROVIDED IN FORMULATION HANDLING POLYMETRIC DISPERSANT HANDLING AND BIOCIDE HANDLING FACILITIES AREA.
2. CALIBRATION CYLINDER SHALL HAVE CALIBRATION IN VOLUME.
3. CHEMICAL DRAINS TO BE COLLECTED IN DRUM/JAR, CLEARENCE AND ACCESS FOR COLLECTION OF CHEMICAL DRAINS TO BE PROVIDED.
4. SHOCK DOSING OF FOLLOWING TWO BIOCIDES @50 MG/L BASED ON HOLD-UP SHALL BE DONE ALTERNATIVELY ONCE IN A FORNIGHT.
   - QUATERNARY AMMONIUM COMPOUND BASED FORMULATION CONTAINING A MIN. OF 25% OF ACTIVE INGREDIENTS.
   - CARBAMATE/ISOTHIAZOLENE/BISPHANE BASED FORMULATION CONTAINING A MIN. OF 25% OF ACTIVE INGREDIENTS.
5. FORMULATION CONSISTING, OF ZINC AS ZINC SULPHATE, ORGANO PHOSPHONATE, POLY PHOSPHATE AND AZOLE (BENZOTRIAZOLE) SHALL BE DOSED AS CORROSION/SCALE INHIBITOR.
6. DOSING VESSEL ELEVATION BY VENDOR BASED ON NPSH REQUIREMENT OF THE PUMP.
7. LOCATION OF CALIBRATION CYLINDER SHALL BE BELOW DOSING VESSEL SO THAT THE CYLINDER CAN BE FILLED UP DURING CALIBRATION.
8. ALL EQUIPMENTS,LINES,INSTRUMENTS SHOWN WITHIN BATTERY LIMIT ARE REQUIRED AS MINIMUM. DETAILING BY VENDOR.
9. DRUM PUMPS SHALL BE DRIVEN BY PLANT AIR. A PLANT AIR CONNECTION TO BE PROVIDED NEAR THE VESSEL FOR DRIVING THE DRUM PUMP.
10. METALLIC HOSE CONNECTION TO BE PROVIDED.
11. ALL THE INSTRUMENTS ARE IN VENDOR SCOPE OF SUPPLY.
12. AGITATORS, IF REQUIRED FOR THE DOSING VESSELS WILL BE IN VENDOR SCOPE OF SUPPLY.
13. OVERALL HYDRAULICS TO BE GUARANTEED BY VENDOR. LINE SIZES TO BE CHECKED/UPDATED BY VENDOR TO MEET HYDRAULICS AS NECESSARY.
14. DETAILS FOR PACKAGE UNIT ARE PRELIMINARY.
15. ALL DOSING PACKAGES SHALL BE MODULAR SKID.
16. TAPPING OF SERVICE WATER, PLANT AIR AND INSTRUMENT AIR LINES SHOWN IN THIS P&ID, TO BE TAKEN FROM RW-1U68-4800 01 (P&ID-1111-1), PA-1U68-59001(P&ID-1111-2) AND IA1U68-58001 (P&ID-1111 SHT. 2) LINES RESPECTIVELY.
17. PRESSURE TRANSMITTER FOR DIAPHRAGM FAILURE ALARM IN DCS ARE IN PUMP VENDOR SCOPE.
18. CHEMICAL DRAINS/SPILL OVER TO BE COLLECTED AND ROUTED TO NEUTRALIZATION PIT WITHIN CT PACKAGE ISBL.

NRL DOCUMENT NO.
EL-1U68A-PR-PID-4303.00

No.	DATE	REVISIONS	DRN	BY	CHKD	APPD.
1	19.01.26	REVISED AS MARKED	RS	MPS	SC	MS
0	19.08.25	ISSUED FOR ENGINEERING	RS	MPS	SC	MS
B	07.08.25	RE-ISSUED INCORPORATING ENGINEERING COMMENTS	RS	MPS	SC	MS
A	18.07.25	ISSUED FOR COMMENTS	RS	MPS	SC	MS

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ई.आई.एल
ENGINEERS INDIA LIMITED
(A Govt. of India Undertaking)

NRL
NUMALIGARH REFINERY LIMITED
EPCM SERVICES (PART-A) FOR 360 KTPA PPU AT NRL

पाइपिंग एण्ड इंस्ट्रूमेन्टेशन डायाग्राम
PIPING AND INSTRUMENTATION DIAGRAM

CHEMICAL DOSING SECTION

अनुमाप SCALE	कार्य संख्या JOB NO.	विभाग DEPT.	अनुभाग SECTN.	इकाई UNIT	आरेख संख्या DWG. No.	संशो REV.
~	C050	79	41	1U68	1112	1

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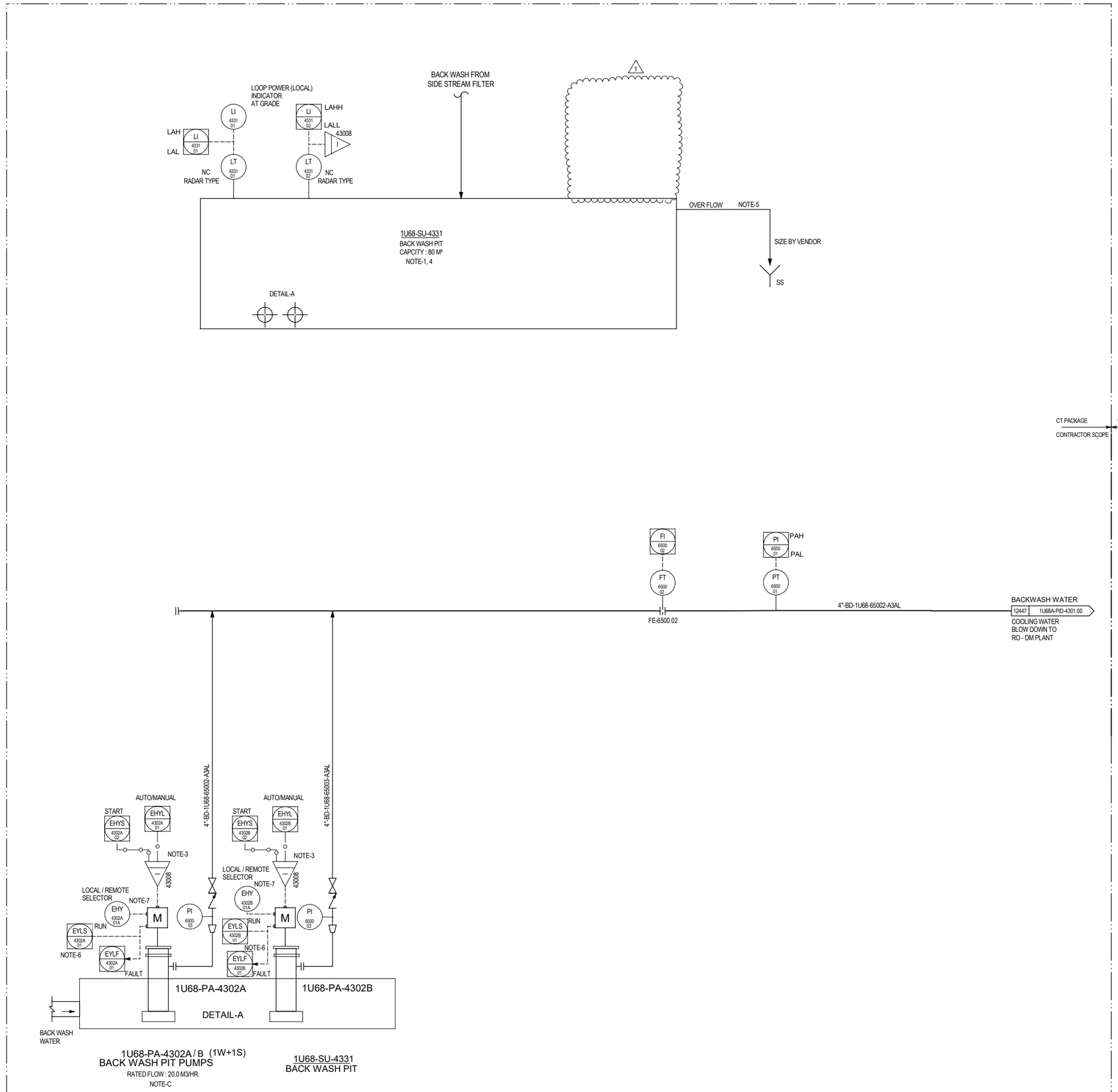

GENERAL NOTES :

A. FOR GENERAL NOTES, DETAILS AND SYMBOLS REFER LEGEND P&ID`S.
B. ALL INSTRUMENT TAGS TO BE PREFIXED BY UNIT NO. 1U68.
C. FOR DETAILS OF PUMP VENT/DRAIN AND SAMPLE CONNECTION, REFER LEGEND P&ID`S.

NOTES:

1. DETAILS SHOWN ARE PRELIMINARY AND TO BE DEVELOPED FURTHER BY CONTRACTOR.
2. DELETED.
3. INTERLOCK DESCRIPTION :

INTERLOCK NO.	ACTUATED BY	ACTION
1U68-I-43008	1 LAHH-4331 02	START 1U68-PA-4302 A/B
	LALL-4331 02	STOP 1U68-PA-4302 A/B

FOR THIS P&ID ALL INSTRUMENTS & INTERLOCKS IN CT PACKAGE SCOPE SHALL BE CONNECTED TO CT PACKAGE CONTROL SYSTEM.

4. PUMP MAY RUN INTERMITTENTLY ON CONTINIOUSLY OR IN PARALLEL OPERATION SUITABLE PROTECTION MEASURE TO BE PROVIDED TO PREVENT PUMP CAVITATION.
5. NO. OF OVERFLOW CONECTION IN EACH COMPARTMENT SHALL BE CONFIRMED DURING DETAIL ENGINEERING.
6. RUNNING INDICATION SHALL BE PROVIDED IN PACKAGE SYSTEM.
7. WHERE L/R SELECTOR SWITCH IS SHOWN FOR PUMP, LOCAL START`S LOCAL STOP TO BE PROVIDED IN LCS IN FIELD.

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B	07.08.25	RE-ISSUED INCORPORATING ENGINEERING COMMENTS	RS	MPS	SC	MS
A	18.07.25	ISSUED FOR COMMENTS	RS	MPS	SC	MS

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ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

NUMALIGARH REFINERY LIMITED
EPCM SERVICES (PART-A) FOR 360 KTPA PPU AT NRL

पाइपिंग एण्ड इंस्ट्रूमैन्टेशन डायाग्राम
PIPING AND INSTRUMENTATION DIAGRAM

BACK WASH PIT AND PUMP

SCALE	JOB NO.	DEPT.	SECTN.	UNIT	DWG. No.	REV.
	C050	79	41	1U68	1113	1

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3डी मॉडलिंग के लिये दिशा निर्देश

GUIDELINES FOR 3D MODELING

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	10.02.2025	REVISED AND REISSUED AS GUIDE	AR	VS	SV	MN
3	26.12.2016	REVISED AND REISSUED AS GUIDE	SH	AK	RP	RN
2	12.07.2012	REVISED AND REISSEUD AS GUIDE	RN	SC	VK	DM
1	02.02.2009	REVISED AND REISSUED AS GUIDE	DM	AK	AA	VC
0	04.06.2001	ISSUED AS GUIDE	RP	VPS	MR	MI

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Abbreviations:

3D	-	Three Dimensional
AFC	-	Approved for Construction
CRWS	-	Contaminated Rain Water Sewer
DCN	-	Design Change Note
E3D	-	Everything 3D
GAD	-	General Arrangement Drawing
IBR	-	Indian Boiler Regulations
ISBL	-	Inside Battery Limit
ISO	-	Isometric
ITS	-	Information Technology Services
JB	-	Junction Box
LSTK	-	Lump Sum Turn Key
MCT	-	Multi Cable transit
MTO	-	Material Take Off
OSBL	-	Outside Battery limit
OWS	-	Oily Water Sewer
P&ID	-	Piping & Instrumentation Diagram
PDMS	-	Plant Design Management System
PDS	-	Plant Design System
PEM	-	Project Engineering Manager
PM	-	Project Manager
PSIMS	-	Piping Structural Input Management System
PWB	-	Pipeway Bridge
RCM	-	Resident Construction Manager
ROLRM	-	Remote operated Long Range Monitor
S3D	-	Smart 3D
SGL	-	Senior Group Leader
SS&EW	-	Safety Shower & Eye Wash
SWS	-	Sanitary Waste Sewer
TFMS	-	Tank Farm Management System

General Engineering Standards Committee

Convenor: Ms. Shalini Verma, PEMD

Members:
Mr. Vinod Mahajan, PEMD
Mr. Harish Kumar, Electrical
Mr. Amit Prakash, FED
Mr. Deepak Agrawal, Structural
Mr. Vinay Sonkar, PEMD
Mr. Shishupal Choudhary, SMED-PE
Mr. Surojit K Gayen, Projects
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Mr. Abhinandan Swami, Process-2
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1.0 INTRODUCTION

These guidelines are developed to frame and implement the requirements of 3D modeling of a plant on E3D / S3D / PDS / PDMS system or any other software. Primary objective of these guidelines are:

- To define the scope of various departments participating in the 3D model design.
- To establish a procedure of developing the model.
- To standardize on working philosophy for using these packages.
- Define backup storage and retrieval methodology.

This guide will help in achieving uniformity for various projects and reduce problems during interdepartmental coordination. The projects can be easily monitored, structured files can be transferred to site and deciphering of the names will be easier. This will also help in developing an archival system for all future reference of the electronic files generated during a project execution.

2.0 REFERENCE DOCUMENTS

8-76-0033	-	Guidelines for Review of 3D Model
8-76-0032	-	Guidelines for Preparation of As-Built Documents
8-1643-2011	-	Guidelines for Modelling Structural Input
8-1643-2010	-	Guidelines for location of Underground Piping Points and Funnel

3.0 SCOPE AND EXTENT OF MODELING

All plant engineering activities beginning from Plot Plan development to generation of as-built drawings shall be done using 3D modeling applications. All plant items listed below shall be modeled for completeness of 3D model and for extraction of deliverables from model.

Discipline wise scope of modeling is as under:

A. Piping

a) Overall system co-ordination.
b) All equipments 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, lifting lugs, piping clips etc., for all the equipments in the plant like, vessels, columns, reactor, receivers, pumps with motors, air coolers with motors and fans, filters, blow down drums, heat exchangers etc. For vertical equipments inside structural platforms subject to higher vertical thermal growth exceeding 50mm, viz. like reactors, columns etc., thermal growth envelops to be modeled.
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, etc.
f) All in-line instruments like control valves, safety valves, rota-meters, orifice plate, flow

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meter etc. For analyzer shelters and cabinets, utility lines to be modelled up to the corresponding utility connections in analyzer shelters and cabinets as per the shelter / cabinet general arrangement drawings.

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 standpipes, level gauges, level switches, level transmitters (including chambers wherever applicable), equipment/instrument vents/drains, utility connections, temperature elements, temperature / pressure gauges etc. .
i) Insulation type like IH, IT, IJ, IC, IE etc., Insulation thickness operating/design pressure/temperature etc.
j) Manhole vent 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 packages like Compressor, Blower, Heater, Refrigeration etc. If package modeling is not done by Vendor, the same shall also be undertaken by concerned disciplines as per "Scope Matrix For 3D Modelling" (Annexure –I)
n) Tagging of all Line nos., Instruments nos., special items, 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) Modeling of Above-ground fire water piping & associated equipment in the process unit/ CPP.
r) Modeling of Fire water spray piping, foam piping & associated equipment on process equipment, tanks, gantry, compressor shed, pumps, spheres, bullets etc. in the offsites & process unit/ CPP.
s) Steam supply, return manifold near the trenches shall be modelled by Piping. Layout shall be reviewed by Piping from Stress and Support perspective. Trench and line shall be modelled by Civil
t) Above-ground piping of drinking water including SS&EW, OWS/ CRWS pump & pump-station/ offsite above-ground piping.

B. Structural Division

B.1 General Civil

a) Process Unit - Complete underground facilities including Underground Piping (water, waste water & blowdowns), funnels, manholes, catch basins, RCC trenches, pavement plate etc.
b) Offsites - Envelope for Overall Plot plan, roads, approach roads, FGL plate, Earth Dyke, Earthen reservoirs, fencing, boundary wall (masonry), storm water drains, trenches, drinking water, sanitary sewer, OWS, CRWS, Process Blowdown, sleepers (up to 500 mm Height from FGL), Instrumentation/ Electrical Road crossing (IRC/ERC) and storm water culvert, PWB etc. to be modeled.
c) Modeling of complete under-ground Fire water piping in the unit/ CPP.
d) Modelling of complete under-ground & above-ground (on sleepers) Fire water piping & associated equipment in the offsites..
e) Offsites - Cooling Water pump, pump station piping.
f) Separate trussles for instrument duct / tray support in offsite facilities wherever no pipe-racks and pipe sleepers are available for routing of instrument ducts / trays.

B.2 Structures

The scope of modeling for structural shall include but not limited to the following:

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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, corbel, fire proofing, 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) Structural shall model moment connections, stiffener plates, gusset plates (vertical bracing), with tentative sizes at initial stage of modelling. Fabricator model shall be integrated whenever uploaded by Contractors. However it shall be before the start of release of piping isometrics to the site.
c) Actual tank platforms & spiral stair-case.
d) Handrails, gratings to be modeled in approximate geometry.
e) Skid supports, platforms, ladders & Equipment supports inside skids are to be modeled in exact geometry. No welds to be modeled.
f) 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.
g) Foundation and structure for platforms, gratings, hand rails etc. for packaged item and skid mounted items are also included.
h) 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.
i) Structural steel members used for the pipe supports to be modeled in complete details based on Structural input furnished by Piping on Model.
j) Buildings shall be modeled where applicable. This modeling shall include all external doors, windows, MCT cut-outs (as required for the Control Room, SRR, Local Control Room), and other relevant elements, which shall be imported from the architectural 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 and major package skids including duct drops.
   3. Nucleonic Level Detectors (Not mounted on Equipment)

   Structure to model these supports even if regular structure 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.

B.3 Architecture

The scope of modeling for Architecture shall include but not limited to the following:

a) Modeling of applicable buildings including all external doors & windows, external walls, projections, porch etc. which will be imported from Architecture model. developed on REVIT software

C. Instrumentation

a) Instrument cable Duct with fire-proof envelope (Instrument ducts are of minimum 400mm width and 200mm depth and maximum 1200mm width and 400mm depth) including Cable Duct/tray on pipe sleeper and through Culvert.
b) Following instrument entities shall be modeled:
   - Analyser Shelter / House, Analyser Racks/ Cabinets located in the field to be modeled near exact geometry
   - Local Control Panels

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Inside details of Shelter/ Racks/Cabinets are excluded from the scope of modeling. .

c) Prefabricated Assemblies (Hook-ups)
d) Fire & Gas detectors, Hooter, Beacon, Push Button Stations
e) Detectors of nucleonic level instruments
f) Closed Circuit Television (CCTV) for process units
g) Instrument Stanchions for field instruments like temperature / pressure / differential pressure transmitters
h) Instrument Air Manifold
i) Instrument Junction Boxes
j) Instrumentation ducts connectivity between main pipe rack & all technical structures, heaters, compressors, major package skids, Columns etc. .
k) Tentative location of volume bottle envelope near applicable ON-OFF / Control valves for clash check with Piping

D. Electrical

The modeling for electrical facilities shall include the following:

a) Electrical Cable Trays of size 300mm & above.
b) Local Control Stations, motor intermediate junction boxes (as applicable) in the field for motor/other equipments .
c) Lighting, & power panels & MOVDB .
d) Light fixtures, plugs, sockets, welding receptacles, lighting poles in the field .
e) Highmast lighting system
f) Earth electrodes in test pit.
g) Plant communication system equipment including field call stations, paging loudspeakers and telephones in the field.
h) FA system equipment including break glass units in the field.
i) Sleeves for cables in the field.

E. Others / Miscellaneous Models

- Package units /modular units are to be treated like the main units and all the requirements of modeling shall be followed by the package 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.
- The under-ground funnel points for the packages shall be provided in the model by package vendor. Piping to integrate the package model in the base model.
- Architecture shall model the building envelope as per the actual shape and plan in the units as well as offsites.

F. For Discipline wise modeling responsibilities refer "SCOPE MATRIX FOR 3D MODELLING" (Annexure –I)

4.0 PROJECT SETUP & DATA MANAGEMENT

A. Software Selection

PEM alongwith Projects and client shall decide about the use of E3D/S3D/other systems alongwith its database for a project and communicate to the technical departments. PEM shall facilitate the procurement of monthly coupon for the 3D model software as per project provisions. Piping department shall be the overall coordinator for the 3D systems. 3D modeling software to be used should be decided at the beginning of the project based on client specific/ contract requirements, reference project data and availability of system resources.

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B. Project Database Setup

Piping department shall carry out the project creation activity. Major steps involved are:

- Creating directory structure in the server.
- Creation of Project databases for all disciplines.
- Copying of reference database / files / catalogues etc. from master, reference project.
- If the project consists of multiple units then one project master to be maintained for all the specs & catalogs for ease of maintenance & uniformity. All the units shall refer to this one project master.
- Any new catalog requirement is to be created in the project master.
- Once the project is complete, the project specific catalogs have to be reviewed by the respective department and added in the master project catalog.
- Creating user log in for all disciplines.
- Setting up of Project back-up systems.
- Configuration of database files in case 3D modeling is being carried out at multiple locations.
- Other misc. activities required for project creation.
- Completed project databases and Master catalog shall be maintained at one location (central repository)

Piping administrator will create the project database and inform respective disciplines administrators. Administrators of respective disciplines shall be responsible for creation / updation and maintenance of specifications and catalogues used for their part of work.

C. Creation Of Areas / Model Files And Design Databases

This activity shall be carried out by piping on finalization of the equipment layout and area division drawings. It involves creation of areas / model files / databases for piping, equipment, structure disciplines. The advantages of creating several areas / models are to break-up a big plant into smaller parts and facilitate simultaneous working of several persons of a discipline. Area division shall conform generally to piping area division. However, multiple areas can be clubbed together for modeling ease and shall be termed as modeling zones. Organisation of areas shall generally be uniform for all disciplines and any variation shall be in consultation with piping and well documented. Maintaining uniformity in areas for various departments shall help in organizing data properly and facilitate generation of deliverables, reports and interference management.

Automatically scheduled batch mechanism shall be created to generate Navisworks review file (.nwd) on any network shared folder location by Piping.

D. Project Database & Naming Convention

Standard project naming convention for 3D Modeling shall be followed as under:

a) **PDS**

Separate models to be generated for each discipline

Discipline	Model Identifier
- Piping above ground	- PI
- Piping under ground (General Civil)	- UG
- Equipment	- EQ
- HVAC	- HV
- Structural	- ST
- Architectural	- AR

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-	Electrical	-	EL
-	Instrumentation	-	IN

Within each discipline models to be generated based on the zone division developed by piping. The naming conventions for model in the PDS Database in PDS shall be as follows:

X	X	--	XX
Model Identifier as given above	Levels (given below)	Under Score	Area number from Key Plan

A - Grade
B - First Level above Grade
C - Second Level above Grade
X - All Levels in one model
U - Under ground

- Above ground and underground piping shall always be in different models.

Database Hierarchy

PIPING

a) PIPE NAME:
INSPECTION ISO ID
P&ID(NPD)+FLUID CODE +UNIT NUMBER+LINE SEQUENCE NUMBER+SPECIN(P&ID)+INSULATION GIVEN BELOW

b) LINE ID:
FLUID CODE + UNIT NUMBER +LINE SEQUENCE NUMBER

c) TAG NOS.: For all Inline Instruments, Special items as component Name in PDS, Same tag numbering philosophy to be followed in PDS.

XXX	-	XXX	XXXX	- X
UNIT No.	DASH	INST. TYPE i.e. PSV, FV, PV	INST. NO./ SPECIAL ITEM NO.	A,B,C.. Only if same no. is getting repeated

EQUIPMENT NAME

a) EQUIPMENT NAME = UNIT NUMBER + EQUIPMENT NAME(A,B,C,ONLY IF THE N0.IS GETTING REPEATED.)

b) Description= Drawing number + revision number given in datasheet.

Line information required in PDS model:

The following attributes must be keyed in while modeling:

- Line operating/design, temperature/pressure in deg.C and Kg/cm2g respectively.
- Insulation type i.e. IH/IT/IS/IJ/IC/IE etc.
- Contractor Code;

INSPECTION ISO ID= Line number label should be as per the P&ID with the following attributes:

Line size + unit no. + line sequence no.+ sub-line no. + Piping material specification +

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Insulation Type. Pre-requisite attributes viz., PMS, Insulation and Model Zone (for hierarchy) to be ensured before creating Pipe as per Line List and Zone-Division.

b) **PDMS / E3D**

Separate models to be generated for each discipline

Discipline		Model Identifier
- Piping above ground	-	PI
- Piping under-ground (General Civil)	-	UG
- Equipment	-	EQ
- HVAC	-	HV
- Structural	-	ST
- Architectural	-	AR
- Electrical	-	EL
- Instrumentation	-	IN

Within each discipline, models to be generated based on the Zone Division developed by piping. The Naming conventions for model Database in PDMS/E3D shall be as follows:

XX	ZONE	XX
Model Identifier as given above	Levels	Zone Number

- Above ground and underground piping shall always be in different models.

Database Hierarchy

Piping

a) PIPE NAME:

Line No. Label (as given in P&ID)	-	XX
	Under Score	Zone/Area No

b) Branch Name:

PIPE NAME/B1,B2

c) TAG NOS:

For all Inline Instruments, Special items as component Name in PDS, Same tag numbering philosophy to be followed in PDMS/ E3D.

XXX	-	XXX	XXXX	-X
UNIT No.	DASH	INST. TYPE i.e. PSV, FV, PV	INST. NO./ SPECIAL ITEM NO.	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 Zone
/XXX/MPRXX	Container for Main Pipe Rack Zone
/XX-CC-XXX/STR	Container for Structural Foundation and Platforms Zone
/XX-CC-XXX/FDN	Foundation for the Equipment STRU/FRMW
/XX-VV-XXX/STR	Container for Saddle Support for Vessel, all Associated Platforms etc. STRU/FRMW

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Line information required in PDMS/E3D model:

The following attributes must be keyed in while modeling:

- Line operating/design, temperature/pressure in deg.C and Kg/cm2g respectively.
- Insulation type i.e. IH/IT/IS/IJ/IC/IE etc
- Contractor Code;

Line number label should be as per the P&ID with the following attributes:

- Line size + 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.

c) **S3D**

Separate generic systems are to be created for each discipline

Discipline	Model Identifier
- Piping above ground	- PI
- Piping under ground (General Civil)	- UG
- Equipment	- EQ
- HVAC	- HV
- Structural	- ST
- Architectural	- AR
- Electrical	- EL
- Instrumentation	- IN

Within each Generic system, Unit system are to be generated. This Unit system is further divided into Area systems (zones) based on the zone division developed by piping. These Area systems are then divided into piping/ equipment/ electrical/ HVAC/ Structure etc systems in their respective generic systems as per the requirement. For example, a piping system will allow the user to extract a system isometric in which all the connected pipelines in that zone are shown.

In case 3D modelling is done with the inputs from Smart P&ID then end to end piping shall be modelled with reference to data imported from Smart P&ID and without any one break. For zone wise extraction of isometrics, work break down structure shall be implied by defining zone volumes in 3D model as per zone division.

Database Hierarchy

PIPING

a) PIPE NAME:

INSPECTION ISO ID

P&ID(NPD)+FLUID CODE +UNIT NUMBER+LINE SEQUENCE NUMBER+SPECIN(P&ID)+INSULATION

b) LINE ID:

FLUID CODE + UNIT NUMBER +LINE SEQUENCE NUMBER
(Auto correlation of Smart 3D model with Smart P&ID is based on this field)

c) TAG NOS.: For all Inline Instruments, Special items as component Name in Smart 3D, Same tag numbering philosophy to be followed in Smart 3D.

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XXX	-	XXX	-	XXXX	X
UNIT No.	DASH	INST. TYPE i.e. PSV, FV, PV	DASH	INST. NO./ SPECIAL ITEM NO.	A, B, C. Only if same no. is getting repeated

d) Equipment name and description/designation shall be as mentioned in MDS.

Line information required in Smart 3D:

A) WHEN MODELED USING PHYSICAL SET OF P&IDS

The following attributes must be keyed in while modelling at pipeline level:

- In the field name rule select EIL_Line ID and fill the fields as mentioned above in b).
- P&ID Line number for generation of inspection iso ID
- Nominal Diameter and Specification as per the P&ID.
- Contractor Code.

The following attributes must be keyed in while modelling at piperun level:

Select EIL _Pipe Name as the name rule for piperun and fill in the details for flow direction, Line operating/design, temperature/pressure (in deg.C and Kg/cm2g respectively), Insulation type i.e. IH/IT/IE/IS/IJ/IC/IE etc and Insulation Thickness.

B) WHILE MODELLING WITH REFERENCE TO SMART P&ID

Plant breakdown structure in Smart 3D, SPI and SPEL is to be aligned with that of Smart P&ID to ensure seamless flow of data from Smart P&ID to Smart 3D, SPI and SPEL. While modelling multiple units in the same project, common plant breakdown structure is to be followed and common reference database is to be maintained.

Pipelines are created in system at the time of import of published Smart P&ID in Smart 3D, the following attributes must be ensured while modelling at pipeline level:

- All piping attributes like flow Direction, Line operating/design, temperature/pressure, Insulation type, Insulation Thickness etc. are automatically populated at the time of import of published Smart P&ID, so the modeler can start modelling work without manually keying in these attributes at piperun level.
- Fields required for Inspection Iso ID and Contractor Code are to be filled manually.
- Regular process check of 3D model w.r.t. Smart P&IDs to be performed.

5.0 WORKING METHODOLOGY

Detailed workflow of 3D model is indicated in the Annexure-III, However, discipline-wise 3D modeling methodology shall be as follows:

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5.1 Working Methodology of Piping Department

Piping department shall be responsible for overall coordination, Project creation, piping specifications & catalogues, equipment modeling, piping modeling, interference management and extraction of piping deliverables eg. GAD's, Isometrics, System Isometrics and MTO.

5.1.1 Piping Specifications & Catalogues

Piping specifications shall preferably be created after first issue of PMS and catalogues to be imported from Master project catalogues. Piping specifications shall be imported from IPMCS using utilities developed for E3D / S3D / PDS / PDMS. During the course of the project these specifications and catalogues shall be updated based on specific project requirement.

Job specific new catalogs shall be created following EIL's naming convention. At the end of the project all newly created catalogues & specs shall be sent back to piping administrator for incorporation in Master project. 3D PMS shall be checked w.r.t. issued IPMCS PMS before 30% model review.

Consistency of 3D model specs w.r.t latest spec in material management software need to be verified by 3D model administrator prior to extraction of piping MTO from 3D model.

5.1.2 Equipment Modeling

Equipment modeling shall commence at the beginning of the project at Equipment Layout finalization stage. The modeling shall be done using reference dimensions / data provided by originating disciplines or from similar reference jobs previously done in the system. Unit wise Equipment modeling shall be done in relevant model files.

Piping shall also model basic requirement like extent of equipment platforms, ladders, as input for Structures and package units locations. These shall be modeled as outlines in a separate model and shall be referred till the structural modeling is complete. Naming of inputs shall be as per the Guidelines for Modelling Structural Input (8-1643-2011). The envelope for the main under-ground piping corridor shall be modeled by General Civil to avoid any interference later on as input to other departments.

Refer Annexure-II for location priority of various items on pipe rack column faces.

After issue of Equipment Layout, Equipment modeling shall be done zone wise in relevant zone / model files, based on equipment data sheets / mechanical data sheets / setting plans for exchangers and air coolers / vendor drawings / drawings for heater etc. Columns and vessels shall be modeled based on the equipment drawings and data sheets.

Input for Nozzle orientation drawings shall also be extracted from the model.

Fired heaters including air pre heaters, ID & FD fans, stack, duct's etc., shall be modeled based on drawings / Vendor drawings as applicable.

Package units and skid's where engineering is done by vendors / other agencies shall be modeled as box with piping hookup locations being precisely modeled.

Maintenance / operational and access areas eg. Exchanger bundle pulling, drop out areas for columns and compressor sheds, unit access areas, pump access areas below pipe racks, skid access area below the compressor deck etc. shall be modeled as soft envelops.

For projects where safety and escape routes are required, shall also be modeled as soft envelops.

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5.1.3 Piping Modeling

After the finalization of Equipment layout, Piping modeling shall be carried out zone wise in relevant zone / model files. Piping study and conceptualization of pipe routing shall be done directly on the 3D model and shall commence once the equipment data is received.

It shall be ensured that critical lines such as transfer lines, two phase flow lines, overhead vapor lines, air cooler inlet / outlet piping, reboiler outlet etc. which may influence equipment layout and structure requirements shall be stress analysed during the course of piping study in the model.

One master set of zone marked P&ID's and line list shall be maintained with the piping administrator and modelers shall regularly highlight the extent of modeling on these P&ID's in order to identify and monitor the model progress.

Weekly review sessions of the model shall be extracted and made available to Group leader, designers and engineers for checking, clash detection, support planning and support marking. After 30% model review stage, the 3D review model shall be sent to site for their reference and construction planning at regular intervals as per job requirement.

Zone wise isometrics shall be extracted and sent for checking, stress analysis & supporting.
A master set of zone marked P&ID's shall also be maintained with the Lead engineer wherein the extent of checking shall be colour marked by the checker. Line list shall also be marked & updated in order to know the completeness of the lines.

All DCN's received shall also be marked on the Lead engineer's P&ID set as well as the modeling administrator's set.

Support modeling shall be carried out after the receipt of support marked isometrics, clashes if any shall be resolved before AFC issue of isometrics.

AFC Isometrics shall be issued zone wise, however for critical lines these shall be issued after the line is completed.

Suitable attribute in model shall be provided for segregation between Working / AFC piping with specific colour code for each in review model.

In order to reach the second MTO milestone it is envisaged that 80% of the model shall be completed. Model completion shall be targeted to coincide with third MTO stage.
Fire water headers in units shall only be modeled. Tap offs' for sprinkler system in mechanical contractor's scope of supply, shall be modeled for indicative MTO purpose.

All small bore utility lines shall be modeled except lines which are required to be field routed eg., Instrument flushing lines, steam tracing non IBR lines etc.

AG piping at interface point of UGterminating at AG/UG interf shall ace to have a tag asend with a tag "to UG XXX". Where XXX is code for sService.

Record for lines which are not being modeled shall be kept in order to account for manual MTO of these lines. However for steam tracing system, steam supply header up to tracing tap-off valve and condensate manifold beyond steam trap and valves shall be modeled.

Jacketed lines shall be modeled only for core piping. Outer Jacket can be drawn in drafting tools and manual MTO for the same shall be taken care of.

GAD extraction shall commence after 60 % model review is completed. Area wise GAD's shall be taken up progressively depending on the completion of areas. GAD's shall have minimum

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annotation such as grid nos, equipment nos., line nos. instrument tags and salient locating dimensions.

Line nos. and location co-ordinates of all lines shall be at the B/L of the GAD.

Instrument tappings in each line/equipment shall be marked tag-wise along with line/ equipment modelling.

5.2 Working Methodology of Structural Department

5.2.1 Structures

Structural modeling shall commence with grid modeling at beginning of project.
Basic framework like width & elevation, floor elevation, platform extent and tentative column sizes for Pipe racks, Tech structures and plant buildings shall be modeled for Apex review of equipment layout by structures.
After the apex review and finalization of equipment layout for engineering, structures shall proceed with design & modeling of structural entities as listed in the scope matrix (Annexure-I).

The following shall be the sequential steps:

- Structural modeling on TEKLA shall be done for all structures (pipe racks, technological structures, T-supports etc.) and shall be transported to 3D modeling system. Input for pipe racks / technological structures etc. shall be taken from equipment layouts. 3D modeling of pipe rack shall precede piping modeling.

- Inputs for equipment locations, elevation and extent of local & vessel mounted platforms, T-supports, inter-connecting platforms, shall be taken from the 3D model after confirmation of completeness of input from piping department.

- All equipment mounted platforms shall be modeled on 3D modeling system on completion of design and drafting of these as per structural standard / Circular Platform Module in TEKLA Control Center .

- For Instrument Duct (main and branch) and Electrical Tray (main and branch) supporting structure, Structural shall take input from 3D model. Supports shall be provided even if branch pipe rack is not available. The structural supports shall be at main duct elevation as far as possible. Modelling of the above supports shall be ensured before 60% model review. Trenches, Pipe cross-overs and culverts shall be modeled in consultation with Electrical & Instrumentation. Separate structural members shall be used for instrument cable duct support and support for the adjacent walkways.

- Gratings / Chequered plates including cutouts, Equipment supporting stools, foundation, table top, saddle supports & monorails etc. shall be modeled on 3D model. All handrail and stairs / ladders shall be modeled using customized modules on 3D modeling system.

- Suitable attribute in model shall be provided for segregation between Working /AFC / Model imported from fabricator with specific colour code for each in review model.

- Structural clash check with Piping & Equipments shall be performed on Navisworks Manage software. Clash check report shall be jointly reviewed by Structure & Piping.

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- MTO for steel structures shall be extracted from the primary modeling software i.e TEKLA / Advance Steel which shall include stairs, handrails, ladders etc. However MTO for concrete structures & foundations will not be generated from the model.
- The moment connection in the bolted structure shall be modeled by Structural along with the main structure to avoid clashes at a later date.
- The deliverables from the structural steel fabricator to be expedited and imported in the base model.

5.2.2 General Civil

General Civil shall commence the modeling of Plot plan after PPRRC approval. Complete Plot Plan shall be modeled indicating the various blocks for offsites, utilities, units, road layout.

In offsites, General Civil shall model all the Under-ground facilities like, UG piping (Water, Waste Water & Blowdowns), storm water drains, cable trenches, pipe way bridges, storm water culverts, electrical & instrumentation road crossings, pipe sleepers, pipe sleeves, fire water pipes (under-ground & above-ground on sleepers), hydrants, monitors, hose boxes, hose reels etc. as defined in the scope matrix (Annexure-I) in close coordination with Piping and Structure departments. (Modeling of Fire water spray piping, foam piping & associated equipment on process equipment, tanks, gantry, compressor shed, pumps etc. in the offsites shall be carried out by Piping)

Above-ground piping of drinking water including SS&EW, OWS/ CRWS pump & pump-station/ offsite above-ground piping.

In Process Units/ CPP, General Civil shall model all the Under-ground facilities like, UG piping (Water, Waste Water & Blowdowns), storm water drains, cable trenches, fire water pipes (under-ground) as defined in the scope matrix (Annexure-I) in close coordination with Piping and Structure departments. (Modeling of Above-ground fire water piping & associated equipment in the process unit/ CPP shall be carried out by Piping department.)

Steam traced underground lines including all relevant supports and steam tracing details including steam traps, etc. shall be modeled by Piping. The RCC trenches shall be modeled by General Civil.

For the Apex Review of Equipment Layout for units, General Civil shall model pavement plate, FGL plate, hard stand, fire water header around the unit, main Roads, Approach Roads, etc. Basic Corridors of UG piping shall be identified on 3D model by Piping department and shall be modeled by General Civil based on input given in Equipment Layout.

After Apex Review of the Process Unit/ CPP, once Piping department uploads the PMS in the model, General Civil shall model UG piping for Cooling water/ OWS/ CRWS/ CBD/ Caustic/ Drinking water etc., electrical / instrumentation cable trenches, catch basins, manholes, manhole vents (UG part), clean out pit, valve pit, under-ground fire water network etc.

Piping shall model all AG piping terminal points for OWS, CBD, ABD, other blowdowns, Chemical sewer drain points, SS points for pumps, exchangers, compressors, vessels, etc in 3D model. General Civil will connect these points with UG piping connections. In case the AG piping terminal point locations are not available due to lack of vendor data (pumps, compressor sheds, packaged units etc.), non finalization of manifold locations etc. General Civil shall start modeling of headers, sub-headers and UG points as per guidelines for location of underground piping points & funnel 8-1643-2010 for planning purpose. Model shall be updated after incorporation of vendor data.
UG & AG piping at interface point shall have a tag as "From AG XXX" & "To UG XXX" respectively, Where XXX is code for Service.

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Interference check shall be carried out on regular basis within Structural/ General Civil scope of model as well as with Structural, General Civil and Piping entities for assuring clash free model. General Civil shall extract all Project deliverables from the Model only after interference checking.

MTO for underground piping shall be extracted from the Piping module which shall include pipes, valves, fittings, bends etc. However, MTO for concrete structures like manholes, valve pits, Trenches etc. shall be extracted separately

In case of U/G pits for in-line flow meters, modelling of pits shall be done by General Civil in close coordination with Instrumentation department.

Geotechnical shall arrange for the borehole log data in the CSV format of Civil 3D which will help in the modelling of sub-surface layers in the model.

5.3 Working Methodology of Electrical Department

3D modeling by electrical shall commence after unit area equipment layout has been issued for engineering, 3D modeling including pipe rack and tray supports have been completed and the area has been cleared by both piping and structural departments after interference check.

Following methodology shall be adopted for modeling major electrical items in unit areas once the process of customization in PDS/PDMS/E3D/SP3D system is completed.

- Overhead cable trays along with cable tray accessories like horizontal/vertical bends, tee, cross, reducer etc. of size equal to or greater than 300 mm as per standard geometry available in respective PDS/PDMS/E3D/SP3D system.
- Local Control Stations for all motors. Motor intermediate junction boxes (as applicable) .
- "All lighting/power panels, welding receptacles, highmast lighting system, MOV DB, heat tracing DB, earth electrodes in test pit etc., shall be modeled along with their dimensions .
- All break glass type manual call points required for fire alarm system.
- All field mounted call stations, paging loudspeakers, telephones, acoustic hood etc. required for plant communication system.

The following advantages can be derived from the above activities.

- Interference of overhead cable trays and other electrical equipments can be avoided from the structural and piping members already modeled in the unit areas.
- MTO can be generated for overhead cable trays and accessories modeled in 3D.

The following layout drawings can be extracted from the system which are presently being made on AutoCAD.

- Cable Tray layout
- Plant communication system layout
- Lighting Layout
- Fire alarm layout
- Earthing Layout (extraction limited to electrodes)

5.4 Working Methodology of Instrumentation Department

3D modeling by instrumentation shall commence after unit area equipment layout has been finalized for engineering by piping and the following activities can carried out:

- Instrument cable ducts along with fittings like elbows, tees, reducers/expanders etc.

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Instrumentation to discuss with piping and ensure that duct layout is based on the number of zones within a unit given by piping.
Cable trays on Main Pipe Racks (for trays >= 300mm)
Piping shall provide area grouping drawing (Zone drawing) as soon as they finish clubbing of area.
Instrumentation to ensure that continuous supports for duct with structural department.

- Dimensional representation of analyzer shelters and local control panels, analyzer racks/cabinets located in field.
- Local Control Panels (LCP) like Heater LCPs, Damper Control Panel, LCP for FD/ ID Fan, LCP for BMS shall be modeled as blocks based on dimensions provided in corresponding vendor drawings
- Instrument Junction boxes.
  Allocate space for mounting Instrument Junction Boxes:
  a) On every alternate column - outer face
  b) Inner face of first and then fourth column.
- Prefabricated Hook ups
- Fire & Gas detectors, Hooter , Beacon, Push Button Stations
- Closed Circuit Television for process areas
- Instrument Stanchions for field instruments like temperature / pressure / differential pressure transmitters
- Instrument air manifold
- Detectors of nucleonic level instruments
- Volume bottles for ON-OFF / Control valves

For Package units where engineering is done by vendors / other agencies, shall be modeled as box with hookup locations. Inside the box, it is vendor's responsibility to carry out the precise modeling.

5.5 In case of EIL as LSTK contractor, If vendor is unable to carry out the modeling, then EIL to take up and complete the activity if agreed as per contract.

5.6 Data Consistency Check

Modelers shall be responsible for performing a data consistency check on each pipe at completion of its respective input and shall correct all errors and or inconsistencies reported. The modelers shall ensure that:

- Adjacent items are connected
- Connection types are compatible
- Bores are consistent
- No gaps exist in the pipe and all branches are within the network
- Components are geometrically aligned
- All branch connections are made and complete
- All vessels connections are made and complete
- Minimum pipe lengths are within acceptable range.
- Elbow angles are acceptable
- While working with Intelligent P&IDs, correlation of Piping, Equipment & Instrumentation components need to be established through system integration.

Working of the other Disciplines, Refer 3D modeling workflow chart Annexure –III

6.0 DISCIPLINE INTERFACE

3D Systems shall be customized to extract all reports and deliverables (eg. General arrangement drawings for structures, electrical and instrumentation, piping GAD's, Isometrics, MTO's etc.) directly from the model so that correct and coherent information and data flows across the project.

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All the inter-discipline inputs shall be furnished in the model and validation of the data shall be through 3D model platform.

Structural department will match the location & elevations of equipment foundations with respect to the modeled equipments and resolve any discrepancy in consultation with piping. Foundation drawings will be sent to piping for information only. Any change in equipment location during detail engineering stage shall be communicated to structural department by piping. The level of the foundation top shall be finalized in consultation with General Civil in the beginning.

Piping shall number the dummy modeled local platforms for all equipment etc. A report shall be generated periodically during the execution of the job and on completion 90% model review to ensure that all platforms have been modeled by Structural.

Floor / platform penetrations shall be taken / verified from the completed piping area models and shall be modeled by structures so that these are not reported as clashes during interference checking. Minimum 75mm gap all around the pipe or 25mm all around the pipe insulation whichever is maximum shall be considered for openings on floors at penetration points. Coordination for any subsequent change shall be done by discipline initiating change after agreed interference check.

Structures while modeling secondary members and bracings shall keep the piping model in view and locate these members so as to clear piping. Resolutions to problems if any, shall be carried out in consultation with piping. Centre line of monorail for Pump maintenance shall be aligned with Pump/Motor CL and not with CL. of base plate/foundation.

All underground Piping & trenches being modeled shall be checked for interference with structural foundations.

Co-ordination with Electrical, Instrumentation, General Civil & Piping departments shall be done for cable trenches, pipe sleeves and road crossings.

Interface for utility lines for buildings i.e., Substations, SRR, MCR etc. shall be coordinated with Structural, General Civil, PED, Architecture & Piping.

Interface for LG/LT vent and drain connections shall be coordinated with Piping and Instrumentation departments

Interface for MCT cut-outs for buildings i.e., MCR, SRR, Local Control Room etc. shall be coordinated with Structural / Architecture & Instrumentation

7.0 INTERFERENCE MANAGEMENT

Modeling of all the disciplines shall progress concurrently in order to have effective interference detection. Interference checking is a progressive activity and shall depend on the modeling status of piping, equipment, cable ducts/trays & structures. The following methodology shall be adopted to check interference:

a) All disciplines to ensure clash-free design prior to extraction of deliverables from the model.
b) All lines/ for which AFC isometrics being issued shall be checked for interference by piping.
c) All under-ground lines for which the AFC isometrics (after 60% model review) are being issued by General Civil, the interface shall be checked before issuance. After the issuance of isometrics, the line shall be locked and identified by a separate color in the model.
d) All equipments being modeled shall also be checked for interference and also when these are being modified they shall be checked for interference by piping.

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e) All structures being modeled by structural department shall also undergo interference checking as and when the structures are completed and also subsequently as and when any structure is modified. This activity shall be performed by structure group.
f) Piping and structures shall coordinate to resolve interference, sitting on the terminals at the earliest as and when interference is detected.
g) At the 100% model completion stage each area shall once again be checked by all contributing disciplines for clash detection.
h) During the modeling activities, it is mandatory that all modelers attach / display the models of all disciplines for that particular zone so as to minimize clashes. Modelers can also use the clash detection facility of the 3D modeling system on regular (preferably weekly basis) for their respective zones.
i) The complete 3D model must be clash checked prior to any model review, internal review as well as review with the client.
j) The modeler is responsible for correcting any clashes that are highlighted by this utility as they occur and resolve them with the model coordinator of respective discipline.
k) In case of clash between two items modeled by different disciplines, then the resolution will be found and recorded after mutual discussion between concerned disciplines. e.g. if there is a clash between rack foundation & Electrical UG cable trench it will be discussed & resolved by General Civil, Structure and Electrical.
l) Before release of AFC drawings, all entities will be checked for clashing, reports will be generated and clashes if any will be resolved. For interface management in the packages, the model of the package vendor shall be integrated in the base model at regular intervals to avoid any clashes later.
m) The equipment layout shall be reissued before 30%, 60% & 90% client review in order to regularize the changes if any during the due course of engineering
n) The location of the fire-fighting equipment shall be reviewed by EWS-Safety

8.0 DESIGN REVIEW

The 3D model is an intelligent, to the scale and specification driven electronic replica of the plant to be constructed which is amenable to review in design office. Stage wise reviews shall be carried out with active participation by Piping, Structural, Instrumentation, Electrical, Process, Construction and Client.

Design review for a project shall be carried out in two stages.

- Internal Model Review
- Client Model Review

A. Internal Model Review

3D Model Review shall be conducted internally by individual Departments to check the model for completeness of inputs, hold identification, progress review, identification & resolution of model queries and interface with other departments. Model Coordinator shall arrange for Internal Reviews as directed by the PEM, all Engineers shall be present in the Review. Internal Model Review shall be conducted regularly (preferably on monthly basis).

Regular Inter departmental reviews are crucial to create consensus on the plant layout and avoiding future rework. Internal review of model shall be carried out regularly and at 4 significant progress milestones. The monthly Internal model reviews to coordinate engineering inputs, resolve clashes and improve model interface shall be coordinated by Piping administrator. Model coordinators and Lead engineers of all modeling departments shall be a part of these reviews, other departments can be invited on need basis.

The internal model review with wider participation shall be conducted at following project progress stages:

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Stage I (30%) - After modeling of major equipments, pipe rack, technological structures, foundations, cable trays and ducts, major lines.

Stage II (60%) - When approximately 50 to 60% piping modeling is complete.

Stage III (90%) - When 90% piping modeling is complete.

These Internal reviews shall be coordinated by Project Manager / Project Engineering Manager (PM / PEM) involving all the modeling participating departments, Process and Construction and conducted by Piping.

The review shall be carried out on the system and comments if any shall be jointly finalised and recorded so that the respective departments can update the model accordingly. Subsequent to updation of the model, a second review shall be carried out to verify the incorporation of the comments.

B. Client Model Review

Review by Client shall be done after the completion of 30%, 60% and 90% modeling by all participating departments. This activity shall be coordinated by Project Manager. All the modeling departments as well as Process and Construction (preferably RCM) shall participate in this review.

The Review shall be carried out on the system and all finalised comments originating as a result of this review shall be compiled by PM/PEM and incorporated by respective engineering discipline in the model.

After the incorporation of client comments, a further review will be performed by PM/PEM to check compliance, client participation can be at the discretion of PM.

For LSTK jobs, where EIL is the LSTK contractor, specific Client and PMC requirements shall be taken into account before finalization of the Model Review plan and sequence.

The model shall be reviewed with the client in the presence of the relevant discipline Engineers/Designers, to discuss accessibility, operability, maintainability and constructability aspects.

Model review report will be prepared listing all action points with comments and recommendations. Modifications / changes if suggested by client shall be mutually agreed. The same will be issued as MOM after the review.

Model review comment-Action close out report will be issued once all the actions are taken incorporating model review comments.

The review schedule for 3D Model shall be as follows:

FIRST MODEL REVIEW (30% REVIEW):

The objective of the first 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. Issued for Engineering (IFE) P&IDs shall be the basis of conducting 30% model review.

The model content must consist of the following items:

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- 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, etc).
- Pipe rack with moment connections, gusset plates, bracings and sleepers.
- Electrical Cable Tray & Instrumentation items that impact equipment layout, Instrument Cable duct on main pipe rack, Analyzer Shelter, Local Control Panel etc
- Technological structures with moment connections, gusset plates & bracings, main platforms, ladders and stairs.
- Roads, drains, culverts, PWB, unit/ utility blocks, dyke wall, earthen reservoir, ERC/ IRC and plot limits as applicable.
- Main fire-fighting equipment.
- Plant Boundary.
- Main header of under-ground piping (Water, Waste Water & Blowdowns). The CRWS system shall be completely modeled including Catch Basins & Manholes. The branch headers of OWS, blowdowns, cooling water, fire water and other services shall be modeled as per the available input .
- Underground trenches

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 buildings and shelters with detailing as applicable
- All Equipment with trims such as stand pipes / level gauges/transmitters etc.
- All package units (Model of 60% stage for packages to be integrated).
- All structures with fabrication stage model & supports, including Fire-Proofing.
- All platforms, ladders, stairs
- All fire fighting systems (excluding spray piping on equipment)
- All Underground Systems including funnel points. The under-ground piping model shall be completed within 4 weeks of 60% model review and all the isometrics & GAD`s shall be issued as AFC.
- Branch cable tray/trench routing & support
- Earth electrode in Test pit
- Instrument Cable duct on branch Pipe rack and Tech Structures with their supports and fire-proofing (as applicable)
- CCTV, Fire & Gas Detectors, Hooter, Beacon, Push Button Stations , Part of Instrument Junction Boxes.
- Identification of HOLD/dummy items with specific colour code.

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 model must be complete with only minor items under "HOLD".

- All small bore piping and associated instruments.
- Fire Water Spray systems on equipment's, compressors, pumps etc.
- Offline instruments
- Utility stations
- Instrumentation facilities including local operation panels

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- 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 / sleeves.
- All lighting fixtures, lighting & power panels, unit area lighting poles, high mast lighting system.
- Earth electrodes in test pit.
- All fire alarm equipments
- All PA system equipments & telephones.
- All local control stations, motor intermediate junction boxes for motor
- All Package vendor models of 90% stage to be integrated.
- MOVDBs, heat tracing DBs, junction boxes, welding receptacles, plug & sockets
- Instrument Air Manifolds
- Detectors of nucleonic level instruments and their supports
- Volume bottles for ON-OFF / Control valves

9.0 DELIVERABLES & DRAWING EXTRACTION

All reports and deliverables for various disciplines like Piping, Structures, Electrical and Instrumentation shall be extracted from the system so that correct and coherent information and data flows across the project. All deliverables listed below shall be extracted from the model and uploaded in EngDMS as per EIL numbering procedure:

Piping

a) Nozzle Orientation
b) Piping Isometrics for all lines (including small bore)
c) Piping General Arrangement Drawings
d) Support Index for Offsites, if applicable

Structure

a) Pipe rack structure drawings (Plan & Elevation)
b) Equipment Platforms, Tech Structure Drawings
c) Platform on Grade
d) Compressor House Drawings
e) Offsite Structural Facility Drawings

General Civil

a) Offsite Area Drawings
b) Unit underground piping area drawings
c) Isometrics of under-ground piping in Process Unit/ CPP
d) GAD of the Cooling water Pump Station, Fire Water Pump House, Raw Water Pump house/ Station, Drinking water pump station, SWS Pump Station
e) Overall Layouts of Cooling Water, OWS, CRWS, Blowdowns
f) Road crossings table (ERC/ IRC/ Culverts/ PWB)
g) FLM Schedule
h) MTO for piping in General Civil scope

Instrumentation

a) Instrument Duct Layout
b) Gas detector, CCTV Location Drawing
c) Junction Box Layout
d) Instrument Location Layout

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e) Air Distribution Layout

Electrical

a) Electrical Cable Layout
b) Lighting Layout
c) Earthing Layout (extraction limited to electrodes)
d) Plant Communication and Fire Alarm system layout

10.0 SYSTEM BACKUP

System backups shall be taken at two levels.

Level 1-Level 1 backup is a back up which is taken by the ITS group every week .

Level 2- Level 2 back ups are to be taken by individual administrators at their respective locations These backups shall be taken for the entire project and shall be taken on one of the local hard disk of the system. The frequency of such backups shall be decided by each coordinator depending on the criticality of the project. However, at least one backup must be taken every week preferably on Wednesday so that midweek data is available.

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Annexure – I

Scope Matrix for 3D Modeling

	Category	Design Item	Modeling Item	SCOPE of MODELING (department)				GC	Arch	REMARKS
				PIP	INST	ELEC	STR			
A/G	Piping	A/G Piping Components	All Piping Components (*)	X						(*) Except for steam trace piping, jacketed piping
			Insulation	X						
			Piping Supports including springs	X						
			Piping Specialty	X						
			Piping clips	X						
			Package Vendor's items	X						Wherever applicable
	Equipment	Reactors / Columns/ Vessel Drums	Body	X						including envelops for maintenance , drop out areas etc
			Nozzle	X						
			Skirt	X						
		Horizontal Drums	Body	X						
			Nozzle	X						
		H/Exchangers	Body	X						
			Nozzle	X						
		Air Fin Coolers	Body	X						
			Nozzle	X						
			Support structure				X			
		Tanks	Equipment Body	X						
			Nozzle	X						
		Equipment Platform	Body				X			Initial input by piping in 3D model
			Handrail				X			Vendor's engineered items , shall be modelled by vendor
			Bracket				X			
		Ladder for Equipment	All				X			Vendor's engineered items , shall be modelled by vendor
		Stair for Equipment	All				X			Tank top platform & staircase drawing shall not be extracted from model. Vendor's engineered items , shall be modelled by vendor

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	Category	Design Item	Modeling Item	SCOPE of MODELING (department)						REMARKS
				PIP	INST	ELEC	STR	GC	Arch	
		Insulation		X						extent & detailing to be debated
	Rotary	Rotating Machinery (Pumps, Blowers, Compressors, Turbines)	Body	X						Simplified Model (Outline Only)
			Nozzle	X						
			Driver	X						Simplified Model (Outline, tie-in nozzle and elect. JB)
			Auxiliary Skid such as Lube oil unit, Dry Gas Seal unit, Water Injection unit and so on	X						Simplified Model (Outline, tie-in points)
	Package	Packaged Equipment	Body	X						Simplified Model (Outline, tie-in points), as per project requirement
			Nozzle	X						
	Furnace	Furnace	Body	X						Simplified Model(Outline Only)
			Nozzle	X						
			Platform, Handrail				X			
			Ladder				X			
			Stair				X			
			Duct	X						
	Fire Fighting	Fire Fighting Equipment	Body					X		
		Fire water spray systems, Dry risers, Foam system piping, Fire ring main routing.	ALL	X						
		Hydrant / Monitors, LRM, Hose boxes, Block valve, Deluge valve manifolds, Skids for Foam System.,	ALL					X		
A/G	Civil	Paving	ALL					X		(*) Paving will be modeled as a flat slab at

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	Category	Design Item	Modeling Item	SCOPE of MODELING (department)						REMARKS
				PIP	INST	ELEC	STR	GC	Arch	
										high point level
		Road	ALL					X		
		Site Grading	ALL					X		If required
		Earth Dike & Earth Pond	ALL					X		If required
	Structure	Foundation (Pedestal)	ALL				X			
		Concrete Structure	ALL				X			
		Table Top	ALL				X			
		Pit & Pond	ALL				X			
		Retaining Wall	ALL				X			
		Spill Wall	ALL				X			
		Pipe Sleeper	ALL				X			
		Concrete Dike	ALL				X			
		Steel Pipe rack	ALL				X			
		Steel Structure	ALL				X			
		Shelters	ALL				X			
		Monorail	ALL				X			
		Platform	ALL				X			
		Walkway	ALL				X			
		Ladder	ALL				X			
		Stair	ALL				X			
		Handrail	ALL				X			
		Stanchion	ALL		X					
		T support	ALL				X			
		Cable tray / duct support	ALL				X			
		Fireproof	ALL				X			
A/G	In-Line Instruments	Pressure Instruments	ALL	X						
		Flow Instruments	ALL	X						
		Prefabricated Assemblies	ALL		X					
		Temperature Instruments	ALL	X						
		Control Valves (*)	ALL	X						actuator dimensions shall be modelled
		On-Off Valves (*)	ALL	X						
	Off-Line Instruments	Main A/G Cable Tray	300 mm and above		X					After modeling of main structure by Structural

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	Category	Design Item	Modeling Item	SCOPE of MODELING (department)						REMARKS
				PIP	INST	ELEC	STR	GC	Arch	
		Junction Box	ALL		X					
		Local Panel & Cabinet	ALL		X					
		Gas detector, CCTV	ALL		X					
		Stanchion	ALL		X					
		Inst. air Manifold	ALL		X					
		Analyzer shelter / cabinet	Outline		X					
	Electrical	A/G Cable Tray	300 mm and above			X				After modeling of main structure by Structural
		Local Control Station including supports	Outline			X				
		Lighting fixtures, control gear boxes, junction boxes, welding receptacles, flood light mast	ALL			X				
		lighting / power panels	ALL			X				
		earth electrodes	ALL			X				
		break glass units,	ALL			X				
		Outdoor field call stations , loud speakers, telephones	ALL			X				
A/G	Building	Substation & Power Station	Outline						X	Location of entrance to be identified. Simplified Model(Outline Only)
		Control Building & PIB	Outline						X	
		Laboratory	Outline						X	
		Warehouse & Storage Building	Outline						X	
		Machine & Equip. Building	Outline						X	
		Office & Clinic	Outline						X	

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	Category	Design-Item	Modeling Item	SCOPE of MODELING (department)						REMARKS
				PIP	INST	ELEC	STR	GC	Arch	
		Guard House	Outline						X	
		Fire Station	Outline						X	
		All other buildings	Outline						X	
	Others	Lay down Area(*) / Drop Down Area		X						(*)Area Marking only
		Tube Bundle Extraction Space		X						
		Escape Way		X						
U/G	Non-Pressure Piping	Oily Water Sewer/Contaminated Surface Water/ Sanitary Drain (OWS/SWS /SYS)	U/G Piping components					X		
			Catch Basin					X		
			Manhole					X		
			Valve Pit					X		
			Vent Pipe	X				X		Above ground by piping
			Drip Funnel					X		
	Pressure Piping	Closed Drain, Amine Drain etc.	U/G Piping					X		
			Pipe Trench					X		
		Fire Water/Foam line (FW / FF)	U/G Piping					X		
			Valve Pit(*)					X		(*)If any
		Other Pressured Line (CW, DW, etc)	Modeling (U/G Piping)					X		
			Valve Pit(*)					X		(*)If any
	Inst./Elec. Cables	Direct Buried Cable Trench	Outline		X	X		X		initial input by inst. Electrical in Eqpt. Layout (2D drawing)
		Concrete Cable Trench	Outline		X	X		X		initial input by inst. Electrical in Eqpt. Layout (2D drawing)
		Telecom Manhole	Outline					X		
		box culvert	Outline		X(*)	X (*)				(*) Information only
		Electrical / instrumentation Road crossing						X		initial input by inst. Electrical in Eqpt. Layout

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	Category	Design Item	Modeling Item	SCOPE of MODELING (department)						REMARKS
				PIP	INST	ELEC	STR	GC	Arch	
		Road culvert						X		initial input by inst. Electrical in Eqpt. Layout
	Concrete	Foundation	All				X			
		Concrete Pit	All				X			
		Open Ditch	All				X			
		Pile	All				X			

Legend : X Indicates Modeling responsibility

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Annexure-II

Location Priority of various items on Pipe rack column faces

Outer face of Pipe rack Column	Manhole vent	Route offset from column centerline
	Steam / condensate station	Every 30 of pipe length
		1 per 3 bays
		Can be run along u-clamp from column face
	Utility hose station	1 per 3 bays
		Can be run along u clamp from column face
	Fire Water Hydrant, Hose Box & Hose Reel	As required
	Control Valve Assemblies	Alternate column clearing manhole vents , SS & CR stations
	Instrumentation Junction Box	Every alternate column
	Stanchion	Wherever space is available
Inner faces	PA system(call station and loud speaker, fire alarm panel and telephone)	Wherever space is available
	Electrical Junction Box , lighting panel, power panel	Every alternate column
	Instrumentation Junction Box	Every first and then fourth column
	Welding spectacles, plug and socket	63A Welding spectacles - Every 50m 16A plug and socket - Every 15M
	Control Valve Assemblies	Wherever space is available
Side faces	Bracket	

Refer page 32 of 35 for drawing depicting the above mentioned location priorities.

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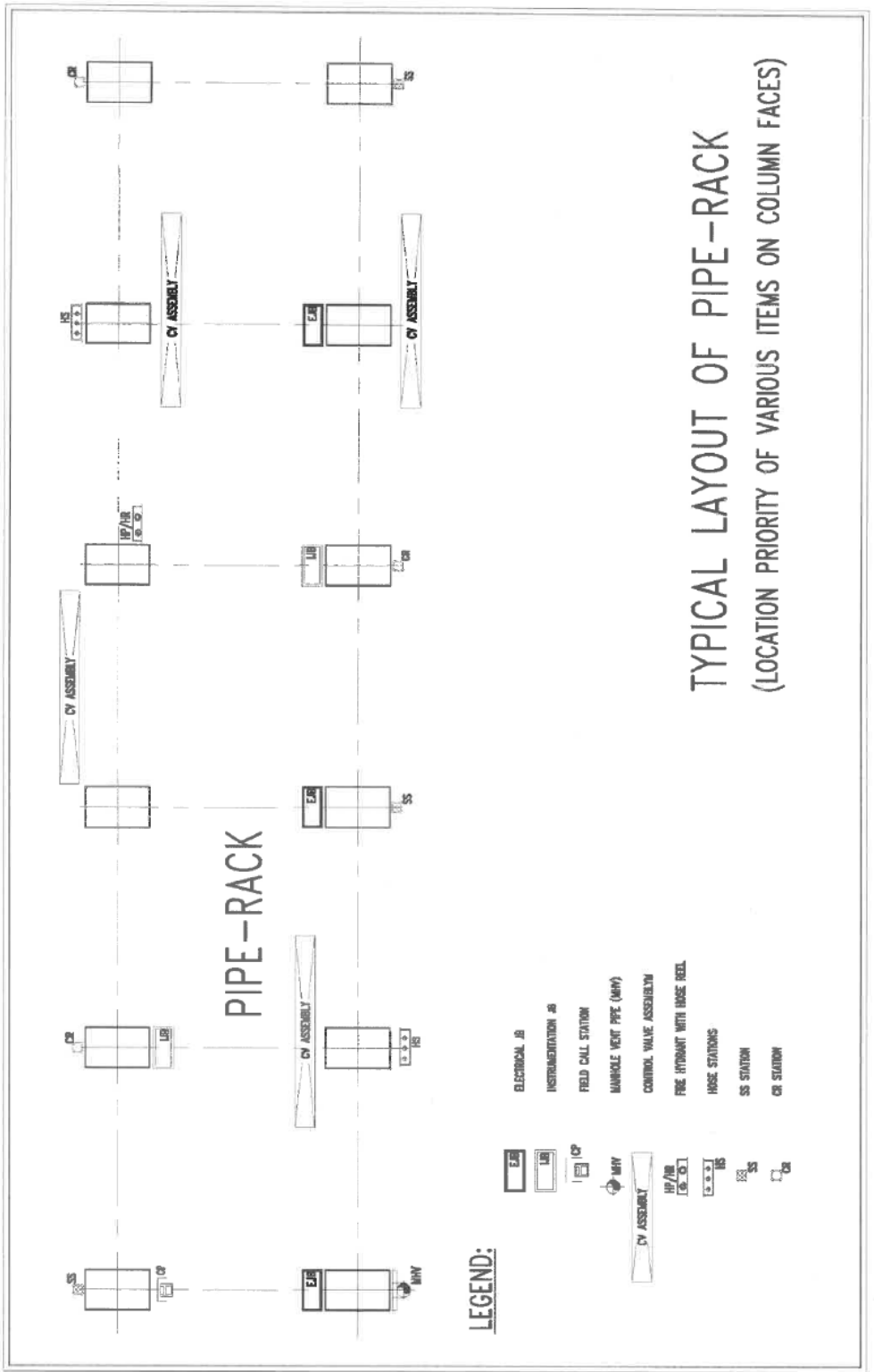

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Annexure-III

3D Modeling Workflow

Project Creation

a. Identify System for 3D modeling, integration tool as per project requirement.
b. Piping Administrator creates Project Databases

Specs and Catalogues

a. Departmental Administrators create respective Specs and catalogues

Customization and Project Specific Requirement

Plot Plan Modeling

a. General Civil to models roads, etc and Units/ Utilities are modeled as blocks. .

Equipment Layout

a. Piping
   i. Models equipment using tentative data or similar data from previous jobs,
   ii. Models indicative Pipe Rack, Tech Structure, Grids
   iii. Extracts 2D Layout for commenting and Apex Review
b. Structural Division
   i. Models U/G corridor, U/G trenches, Roads, etc
   ii. Models Pipe Rack, Tech Structures etc. based on Piping Input.
c. Electrical
   i. Provides Electrical Tray Location
d. Instrumentation
   i. Provides Instrument duct Location
   ii. Provides Analyzer Shed Location

Structure Modeling

a. Grid Marking
b. Rack Modeling
c. Tech Structure Modeling
d. Modeling of Air Cooler main beams and columns

Offsite Modeling

a. Piping
   i. Equipment Modeling of Tanks, Pump House, Flare Stack
   ii. All Above Ground Piping (to be started after Grid and Rack modeling)
   iii. Piping supports Tags only. Extract Support Index for Offsites.
b. Structural Division
   1. For Structures
   i. Grid Marking
   ii. Modeling of Rack, Pipe Bridges, Road Crossings etc
   2. General Civil
   i. Roads
   ii. Road crossings
   iii. Storm water drains, Trenches, Manholes, , Firewater network & underground water & waste water network modeling
   iv. Cooling water pump station, Raw water pump station, sanitary sewer pump station, drinking water pump station
   v. Earthen Dykes
   vi. Masonry Boundary Wall, Fencing.
c. Electrical
   i. All Offsite trays modeling
d. Instrumentation
   i. All Offsite Ducts modeling

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Unit Detail Modeling

a. Structural Division
   i. Grid Marking
   ii. Rack Modeling
   iii. Tech Structure Modeling
   iv. Modeling of Air Cooler main beams and columns

b. Piping
   i. Equipment Modeling based on Process Data sheets/ Mechanical Data Sheets / Setting Plans with equipment dimensions, nozzle sizes, ratings and projection, preferred nozzle orientation for columns, Thermowell nozzle elevations, Manhole, BTL Elevation and setting plan by Process, Final Level sketches, Tentative data (Orientation, Skid sizes, Layout, Nozzle size and rating) for pumps and compressors, Tentative size of Filters and Coalescer package items. Equipment clips and insulation shall also be modeled.
   ii. Above Ground Piping (to be started after Grid and Rack modeling). Modeling to be done based on Zone marked MTO-I P&IDs and major assemblies marked on Equipment Layout. Modeling of Piping of Vessels, Pumps, Exchangers and Air Coolers to be done directly on Model.
   iii. Extent of Vessel, Tech Structure Platforms, Equipment support location.
   iv. Physical Support modeling, clash reporting, 2D drawings for special supports, support MTO.

c. General Civil
   i. Underground Piping modeling
   ii. Underground Equipment modeling
   iii. Trenches, Catch Basins, Manholes, U/G Pits, Firewater network modeling
   iv. Extract drawings from model

d. Electrical
   i. Model all Electrical trays 300mm and above
   ii. Junction boxes, Push buttons
   iii. Light Fixtures, PCS, PA system
   iv. Electrical earthing pits
   v. Extract drawings from model

e. Instrumentation
   i. Model all instrument ducts
   ii. Model junction boxes
   iii. Stanchions
   iv. Block model of control room with Piping and cable entry points
   v. Model Instrument air lines to consumer
   vi. Check Thermowell projection for insulated lines
   vii. Extract Drawings from model

Piping-Structural Division Interface

A For Structure

a. Piping
   i. Mark extent of numbered local platforms for all equipment etc.
   ii. Generate report of platforms modeled
   iii. Equipment support location, dummy ladders, staircase etc in model
   iv. 3D Model of supports

b. Structural
   i. Pick platform, ladder, staircase, equipment support, piping support requirement from piping model
   ii. Model secondary beams, equipment support beams, insert plates, piping supporting members, platforms etc.
   iii. Extract All drawings from model

c. Joint Review & Commenting by Piping & Structure

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i. Commenting on model by assigned team before issuing AFC Drawings

B For Underground Piping

a. Piping
   i. Tentative scheme for pump U/G connection as per Standard
   ii. For Compressor Packages, Plan sub-headers outside shed area for U/G Connections. Location of Tie-in points on sub-headers as per Standard. Connection between skids and sub-header tie-in points after Vendor data.
   iii. Model all OWS, CBD, ABD points for pumps, compressors, exchangers & vessels.
   iv. Above ground piping for manhole vents.

b. General Civil
   i. Directly connect U/G piping in model to points modeled by Piping
   ii. U/G piping for manhole vent.
   iii. Extract All drawings from model

c. Joint Review & Commenting by Piping & General Civil
   i. Commenting on model by assigned team before issuing AFC Drawings

Clash Checking

MTO

a. Above Ground Piping MTO
b. Underground Piping MTO

Drawing Extraction
Refer Clause 9.0

Model Review

a. Internal Model Review
b. Client / Licensor Model Review: 30%, 60%, 90%

Model Administration

a. Zone-wise teams for various disciplines for co-ordination and control

Interface with Site

a. 3D Models should be sent to site at regular intervals
b. All 3D Model files including database to be sent to site after 90% model review (as applicable).

Reports

Interface with Software

a. IPMCS
b. Bought-out
c. EDMS
d. I-Online
e. TEKLA
f. REVIT
g. Intelligent P&ID and Electrical software.
h. Autodesk Advance Steel
i. Civil3D

Archival & Job Backup

After validation of project database is done by Piping Administrator, as-built model shall be transferred to ITS for archival.

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ATTACHMENT -1: GENERAL INSTRUCTIONS

- Vendor to follow NRL expansion Project Process Design Basis Overall (TP-1ZZZA-PR-BOD-0001) and also the legend P&IDs.
- Insulation thickness: Vendor to follow EIL insulation thickness document.
- Vendor to refer scope marked up Process P&ID.
- Vendor shall provide the interface table (Tie-in list) for all incoming / outgoing process & utility lines. This document shall contain following as minimum for each of the tie-in. Service, size, Tie-in Number, rating, flow rate, operating pressure, operating temperature, design pressure, design temperature.
- Vendor to provide operating and maintenance manual covering the start-up shut-down and troubleshooting, maintenance etc. requirements.
- For hydrogen service irrespective of rating and for other services 600# (atleast) and above, double isolation root valves and double vent & drain valves shall be considered.
- Individual Level Transmitter in close loop and trip/ safety interlock shall be hooked up with the Vessel/ column with dedicated nozzle without any standpipe. However, Level Transmitter in open loop and level gauges (single/ multiple) will be mounted on standpipe.
- Displacer type instruments shall be used for level measurement depending upon application upto and including 1524 mm in clean service and also in interface level measurement. Remote seal type Differential pressure transmitter shall be used for level measurement above 1524 mm
- For sump levels, Displacer type for level measurement upto 3m and connected with DCS. Non-contact type Radar level instrument for interlock or level measurement range greater than 3m shall be used within accuracy ±3mm.
- By default, at least 2 Nos. of level transmitter (with DCS indication) shall be considered for each vessel, column, hooper.
- Dual SOV (2oo2 with independent DO from ESD) shall be considered for the On/Off valves linked with Trip/ Emergency depressurization/ safety Interlock
- Each transmitter (PT/DPT/LT/FT) linked with closed loop control shall have redundant DCS indication for the same service with additional/ alternate transmitter.
- Vendor to provide SMART P&ID (version 11 with MS SQL database 2019, Windows server 2019/2022). Refer annexure-A to attachment-1 for typical data to be filled in the SMART P&ID database as minimum, any additional information shall be decided and finalized during KOM. Seed file shall be provided to vendor during KOM. Vendor to work on workshare environment as a satellite on client database/PBS if required.
- Vendor P&IDs shall be preferably in A1 size with adequate font size (2.5mm), spacing, and layout in accordance with industry best practices and applicable standards ISO 10628 etc. to ensure all information is clear and legible.
- Vendor to consider single/ common database for entire package.
- Line list, instrument list/ equipment list should be extracted from the SMART P&ID with filled in data as per the annexure-A.
- Dummy graphics should not be used. All graphics should be intelligent.

- Intelligent labels symbols to be placed on all items in P&ID drawing like line number, equipment tag number, instrument number etc. and placing of note label symbol at these items is not accepted. Note label to be considered to write any general text in the P&ID only.

ANNEXURE-A: TYPICAL CONTENT OF SMART PLANT DATABASE

Typical Content of Smart Plant Database

For Equipment:

#	Equipment Attribute Name	Example
A	General	
1	General Equipment Code	xxxxxx
2	Equipment Description	Vessel
3	Tag Sequence Number	XX
5	Operating Pressure	XXX kg/cm2 (g)
6	Operating Temperature	XX C
7	Design Pressure	XXX kg/cm2(g)
8	Design Temperature	XX C
9	Dimensions LxD	XXmDia XXX m T/T
10	Insulation Type	XX
11	Insulation Thickness	XX
12	Materials of Construction	XX

#	Exchangers	
1	Heat Duty	XX kW
2	Equipment Surface Area	XX m2
3	Shell Design Pressure	XX kg/cm2(g)
4	Tube Design Pressure	XX kg/cm2 (g)
5	Shell Design Temperature	XX C
6	Tube Design Temperature	XX C
7	Shell Material	304 SS
8	Tube Material	304 SS
9	Shell Operating Pressure	XX kg/cm2 (g)
10	Tube Operating Temperature	XX C
11	Trim Material	304 SS
12	Insulation Spec	

#	Filters	
1	Capacity & Delta P	
2	Differential Pressure	XX kg/cm2 (g)
3	Dimensions LxD	XXmDia XXX m T/T
4	Filter Material	xxxx
5	Trim Material	xxx

#	Pumps & compressors	
1	Capacity	nm3/hr, M3/hr
2	Suction Pressure	XX kg/cm2(g)
3	Suction Temperature	XX degC
4	Discharge Pressure	XX kg/cm(g)
5	Discharge Temperature	XX degC
6	Differential Head	XX m
7	Design Pressure	XX kg/cm(g)
8	Design Temperature	XX degC
4	Driver Power	XX kW
5	Casing Material	316 SS
6	Impeller Material	316 SS

#	Air Coolers	
1	Heat Duty	XX kW
2	Equipment Surface Area	XX m2
3	Tube Material	304 SS
4	Fin Material	304 SS
5	Insulation Spec	

For Piping, Instrument and Other Attributes

#	Piping Attributes Name	Example
1	Pipe Line Number	
2	Line Service Code	
3	Size	
4	Unit Number	
5	Line Class	XXXXXXX
6	Line Sequence Number	
7	P&ID No.	
8	Fluid Name	Steam
9	Fluid Phase	V
10	Flow regime	
11	Corrosion Allowance	3.0 mm
12	Operating Pressure	XX kg/cm2 (g)
13	Operating Temperature	XXX c
14	Design Pressure	XXkg/cm2(g)
15	Design Temperature	XX C
16	Heat Tracing (Min. Temp.) / Maintenance Temp.	XX C
18	Tracing type	
19	Insulation Code	
20	Pipe ID/ Schedule	
21	Density	
22	Viscosity	
23	Mass flowrate	
24	Linear DeltaP	
25	Velocity	
26	PWHT Requirement	
27	Remarks	

#	Piping Specialty Attribute Name	Example
1	Piping Specialty item Tag Number	xxxx
2	Description	Globe Valve
3	Nominal Diameter	
4	Sequence Number	
5	Corrosion Allowance	XX mm
6	Rating	300#
7	Heat Tracing (Min. Temp.)	75 c
8	Tracing type	
9	Opening Action	CSO
10	Insulation Code	

#	Instruments Attribute Name	Example
1	Instrument Tag Number	xxxxxx
2	Tag Sequence Number	
3	Tag Suffix	A
4	Operating Pressure	XX kg/cm2 (g)
5	Operating Temperature	XXX c
6	Design Pressure	XXkg/cm2(g)
7	Design Temperature	XX C
8	Flow	Kg/hr
9	Element Type	

TECHNICAL DOCUMENTATION FRONT SHEET

Total pages: 15

NUMALIGARH REFINERY LIMITED

NRL EXPANSION PROJECT
TECHNICAL DOCUMENT NUMBERING SPECIFICATION

Digitally signed by Medini Kumar Bora
Date: 2022.08.08 08:56:36 +05'30'

Rev	Date	Reason for Issue	Prepared	Checked	Approved	Prepared	Review	Review
P4	24/12/2021	Approved for Projects use				MKB	RG	GKB
P3	29/07/2021	Approved for Projects use				MKB	RG	GKB
P2	12/05/2021	Approved for Projects use				MKB	RG	GKB
P1	02/04/2021	Approved for Projects use				MKB	RG	GKB
A6	24/09/2020	New document type added				MKB	RG	GKB
A5	15/09/2020	New revision code added				MKB	RG	GKB
A4	30/06/2020	Fluid code revised				MKB	RG	GKB
A3	30/04/2020	Assets code revised				MKB	RG	GKB
A2	22/02/2020	Revised for new facility				MKB	RG	GKB
A1	11/09/19	Issued For Information				MKB	RG	GKB
			Disc. Eng.	Disc. Lead	Contr. Rep	Disc. Eng.	Proj. Eng	Com.Rep. Dept. Head

NRL

Contract Number

Disk Ref.

Category	Code	Description
Facility Area Code	0Z	Common Document
Document Type	SPE	Specification
System Number	00	General
Life Cycle	01	

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Originator/ Contractor	Asset Code	Disc	Document Type	Sequence Number	Revision
NR	0ZZZZ	GE	SPE	0001	P4

TECHNICAL DOCUMENT NUMBERING SPECIFICATION

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1.0 GENERAL

1.1 Purpose

The purpose of this document is to provide a standardized numbering system for NRL technical documentation.
Historical numbering system used by NRL will continue to be used for already operating facilities and any modification/revamp related to those facilities.

This document shall be applied to documentation generated for NRL starting from Expansion Project onwards.

1.2 Implementation and Responsibility

The contents of this specification shall be adhered to by NRL, Licensors, Any Contractors/Sub-Contractors and Vendors performing work for NRL. NRL Document Management Team shall be responsible for the implementation of and compliance to this document, ensuring input and communicating changes.

1.3 Coordination of Amendments

Amendments to this specification will be controlled by the document owner named on the front sheet.

The owner shall ensure that appropriate review and update processes are established to ensure that the various stakeholders are consulted and informed of changes to the Technical Document Numbering System. The owner shall assess changes to determine the extent of consultation, however as a guide, if a variation to the document numbering structure (including length of component parts) is proposed, NRL DMT and/or TA review is required. Addition of extra contractor codes or other components does not require NRL DMT/TA review.

The owner may delegate this responsibility to others if appropriate.

1.4 Using the Document

Section 1 provides instructions and guidelines as to how to manage document numbering across NRL Expansion Facilities.

Section 2 gives the basic format for the document numbering philosophy for Engineering and Vendor documents/drawings that shall apply throughout the NRL Expansion Facilities.

Section 3 provides the various codes that form the components of the document number. Please note that some codes, for example asset codes, also apply to equipment and therefore also appear in the Engineering Numbering Specification (NR-0ZZZZ-GE-SPE-0002). In order to avert the risk of differences between the Engineering Numbering Specification (ENS) and the Technical Documentation Numbering Specification (TDNS) the master coding for such codes shall be preserved within the TNDS.

Section 4 provides guidance on document revision numbering.

Section 5 provides examples of non-standard numbering.

1.5 Document number format diagrams

The diagrams in this document use the letter “A” to refer to alphanumeric characters (i.e. 0 to 9, or A to Z). The letter “N” is used to denote numeric characters only (i.e. 0 to 9). () denote provision optional additional character (if require).

1.6 Electronic document management

Where a document number is used in transmittals, document registers, electronic document management systems and other linked database systems where the document is referenced, strict rules need to be established for handling padding characters such as hyphens to ensure successful transfer and/or retrieval of information from such systems.

1.7 Document number uniqueness

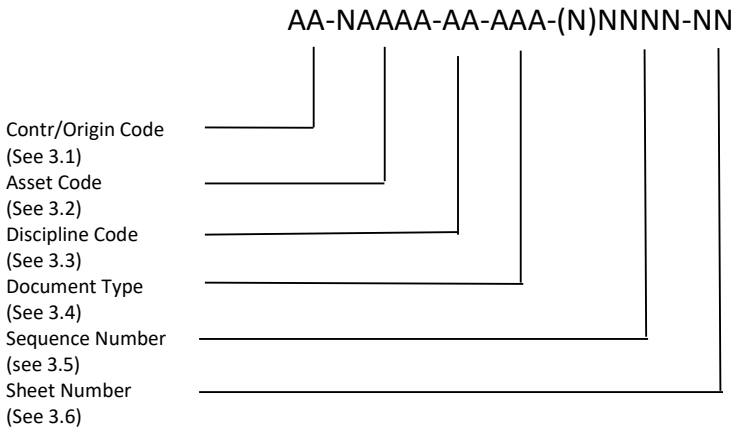
Application of the coding rules described in this document ensures uniqueness of document numbers that are shown on the front sheet and on each page of documents. When transmitted as an electronic file, the filename shall include the revision code.

2. DOCUMENT & DRAWING NUMBERING

This section describes how to number and document and what are the various character used for numbering a document.

2.1 ENGINEERING Document & Drawing Numbering Format

All Technical Documents & Drawings shall be numbered according to the following format:

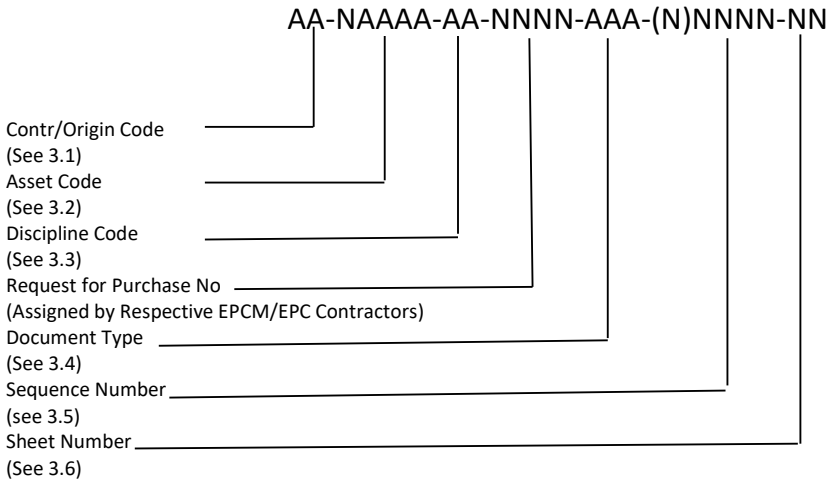


Examples for Engineering Document & Drawing Numbering

- Technical Document Numbering Specification : NR-0ZZZZ-GE-SPE-0001
- Reciprocating Pumps RFQ : TP-1U59A-ME-RFQ-0001
- Area Plot Plan MS Plant: TK-1P22A-PI-PPL-0001.01

2.2 VENDOR Document & Drawing Numbering Format

All Technical Documents & Drawings shall be numbered according to the following format:



Examples for Vendor Document Numbering

- Reciprocating Pumps RFP : TP-1U59A-ME-RFP-0001

Vendor Drawings/Documents issued for the above RFP

- TP-1U59A-ME-0001-PRC-0001 : Painting Procedure For Reciprocating Pumps
- TP-1U59A-ME-0001-PRC-0002 : Hydrotest Procedure For Reciprocating Pumps
- TP-1U59A-ME-0001-LST-0001 : List of Documents For Reciprocating Pumps
- TP-1U59A-ME-0001-GAS-0001.01 : General Arrangement Drawing for Reciprocating Pumps PA-1212 (Sheet 1)
- TP-1U59A-ME-0001-GAS-0001.02: General Arrangement Drawing for Reciprocating Pumps PA-1212 (Sheet 2)
- TP-1U59A-ME-0001-GAS-0002_01 : General Arrangement Drawing for Reciprocating Pumps PA-1213

- Centrifugal Pumps RFP :TP-1U59A-ME-RFP-0002

Vendor Drawings/Documents issued for the above RFP

- TP-1U59A-ME-0002-PRC-0001 : Painting Procedure For Centrifugal Pumps
- TP-1U59A-ME-0002-PRC-0002 : Hydrotest Procedure For Centrifugal Pumps
- TP-1U59A-ME-0002-LST-0001_ : List of Documents For Centrifugal Pumps
- TP-1U59A-ME-0002-GAS-0001.01 : General Arrangement Drawing For Centrifugal Pumps PA-1712 (Sheet 1)
- TP-1U59A-ME-0002-GAS-0001.02 : General Arrangement Drawing For Centrifugal Pumps PA-1712 (Sheet 2)
- TP-1U59A-ME-0002-GAS-0002 : General Arrangement Drawing For Centrifugal Pumps PA-1803

2.3 Multidiscipline Design Documents/Drawings

Where a Document/Drawing covers two or more disciplines or document types, then the principal Discipline/Document Type Code shall be included in the Document/ Drawing Number.

3. CODES

This section covers to list out different codes used while numbering a document.

3.1 Contractor/Originator Codes

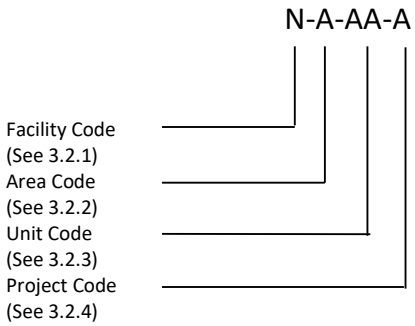
Each Contractor shall have a unique two-character code as listed below. This list will be expanded and revised for issue as new contracts are placed.

Code	Contractor/Originator Name
AX	AXENS
CV	CHEVRON (CLG)
DP	DUPONT
EL	EIL
GA	GARO
HG	HEXAGON
HT	HALDER TOPSOE (HTAS)
HW	HONEYWELL
KT	KINETIC TECHNOLOGIES
LU	LUMMUS
IP	IIP
IT	IOTL
MM	MOTT MCDONALD
MK	McKENZIE
NR	NRL
PP	PAHARPUR
PD	PDIL
PT	PLANTECH
SH	SHELL

Code	Contractor/Originator Name
SL	SNC LAVALENE
TP	TECHNIP
TK	THYSENKRUPP
TX	THERMAX
TY	TOYO
UP	UOP
VC	VCS QUALITY SERVICES PVT. LTD.

3.2 Asset code

The Asset Code is a five-character code consisting of the following:



Asset code for common facility such as common plot plan within a unit would be paired with the main unit. Eg. MS Block is consisting of 3 units (NHT, CCR & ISOM), therefore asset code of NHT (main unit) would be used for all common documents.

3.2.1 Facility Code

This code indicates storage, processing, transporting, and marketing facilities of Numaligarh Refinery.

1 Character Facility Code	Description
0	Common Facility
1	Numaligarh Refinery & Marketing Terminal
2	Crude Oil Pipeline From IOCL Paradip To NRL COT At Paradip
3	Paradip Crude Oil Terminal
4	Paradip Numaligarh Crude Pipeline
5	Numaligarh Siliguri Product Pipeline
6	Siliguri Marketing Terminal
7	NRL LPG Facilities At Dabidubi

3.2.2 Area Codes

This code indicates different functional area under one facility.

1 Character Area Code	Description
G	General
P	Process

1 Character Area Code	Description
U	Utility
S	Offsite
C	Construction
Z	Non Specific

3.2.3 Unit Code

Unit code is listed in ANNEXURE-13 of NR-0ZZZZ-GE-SPE-0002 (Engineering Tag numbering procedure).
This code indicates different units under a functional area. Non-specific unit code shall be denoted as "ZZ".

3.2.4 Project Code

Project code shall be allocated against respective project as per table below:

Project Code	Project Name
Z	Applicable to all projects
A	Numaligarh Refinery Expansion Project (NREP)
B, C, D etc..	To be allocated for future Project

3.3 Discipline Codes

The two-character discipline codes for the engineering disciplines are as listed below together with additional codes for non-engineering groups.

Code	Discipline
AR	Architectural
CG	Commissioning
CM	Construction
CN	Conditional Monitoring
CT	Subsea Connectors
CS	Control Systems (Elec/Inst/Tele)
CV	Civil
DC	Document Control
DG	Decommissioning
DI	Diving
DR	Drilling
EL	Electrical
EN	Engineering
EV	Environmental
FC	Foundations
FL	Flowlines
GE	General
GJ	GSH subsea
GS	Geo-Science
HS	Health, Safety and Environment

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Code	Discipline
HV	HVAC
HP	Plumbing
IC	Instrumentation
MA	Marine
ME	Mechanical
MS	Manifolds
AC	Accounts Payable
CC	Cost Control
CL	Contracts Management
ES	Estimating
FA	Finance & Administration
IF	Information Management
IM	Integrity Management
IP	Inspection
IS	PRISM Information Systems
IT	Information Technology
LG	Logistics/Transportation
MM	Materials Management
MP	Procurement
MT	Materials Engineering
NA	Naval architecture
OI	Installation
OP	Operations
PC	Project Control
PE	Project Engineering
PF	Performance
PI	Piping
PL	Pipelines
PM	Project Management
PN	Preservation
PQ	Procurement and Supply Chain Management
PR	Process
PS	Planning
PT	Project Services
PU	Purchasing
QA	Quality Assurance
RE	Reservoir
RL	Reliability Engineering
RS	Resource
SA	Process Safety
SC	Security
SE	Sub Sea Execution
SF	Structural Floater
SJ	Structural Jackets
SL	Common to Structural Jackets and Structural Topsides
SM	Structural Template

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Code	Discipline
SR	Geo-Technical/Geo-Physical surveys
SS	Subsea
ST	Structural Topsides
SU	Subsea Survey
SV	Sub-Surface
TA	Turnaround
TE	Telecommunications
TS	Trees
TW	Temporary works
UR	Intervention System and Tools (ROT)
WC	Weight Control
WE	Well Engineering

3.4 Document Types

The table below lists all document three letter codes acceptable for use.

Code	Document Type
ACE	Agreed Comments and Exceptions
ALL	Area Lighting Layout
ALS	Alignment Sheet
ANS	Analysis
APD	Area Protection Drawing
BDD	Buildings drawings
BLD	Block Diagram
BLP	Building Lighting and Power Layout
BOD	Basis of Design
BOM	Bill of Material
BOQ	Bill of Quantities
CAB	Cable Schedule
CAL	Calculation
CCN	Construction Change Notice
CCR	Concession Requests
CED	Cause and Effect Diagram
CEN	Cause and Effect Change Notice
CHS	Chemical Summary
CHT	Chart
CNN	Control Narrative
COD	Concrete drawings
COF	Contract/Agreement Call-Off
CRD	Crossing Drawing
CRL	Cable Rack Layout
CRT	Certificate
CSD	Construction Standard
DAA	Data
DAT	Data Sheet
DCN	Design Change Notice
DEP	Decision Paper
DFD	Ducting Flow Diagram
DFM	Define Financial Memorandum
DFS	Duct Fabrication Drawing
DID	Ducting and Instrumentation Diagram
DNP	Design Proposal

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DOS	Dossier
DQF	Data Query Form
DSB	Design Brief
DSP	Decision Support Package
DTL	Detail Drawing
DTS	Special Piping Items Datasheet
DVR	Deviation Request
ECR	Engineering Change Request
EFM	Execute Financial Memorandum
EFS	Effluent Summary
ELD	Earthing Layout Drawing
ELL	Electrical Load List/Schedule
EPC	Engine Performance Curves
EPD	Earth Test Point Drawing
EQL	Equipment Layout Drawing
ERP	Emergency Response Plan
ETD	Electrical Termination Diagram
ETP	Engineering Technical Practice
EVP	Bid Evaluation Plan
FGD	Fire and Gas Detector Layout
FLD	Functional Logic Diagram
FLE	Firefighting/Life Saving/Escape Route
FPG	Fire Protection General Arrangement
FRM	Form
FSL	Fire Siren Layout
FTR	Functional and Technical Requirements
FZC	Fire Zone Evaluations Chart
GAS	General Arrangements
GLN	Guidelines
HAD	Hazardous Area Drawing
HCA	High Consequence
HMB	Heat and Material Balance
HTR	Heat Tracing Route
HUP	Hook-up
HWW	How We Work
IDX	Index
ILD	Instrument Layout Drawing
IND	Installation Diagram
INS	Instruction
INT	Interface
ISO	Isometric
ITD	Interlock Description
ITP	Inspection Test Plan
KEY	Key Plan
LOM	Location Map
LOP	Loop Diagram
LPL	Lightning Protection Layout
LSP	Small Lighting and Power layout
LST	List
MAN	Manual
MAT	Matrix
MEM	Engineering Memorandum
MMR	Material Movement Request
MOC	Management of Change
MOD	Model
MOM	Minutes of Meeting
MOS	Method Statement
MSG	Material Selection Guide

MTO	Material Take Off
MTP	Maintenance training plan
NIT	Notice Inviting Tender
NOD	Nodal Diagram
OCL	Overall Cable Layout Drawing
OED	Overall Earthing Layout Drawing
OGM	Operating Guide Manual
OMM	Operation & Maintenance Manual
PCN	Project Change Notice
PCP	Project Coordination and Communication Procedure
PEP	Project Execution Plan
PFD	Process Flow Diagram
PHI	Philosophy
PID	Piping and Instrumentation Diagram
PKD	Piperack drawings
PLC	Policy
PLD	Piling drawings
PLN	Plan
PMS	Piping Material Specification
POR	Purchase Order
POU	Purchase Order Update (KCAD use only)
PPC	Pipeline crossing (Operations only)
PPL	Plot Plan
PQR	Purchase Order Quality Requirements
PRC	Procedure
PRD	Process Description
PRM	Process Map
PRS	Preparedness Response Scheme
PSD	Pipe Support Detail
PSL	Pipe Support Location Drawing
PUN	PID Change notice
QCP	Quality Control Plan
RAR	Roles and Responsibilities
RCF	Root Cause Failure Analysis
REC	Record
REG	Register
REP	Reports
REQ	MR for IFI – Firefighting & Safety Equipment
RFP	Purchase Requisition/ Request for Purchase
RFQ	Material Requisition/ Request for Quotation
RLS	Relief Load Summary
RSK	Risk Assessment
RTA	Recommendation to Award
RTM	Route Maps - Single pipeline route strip on mapping/imaginary
RTO	Route Overview - Large Scale Drawings of whole countries or districts
SCD	System Completion Dossier
SCH	Schedule
SCI	Electrical Schematic/ Interconnection Diagram
SCM	Schematic Diagram
SDD	Standards
SDM	Shutdown Matrix
SDR	Supplier Document Requirement Listing
SEQ	Site Engineering Query
SFB	Structural Beam Penetration
SFD	Structural Fabrication Drawing
SFP	Structural Deck Plate Penetration
SFT	Sea Fastening Drawing

SGD	Safeguarding Diagram
SGN	Safety Guidance Note
SHM	Scheme
SIN	Site Instruction
SIS	Site Survey
SKE	Sketch
SLA	Service Level Agreement
SLD	Single Line Diagram
SOG	System Operating Guidelines
SOM	Statutory Operations Manual
SOR	Statement of Requirements
SOS	Scope of Supply
SOW	Scope of Work
SPA	Structural Primary Arrangement
SPD	Structural Primary Detail
SPE	Specification
SPN	Supplier Package Change Notice
SPS	Pipelines - Special Section Drawings - Any special Area/section/seismic design drawings
SRD	Structural Reaction Diagram
SSA	Structural Secondary Arrangement
SSD	Structural Secondary Detail
SSL	Safety Sign Layout
STD	Standard Detail Drawing
STG	Strategy
STM	Pipelines - Strip Maps - Multiple Pipeline route strips o mapping/imaginary
STP	Site Technical Practice
STQ	Site Technical Query
STU	Studies
SUD	Structural drawing
TBT	Tool Box Talk
TCL	Telephone Cable Layout
TCN	Technical Change Note
TEM	Template
TEN	Technical Note
TEQ	Technical Engineering Query
TEV	Technical Bid Evaluation
TLD	Telecomms Layout
TOP	Topographical Plan
TOR	Terms of Reference
TPM	Topographic Map
TYP	Typical Pipelines Drawing
UFD	Utility Flow Diagram
UGD	Underground drawings
UTS	Utility Summary
VFD	Vendor Final Documentation
VNL	Vendor List
VOR	Variation order
WID	Wiring Diagram
WPK	Work Pack
WSE	Written Schemes of Examination
WSV	Written Scheme of Self-Verification

3.5 Sequence Number

The four-digit (with optional additional one) document Sequence Number shall restart from 0001 for each different combination of Contractor Code, Area Code, Discipline and Document Type. NRL Document Management Team shall be responsible for assigning the document Sequence Number.

In case of allocation of system number based sequence numbers, the first two digits (with optional additional one) of four-digit Sequence Number shall be selected from the system number list. The last two digit of the sequence number shall be from 00 to 99.

Service Code & System number list is mentioned in ANNEXURE-1 of NR-0ZZZZ-GE-SPE-0002 (Engineering Tag numbering procedure).

3.6 Sheet Number

The two-character sheet number is mandatory for drawings. Sheet Numbers shall be indicated in a separate box following the Sequence Number for all drawings. The Sheet Number makes the drawing unique and allows it to be issued, tracked and revised separately.

For drawings and documents containing multiple datasheets, sheet numbering shall be from 01 to 99. If sheet numbers are not required then the sheet number shall be omitted for documents, and but display as 00 for drawings.
For drawing, use sheet number as '.NN'. (dotNN)
For document, use sheet number as '-NN'. (dashNN)

3.7 Life Cycle Code

The Statement of Requirements for Engineering Information Handover to Operations describes in detail below which document types are required for operations and the level of as-building required for each document type.

Life Cycle Code	As Build Required	Description
00	Yes	Documents that are required to operate the asset and that must be maintained by operations through the assets life cycle.
01	No	Documents that are required to operate the asset and that must be maintained by operations through the assets life cycle.
02	No	Documents that are not required to operate the asset on a daily basis and do not need to be maintained by operations through the asset life cycle.

Life cycle code is applicable to document only.

4. DOCUMENT REVISION

Document number shall be accompanied by applicable revision codes. For any update new revision of document shall be issued.

4.1 Revision Codes- Engineering Drawings and Documents by MPMC/EPCM CONSULTANTS & EPC CONTRACTORS

A 2-alpha-numeric Revision Code shall be assigned to a document to distinguish multiple issues of a document. The current Revision code shall be indicated on the front sheet of the document or the drawing title block in a box following the unique document number, and also in the revision history table.

The Revision Codes shall be as follows:

A1, A2, A3, etc.	Preliminary/Review Issues
B1, B2, B3, etc.	Approved for Enquiry (Applicable for the items before completion of BEDP)
D1, D2, D3, etc.	Approved for Design, Enquiry
C1, C2, C3, etc.	Approved for Construction/Purchase
N1, N2, N3, etc.	Issued For Information

P1, P2, P3, etc.	Approved for Projects use
R1, R2, R3, etc.	Redline issue for construction/completions information transfer for as-building engineering documents.
S1, S2, S3, etc.	As-built supplier documents
Z1, Z2, Z3, etc.	As-built engineering and Supplier documents
X	Document superseded/voided at any stage

4.2 Revision Codes- Vendor Drawings and Documents

Two digit -numeric Revision Code shall be assigned to a document to distinguish multiple issues of a document. The current Revision code shall be indicated on the front sheet of the document or the drawing title block in a box following the unique document number, and also in the revision history table.

The Revision Codes Shall be as 00, 01,02……. (only Two digits allowed)

Issue Status for the vendor drawing shall be as follows and this status cannot be fixed to one particular revision. The Party who is going to submit the document shall decide to use any one of the below issue status to specify the purpose of issue.
This issue status details about the document transmission category between Vendor and Contractor/Consultant.

- Issued For Review
-Issued For Approval
- Issued For Information
- Approved for Manufacturing
- Final As-built
- Issued for Cancellation/Void

The Consultant/Contractor, after reviewing and approving the vendor drawings and documents, shall submit the same to OWNER/MPMC in the below category as applicable through the IEDDMS system with appropriate stamps.
This details about the document transmission category between Contractor/Consultant and MPMC/OWMER.

- Review
- Approval
- Information

5. EXAMPLES OF NON-STANDARD NUMBERING

Standard document numbering format described in this document might not be always applied for easy of identifying and where the document is linked to a particular tagged item. For those reference number of parent item shall be made available in the document number itself. There cannot be a general rule for this approach but standard practice shall be followed on case to case basis.

5.1 Piping isometric numbering format (example)

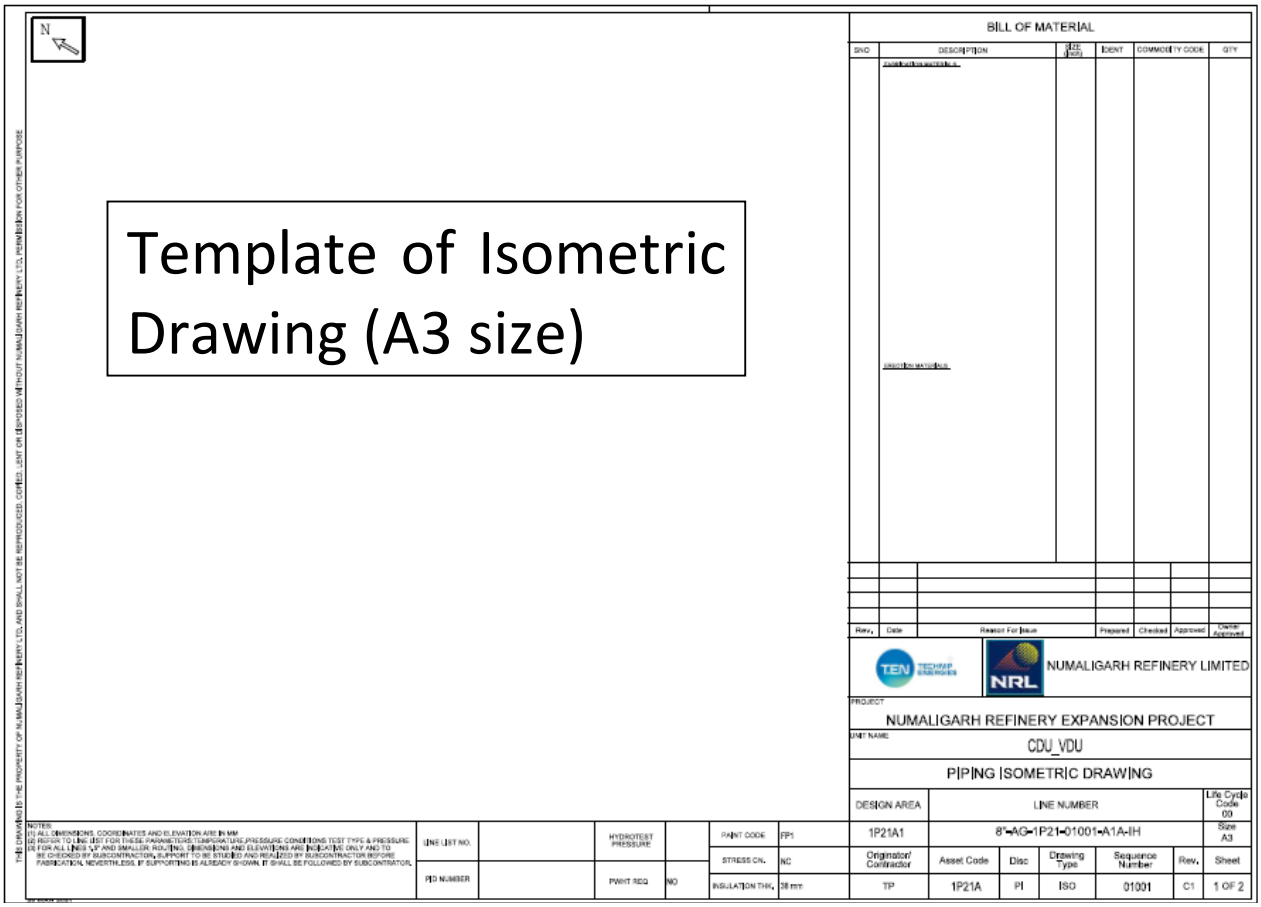
Piping Isometric shall follow same format of document numbering except the below:

- Sequence number which shall be same as the Line number (System number and sequence number - 5 digits) of the parent line as mentioned in the PID.
- Design area used in 3D tool to be added after the Sequence number.
  Suffix (A, B, etc.) for the Line number can be added when required for 3D modelling. E.g.: When a line travels from Design Area A1 to R1 and then returns to A1, the line number shall be 5 digits as in PID in Design Area A1 and R1 and suffix to be added to Line number when it re-enters Design Area A1.
  Example of Isometrics number in CDU_VDU_ATU unit:

  TP-1P21A-PI-ISO-01001-1P21A1-C1
  TP-1P21A-PI-ISO-01001-1P21R1-C1
  TP-1P21A-PI-ISO-01001A-1P21A1-C1

  TP-1P34A-PI-ISO-02001-1P21A3-C1

- Supports to be tagged as per the Support standards and no separate numbering is required for the supports.


Template of Isometric Drawing (A3 size)
BILL OF MATERIAL
NUMALIGARH REFINERY LIMITED
NUMALIGARH REFINERY EXPANSION PROJECT
CDU_VDU
PIPING ISOMETRIC DRAWING
1P21A1
8"-AG-1P21-01001-A1A-IH
1P21A
01001
1 OF 2

TECHNICAL DOCUMENTATION FRONT SHEET

NUMALIGARH REFINERY LIMITED

Total pages: 29

NRL EXPANSION PROJECT
ENGINEERING TAG NUMBERING SPECIFICATION

						Digitally signed by Medini Kumari Bora Date: 2021.04.05 14:52:40 +05'30'		
P1	05/04/2021	Approved for Projects use				MKB	RG	GKB
A4	20/10/2020	Instrument tagging philosophy revised				MKB	RG	GKB
A3	02/07/2020	Fluid code, Instrument tagging philosophy revised				MKB	RG	GKB
A2	30/04/2020	Assets code revised				MKB	RG	GKB
A1	22/02/2020	Issued For Information				MKB	RG	GKB
Rev	**Date**	**Reason for Issue**	Prepared	Checked	Approved	Prepared	Review	Review
			Disc. Eng.	Disc. Lead	Contr. Rep	Disc. Eng.	Proj. Eng	Com.Rep. Dept. Head
						NRL		
			Contract Number			Disk Ref.		

	Category	**Code**	**Description**
	Facility Area Code	0Z	Common Document
	Document Type	SPE	Specification
	System Number	00	General
	Life Cycle	01	

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Originator/ Contractor	Asset Code	Disc	Document Type	Sequence Number	Revision
NR	**0ZZZZ**	**GE**	**SPE**	**0002**	**P1**

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1. GENERAL

1.1 PURPOSE

This document details the tag numbering structure to be used when assigning project tag numbers to items of equipment and materials for Numaligarh Refinery Limited.This document also details line and cable numbering.

All vendor equipment requiring purchaser interface will be given a unique project tag number in accordance with this numbering system.

Each project shall develop work instructions for use of numbering systems and codes defined in this specification to assign unique “project tag numbers” to items in documents, drawings, databases and physical equipment labels for development of a specific facility(s).

1.2 ABBREVIATIONS,DEFINITIONS AND REFERENCE

1.2.1 Abbreviations

Abbreviation/ Acronym	Description
NRL	Numaligarh Refinery Limited
NREP	Numaligarh Refinery Expansion Project
NRPT	Numaligarh Refinery Paradeep Terminal
PNPL	Paradeep Numaligarh Crude Pipeline
NSPL	NumaligarhSiliguri Product Pipeline
SMT	Siliguri Marketing Terminal
CTDB	Central Tag Database
DCS	Distributed Control System
PIM	Project Information Manager
P&ID	Piping & Instrument Diagram
TDNS	Technical Document Numbering Specification

1.2.2 Definitions

Term	Meaning
Tag Number	Tag Number is a unique functional identifier of an asset item or software in the Facility.

1.2.3 Reference

Document Number	Document Title
NR-0ZZZZ-GE-SPE-0001	Technical Document Numbering Specification

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2. ENGINEERING EQUIPMENT NUMBERING

All equipment, instruments, cables and lines shall be uniquely tagged in accordance to this specification.

All new tags shall be unique for NREP,NRPT, PNPL,NSPL and SMT.

All issued tags shall be physically labelled in full on the equipment, instruments, cables and lines and should be visible from ground or operating platform.

All equipment Certified for use in Hazardous/non-Hazardousareas shall be allocated a Project Tag Number. This includes equipment within Sub- Contractor and / or Supplier packages.Theexception to this rule is Cable glands which are hazardous area certified but are not allocated unique tag numbers.

2.1 TAG UNIQUENESS

Tag number as a whole should be unique across each asset. Asset code makes tag unique and should be used as a part of the tag number all the times.

2.2 TAG FORMAT DIAGRAMS

Tag number consists of different parts some of which are standard across all tag diagrams and described in the sections below.

Tag diagrams contain the following characters

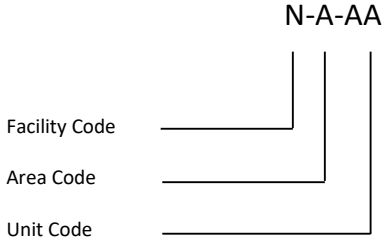
“A” – alpha numeric character(i.e. 0 to 9, or A to Z)
“N” – numeric character(i.e. 0 to 9)
“()“ - brackets denote an optional value or maximum number of characters allowed. Brackets shall not be included in the Tag Number

Hyphen symbol shown in the tag diagrams i.e. “-“ shall be used in the Tag Number. Spaces shown in the tag diagrams shall not be used in the Tag Number.

2.2.1 Asset Code

Asset code consist of Facility code, Area code, and Unit code. Asset codes are defined in Technical Document Numbering Specification NR-0ZZZZ-GE-SPE-0001. Project code is not considered for Tag Numbering. Modifications to asset codes must be controlled by revision cycle of NRL Document number.

The Asset Code is a four-character code for this document consisting of the following:



Above codes are defined in Technical Document Numbering Specification NR-0ZZZZ-GE-SPE 0001.

- Asset code for common facility such as Flare KOD,Steam Drum etc. within a unit would be paired with the main unit. Eg. MS Block is consisting of 3 units (NHT, CCR & ISOM), therefore asset code of NHT (main unit) would be used for all common facility.

2.2.2 Service Code & System number

All main units are comprising of different systems for different services.Each system has a system number and service code with function description assigned to it. The system number & service code are defined in Technical Document Numbering Specification NR-0ZZZZ-GE-SPE-0001.

2.2.3 Sequence Number

Sequence number consists of minimum two and maximum three digits, the first number in the sequence should always be (01 or 001) i.e. shall not be (00, or 000). Sequence number shall be part of the tag number and provides uniqueness in combination with system number for the same type of equipment.

2.2.4 Suffix

Suffix is a single capital alpha character from A-Z with the exception of letters I and O to avoid ambiguity with the digits.

Eg.1P21-PA-0401A and 1P21-PA-0401B

2.3 ENGINEERING EQUIPMENT TAG NUMBERING

All major items of mechanical, safety, HVAC, telecom equipment and packages equipment will need to be given a project tag number. This includes but is not limited to the majority of equipment items shown on Project and/or Supplier P&IDs.

Equipments which are part of any Package shall be numbered like other equipments of the unit. However, block of tag numbers to be allocated to the packages for their equipments.

Equipmemt Tag number shall be as per Fig 1.0 below:

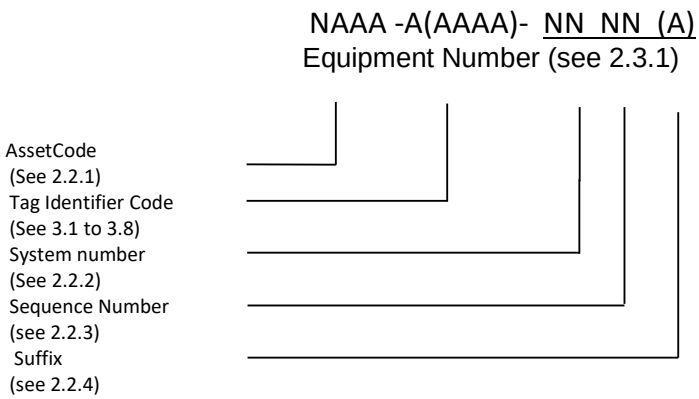


Figure 1 Engineering Equipment Tag Numbering Format

e.g.1st Crude Oil Pump Tag number in New CDU-VDU of Expansion would be 1P21-PA-0401A.

2.3.1 Equipment Number

The combination of system number and sequence number of equipment tags (figure 1.0) is called "Equipment Number". It shall be unique within each asset for the Equipment Tags numbered using 'Mechanical Equipment', or 'Electrical Equipment' Tag Identifier codes are defined in **ANNEXURE-2 to 11.**The exceptions to this rule are:

Mechanical, Electrical or Instrument equipment that is a sub-component of a larger item (e.g. Pump Motor 1P21-PM-0401 on Pump 1P21-PA-0401), which should have the same Equipment Number of the tag as the main item of equipment.

- The equipment sequence number shall be 01, 02, 03 and so on for a unit irrespective of system/service .
- In case of similar service, equipment tag number shall be numbered with suffix (A/B/C etc.). For instance, 1st Crude Oil Pumps (3 nos.) Tag number in new CDU-VDU of Expansion would be 1P21-PA-0401A, 1P21-PA-0401B and 1P21-PA-0401C.
- No equipments can have same sequence number within one system. For instance Pump, Vessel, Heat Exchanger, Column of Crude Oil system have to be numbered with different block of sequence number. For example, Crude Oil system Pump sequence to be numbered from 01 to 20, Vessel from 21 to 30, Exchanger from 31 to 50 and so on.
- 'Lifting Equipment' Tag Identifier codes may have the same equipment number as other tags numbered as 'Mechanical Equipment' or 'Electrical Equipment' as defined in **ANNEXURE-5.**

3. TAG ENGINEERING NUMBERING FORMAT

The following sub-sections describe the tag numbering formats that must be used for each equipment type. Equipment codes are listed in **ANNEXURE-1** to **11** together with the attribute requirements for each class. If a new equipment code needs to be created then is must be added to the said **ANNEXURES** using the appropriate management of change process.

3.1 MECHANICAL EQUIPMENT TAG NUMBER

Mechanical equipment must be allocated a project tag number in accordance to Figure 1.0

Mechanical Equipment tag identifier codes consist of two parts. The first alpha represents the main mechanical equipment. The second alpha can be used if needed to identify subsidiary items associated with the main equipment.

Example: 1P21-PM-0401 is a pump motor associated with pump 1P21-PA-0401.

3.1.1 Mechanical Equipment Tag Identifier Codes

Mechanical Equipment tag identifier codes are defined in **ANNEXURE-2.**

3.2 SAFETY EQUIPMENT TAG NUMBER

Fire fighting/safety equipment stations shall be given a unique project tag number in accordance to Figure 1.0. Individual fire fighting and safety equipment i.e. fire extinguishers, etc, will also require a project tag number.

3.2.1 Safety Equipment Tag Identifier Codes

Safety Equipment tag identifier codes are defined in **ANNEXURE-3.**

3.3 HVAC EQUIPMENT TAG NUMBER

All HVAC Equipment Items require a unique project tag number as per the tagging structure shown in Figure 2.0 below:

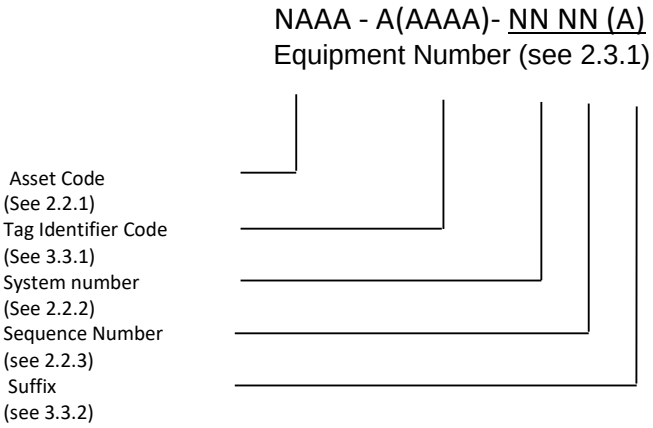


Figure 2 HVAC Equipment Tag Numbering Format

3.3.1 HVAC EquipmentTag Identifier Codes

HVAC Equipment tag identifier codes are defined in **ANNEXURE-4.**

3.3.2 HVAC Suffix

The optional suffix is used to identify HVAC equipment of the same type serving the same room e.g. 1P21-HAC-0401A and 1P21-HAC-0401B.

3.4 LIFTING EQUIPMENT TAG NUMBER

Lifting equipment must be allocated a project tag number in accordance to Figure 1.0.

All fixed mechanical handling systems (e.g. runway beams, pad-eyes,monorail etc.) require a project tag number. Portable mechanical handling equipment that is permanently located on a specific asset, such as fork lift trucks, trolleys, load slings, etc. bought by a contractor shall be assigned a unique project tag number.

Lifting gear items that are to be purchased by Operations and will be used on a temporary basis on any asset are outside the scope of this document.

3.4.1 Lifting Equipment Tag Identifier Codes

Lifting Equipment tag identifier codes are defined in **ANNEXURE-5.**

3.5 ARCHITECTURAL /CIVIL /STRUCTURAL /BUILDING EQUIPMENT TAG NUMBER

Architectural /Civil /Structural /Building Equipment that requires a tag number must be allocated a project tag number in accordance to Figure 1.0.

3.5.1 Architectural /Civil /Structural /Building Equipment Tag Identifier Codes

Architectural /Civil /Structural /Building Equipment tag identifier codes are defined in **ANNEXURE-6.**

3.6 PIPING EQUIPMENT (PIPING SPECIAL ITEMS) TAG NUMBER

All piping special items, require a unique project tag number in accordance to Figure 1.0 e.g. 1P21-BS-0401.The two digits sequence number will recommence from the beginning of the sequence (e.g. at 01) (see section 2.2.3) for each piping equipment type. This is the unique operational tag. The exception to this is that any special / off spec piping valves that do not have codes specified (e.g. non-standard / dissimilar check valves, reduced pressure zone valves, auto-drain valves) shall be assigned unique Tag Numbers in the same manner as for on spec piping valves.

The generic tag SPNNNN will be used by project for bulk materials and should be replaced by operational tag number at agreed stage of the project. The generic SP item tag can be used alongside the on spec piping valve Tag Numbers for special / off spec valves.

3.6.1 Piping Equipment Tag Identifier Codes

Piping Equipment tag identifier codes are defined in **ANNEXURE-7.**

3.7 PIPING VALVE TAG NUMBER

This tag group comprises all valves (including non-return valves) that are not instrumentation valves or equipment tagged as Piping Equipment.

The numbering format for Piping Valves is defined in Figure 3.0 below

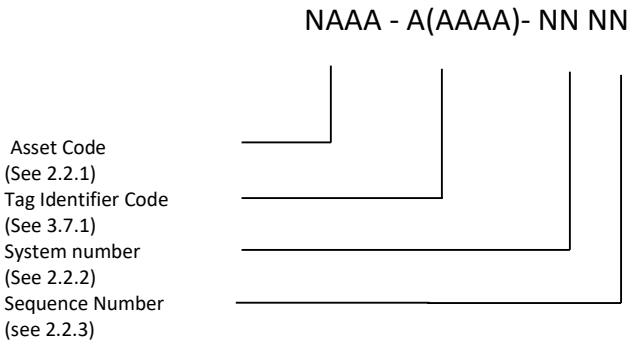


Figure 3 Piping Valves Numbering Format

Notes:

Note 1: Piping valves sequence number does not need to be related to the line number.
Note 2: Tag Identifier Code for all valves shall be used as “HV” irrespective of type of valve.

3.7.1 Piping Valve Tag Identifier Codes

Piping Valve tag identifier codes are defined in **ANNEXURE-7.**

3.8 ELECTRICAL EQUIPMENT TAG NUMBER

All major electrical equipment located inside electrical substation must be allocated a project tag number with substation number in accordance to Figure. 4.0. In order to have substation number part of all electrical equipment inside substation, below tagging procedure shall be used.

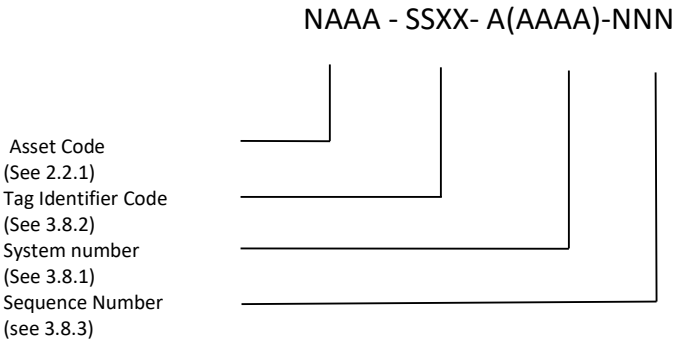


Figure 4 Electrical Equipment Tag Number inside substation numbering format

Example: 33kV GIS, 6.6kV AIS and 415V PMCC located in new CDU/VDU unit shall be 1U64-SS12-GIS-104, 1U64-SS12-AIS-203 and 1U64-SS12-PMCC-311 respectively.
6.6kV AIS and 415V PMCC located in new PFCC unit shall be 1U64-SS12-AIS-204 and 1U64-SS12-PMCC-315 respectively.
33kV GIS, 6.6kV AIS and 415V PMCC located in new RPTU unit shall be 1U64-SS14-GIS-107, 1U64-SS14-AIS-208 and 1U64-SS14-PMCC-311.

All electrical equipment located outside electrical substation must be allocated a project tag number in accordance to Figure 5.0.

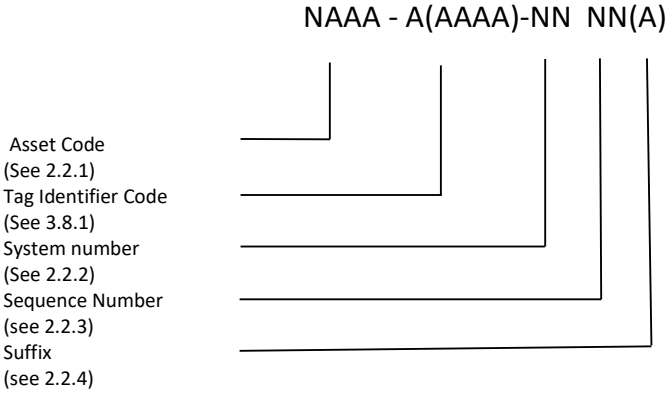


Figure 5 Electrical Equipment Tag Number outside substation numbering format

Example: LDB (Lighting Distribution board), ELDB (Emergency Lighting Distribution board), PDB (Power Distribution Board), Welding Socket (WS), Socket outlet (SO) located in field for new CDU/VDU of NREP shall be 1P21-LDB-0001, 1P21-PDB-0001, 1P21-WS-0001, 1P21-SO-0001

3.8.1 Electrical Equipment Tag Identifier Codes

Electrical Equipment tag identifier codes are defined in **ANNEXURE-8.**

3.8.2 Electrical Substation Number

As the existing NRL refinery has substation numbers till SS #09, shall start using from SS #10 for the NREP. Below substation number shall be used for the NREP.

Unit	Substation no,
DHDT	SS #10
HGU	SS #11
CDU/VDU, PFCC, GDS & LPGTU	SS #12
Utility	SS #13
RPTU & NHT/CCR/ISOM	SS #14
OFFSITES-1 (North-West)	SS #15
SRB (SRU/SWS/ARU)	SS #16
OFFSITES -2 (North-East)	SS #17
CT - (North-East)	SS #18 (Provision)
CPP – TBC	TBC
ETP	TBC

3.8.3 Electrical Equipment sequence number

Below sequence number shall be followed for the HV switchgears (33kV GIS, 6.6/11kV AIS), MV Switchgears(MV PMCC, MV MCC, MV ASB/MLDB/EMLDB, AC UPS, DC UPS, ACDB, DCDB ..etc..)

101 to 199 – 33kV GIS (Gas Insulated Switchgear) or GIS breaker panel

New main 33kV GIS @ SS #CPP or SS #09 - 101

DHDT 33kV Breaker panel - 102, 103

CDU/VDU and PFCC common 33kV GIS - 104

Utility 33kV Breaker Panel - 105, 106

RPTU & NHT/CCR/ISOM common 33kV GIS - 107

SRU 33kV Breaker panel - 108, 109

CT (North East) 33kV Breaker Panel - 110, 111

201 to 299 – 11kV or 6.6kV AIS (Air Insulated Switchgear)

DHDT 6.6kV AIS - 201

HGU 6.6kV AIS - 202

CDU/VDU 6.6kV AIS - 203

PFCC 6.6kV AIS - 204, 205

Utility 6.6kV AIS - 206, 207 (Reserve)

RPTU 6.6kV AIS - 208, 209 (Reserve)

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NHT/CCR/ISOM 6.6kV AIS	- 210, 211 (Reserve)
OFFSITES-1 (North-West) 6.6kV AIS	- 213
SRU 6.6kV AIS	- 214, 215 (Reserve)
OFFSITES -2 (North-East) 11/6.6kV AIS	- 216, 217(Reserve)
CT - (North-East) 11/6.6kV AIS	- 218, 219 (Reserve)
ETP 6.6kV AIS	- 220
CPP 6.6kV AIS	- TBC

301 to 399 – 415V MV Switchgear (415V PMCC)

DHDT 415V PMCC	- 301 to 305
HGU 415V PMCC	- 306 to 310
CDU/VDU 415V PMCC	- 311 to 315
PFCC 415V PMCC	- 316 to 320
Utility 415V PMCC	- 321 to 325
RPTU 415V PMCC	- 326 to 330
NHT/CCR/ISOM 415V PMCC	- 331 to 335
OFFSITES-1 (North-West) 415V PMCC	- 336 to 340
SRU 415V PMCC	- 341 to 345
OFFSITES -2 (North-East) 415V PMCC	- 346 to 350
CT - (North-East) 415V PMCC	- 351 to 355
ETP 415V PMCC	- 356 to 360
CPP 415V PMCC	- TBC

401 to 499 - 415V MV Switchgear (415V MCC)

DHDT 415V MCC	- 401 to 405
HGU 415V MCC	- 406 to 410
CDU/VDU 415V MCC	- 410 to 415
PFCC 415V MCC	- 416 to 425
Utility 415V MCC	- 426 to 435
RPTU 415V MCC	- 436 to 445
NHT/CCR/ISOM 415V MCC	- 446 to 455
OFFSITES-1 (North-West) 415V MCC	- 456 to 460

SRU 415V MCC	- 461 to 465
OFFSITES -2 (North-East) 415V MCC	- 466 to 470
ETP 415V MCC	- 471 to 475
CT - (North-East) 415V MCC	- 476 to 480
CPP 415V MCC	- TBC

501 to 599

Sequence number starting from 501 shall be used for all the other Auxiliary Switchboards, MLDB, EMLDB, AC UPS, DC UPS, ACDB, DCDB, lighting transformers, LDB, ELDB, PDB, etc.in each Substation.

3.8.4 Associated Electrical items for Electrical/Process Equipment

All associated electrical items to electrical / process equipment (Space heater, control stations, Instrument, etc.) require a unique project tag number as per the tagging structure shown in Figure 6.0.

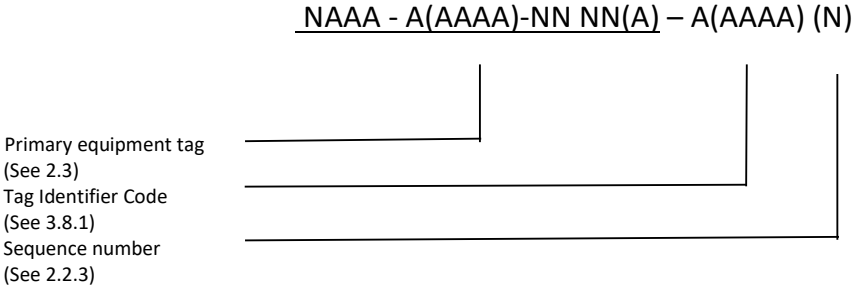

Figure 6 Associated Electrical items for Electrical/Process Equipment Numbering Format

Example: Motor Tag: 1P21-PM-0401
Motor Space heater tag: 1P21-PM-0401-SH
Local Control station tag: 1P21-PM-0401-LCS1, 1P21-PM-0401-LCS2
Motor winding temperature Tag: 1P21-PM-0401-RTD
PJB Tag: 1P21-PM-0401-PJB1
Welding Socket Junction box tag: 1P21-WS-0001-WJB1
Cable splice tag: 1U64-SS12-AIS-201-ESP1

3.9 LIGHTING AND SMALL POWER DISTRUBITION EQUIPMENT TAG NUMBER

This section applies to electrical items which are fed from a distribution board. All PESO (Petroleum and Explosives Safety Organization) certified electrical fittings e.g. lights, switches, etc within sub-contractor and/or supplier packages or modules must be allocated a project tag number.

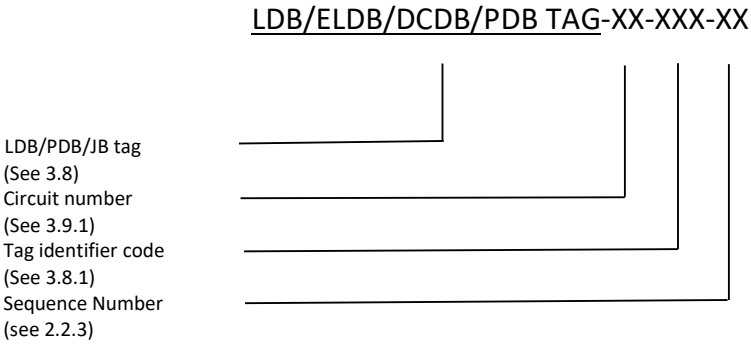

Figure 7 Lighting and small power distribution tag number format

Example: Light fixture, Intermediate junction box powered from LDB (Lighting Distribution board) and from ELDB located in field for new CDU/VDU of NREP shall be 1P21LDB0001-01-LF-01, 1P21LDB0001-01-IJB-01 and 1P21ELDB0001-01-LF-01, 1P21ELDB0001-01-IJB-01. Socket outlet powered from PDB (Power Distribution board) located in field for new CDU/VDU of NREP shall be 1P21PDB0001-01-SO-01.

Light fixture powered from LDB (Lighting Distribution board) and from ELDB located inside substation for new CDU/VDU of NREP shall be 1U64SS12LDB501-01-LF-01 and 1U64SS12ELDB501-01-LF-01. Socket outlet powered from PDB (Power Distribution board) located inside substation for new CDU/VDU of NREP shall be 1U64SS12PDB501-01-SO-01.

3.9.1 Circuit number

Circuit number is the number of the distribution board circuit from which the items are fed, circuit numbers should be two digit number assigned by design contractor's Electrical Discipline.

3.10 SWITCHBOARD CUBICLE NUMBERING

The Switchboard Cubicle number consists of the switchboard plus the cubicle number and is described in figure 8.0.

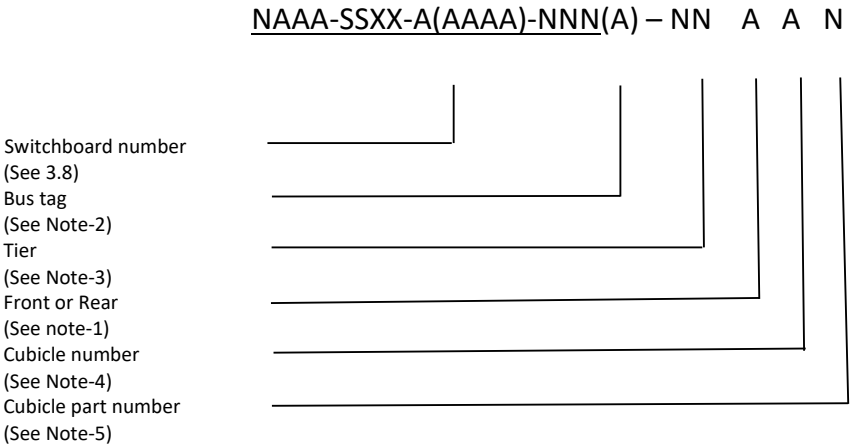

Figure 8 Switchboard Cubicle Equipment Numbering Format

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Notes:

Note 1: Bus section is a one character Alpha code.
Note 2: Tier which is a one character numerical code assigned in ascending order
Note 3: Cubicle position "F" – Front, "R" – Rear. This is optional and can be omitted if there is not a Front and Rear section for example with HV Switchboards
Note 4: Cubicle Number one character Alpha code in ascending order i.eA, B, C etc. while moving from top to bottom. The Cubicle Number is optional and can be omitted if the cubicle consists of the full tier.
Note 5: Cubicle part Number which is one numeric character in ascending order i.e. 1, 2, 3 etc. if a particular cubicle has more than one outgoing feed

3.11 INSTRUMENT TAG NUMBER AND TAG IDENTIFIER CODES

Instrument tag number and tag identifier codes are defined in **ANNEXURE-9.**

3.11.1 Additionally, following key points to be considered for the Instrumentation tag Philosophy:

For the Instrumentation Tag, there will be two types of consideration for the tagging of the Instrumentation items i.e. Equipment specific (associated with a particular equipment) and Piping/ line specific.

- **Equipment specific (associated with a particular equipment):** If the Instruments are directly mounted on the equipment or intended for the control/ indication of the process parameters of the equipment, then the Instrumentation items shall be considered as Equipment specific (associated with the particular equipment). In this case, the System Number and the Sequence number of the associated equipment shall be considered for the tagging of the instruments. In the other word all components of the control loop shall have same system and sequence number w.r.t. the associated equipment followed by it's (Instrument's) own sequence number as per Tag identifier code metioned elsewehere in this document.

- **Piping/** line specific: If the Instrument is mounted on Piping /line and not linked with any particular equipment, then the System Number of the piping to be considered. Additionally, "00" to be considered in the place of equipment Sequence number followed by it's own sequence number as per Tag identifier code metioned elsewehere in this document.

Notes:

- **Tagging of an Instrumentation loop (control/ Indication/interlock):** Primary Measuring Instruments mounted/ associated with equipment along with other FCE (Final Control Element) and related controller/ Indicator/ function block of the entire control loop shall be tagging with the same system no. and Equipment Sequence no. of the associated equipment. Also, the Instrument tag no. (excluding the asset code and tag Identifier code) of the primary Measuring Instruments shall be used for all the component of the control loop including FCE (with suffix A/B..X/Y in case of redundant Instruments, FCE or split range control) with applicable tag identifier code as per the component/ Instrument category.

e.g.

- For a level control scheme: If the tag No. of the level transmitter (Primary Instrument) is LT-1201A01, the tag of level controller, Function (calculation/ logical), control valve block will be LIC-1201A01, YLIC-1201A01 and LV-1201A01 respectively.

- For a top pressure control scheme having split range control valves (dual): If the tag No. of the pressure transmitter is PT-1201A01, then the tag of main controller, sub controller/function (spilt range) for split range valves (dual) will be PIC-1201A01, YPIC-1201A01A, YPIC-1201A01B, PV1201A01A and PV1201A01B respectively. This is irrespective of the system no. (Fluid type) of piping/ line where the valves are installed.

3.11.2 Exceptions:

- If the Primary Measuring Instrument is common for multiple equipment (not redundant equipment), then the piping/ line parameters shall be considered for tagging instead of the equipment.
- If the Primary Measuring Instrument is common for redundant equipment and associated to equipment as defined above, then the tagging philosophy shall be equipment specific. However, the suffix A/B etc. of the redundant equipment should not be considered while tagging the items of the Instrument loop being common for both the redundant equipment.
- Any secondary control loop (closed) used for a primary control loop (closed) for cascade control will be tagging with the installation location/ intended control of the secondary control loop only, not the primary one e.g. Primary control loop is level and secondary loop for cascade control is Flow: Then the primary loop will be tagging as per the parameters (System no. and Equipment no.) of the associated vessel/ column etc. and the secondary flow loop will be as per the piping parameter (System no.) of the associated piping where the FT/FV are installed/ connected.

Common examples: In line with the above philosophy, **following shall be considered as Instruments associated with equipment (Equipment specific) and accordingly the system no. and sequence no. of the associated equipment *followed by it's (Instrument's) own* sequence number as per Tag identifier code mentioned elsewhere in this document to be considered.** Primary Measuring Instruments, related Function blocks, Controllers, Indicators and Final control element of the control loops shall be tagged considering the parameters (System No, and Equipment No.) of the equipment as mentioned below (for reference).

➢ For vessel/ column/ Reactor/ Tank etc.:

- Primary Measuring Instruments mounted on the equipment (directly associated) along with related Function blocks, Controllers, Indicators and Final control element of the control loops.
- Primary Measuring Instruments mounted on the piping/ line connected to an equipment and meant for the control/ indication of the process parameters (Pressure, Temperature, Inlet/ outlet flow etc.) of the equipment and installed near to the equipment along with related Function blocks, Controllers, Indicators and Final control element of the control loops. (e.g. column pressure control PT mounted on Column overhead line etc.).

e.g.: Level Control/Temperature Control/ Top pressure control/ Inlet & outlet process parameters (Pressure, Temperature, flow, analysers etc.) installed near to the equipment/ DP Across BED or Tray/ Bed Temperature/ PSV/PRV/ N2 blanketing etc.

➢ For rotary equipment:

- Machine Monitoring System, Antisurge Controller/ spill back system, Speed Controller, Suction and discharge process parameters shall be considered as equipment specific and shall be in line with the main equipment.
- For other utilities/ sub system of the main equipment like Lube oil/ Seal oil/ Seal gas system, the respective system no. including the sequence no. of associated sub equipment shall be considered for tagging of the associated Instruments.

Note: Package Equipment/Auxiliary Skid: Individual auxiliary skid (like Lube Oil, Seal Oil etc) (sub system) which are part of main package equipment (like Compressor, Pump etc) shall follow own system and sequence number of the sub system/ sub equipment. However non-skid item like seal pot instrumentation associated with pump to be numbered as equipment specific.

- For Furnace/ Heaters/ burners: Skin temperature, Pass flows, Coil inlet/ outlet temperature/ pressure, Flame temperature, temperature monitoring and control loop of product, Pressure/ temperature/ Flow of Box/ Duct/ Stack, Instruments for inlet/ outlet air flow of duct etc.
  Note: In case of fuel to furnace/ burner loop, the related Instrument shall be tagged with the system no. of the associated piping.

- For Heat Exchanger: Instruments for inlet/ outlet parameters (temperature/ pressure).

- Others: Associated Command Switches (Start/ Stop/ ESD etc.): Should be considered as the associated Instruments of the Main equipment and sub equipment along with related System No. and Equipment Sequence No.

Tagging philosophy of Interlock function: Following format shall be considered:

Case 1: If linked with safety Instrumentation system/ ESD:
Asset code- IS-XX

Case 2: For others, (not linked with safety Instrumentation system/ ESD):
Asset code-I-XX

XX- Numerical (00 to 99) (Sequence No.) and if required, 3 digits can also be considered as per number of interlocks.

3.12 FIRE AND GAS FIELD DEVICES

The items that are used to detect fire or emissions of gas on any asset will be classified as Fire and Gas field devices. The tag format structure will be as defined in Figure 9.0.

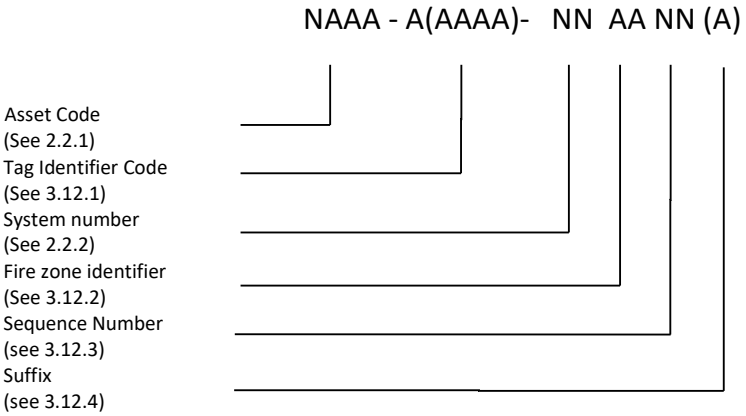


Figure 9 Fire and Gas Field Devices Engineering Numbering Format

3.12.1 Fire and Gas Field Devices Tag Identifier Codes

Fire and Gas Field Devices tag identifier codes are defined in **ANNEXURE-10.**

Where any detector has Remote status lamps fitted, such as smoke detectors where the detector is in a cabin and the remote status lamps are fitted outside the room in the corridor then these can be identified by adding the letter L to the identifier. For example: DSIL, DSOL, DHCL, etc.
All Fire and Gas physical switches shall be tagged using Instrument tag code “HS”.

3.12.2 Fire Zone Identifier

The Fire Zone Identifier is two characters code which is assigned by design contractor during design stage of the project. Fire zone register should be issued by design contractor for each asset prior to assigning Fire and Gas field devices tags.

3.12.3 Sequence number

Sequence number consists of two numeric characters and format should be as per section 2.2.4.

3.12.4 Fire and Gas Field Devices Suffix

Suffix will be used in Fire and Gas field devices to identify the functions of sight devices as following “A” will be used to identify the transmitter and “B” will be used to identify the receivers.

3.12.5 Fire and Gas Loop Number

The Fire and Gas loop number consists of full Fire and Gas Tag Identifier Code, Fire and Gas tag system number, Fire Zone Identifier and Fire and Gas tag sequence number. Any suffixes will be omitted, for Example: XA-04001A and XA-04001 Bare Fire and Gas tags on Loop XA-04001.

All devices on a single loop will have the same loop number.The combination of Fire Zone and Sequence number will be unique for any given system.

3.13 COMMUNICATIONS EQUIPMENT TAG NUMBER

All permanently installed communications equipment requires a project tag number in accordance to Figure 1.0. Internal components of equipment panels generally don’t need their own project tag numbers unless they interface with the DCS or other platform systems.

3.13.1 Communications Equipment Tag Identifier Codes

Communications Equipment tag identifier codes are defined in **ANNEXURE-11**.

3.14 COMMUNICATIONS FIELD DEVICE TAG NUMBER

Communication field devices will have different function and Tag Identifier codes from communication equipment. Communications field devices tag format structure will be as defined in Figure 10.0.

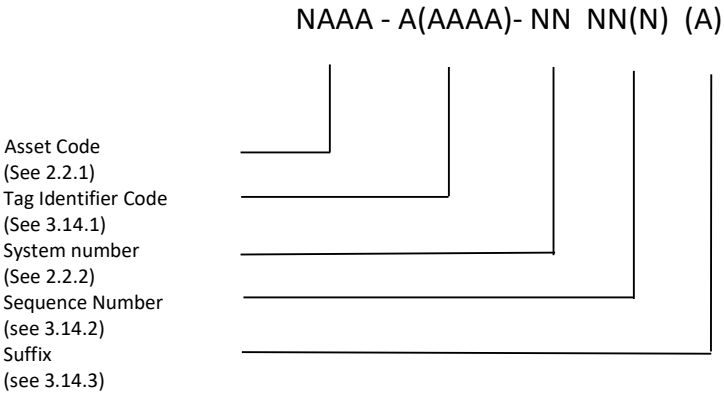


Figure 10 Communications Field Devices Engineering Numbering Format

3.14.1 Communications Field Device Tag Identifier codes

Communications Field Devices Tag Identifier codes are defined in **ANNEXURE-11.**

3.14.2 Communications Field Device Sequence Number

Sequence number consists of four numeric characters and format should be as per section 2.2.3.

3.14.3 Communications Field Device Suffix

Suffix (eg.A, B etc.) is used to identify parallel Telecom Field Devices with the same sequence number.

3.15 JUNCTION BOX NUMBERING

All PESO certified junction boxes within sub-contractor and/or supplier packages or modules must be allocated a project tag number.

All skid edge / interface junction boxes into which a purchaser's or other contractor's cable is terminated must have a project tag number.

All Junction Boxes will be numbered in accordance to this procedure and to the structure paragraphs below.

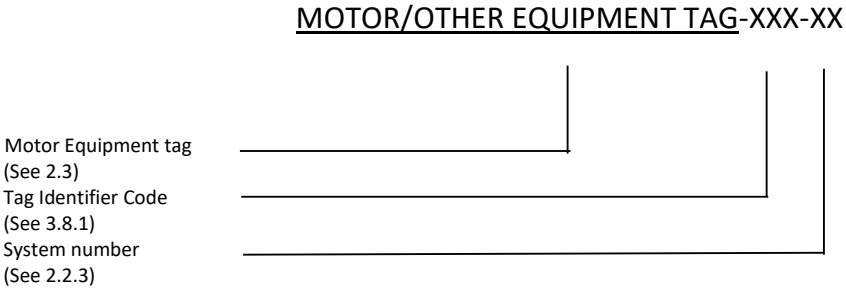


Figure 11 Heat tracing junction box tag number

Heat Tracing Junction Boxes that are fed from a Distribution Board must have a tag format as defined in Figure 12.0. Heat Tracing junction boxes that are fed from a distribution board will be given a Junction Box Number that consists of the Equipment Number of the distribution which the junction box is fed from, followed by a two digit number corresponding to the circuit number of the distribution board which junction box is fed from.

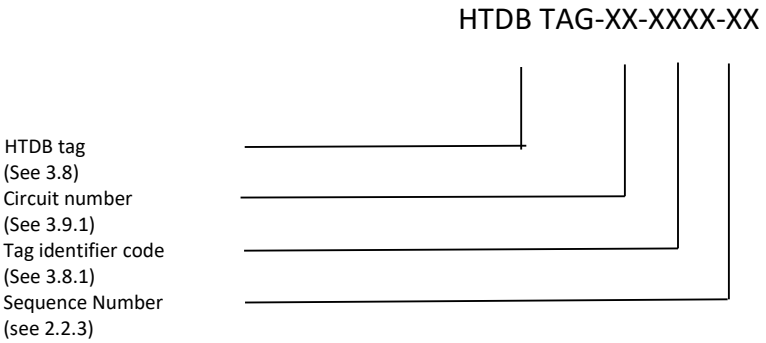


Figure 12 Heat tracing junction box tag number

Example: Heat tracing Junction box located in field in New CDU/VDU shall be 1P21-HTDB-0001-01-HTJB-01.

3.16 INSTRUMENT, FIRE & GAS AND COMMUNICATIONS EQUIPMENT JUNCTION BOX TAG NUMBER

Instrument, Fire & Gas and Communications Equipment junction boxes will follow the structure defined in Figure 13.0 below and will have assigned a three (one optional) digit unique sequence number.

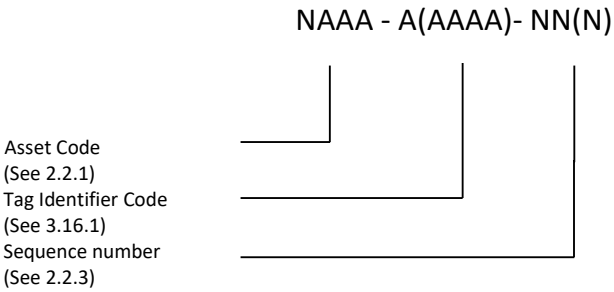


Figure 13 Instrument/Fire&Gas/Communications Equipment Junction Boxes Engineering Numbering Format

3.16.1 Instrument, Fire & Gas and Communications Equipment Junction Box Identifier Codes

Lighting, Small Power, Welding and Heat Tracing Junction Box tag identifier codes are defined in **ANNEXURE- 9,10, & 11.**

3.17 CATHODIC PROTECTION JUNCTION BOX TAG NUMBER

Cathodic protection junction box must have a tag format as defined in Figure 14.0. Sequence number for Junction box shall be two digits.

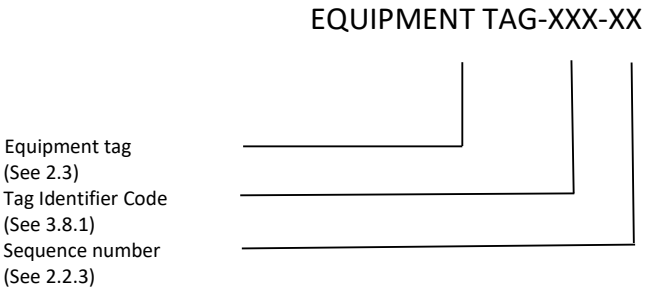


Figure 14 Cathodic protection Junction box numbering format

Example: Cathodic protection junction associated to crude tank shall be 1S71-TT-0401-CJB-01.

3.18 INSTRUMENTS AND COMMUNICATIONS FIELD DEVICES JUNCTION BOX TAG NUMBER

Instrument and Communications Field Devices Junction Boxes will follow the structure defined in Figure 15.0.

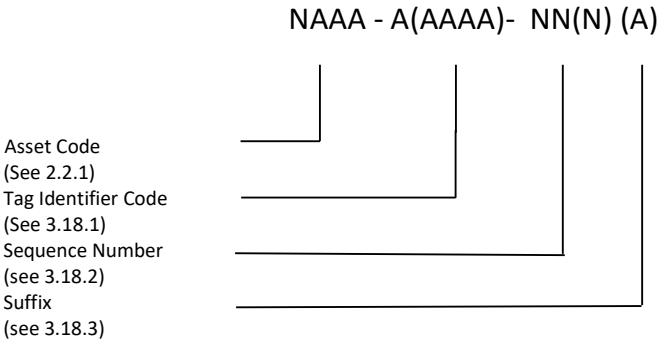


Figure 15 Instrument and Telecom Devices Junction Boxes Engineering Numbering Format

Example : 1P21-DJB-001A

3.18.1 Instruments and Communications Field Devices Junction Box Identifier codes

Instrument and Communications Field Device Junction Box tag identifier codes are defined in **ANNEXURE-9, 10 & 11**.

3.18.2 Instruments and Communications Field Devices Junction Box Number

The seven character Junction Box Number for Instruments and Communications Field Devices Junction Boxes must correspond to the System number and sequence number of the associated field device. (see sections 3.15 and 3.16).

3.18.3 Instruments and Communications Field Devices Junction Box Suffix

Suffix is optional and may be used if the associated field device is a parallel device that has a suffix in the tag number or Suffix can be used to identify parallel Local Field Device Junction Boxes.

3.19 FIRE AND GAS FIELD DEVICES JUNCTION BOXES

Fire and Gas Field Device Junction Boxes number format will be as shown in Figure 16.0 below.

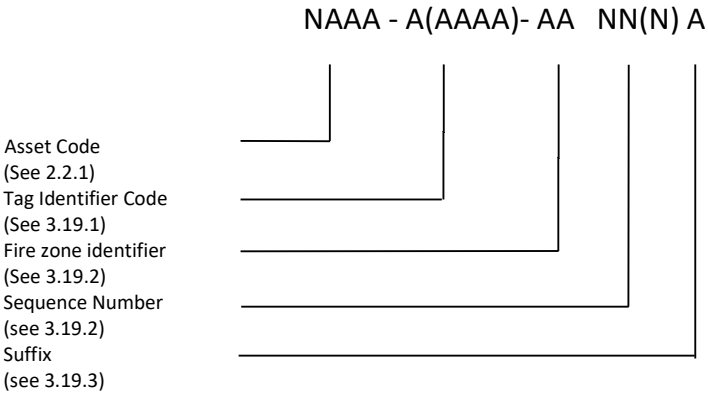


Figure 16 Fire and Gas Field Devices Junction Boxes Engineering Numbering Format

3.19.1 Fire and Gas Field Devices Junction Box Equipment Codes

Fire and Gas Device Junction Box tag identifier codes are defined in **ANNEXURE-10.**

3.19.2 Fire and Gas Field Device Junction Box Number

The Fire and Gas Field Device Junction box number shall consist of Fire Zone Identifier and Sequence Number.

Two digits Fire Zone Identifier code will be used where fire zone can be clearly identified, in cases where there are multiple fire zones “00” will be used instead.

In the case of supplier packages **NN AA N** portion of the junction box number could be numeric part of the package equipment tag number followed by two digit sequence number.

Examples:

1P21-FJB54003A DGL705403A LOS TRANSMITTER BOX
1P21-FJB54003B DGL705403B LOS RECEIVER BOX

Example of Fire and Gas Junction box on Generator package: 1P21-FJB1201A where 8012 is the numeric part of the Generator skid and 01 is the sequence number of the FJB on the skid.

3.19.3 Fire and Gas Field Device Junction Box Suffix

Suffix can be used to identify parallel Local Field Device Junction boxes with the same sequence number or when the field device is a detector / receiver.

4. CABLE ENGINEERING NUMBERING FORMAT

All the cables that connect to the tagged items that numbered in line with the project tagging specification shall have the project cable number in accordance to this specification and structured as described in this section. Instrument package cables are exception to this rule. These cables will be numbered as per the vendors numbering system after approval from NRL competent authorities.

Cables and Control wiring inside packages of the equipment which is not tagged in accordance to this specification will not require the project cable number in accordance to this specification. These cables will be numbered as per the vendors numbering system.

All cable numbers shall be unique..

Cable tag numbering format is defined in figure 17.0

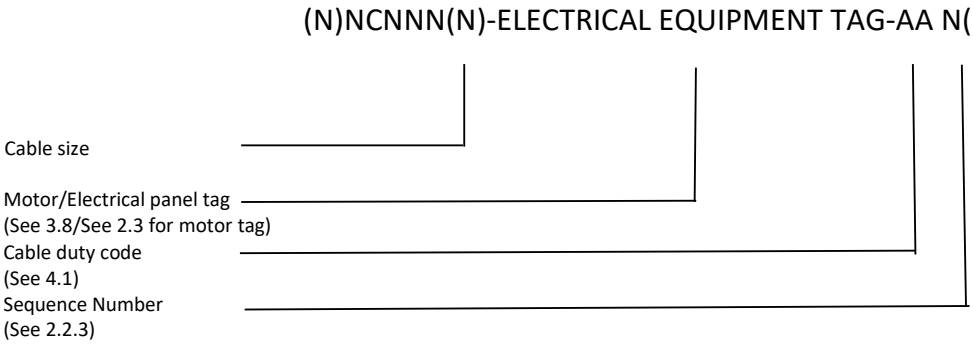


Figure 17 Cable tag numbering format

Example: : In New CDU/VDU, 1st Crude Oil Pump motor power cable tag, local control station, motor anti-condensation heater, motor temperature measurement RTD & (Interposing Relay Panel) IRP cable tag number shall be 3C120-1P21-PM-0401-P1, 7C2.5-1P21-PM-0401-LCS-C1, 3C2.5-1P21-PM-0401-SH-S1, 6T1.5-1P21-PM-0401-RTD-T1 and 3C2.5-1P21-PM-0401-IRP-C1

In New CDU/VDU, 33/6.9kV transformer 1U64-SS12-TR-203A incomer cable from 33kV GIS 1U64-SS12-GIS-104 shall be 1C500-1U64-SS12-TR-203A-R1/Y1/B1/R2/Y2/B2 for 2 runs of 1Cx500mm² per phase and 3C500-1U64-SS12-TR-203A-P1/P2 for 2 runs of 3Cx500mm².

The cable number will include the equipment tag number of which the cable is feeding (the load/instrument).

Exceptions to this rule include:

- Where a cable feeds a switchboard incomer (from generator or transformer). In this case the source equipment tag is used instead.
- For interconnect cables between switchboards, the smaller board (Board of lower voltage rating) will be taken as the load.
- For control and instrument cables between switchboards or unit control panels (UCPs) and DCS marshalling cabinets, the switchboard or UCP will be the end device / instrument (load).
- For cables between Switchboard & GEP/GCPP/IRP/ECS, corresponding load tag for which cable is intended will be considered as electrical equipment tag. [(N)NCNNN(N)-ELECTRICAL EQUIPMENT TAG - XXXXX - AA N(N)]
  [Cable Size – Electrical Equipment Tag – Equipment Naming – Cable Duty Code – Sequence Number]. **Example:** Control cable from 1U64-SS11-MCC-501 to IRP Cabinet for consumer 1P21-PM-0401A will have tag as 3C2.5- 1P21-PM-0401A-**IRP**-C1.

4.1 CABLE DUTY CODE

Cable Duty Codes are defined in **ANNEXURE-12.**

4.2 DIRECT ELECTRICAL HEATING CABLE NUMBER

Cable tag numbering format for direct heating of lines is defined in the figure 18.0 below.

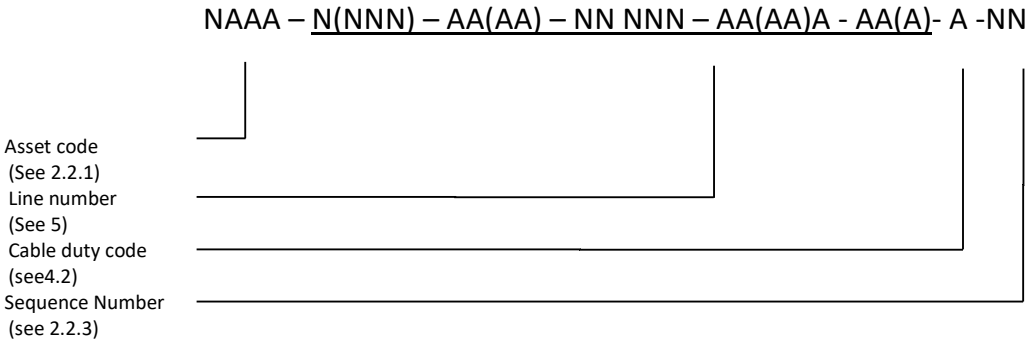


Figure 18 Direct Electrical Heating Cables Engineering Numbering Format

4.3 HEAT TRACING TAPE CABLE NUMBER

Tag numbering format for heat tracing tapes is defined in the figure 19.0.

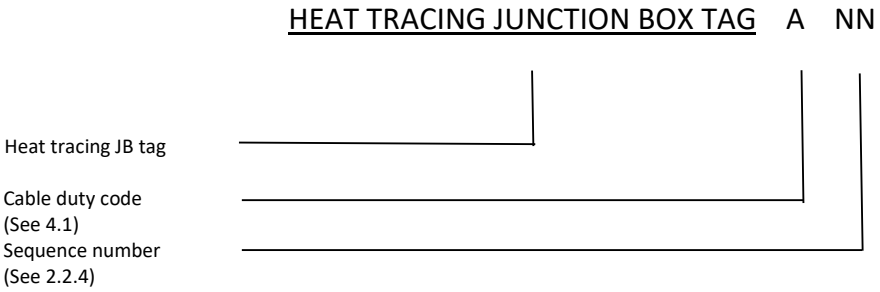


Figure 19 Heat Tracing Tape Engineering Numbering Format

4.3.1 Junction Box Number

The Junction Box number consists of the junction box tag number from which the heat tracing tape is fed.

4.4 EARTHING CABLE EXAMPLES

Figure 20.0 below provides examples of how earthing cables should be tagged. The tagging of supplementary bonding is not required.

Page 2769 of 5436 : C050-TENDER DOC-C050-1U68-81-45-PB-T-8010 : Rev. A

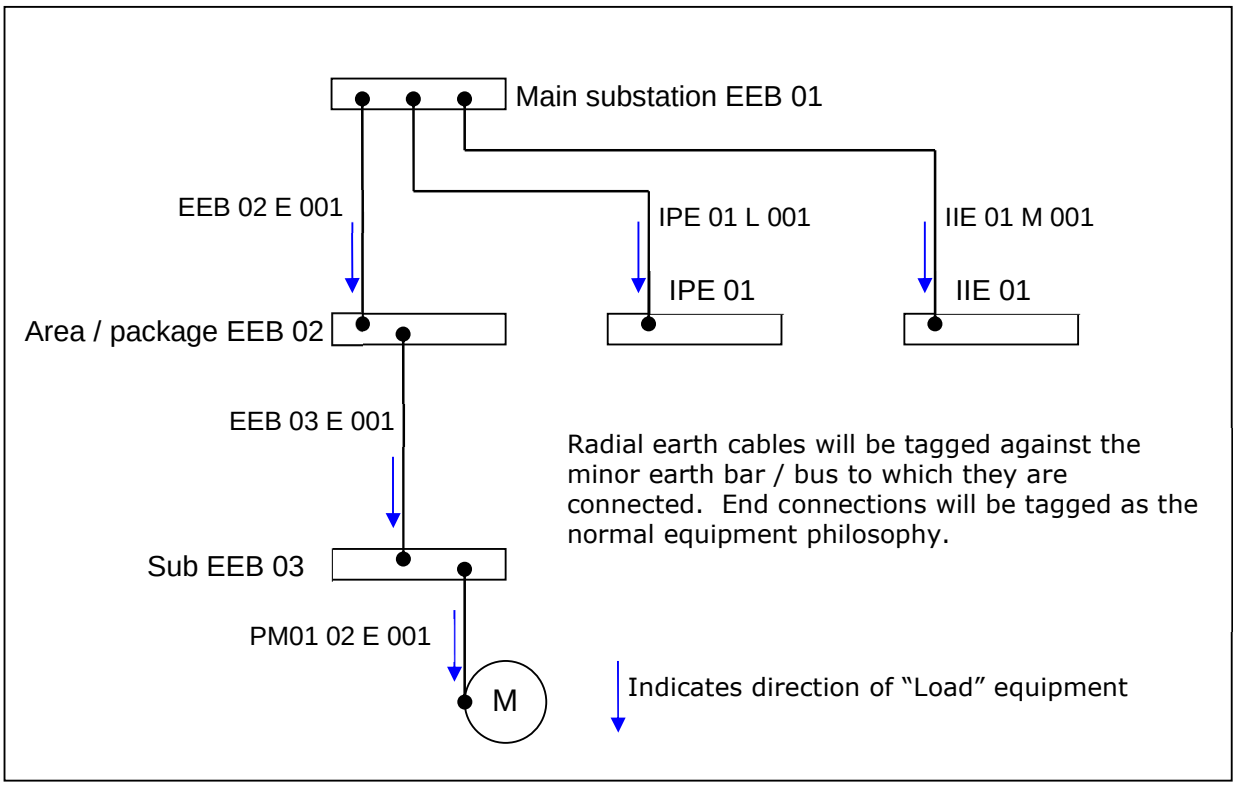


Figure 20 Radial Earth Connections

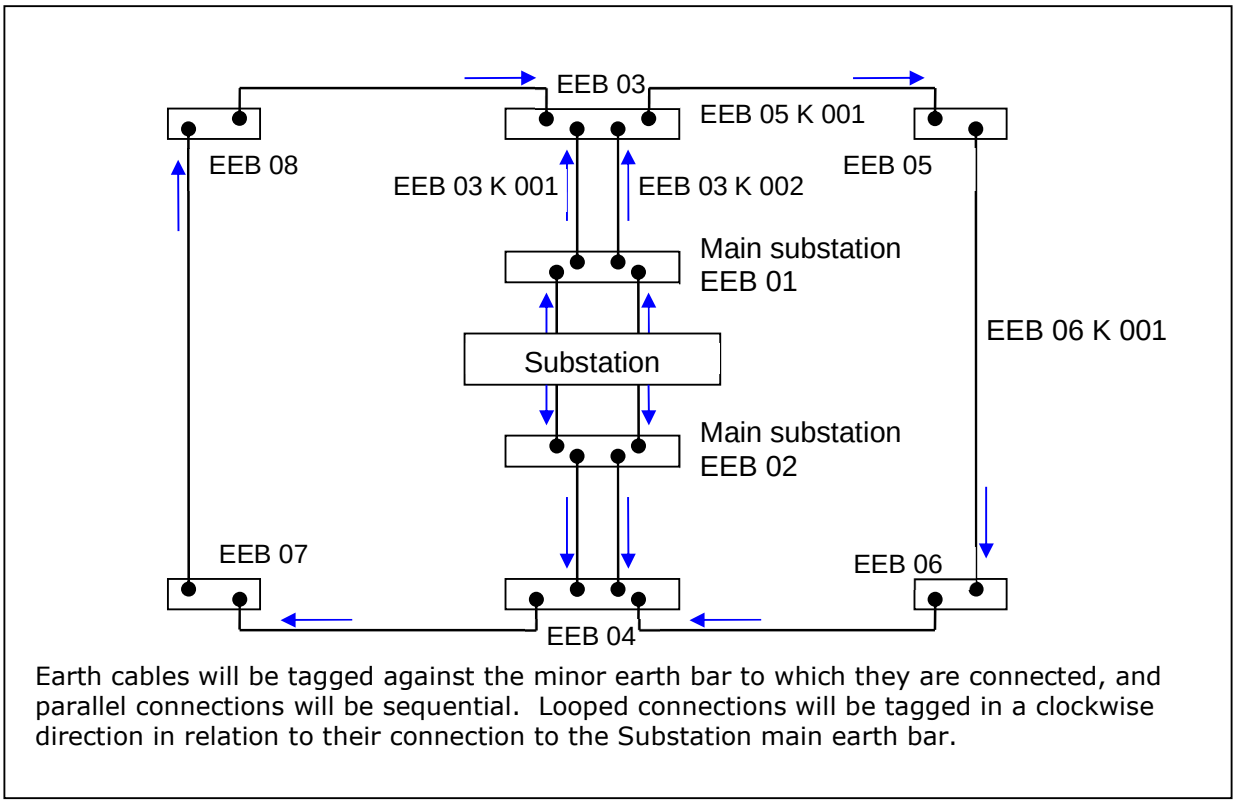


Figure 21 Ring / Looped Earth Connections

5. LINES ENGINEERING NUMBERING FORMAT

All lines within supplier process packages (e.g. RGC) shall have a project tag number (line number).

All lines within supplier machinery packages that connect directly to a unit line shall be identified via a skid tie-in Point (TP1, TP2, etc.).

All lines will be numbered in accordance with this specification. Each line will have a line number which will be shown on project drawings i.e. Piping and Instrumentation Drawings which will start with nominal bore size in inches and will follow structure defined in Figure 22.0.

The combination of system number, facility code and sequence number will define uniqueness i.e. no two lines can have the same number combination if they have different service codes.

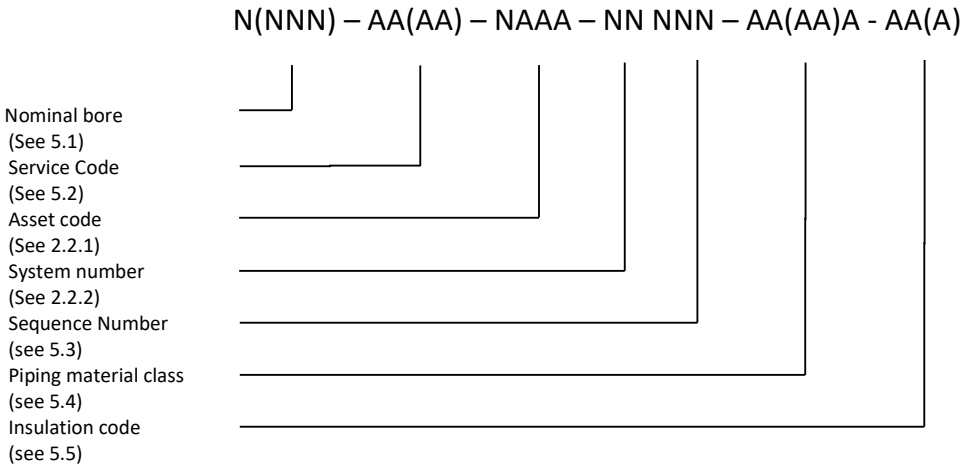


Figure 22 Lines Engineering Numbering Format

e.g.1st Plant Air line (4") in Crude Storage Unit of COT at Paradip would be numbered as 4"-PA-3U21-59001-A01E-NI.

5.1 LINE NOMINAL SIZE

Pipe nominal bore is in inches, sizes below 1" are represented as, for example 3/4", and not 0.75". Note that this can result in 11/2" using up 3 characters.

5.2 LINE SERVICE CODES

The Line Service codes are defined in **ANNEXURE-1.**

5.3 LINE SEQUENCE NUMBER

Sequence number consists of three (03) numeric characters and format should be as per section 2.2.3.

5.4 LINE PIPE MATERIAL CLASS

Line Pipe Material Class will be defined in the Piping Material Specification (PMS) of NRL's project document (**NR-0ZZZZ-PI-SPE-0001**).

5.5 LINE INSULATION CODES

The Line Insulation codes are defined in **ANNEXURE-1.**

6. Design Area Number shall be composed of 6 digits as follow:

The Below naming philosophy for the Design areas, shall be used for splitting each asset/area geographically.

NAAAAN(N) where
NAAA is the Asset Code (Primary asset code to be used for Design area. For instance, ATU unit inside CDUVDU unit will bear the asset code of CDUVDU unit)
A is the sub facility inside the asset where
R - for Piperack
C- for the Platform (PSV/other Valve stations/piping supported on the platform) above the respective Piperack
W - for Pipeway/Sleeper
A - for Area
U - for UG
N(N) is the sequence number starting from 1 for each sub facility

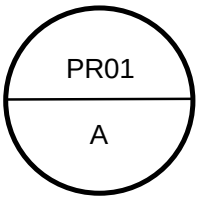
Example : In CDUVDU unit, the Design areas will be named as:
1P21A1
1P21A2…
1P21R1 and PSV Platform will be 1P21C1
1P21R2 and PSV Platform will be 1P21C2
1P21U1
1P21U2…

7. Grid numbering :

a) Grid numbering to be made Structure wise for each structure in an asset. Example in CDU VDU unit, a Piperack will be named as 1P21-PR-0001, 1P21-PR-0002 and a Technical Structure will be named as 1P21-ST-0001, 1P21-ST-0002.

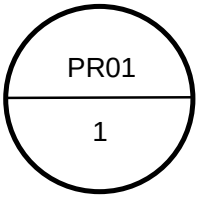
b) The Structure Tag Code as per Annexure 6 to be added on the Top portion of the Grid name along with the sequence number. (System number will always be 00 for the Civil tag items as they cannot be linked with the System Code)

c) On North-to-South axis, grid shall be numbered with letters:
- Starting from A on the most southern point.
- Then following alphabetic order while going North.
- Letter O and I shall not be used.
- If a new grid needs to be added between A and B, its name shall be A1.



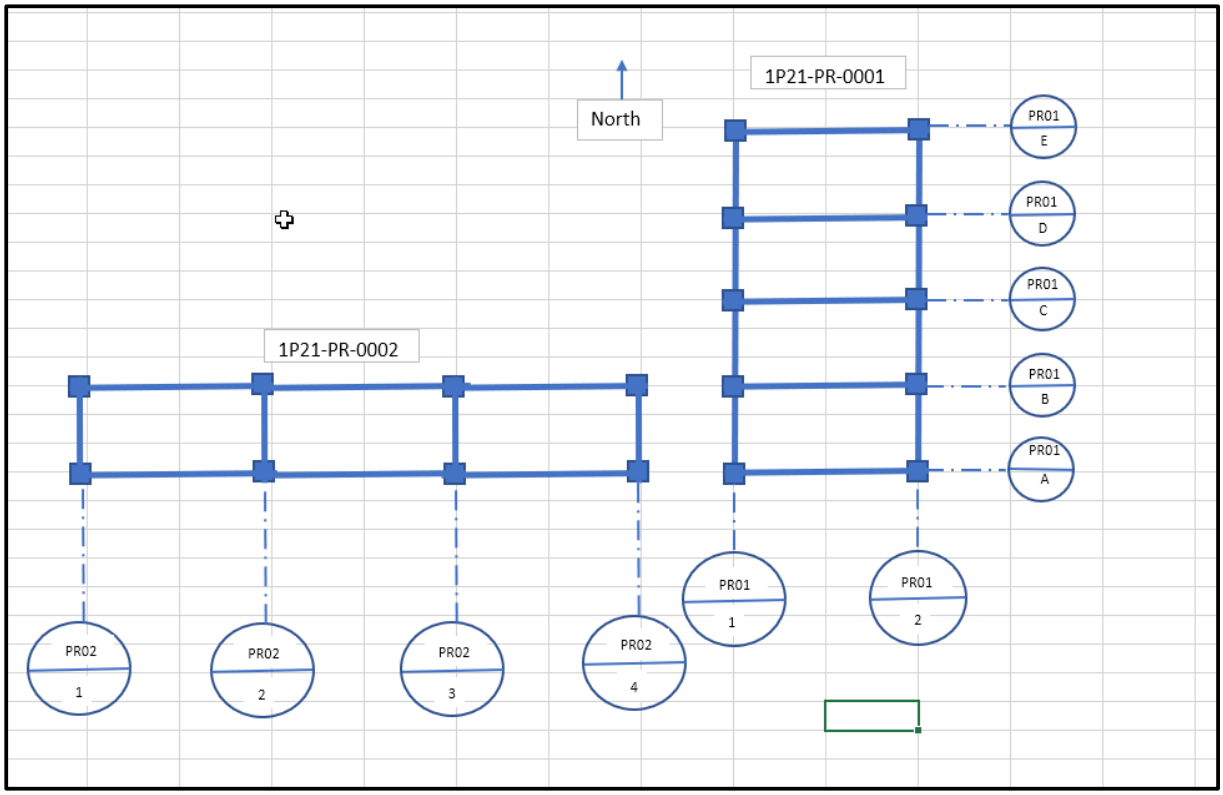
d) On West-to-East axis, grid shall be numbered with numbers:
- Starting from 1 on the most western point.

- Then following numerical order while going East.
- If a new grid needs to be added between 2 and 3, its name shall be 2A.



e) For Sleepers, Tag code PW to be added in the Tag numbering philosophy and the above points to be followed.

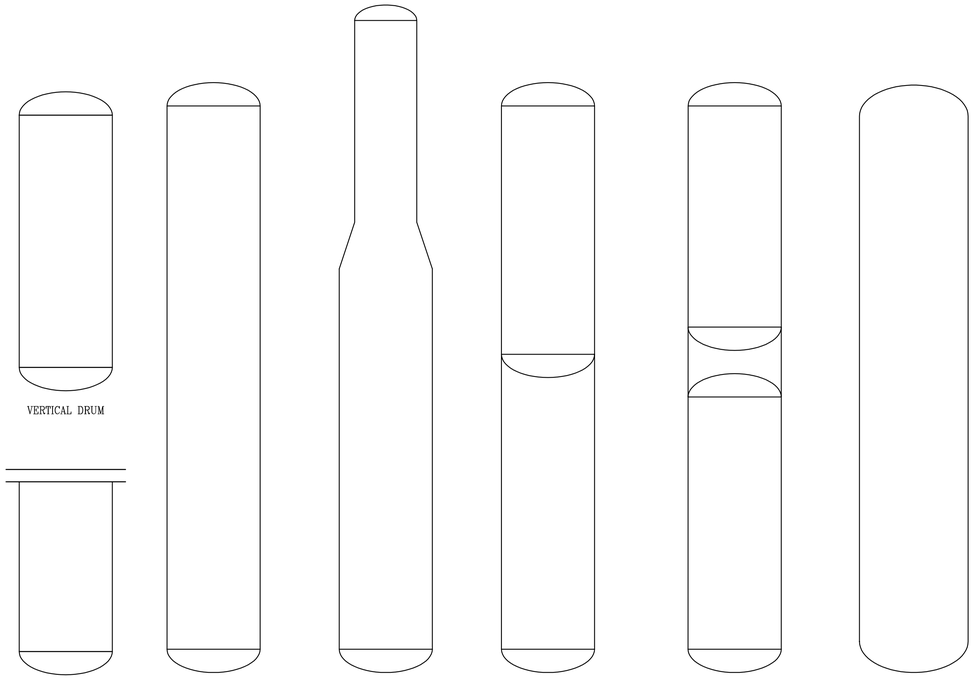
Example :



8 REFERENCE DOCUMENTS: LIST OF ANNEXURES

ANNEXURE-1	List of Service Code, System numbe& Insulation Coder
ANNEXURE-2	List of Tag Code for Mechanical Equipment
ANNEXURE-3	List of Tag Code for Safety Equipment
ANNEXURE-4	List of Tag Code for HVAC Equipment
ANNEXURE-5	List of Tag Code for Lifting Equipment
ANNEXURE-6	List of Tag Code for Architectural/Civil /Structural /Building
ANNEXURE-7	List of Tag Code for Piping Equipment
ANNEXURE-8	List of Tag Code for Electrical Equipment
ANNEXURE-9	List of Tag Code for Instrument Tag
ANNEXURE-10	List of Tag Code for Fire and Gas Field Device
ANNEXURE-11	List of Tag Code for Telecom Equipment
ANNEXURE-12	List of Cable Duty Code
ANNEXURE-13	List of Asset/Location Codes

VERTICAL VESSELS & REACTOR



VERTICAL DRUM

VERTICAL DRUM WITH FLAT FLANGE

COLUMN

COLUMN (SINGLE SWAGE)

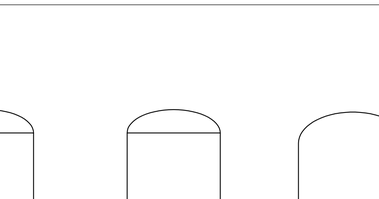
COLUMN STACKED (INTERNAL COMMON HEAD)

COLUMN STACKED (INTERNAL SEPARATE HEADS)

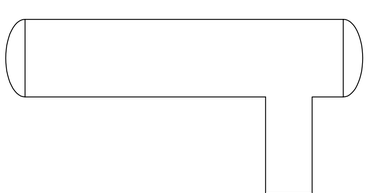
REACTOR

HORIZONTAL VESSELS

HORIZONTAL VESSEL (TYPICAL)

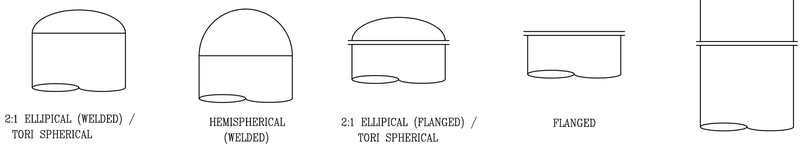


DRUM WITH GAS SEPARATION SECTION



HORIZONTAL VESSEL WITH BOOT (DROP LEG) (TYPICAL)

VESSEL HEAD TYPES



2:1 ELLIPICAL (WELDED) / TORI SPHERICAL

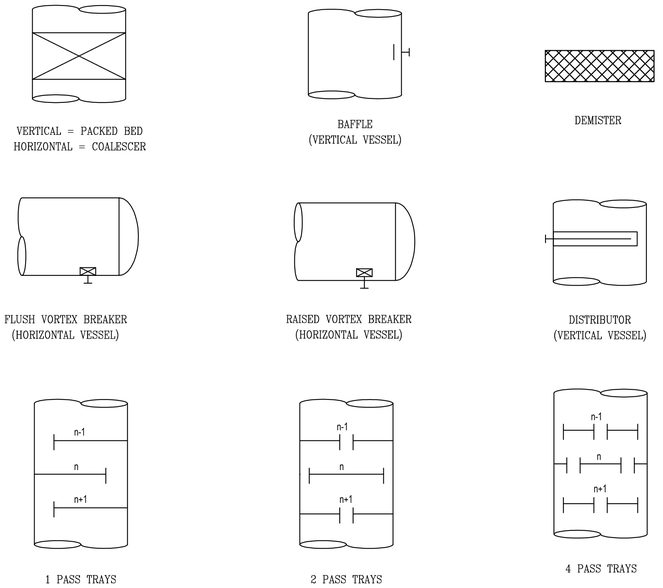
HEMISPHERICAL (WELDED)

2:1 ELLIPICAL (FLANGED) / TORI SPHERICAL

FLANGED

INTERMEDIATE BODY FLANGE

VESSEL INTERNALS



VERTICAL = PACKED BED
HORIZONTAL = COALESCER

BAFFLE (VERTICAL VESSEL)

DEMISTER

FLUSH VORTEX BREAKER (HORIZONTAL VESSEL)

RAISED VORTEX BREAKER (HORIZONTAL VESSEL)

DISTRIBUTOR (VERTICAL VESSEL)

1 PASS TRAYS

2 PASS TRAYS

4 PASS TRAYS

FLUSH VORTEX BREAKER (VERTICAL VESSEL)

BAFFLE (HORIZONTAL VESSEL)

GENERIC TRAY

CHIMNEY TRAY WITH CENTER DRAW

CHIMNEY TRAY

HOLD DOWN GRID/PACKING SUPPORT

SPRAY DISTRIBUTOR

BOTTOM SUMP WITH PARTITION PLATE

BOTTOM SUMP WITH OVERFLOW BAFFLE

DRAW OFF SUMP / SEAL PAN

NOTES:

HOLD:

LEGENDS:

REFERENCE DOCUMENTS

DOC NO	DOC TITLE	REV.

Rev.	Date	Reason for Issue	Prepared	Checked	Approved	Owner Approved
C1	21/12/2022	APPROVED FOR CONSTRUCTION	BSG	SCB	SCB	
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A2	26/10/2020	ISSUED FOR REVIEW	RSA / SS	RK	SCB	
A1	27/08/2020	ISSUE FOR REVIEW	RSA / SS	RK	SCB	

TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020

TP Document NO.: 082176C-ZZZ-PID-0090-0001-01

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE - EQUIPMENTS - 1

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0001.01	C1	01 OF 03

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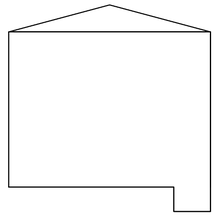
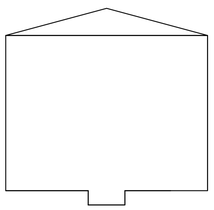
STORAGE TANKS

CLOSED ROOF TANK



TANK WITH SUMP



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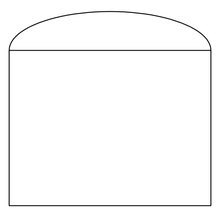
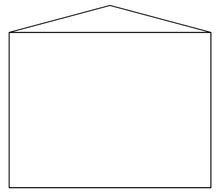
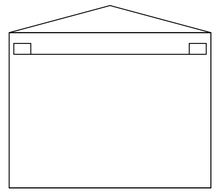


DOME ROOF TANK



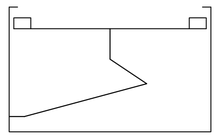
CONE ROOF TANK

SPHERE



CONE ROOF TANK WITH
INTERNAL FLOATING ROOF

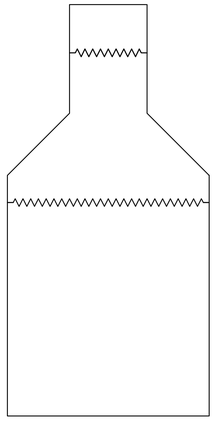
MOUNDED BULLET



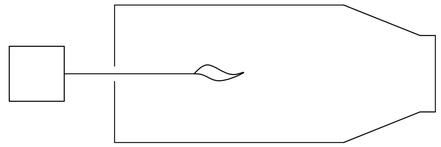
FLOATING ROOF TANK

OPEN TOP TANK

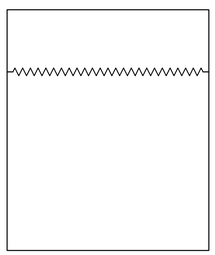
HEAT TRANSFER



FURNACE WITH RADIANT
AND CONVECTION SECTION

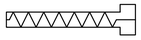


INCINERATOR



FURNACE WITH
RADIANT SECTION

GAS BURNER

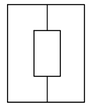


ELECTRIC BAYONET HEATER

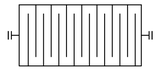
FILTERS, MIXER

FILTER

CARTRIDGE FILTER



MIXER



NOZZLE & MANHOLE

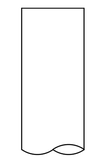
PIPE NOZZLE

INST. NOZZLE

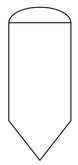
CLEAN OUT DOOR

MISCELLANEOUS

STACK



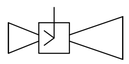
HOPPER



EJECTOR

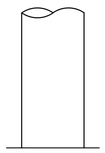
AGITATOR

DESUPERHEATER



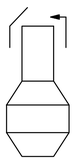
SOOT BLOWER

EDUCTOR



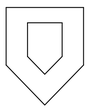
FLUIDIC SEAL FLARE

MOLECULAR SEAL FLARE

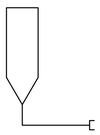


CYCLONE
(SOLID / GAS)

CYCLONE SEPARATOR
(SOLID / LIQUID)



FOAM INJECTION



NOTES:

HOLD:

LEGENDS:

REFERENCE DOCUMENTS

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D2	11/03/2021	APPROVED FOR DESIGN	MNSP/SG	RK	SCB	
D1	23/03/2021	APPROVED FOR DESIGN	BSG	RK	SCB	
A2	26/10/2020	ISSUED FOR REVIEW	RSA / SS	RK	SCB	
A1	27/08/2020	ISSUE FOR REVIEW	RSA / SS	RK	SCB	

TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020

TP Document NO.: 082176C-ZZZ-PID-0090-0001-02

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE -
EQUIPMENTS - 2

Scale: NTS

Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0001.02	C1	02 OF 03

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PUMPS

CENTRIFUGAL PUMP

CENTRIFUGAL SUMP PUMP

PROPORTIONING PUMP

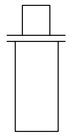
VACUUM PUMP

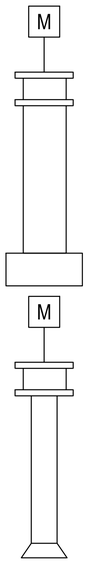
SCREW PUMP

RECIPROCATING PUMP

GEAR ROTARY PUMP

DIAPHRAGM PUMP


VERTICAL BARREL PUMP



VERTICAL TURBINE PUMP

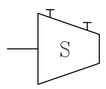
VERTICAL SUCTION LIFT PUMP

DRIVERS

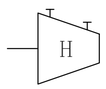
ELECTRIC MOTOR

DIESEL

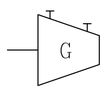
TURBINES



STEAM TURBINE



HYDRAULIC TURBINE

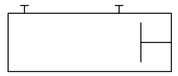


GAS TURBINE

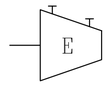
COMPRESSOR AND BLOWER

CENTRIFUGAL FAN

AXIAL / CENTRIFUGAL COMPRESSOR

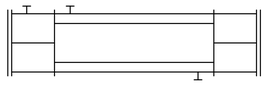

RECIPROCATING COMPRESSOR

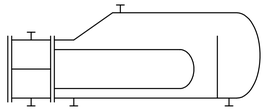
SCREW COMPRESSOR

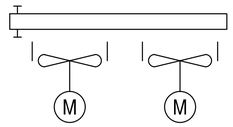


EXPANDER

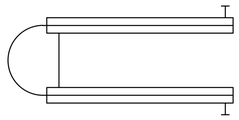
HEAT EXCHANGERS


SHELL AND TUBE EXCHANGER SINGLE PASS

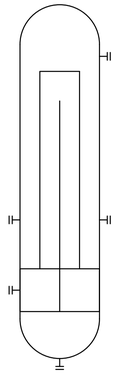

KETTLE EXCHANGER



AIR COOLED EXCHANGER SERVICE WITH MULTIPLE FANS (FORCED DRAFT)


DOUBLE PIPE EXCHANGER

HEAT EXCHANGERS


BAYONET TYPE EXCHANGER

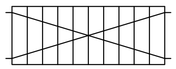


PLATE HEAT EXCHANGER

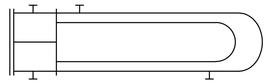
SIMPLE HEATER

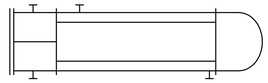
SIMPLE COOLER

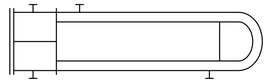
SIMPLE EXCHANGER

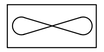
COIL

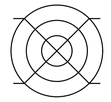
HEAT EXCHANGERS


U-BUNDLE


FIXED TUBESHEET EXCHANGER


FLOATING HEAD EXCHANGER


SIMPLE AIR COOLER


SPIRAL TYPE HEAT EXCHANGER

NOTES:

HOLD:

LEGENDS:

REFERENCE DOCUMENTS

DOC NO	DOC TITLE	REV.

Rev.	Date	Reason for Issue	Prepared	Checked	Approved	Owner Approved
C1	21/12/2022	APPROVED FOR CONSTRUCTION	BSG	SCB	SCB	
D2	11/03/2021	APPROVED FOR DESIGN	MNSP/SG	RK	SCB	
D1	23/03/2021	APPROVED FOR DESIGN	BSG	RK	SCB	
A2	26/10/2020	ISSUED FOR REVIEW	RSA / SS	RK	SCB	
A1	27/08/2020	ISSUE FOR REVIEW	RSA / SS	RK	SCB	

TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020

TP Document NO.: 082176C-ZZZ-PID-0090-0001-03

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE - EQUIPMENTS - 3

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0001.03	C1	03 OF 03

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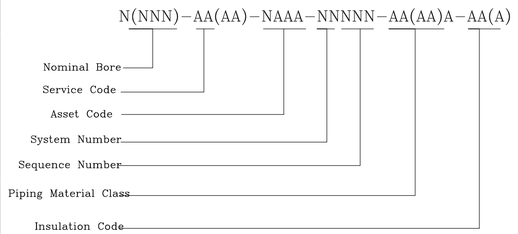
LINES

All lines will be numbered in accordance with NRL Engg. tag specification (NR-0ZZZZ-GE-SPE-0002). Numbering format is given below:



e.g. 1st Plant Air line (4") in Crude Storage Unit of COT at Paradip would be numbered as 4"-PA-3U21- 56001-A01E-NI.

LINE LEGEND

- PROCESS/UTILITY LINE
- BURIED LINE (B)
- TRACED LINE (STEAM / ELECTRICAL / TRACING) (C1)
- VENDOR/PACKAGE LIMIT LINE
- JACKETTED LINE (STEAM JACKETTING)
- EXISTING LINE
- EXISTING DISMANTLED
- BATTERY LIMIT LINE

INSTRUMENT LINE SYMBOLS

- ELECTRICAL SIGNAL
- CAPILLARY TUBING (FILLED SYSTEM)
- SOFTWARE SIGNAL
- PNEUMATIC SIGNAL
- HYDRAULIC SIGNAL
- ELECTROMAGNETIC/SONIC SIGNAL

ANNEXURE-1

Service Code & System number list

System Number	Service Code	Service Description
00	NON SPECIFIC	GENERAL
PROCESS SERVICE		
01	AG	Acid Gas (H2S Rich Gas, NH3 Rich Gas, SRU Tail Gas)
02	ATF	Aviation Turbine Fuel
03	CD	Coker Distillate
04	CRD	Crude
05	LCO	Light Cycle Oil
06	GO	Untreated Gas Oil
07	HSD	High Speed Diesel
08	HYD	Hydrogen
09	ISO	Isomerate
10	LPG	Liquefied Petroleum Gas, C3 ,C4 Stream
11	MS	Motor Spirit
12	NAP	Naphtha
13	OFG	Off Gas, PSA Tail Gas
14	RPC	Raw Petroleum Coke
15	RE	Reformate
16	SLP	Slop
17	SG	Sour Gas
18	SUL	Sulphur
19	KO	Kerosene
20	UCO	Unconverted Oil
21	VD	Vacuum Distillate
22	VR	Vacuum Residue
23	CLO	Clarified Oil
24	OHD	Overhead
25	RF	Reactor Feed (HC+H2)
26	PL	Reactor Effluent, Separator Liquid
27	PG	H2 Rich Gas Service
28	VGO	SR VGO & Hydrotreated VGO
29	HCO	Heavy Cycle Oil
30	FCN	FCC Naphtha
31	PR	Propylene
32	PP	Poly Propylene
33	BZN	Benzene Rich Cut
34	MTO	Mineral Turpentine Oil
35	RCO	Reduced Crude Oil
36	ETY	Ethylene
37	PV	Process Gas / Separator vapor
38	PC	Process Condensate

ANNEXURE-1

WATER SERVICE		
39	SRW	Sour water
40	STW	Stripped Water
41	BFW	Boiler Feed Water
42	CWR	Cooling Water Return
43	CWS	Cooling Water Supply
44	CW	Chilled Water
45	DKW	Drinking Water
46	DMW	Demineralized Water
47	FW	Fire Water
48	RW	Raw Water
49	SW	Service Water
50	TW	Tempered Water
51	PW	Process Water
STEAM AND CONDENSATE		
52	LPS	Low Pressure Steam
53	MPS	Medium Pressure Steam
54	HPS	High Pressure Steam
55	LLPS	Low Low Pressure Steam
56	CON	Condensate
AIR SERVICE		
57	BA	Breathing Air
58	IA	Instrument Air
59	PA	Plant Air
60	AP	Process Air
FLARE SERVICE		
61	FL	Flare
62	AFL	Acid Flare
VENT SERVICE		
63	FLG	Flue Gas
64	SV	Open Vent
BLOWDOWN AND DRAIN SERVICE		
65	BD	Blow Down
66	CBD	Closed Blow Down
67	OWS	Oil Water Sewer
68	CRWS	Contaminated Rain Water Sewer
69	ABD	Amine Blow Down
70	CCBD	Caustic Closed Blow Down
71	CS	Chemical Sewer
72	SS	Storm Sewer
73	PE	Process Effluent
UTLITY OIL SERVICE		
74	FLO	Flushing Oil
75	FO	Fuel Oil
76	HO	Hydraulic Oil
77	HTO	Hot Oil
78	LO	Lube Oil
79	SO	Seal Oil
80	TBA	To Be Allocated
UTILITY GAS SERVICE		
81	FG	Treated Fuel Gas
82	IG	Inert Gas
83	LN	Liquid Nitrogen
84	NG	Natural Gas
85	OXY	Liquid/Gaseous oxygen
OTHER SERVICE		
86	AC	Acid
87	CA	Caustic
88	SCA	Spent Caustic
89	CT	Catalyst
90	REF	Refrigerant
91	ETH	Ethanol
92	ME	Methanol
93	OC	Other Chemical
94	SE	Sewage
95	LAM	Lean Amine
96	RAM	Rich Amine
97,98	TBA	To Be Allocated
99		Modification in existing systems

INSULATION/TRACING TYPE

Insulation Code	Description
AI	Acoustic Insulation
IC	Cold Insulation
IH	Hot Insulation
IJ	Steam Jacketed
IS	Safety Insulation
IT	Steam Traced
CC	Cold Conservation
IE	Electrical traced
FP	Passive fire protection
HT	Heat Conservation with tracing
NI	No Insulation

VALVE, INSTRUMENT AND LINE SYMBOLS

- GATE VALVE NORMALLY OPEN
- GATE VALVE NORMALLY CLOSED (OPTIONAL DESIGNATION)
- GLOBE VALVE NORMALLY OPEN
- CHECK VALVE
- BUTTERFLY VALVE
- PLUG VALVE
- BALL VALVE
- NEEDLE VALVE
- DIAPHRAGM VALVE
- ANGLE VALVE
- BLOWDOWN ANGLE VALVE
- ANGLE BALL VALVE
- ANGLE CHOKE VALVE
- 3-WAY VALVE
- CONTROL VALVE (GENERAL/GLOBE) (C1)
- CONTROL VALVE (BALL)
- CONTROL VALVE (DIAPHRAGM)
- CONTROL VALVE (BUTTERFLY)
- 3-WAY CONTROL VALVE
- CONTROL VALVE (ANGLE TYPE)
- CONTROL VALVE (DOWNSTREAM SELF ACTUATING)
- CONTROL VALVE (UPSTREAM SELF ACTUATING)
- CONTROL VALVE WITH POSITIONER
- PILOT OPERATED VALVE
- CONTROL VALVE WITH HAND WHEEL
- PLUNGER OPERATED VALVE
- MOTOR OPERATED VALVE
- SOLENOID VALVE (2-WAY)
- SOLENOID VALVE (3-WAY)
- REMOTE OPERATED VALVE (ROV)
- TIGHT SHUTOFF STOP VALVE
- CATALYST VALVE
- SPECIAL VALVE
- TIGHT SHUT OFF VALVE (ORBIT) (PRESSURE SEEK)
- STOP CHECK VALVE
- METAL SEATED BALL VALVE WITH PURGE DISRTUBUTION CONNECTION
- TIGHT SHUT OFF STOP CHECK VALVE (Y PATTERN)
- TIGHT SHUT OFF VALVE (Y PATTERN)
- DOUBLE DISK SLIDE VALVE
- DIVERTER VALVE
- CATALYST SLIDE VALVE
- ON-OFF VALVE
- ON OFF BUTTERFLY VALVE
- ON OFF BALL VALVE
- DEADMAN TYPE VALVE
- ANTIFREEZE TYPE VALVE
- REMOVABLE SPOOL (RS)
- BIRD SCREEN
- VENT COVER / HOOD

- INLET SIZE, INCHES / ORIFICE CODE, LETTER / OUTLET SIZE, INCHES (2/3)
- SET PRESS. Kg/CM^2 G (24) RELIEF VALVE
- SAFETY VALVE NUMBER (PSV 1201A 01A)
- PRESSURE VACUUM RELIEF VALVE (PVRV)
- EMERGENCY RELIEF VALVE (ERV)
- 'T'- TYPE STRAINER
- 'Y'- TYPE STRAINER
- TEMPORARY STRAINER (TS)
- CONE TYPE STRAINER
- BASKET STRAINER
- FILTER
- SPECTACLE BLIND (OPEN)
- SPECTACLE BLIND (CLOSED)
- SPACER
- OPEN DRAIN FUNNEL
- EXPANDER/REDUCER (CON/ECC)
- BELLOWS
- STEAM TRAP (ST)
- AIR TRAP (AT)
- AUTO DRAIN VALVE (AD)
- RUPTURE DISK
- UNION
- COUPLING
- BLIND FLANGE
- CAP THREADED
- CAP WELDED
- ADAPTOR
- FREE DRAINING
- 1:XXX LINE REQUIRED WITH SLOPE
- NO POCKET LINE WITH NO POCKETS
- FLAME ARRESTOR
- OPC| DRAWING NO. XXXX|XXXXXXXXXXXXXX> CONTINUITY ARROW, LINES
- OPC| DRAWING NO. XXXX|XXXXXXXXXXXXXX) CONTINUITY ARROW INSTRUMENT SIGNAL
- OPC| DRAWING NO. XXXX|XXXXXXXXXXXXXX▶ CONTINUITY ARROW, B/L
- PULSATION DAMPNER
- VORTEX BREAKER
- FLEXIBLE LINE/HOSE
- PIPING SPECIAL ITEM (SP/XX)
- SILENCER
- FLOATING SUCTION
- DRAIN FUNNEL (CBD / OWS)
- SPEC BREAK
- LINE BREAK
- SAMPLE CONNECTION (SC-XXXX)
- AP - AIR PURGE
  SP - STEAM PURGE
  AA - AERATION AIR
  AS - AERATION STEAM
  AG - AERATION GAS
  NP - NITROGEN PURGE
  OP - OIL PURGE

- DRAIN WITH BLIND FLANGE
- DRAIN WITH THREADED CAP
- FLOW ELEMENT (ORIFICE)
- TURBINE METER
- PD METER
- ROTAMETER (V)
- ULTRASONIC METER (S)
- CORIOLIS METER (C)
- MAGNETIC METER (M)
- PITOT TUBE
- ANNUBAR
- VORTEX METER
- VENTURI METER
- STRAIGHTENING VANES
- IN LINE INSTRUMENT (SIGHT GLASS,MASS FLOW METER ETC.)

TIE-IN POINTS REPRESENTATION

TP XXX — TIE IN POINTS

* ALL TIE IN POINTS ARE TO BE PREFIXED BY UNIT NUMBER SUITABLY.

LESS FREQUENTLY USED SYMBOLS

- STOP CHECK VALVE
- FOUR WAY VALVE
- PRESSURE VACUUM SAFETY VALVE
- PILOT OPERATED SAFETY VALVE
- CONTINUOUS DRAIN
- VANES CONTROL VALVE
- HAND OPERATED VANES VALVE
- SPRING LOADED VALVE
- HAND OPERATED VALVE
- PP PRESSURE POINT
- AUTOMATIC RECIRCULATION VALVE
- R RESET

OTHERS

- CC CORROSION COUPON
- CP CORROSION PROBE

GENERAL ABBREVIATIONS

ATM	ATMOSPHERE
AR	AUTO RESET
BL	BATTERY LIMIT
CS	CHEMICAL SEWER
CSC	CAR SEAL CLOSED
CSO	CAR SEAL OPEN
FB	FULL BORE
FL	FAIL LOCK
FLDC	FAIL LOCK DRIFT CLOSED
FLDO	FAIL LOCK DRIFT OPEN
FC	FAIL CLOSED
FO	FAIL OPEN
HS	HOSE STATION
ISBL	INSIDE BATTERY LIMIT
LC	LOCK CLOSE
LO	LOCK OPEN
MW	MANWAY
NNF	NORMALLY NO FLOW
NO	NORMALLY OPEN
NC	NORMALLY CLOSED
OSBL	OUTSIDE BATTERY LIMIT
TL	TANGENT LINE
TSO	TIGHT SHUT OFF(CL.IV&V)
UC	UTILITY CONNECTION
VAC	VACUUM
VF	VENDOR FURNISHED
PSO	POSITIVE SHUT OFF (CL.VI)
FMR	FIELD MANUAL RESET (FOR SOV)
CMR	CONTROL ROOM MANUAL RESET (FOR SOV)
LPD	LOW POINT DRAIN
HPV	HIGH POINT DRAIN
VFD	VARIABLE FREQUENCY DRIVE
HPT	HIGH POINT
LPT	LOW POINT
PSO	POSITIVE SHUT OFF
INT	INTERFACE LEVEL (C1)

NOTES:

HOLD:

LEGENDS:

REFERENCE DOCUMENTS

DOC NO	DOC TITLE	REV.

Rev.	Date	Reason for Issue	Prepared	Checked	Approved	Owner Approved
C1	21/12/2022	APPROVED FOR CONSTRUCTION	BSG	SCB	SCB	
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D1	23/03/2021	APPROVED FOR DESIGN	BSG	RK	SCB	
A1	26/10/2020	ISSUED FOR REVIEW	RSA / SS	RK	SCB	

TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020

TP Document NO.: 082176C-ZZZ-PID-0090-0002-01

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE
GENERAL - SYMBOLS & LEGENDS

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0002.01	C1	01 OF 02

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INSTRUMENTATION SYMBOLS AND LEGEND

NOTE: PLEASE REFER ANNEXURE–9 OF NRL ENGINEERING TAG NUMBERING SPECIFICATION (NR–0ZZZZ–GE–SPE–0002) FOR INSTRUMENT TAG IDENTIFICATION.

FUNCTION BLOCKS – FUNCTION DESIGNATIONS

NO.	FUNCTION	SYMBOL	NO.	FUNCTION	SYMBOL
1.	SUMMING	Σ	12.	TIME FUNCTION	F(T)
2.	AVERAGING	Σ/n	13.	HIGH SELECTING	>
3.	DIFFERENCE	Δ	14.	LOW SELECTING	<
4.	PROPORTIONAL	K	15.	HIGH LIMITING	▷
5.	INTEGRAL	∫	16.	LOW LIMITING	◁
6.	DERIVATIVE	d/dt	17.	REVERSE PROPORTIONAL	–K
7.	MULTIPLYING	X			+
8.	DIVIDING	○/○	18.	BIAS	–
9.	ROOT EXTRACTION	n√			±
10.	EXPONENTIAL	X^n	19.	CONVERT	*/*
11.	NON LINEAROR UNSPECIFIED FUNCTION	F(X)		* E– VOLTAGE I– CURRENT P– PNEUMATIC A– ANALOG H– HYDRAULIC D– DIGITAL	

DCS/COMPUTER SYSTEM SYMBOLS

SHARED DISPLAY INDICATOR,CONTROLLER, OR OTHER DEVICES WITH OPERATOR ACCESS TO ADJUSTMENTS.

SHARED DISPLAY DEVICES WITH LIMITED ACCESS TO ADJUSTMENTS LOCATED IN FIELD.

AUXILLIARY OPERATORS INTERFACE DEVICE FOR EXAMPLE, BACK UP CONTROLLER OR MANUALSTATION.

COMPUTER COMPONENTS NOT ACCESSIBLE TO OPERATOR LIKE I/O INTERFACE,BLIND CONTROLLER OR A SOFTWARE CALCULATION BOX.

INDICATOR/CONTROLLER/RECORDER OR ALARM POINT NORMALLY ACCESSIBLE TO OPERATOR THROUGH VIDEO DISPLAY.

AUXILLIARY COMPUTER COMPONENTS NORMALLY ACCESSIBLE TO OPERATOR.

SEQUENTIAL LOGIC CONTROL LIMITED ACCESS TO OPERATOR.

SEQUENTIAL LOGIC CONTROL ACCESSIBLE TO OPERATOR.

I — INTERLOCK (CAUSE)

I — INTERLOCK (EFFECT)

IS — INTERLOCK (CAUSE) C1

IS — INTERLOCK (EFFECT)

TFMS — TANK FARM MANAGEMENT SYSTEM

OTHERS

RUNNING LIGHT (LOCAL)

RUNNING LIGHT (PANEL)

RUNNING LIGHT (LOCAL PANEL)

RUNNING LIGHT (DCS)

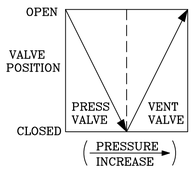
RTU — REMOTE TRANSMISSION UNIT

DIAPHRAGM

CONTINIOUS PURGE OR FLUSHING FOR INSTRUMENT

SPLIT RANGE CONTROL, SEQUENCE AND OPPOSITE ACTING VALVES

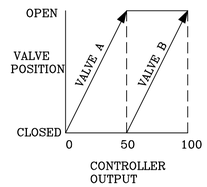
1. SPLIT RANGE VALVES: SOME CONTROL LOOPS HAVE TWO CONTROL VALVES ON THE OUTPUT SIGNAL OF ONE CONTROLLER. FOR EXAMPLE WITH TWO CONTROL VALVES, ONE VALVE PRESSURIZES AND THE OTHER VENTS A VESSEL. A PLOT SHOWS THE VALVE POSITION VERSES PRESSURE.



TYPE–A

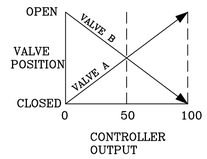
IT IS IMPORTANT TO KEEP THE CONTROL LOOP GAIN CONSTANT FOR GOOD SPLIT RANGE OPERATION. THE GAIN OF EACH VALVE (INCLUDING THE PROCESS) MUST BE MADE SIMILAR. OTHERWISE LIMIT CYCLING OR POOR CONTROL WILL RESULT.

2. WHERE SEQUENCE VALVE OPERATION IS CALLED FOR, THEY ARE INTENDED TO WORK AS FOLLOWS:



TYPE–B

3. OPPOSITE ACTING VALVES CONTROL LOOP NOTED AS OPPOSITE ACTING VALVES HAVE THE FOLLOWING ACTION.



TYPE–C

FUNCTIONAL SYMBOLS

XXX XXXXX — FIELD MOUNTED INSTRUMENT

LOCAL PANEL INSTRUMENT

REAR LOCAL PANEL INSTRUMENT

CENTRAL PANEL MOUNTED INSTRUMENT

REAR CENTRAL PANEL MOUNTED INSTRUMENT

CB — CUT BACK FUNCTION

EXAMPLES OF INSTRUMENTATION OF SYMBOLS WITH INSTRUMENTATION TAG

PT 1002A 01A — SHALL BE APPLICABLE FOR FIELD INSTRUMENT PG/LG/TG/FG/PT/PDT/FT/TE/TT ETC.

PI 1002A 01A — DISPLAY INDICATOR (DCS)

PIC 1002A 01A — DISPLAY INDICATOR CONTROLLER (DCS)

YPIC 1002A 01A — CALCULATION BLOCK (DCS) RELATED TO PIC–1002A01A (DCS)

PV 1002A 01A — CONTROL VALVE

UV 1002A 01A — ON OFF VALVE (SAFETY RELATED)

UZYO 1002A 01A — SOLENOID VALVE (FOR OPEN COMMAND) FOR UV–1002A01A
NOTE: UZYO/UZYC IN CASE OF DUAL SOVs FOR OPEN & CLOSE. OTHERWISE ONLY UZY.

UZSO 1002A 01A — DCS INDICATION POSITION LIMIT SWITCH (OPEN) FOR UV–1002A01A

UHYO 1002A 01AL — HAND OPERATED SWITCH–LOCAL OPEN SWITCH (LOCAL) FOR UV–1002A01A

UHYO 1002A 01AR — HAND OPERATED SWITCH–DCS OPEN SWITCH (REMOTE) FOR UV–1002A01A

EHYS 1002A 01 — HAND OPERATED SWITCH–LOCAL START SWITCH (LOCAL) FOR PUMP EQUIPMENT PA–1002A

EHYS 1002A 02 — HAND OPERATED SWITCH–DCS START SWITCH (REMOTE) FOR PUMP PA–1002A
NOTE: EHY–SINGLE COMMON SWITCH FOR BOTH OPEN AND CLOSE–EHY–XXXX–R/L (REMOTE/LOCAL)

XEHYL 1002A 01 — STATUS FEED BACK INDICATION LAMP (LOCAL) (RUN/START) FOR PUMP EQUIPMENT PA–1002A
NOTE: XEYLS/XEYLT IN CASE OF DUAL INPUT FOR START AND STOP/TRIP. OTHERWISE ONLY XEYL.

EYLS 1002A 02 — STATUS FEED BACK INDICATION (DCS) (RUN/START) FOR PUMP EQUIPMENT PA–1002A
NOTE: EYLS/EYLT IN CASE OF DUAL INPUT FOR START AND STOP/TRIP. OTHERWISE ONLY EYL.

EHYE 1002A 01 — HAND OPERATED SWITCH–LOCAL EMERGENCY SWITCH (LOCAL) FOR PUMP EQUIPMENT PA–1002A

EHYE 1002A 02 — HAND OPERATED SWITCH–DCS EMERGENCY SWITCH (REMOTE) FOR PUMP PA–1002A

M MOV 1002A 01A — MOTOR OPERATED VALVE

MZSO 1002A 01A — DCS INDICATION POSITION LIMIT SWITCH (OPEN) FOR MOV–1002A01A

XMZSO 1002A 01AL — LAMP INDICATION–LOCAL POSITION LIMIT SWITCH (OPEN) FOR MOV–1002A01A

XMZSO 1002A 01AR — LAMP INDICATION–REMOTE–AUX CONSOLE POSITION LIMIT SWITCH (OPEN) FOR MOV–1002A01A

MHYO 1002A 01AL — HAND OPERATED SWITCH–LOCAL OPEN SWITCH (LOCAL) FOR MOV–1002A01A

MHYO 1002A 01AR — HAND OPERATED SWITCH–DCS OPEN SWITCH (REMOTE) FOR MOV–1002A01A

NOTE: FOR INCORPORATING THE TAG CHARACTERS INSIDE THE SYMBOLS, OTHER FORMAT MAY ALSO BE CONSIDERED AS BELOW. HOWEVER, THE FOLLOWING FORMAT WILL CONSUME MORE VERTIAL SPACE.

PT 1002A01A — SHALL BE APPLICABLE FOR FIELD INSTRUMENT PG/LG/TG/FG/PT/PDT/FT/TE/TT ETC.

PI 1002A01A — DISPLAY INDICATOR (DCS)

MHYO 1002A01A L — HAND OPERATED SWITCH–LOCAL OPEN SWITCH (LOCAL) FOR MOV–1002A01A

INT LG 391602 — INTERFACE LEVEL INSTRUMENT C1

NOTES:

HOLD:

LEGENDS:

REFERENCE DOCUMENTS

DOC NO	DOC TITLE	REV.

Rev.	Date	Reason for Issue	Prepared	Checked	Approved	Owner Approved
C1	21/12/2022	APPROVED FOR CONSTRUCTION	BSG	SCB	SCB	
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A1	26/10/2020	ISSUED FOR REVIEW	RSA / SS	RK	SCB	

TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833–AMA/16.06.2020

TP Document NO.: 082176C–ZZZ–PID–0090–0002–02

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE
GENERAL – SYMBOLS & LEGENDS

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0002.02	C1	02 OF 02

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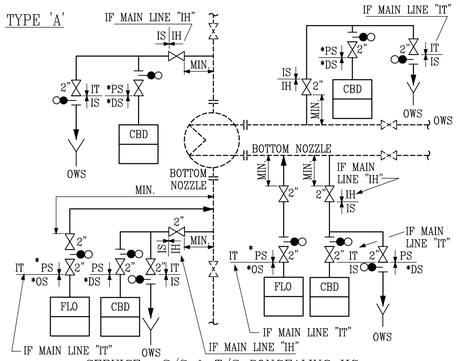
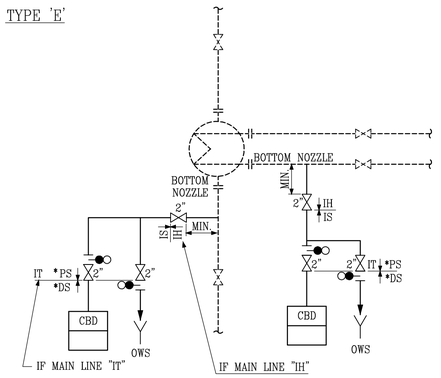
HEAT EXCHANGER FLUSHING AND DRAIN PLAN (REFER NOTE 7)

TYPE 'A'



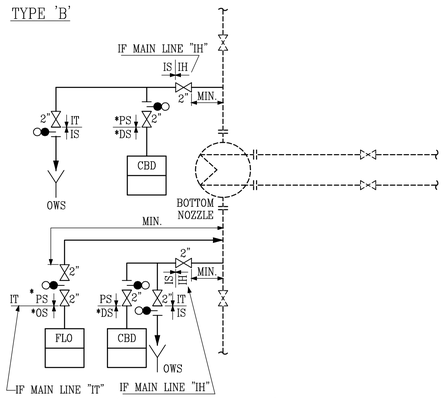
SERVICE : S/S & T/S CONGEALING HC

TYPE 'E'



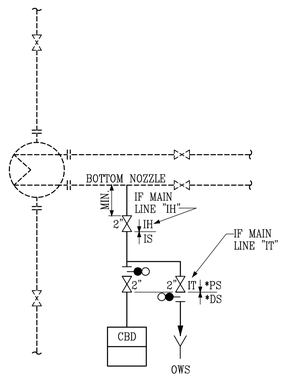
S/S & T/S NONCONGEALING HC

TYPE 'B'



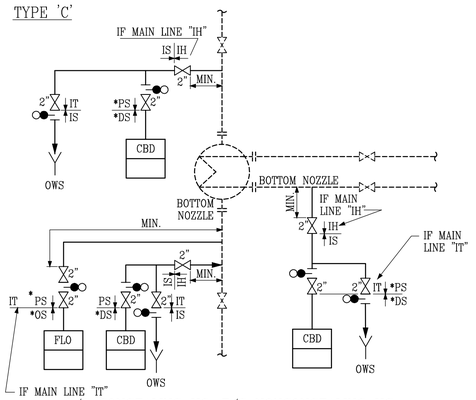
S/S CONGEALING HC, T/S NON HC

TYPE 'F'



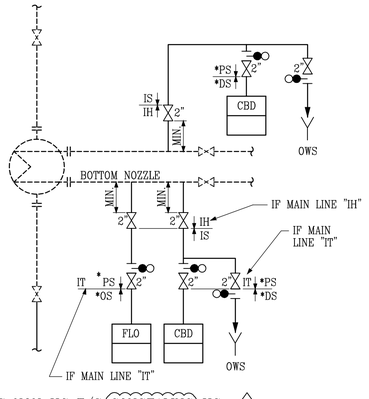
S/S NON HC T/S NONCONGEALING HC

TYPE 'C'



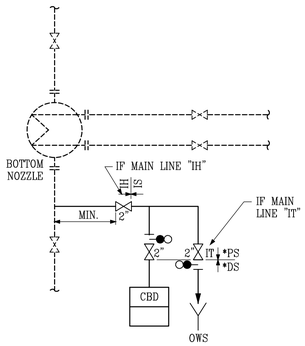
S/S CONGEALING HC, T/S NONCONGEALING HC

TYPE 'G'



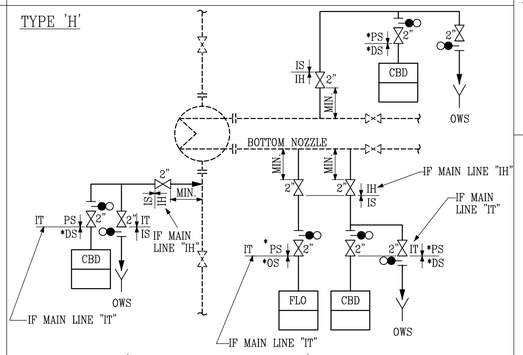
S/S NON HC T/S CONGEALING HC C1

TYPE 'D'



S/S NONCONGEALING HC, T/S NON HC

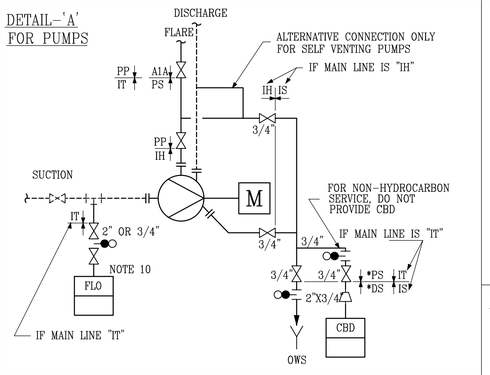
TYPE 'H'



S/S NONCONGEALING HC T/S CONGEALING HC

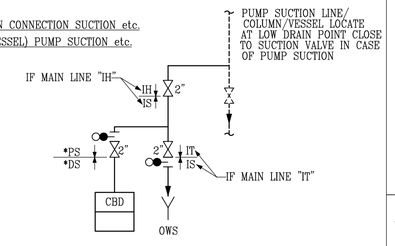
PUMP VENT/DRAIN/BLEEDER CONNECTION DETAILS

DETAIL-'A' FOR PUMPS



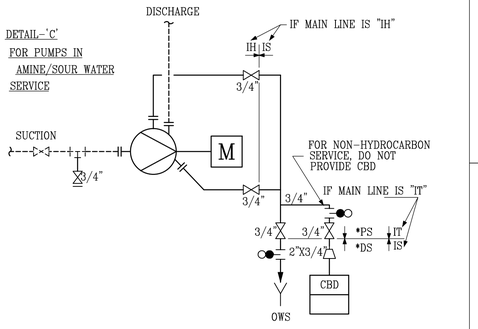
DETAIL-'B'

STANDARD DRAIN CONNECTION SUCTION etc. FOR COLUMN/VESSEL) PUMP SUCTION etc.

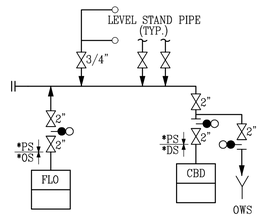


DETAIL-'C'

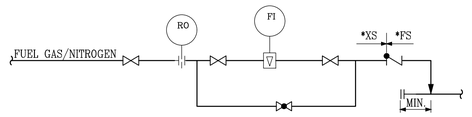
FOR PUMPS IN AMINE/SOUR WATER SERVICE



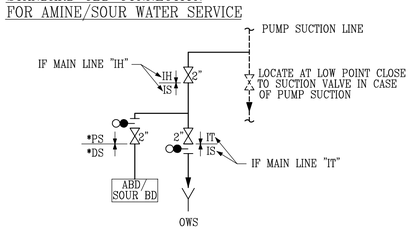
DETAIL-'D'



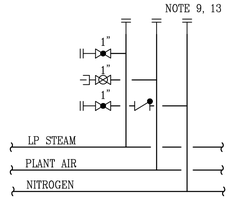
DETAIL-'E'
FUEL GAS/NITROGEN CONNECTION FOR UNIT FLARE HEADER (NOTE 11)



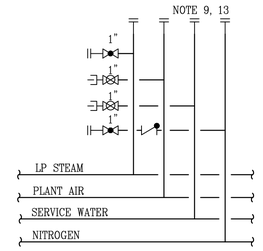
DETAIL-'F'
STANDARD CBD CONNECTION FOR AMINE/SOUR WATER SERVICE



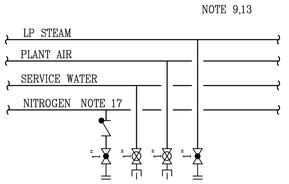
DETAIL-A TYPICAL HOSE STATION AT ELEVATED PLATFORM ABOVE 35m



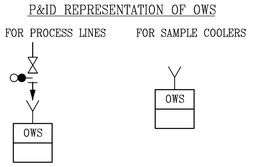
DETAIL-B TYPICAL HOSE STATION AT ELEVATED PLATFORM BELOW 35m AND ABOVE GRADE



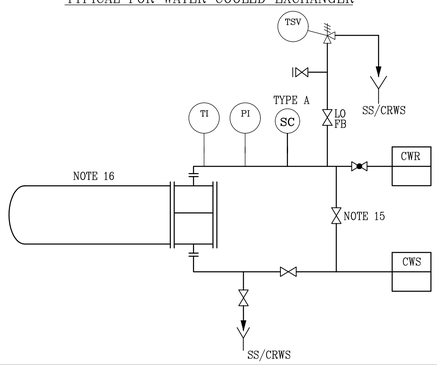
DETAIL-C TYPICAL HOSE STATION AT GRADE



P&ID REPRESENTATION OF OWS

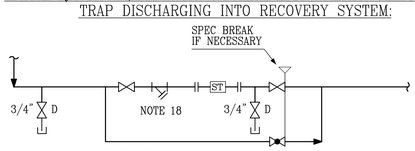


TYPICAL FOR WATER COOLED EXCHANGER

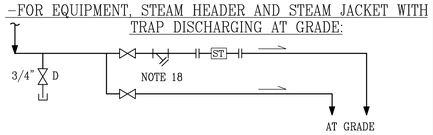


STEAM TRAP

-FOR EQUIPMENT, STEAM HEADER AND STEAM JACKET WITH TRAP DISCHARGING INTO RECOVERY SYSTEM:



-FOR EQUIPMENT, STEAM HEADER AND STEAM JACKET WITH TRAP DISCHARGING AT GRADE:



NOTES:

1. VALVES, VENTS, DRAINS AND MANIFOLDS ON INSTRUMENTS ARE NOT SHOWN IN P&ID'S AND SHALL BE AS PER ENGINEERING STANDARDS.
2. INLET / OUTLET PIPING ON TUBE SIDE OF SHELL & TUBE HEAT EXCHANGERS SHALL BE DESIGNED TO HAVE REMOVABLE SPOOL PIECE FOR EASY MAINTENANCE.
3. REQUIREMENT OF DRAIN CONNECTION TO CLOSED SYSTEM FOR HAZARDOUS / TOXIC CHEMICALS TO BE DECIDED ON CASE TO CASE BASIS DURING DETAILED ENGINEERING FOR NON HC SERVICES.
4. HIGH POINT VENTS & LOW POINT DRAINS OF PIPING ARE NOT SHOWN IN THE P&ID.
5. PROVIDE TW ON EXCHANGER NOZZLE FOR STACKED EXCHANGER SHELLS.
6. ALL SAMPLE POINTS SHOULD BE CONVENIENTLY LOCATED AT GRADE LEVEL PREFERABLY NEAR BATTERY LIMIT & SHOULD BE APPROACHABLE THEY SHOULD BE CLOSE TO OILY WATER SEWER FUNNELS AS FOR AS POSSIBLE.
7. i) WHEN A BANK OF EXCHANGERS ARE ISOLATED BY TWO ISOLATION VALVES, THEN ONLY ONE FLUSHING OIL CONNECTION IS PROVIDED. HOWEVER DRAIN CONNECTIONS FOR PROCESS FLUIDS FROM BOTTOM NOZZLES WILL BE PROVIDED FOR ALL INDIVIDUAL EXCHANGERS.
   ii) DETAILS ARE APPLICABLE FOR INDIVIDUAL EXCHANGER ONLY WHEN SHELL SIDE AND TUBE SIDE ISOLATION VALVES ARE PROVIDED.
   iii) WHEN EXCHANGERS ARE NOT PROVIDED WITH ANY ISOLATION VALVES, DRAIN CONNECTIONS FOR PROCESS FLUIDS AT BOTTOM NOZZLES WILL BE PROVIDED FOR EACH EXCHANGER. FLUSHING CONNECTION WILL BE PROVIDED AT ONLY ONE APPROPRIATE LOCATION.
8. DRAINS OF ALL LEVEL INSTRUMENTS, STAND PIPES IN HC SERVICE PROVIDED AT ELEVATED PLATFORMS SHOULD BE COLLECTED IN A COMMON 2" HEADER FOR ROUTING TO CBD/OWS (DETAIL-D). FLUSHING OIL CONNECTION SHOULD BE PROVIDED NEAR THE BLIND END OF THE DRAIN HEADER FOR FLUSHING. IN CASE OF CONGEALING/ HIGH POUR HC DRAIN COMMON HEADER TO BE PROVIDED FOR EACH ELEVATED PLATFORM.
9. i) TYPICAL LINE SIZE FOR THE INDIVIDUAL UTILITY TAP-OFF LINES TO A HOSE STATION IS 1".
   ii) LINE SIZE FOR THE MAIN LINE CATERING TO HOSE STATIONS AT MULTIPLE ELEVATIONS TO BE DECIDED BASED ON ACTUAL NUMBER OF HOSE STATIONS ATTACHED TO THE LINE.
   iii) ALL TAPPING HAVE TO BE TAKEN FROM TOP OF THE HEADER.
10. WHEN TWO PHASE LINE IS INDICATED, ADEQUATE SUPPORT TO BE PROVIDED TO COMPENSATE FOR VIBRATION IF NECESSARY.
11. ALL DEAD ENDS ON FLARE HEADER SHALL BE PROVIDED WITH A PURGE CONNECTION. A PURGE RATE OF 0.1 FT/SEC IN THE HEADER IS TO BE ENSURED.
12. STAND PIPES FOR ALL LEVEL INSTRUMENTS SHALL HAVE ISOLATION VALVES.
13. CONNECTION TYPE : ONE END WITH SPRAY NOZZLE , OTHER END ADAPTOR (FEMALE TYPE) TO SUIT QUICK RELEASE COUPLER.
14. CONNECT ALL DRAINS AND VENTS FOR STREAMS CONTAINING SELF REFRIGERATING LPG AND LIGHTER FLUIDS TO A CLOSED SYSTEM.
15. BACK FLUSH LINES ARE TO BE PROVIDED WITH SAME SIZE AS MAIN COOLING WATER LINE WHEN LINE SIZE LESS THAN OR EQUAL TO 6".ONE SIZE LOWER TO BE PROVIDED FOR MAIN LINE SIZE UPTO 10".TWO SIZE LOWER TO BE PROVIDED FOR MAIN LINE SIZE GREATER THAN 10".
16. FOR EXCHANGER AT AN ELEVATION VACUUM PROTECTOR TO BE PROVIDED IN COOLING WATER LINE.
17. NITROGEN SERVICE IS NOT REQUIRED FOR UTILITY STATION NEAR CRUDE TANK.
18. NOT TO BE INSTALLED IF STEAM TRAP HAS INTERNAL STRAINER.

HOLD:

LEGENDS:

*DS : DRAIN SPEC
*OS : FLUSHING OIL DRAIN SPEC
*PS : PROCESS SPEC
*XS : FUEL GAS / NITROGEN SPEC
*FS : FLARE SPEC

REFERENCE DOCUMENTS

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TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020

TP Document NO.: 082176C-ZZZ-PID-0090-0003-01

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE -
TYPICAL DETAILS FOR PIPING ARRANGEMENTS

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0003.01	C1	01 OF 01

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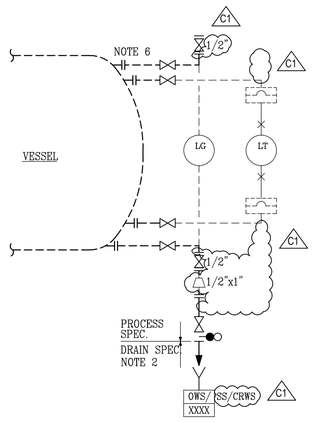
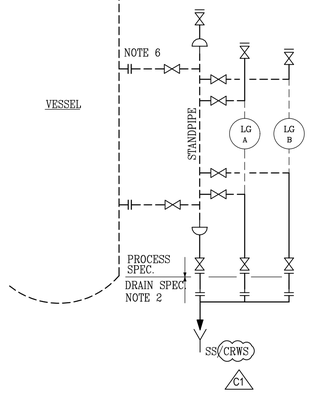
LG/LT VENT & DRAIN DETAILS FOR WATER AND OTHER NON-HAZARDOUS SERVICES

TYPE-1



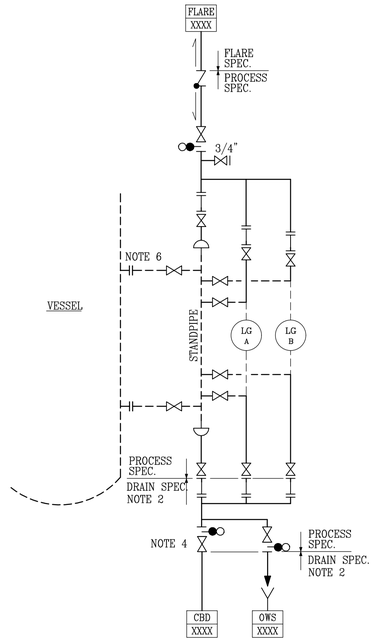
STANDPIPE, LG/LT VENT & DRAIN DETAILS FOR WATER AND OTHER NON-HAZARDOUS SERVICES

TYPE-2



STANDPIPE, LG/LT VENT & DRAIN DETAILS FOR HC APPLICATIONS

TYPE-3A



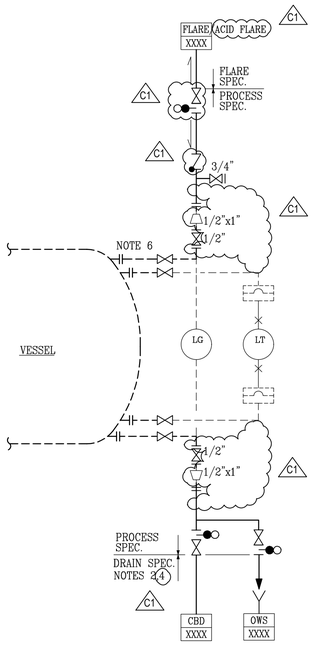
NOTES:

1. PORTION SHOWN WITH DASHED LINE IS PART OF PROCESS P&ID.
2. IN CASE PROCESS LINE IS HAVING HOT INSULATION (IH) OR STEAM TRACING (IT) THEN SAFETY INSULATION (IS) IS TO BE PROVIDED.
3. LOCAL VENT AND DRAIN FOR DIAPHRAGM TYPE LT SHALL BE AS PER INSTRUMENTATION HOOK UP DIAGRAM.
4. CONNECTION SHALL BE PROVIDED TO APPROPRIATE CLOSED DRAIN SYSTEM.
5. LEVEL TRANSMITTERS SHALL BE DIRECTLY MOUNTED ON VESSEL. USE OF STAND PIPE IS NOT ALLOWED.
6. FOR INTERNALLY LINED OR CLADDED VESSELS / COLUMNS, INSTRUMENT NOZZLE SIZE AND ISOLATION VALVE SIZE SHALL BE 3" MINIMUM.
7. DIAPHRAGM SEALS FOR CONGEALING / HIGH VISCOSITY / CORROSIVE / CRYSTALLIZING SERVICES (PRESSURE UPTO 600#).

HOLD:

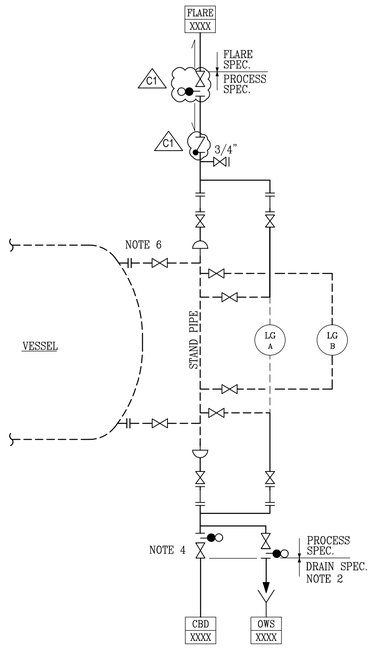
LG/LT VENT & DRAIN DETAILS FOR HC/SOUR/AMINE APPLICATIONS NOTE 7

TYPE-3B



STANDPIPE, LG/LT VENT & DRAIN DETAILS FOR VISCOUS / CORROSIVE SERVICES

TYPE-4



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TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020

TP Document NO.: 082176C-ZZZ-PID-0090-0004-01

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE –
LG / LT DRAIN AND VENT CONNECTION DETAILS

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0004.01	C1	01 OF 01

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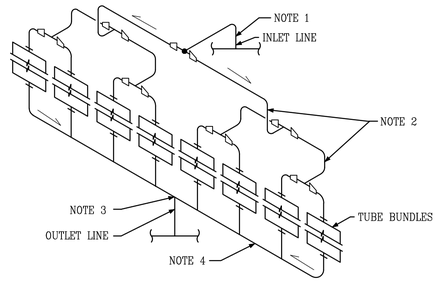
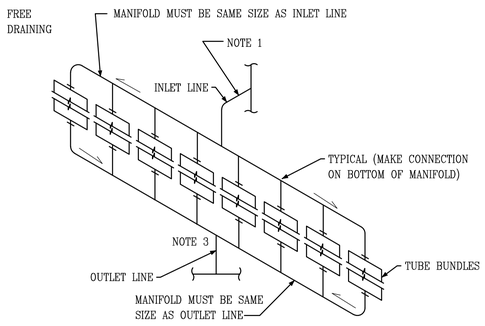
MANIFOLD PIPING REQUIREMENTS FOR AIR COOLERS

(ONLY FOR TYPE SELECTION)

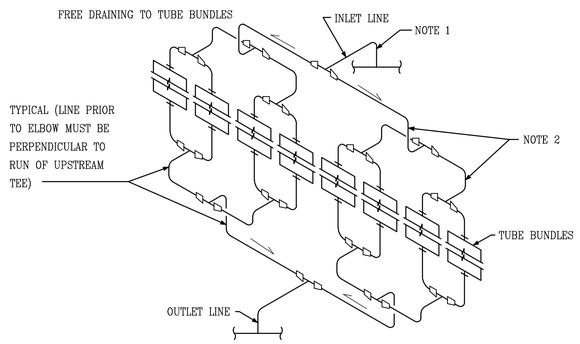


TYPE 'A' MANIFOLD

INLET PIPING MUST BE SYMMETRICAL FROM COMMON INLET TO TUBE BUNDLE
ALL TEES MUST BE FULL SIZE
REDUCERS MUST BE ECCENTRIC; FLAT ON BOTTOM

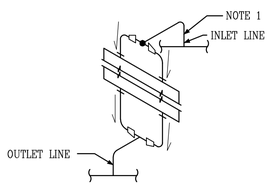


TYPE 'B' MANIFOLD



TYPE 'C' MANIFOLD

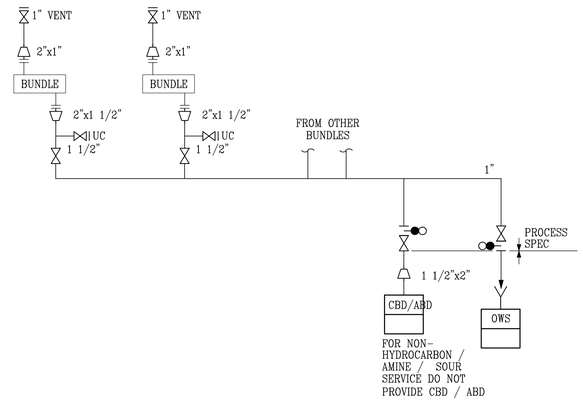
NOTE 5



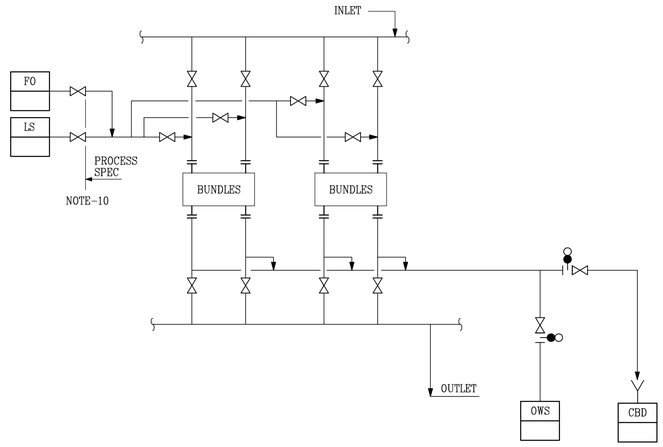
TYPE 'Y' MANIFOLD

NOTE 5

AIR COOLED EXCHANGERS VENT AND DRAIN DETAILS_

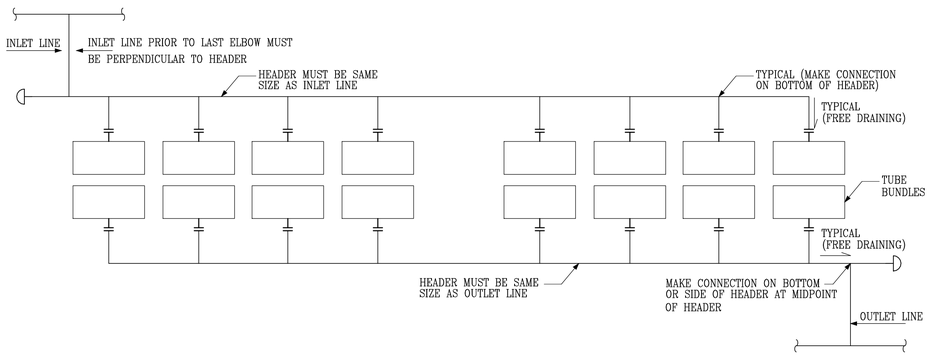


AIR COOLED EXCHANGERS FLUSHING / STEAM OUT DETAILS



TYPE D MANIFOLD IS DETERMINED BY CONTRACTOR

NOTE 11



NOTES:

1. LINE PRIOR TO LAST ELBOW MUST BE PERPENDICULAR TO RUN OF TEE.
2. TYPICAL (LINE PRIOR TO ELBOW MUST BE PERPENDICULAR TO RUN OF DOWNSTREAM TEE)
3. MAKE CONNECTION ON BOTTOM OR SIDE OF MANIFOLD AT MIDPOINT OF MANIFOLD
4. MANIFOLD MUST BE SAME SIZE AS OUTLET LINE
5. INLET AND OUTLET PIPING MUST BE SYMMETRICAL TO AND FROM COMMON TUBE BUNDLE. ALL TEES MUST BE FULL SIZE. ELBOWS MUST NOT BE REPLACED WITH TEES. REDUCERS MUST BE ECCENTRIC; FLAT ON BOTTOM FOR INLET PIPING, FLAT ON TOP FOR OUTLET PIPING. LIMIT VELOCITIES TO 20 FT/SEC (6.1 M/SEC) MAX AND 10 FT/SEC (3.0 M/SEC) MIN FROM TUBE BUNDLE OUTLET TO COMMON JUNCTION AT OUTLET.
6. REQUIREMENT OF FLUSHING OIL, STEAM OUT AND INDIVIDUAL BUNDLE ISOLATIONS TO BE DECIDED ON CASE TO CASE BASIS DURING DETAILED ENGINEERING.
7. ADDITIONAL INSTRUMENTATION REQUIREMENTS SHALL BE AS PER UNIT LICENSOR DESIGN SPECFICATION BASED ON THE SERVICE OF THE AIR COOLED EXCHANGER.
8. CBD / ABD LINE ROUTED TO CBD / ABD HEADER AS PER FLUID SERVICE.
9. WASH WATER SUPPLY PIPING REQUIREMENTS SHALL BE AS PER UNIT LICENSOR DESIGN SPECIFICATION.
10. IBR REQUIREMENTS SHALL BE UPDATED BY CONTRACTOR.
11. TYPE D MANIFOLD CONFIGURATION IS DECIDED BY CONTRACTOR. PMC / OWNER SHALL REVIEW AND CONFIRM.

HOLD:

LEGENDS:

REFERENCE DOCUMENTS

DOC NO	DOC TITLE	REV.

Rev.	Date	Reason for Issue	Prepared	Checked	Approved	Owner Approved
C1	21/12/2022	APPROVED FOR CONSTRUCTION	BSG	SCB	SCB	
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D1	23/03/2021	APPROVED FOR DESIGN	BSG	RK	SCB	
A1	26/10/2020	ISSUED FOR REVIEW	RSA / SS	RK	SCB	

TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020

TP Document NO.: 082176C-ZZZ-PID-0090-0005-01

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE - AIR COOLER DETAILS

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0005.01	C1	01 OF 01

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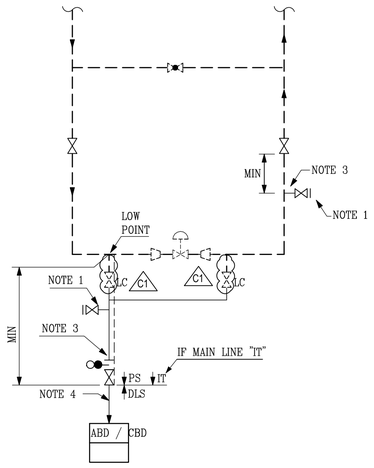
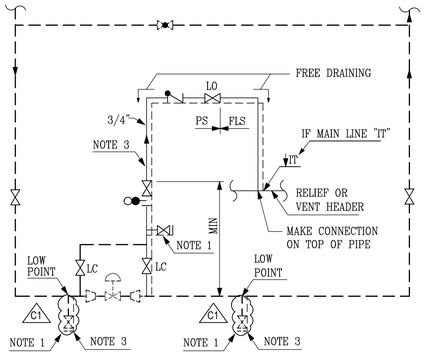
CONTROL VALVE VENT AND DRAIN DETAILS

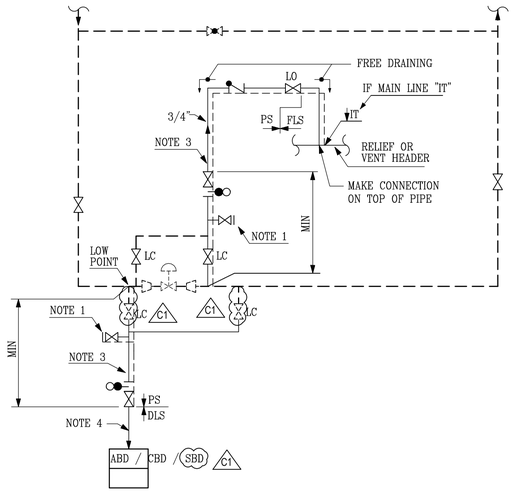
TYPE I (HEAVY LIQUID SERVICE)
CLOSED DRAIN



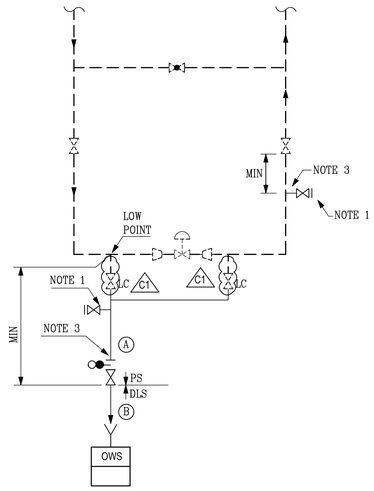
TYPE II (GAS SERVICE)
CLOSED VENT



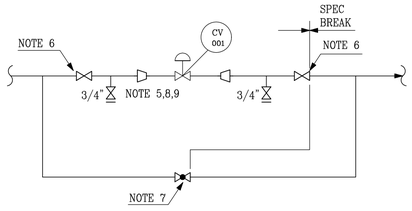
TYPE III
CLOSED DRAIN AND VENT



TYPE IV
(HYDROCARBON LIQUID SERVICE FOR OFFSITES)

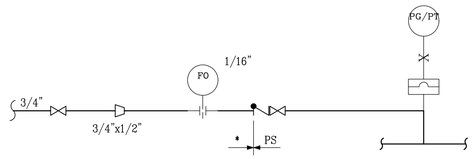


CONTROL VALVE ASSEMBLY



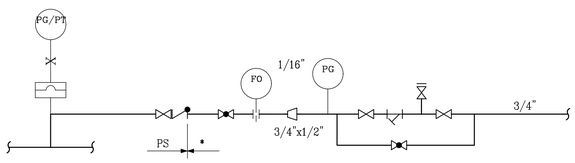
INSTRUMENT PURGING DETAILS

NITROGEN PURGE DETAIL
DETAIL-NP NITROGEN PURGING DETAIL FOR PG/PT



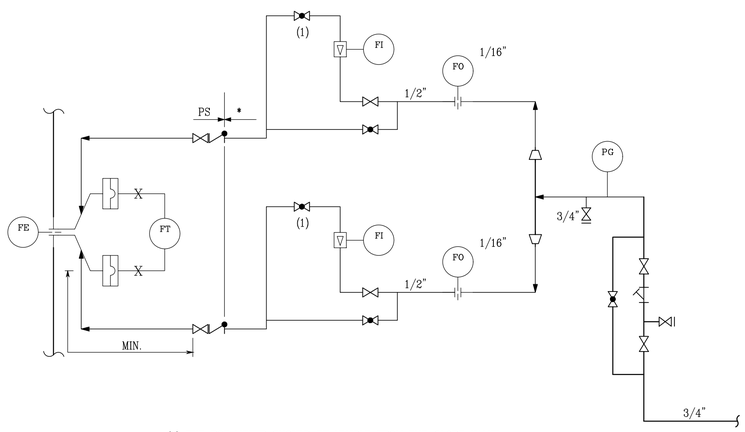
* PIPE SPEC OF PURGE CONNECTION PIPING

OIL PURGE DETAILS
DETAIL-OP-1 OIL PURGE DETAIL FOR PG/PT



* PIPE SPEC OF PURGE CONNECTION PIPING

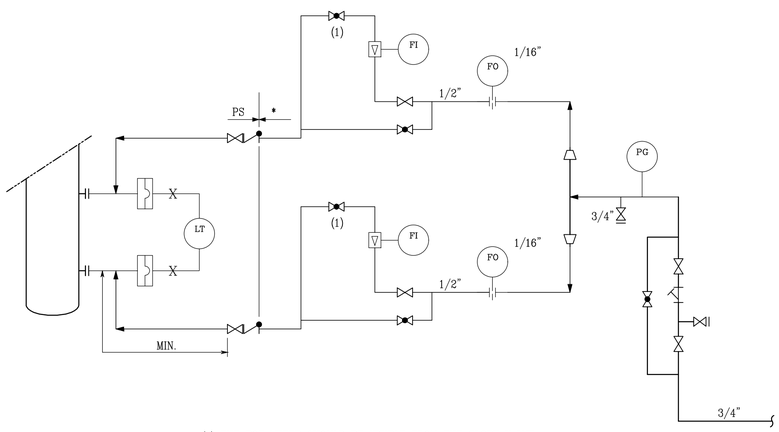
DETAIL-OP-2
OIL PURGE (OP) DETAIL FOR FLOW INSTRUMENTS



(1) THE ROTAMETER SHOULD BE VISIBLE FROM THE GLOBE VALVE.

* PIPE SPEC OF PURGE CONNECTION PIPING

DETAIL-OP-3
OIL PURGE (OP) DETAIL FOR LEVEL INSTRUMENTS



(1) THE ROTAMETER SHOULD BE VISIBLE FROM THE GLOBE VALVE.

* PIPE SPEC OF PURGE CONNECTION PIPING

NOTES:

1. 3/4" BLINDED UTILITY CONNECTION.
2. VALVES AND PIPING SHALL BE OF THE SAME METALLURGY TYPE AND CLASS AS SHOWN ON THE PIPING AND INSTRUMENT DIAGRAM. AND INSTRUMENT DIAGRAM.
3. THE REQUIREMENTS FOR HEAT TRACING AND INSULATION AND THE OBJECTIVE TEMPERATURE SHALL BE AS SHOWN AT THE CONTROL VALVE SERVICE ON THE PIPING VALVE.
4. TO CLOSED DRAIN (ABD/CBD) HEADER.
5. FOR HAZARDOUS FLUIDS, DRAIN SHALL BE PROVIDED ON BOTH U/S & D/S OF CONTROL
6. WHERE PIPING IS EXPANDED AFTER A CONTROL VALVE ASSEMBLY THE BLOCK VALVE DOWNSTREAM OF THE CONTROL VALVE SHALL BE EQUAL TO, OR ONE SIZE SMALLER, THAN THE EXPANDED DOWNSTREAM PIPING.
7. GLOBE VALVE TYPE FOR LINE SIZE $< 12"$, GATE OR BUTTERFLY VALVE TYPE FOR LINE SIZE $\geq 14"$.
8. RATING AND FLANGE FACING TO BE SHOWN ON PID ONLY IF DIFFERENT THAN PIPING CLASS.
9. 1" BLEEDERS SHALL BE PROVIDED UPSTREAM AND DOWN STREAM OF ALL CONTROL VALVES IN CONGEALING HYDROCARBON LINES. THIS SHALL BE DECIDED ON CASE TO CASE BASIS DURING DETAILED ENGINEERING.

HOLD:

LEGENDS:

PS: PROCESS SPECIFICATION.
DLS: DRAIN LINE SPECIFICATION.
FLS: FLARE LINE SPECIFICATION.
— — — — SHOWN ON PIPING AND INSTRUMENTATION DIAGRAM.

REFERENCE DOCUMENTS

DOC NO	DOC TITLE	REV.

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C1	21/12/2022	APPROVED FOR CONSTRUCTION	BSG	SCB	SCB	
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D2	24/11/2021	APPROVED FOR DESIGN	RSA / SS	RK	SCB	
D1	23/03/2021	APPROVED FOR DESIGN	BSG	RK	SCB	
A1	26/10/2020	ISSUED FOR REVIEW	RSA / SS	RK	SCB	

TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020
TP Document NO.: 082176C-ZZZ-PID-0090-0006-01

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE –
CONTROL VALVE VENT & DRAIN, INSTRUMENT PURGING DETAILS

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0006.01	C1	01 OF 01

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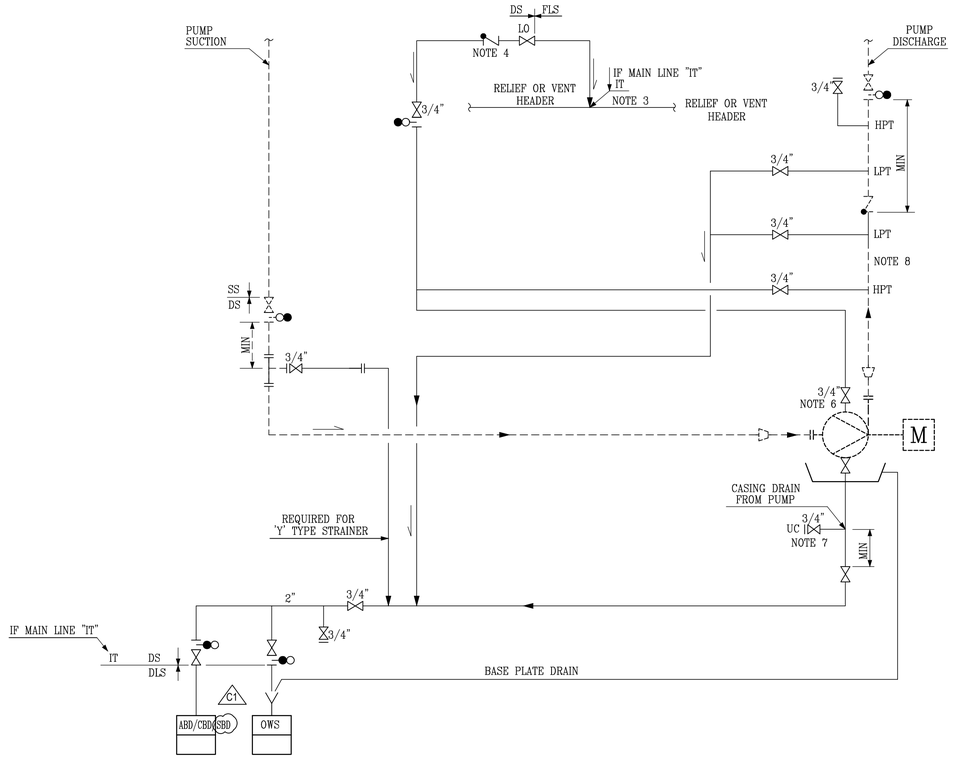
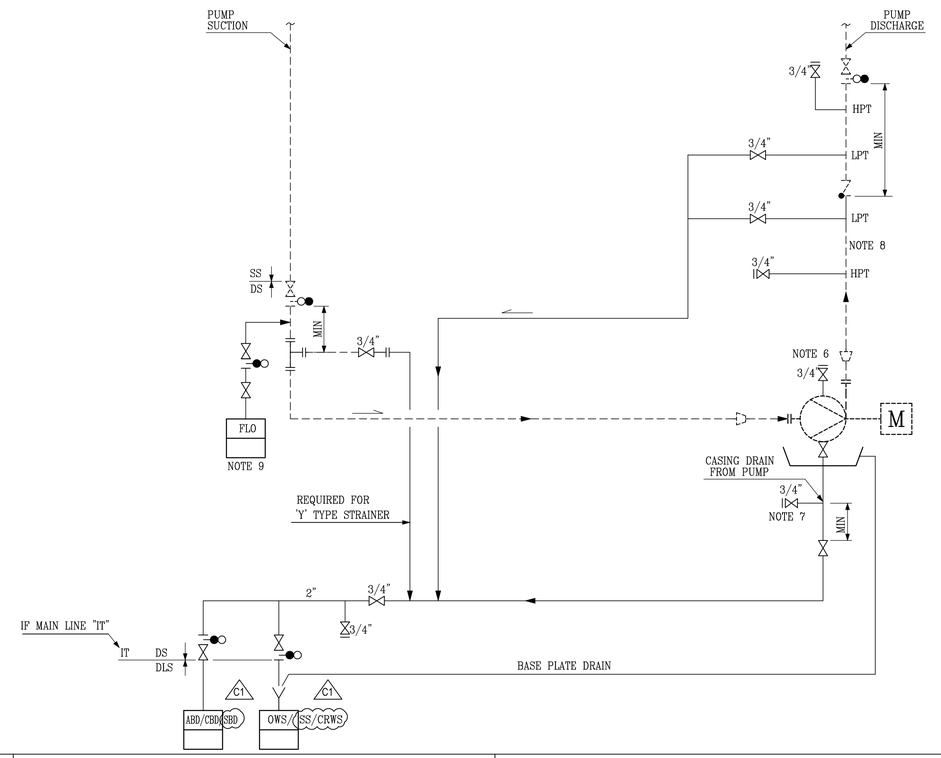
PUMP VENT AND DRAIN SYSTEM (HAZARDOUS)
TYPE-1



PUMP DRAIN SYSTEM (HAZARDOUS)
TYPE-2 (HEAVY LIQUIDS)

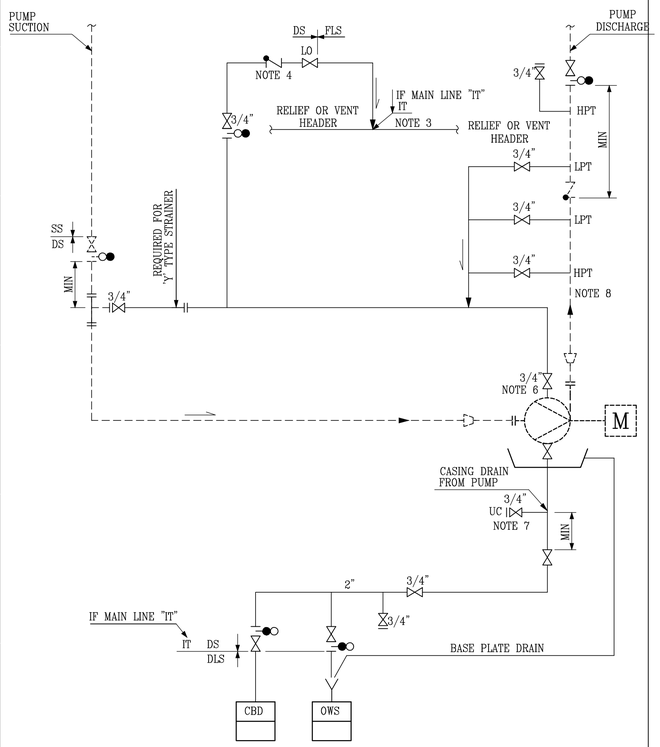


NOTES:

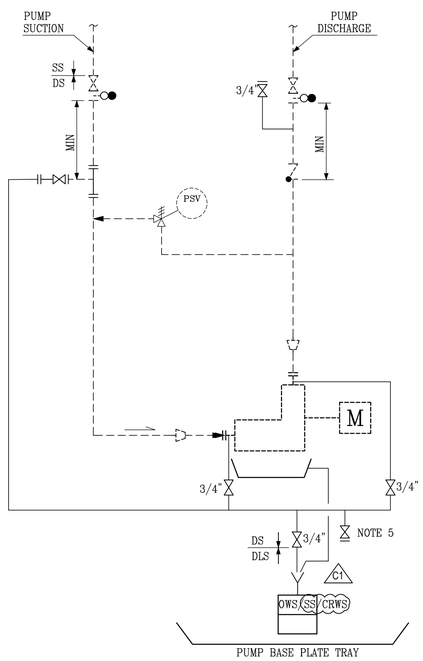
1. VALVES AND PIPING SHALL BE OF THE SAME METALLURGY TYPE AND CLASS AS SHOW ON THE PIPING AND INSTRUMENT DIAGRAM.
2. THE REQUIREMENTS FOR HEAT TRACING AND INSULATION AND THE OBJECTIVE TEMPERATURE SHALL BE AS SHOWN AT THE PUMP SERVICE ON THE PROCESS PIDs.
3. MAKE CONNECTION ON TOP OF FLARE HEADER.
4. CHECK VALVE TO BE LOCATED ON HORIZONTAL RUN.
5. DRAIN PROVISION FOR COLLECTING THE CHEMICALS IN DRUMS.
6. CASING VENT IF SUPPLIED BY VENDOR.
7. 3/4" BLINDED UTILITY CONNECTION.
8. HPT / LPT CONNECTION TO BE DECIDED BASED ON DISCHARGE LINE ROUTING ARRANGEMENT.
9. PROVIDE FLUSHING OIL CONNECTION TO SUCTION LINE ONLY IN CASE OF CONGEALING SERVICE PUMP.
10. FLUSHING OIL CONNECTION IS SHOWN IN RESPECTIVE PUMP P&ID FOR CONGEALING SERVICES.

HOLD:

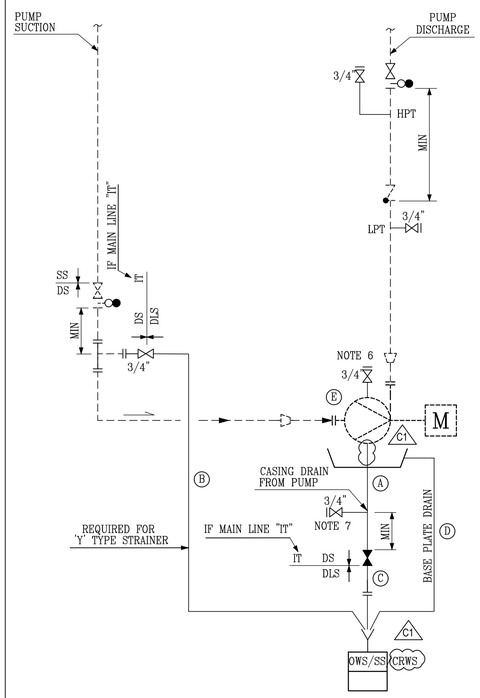
PUMP VENT AND DRAIN SYSTEM (HAZARDOUS)
(HIGH VAPOUR PRESSURE LIQUIDS)
TYPE-3



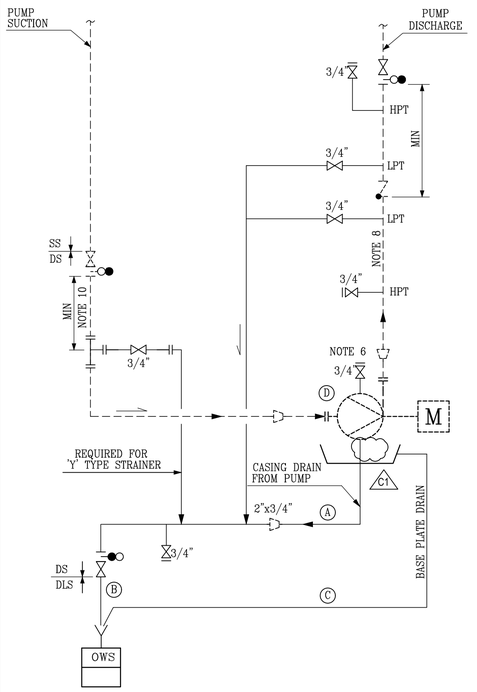
METERING AND RECIPROCATING
TYPE-4



(NON-HAZARDOUS)
TYPE-5



PUMP VENT AND DRAIN SYSTEM FOR OFFSITES
(HAZARDOUS)
TYPE-6



LEGENDS:

SPECIFIC LEGEND:

DS : DISCHARGE LINE SPECIFICATION.
SS : SUCTION LINE SPECIFICATION.
DLS : DRAIN LINE SPECIFICATION.
FLS : FLARE LINE SPECIFICATION.

— — — — SHOW ON PIPING AND INSTRUMENTATION DIAGRAM.

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TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020
TP Document NO.: 082176C-ZZZ-PID-0090-0007-01

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE –
PUMP VENT AND DRAIN DETAILS

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0007.01	C1	01 OF 01

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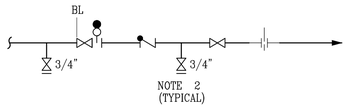
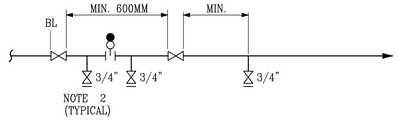
ISOLATION PHILOSOPHY HOOK-UP

PROCESS BATTERY LIMITS

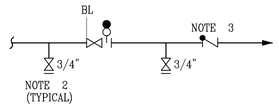


1) GENERAL LOW PRESSURE HYDROCARBON

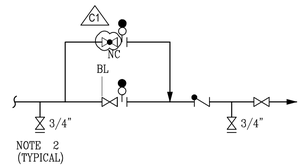


2) TWO WAY ISOLATION (DOUBLE BLOCK & BLEED)

UTILITY BATTERY LIMITS

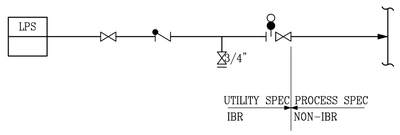


1) GENERAL UTILITY – SERVICE/DRINKING WATER, PLANT AIR, N2



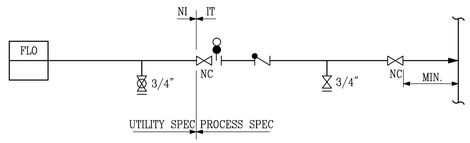
2) STEAM CONNECTION (NOTE 8)

ISOLATION OF UTILITY FROM PROCESS SYSTEMS



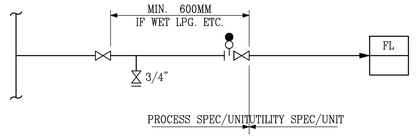
1) STEAM OUT CONNECTION

ISOLATION OF FLUSHING OIL SUPPLY & RETURN SYSTEM

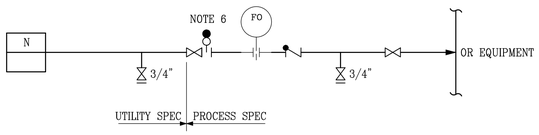


1) FLUSHING OIL SUPPLY

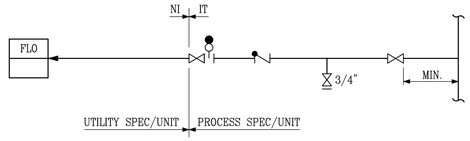
ISOLATION FROM FLARE



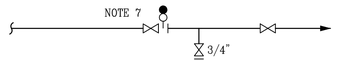
PROCESS SEGREGATION



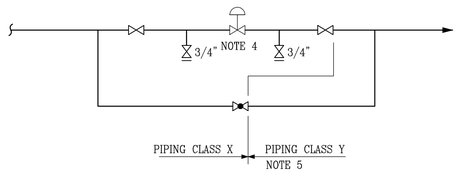
2) NITROGEN PROCESS TIE-IN



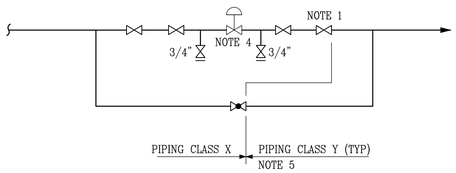
2) FLUSHING OIL RETURN



CONTROL VALVE ISOLATION



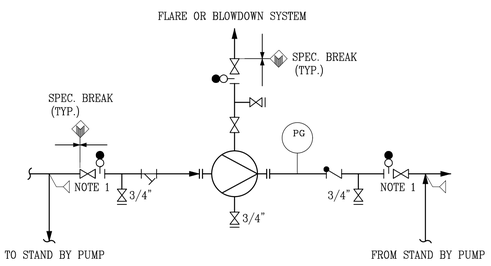
2) GENERAL SERVICE



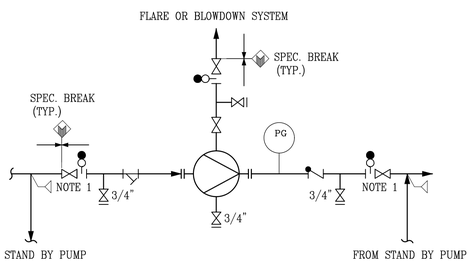
2) HIGH PRESSURE SERVICE

PUMP ISOLATION

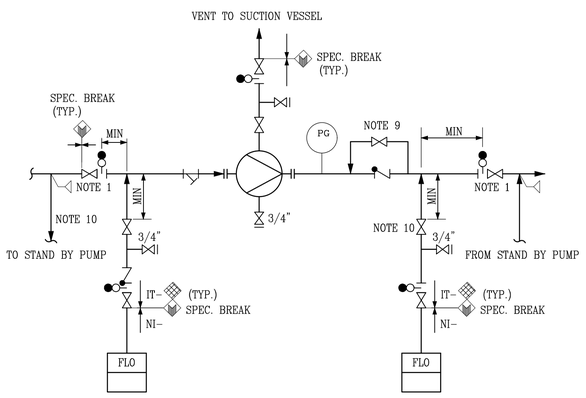
1) HIGH VAPOUR PRESSURE / BUBBLE POINT SERVICE



2) GENERAL SERVICE



3) HIGH TEMPERATUR / HIGH POUR POINT SERVICE



NOTES:

1. DOUBLE BLOCK AND BLEED VALVES REQUIRED AS PER DESIGN PHILOSOPHY.
2. DRAIN VALVE SIZE IS DEPENDENT ON PROCESS/UTILITY LINE SIZE.
3. NITROGEN MAY HAVE NRV OR TRIP SYSTEM BASED ON DIFFERENTIAL PRESSURE CONTROLLERS.
4. CONTROL VALVE FAILURE ACTION TO BE SHOWN.
5. PIPING CLASS MAY NOT NECESSARILY CHANGE ACROSS THE CONTROL VALVE. WHERE DOWNSTREAM SYSTEM HAS HIGHER RATING SPEC BREAK LOCATION NEED TO BE REVIEWED.
6. WHEN NITROGEN MAY BE FREQUENTLY USED DURING NORMAL OPERATION USE THIS DETAIL WHEN USED AS AN ALTERNATE TO STEAM OUT USE SAME DETAIL AS FOR STEAM OUT.
7. BLIND IS OPTIONAL.
8. FOR OTHER UTILITY SERVICES BYPASS VALVE NOT REQUIRED.
9. APPLIES TO SINGLE STAGE PUMPS >260°C OR MULTISTAGE PUMP >204°C MAY ALSO APPLY TO COLD SERVICES, WHERE PUMP NEEDS TO BE COOLED.
10. FLUSHING POINTS MAY BE REQUIRED WHERE THE VISCOSITY >43CST @ 40°C OR POUR POINT IS ABOVE AMBIENT.

HOLD:

LEGENDS:

REFERENCE DOCUMENTS

DOC NO	DOC TITLE	REV.

Rev.	Date	Reason for Issue	Prepared	Checked	Approved	Owner Approved
C1	21/12/2022	APPROVED FOR CONSTRUCTION	BSG	SCB	SCB	
D2	12/04/2022	APPROVED FOR DESIGN	MNSP/SG	RK	SCB	
D1	23/03/2021	APPROVED FOR DESIGN	BSG	RK	SCB	
A1	26/10/2020	ISSUED FOR REVIEW	RSA / SS	RK	SCB	

TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020

TP Document NO.: 082176C-ZZZ-PID-0090-0008-01

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
ISOLATION HOOK-UP DIAGRAM

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0008.01	C1	01 OF 01

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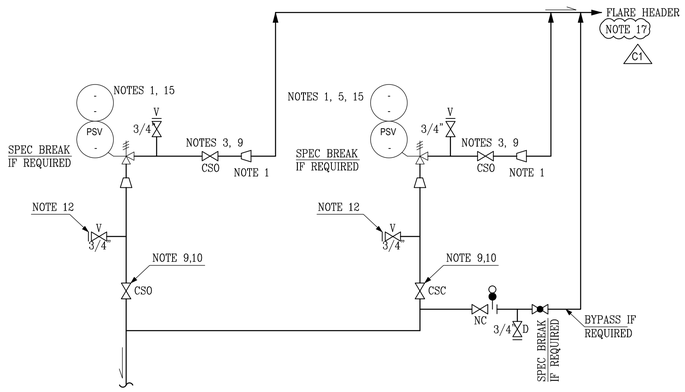
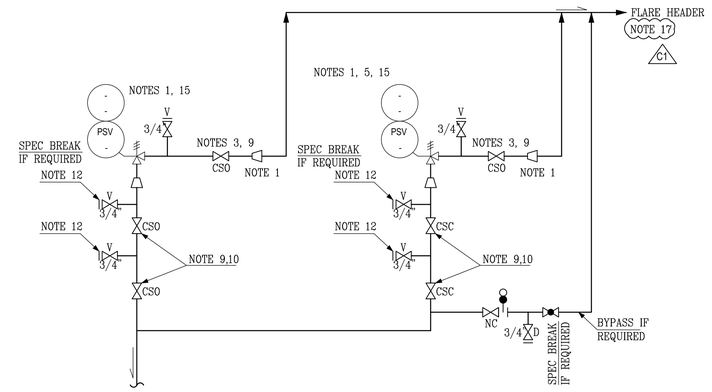
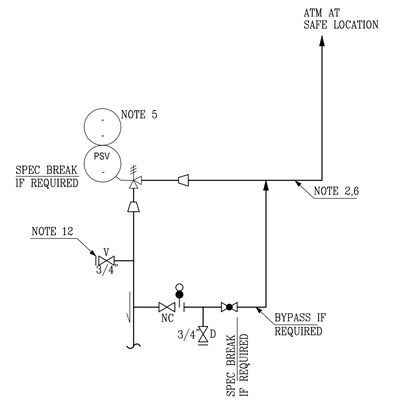
DETAIL 1: PSV' INSTALLATION (NOTE 7)



DETAIL 2: PSV' (FOR NON IBR LINE @ SAFE LOCATION) DOUBLE BLOCK AND BLEED VALVING (NOTE 7)



DETAIL 3: PSV' (FOR IBR) DISCHARGE TO ATM AT SAFE LOCATION



NOTES:

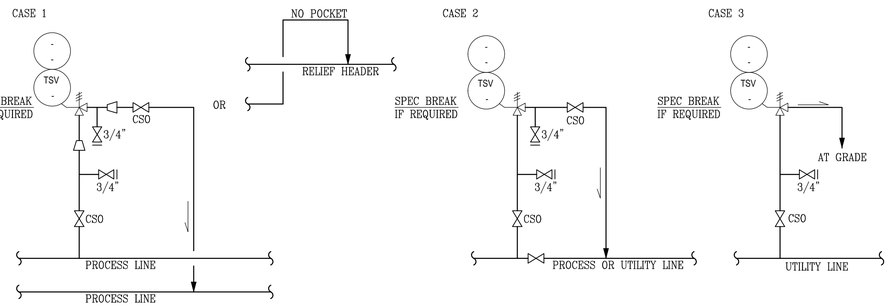
1. DISTANCE BETWEEN PSV AND REDUCER TO BE MINIMIZED.
2. DRIP HOLE AT LOW POINT (Ø= 13MM).
3. DOWNSTREAM BLOCK VALVE IS INSTALLED AS CLOSE AS POSSIBLE WITH PSV. IF BUILT-UP BACK PRESSURE IS TOO HIGH, THIS BLOCK VALVE IS INSTALLED DOWNSTREAM OF THE REDUCER.
4. INSTALLATION OF BYPASS FORESEEN CASE BY CASE DEPENDS ON PROCESS REQUIREMENT.
5. SPARING OF RELIEF VALVES TO BE ON CASE BY CASE BASIS, BASED ON PROCESS REQUIREMENT.
6. IN CASE OF FLUID WITH HIGH TEMPERATURE, DRAIN LINE TO SAFE LOCATION TO BE CONFIRMED.
7. VALVE SELECTION SHALL BE AS PER PIPING CLASS.
8. SPEC BREAK LOCATION TO BE DETERMINED ON CASE BY CASE BASIS BY PROCESS.
9. BLOCK VALVES TO BE INSTALLED WITH STEM ORIENTED DOWNWARDS (PREFERABLY) OR HORIZONTALLY.
10. FB TO BE INDICATED ON BLOCK VALVES UPSTREAM PSV'S WHEN DIAMETER IS BELOW THAN 2" (VALVES > 2" ARE FB BY DEFAULT).
11. BLOCK VALVE WITH DISTANCE 600 MIN IS ONLY REQUIRED IN CASE OF COLD DEPRESSURISATION TO AVOID ICING OF THE BLOCK VALVE AND FOR ALL SERVICES WITH RATING ≥ 600#.
12. FOR LPG SERVICE PROVIDE BALL VALVE TYPE.
13. INLET BLOCK VALVE FOR PRESSURE SAFETY VALVE FOR SPARED EQUIPMENT SHALL BE OMITTED.
14. ALL PSV UPSTREAM PIPING SHALL BE FREE DRAINING TOWARDS VESSEL AND DOWN STREAM TOWARDS FLARE HEADER. PSV DISCHARGE SHALL JOIN FLARE HEADER AT AN ANGLE OF 45 DEGREE IN THE DIRECTION OF FLOW.
15. PSV ISOLATION VALVES (UPSTREAM/DOWNSTREAM) SHALL BE OF FULL PORT SIZE FOR TESTING 3/4" CONNECTION AT INDIVIDUAL PSV INLET & OUTLET LINE.
16. PROVIDE TRACING ON PSV WHEN NECESSARY TO AVOID ANY FREEZING OF SAFETY VALVE, CASE BY CASE BY PROCESS.
17. DESTINATION FOR DISCHARGE OF FLUID MAY BE CBD/ABD/SBD/OTHER INSTEAD OF FLARE AS APPLICABLE DEPENDING ON SERVICE.

C1

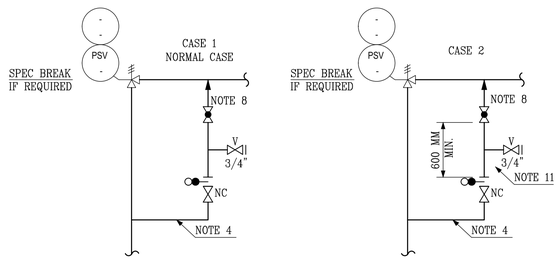
GENERAL NOTE:

1. THIS LEGEND SHEET COVERS THE GENERAL REQUIREMENTS TO BE FOLLOWED FOR ALL PSV'S AND ASSOCIATED PIPING. THESE INSTALLATION DETAILS AND REQUIREMENTS ARE TO BE FOLLOWED IN CONJUNCTION WITH PROCESS PID.

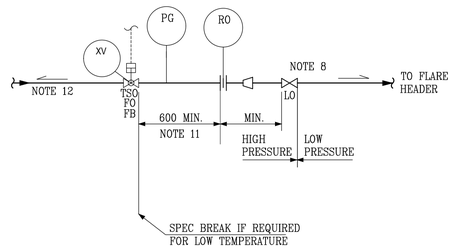
DETAIL 4: THERMAL EXPANSION RELIEF VALVES ARRANGEMENT (NOTE 7)



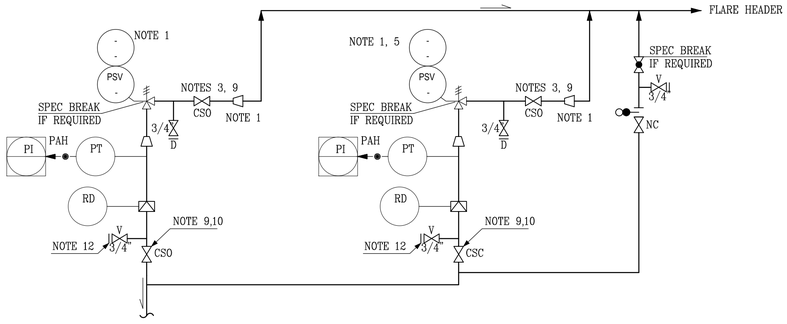
DETAIL 5: SAFETY VALVE MANUAL DEPRESSURIZATION (NOTE 7)



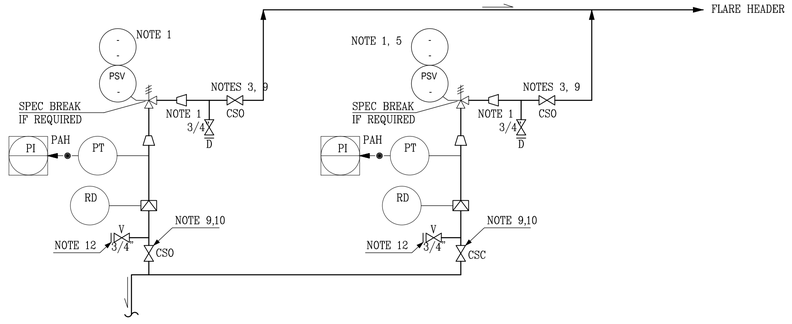
DETAIL 6: DEPRESSURIZATION VALVE ARRANGEMENT (NOTE 7)



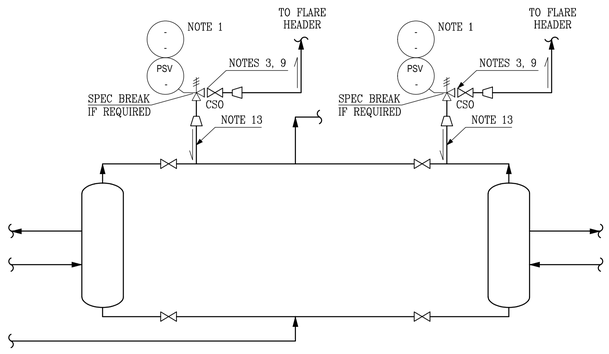
DETAIL 7: PSV ARRANGEMENT WITH RUPTURE DISC AND MANUAL DEPRESSURIZATION (NOTE 7)



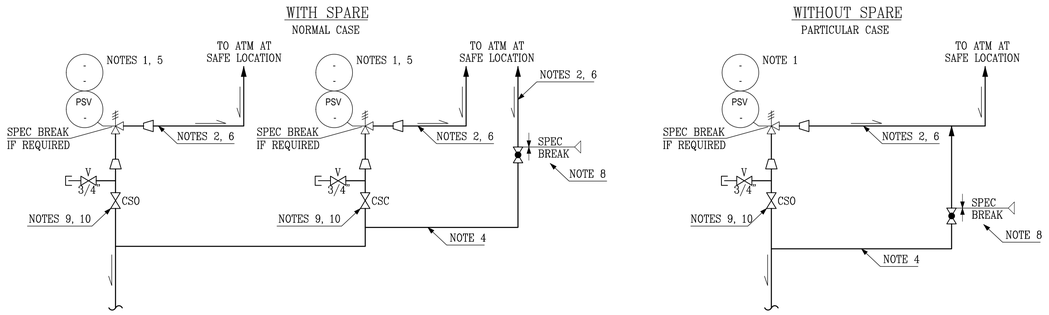
DETAIL 8 : PSV ARRANGEMENT WITH RUPTURE DISC (NOTE 7)



DETAIL: 9 PSV ON EQUIPMENT WITH INSTALLED SPARE OR UNSPARED EQUIPMENT IN NON PERMANENT SERVICE (NOTE 7)



DETAIL: 10 PSV TO ATMOSPHERE (NOTE 7)



HOLD:

LEGENDS:

REFERENCE DOCUMENTS

DOC NO	DOC TITLE	REV.

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D2	11/03/2021	APPROVED FOR DESIGN	MNSP/SG	RK	SCB	
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A1	26/10/2020	ISSUED FOR REVIEW	RSA / SS	RK	SCB	

TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020

TP Document NO.: 082176C-ZZZ-PID-0090-0009-01

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE –
TYPICAL DETAILS FOR RELIEF VALVE ARRANGEMENTS

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0009.01	C1	01 OF 01

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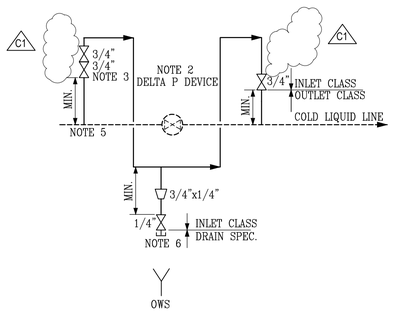
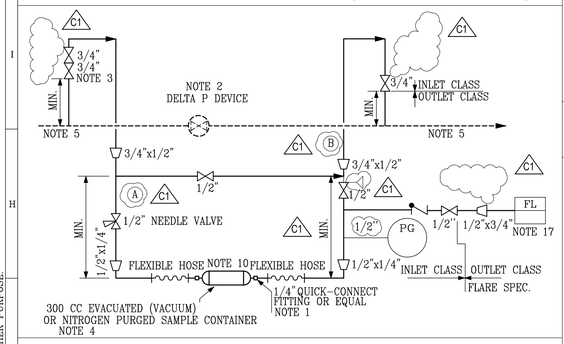
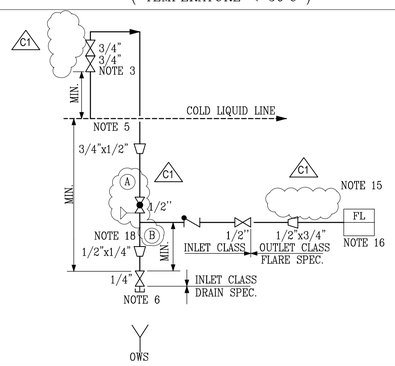
TYPE 'A'
NON HAZARDOUS AND LOW TEMPERATURE LIQUID SAMPLE
(TEMPERATURE < 50°C)



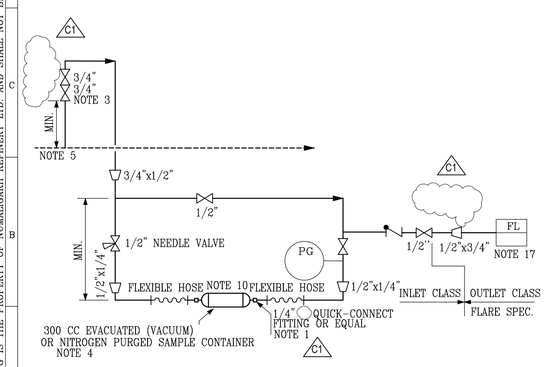
TYPE 'B'
LOW TEMPERATURE GAS OR FLASHING LIQUID
OR HAZARDOUS LIQUID SAMPLE (TEMPERATURE < 50°C)



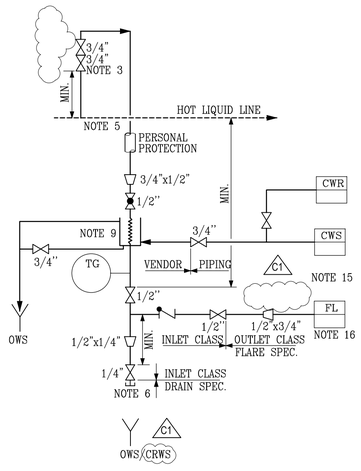
TYPE 'C'
NON HAZARDOUS AND LOW TEMPERATURE LIQUID SAMPLE
(TEMPERATURE < 50°C)



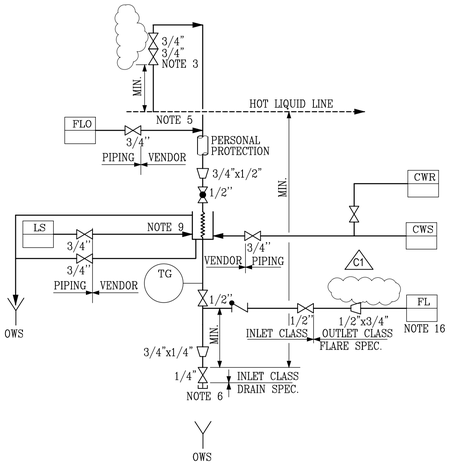
TYPE 'D'
LOW TEMPERATURE GAS OR FLASHING LIQUID
OR HAZARDOUS LIQUID SAMPLE (TEMPERATURE < 50°C)



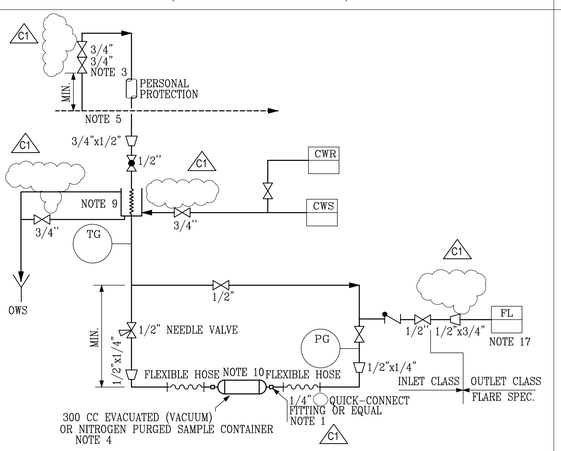
TYPE 'E'
NON HAZARDOUS AND HIGH TEMPERATURE LIQUID SAMPLE
(TEMPERATURE > 50°C)



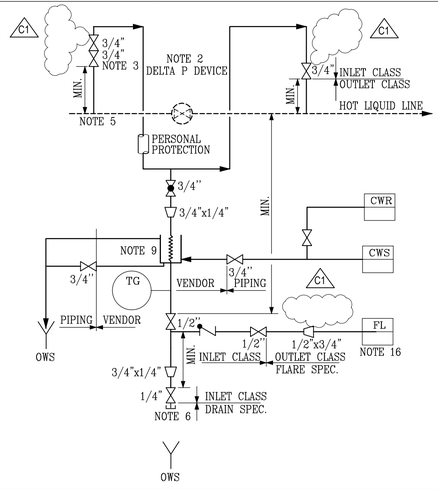
TYPE 'F'
NON HAZARDOUS AND HIGH TEMPERATURE AND HIGH POUR POINT
LIQUID SAMPLING (TEMPERATURE > 50°C)



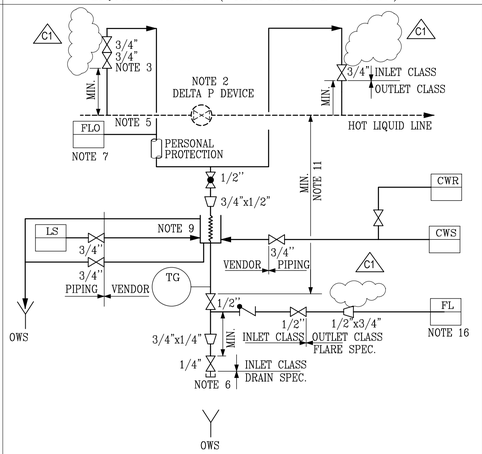
TYPE 'G'
HIGH TEMPERATURE GAS OR FLASHING LIQUID OR HAZARDOUS LIQUID SAMPLE
(TEMPERATURE > 50°C)



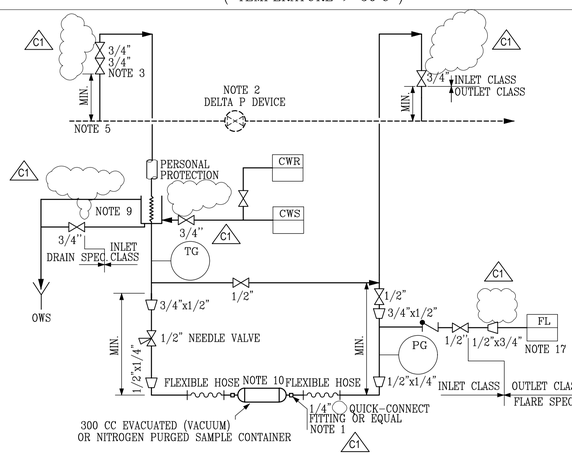
TYPE 'H'
NON HAZARDOUS AND HIGH TEMPERATURE LIQUID SAMPLE
(TEMPERATURE > 50°C)



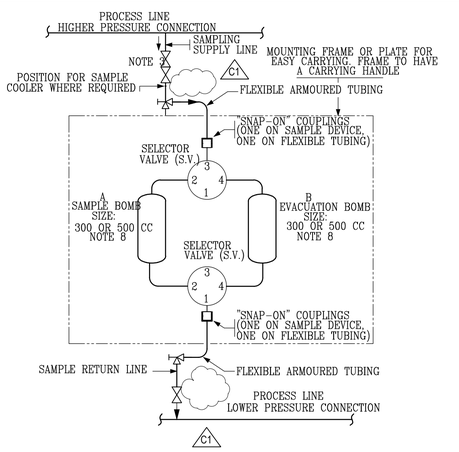
TYPE 'J'
NON HAZARDOUS AND HIGH TEMPERATURE AND HIGH POUR POINT
LIQUID SAMPLING (TEMPERATURE > 50°C)



TYPE 'K'
HIGH TEMPERATURE GAS OR FLASHING LIQUID SAMPLE
(TEMPERATURE > 50°C)



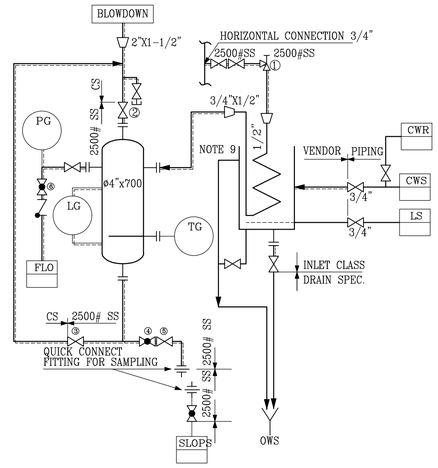
TYPE 'L'
SAMPLING DEVICE FOR VERY HAZARDOUS MATERIAL



TYPE 'N'
CATALYST SAMPLING

NOTE-14

TYPE 'M'
HIGH PRESSURE LIQUID/VAPOR SAMPLE



NOTES:

1. FOR OPERATING PRESSURE UNDER 125 kg/cm2 USE QUICK-CONNECTS.
2. DELTA P DEVICE IS ANY DEVICE OR INSTRUMENT THAT CREATES A PRESSURE DROP TO ENSURE A SUFFICIENT FLOW THROUGH THE LOOP.
3. USE DOUBLE BLOCK FOR ANY CLASS 900 LINES OR HIGHER AND FOR H2 OR H2S SERVICES.
4. FOR OPERATING PRESSURE UNDER 125 kg/cm2 USE SAMPLE BOTTLE OR EQUAL FOR OPERATING PRESSURE 125kg/cm2 AND ABOVE USE XXS 304L PIPE CYCLINDER.
5. TAKE SAMPLE CONNECTION FROM TOP HORIZONTAL LINE,AND FROM SIDE OF VERTICAL LINE.
6. ALL OPEN ENDS OF SAMPLE CONNECTIONS WILL BE 45° ANGLE WITH 75 mm MINIMUM EXTENSION.
7. USE OIL FLUSH AFTER SAMPLING HEAVY LIQUID.
8. ALL SAMPLING BOMBS SHOWN ON THIS PID SHOULD BE EQUIPPED WITH BLOCK VALVES ON EACH SIDE.
9. THE COOLING BOX SHALL BE INTERNALLY COVERED WITH "EPOXY" THE COIL SHALL BE TUBING SPEC OR SS.
10. A SUPPORT FOR THE CYLINDER "BOMB" SHALL BE FORESEEN.
11. SAMPLING SYSTEM LENGTH MUST BE MINIMUM TO LIMIT THE PRODUCT LOST WHEN FLUSHING.
12. FLARE DRUM ALLOWING MIXED PHASE SEPARATION UNDER FLARE PRESSURE. 1-2 LITERS OF LIQUID ARE EXPECTED BEFORE FEEDING LIQUID TO THE SAMPLING SYSTEM.
13. A SUPPORT FOR THE SAMPLE CYLINDER SHALL BE FOR SEEN.
14. SPECIFIC SAMPLING SYSTEM ARRANGEMENT REFER TO RESPECTIVE LICENSOR P&IDs
15. NOT REQUIRED FOR NON-HC SERVICE.
16. DESTINATION FOR DISCARDING THE FLUID MAY BE CBD INSTEAD OF FLARE, AS APPLICABLE DEPENDING ON THE SERVICE.
17. DESTINATION FOR DISCARDING THE FLUID MAY BE SWS (SOUR WATER BLOWDOWN) OR ABD (AMINE BLOWDOWN), INSTEAD OF FLARE, AS APPLICABLE DEPENDING ON THE SERVICE.
18. FOR NON HC SERVICE REDUCER TO BE 3/4"x1/4".
19. SAMPLING SYSTEM SHALL BE A SKID ASSEMBLY.VENDOR/ INSTRUMENTATION/ PIPING SCOPE BREAK SHALL BE UPDATED BY CONTRACTOR.

HOLD:

LEGENDS:

REFERENCE DOCUMENTS

DOC NO	DOC TITLE	REV.

Rev.	Date	Reason for Issue	Prepared	Checked	Approved	Owner Approved
C1	21/12/2022	APPROVED FOR CONSTRUCTION	BSG	SCB	SCB	
D2	11/03/2021	APPROVED FOR DESIGN	MNSP/SG	RK	SCB	
D1	23/03/2021	APPROVED FOR DESIGN	BSG	RK	SCB	
A1	26/10/2020	ISSUED FOR REVIEW	RSA / SS	RK	SCB	

TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020

TP Document NO.: 082176C-ZZZ-PID-0090-0010-01

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE -
SAMPLE CONNECTIONS DETAILS -1

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0010.01	C1	01 OF 02

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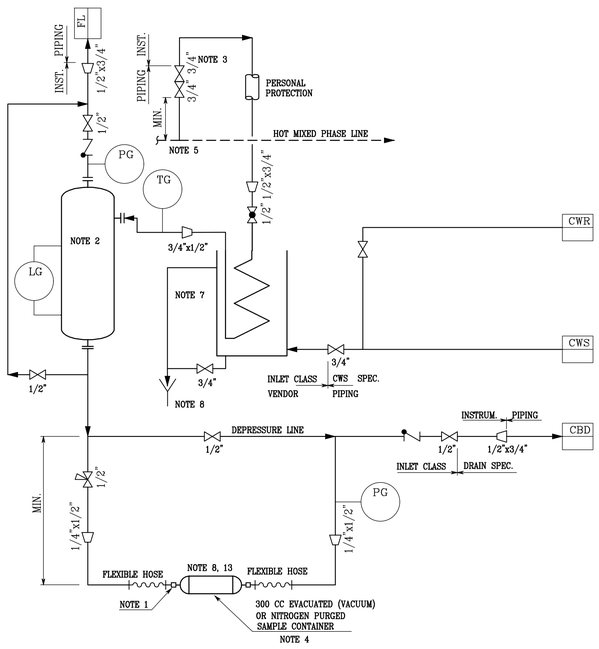
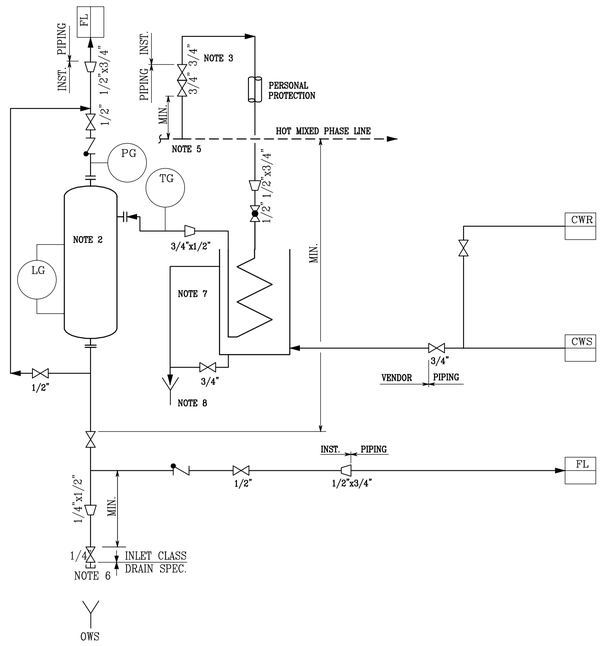
TYPE 'Q'

HAZARDOUS AND HIGH TEMPERATURE LIQUID/VAPOR SAMPLE
(TEMPERATURE GREATER THAN 50°C)



TYPE 'R'

NON HAZARDOUS AND HIGH TEMPERATURE LIQUID/VAPOR SAMPLE
(TEMPERATURE GREATER THAN 50°C)



NOTES:

1. FOR OPERATING PRESSURE UNDER 125 kg/cm2 USE SWAGELOCK QUICK-CONNECTS.
   STEMS: SS-QT8-5-8PM
   BODIES: SS-QT8-8-8PM
   OR EQUAL.
   FOR OPERATING PRESSURE ABOVE 125 kg/cm2 USE SWAGELOCK QUICK-CONNECTS.
   STEMS: SS-QT2-5-4PM
   BODIES: SS-QT2-8-4PM
   OR EQUAL.
2. DELTA P DEVICE IS ANY DEVICE OR INSTRUMENT THAT CREATES A PRESSURE DROP TO ENSURE A SUFFICIENT FLOW THROUGH THE LOOP.
3. USE DOUBLE BLOCK FOR ANY CLASS 900 LINES OR HIGHER AND FOR H2 OR H2S SERVICES.
4. FOR OPERATING PRESSURE UNDER 125 kg/cm2 USE WHITEY 304L-HDF4-300 SAMPLE BOTTLE OR EQUAL FOR OPERATING PRESSURE 125kg/cm2 AND ABOVE USE XXS 304L PIPE CYLINDER.
5. TAKE SAMPLE CONNECTION FROM TOP HORIZONTAL LINE, AND FROM SIDE OF VERTICAL LINE.
6. ALL OPEN ENDS OF SAMPLE CONNECTIONS WILL BE 45° ANGLE WITH 75 mm MINIMUM EXTENSION.
7. THE COOLING BOX SHALL BE INTERNALLY COVERED WITH "EPOXY" THE COIL SHALL BE TUBING SPEC OR SS.
8. TO BE ROUTED TO BEARING COOLING WATER SUMP.
9. NOT REQUIRED FOR NON-HC SERVICE.

S.NO.	TECHNIP P&ID	TAG NO.	TYPE	PROCESS/VENT LINE	PROCESS/VENT LINE	COOLING WATER SUPPLY	COOLING WATER RETURN	DRAIN (TO BEARING COOLING WATER SUMP/ CBD)	PG	TG	LG

HOLD:

LEGENDS:

REFERENCE DOCUMENTS

DOC NO	DOC TITLE	REV.

Rev.	Date	Reason for Issue	Prepared	Checked	Approved	Owner Approved
D2	11/03/2021	APPROVED FOR DESIGN	MNSP/SG	RK	SCB	
D1	23/03/2021	APPROVED FOR DESIGN	BSG	RK	SCB	
A1	26/10/2020	ISSUED FOR REVIEW	RSA / SS	RK	SCB	

TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020
TP Document NO.: 082176C-ZZZ-PID-0090-0010-02

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE -
SAMPLE CONNECTIONS DETAILS -2

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0010.02	D2	02 OF 02

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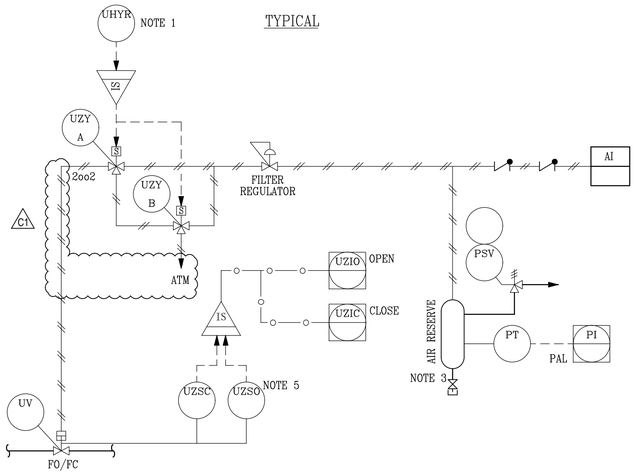
ON/OFF VALVE TYPICALS

TYPICAL 1: SINGLE-ACTING ON/OFF VALVE FOR SAFETY ISOLATION / DEPRESSURING SYSTEM WITH AIR RESERVE

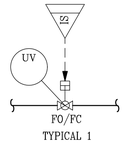
TYPICAL



– RESERVOIR REQUIREMENT IS INDICATED IN CORRESPONDING P&ID AS A NOTE, WHEREVER APPLICABLE.

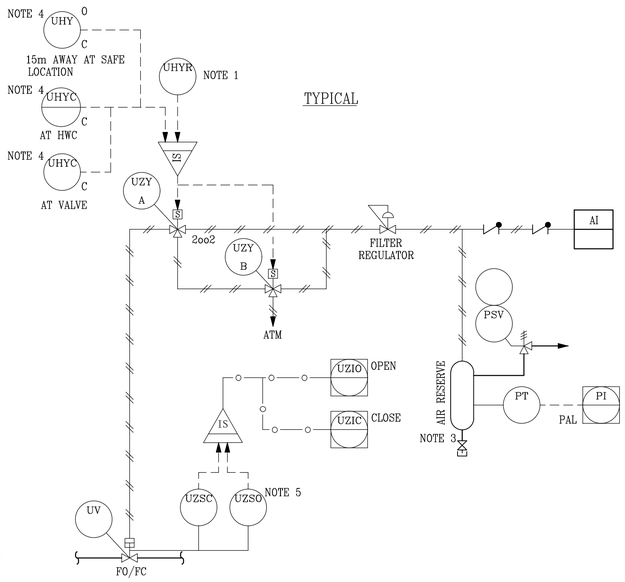
– AIR RESERVIOR IN STAINLESS STEEL OR ADEQUATE MATERIAL TO AVOID CORROSION.

P&ID REPRESENTATION



TYPICAL 2: SINGLE-ACTING ON/OFF VALVE FOR SAFETY / FUNCTION ENSURING MORE PROCESS AVAILABILITY WITH AIR RESERVE

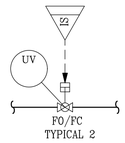
TYPICAL



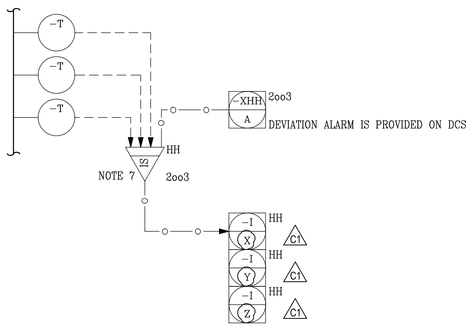
– RESERVOIR REQUIREMENT IS INDICATED IN CORRESPONDING PROCESS P&ID AS A NOTE, WHEREVER APPLICABLE.

– AIR RESERVIOR IN STAINLESS STEEL OR ADEQUATE MATERIAL TO AVOID CORROSION.

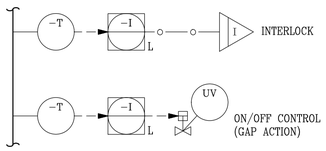
P&ID REPRESENTATION



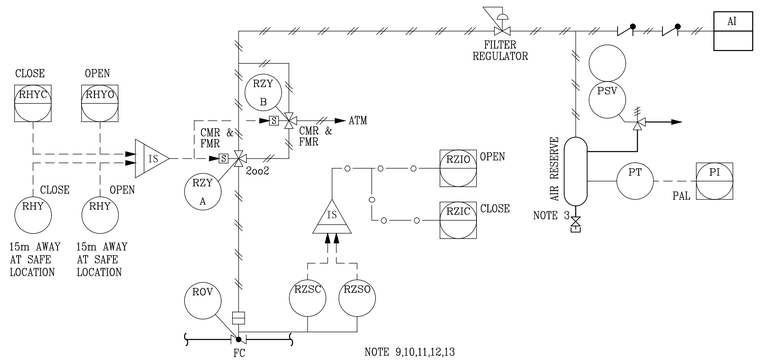
TYPICAL ESD LOGIC DESIGN VOTING 2oo3



TYPICAL DCS LOGIC DESIGN



TYPICAL ROV DETAILS



NOTES:

1. PUSH BUTTON RESET, LOCATED NEAR ON/OFF VALVE. SEPARATE FIELD RESET SWITCH TO BE PROVIDED FOR FIRE CASE ESD VALVE.
2. CONTRACTOR TO FOLLOW SCHEME SHOWN IN THIS P&ID. OWNER/PMC APPROVAL SHALL BE TAKEN IN CASE ANY MODIFICATION IS REQUIRED TO THE SCHEME.
3. AIR RESERVE TO BE SIZED FOR MINIMUM 3 STROKES OVER FULL TRAVEL OF THE VALVE.
4. REQUIRED ONLY FOR INVENTORY ISOLATION VALVES. INVENTORY ISOLATION VALVES SHALL BE PROVIDED AS PER DOCUMENT "PROCESS DESIGN BASIS/OVERALL SECTION 11.1 (DOC.NO.TP-1ZZZA-PR-BOD-0001)
5. FOR ALL INVENTORY ISOLATION VALVES, DUAL PROXIMITY LIMIT SWITCHES TO BE PROVIDED, LIMIT SWITCH FEED BACK SIGNAL TO BE HARDWIRED TO ESD/PLC.
6. FOR REMOTE OPERATED VALVES (ROV), ADDITIONAL FIELD MOUNTED REMOTE OPERATED HAND SWITCH (OPEN/CLOSE) SHALL BE PROVIDED AT A SAFE LOCATION WITH VALVE POSITION STATUS.
7. INTERLOCK SHOWN HERE IS TYPICAL FOR 2oo3. FOR OTHER VOTING INTERLOCKS SIMILAR CONFIGURATION SHALL BE FOLLOWED.
8. INVENTORY ISOLATION VALVES AND ITS ASSOCIATED ACCESSORIES SHALL BE PROVIDED AS FIRE SAFE TYPE
9. ALL ROV'S TO INCLUDE VOLUME BOTTLE ARRANGEMENT TO HAVE ATLEAST TWO OPERATIONS OF THE ROV'S & SOV'S DURING INSTRUMENT (DIVERTED VALVES).
10. ALL SOV's SHOULD BE LOCATED CLOSE TO RESPECTIVE ROVs / DVs.
11. ROVs TO BE OUTSIDE THE ENCLOSURE WALL AND SHOULD BE FIRE SAFE WITH SAFE ACTUATOR.
12. ALL SOVs OF ROVs SHALL BE CMR & FMR TYPE AND TSO TYPE.
13. SOFTWARED EMERGENCY PUSH BUTTONS (ROV) SHALL BE PROVIDED IN CONTROL ROOM AND ALSO IN FIELD AT SAFE LOCATION FOR MANUAL ACTUATION.
14. VALVE PST WILL BE EQUIPPED WITH BOTH SMART POSITIONER AND PST POSITION LIMIT SWITCH (REDUNDANT 1oo2).
15. N2 CYLINDER BACKUP WILL BE CONSIDERED FOR DEPRESSURIZING VALVE.
16. IN CASE OF ANY ACTION BASED ON LIMIT SWITCH POSITION, THE INTERLOCK SHALL BE NUMBERED. IN CASE OF NO ACTION THROUGH LIMIT SWITCH, INTERLOCK SHALL NOT BE NUMBERED. THIS MEANS THAT THE SIGNAL IS HARDWIRED TO PLC/ESD.

HOLD:

LEGENDS:

REFERENCE DOCUMENTS

DOC NO	DOC TITLE	REV.

Rev.	Date	Reason for Issue	Prepared	Checked	Approved	Owner Approved
C1	21/12/2022	APPROVED FOR CONSTRUCTION	BSG	SCB	SCB	
D2	22/04/2022	APPROVED FOR DESIGN	MNSP/SG	RK	SCB	
D1	23/03/2021	APPROVED FOR DESIGN	BSG	RK	SCB	
A1	15/02/2021	ISSUED FOR REVIEW	RSA / SS	RK	SCB	

TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020

TP Document NO.: 082176C-ZZZ-PID-0090-0011-01

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE – CONTROL AND ON-OFF VALVE DETAIL – 1

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0011.01	C1	01 OF 02

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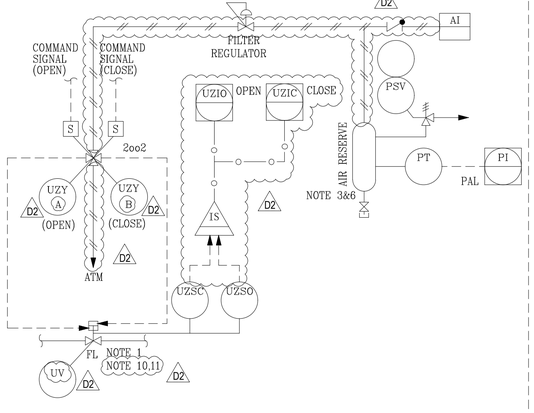
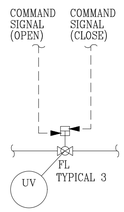
ON/OFF VALVE TYPICALS

TYPICAL 3: DOUBLE-ACTING ON/OFF VALVE FOR SAFETY FUNCTION WITH AIR RESERVE

TYPICAL



P&ID REPRESENTATION

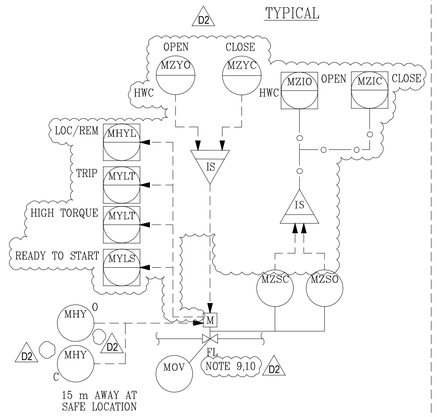


– RESERVOIR REQUIREMENT IS INDICATED IN CORRESPONDING PROCESS P&ID AS A NOTE, WHEREVER APPLICABLE.

– AIR RESERVIOR IN STAINLESS STEEL OR ADEQUATE MATERIAL TO AVOID CORROSION.

TYPICAL 4: MOTOR OPERATED ON/OFF VALVE

TYPICAL



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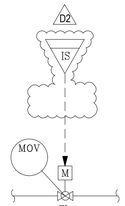
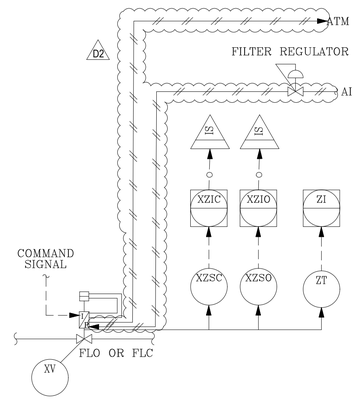


TYPICAL 5 : ON/OFF VALVE WITH RAMP (RAMP BY DCS)

TYPICAL



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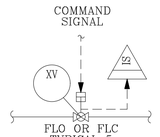


NOTES:–

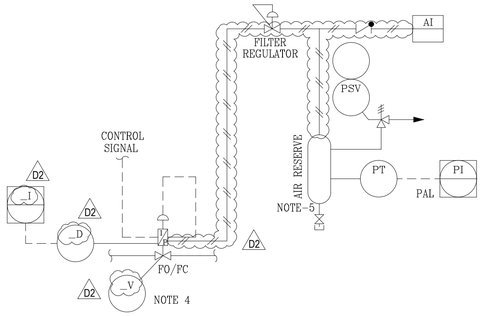
– COMMAND SIGNAL FROM BPCS IS ANALOGUE TYPE (4 TO 20 mA) FOR RAMPING PURPOSES.

– FLC = FAIL LOCKED IN CASE OF AIR FAILURE AND CLOSED IN CASE OF SIGNAL FAILURE.

– FLO = FAIL LOCKED IN CASE OF AIR FAILURE AND OPEN IN CASE OF SIGNAL FAILURE.

TYPICAL 6 : CONTROL VALVE WITH AIR RESERVE

TYPICAL



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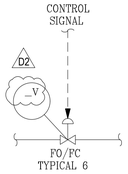
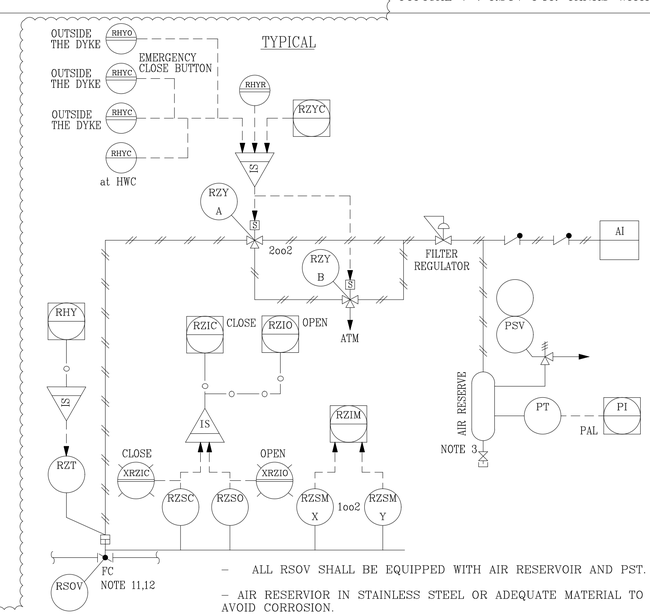


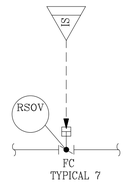
– AIR RESERVIOR IN STAINLESS STEEL OR ADEQUATE MATERIAL TO AVOID CORROSION.

TYPICAL 7 : RSOV FOR TANKS WITH AIR RESERVE

TYPICAL



P&ID REPRESENTATION

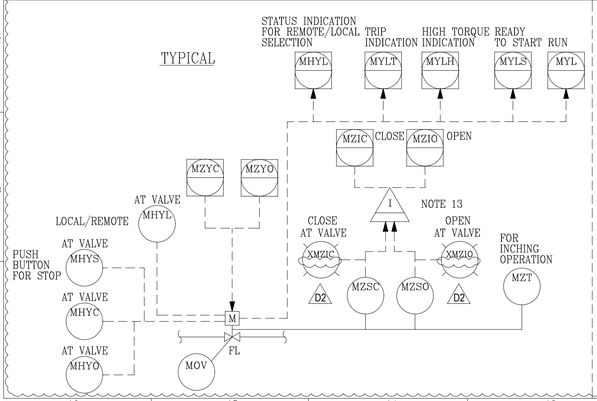


– ALL RSOV SHALL BE EQUIPPED WITH AIR RESERVOIR AND PST.

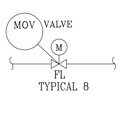
– AIR RESERVIOR IN STAINLESS STEEL OR ADEQUATE MATERIAL TO AVOID CORROSION.

TYPICAL 8 : MOTOR OPERATED ON/OFF VALVE FOR OFFSITES

TYPICAL

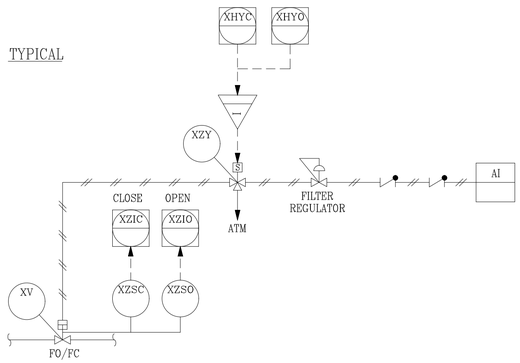


P&ID REPRESENTATION



TYPICAL 9 : ON/OFF VALVE WITH DCS

TYPICAL



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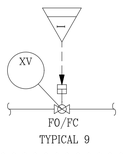

D2

NOTES:

1. PUSH BUTTON RESET, LOCATED NEAR ON/OFF VALVE.
2. CONTRACTOR SHALL FOLLOW SCHEME SHOWN IN THIS P&ID. OWNER/PMC APPROVAL SHALL BE TAKEN IN CASE ANY MODIFICATION IS REQUIRED TO THE SCHEME.
3. AIR RESERVE TO BE SIZED FOR MINIMUM 3 STROKES OVER FULL TRAVEL OF THE VALVE.
4. CONTROL VALVE MAY BE PV, LV, FV, TV OR PDV.
5. AIR RESERVE TO BE SIZED FOR 30 MINUTES OPERATION OF CONTROL VALVE.
6. ADDITIONAL N2 CYLINDER BACKUP SHALL BE PROVIDED. IN CASE BOTH INSTRUMENT AIR SUPPLY & RESERVOIR GOES BELOW LIMIT, THE ATTACHED PNEUMATIC RELAY WILL CHANGEOVER TO REGULATED N2 SUPPLY CYLINDER FOR ENABLING FURTHER OPERATION.
7. REQUIRED ONLY FOR INVENTORY ISOLATION VALVES. INVENTORY ISOLATION VALVES SHALL BE PROVIDED AS PER DOCUMENT "PROCESS DESIGN BASIS/OVERALL SECTION 11.1 (DOC.NO.TP-1ZZZA-PR-BOD-0001)
8. FOR ALL INVENTORY ISOLATION VALVES, DUAL PROXIMITY LIMIT SWITCHES TO BE PROVIDED, LIMIT SWITCH FEED BACK SIGNAL TO BE HARDWIRED TO ESD/PLC.
9. THERMOSTAT STATUS TO BE SHOWN IN PID, IN CASE OF SPACE HEATER.
10. IN CASE OF PST REQUIREMENT, SAME SHALL BE SHOWN IN PID.
11. VALVE PST WILL BE EQUIPPED WITH BOTH SMART POSITIONER AND PST POSITION LIMIT SWITCH (REDUNDANT 1oo2).
12.
a. FOUR NO'S OF FOLLOWING PST STATUS INDICATION TO BE PROVIDED IN LOCAL PANEL (FIELD).
XRZI-xxxxxxA->VALVE PST-ENABLED
XRZI-xxxxxxB->VALVE PST-RUNNING
XRZI-xxxxxxC->VALVE PST-SUCCESSFUL
XRZI-xxxxxxD->VALVE PST-SUCCESSFUL

b. FOUR NO'S OF FOLLOWING PST STATUS INDICATION TO BE PROVIDED IN HMI.
RZI-xxxxxxA->VALVE PST-ENABLED
RZI-xxxxxxB->VALVE PST-RUNNING
RZI-xxxxxxC->VALVE PST-SUCCESSFUL
RZI-xxxxxxD->VALVE PST-SUCCESSFUL

13. IN CASE OF ANY ACTION BASED ON LIMIT SWITCH POSITION, THE INTERLOCK SHALL BE NUMBERED. IN CASE OF NO ACTION THROUGH LIMIT SWITCH, INTERLOCK SHALL NOT BE NUMBERED.

D2

HOLD:

LEGENDS:

REFERENCE DOCUMENTS

DOC NO	DOC TITLE	REV.

Rev.	Date	Reason for Issue	Prepared	Checked	Approved	Owner Approved
D2	22/04/2022	APPROVED FOR DESIGN	MNSP/SG	RK	SCB	
D1	23/03/2021	APPROVED FOR DESIGN	BSG	RK	SCB	
A1	15/02/2021	ISSUED FOR REVIEW	RSA / SS	RK	SCB	

TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020

TP Document NO.: 082176C-ZZZ-PID-0090-0011-02

NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE – CONTROL AND ON-OFF VALVE DETAIL – 2

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0011.02	D2	02 OF 02

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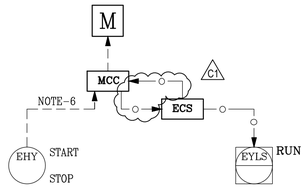
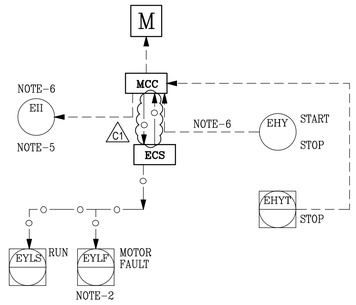
TYPICAL FOR MOTORS

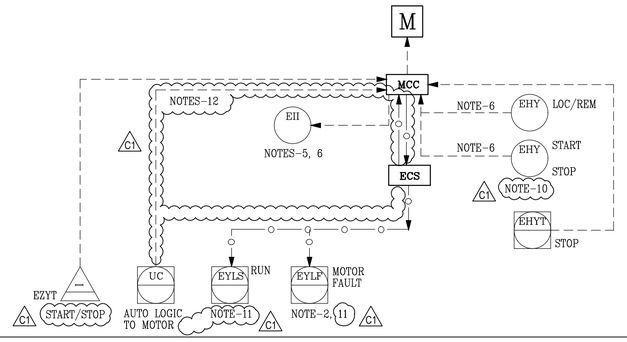
TYPICAL-1 / M0 : SIGNALS AND COMMANDS FOR THE MOTORS - ONLY LOCAL



TYPICAL-2 / M1 : SIGNALS AND COMMANDS FOR THE MOTORS WITHOUT ANY INTERLOCK.

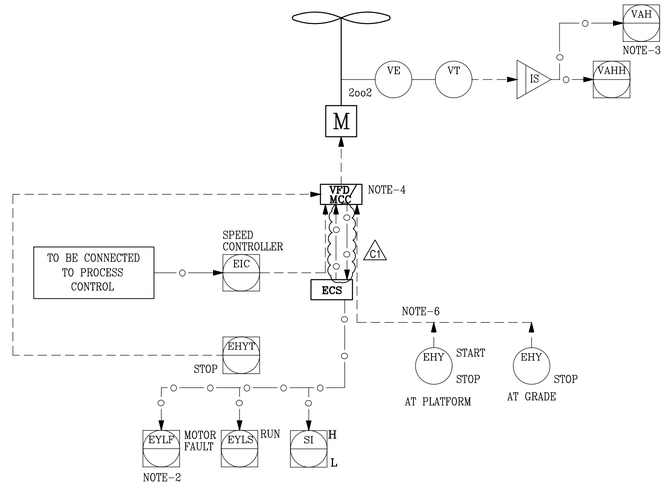


TYPICAL-3 / M1Z : SIGNALS AND COMMANDS FOR THE MOTORS WITH DCS INTERLOCK

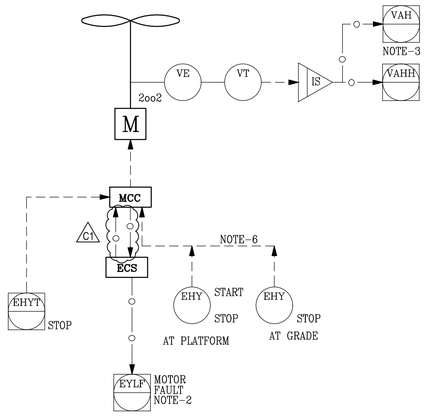


TYPICAL FOR AIR COOLER FAN MOTORS (NOTE 8)

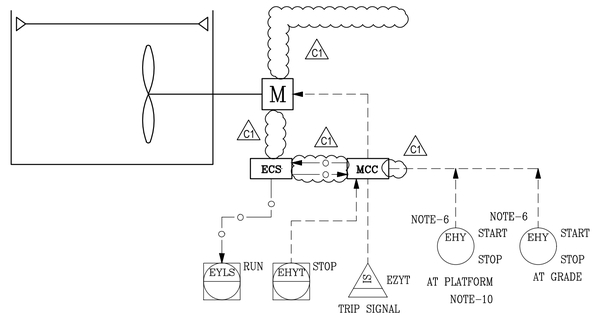
TYPICAL-1 / M3 : SIGNALS AND COMMANDS FOR VFD DRIVEN MOTORS



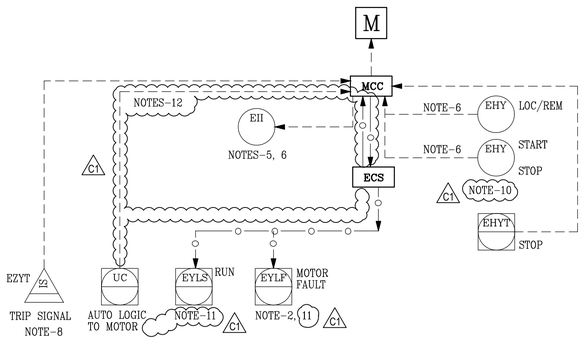
TYPICAL-2 / M5 : SIGNALS AND COMMANDS FOR AIR FAN COOLER MOTOR



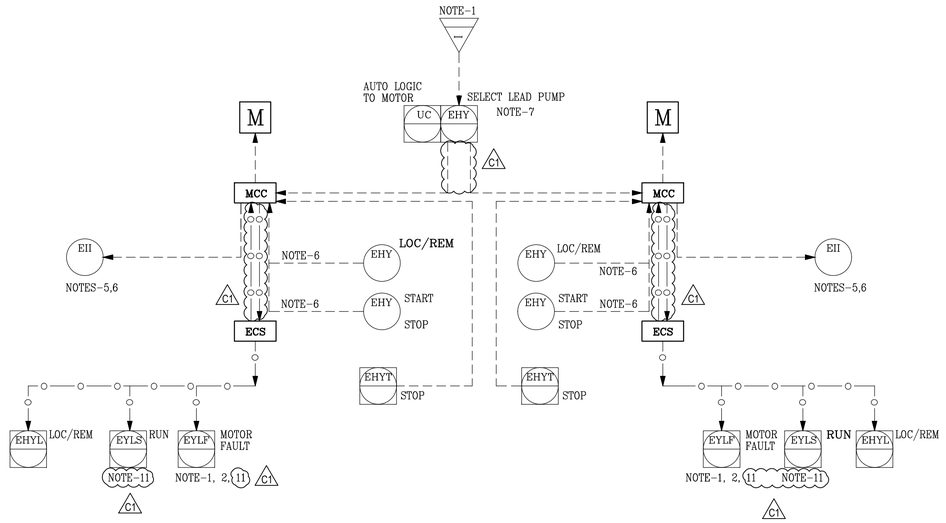
TYPICAL-5 PROPELLER MIXER DETAILS



TYPICAL-3 / M2 : SIGNALS AND COMMANDS FOR THE MOTOR WITH ESD INTERLOCK



TYPICAL-4 / M6 : SIGNALS AND COMMANDS FOR THE AUTO START / STOP PUMP MOTORS.



NOTES:

1. THE AUTO START LOGIC SHALL BE PROCESS INPUT (LEVEL / PRESSURE / FLOW). MOTOR FAULT OF RUNNING PUMP SHALL ALSO GIVE START SIGNAL TO STAND - BY PUMP.
2. GENERATE ANNUNCIATOR ALARM AND USED TO CHANGE MOTOR GRAPHIC COLOR STATUS.
3. VIBRATION TRANSMITTER SIGNAL SHALL BE USED FOR INDICATION AND ALARM PURPOSE IN DCS AND SHALL BE CONNECTED VIA HARDWARE.
4. AIR COOLER FANS SHALL OPERATE AT MAXIMUM SPEED IN CASEOF VFD FAILURE.
5. FIELD AMMETERS ARE TO BE PROVIDED FOR ALL MOTORS RATED 3.7kW & ABOVE, AND FOR ALL CRITICAL DRIVES (INCLUDING AUX. LUBE OIL PUMP, HEATER ETC) IRRESPECTIVE OF RATING.
6. BY ELECTRICAL
7. LEAD PUMP SELECTION SWITCH REQUIREMENT TO BE DECIDED ON CASE BY CASE.
8. REDUNDANT ESD SWITCH SHALL BE CONSIDERED AT CONTROL ROOM CONSOLE.
9. SEISMIC VIBRATION TRANSMITTER RELATED TO FIN FAN/ COOLING FAN TO BE INCORPORATED/ INSTALLED FOR TRIPPING PURPOSE.
10. START/STOP AT OPERATING PLATFORM IF APPLICABLE.
11. RUN/STATUS FEEDBACK SHALL BE HARDWIRED TO MCC IF THE SIGNAL IS LINKED WITH INTERLOCK.
12. IF APPLICABLE.

C1

HOLD:

LEGENDS:

REFERENCE DOCUMENTS

DOC NO	DOC TITLE	REV.

Rev.	Date	Reason for Issue	Prepared	Checked	Approved	Owner Approved
C1	06/07/2022	APPROVED FOR CONSTRUCTION	MNSP	RK	SCB	
D3	22/04/2022	APPROVED FOR DESIGN	MNSP/SG	RK	SCB	
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TECHNIP INDIA LIMITED

NRL's PO NO.: 4300062833-AMA/16.06.2020

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NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE - MOTOR TYPICALS

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0012.00	C1	01 OF 02

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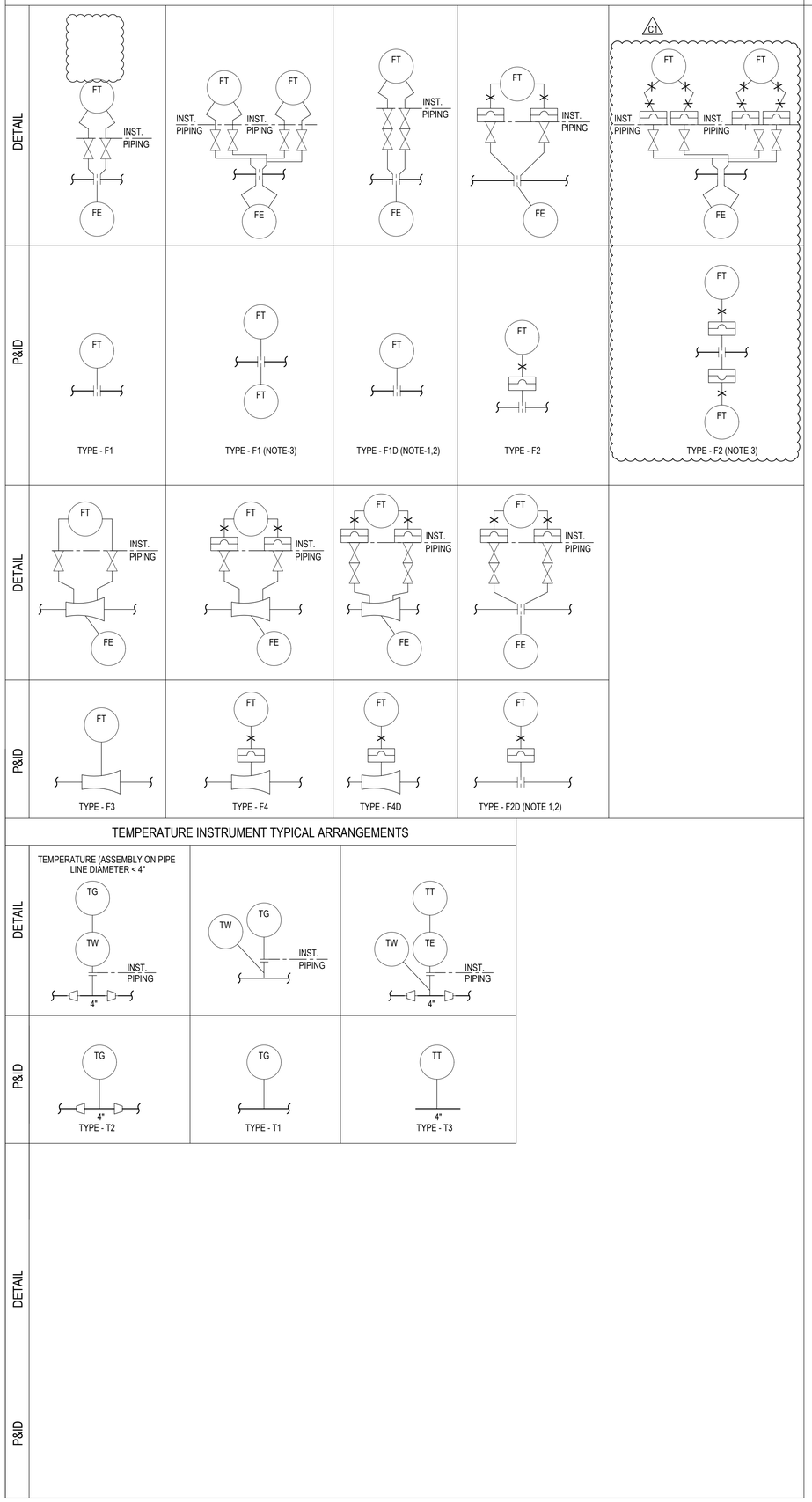
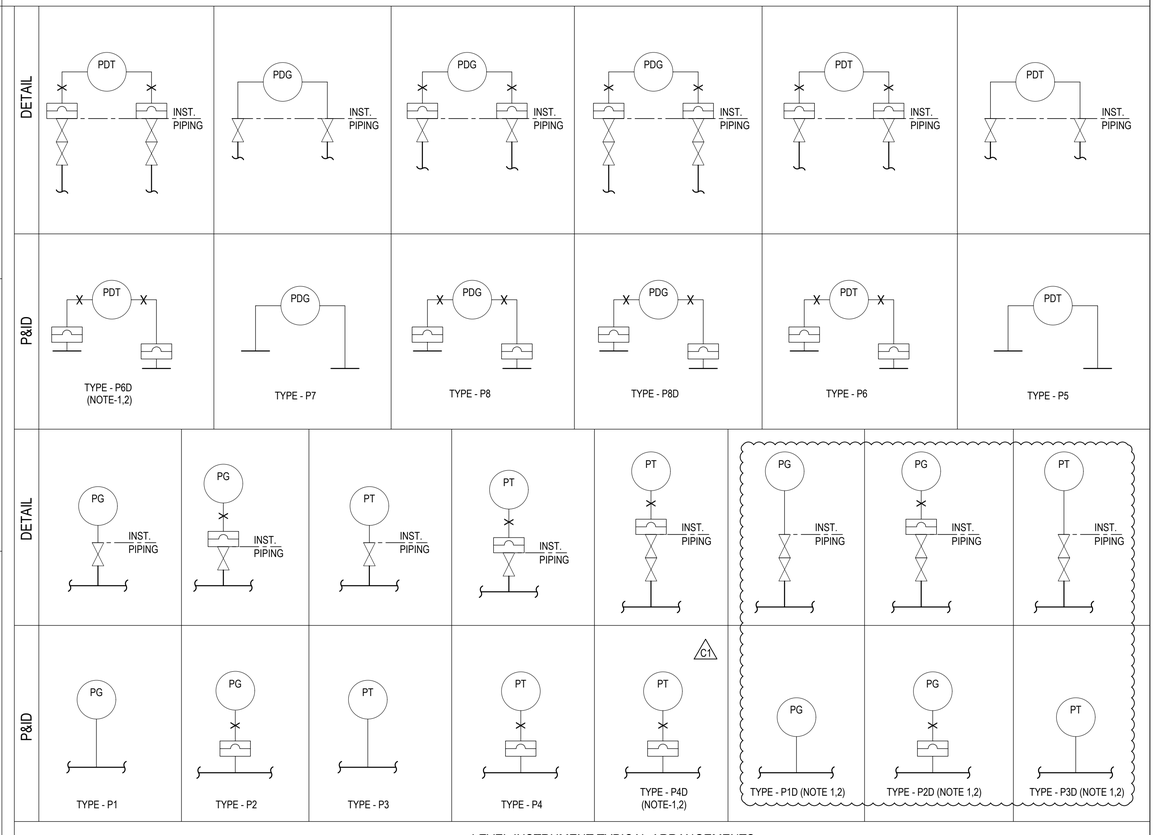
TYPICAL DETAILS FOR INSTRUMENTATION

FLOW INSTRUMENT TYPICAL ARRANGEMENTS

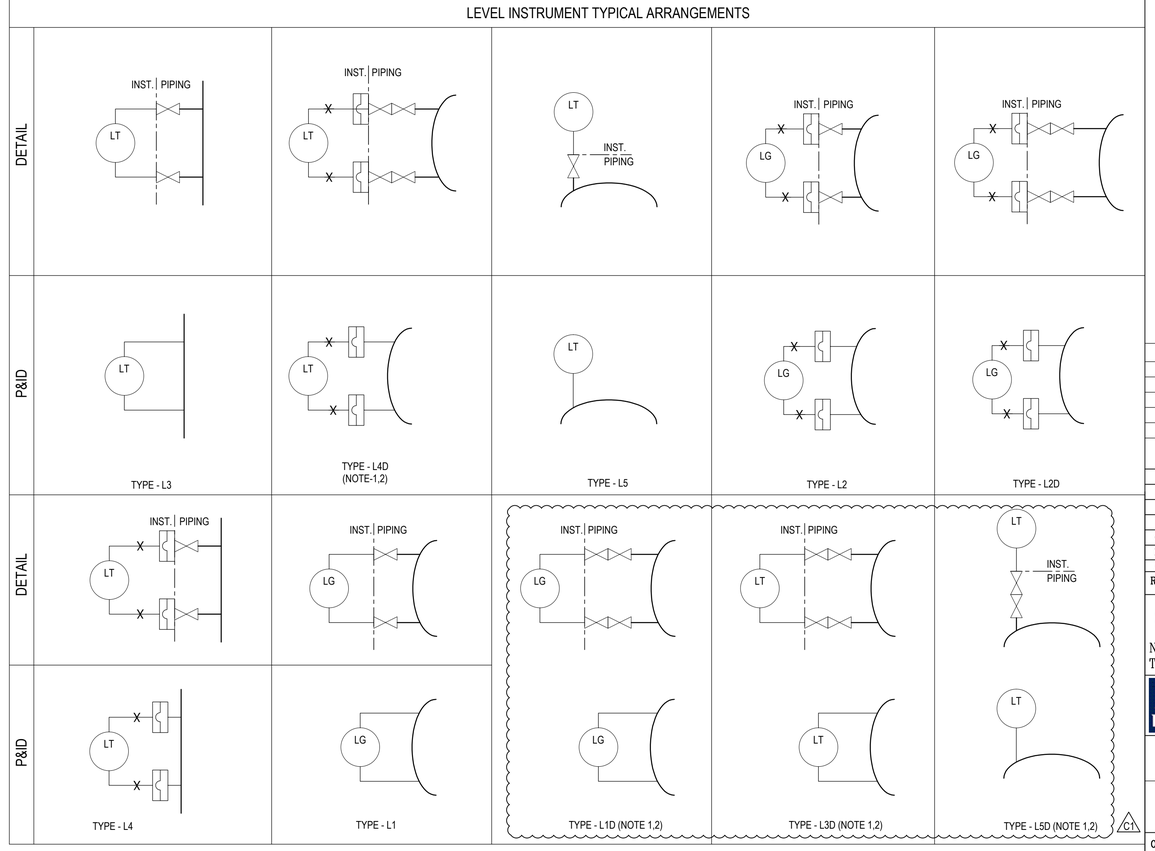


TEMPERATURE INSTRUMENT TYPICAL ARRANGEMENTS

PRESSURE INSTRUMENT TYPICAL ARRANGEMENTS



LEVEL INSTRUMENT TYPICAL ARRANGEMENTS



NOTES:

1. FOR INSTRUMENTS, DOUBLE VALVING REQUIREMENTS SHALL BE FOLLOWED AS PER ENGINEERING DESIGN BASIS FOR INSTRUMENTATION TP-1ZZZA-IC-BOD-0001. DOUBLE VALVING REQUIREMENT SHALL BE DENOTED BY SUFFIXING "D" TO THE TYPICAL NUMBER.
2. SIMILAR DOUBLE VALVING TYPICALS TO BE DEVELOPED BY INDIVIDUAL CONTRACTOR FOR OTHER INSTRUMENT TYPES BASED ON UNIT SPECIFIC REQUIREMENT.
3. DEDICATED ORIFICE TAPPINGS SHALL BE USED FOR EACH TRANSMITTER FOR THE INSTALLATION OF MULTIPLE TRANSMITTERS FROM A COMMON ORIFICE.
4. HOOKUPS FOR INSTRUMENTATION SCOPE SHALL BE REFERRED FROM THE RESPECTIVE TYPICAL HOOKUP DRAWING PREPARED BY MPMC. FOR DETAILS REFER TO TP-1ZZZA-IC-STD-0003.
5. REQUIREMENT OF PRE-FABRICATED HOOKUP SHALL BE FOLLOWED AS PER INSTRUMENTATION DESIGN BASIS AND SAME SHALL BE INDICATED CLEARLY IN HOOKUP DRAWING. PREFABRICATED HOOKUP SHALL BE IDENTIFIED BY SUFFIXING "(P)" TO THE TYPICAL NUMBER.
   FOR EXAMPLE: F1(P) MEANS TYPE F1 INSTRUMENT WITH PREFABRICATED HOOKUP.
6. INSTALLATION DETAILS OF INSTRUMENTS SHALL BE FOLLOWED AS PER TYPICAL INSTALLATION DRAWING PREPARED BY MPMC & REQUIREMENTS AS PER INST DESIGN BASIS.
7. INSTRUMENT MOUNTINGS SHALL BE IN ACCORDANCE WITH INSTRUMENT HOOK-UP DRAWINGS. FOR DETAILS REFER TO TP-1ZZZA-IC-STD-0003.
8. FOR INSTRUMENT CONNECTION DETAILS AND SIZE REFER TO ANNEXURE-1 OF ENGINEERING DESIGN BASIS FOR INSTRUMENTATION TP-1ZZZA-IC-BOB-0001.

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NUMALIGARH REFINERY LIMITED

NUMALIGARH REFINERY EXPANSION PROJECT (NREP)

PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS AND NOMENCLATURE – TYPICAL DETAILS FOR INSTRUMENTATION

Scale: NTS
Drg.Size: A1

Originator/ Contractor	Asset Code	Disc	Drawing Type	Sequence Number	Rev.	Sheet
TP	1ZZZA	PR	PID	0013.00	C1	01 OF 01

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	NUMALIGARH REFINERY LIMITED	Total pages: 49

NRL EXPANSION PROJECT

SPECIFICATION FOR PFD & PID PREPARATION

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D1	12/11/2020	APPROVED FOR DESIGN	RK	SCB	AR			
A1	30/09/2020	ISSUED FOR REVIEW	RK	SCB	AR			
			Discipline Engineer	Discipline Lead	Contractor Representative	Discipline Engineer	Project Engineer	Department Head

TECHNIP INDIA LIMITED	**TPIL**		**NRL**		
	Category	Code	Description		
	Facility Area Code	1ZZZA	Common Document		
NRL's PO NO: 4300062833-AMA/16.06.2020	Document Type	BOD	Basis of Design		
TP DOC REF: 082176C-ZZZ-CN-0007-0002_D2	System Number	00	General		
	Life Cycle	01	Disk Ref.:		
This document is copyright and shall not be reproduced without permission of NRL	Originator/ Contractor	Asset Code	Discipline	Document Type	Sequence Number	Revision
	TP	**1ZZZA**	**PR**	**BOD**	**0002**	**D2**

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REFERANCE DOCUMENTS

1. Piping and Instrumentation Diagram, Standard Symbols and Nomenclature – Equipment's – 1 to 3, Drawing Number TP-1ZZZA-PR-PID-0001-01 to 03.
2. Piping and Instrumentation Diagram, Standard Symbols and Nomenclature General – Symbols & Legends, Drawing Number TP-1ZZZA-PR-PID-0002-01 to 02.
3. Piping and Instrumentation Diagram, Standard Symbols & Nomenclature – Typical Details for Piping Arrangements, Drawing Number TP-1ZZZA-PR-PID-0003.
4. Piping and Instrumentation Diagram, Standard Symbols & Nomenclature – LG / LT Drain and Vent Connection Details, Drawing Number TP-1ZZZA-PR-PID-0004.
5. Piping and Instrumentation Diagram, Standard Symbols & Nomenclature – Air Cooler Details, Drawing Number TP-1ZZZA-PR-PID-0005.
6. Piping and Instrumentation Diagram, Standard Symbols & Nomenclature – Control Valve Vent and Drain Connection Details, Drawing Number TP-1ZZZA-PR-PID-0006.
7. Piping and Instrumentation Diagram, Standard Symbols & Nomenclature – Pump Vent and Drain Connection Details, Drawing Number TP-1ZZZA-PR-PID-0007.
8. Piping and Instrumentation Diagram, Isolation Hook Up Diagram, Drawing Number TP-1ZZZA-PR-PID-0008.
9. Piping and Instrumentation Diagram, Standard Symbols & Nomenclature – Typical Details for Relief Valve Arrangements, Drawing Number TP-1ZZZA-PR-PID-0009.
10. Piping and Instrumentation Diagram, Standard Symbols & Nomenclature – Sample Connections Details 1 - 2, Drawing Number TP-1ZZZA-PR-PID-0010-01 to 02.
11. Piping and Instrumentation Diagram, Standard Symbols & Nomenclature – Control and On-off Valve Details 1 - 2, Drawing Number TP-1ZZZA-PR-PID-0011-01 to 02.
12. Piping and Instrumentation Diagram, Standard Symbols & Nomenclature – Motor Typical, Drawing Number TP-1ZZZA-PR-PID-0012.

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1. INTRODUCTION

NUMALIGARH REFINERY LIMITED (NRL), a group company of Bharat Petroleum Corporation Limited, is a Government of India Enterprise located at Numaligarh, Dist. Golaghat, Assam. At present, Numaligarh refinery is processing 3 MMTPA of Assam Mix Crude Oil. Existing configuration includes CDU/VDU, DCU, HCU, HGU, DHT, MSU, Coke calcination unit, SRU and Wax unit apart from the Marketing terminal and LPG Bottling plant.

Numaligarh Refinery Limited is expanding its refining capacity from current 3 MMTPA to 9 MMTPA by installing a new 6 MMTPA capacity CDU/VDU and associated downstream process units, utility & offsites, as part of Numaligarh Refinery Expansion Project (NREP).

Numaligarh Refinery Limited (NRL) has selected M/s. Technip India Limited (TPIL) to provide M-PMC / EPCM services and supply of Basic Process Package for CDU/VDU with (ATU), ARU & SWS units. M-PMC (Managing PMC) shall be the overall coordinator for the entire project and also act as EPCM for LPGTU and Utility & Offsite facilities. M-PMC shall be responsible for entire NREP activities in respect to integration and schedule completion including interface management with EPCM-1, EPCM-2 and BOO contractor.

2. DEFINITIONS & ABBREVIATIONS

Wherever the following terms used in this document shall have the meaning as defined below:

Abbreviation	**Definition / Expanded form**
NRL / OWNER / CLIENT	shall mean Numaligarh Refinery Limited.
M-PMC	Managing PMC (shall mean Technip India Limited).
LICENSOR	shall mean agency responsible for the supply of basic know-how and process package for any licensed units.
PROCESS DESIGNER	shall mean the agency responsible for supply of basic know-how and process package for the open art units / facilities.
EPC	shall mean the work for the Engineering, Procurement and Construction of the Project.
CONTRACT	shall mean the Contract including all Annexes thereto and all documents therein attached and amendments which the parties may hereafter agree in writing to be made to this Contract.
CONTRACTOR	shall mean any third party whose services are obtained for supply execution and / or erection of units/ facilities covered under contract scope.
VENDOR / SUPPLIER	shall mean any third party supplying any of the equipment / materials for setting up Plant covered under Scope of Work.
PROJECT	shall mean the Capacity Expansion of Numaligarh Refinery Project.

SITE	shall mean Numaligarh Refinery (Numaligarh, Dist. Golaghat, Assam, India).
PLANT	shall mean the units and facilities comprised in the Project, and if divided into different packages for the award of LSTK Contracts / EPCM Contracts / Work Contracts / Supply Contracts.
UNIT	shall mean a particular process unit etc. which forms a distinct operating system and is a part of the Plant.
BATTERY LIMIT	shall mean the demarcated area within which all the units and facilities under scope as detailed in the contract are being installed for Plant.

Wherever the following acronyms used in this document shall have the meaning as defined below:

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
BFW	Boiler Feed Water
BL	Battery Limit
CSO	Car Seal Open
CSC	Car Seal Closed
DCS	Distributed Control System
DM	Demineralized
ESD	Emergency Shutdown System
FB	Full Bore
FC	Fail Close
FG	Fuel Gas
FLDC	Fail Lock Drift Closed
FL	Fail Lock
FO	Fail Open
IBR	Indian Boiler Regulation
ISBL	Inside Battery Limit
LPG	Liquified Petroleum Gas
MOV	Motor Operated Valve
M-PMC	Managing Project Management Consultant
NNF	Normally No Flow
NREP	Numaligarh Refinery Expansion Project
NRL	Numaligarh Refinery Ltd
OISD	Oil Industry Safety Directorate
OSBL	Outside Battery Limit

P&ID	Piping & Instrumentation Diagram
PFD	Process Flow Diagram
PLC	Programmable Logic Controller
PSV	Pressure Relief Valve
TEMA	Tubular Exchanger Manufacturers Association
TI	Temperature Indication
TL	Tangent Line
TPIL	Technip India Ltd
TSO	Tight Shut Off
TSV	Thermal Expansion Valve

3. PURPOSE

The purpose of this document is to define the rules which have to be followed to prepare PROCESS FLOW DIAGRAM (PFD's) and PIPING & INSTRUMENTATION DIAGRAM (P&ID's) for Process (Open-art / Licensed) units, Utility units, Interconnecting and off-site facilities for Numaligarh Refinery Expansion Project.

The objective of this document is to ensure the consistency in the design and the deliverables being part of the Numaligarh Refinery Expansion Project.

A Process flow diagram (PFD) presents the succession of the operations in the fluid(s) processing to reach the required products specifications set in the objectives of the plant processing including also associated off-sites and utility fluids. The succession of operations is pictorially represented by equipment symbols and lines for a good understanding.

A Piping and Instrumentation diagram (P&ID) is a detailed drawing used for design, assistance to construction and operation of the processing plant including associated off-sites and utility fluids. This Procedure shall be read in conjunction with the Legend and Typical for P&I Diagrams for the symbolic presentation and typical hook-ups (refer to the documents listed under reference document section).

In case of conflict between Licensor's specification / Client (NRL) or M-PMC's specification it shall be brought to Client (NRL) / MPMC notice for clarification and proper approval shall be obtained and the decision of Client (NRL) / M-PMC in resolution of the conflict shall be final.

This specification is meant mainly for grassroot / new units.

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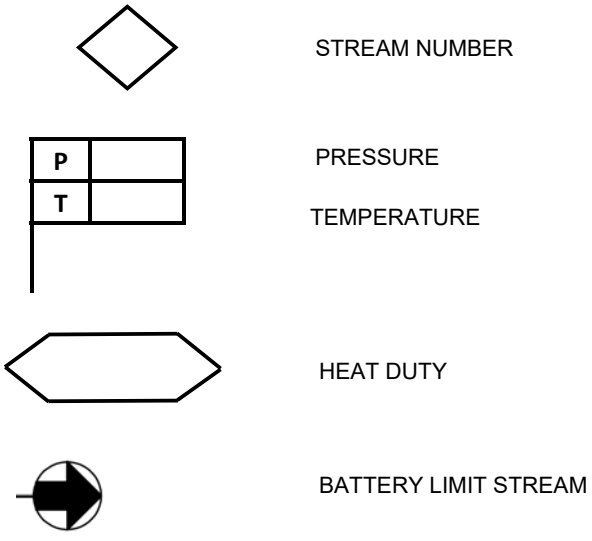
4. PFD PREPRATION

A Process Flow Diagram (PFD) is a schematic representation of the sequence of basic process operations of a unit and indicating the operating conditions of each run case. It provides an overall view of the main process flows through a Process or Utility Unit and allows understanding. It includes major equipment items and control loops of the unit in normal operation and connections with other systems and units outside battery limit.

Typically, PFD contains:

- Main flow lines.
- Major equipment items identified by their tag numbers shown by symbolic representation and repeated at the upper part of the drawing to indicate the description of each equipment item.
- Controls, indicated by a simplified symbolic representation of control loops.
- Connections with other systems.
- Analyzers.
- Major bypass and recirculation streams used in normal operation.
- Process stream are identified with numbers referring to separate document “Heat and Material Balances”.
- Operational data (temperature, pressure, mass flow rate, etc..).
- Heat exchangers, Air coolers and Furnaces normal operating duties.
- Main dimensions for columns, drums and tanks (ID and TL-TL).
- Main characteristics for pumps (rated capacity and differential head).
- Main characteristics for compressors (rated capacity and differential pressure).

The pressure, temperature, flow rate, power and heat duty values are indicated where of interest (for example, temperature at heat exchanger inlet and outlet, pressure at pump and compressor discharge, heat exchanger duty, …) as following:



Process unit data of the different operating cases, including Start of Run (SOR) and End of Run (EOR) conditions when relevant, shall be given.

Numbers inside diamonds, added on main lines, refers to the stream number of the heat and material balances documents of the unit which shall be issued separately.

On case by case, for utilities and storage, HMB tables could be integrated in the bottom part or in separate sheet of the PFD sheet if the amount of information allows it (the most relevant design and operating cases are indicated, no stream composition indicated). This table shall contain stream phase, temperature, pressure, normal and design mass flow, design case and explanatory notes.
When a line is connecting two different PFDs, the labelling will be detailed as follows:

- Fluid name
- To / from unit name (when it comes from a different unit number)
- To / from equipment tag
- PFD number

The following rules are applied, to ease the reading of the drawings:

- When equipment is duplicated or if it is spared, only one equipment item is shown on the PFD.
- Tag number will reflect the fact that there are several identical items.
- When a stream is entering a drawing and is feeding multiple equipment, equipment tags on connector may not be shown (only unit name or system name).
- Stream destination on connectors can be replaced by specific system name to ease the PFD understanding.
- Start-up lines are not shown on PFD. However, start-up lines will be shown when associated to a process control (e.g. pressure control valve to flare system) and in certain cases to improve understanding of complex interconnections between units.
- Normally no flow lines are not shown on PFD. However, in certain cases, normally no flow lines will be shown to improve understanding of complex interconnections between units and “NNF” will be added above or below the corresponding lines.
- Specific connectors are drawn when stream is coming from or leaving to another outside battery limit unit.

The Heat and Material Balances (HMB) shall be provided for all design cases for each revision of PFD and will include as a minimum the following information:

- Stream number (corresponding to PFD), name and phase of fluid
- Total mass & volume flow
- Component wise material balance (stream composition)
- Normal operating temperature and pressure
- Density of fluid at operating conditions
- Specific gravity of liquid components
- Molecular weight of vapor components
- Dynamic viscosity at operating conditions
- Thermal conductivity at operating conditions
- Specific heat at operating conditions
- Cp/Cv ratio, compressibility factor
- Surface Tension
- Stream enthalpy
- H2/H2S content and other trace components of relevant streams that may affect the selection of materials of construction.
- For mixed phase streams, the vapor and liquid phases shall be shown separately.
- For total streams, the average enthalpy, viscosity, density and molecular weight shall be given. weight % of vapor & free water shall also be indicated.
- Critical temperature and pressure.

5. PID PREPRATION

P&IDs shall be prepared using the standard symbols as detailed in the Piping & Instrument Legends and typical' s sheets.

Information to be included on P&ID (minimum),

- Representation of all itemized equipment items, with design details (PI / TI on trays / down comers, etc.), including stand-by equipment. Vessels representation should comply as accurately as possible with process specifications.
- Package units or equipment whose detailed design technology such as the number of furnace passes, number of bundles/ bays for air coolers may be represented in a simplified manner or on schematics diagrams suitably.
- For packages detailed information shall be made available once complete design information obtained from vendor.
- Process and Utility lines on process P&IDs, numbered and sized, with their piping classes including flare and vent / drain systems.
- Numbered utility lines on utility Battery Limit P&IDs (size of main headers shall be indicated), including those feeding package units.
- Representation of draining and venting systems (or with symbols based on the symbol table).
- Manifolds located upstream and downstream of pressure relief valves and rupture discs.
- Details of lines at battery limits with valves, drains, vents, spectacle blinds, instruments and removable spool.
- All layout / installation process requirements originating from Licensor or FEED Consultant rules / documents (relative height between equipment items or equipment elevation, sloped lines, etc.) and special piping requirements.
- Valves and fittings on equipment and process piping.
- Control valve with manifolds size.
- Valves provided in the case of control valves by-passed for process reason shall be shown.
- Tracing and insulation requirements.
- Instrumentation (including numbering): simplified representation of instrument technology and of instrument installation shall be preferred on PID; technology outline of instruments and attached shut-off valves will not be represented (except if required by Licensor).
- References to standard tables / details explaining details might be added.
- Fail safe position of control and On-off valves shall be shown.
- Tight Shut-Off (TSO) indication of control valves will be shown where required.
- Some columns trays identified with a number will be shown on P&ID in order to facilitate the understanding of the columns connections, e.g. tray located where piping is connected to the column, sensible trays, tray above and below manholes.
- Numbering will follow the columns trays numbering philosophy, i.e. from bottom to top. Only key (sensible) trays will be equipped with a DCS TI. DCS PI will be provided at least on the top and on the bottom of the column but also between section of trays if identified required for process monitoring.

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6. NOZZLE DESIGNATION

The following nozzle designations shall be used in specifying vessels, columns reactors and exchangers

Nozzle Designations	Description
A	Inlet
B	Liquid Outlet
C	Vapour Outlet
D	Drain
F	Outlet
G	Gauge Hatch / Site Glass
H	Hand hole
J	Agitator / Mixer
L	Level Instruments
M	Manway
N	Spare
P	Pressure Instruments
R	Relief Valves
S	Sample Connection
T	Temperature Instruments (for both TI or TW)
U	Utility Connection
V	Vent
Z	Miscellaneous

Note: Suitable suffix with numbers (1,2,3….) shall be added for additional number of nozzle connections under same nozzle designations.

7. LINE NUMBERING

The following criteria shall be followed for assigning the line numbers while preparing the P&IDs, for detailed numbering philosophy refer to NRL Tag Numbering Specification document number NR-0ZZZZ-GE-SPE-0002.

- Process lines shall normally be numbered from equipment to equipment following the fluid flow based on process flow diagram.
- After all the primary process lines have been numbered, go back and number the secondary lines.
- Number all lines in a single P&ID at a time, then move on to the next one.
- Only for size change, no need to assign a new line number. Line size changes are to be recorded in Line list sheet (e.g. 2, 4, 6).
- For control valve/station along the line, assign one number for the portion upstream of the control valve and a subsequent number for the portion of downstream line, regardless if there is a pipe class break or not.
- At each pipe class break where the pressure or temperature changes, the numbering shall also be changed.
- Line sequence numbers shall be unique within each system code, no duplicate line numbers are allowed.
- Miscellaneous connections on a vessel are assigned with a line number with the fluid code of the incoming lines. (vessel trim)
- Assign separate number for each pipe class listed as a miscellaneous connection.
- Closed Sampling Systems connection lines are to be numbered suitably.
- Inlet and out lines to Relief valves are to be numbered and respective line numbers to be utilized for the bypass line suitably.
- By-pass line around a control valve shall not be numbered.
- For pump inlet, assign a line number from the vessel to the suction nozzle of pump A. Assign another number for line running from the isolation valve to the suction nozzle of pump B.
- For pump discharge, assign individual line numbers for each line coming out of the discharge nozzle. Discharge line from pump A can be retained as main discharge line.
- Line numbers shall terminate at process unit or utility plant battery limits.

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8. EQUIPMENTS

8.1 Vessels

8.1.1 Nozzles & Manholes

Unless otherwise dictated by Process or Licensor requirements, the vessel's connections shall be minimized by installing relief valves, temperature and pressure measurements connections on piping where possible instead of on vessel.

Minimum Nozzle Size: The mini. recommended nozzle connection (process) attached to any vessel shall be

- For flanged connections attached to unclad vessel shall be 2"
- For flanged connections attached to internal lined / clad shall be 3"

Emergency shutdown valve requirement to be provided for liquid containment as per project philosophy and OISD requirement.

Refer to TP-1ZZZA-PR-BOD-0001, Process Design Basis Overall for number, size and location of manholes.

8.1.2 Vent & Drains

Vent to be located on at the highest possible point of vessel / vessel top piping. For Horizontal vessel vent nozzle shall be on top opposite end of the manway and steam-out connection. Non-operating vents shall be located on top of vessel with valve blinded.

Drain shall be preferably located on the low point of the bottom outlet piping, outside the skirt. If there is no bottom line or said line does not allow complete drainage of the vessel, the drain shall be connected to a separate nozzle on the bottom head for vertical vessels and on lower tangent line for horizontal vessels.

Vessels with internal baffling require special consideration, two drains or drip hole on the baffle shall be provided.

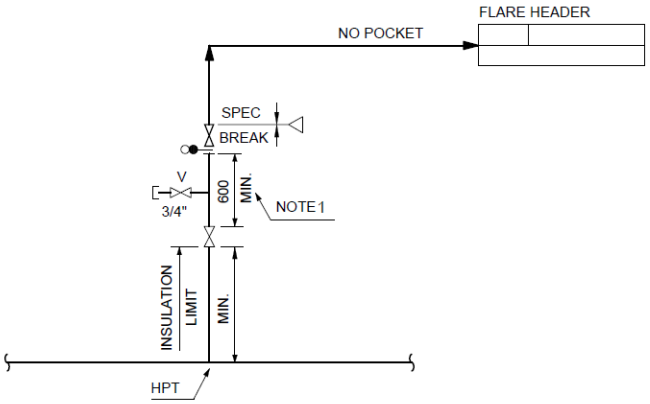
Process drain shall be equipped with double block and bleed and a spectacle blind located just upstream the last block valve. Specification break limit is after the last block valve.

Refer to TP-1ZZZA-PR-BOD-0001, Process Design Basis Overall for minimum size of vent and drain for equipment, for columns, trays and manholes details.

In general, all Hydrocarbon, hazardous and steam service shall use blind flange, non-hazardous and other utility services shall use cap or as per piping material specification (PMS).

a) For Non-Recovered Vents: (type of valve selection based on PMS)

b) Line vent to Flare Header:

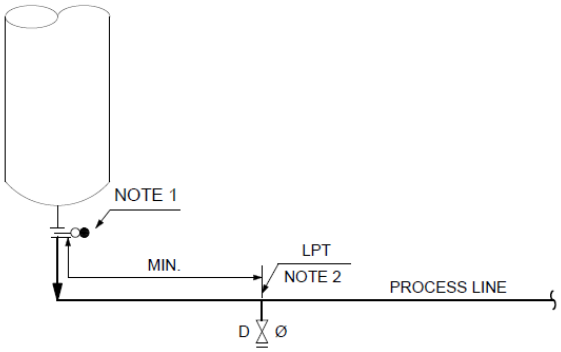


Notes:

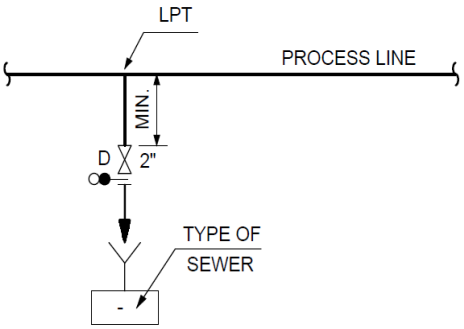
1) If necessary for cold service to be decided case to case.

c) Non-Recovered Drains:

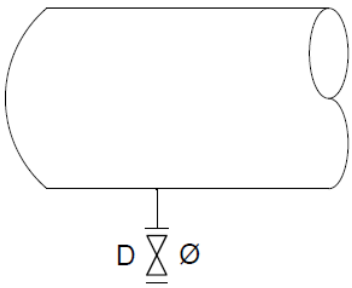
Vertical vessel



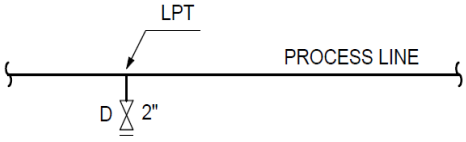
Routine purge (sent directly to funnel)



Horizontal vessel



Non-Routine purge (flexible or portable drip pan)

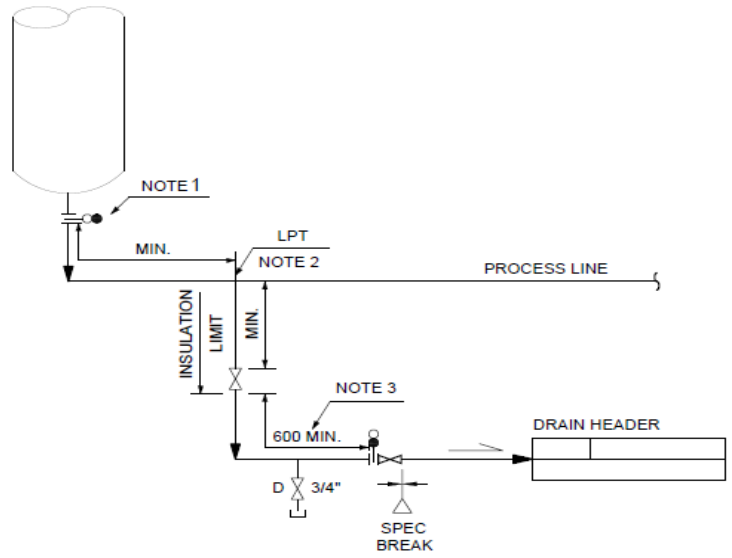


Note:

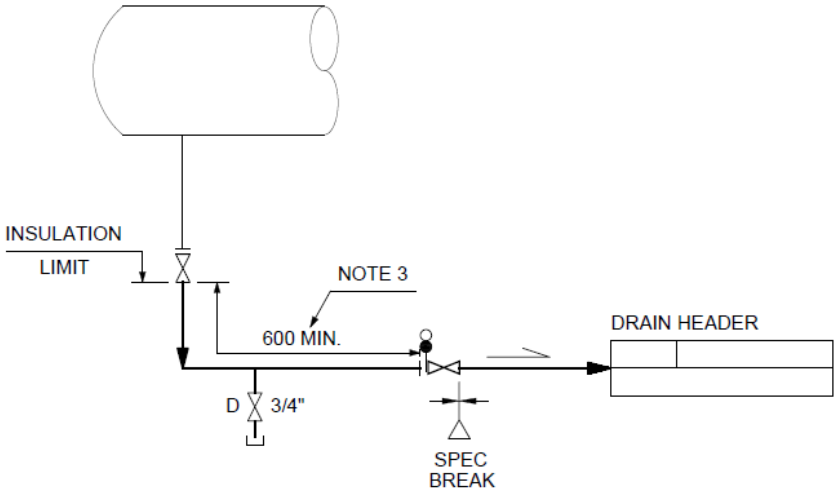
1) Spacer or spectacle blind for isolation. (Refer to section 11.15)
2) Drain to be located at low point between the vessel and the first shut-off location.

d) Recovered Drains:

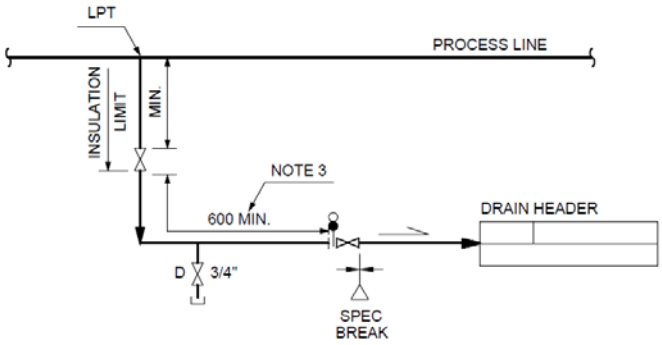
Vertical vessel



Horizontal vessel



Lines

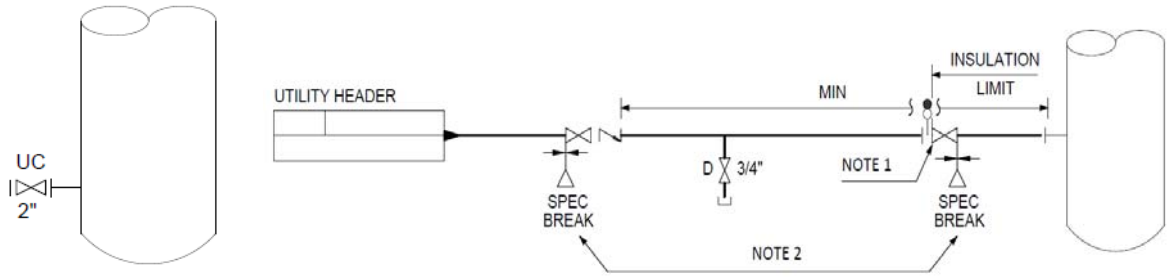


Note:

1) Spacer or spectacle blind for isolation. (Refer to section 11.15)
2) Drain to be located at low point between the vessel and the first shut-off location.
3) If necessary for cold service to be decided case to case.

8.2 Utility Connections

Refer to TP-1ZZZA-PR-BOD-0001, Process Design Basis Overall for utility connections size.



Note:

1) Globe valve for manual flow regulation if required.
2) Spec. breaks and spectacle blind location to be determined on case by case basis.
3) Installation of permanent utility connection to be foreseen case by case depending on process requirement.

8.2.1 Liquid Side Draw-off

For side draw-off lines, typically a vertical pipe run of 3 meters from draw-off nozzle, and of same diameter than draw-off nozzle, before reducing the size of the line will be specified in order to achieve better vapor disengagement.

8.2.2 Safety Valves for Itemized filters

Safety valves are not required for small capacity isolable filters (< 500 liters) which contain liquid not identified as hazardous and having an initial boiling point higher than the maximum ambient temperature, and for which the only overpressure scenario is the fire case.

8.3 Tubular Heat Exchangers

Refer to the drawings TP-1ZZZA-PR-PID-0003, Piping and Instrumentation Diagram Standard Symbols and Nomenclature Typical Details for Piping Arrangement.

8.3.1 Water Coolers

Block valves are required for each exchanger cooling water supply and return line when several units are in common service and the ability to take one or more out of service during operation is required to avoid shutdown.

Block valves shall be:

- At Exchanger inlet : gate valve for lines < 12
  : butterfly for lines ≥ 12"
- At Exchanger outlet : globe valve for lines < 12"
  : butterfly for lines ≥ 12"

A sample connection shall be provided on the cooling water outlet. One thermal expansion relief valve shall be installed on the cooling water outlet line. A Car Seal Open (CSO) block valve shall be provided to allow for isolation of the TSV.

As a general rule, temperature control if any shall be installed on process side (i.e. not on cooling water side). A local TI & PI along with DCS temperature instrument shall be provided on the cooling water outlet of exchanger. For multiple shell exchangers TG/TI shall be provided in the intermittent line / nozzle on the process side between the exchangers.

For heat exchangers installed at a higher elevation than the cooling water return line to the tower, the addition of one vacuum breaker on the cooling water side has to be examined case by case. Backflush facilities shall be provided on cooling water side to clean exchanger tubes during maintenance.

Refer to TP-1ZZZA-PR-BOD-0001, Process Design Basis Overall and TP-1ZZZA-PR-PID-0003 Piping and Instrumentation Diagram Standard Symbols and Nomenclature Typical Details for Piping Arrangement of backflush line with sample connection and instruments details.

8.3.2 Vents & Drains

Vent and drain are to be provided on exchanger as per TEMA design and shall be shown on PID. All connections are to be valved and blanked off.
For liquid filled exchangers, process vent and drain facilities shall be provided with blanked off high point vent (2") and low point drain (2") on inlet / outlet lines. The drain shall be connected to the appropriate closed drain system for hazardous liquids (e.g. hydrocarbons, sour water and amine).

Refer to the drawings TP-1ZZZA-PR-PID-0003, Piping and Instrumentation Diagram Standard Symbols and Nomenclature Typical Details for Piping Arrangement.

8.3.3 Thermowell & Pressure Connections

Each exchanger is equipped with Local and DCS temperature instrument (TI) at process inlet and outlet of each service. Local and DCS pressure instrument (PI) at process inlet and outlet of each service, except if similar instruments are already provided for the same process stream measurements on upstream or / and downstream of the equipment.

Temperature and pressure instrument connections shall not be located on heat exchanger nozzles. Such connections shall be located in the connected pipe. Intermediate nozzles on stacked exchangers, and exchangers connected directly to equipment are exceptions.

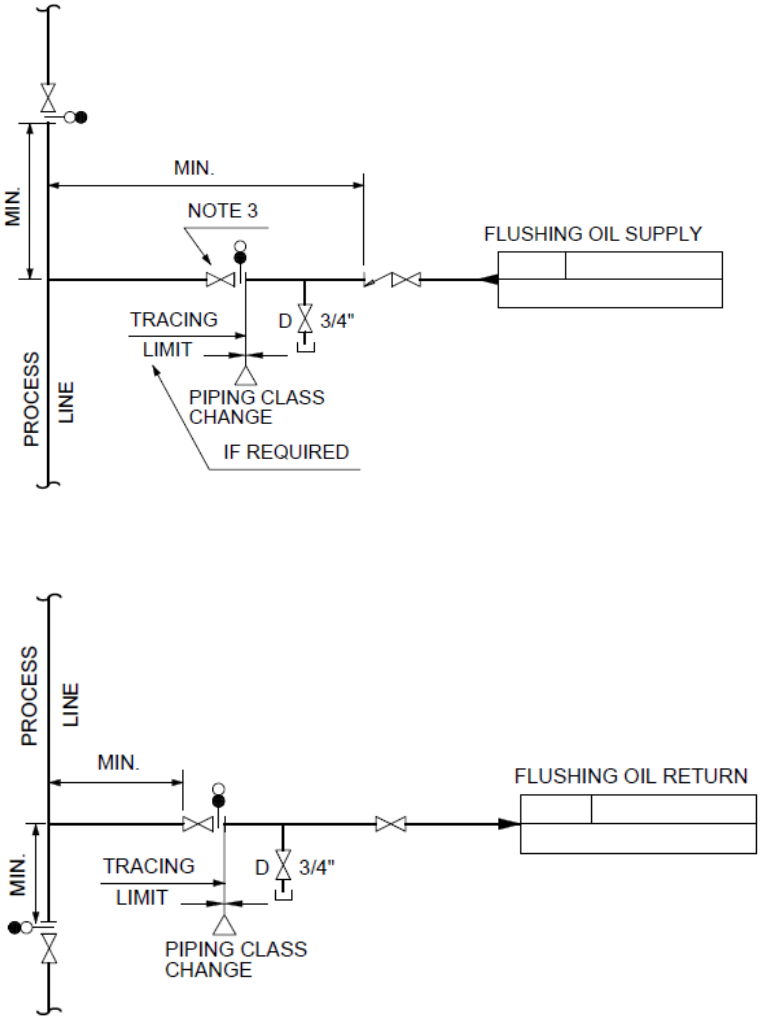
8.3.4 Safety Valves for Isolable Exchangers

The cold side of all heat exchangers in liquid service requires thermal expansion relief valve if the cold side of the exchanger can be blocked in during operation.

Pressure relief valve will not be considered specifically for fire exposure of exchanger blocked in for maintenance considering that adequate measures are put in place, i.e. heat exchanger is flushed and emptied after isolation. However, fire exposure pressure relief needs to be considered for kettle type reboiler and vaporizer which can be blocked in as per good engineering practice.

8.3.5 Washing / Flushing Oil Connections

Washing / flushing oil connections will be added as required to both the tube and shell side of exchangers. Utility connections will be added as required.



8.4 Air Coolers

8.4.1 Vents & Drains

One 2" vent shall be located at the highest point in the inlet header and one 2" drain at the lowest point in the outlet header. Connections are to be valved and blanked off. For multi-pass condensers a vent shall be provided at the high point of the inlet and at the outlet end of each pass. Vent shall be connected to flare header in case of LPG or H_2S service.

Flanged process nozzles shall not be smaller than 2".

8.4.2 Thermowell & Pressure Connections

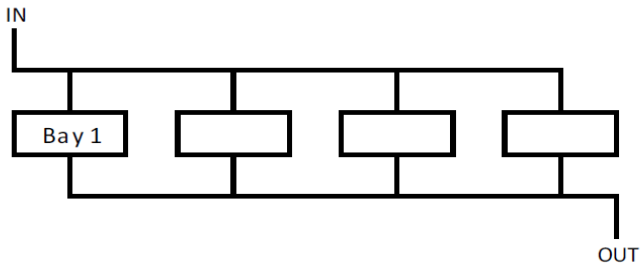
Each air cooler shall be equipped with:

- One local pressure indicator on the common inlet line
- DCS Temperature Instrument (TI) at the outlet of each Air Cooler element.
- One local pressure indicator on the common outlet line

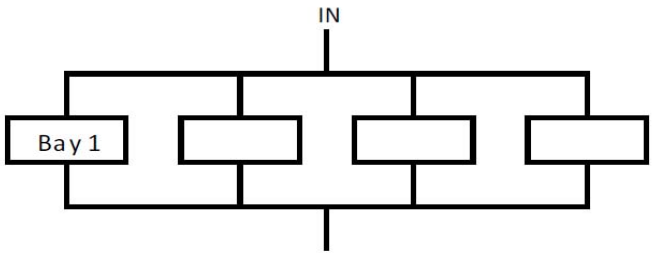
In addition, a DCS temperature indicator and thermowell shall be provided on the common inlet/ outlet lines except if similar instruments are already provided for the same process stream measurements on upstream or/ and downstream equipment.

8.4.3 Piping Arrangement at Air Cooler Inlet / Outlet

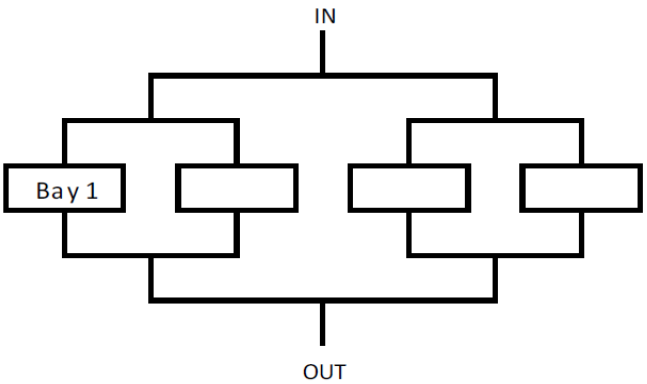
Following are the typical piping arrangements for air cooler inlet / outlet lines which shall be followed unless otherwise there is any specific licensor requirements which shall be preceded.



Single phase without phase change



Single phase without phase change
or mixed phase at inlet
or single phase with phase change



Mixed Phase corrosive service
when specified by Licensor

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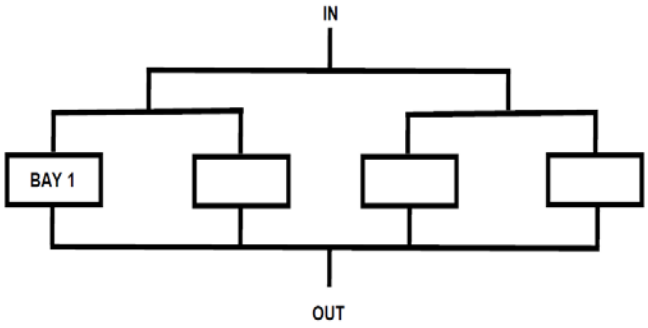


Mixed Phase corrosive service at inlet
with phase change

Air cooler typical representation, number of bundle, bays, distribution and collection manifold type will be developed during detailed engineering. Refer to the drawings TP-1ZZZA-PR-PID-0005, Piping and Instrumentation Diagram Standard Symbols and Nomenclature – Air Cooler Details .

8.5 Heaters

8.5.1 Fuel Gas KO Drums

For fuel gas systems, provisions shall be made so that no condensation occurs in fuel lines to the burners. A knock-out drum equipped with a demister pad shall be installed for each unit as appropriate.

The fuel gas drum will not be insulated, or heat traced. Fuel gas header shall be electrically heat traced (preferably) downstream of KO Drum (associated with the heater).

8.5.2 Pilot Gas

The pilot gas feed line to heater (from the pilot gas network) shall be equipped with "Y" type strainer and shall be installed upstream of main fuel gas control valve. Pilot gas header shall be heat-traced to the burners.

8.5.3 Snuffing Steam

Snuffing steam shall be provided for heaters at header boxes and fireboxes.

8.5.4 Manually Operated Isolation Valves

All manually operated isolation valves on pilot gas, fuel gas and snuffing steam lines must be located at safe location (e.g. behind a fire wall 15 m minimum away from the heater in an easily accessible position at grade).

Locate burner valves adjacent to observation door to permit burner adjustments while observing the flame. Note to be specified in P&ID for above requirement.

8.5.5 Steam Injection

For emergency purpose, manual steam injection actuated through ESD shall be provided for each pass where applicable.

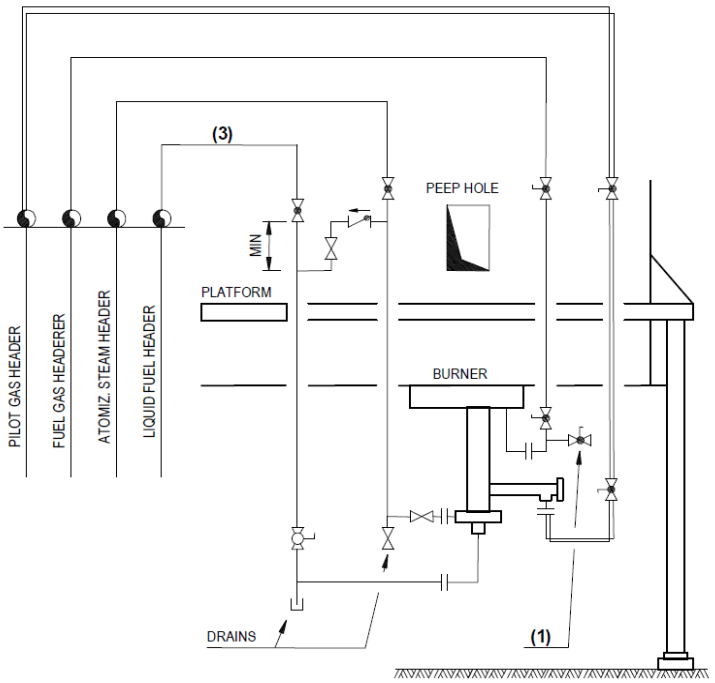
8.5.6 Transfer Lines

Transfer lines from heaters to distillation columns shall, immediately upon leaving the heater, be led to an elevation above the elevation of the column feed nozzle in order to ensure free draining.

8.5.7 Instrumentation

Refer to the document TP-1ZZZA-PR-BOD-0001, Process Design Basis Overall for standard heater Instrumentation.

8.5.8 Typical Arrangement for Heaters



Notes:

1) Connection for portable manometer shall be provided for all burners. Pressure gauges are required for burner performance testing. Pressure gauges to remain installed on Fuel Oil, Fuel Gas and Steam lines for 10% of burners including one (1) end burner. Rest of the burners to have diaphragm seal/cock to enable installing loose gauges. To be confirmed by specialist / vendor during detailed engineering phase.
2) Flexible hose shall be normally used in burner piping. Use ball valves in all fuel lines just before the burner inlet.
3) Heat tracing to be provided as required.

8.6 Pumps

Refer to the drawings TP-1ZZZA-PR-PID-0007, Piping and Instrumentation Diagram Standard Symbols and Nomenclature – Pump Vent and Drain Details.

8.6.1 Block Valves Size

Suction and discharge valves shall be of line size.

8.6.2 Block Valve Rating

The pump design pressure at discharge shall also be applied up to and including the suction block valves for pumps with installed spare.

The pump Design Pressure at discharge could also be applied to a vessel Emergency Isolation Valve (EIV) located in the common pump suction line (To be evaluated on a case to case basis, e.g. hydrogen back flow from a reaction section which is a sizing case for relief valve on suction vessel, pump process design pressure shall be applied up to and including the EIV).

On discharge side of the pump where the pump differential pressure exceeds 70 Kg/cm2, double check valves installation should be analysed, unless otherwise specified.

8.6.3 Strainer

Temporary strainers shall be installed on suction side of all pumps, unless permanent strainers are specified.

Permanent strainers installation shall be analysed in the following cases:

- Pumps in dirty service
- Suction line larger than 8” or smaller than 2”
- Steam traced suction lines

In general, the strainer selection is:

- "Y" type for lines 2" and smaller
- "T" type for lines larger than 2"

They should not install if not allowed by the handled fluid (slurries, etc.,) or for jacketed lines. Strainer body material shall be suitable for handled fluid. Screen shall be made of S.S. for permanent strainers and carbon steel for temporary strainers, unless otherwise required by the operating temperature and fluid.

8.6.4 Warm-up & Cool-down Bypass System

A bypass system shall be provided for spared pumps which have common suction and discharge pipes. The bypass line shall be equipped with a throttling valve around the discharge check valve to allow a small flow to keep the spare pump at operating temperature, ready for immediate start-up. A bypass shall be installed in the following cases (to be confirmed by pump vendor when pump model will be selected):

- For single stage pumps operating at temperature above 260°C and multistage pumps operating at temperature above 204°C in order to maintain the spare pump hot, or specific process cases.
- If pump operating temperature is below 0°C to maintain the spare pump at low temperature, or cryogenic pumps.
- If ambient temperature is below the pour or freezing point of the process fluid.

In order to be able to limit the bypass flow, the bypass arrangement around check valve will include a restriction orifice when necessary, also the warm-up line shall be provided with double isolation valve and a break flange between the valves.

8.6.5 Pump Minimum Flow Requirement

Refer to the document TP-1ZZZA-PR-BOD-0001, Process Design Basis Overall for standard heater Instrumentation.

8.6.6 Boiler Feed Water Pumps

An automatic combined low-flow bypass / check valve shall be provided for each pump (instead of an orifice bypass).

8.6.7 Drains & Vents

Refer to the drawings TP-1ZZZA-PR-PID-0007, Piping and Instrumentation Diagram Standard Symbols and Nomenclature – Pump Vent and Drain Details.

Valved vent connection is not applicable to self-venting pumps. Self-venting pumps are identified by the rotating specialist after pump selection.

For pump drain line size, 3/4" shall be considered as a minimum. Conformity with vendor data shall be checked and size shall be increased if necessary.

A piping specification break shall be shown downstream of the last block valve on drain and vent lines. When double block and bleed is provided, a spectacle blind will be installed upstream the second block valve, i.e. the closest to the closed drain system.

If tracing is required, limit is at the last block valve. If insulation break is required, limit is at the first block valve.

8.7 Compressors

For maintenance purpose, suction piping and discharge piping must be equipped with a block valve or double block valves according to the rating with a spectacle blind on the compressor side.

Block valves shall be installed in the suction and discharge pipes, the block valve in the suction pipe and the piping to the suction nozzle shall have the same rating as the discharge piping.

Compressor discharge pipes shall have a check valve between the block valve and the discharge nozzle as close as practical to the compressor discharge nozzle. In each compressor suction pipe, a temporary start-up suction (conical in-line) strainer shall be installed downstream of the block valve of the compressor and as close as possible to the compressor suction nozzle.

The suction pipe between a knock-out drum and the compressor shall be as short as practicable, should have no pockets for compressor with top inlet suction connection, otherwise a low point is acceptable for compressor with bottom inlet suction nozzle. In this last case, draining pots with liquid traps devices shall be provided. Line from compressor KO drum to compressor inlet nozzle shall be sloped toward compressor KO drum as far as practicable from layout point of view considering elevation of respective nozzles.

The tracing of the suction piping from compressor KO Drum to compressor suction is required when the minimum ambient temperature is equal or lower than gas dew point to prevent condensation (for both centrifugal and reciprocating compressors).

8.8 Packages

For the packages where details are not shown on the P&ID's provide suitable reference to vendor document, all the connections to common facilities (drain, vents), utilities and flare shall be shown.

8.9 Steam Turbines

Flow measurement to be provided on inlet line

De-superheater requirement on exhaust line to be reviewed on case by case in order to not exceed downstream steam header maximum temperature

Usually the turbines are provided with permanent strainers (vendor supply). If not, a Y-type strainer with blowdown valve shall be provided and installed in the steam inlet line as near to the turbine flange as feasible.

Drain connections, with steam traps to remove condensate, shall be provided at the low point on the turbine inlet line before the block valves. For turbines on automatic start-up, traps shall be connected as close as possible to the inlet side of the automatic start valve as well as the low point of the inlet line.

The exhaust side of each turbine shall have a separate block valve, located at the turbine downstream of the relief valve. No additional block valve shall be provided at the exhaust steam header.

Drain with steam trap shall be provided at the low point of the exhaust line, downstream of the block valve.

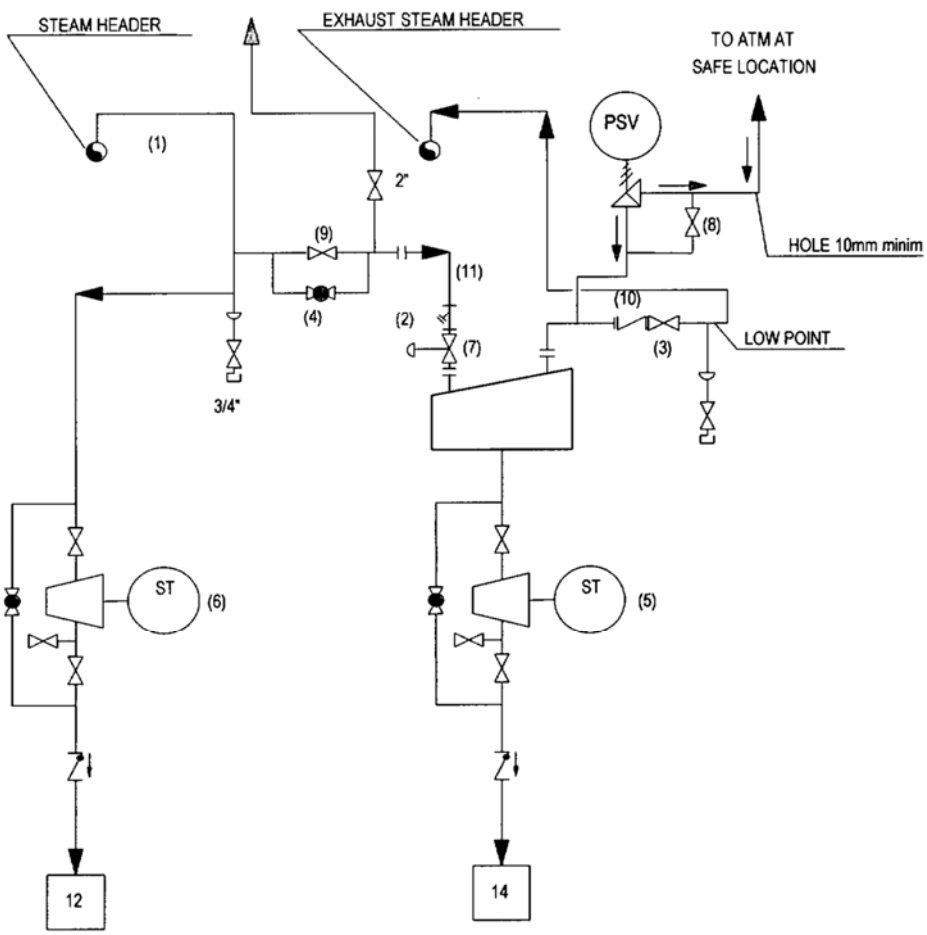
A connection to atmosphere with silencer shall be provided on steam inlet line in order to permit warm-up during start-up operation. A connection to atmosphere with silencer shall be provided on steam outlet line for start-up operation.

A full capacity relief valve shall be installed upstream of the exhaust block valve of each noncondensing turbine. This safety valve will be equipped with one by-pass used during start-up operations.

For turbines arranged for automatic start, a bypass around the control valve may be used to run the turbine continuously at a slow-roll speed if the turbine has suitable lubrication provisions. Provision for slow-roll operation shall be confirmed by Rotating Specialist.

Steam feed pipe shall be valved at branching off from the header and near the turbine; the latter is not necessary if on-off valve is provided for automatic start-up.

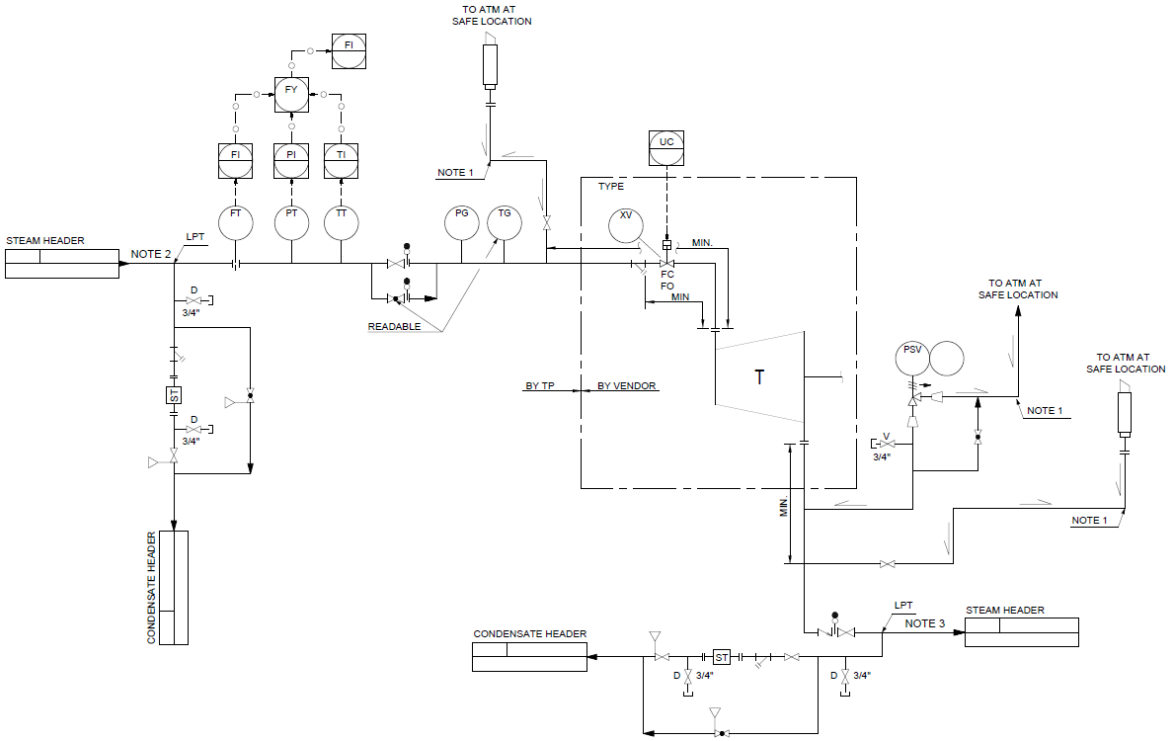
a. Piping arrangement for steam turbine is shown in the below sketch



Notes:

1) Locate block valve at min. distance from header (if required).
2) Strainer type according to vendor requirements.
3) For automatic start of turbine this valve must be Car seal open.
4) Turbine warm-up-by-pass (3/4" min. size shall be provided)
5) Number and connection type for steam trap shall be in accordance with the requirements of turbine supplier.
6) Steam trap to be located at low point of steam line.
7) On/off valve for automatic turbine start-up, globe valve for manual turbine star-up will be provided.
8) By-pass to be sized for turbine start-up. Valve type as per piping class.
9) Distance from inlet isolation valve to the turbine inlet to be minimized
10) Installed in horizontal position (valve and check valve)
11) Piping arrangement to allow pipe cleaningness test.

b. Typical instruments and silencer arrangement sketch



Notes:

1) Drip hole at low point Ø = 13 mm.
2) Flow measurement to be provided.
3) De-superheater requirement to be reviewed on case by case basis in order to not exceed downstream stream header maximum temperature.

9 INSTRUMENTS

9.1 Control Valves

Refer to the drawings TP-1ZZZA-PR-PID-0006, Piping and Instrumentation Diagram Standard Symbols and Nomenclature – Control Valve Vent and Drain Connection Details.

Refer to TP-1ZZZA-PR-BOD-0001, Process Design Basis Overall for number, size and location of manholes

9.1.1 Requirements for Block Valves & Bypass

Block and bypass valves are installed for all control valves except:

- Control valve greater than 12" unless specified case by case.
- Compressor Anti-surge valve (hand wheel is not acceptable),
- Normally no flow valve, e.g. valve not used during normal operation,
- When no manual control is possible due to operational / safety reasons, e.g. high pressure let-down valves.

When a control valve discharge to atmosphere neither block valve nor drain valve downstream the control valve is required.

The size of the by-pass valve has to be selected carefully if it has an impact on a downstream pressure relief valve.

9.1.2 Flashing Service

Where piping is expanded after control valve for flashing condition, the downstream block valve shall be equal to the expanded piping or according to Process / Licensor requirements.

9.1.3 Sizing of Control Valve Manifold

Except where Licensor requirements / specification exists, the following table shows the recommendations for the sizing of control valves manifold, it shall be read in conjunction with the following remarks,

- Indicated size is main line size
- Block valve shall be selected as per piping class.
- The bypass valve shall be globe type for 12" and smaller, and gate or butterfly type (i.e. full bore, FB, and according to piping class) for sizes equal or greater than 14" (if bypass is implemented).
- Size for the by-pass line shall be as same as the by-pass valve
- Reference diameter for block valves is the size of the line on which the valve is located; reference diameter for by-pass valve is the upstream line.

Line Size	Valve Size	Control valve size																
		½"	¾"	1"	1.5"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	28"
½"	Block	½"																
	Bypass	½"																
¾"	Block	¾"	¾"															
	Bypass	¾"	¾"															
1"	Block	1"	1"	1"														
	Bypass	1"	1"	1"														
1.5"	Block	1.5"	1.5"	1.5"	1.5"													
	Bypass	1.5"	1.5"	1.5"	1.5"													
2"	Block		2"	2"	2"	2"			API 550 →									
	Bypass		2"	2"	2"	2"												
3"	Block			2"	2"	3"	3"											
	Bypass			2"	2"	2"	3"											
4"	Block				3"	3"	4"	4"										
	Bypass				3"	3"	3"	4"										
6"	Block					4"	4"	6"	6"									
	Bypass					4"	4"	4"	6"									
8"	Block						6"	6"	8"	8"								
	Bypass						6"	6"	6"	8"								
10"	Block							8"	8"	10"	10"							
	Bypass							6"	6"	8"	10"							
12"	Block								10"	10"	12"	12"						
	Bypass								6"	10"	10"	12"						
14"	Block										12"	14"	14"					
	Bypass										10"	12"	14"					
16"	Block											14"	16"	16"				
	Bypass											12"	14"	16"				
18"	Block												16"	18"	18"			
	Bypass												14"	16"	18"			
20"	Block													18"	20"	20"		
	Bypass													16"	18"	20"		
24"	Block														20"	24"	24"	
	Bypass														18"	20"	24"	
28"	Block															28"	28"	28"
	Bypass															28"	28"	28"

Note: Bypass valve size to be checked based on installed control valve CV if downstream PSV is governed by control valve failure.

9.1.4 Control Valve Identification

Control valve shall be identified on P&ID with:

- Tag number
- Size and rating of flange if different than piping class (to be specified during detailed engineering phase)
- Fail safe position (FO, FC, FLO, FLC)
- Tight Shut-Off (TSO)

9.2 Safety Valves

Safety valves shall be located according to process requirements as close to the equipment as possible, in order to fulfil the API requirements on pressure drops through upstream piping, or on equipment.

Whenever the protected equipment is provided with a demister pad, the safety valve shall be installed on the vessel, upstream of the demister.

For columns, PSV's device (if any) shall generally be located on the overhead line.

Rupture disc requirement to be specified for service like toxic, corrosive, congealing, high value products, etc.

Inlet lines of safety valve shall always be free drain towards the protected equipment and the discharge lines of safety valve towards the common relief header.

For details Refer to document number TP-1ZZZA-PR-BOD-0001, Process Design Basis Overall.

9.2.1 Block Valves

Full bore (FB) area block valves shall be installed upstream and/or downstream of safety valves. However, no block valves shall be installed for safety valves on IBR equipment (not allowed by code, it is an exception to the general rule).

They shall be of such type and size that the increase in pressure shall not reduce the relieving capacity below that required, nor adversely affect the proper operation of the pressure relieving devices.

Block valves at inlet/discharge of PSVs shall be Car seal open (CSO) in case of PSV without spare. Block valves shall be CSO (for Operating PSV) and CSC (for Spare PSV) for inlet valve in case of N+1 configuration.

Block valve at relief valve inlet shall be same size as process line (full bore FB), block valves shall be installed with stem oriented horizontal or downward. Block valve at relief valve discharge shall be installed as close as possible to the relief valve nozzle to permit to install a bleed valve.

PSV in steam generation service shall have no isolation as per IBR.

One bleed valve of ¾ inch shall be installed upstream and downstream of every safety valve between the safety valve and the block valve.

Isolation valves shall be required upstream thermal expansion relief valves on lines that cannot be isolated for PSV maintenance. Isolation valves shall be required downstream thermal expansion relief valves connected to the flare or to other closed system.

9.2.2 Spare Valves

All pressure relief valves that require testing within planned maintenance period shall be duplicated and fitted with suitable block valves. However, relief valves shall not be spared in the following cases:

- Installed on (spared) equipment which can be isolated & bypassed with unit in operation
- specified only for thermal relief
- specified only for fire
- specified only for tube rupture on exchanger
- Equipment in intermittent service or discontinuous service

9.2.3 Discharge Sub-header & Header

Safety valves shall be free draining towards flare header. When such arrangement is not possible, facilities to prevent the stagnation of liquid shall be provided.

All laterals and main header shall be sloped 1:500 (min.), free draining towards the knockout drum, avoiding intermediate pockets preferably branching-off of a discharge pipe to relief header shall always be at top of pipe and sloped 45° in the direction of flow.

All safety valve relief to atmosphere and vents to atmosphere shall be routed to a safe location away from working platforms. Safe location height to be considered typically 3m to 5m above equipment or any service platform located within a radius of 15 m.

When safety valve discharge steam to the atmosphere at safe location, the vent line shall terminate at least 3 m above any service platform located within a radius of 8 m.

9.2.4 Flare Header

Flare header shall be continuously purged from any convenient location to avoid air ingress in to the system. Fuel gas, inter gas and nitrogen are commonly used as purge material,

For details refer to the drawing TP-1ZZZA-PR-PID-0003, Legend Sheet, Typical Details for Piping and instrument arrangement

9.2.5 Safety Valve Bypass

PSV's bypass line diameter is according to process requirements, typically diameter shall be of 2” size. Bypass to be provided with gate and globe valves with spectacle blind. For auto refrigeration service minimum inter distance of 600 mm shall be provided between the bypass gate and globe valve.

Pressure safety valves will not be equipped with a by-pass when the depressurization of the vessel to the flare is possible through accessible valves and suitable piping.

9.2.6 Thermal Expansion

TSV shall be provided to protect interconnecting piping against overpressure in case the pipe is blocked in while it is filled with liquid at near-ambient temperature and is heated by direct solar radiation or by heat tracing if any.

Note: Installation of Car Seal Open (CSO) valve at one end of the pipe is an acceptable alternate to TSV installation. To be reviewed case by case.

TSV shall not be provided on interconnecting piping when:

- the line is insulated (but not traced).
- the line inventory is small (below 1 m^3).
- the line is not insulated, with an operating temperature higher than the expected fluid temperature due to solar radiation (> 65 °C).
- Lines with vapor / gases (steam, FG, H2, N2 and compressed air).
- Utilities lines that are normally open on one end, like condensate and utility / process water.
- Lines that are short in length (less than 30 m unless volume is greater than 10 m^3 for 150# flanges / 5 m^3 for 300# flanges / 1 m^3 for 600# or greater flanges / 0.5 m^3 for LPG).
- Fire water lines.
- Lines have pressure relief from process relief valves.

Thermal relief valves shall discharge to a closed system for hazardous service, if required. For non-hydrocarbons non-hazardous service, a single thermal relief valve without downstream isolation valves is permitted with discharge to atmosphere at safe location / grade. (SS / CRWS).

9.2.7 Volumetric Pump

Volumetric pumps shall be protected by an external relief valve between discharge and suction lines. However, discharge of relief valve preferably to suction vessel if possible.

9.2.8 Safety Valves Identification

Pressure safety valves shall be identified on P&ID with:

- tag number
- orifice designation (to be specified only during detailed engineering phase)
- inlet & outlet size (to be specified only during detailed engineering phase)
- set pressure
- rating of flange if different from piping class (to be specified only during detailed engineering phase)

9.3 Temperature Elements

When several streams are mixed, the temperature element, if any, will be installed at least at 10 x diameter equivalent length downstream the last mixing point (with a minimum length of 5 m).

Column top temperature element shall be installed:

- On pipe as close as possible to the column nozzle,
- Upstream product injection (for example chemical injection) at 1 diameter from connection point (with a minimum of 500 mm).

9.4 Double Valving for Instruments

Double valving shall be provided in the following cases:

- Hydrogen services with rating ≥ 600#
- Sour / Toxic services with rating ≥ 600#
- Rating ≥ 900# (for all service)

9.5 Instruments Drainage

9.5.1 Control Valves

Maintenance on control valves are exceptional and most of the time they are located on ground floor or on platform. Control valve drain shall be connected to the closed drain when one of the following conditions is met:

1) High Pressure
2) High Temperature
3) Hazardous or toxic material
4) Manifold inventory more than 50 Liters

For LPG and lighter services, venting to flare will be considered, for water and non- hazardous systems, the vent and drain shall be connected to atmosphere / grade.

For all control valve, 3/4" bleed valves shall be provided upstream and downstream of the control valve. The 3/4" bleed valves shall be located upstream and downstream of the reductions (on the larger diameter).

Bleed valves tie-in shall be located on the largest pipe diameter of the manifold.

9.5.2 Level Gauges / Level Transmitters

Level gauges and displacer level transmitters may require more maintenance and shall consequently be drained by means of hard piped connections according to drained product.

Level gauges drain shall be connected to the closed drain when one of the following conditions is met:

1) High Pressure
2) High Temperature
3) Hazardous or toxic material
4) Quantity of liquid is more than 5 Liters.

For water and non- hazardous systems, the vent and drain shall be connected to atmosphere / grade. For LPG and lighter services, venting to flare will be considered.

Refer to the drawings TP-1ZZZA-PR-PID-0004, Piping and Instrumentation Diagram Standard Symbols and Nomenclature – LG / LT Vent and Drain Connection Details.

9.5.3 Instrument with Diaphragm Seal

For pressure measurement by pressure transmitter, level and flow measurements by differential pressure transmitter, diaphragm seals are necessary for the following services (pressures up to 600#)

- Congealing and high viscous (Vacuum Resid and similar viscous fluids)
- High pour point services (≥ 10cSt)
- Corrosive fluids: Acid (i.e. sulfuric acid)
- Sour / Toxic services (Rich Amine, fluid containing H_2S and sour water)
- Vapor and liquid Sulphur steam jacketed services
- Where licensors specify diaphragm seals.

For pressure rating > 600# flushing of instruments shall be considered suitably, adequate care and attention shall be required to address the temperature limitations of the diaphragm seal.

9.6 Interlocks

For all critical PLC inputs (for trips and shutdown), 2 out of 3 voting logic shall be implemented from field so that failure of any instrument does not lead to plant trip.

9.7 Tracing

The instrument impulse line shall be insulated/traced whenever required to avoid congealing or condensation.

9.8 Limit Switches

Limit switches shall be provided for all ESD shutdown valves (with position indication in DCS).

9.9 Flushing / Purging

Continuous flushing/ purging facilities shall be provided as required for level, pressure, temperature instruments in heavy residue services (except bitumen) and services with catalyst fines. Vapor phase flushing shall also be considered in high temperature congealing services.

For details Refer to TP-1ZZZA-PR-BOD-0001, Process Design Basis Overall for details.

9.10 Pressure Differential Measurements across Strainers / Filters

Pressure differential indication shall be provided on all permanent Strainers / Filters. In critical / fouling / dirty / viscous services, such pressure differential indications shall be by means of a Pressure Differential Indication Transmitter (PDIT) with a High Differential Pressure (DP) Alarm in the DCS.

For non-critical / clean services, a local Pressure Differential Gauge (PDG) shall be considered in lieu of a PDIT, unless otherwise specified.

10 EMERGENCY BLOCK-IN VALVES

Emergency block valves will be provided in order to contain the fire in the affected area. Refer to Process Design Basis Overall TP-1ZZZA-PR-BOD-0001.

The closure of a remotely operated block valve located on the suction system of a pump shall result in the automatic shutdown of the corresponding pump.

All emergency shutdown valves located at bottom of the vessel or column will be installed flange to flange, if possible, within piping installation constraints.

Emergency shutdown valves on pump suction lines shall be of corresponding line size and full bore.

11 PIPING

11.1 Utility Connections

Utility connections are provided for steam-out, oil flushing, nitrogen, fuel gas purging.

11.1.1 Steam Out Connections

The plant shall be designed with steam out / purging connections adequate in number and size, to enable inert sweeping during start-up, shutdown and maintenance operation. Purge connection provided on vessels shall be at min. distance from tangent line.

Refer to Process Design Basis Overall document number TP-1ZZZA-PR-BOD-0001 for minimum size of utility connections.

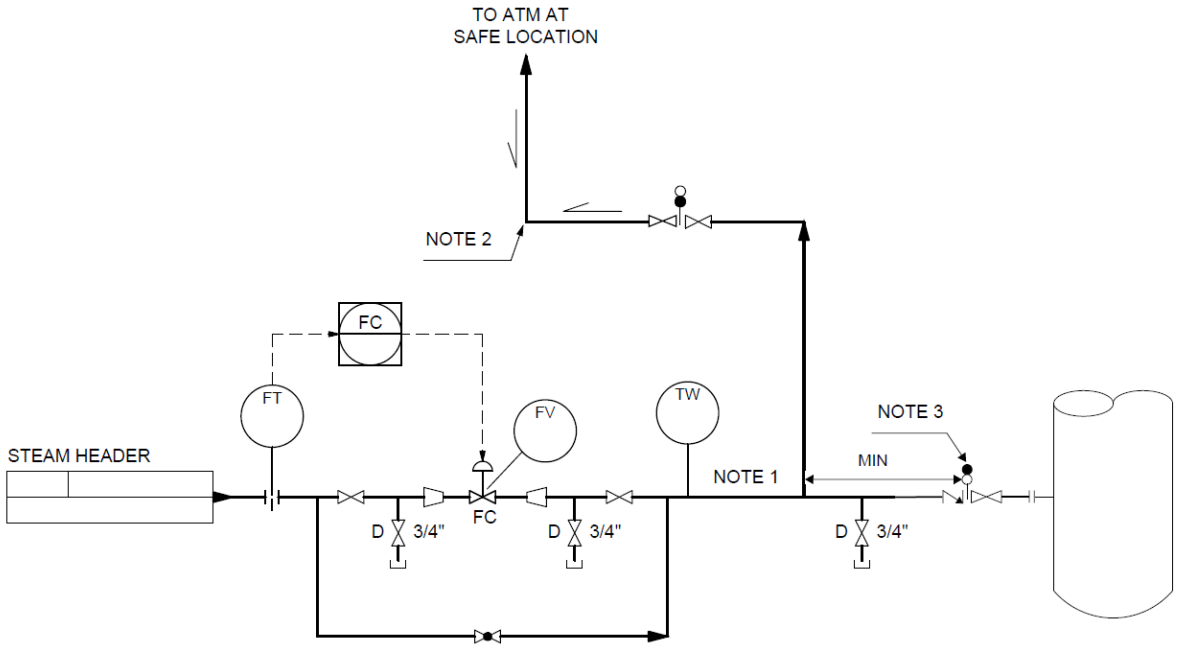
Hard piped connection is foreseen for steam out connections greater or equal to 3".

A blinded gate valve will be only provided on vessel nozzle where no hard piped connection is required.

Refer to the sketch in section 8.2

11.1.2 Stripping Steam Lines

Each stripping steam line will be equipped with venting provision to enable warm up.



Note:

1. Provide piping stream traps at suitable locations.
2. Drip hole at low point Ø = 13 mm.
3. Spacer or spectacle blind for isolation. (Refer to section 11.15)

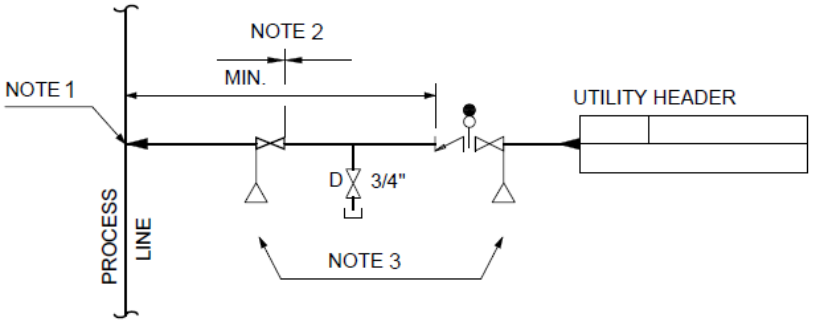
11.1.3 Washing & Flushing Oil Connections

This detail describes both the washing oil inlet and outlet arrangement. Refer to the sketch provided in section 8.3.5

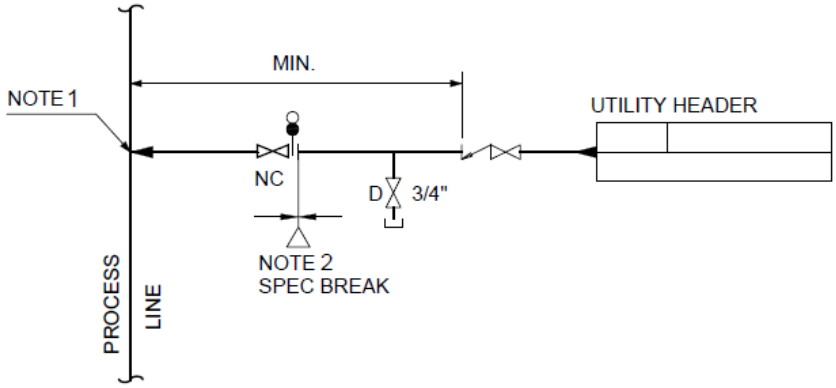
11.1.4 Hard Utility Connection

Other hard utility connection such as nitrogen, fuel gas etc.,

Injection during normal process operation:



Injection made only when process side is depressurized:



Note:

1. Top or side connection.
2. Limit of Insulation.
3. Spec. breaks location & type of valve to be determined on case to case basis.

11.1.5 Utility Station

The utility station to be provided for each unit shall be:

- Plant Air,
- Low Pressure Steam,
- Service Water,
- Nitrogen to be provided on case by case basis.

Utility hose stations should be located so that all points of use in the area can be reached by 15 m long hose. However, locations of utility hose stations will be developed during detailed engineering.

Each point shall be equipped with a block valve according to the piping specification and with fast acting fittings. The size of each line shall be 1" minimum.

Refer to the drawings TP-1ZZZA-PR-PID-0003, Piping and Instrumentation Diagram Standard Symbols and Nomenclature – Typical Details for Piping Arrangements.

11.1.6 Steam Ring

In the event of a flange leak in hydrogen service and services with flammable liquids at or above their auto-ignition temperature, steam shall be used to control fires by means of steam lances or fixed steam rings system. Steam system design for firefighting will be developed in detail for P&ID during detailed engineering phase.

11.2 Block Valves On Utility Systems

Block valves shall be provided for every branch lines for the following utilities:

- Steam,
- Instrument air

These valves shall be located at the header. No specific accessibility is required for these header block valves.

For other utility headers (cooling water, utility water, plant air, ...), block valves are located close to the user (to be able to isolate each individual user) and not close to the main header.

Block valves shall be provided at the battery limit of vendor packages (outside vendor scope). This allows for early commissioning of utility headers.

11.3 Utility Network End Connection

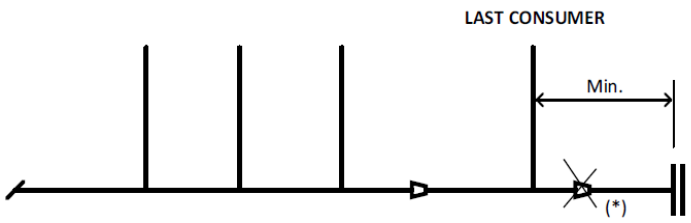
11.3.1 Underground Networks

Underground network will not be extended after the last consumer (e.g. "dead ends" to be avoided). Requirement for purging and flushing connection shall be provided suitably at the dead end for the underground lines

11.3.2 Aboveground Networks

General Networks:

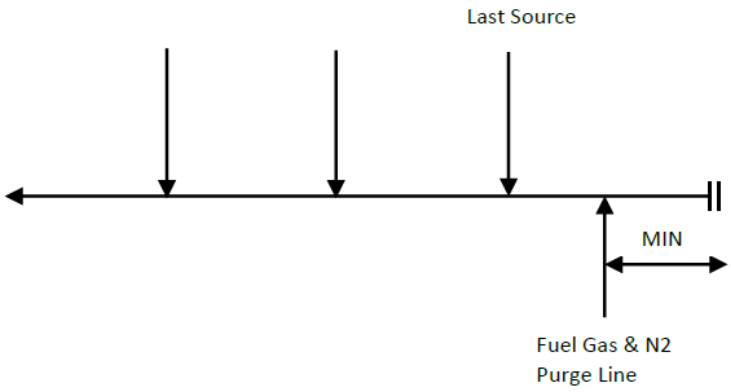
The extremity of the network end will be equipped with a header size flange blinded for blowing or flushing / cleaning:



(*) No reducer shall be provided downstream of last consumer to provide flexibility for the addition of future users.

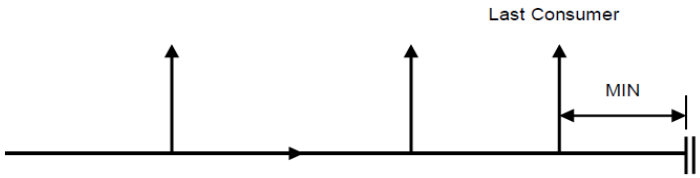
Flare Networks:

The extremity of the flare network end will be equipped with a flange:



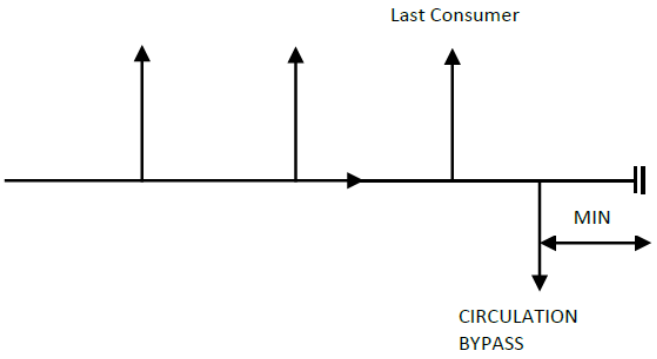
Gas & Steam Headers:

The end connections of header dedicated to steam, condensates, air, nitrogen and fuel gas will be equipped with a flange. This flange can be dismantled for start-up operation.



Water Headers:

The end connections of header for water service will be equipped with a flange and a circulation bypass (refer to the sketch below)



11.4 Steam Traps

Process steam traps are provided to eliminate condensate at low points of steam lines and from steam heated exchangers (to be reviewed on case by case for very small duties), equipment/ lines, jackets and steam coils, etc.

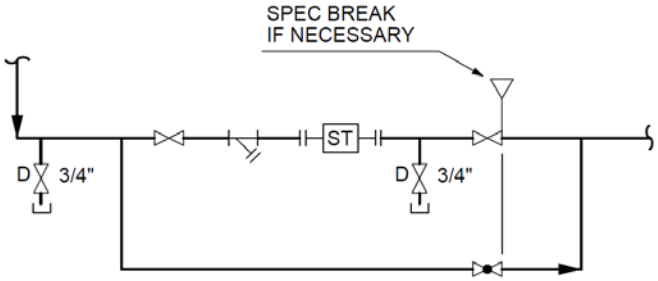
Normally, float type steam traps shall be used for process service.

Steam headers low points steam trap will be shown on PID by Piping / Layout Discipline only during detailed engineering phase according to lay-out study. The condensate from steam tracing and steam header low points shall be recovered and sent back to the utilities facilities.

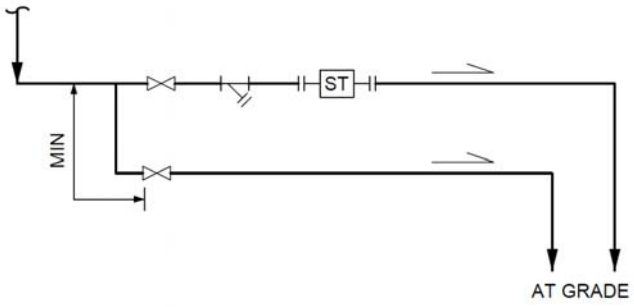
Process steam trap assembly:

- All steam traps shall be protected by a "Y" type strainer unless included in trap supply.
- Traps which discharge to a condensate recovery system shall be provided with a bypass valve(globe) and two block valves.
- Upstream each steam trap the isolation valve shall be installed at grade.
- Traps which discharge to the open system will have no by pass.

For equipment, steam header and steam jacket with trap discharging in to recovery system:



For equipment, steam header and steam jacket with trap discharging at grade:



11.5 Insulation & Tracing

Personnel protection will be provided for line operating at a temperature higher than 60 °C.

Electrical tracing is the preferred method for heat tracing.

Electric tracing is utilized when precise temperature control is required, thermostat setting for Electric Tracing should not be higher than fluid operating temperature.

Steam jacketing is utilized in specific services where steam tracing is inadequate, e.g. sulphur, heavy oils.

11.6 Double Valving

Double manual isolation valves shall be provided in the services which can be in maintenance with the unit still in operation.

Typical examples are spared pumps, compressors, control valve manifolds with by-pass, spared relief valves and pressure indicators.

Double valving shall be provided in the following cases:

- Hydrogen services with rating ≥ 600#
- Rating ≥ 900# (even if not hazardous)
- Operating vents and drains on LPG service where flashing and consequent freezing can occur.
- Preventing product contamination where the use of spectacle blinds is not suitable.
- Dirty or coking services.
- Sour / Toxic services.
- Utility lines permanently connected to process lines or equipment in all cases.

11.7 Hydrogen Service

Hydrogen service refers to hydrogen or its gaseous mixtures having a partial pressure of hydrogen equal or higher than 7 kg/cm2(a) or containing 90 volume % hydrogen and higher at pressure level.

Requirements:

- No permanent drains or vents shall be provided in Hydrogen carrying lines. Any vents or drains installed for hydrostatic testing shall have valves removed and connections plugged and welded after testing.
- The minimum size of small connections on process lines (excluding orifice flange and carrier ones), and equipment is to be 1" for strength.
- In order to isolate equipment / item that can be idle during normal plant operation, double block valves shall be provided when rating is ≥ 600#.
- In case of permanent utility connections to process, normally isolated (such as nitrogen purging connections), double block and bleed valves shall be provided.
- On heat exchanger nozzles, when connections for PI, TI are to be provided per TEMA, 1" minimum size flanged and blinded nozzles are to be foreseen. On intermediate nozzles of multiple shell heat exchangers, pressure and temperature connections shall not be installed.

11.8 Grayloc Requirements

Graylocs requirements are specified in RPTU units (based on Licensor requirements) for hot high pressure area (from the reactor feed furnace to the HP/MT Separator), black oil, HP pressure let down station, and catalyst handling lines.

Any use of Graylocs in processing units other that RPTU require the approval of the NRL / MPMC.

11.9 Purging requirements

Purging in high pour point services and other services including catalyst handling section shall be specified by the Technology Licensor. Such requirements shall be further evaluated, and detailed purging needs shall be clearly established by the Contractor.

11.10 Sampling

Refer to the drawings TP-1ZZZA-PR-PID-0010-01 to 02 Piping and Instrumentation Diagram Standard Symbols and Nomenclature – Sample Connection Details 1 & 2.

Sampling Connections

Sampling connection on piping shall be not less than 3/4".

A first block valve shall be provided as close to the header as possible. It shall be followed by a globe or needle valve (Ø = ½"). The distance between these valves shall be as short as possible.

For liquefied gases the distance between the two valves shall be 600 mm min.

Where sampling is required for dangerous fluids, the sample outlet shall be connected to process line or to flare / closed drain. All hydrocarbon sample connection shall be closed connection type.

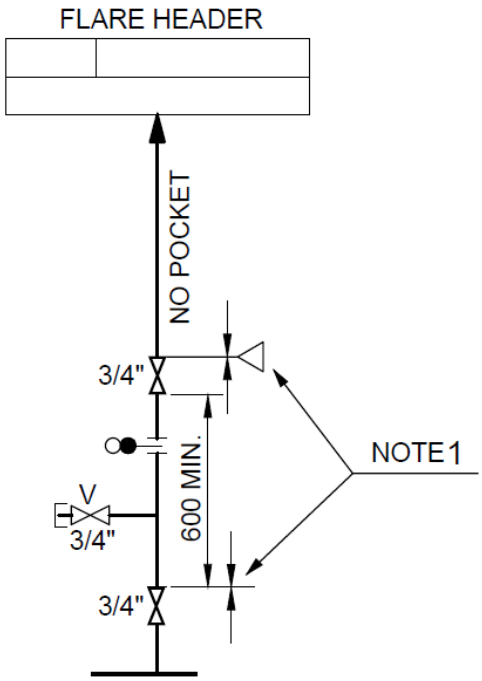
The sampling connection shall not be located at dead points of the process line. Sampling station shall be located at grade or accessible from platform.

Sample Coolers

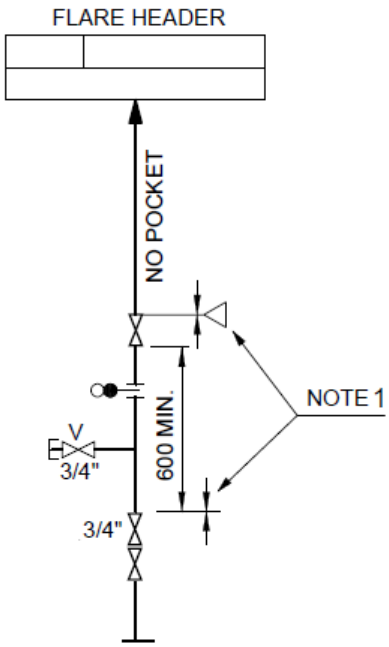
Sample cooler shall be specified for a process temperature of 60°C and above, according to personnel protection requirements.

11.11 Valve Arrangement on Auto Refrigeration Services

Vent to flare header for Rating ≤ 600#



Vent to flare header for Rating ≥ 900#



Note 1: Spec. break and limit of insulation to be determined on case by case basis.

11.12 Preheating & Pressurization Valve Bypass

As a general rule, bypass manual valve shall be added on the following services:

- steam header/network or equipment preheating
- pressurization or depressurization of equipment/section of ≥ 600# rating (for other services).

By-pass globe valve size (pipe size in inches):

Main Valve size (inch)	Rating & Bypass Globe valve size (inch)	
	≤ 300#	≥ 600 #
6-8	-	1
10-12	1	1
14-18	11/2	11/2
20 and above	2	2

Refer to the drawings TP-1ZZZA-PR-PID-0008, Piping and Instrumentation Diagram – Isolation Hook-Up Diagram.

11.13 Dual Check Valves (NRVs) in series

Wherever two Check Valves (NRVs) are required to be installed in series to prevent reverse flow, the two Check Valves (NRVs) shall be of dissimilar type and from different manufacturers. This shall be duly noted on P&IDs. Also, both Check Valves (NRVs) shall be tagged individually as Piping Speciality Items to avoid any erroneous installation during construction or any erroneous replacement during normal run.

11.14 Tight shutoff valves where required by 'special service':

Due to the high temperature, high pressure, toxicity, and flammability of many services in a typical hydroprocessing unit, special attention should be given to protecting operators from exposure to leaks during routine operations / maintenance work.

The most common type of exposure is a leak through a drain valve or a valve isolating a piece of equipment, such as control valve, taken out for maintenance. General practice is to protect operators from such exposure to the process with 'tight shut-off valves'

Provision of such Tight shutoff valves is usually stipulated by the Technology Licensor(s).

11.15 Positive Isolation

Positive isolation shall be provided when:

- Hot works need to be done.
- Equipment needs to be pressure tested.
- Personnel entry is required for inspection or maintenance.
- Equipment has to be opened or removed while the rest of the unit is still in operation.

If personnel are to enter the equipment, the points of positive isolation should be as close as possible to the equipment. Positive isolation can only be achieved by:

- Spectacle blinds including quick-acting blinds.
- Spades.
- Removal spools with blind flanges.
- Blind plates.

Spectacle blinds shall not be installed on pipe operating below 0°C. Spades shall be used in this case. Due to operational constraint for spectacle blinds handling, spades with spacers should be used instead and according to the following rating / diameter criteria:

ANSI Rating class	Permanent spectacle blinds	Spades with spacers or ring blinds
150#	Ø ≤ 12"	Ø ≥ 14"
300#	Ø ≤ 10"	Ø ≥ 12"
600#	Ø ≤ 8"	Ø ≥ 10"
900# & above	Ø ≤ 8"	Ø ≥ 10"

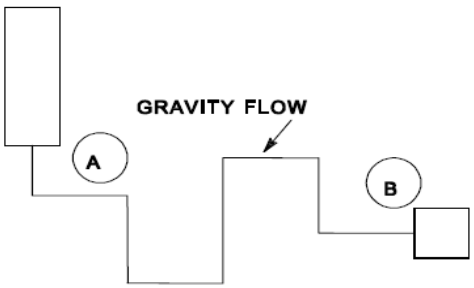
11.16 Motor Operated Valves

For valve size of 14” and above, motor operated valves (MOVs) can be considered of the valves are frequently operated.

11.17 Representation of commonly used Layout terms

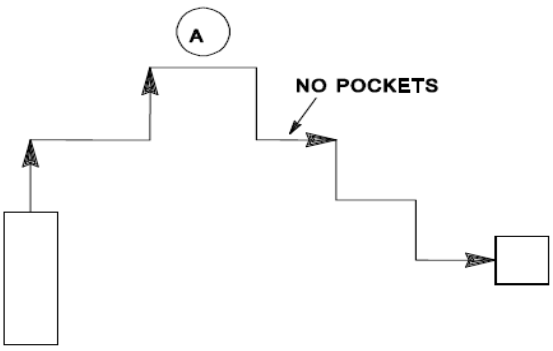
The following are some of the commonly the comely used terms of piping layout and design which shall be represented in the P&IDs based on process requirements suitably. (Refer to the sketch).

a) Gravity flow

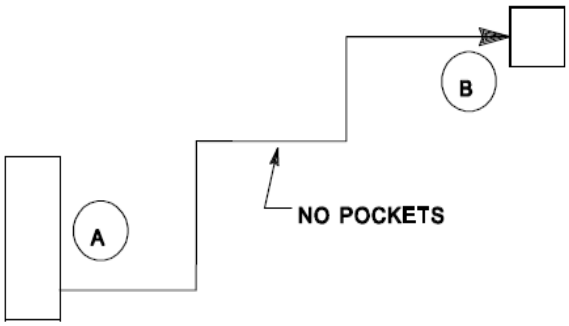


GRAVITY FLOW
POINT B AT LOWER ELEVATION THAN
POINT A,LINE CAN CONTAIN POCKETS

b) No Pocket

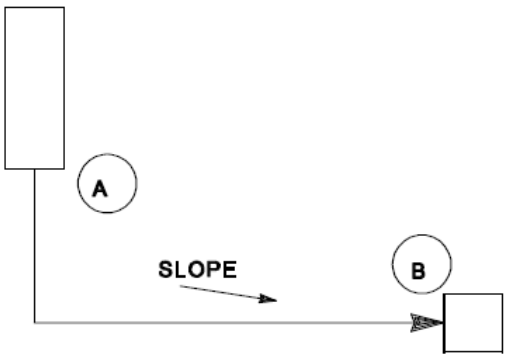


NO POCKETS
LINE DRAINS CONTINUOUSLY IN BOTH
DIRECTIONS FROM SINGLE HIGH POINT A



NO POCKETS
LINES DRAIN CONTINUOUSLY IN ONE DIRECTION FROM HIGH POINT B

c) Slope



GRAVITY FLOW NO POCKETS
POINT B AT LOWER ELEVATION THAN POINT A. LINES MUST NOT CONTAIN POCKETS

12 PROCESS DRAIN SYSTEMS

For detailed drain system philosophy refer to the document number TP-1ZZZA-PR-BOD-0001, Process Design Basis Overall.

13 WINTERIZING PROTECTION

The winterizing protection shall be based on the minimum ambient temperature. Piping shall be designed to avoid tracing whenever possible by circulation of the fluid within the piping.

Piping shall be designed for normally flowing lines to eliminate stagnant pockets where freezing may occur. Where unavoidable, protection by insulation and tracing should be provided.

Non flowing lines, intermittent service, and dead ended lines should be avoided as far as possible. Where unavoidable, such lines should be insulated and traced.

13.1 For Equipment's

- A drum or vessel containing liquid hydrocarbon and water which may freeze shall be protected by heat tracing and by insulating nozzles, block valves and drain piping.
- Exchangers and coolers containing liquids which may freeze shall have sufficient drain provision to insure complete drainage upon shutdown.
- For pumps, bypass provision across the NRV to be provided. Size to be confirmed by pump vendor.

14 UNIT BATTERY LIMIT

The Battery limit isolation for all the incoming and outgoing process and utility lines from / to the process units shall be configured as per the below table

14.1 Isolation Arrangement at Battery Limits

All incoming and outgoing lines from the units shall be provided with isolation block valves with a spectacle blind and drain located at the battery limit. Details as table given below.

Incoming/ Outgoing streams	Double Block isolation valves	Single Block Isolation valve	Non-Return Valve (unit side)	Spectacle Blind (unit side)	Bleeder (note1)
Hydrocarbon Lines					
All HC (Heavy & Light)	Yes	-	Yes	Yes	Yes
Hydrogen	Yes	-	Yes	Yes	Yes
Utilities					
VHP / HP steam	Yes	-	-	Yes	Yes
MP / LP steam	-	Yes	-	Yes	Yes
Condensate	-	Yes	-	Yes	Yes
Instrument Air	-	Yes	-	Yes	Yes
Plant Air	-	Yes	-	Yes	Yes
Nitrogen	-	Yes	Yes	Yes	Yes
CW supply / Return	-	Yes	-	Yes	Yes
HP BFW (Note2)	Yes	-	-	Yes	Yes
DM water	-	Yes	-	Yes	Yes
Service water	-	Yes	-	Yes	Yes
Drinking water	-	Yes	-	Yes	Yes
Caustic	Yes	-	Yes	Yes	Yes
Chemicals	Yes	-	Yes	Yes	Yes
Fuel Gas	Yes	-	Yes	Yes	Yes
Flare	-	Yes (Note 3)	-	Yes	Yes

Notes:

1) This will include a spool piece, attached to the ¾ inch vent / drain connection in the unit side.
2) For MP BFW if applicable, to have Single Block Valve.
3) For flare line, isolation valve should be Car seal open.
4) All the valves are to be provided at approachable height with suitable platforming ensuring accessibility, safety and ease of operation.
5) Fuel oil supply and return system for the process unit will be from OSBL. Independent fuel oil system inside the unit is not considered (For fuel supply to fired heaters in respective unit)

14.2 Instrumentation Arrangements at Battery Limit

Process Lines:

As a minimum, the following shall be provided in process lines at / near the battery limit of the unit. Process line instrumentation to be decided on case to case basis. (Flow element at battery limit shall be reviewed case by case if the same is provided elsewhere in the same line).

Process	Local PI	DCS PI	DCS PAL/PAH	Local TI	DCS TI	DCS TAL/TAH	DCS FI	DCS FAL/FAH	DCS FQ
Feed	Yes	Yes		Yes	Yes		Yes		Yes
Product	Yes	Yes		Yes	Yes		Yes		Yes
Other Process stream	Yes								
Chemical	Yes	Yes		Yes			Yes		

Utility Lines:

As a minimum, the following shall be provided in utility headers at / near the battery limit of the unit.

Utility	Local PI	DCS PI	DCS PAL/ PAH	Local TI	DCS TI	DCS TAL/ TAH	DCS FI	DCS FAL/ FAH	DCS FQ
HP Steam	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MP Steam	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LP Steam	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Condensate	Yes	Yes		Yes	Yes		Yes		Yes
CW supply	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
CW return	Yes	Yes		Yes	Yes	Yes			
Instrument Air	Yes	Yes	Yes	Yes			Yes	Yes	Yes
Plant Air	Yes	Yes		Yes			Yes	Yes	Yes
Nitrogen	Yes	Yes	Yes	Yes			Yes	Yes	Yes
Fuel Gas	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BFW	Yes	Yes		Yes	Yes		Yes		Yes
DM water	Yes	Yes	Yes	Yes	Yes		Yes		Yes
Service water	Yes	Yes	Yes	Yes	Yes		Yes		Yes
Drinking water	Yes	Yes	Yes	Yes	Yes		Yes		Yes
Flare	Yes	Yes			Yes		Yes		Yes
Fire water	Yes	Yes	Yes						

For vapor lines temperature / pressure if available, compensation is to be provided for flow measurement.

Others

- Online corrosion monitoring probes (Digital or electronic resistance type) to be provided in critical piping circuits and equipment with provision for display in DCS.

- Online Steam, Water Analysis System (SWAS) to be provided wherever steam export to refinery header is envisaged.

14.3 Flare Valve Installation

Flare headers shall be provided with locked open double isolation block valves with bleed and spectacle blind at individual unit battery limits. These isolation valves should be installed with their stem downwards (preferably) or in horizontal position to minimize the chances of accidental closure.

LIST OF ENGINEERING / INSTALLATION STANDARDS (INSTRUMENTATION) FOR COOLING TOWER PACKAGE

TENDER No: C050-1U68-81-45-PB-T-8010

PROJECT : **EPCM SERVICES FOR POLYPROPYLENE UNIT AT NRL**

UNIT/UNIT NO. : **PROPYLENE UNIT (PP) / 1U68**

OWNER : **NUMALIGARH REFINERY LIMITED (NRL)**

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

JOB NO. : **C050**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	07.08.2025	ISSUED WITH TENDER			

Signature Not Verified
Digitally Signed by MD MAZHER ALI
Date: 2026.04.09 17:55:41 IST
Location: eProcure-EPROC

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